Volume 6 - 1964

RADIOCARBON

Published annually by
THE AMERICAN JOURNAL OF SCIENCE

Editors
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INSTRUCTIONS TO CONTRIBUTORS

Manuscripts of radiocarbon papers should follow the recommendations in Suggestions to Authors, 5th ed.* All copy must be typewritten in double space (including the bibliography); manuscripts must be submitted in duplicate by December 1, 1964.

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. Date lists should therefore not be preceded by abstracts, but abstracts of the more usual form should accompany all papers (e.g. 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 B.P. (before present, i.e. before A.D. 1950) and, for finite dates, in years A.D. or B.C. The standard error following the date should express, within limits of ± 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.

5. Reference to relevant publications. Citations within a description should be to author and year, with specific pages wherever appropriate, except that references (e.g. to published date lists that are frequently repeated) may be simplified by use of a code (e.g. Groningen III) that is explained in the bibliography. 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 implicitly showing that the radiocarbon measurement was worth making, belongs here, as do technical matters, e.g. chemical pretreatment, special laboratory difficulties, etc.

Illustrations, in general, should be originals, but photographic reproductions of line drawings are sometimes acceptable, and should accompany the manuscript in any case, if the originals exceed 9 by 12 inches in size.

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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EDITORIAL STATEMENT

**Half life of C\textsuperscript{14}.** In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, all dates published in this volume (Volume 6) are based on the Libby value, 5570 ± 30 yr, for the half life. The decision of the Conference gains time for further study, not only of the half life, but of other uncertainties, before republication of all dates is agreed upon. As stated in Professor Harry Godwin’s letter to *Nature* (v. 195, no. 4845, p. 984, September 8, 1962), the mean of three new determinations of the half life, 5730 ± 40 yr, is regarded as the best value now obtainable. Conversion of published dates to this basis is accomplished by multiplying them by 1.03.

**A.D./B.C. dates.** As agreed at the Cambridge Conference in 1962, A.D. 1950 is accepted as the standard year of reference for all dates, whether B.P. or in the A.D./B.C. system.
UNIVERSITY OF MICHIGAN RADIOCARBON DATES IX

H. R. CRANE and JAMES B. GRIFFIN

The University of Michigan, Ann Arbor, Michigan

The following is a list of dates obtained since the time of the compilation of List VIII in December 1962. The method is essentially the same as that used for the work described in the previous list. Two CO₂-CS₂ Geiger counter systems are used. The equipment and counting techniques have been described elsewhere (Crane, 1961a, 1961b). The dates and the estimates of error in this list follow the practice recommended by the International Radiocarbon Dating Conference of 1962, in that (a) dates are computed on the basis of the Libby half life, 5570 years, (b) A.D. 1950 is used as the zero of the age scale and (c) the errors quoted are the standard deviations obtained from the numbers of counts only. In previous Michigan date lists up to and including VII we have quoted errors at least twice as great as the statistical errors of counting, in order to take account of other errors in the over-all process. If the reader wishes to obtain a standard deviation figure which will allow ample room for the many other sources of error in the dating process, we suggest he double the figures that are given in this list. Where there is no comment, it is because the submitter of the sample had none to make.

We wish to acknowledge the help of Patricia Dahlstrom in preparing chemical samples and Roscoe Wilmeth in preparing the descriptions. The descriptions and comments are essentially those of persons submitting the samples.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

M-355. Shell Point, Florida 1550 ± 250 A.D. 400

Plant material, Spartina alterniflora, from Shell Point (30° 02' N Lat, 84° 22' W Long), Wakulla Co., Florida. Area is a salt marsh meadow covered with Distichlis. First 3 ft of soil contain only Distichlis rhizome peat. Below this, a narrow layer of Juncus peat, above a layer containing only Spartina alterniflora and 5 ft deep. Marsh ends at depth of 4.5 ft with light-colored clean sand below. Sample from upper 2 or 3 in. of sand layer. Site at that time probably emerging barrier ridge, or possibly edge of meandering tidal channel eroding into bordering flatwoods (Kurz and Wagner, 1957). Coll. 1954 by K. A. Wagner and Herman Kurz; subm. by K. A. Wagner, Powell Laboratories Division, Carolina Biological Supply Co., Gladstone, Oregon. Comment
(K.A.W.) date yields aggradation rate of 3.48 in./100 yr. Artifacts from a Fort Walton shell midden in same general area, suggested a rate of 1 in./60 yr.

M-1252. Ontonagon Beach Site, Michigan 5990 ± 200 4040 B.C.

Wood fragments, one with bark (aspen?) from a Lake Superior beach (46° 52' 36" N Lat, 89° 18' 40" W Long) in NW ¼ Sec. 30, T52N, R39W, on the E side of Ontonagon, Ontonagon Co., Michigan. Sample from a well in the beach, 75 ft from water's edge and 8 ft above level of Lake Superior, obtained at well depth of 35.5 ft. Drilling encountered 22 ft of sand, 13 ft of clay, wood (the sample), 11 ft of sand, 1 ft of clay, more wood, 13 ft of sand, and more wood. Wood at depths of 48 ft and 61 ft insufficient for collecting. Sample indicates a change in water level of Lake Superior of at least 30 ft, due either to uplift of N shore or a low stage in the lake's history. Coll. 1961 and subm. by A. E. Slaughter, Michigan Dept. of Conservation.

M-1344. Challenger Bank, Bermuda 485 ± 100 A.D. 1465

Coralline algal ball with marine shell inclusions from Challenger Bank (32° 07' 42" N Lat, 65° 03' 42" W Long), in 54.5 m of water, off Bermuda. Algal balls form dominant bottom feature on off-shore banks and at 50 to 60 m depth around Bermuda. Date permits estimate of rate of growth of algae and of productivity of area (Frederick, 1963). Coll. 1960 and subm. by J. J. Frederick, Dept. of Botany, Univ. of Michigan. Comment (J.J.F.): date indicates growth rate of approx. 100 mu/yr, which agrees with estimates based on thickness of the discontinuous layers. Also indicates that algal balls are not necessarily Pleistocene, but may be modern.

M-1402. Scotts Musk Ox, Michigan 11,100 ± 400 9150 B.C.


II. ARCHAEOLOGIC SAMPLES

A. Upper Mississippi Valley and Great Lakes

M-1343. Casey's Mound Group (13WB6), Iowa 785 ± 100 A.D. 1165

Bone from Casey's Mound Group (42° 20' N Lat, 94° 01' 20" W Long), NW ¼ SE ¼ Sec. 20, Webster Township, Webster Co., Iowa. From adult female burial in a sub-floor pit 15 in. below original ground level in conical mound. Two flexed burials in this mound with red ochre, Marginella shells, and two conch shell tablets in association. Pit excavated to natural sand stratum.
Neighboring mound contained bundle burial associated with a Great Oasis vessel (Flanders, 1963). Coll. 1961 by R. E. Flanders; subm. by Flanders for Marshall McKusick, State Univ. of Iowa. Comment (R.E.F.): close to date expected as representative of Late Woodland in NW Iowa.

**Hilltop Site (23SC50) series, Missouri**

Charcoal from Hilltop Site (38° 48' N Lat, 90° 29' W Long), St. Charles Co., Missouri. From pits containing sherds and numerous artifacts. Should give date for the Late Woodland occupation in the St. Charles area, as well as confirm the date of M-619 (Michigan V, p. 36). Coll. 1956 by Leonard Blake; subm. by J. M. Shippee, Univ. of Missouri.

**M-620. Hilltop Site, Excavation Unit Pit D**

A.D. 1020

Charcoal from lower 10 in. of Excavation Unit Pit D, bell-shaped, extending from 18 in. to 38 in. below the surface. The flat, roughly oval bottom measured 4 ft by 5 ft. Associated material included a cord-marked restorable pot with subconical base, and rim sherds of 15 or more pots, generally large and heavy, cord-marked and tempered with clay or shale and some grit. Sherds usually very hard, with square fracture, while others flake badly. Wood id. by R. Yarnell, Mus. of Anthropology, Univ. of Michigan, as white oak group, red oak group, and hickory.

**M-621. Hilltop Site, Excavation Unit Pit E**

A.D. 770

Charcoal from Excavation Unit Pit E, 24 ft from Pit D, extending from 19 to 27 in. below the surface. Sherds recovered similar to those from Pit D. Wood id. by R. Yarnell as red oak group and white oak group.

General Comment (J.M.S.): questionable that Pit D is this much later than Pit E and Pit A (M-619), as cultural material in all three was similar. Date for Pit D seems too late for this complex in view of other evidence.

**M-1214. Aztalan, Wisconsin**

A.D. 1370

Charcoal from Aztalan (43° 04' N Lat, 88° 55' W Long), Jefferson Co., Wisconsin. From Pit 10, in the NE quadrangle of the village area. Coll. 1960 by Lee Parsons; subm. by S. F. de Borhegyi, Milwaukee Pub. Mus. Comment (S.F.B.): date appears reasonable in the light of others obtained at this site.

**M-515. North Site, Illinois**

A.D. 890

Charcoal from tomb at the North Site (38° 35' N Lat, 89° 21' W Long), 2 mi N of Posey on SE bank of Kaskasia River, Clinton Co., Illinois. Sample taken from remains of fired log tomb in small mound ca. 3 ft high, 25-30 ft in diam. Tomb probably 1 ft high, 6 to 8 ft in diam. In the center of the tomb were a large copper adze, two sheets of mica 6 and 8 in. in diam, and a small copper awl. In another mound of this group a bone and stone gorget, platform pipe, and human bone fragments from several burials were found. Coll. by R. North and G. Perino; subm. by G. Perino, Thomas Gilcrease Foundation. Comment (G.P.): this is an extremely late Hopewell site but should not be as late as the C date indicates. Investigator cannot account for the apparent error.
Stilwell Site series, Illinois

Wood charcoal from the Stilwell Site, Pk-18 (39° 29' 8" N Lat, 90° 36' 6" W Long), SE ¹⁄₄ SE ¹⁄₄ Sec. 3, T7S, R2W, Pike Co., Illinois. From redepositional fill in storage-refuse pits yielding pottery of the recently defined Apple Creek Series. Excavations at the type site (8 mi from Stilwell) by S. Struever during 1962 and 1963 provide basis for recognition of the Apple Creek Phase, lower Illinois Valley expression contemporaneous with Weaver in the central Illinois Valley. Vessel forms and the relationship of decorative elements on the exterior of Apple Creek vessels duplicate those of earlier Hopewell Series. These and other stylistic carry-overs indicate that Apple Creek, like Weaver, immediately post-dates the Classic Havana (i.e., “Hopewell”) Phase. Estimated dates for the Apple Creek Phase are A.D. 350 to 600.

Stilwell is habitation site in which 22 pits were excavated. Besides the Apple Creek component, a later Jersey Bluff manifestation occurs at the site. Coll. 1961 and subm. by S. Struever, Univ. of Chicago.

M-1262. Stilwell Site, Illinois 1330 ± 120 A.D. 620

Wood charcoal from Feature #9, a storage-refuse pit beginning at 14 in. below ground surface, continuing to depth of 52 in. below ground surface. Pit circular, 40 in. in diam. Sample from lower 18 in. of pit fill.

M-1263. Stilwell Site, Illinois 1550 ± 120 A.D. 400

Wood charcoal from Feature #14, a storage refuse pit beginning at 12 in. below surface, continuing to depth of 42 in. below surface. Roughly circular, 44 in. in diam. Sample from pit fill at depth of 18 to 30 in. below ground surface.

General Comment (S.S.): both dates fall within the estimated time span of the Apple Creek Phase.

M-1307. Fill Site (20B2-5), Illinois 720 ± 100 A.D. 1230

Charred wall post (IAS-30) from Fill Site (38° 45' 24" N Lat, 90° 05' 30" W Long), Madison Co., Illinois. Found during scraper operations along S shore of Long Lake, associated with pottery at a depth of approx. 50 to 80 cm below the surface. Exact provenience data unavailable. Should be equivalent to sample M-1301 from the same site (Michigan VIII, p. 232) and help to date the maximum expansion of Middle Mississippian in the Mitchell area. Coll. 1960 and subm. by James Porter, Southern Illinois Univ. Comment (J.P.): difference in dates for M-1307 and M-1301 (910 ± 150; Michigan VIII, p. 232) suggests possibility of greater time depth at Fill Site than was anticipated on the basis of other evidence. Maximum and final expansion in the Mitchell area should come sometime after M-1301 date. Occupation at Fill Site, even if two phases present, still regarded as short, the differences in the dates being accounted for by the range in error.

Cahokia Site series, Illinois

M-1332.  Cahokia Site, Tract 15B, House 43  
      A.D. 1435
Charred wood (IAS-1) from timbers on floor of House 43, at 1.3 ft below surface and 0.4 ft below plow zone. Late (?) Mississippian.

M-1333.  Cahokia Site, Tract 15B, House 44  
      A.D. 1125
Charred wood (IAS-2) from central floor area of House 44, at 1.8 ft below surface and 0.9 ft below plow zone. “Bluff” Culture.

M-1334.  Cahokia Site, Tract 15B, House 59  
      A.D. 1565
Charred wood (IAS-3) from floor of House 59, at 1.7 ft below surface and 0.8 ft below plow zone. Late (?) Mississippian.

M-1335.  Cahokia Site, Tract 15B, House 77  
      A.D. 1185
Charred wood (IAS-4B) from House 77, floor level to 1.0 ft above. “Bluff” Culture.

M-1336.  Cahokia Site, Tract 15B, House 113  
      A.D. 1065
Charred wood (IAS-5B) from House 113, 5 ft test square 280 L 285, 1.0 to 1.5 ft below plow zone. “Bluff” Culture.

M-1337.  Cahokia Site, Tract 15A, House 2  
      A.D. 1145
Charred wood (IAS-6) from burned posts in wall trench of House 2. Late Mississippian.

M-1338.  Cahokia Site, Tract A, House 32  
      A.D. 1225
Charred wood (IAS-7) from 0.2 ft above floor of House 32, at 1.7 ft below surface. Mississippian.

M-1339.  Cahokia Site, Tract A, House 35  
      A.D. 1265
Charred wood (IAS-8) from 0.3 ft above floor of House 35, at 1.7 ft below surface. Late (?) Mississippian.

M-1340.  Cahokia Site, Tract 15A, House 74  
      A.D. 925
Charred wood (IAS-9) from House 74, floor level to 0.3 ft above floor, at 1.2 to 1.5 ft below surface. “Bluff” Culture.

M-1341.  Cahokia Site, Tract 15A  
      A.D. 1045
Combined sample of charred wood and wood fragments from fill of Feature 174 (IAS-10A), at 0.9 to 2.3 ft below surface, and fill of Feature 134 (IAS-10B), at 0.9 to 3.9 ft below surface. Both features are post pits from a circle 480 ft in diam. Probably Early Mississippian.

General Comment (W.L.W.): Late Woodland “Bluff” Culture apparently survived quite late in the Monk’s Mound area, at a time when the Powell Mound area and the Mitchell Site area were occupied by Mississipians. M-1341 is most interesting date, since it indicates that huge circles, of which four were located partly on Tract 15A, were one of the earliest forms of ceremonialism
at Cahokia and probably antedate most of the mound-building activities. See also comment in Fowler (ed., 1962, p. 56-57).

**M-1355. Klunk Mound 8, Illinois**  

Wood charcoal, id. by R. Yarnell as white oak group, from Klunk Mound 8 (39° 12' 35" N Lat, 90° 32' 48" W Long), Calhoun Co., Illinois. From Crematory B, situated on a low platform of earth, 12 to 16 in. high, constructed in Mound 8 between primary Mounds A and B. Mounds A and B subsequently covered with 2 ft secondary cap which created a linear mound. Crematory B rectangular, 9.5 ft long and 7 ft wide. At each end of crematory floor lay carbonized logs; sample part of uppermost log. On fire-redened crematory floor lay charred remains of disarticulated skeleton. Dating essential for placing this phase of Late Woodland Complex in its proper sequence. Few artifacts recovered from Mound 8 indicate Late Woodland group existing between disappearance of Hopewell and before advent of Mississippian-influenced Late Woodland groups such as the Jersey Bluff Culture. Mound 8 and its 32 burials appear to belong to an early Late Woodland group. Few potsherds recovered belong to “Canteen Wares” category. None of the brighter Jersey Bluff pottery was found (see Titterington, 1935, 1942; Fowler, 1953; Shalkop, unpub.). Coll. 1961 and subm. by Gregory Perino, Thomas Gilcrease Foundation. **Comment (G.P.)**: date also significant in that it tends to date earliest common use of bow and arrow. Crematory A, Mound 8, contained charred flexed male burial with grave goods including a burned side-notched arrow head made from an edge-retouched flake. With another of the 32 burials under the mound were found Late Hopewell-like large projectile points and a barbed stemmed variety, as well as a vertical-handle type pipe common to the later Jersey Bluff foci.

**M-772. Riverside Cemetery, Michigan**  

Charcoal from Riverside Cemetery (45° 15' N Lat, 87° 44' W Long), Menominee Co., Michigan. From Feature 10, a burial, possibly flexed, well below old soil zone. No trace of pit above. Recognizable mandible fragment and probably part of a long bone. Faint stain of ochre, 1 ft by 2 ft, seems to have been placed on top of bone. Few scraps of copper associated. Possibly disturbed by excavation of Feature 9. Coll. 1957 by A. C. Spaulding; subm. by J. B. Griffin, Univ. of Michigan. **Comment (J.B.G.)**: date indicates this burial associated with the Late Woodland occupation at the site.

**Lookout Site series, Michigan**

Charcoal from the Lookout Site, 20IR30 (48° 9' 34" N Lat, 88° 29' 17" W Long), on Greenstone Ridge, Isle Royale, Keweenaw Co., Michigan. From fill of Pit 56, a prehistoric copper mine. Fill thought to have accumulated through natural processes after mine was abandoned, so age of mining activity exceeds that of the fill. In order to have an adequate sample of charcoal from as low a level as possible, several samples coll. from various places in the fill in the lower part of the pit were combined. Coll. 1961 and subm. by Tyler Bastian, Univ. of Utah.
University of Michigan Radiocarbon Dates IX

M-1275c. Lookout Site, Michigan 2800 ± 120 850 B.C.
Charcoal from Pit 56, 3.2 to 3.4 ft below highest edge of mine.

M-1275d, e, f, g. Lookout Site, Michigan 4110 ± 130 2160 B.C.
Charcoal (combined sample) from Pit 56, 3.4 to 5.1 (bottom of mine) ft below highest edge of mine.


Angel Site series, Indiana
Charcoal and shell from the Angel Site (37° 57' N Lat, 87° 28' W Long), Vanderburgh Co., Indiana. Site almost completely homogeneous culturally and chronologically, and may be considered a classic example of Middle Mississippi (Black, 1944). Coll. 1941 and subm. by G. A. Black, Indiana Hist. Soc.

M-2. Angel Site, Mound F, 4 ft below upper surface 1340 ± 120 A.D. 610
Charcoal (Sample Md. F/408) from depth of 4 ft below upper surface of Mound F, in Block 13-R-4, included in the mound during process of constructing the secondary mantle.

M-4. Angel Site, Mound F, pit in primary mound 530 ± 100 A.D. 1420
Charcoal (Sample Md. F/4489) from mass of charred organic and vegetable material found in a pit inclusive within the top of the primary mound. Pit inside S room of large building formerly standing on top of primary mound, burned prior to laying down of secondary mantle. Material should date from time of burning of this structure.

M-9. Angel Site, Mound F, primary surface 1980 ± 130 30 B.C.
Shell (Sample Md. F/1932) removed from primary surface of Mound F, Block 8-R-5.

M-5. Angel Site, village area, house wall trench 580 ± 100 A.D. 1370
Charcoal (Sample W 10 D/8058) from house wall-trench in village area, Block O-R-1. Trench one of several representing repeated rebuilding of dwellings on approx. the same spot. These could not be separated chronologically, but were all Middle Mississippi.

M-7. Angel Site, village area, house wall trench 760 ± 100 A.D. 1190
Charcoal (Sample W 11 A/14159) from dwelling wall trench in village proper. Situation similar to that of M-5.
M-10. Angel Site, village area  

Shell (Sample W 11 A/2738) from Block 9-R-5 within the 0.4 to 0.8 ft cut in the village area.

*General Comment* (G.A.B.): dates were expected to be approx. the same. M-5 could be from later structure than M-7, but there is no evidence. M-7 looks a bit early compared with M-4 and M-5, but is not too badly out of line. M-4 appears the most realistic, M-2 to be completely unrealistic. Dates for M-9 and M-10 probably reflect the unreliability of shell. *Comment* (J.B.G.): these early Michigan dates run with carbon black were not consistent and were withheld pending clarification. Additional material from the Angel site will be run in the future.

M-467. Canter Caves, Ohio  

Dessicated (not charred) corn cobs from Canter Caves (39° 8' N Lat, 82° 41' W Long), NW 1/4 Sec. 36, Jackson Township, Jackson Co., Ohio. Occurrence and stratigraphic position unknown. Corn described by V. H. Jones: 8-, 10-, and 12-row ears, mostly short and thick. Most show elliptical cross section, a characteristic of Basketmaker corn of the Southwest. Some influence of Eastern Complex corn is also evident. Site described in Shetrone (1928). Coll. 1925 by G. N. Miller; subm. by Raymond Baby, Ohio State Mus. *Comment* (V.H.J.): the date and somewhat “primitive” nature of the corn are not consistent and reconcilable. The corn shows only a dilute influence of Eastern Complex, which should be dominant in Ohio by the date derived. Basketmaker influence on corn should be assimilated by this late date into the Eastern Complex, which is closely associated with the Mississippi Pattern.

B. Lower Mississippi Valley and Southeast  

M-582. Williams Island, Tennessee  

Charred ordinary beans (*Phaseolus vulgaris*) contained in the dirt in a shell-tempered plain-surface bowl from a site on Williams Island (35° 5' N Lat, 85° 22' W Long), Hamilton County, Tennessee. Vessel and its contents given by Earl C. Townsend, Jr., to J. B. Griffin in May 1955. Date of collection of vessel not known. Subm. by J. B. Griffin, Univ. of Michigan. *Comment* (J.B.G.): the low bowl has a short, sharply flaring, and almost horizontal rim. It is a late Mississippi vessel and the date is reasonable.

Stanfield-Worley Shelter series, Alabama  

Charcoal from the Stanfield-Worley Shelter, Cct125 (34° 39' N Lat, 87° 53' W Long), W center of SE 1/4 Sec. 34, T4S, R13W, Colbert Co., Alabama. Dating of charcoal will give information on the cultural assemblage in the level represented, which includes Dalton projectile points, Big Sandy side-notched #1 points, Cumberland unfluted projectile points, and blade-type tools (DeJarnette, Kurjack, and Cambron, 1962). Coll. 1960 and subm. by D. L. DeJarnette, Univ. of Alabama.
M-1152. Stanfield-Worley Shelter, 55 in. depth

Charcoal from Square 130 R 3, depth 55 in., in enclosed stratum which has been designated as the “Dalton” level.

M-1153. Stanfield-Worley Shelter, 44 in. to 55 in. depth

Charcoal from Squares 130 R 1 through 130 R 7, depth 44 in. to 55 in., which also is designated as the Dalton level.

General Comment (D.L.D.): the lowest occupational layer at the Stanfield-Worley Bluff Shelter, a stratified multicomponent site, was dated by the above. Layer was dark black in color, contrasting with the sterile zone below and a silt-like sterile deposit above. Contained numerous uniface tools, side and end scrapers, gravers and spokeshaves, as well as projectile points of two major styles: Meserve-Dalton and the side-notched, basally ground Big Sandy I point. This earliest occupation can be considered a post-fluted-point and pre-shell-mound Archaic manifestation.

M-1215a. Mandeville Site, Georgia

Charcoal from the Mandeville Site (31° 40’ N Lat, 85° 05’ W Long), Clay Co., Georgia. From Feature 5, Mound B, Feature 5, 4.5 ft above mound base and slightly W of final mound (upper area of mound destroyed by bulldozer), was an oval area of charcoal-stained sand with max length of 5.4 ft and width of 3.0 ft. Major association was redeposited human cremation (single individual) with charred wood from crematory fire. Probably incorporated in Phase III (of 4 major additions to mound). Associated artifacts, deposited subsequent to cremation, included 9 ground stone celts; large chipped stone “spade”; 13 bicymal copper spools, one of which was covered with meteoric iron; 4 to 5 lbs. of galena; and several sherds, 3 check-stamped and 2 plain. Artifacts should relate to Mandeville II as defined in Mound A, regarded as representing Late Hopewell time level as determined for Illinois. Coll. 1960 and subm. by A. R. Kelly, Univ. of Georgia. Comment (J. H. Kellar): date received quite consistent with above conclusion. M-1044, Mound A, Layer III, Swift Creek occupation, Mandeville II, gave a date of 1420 ± 150 B.P. (A.D. 530); M-1045, Mandeville II, Mound A, gave a date of 1460 ± 150 B.P. (A.D. 510) (Michigan VII, p. 190).

M-1209. Yough Hall Plantation, South Carolina

Oyster shell from Yough Hall Plantation (32° 51’ N Lat, 79° 47’ 32” W Long), Porcher’s Bluff, Charleston Co., South Carolina. Associated with pre-Deptford and post-Fiber-tempered wares, from a late shell ring, the northernmost and probably latest of these structures. Sample should be Terminal Archaic. Shell rings are earliest structures on south Atlantic coast suggesting group ceremonial activity, and probably involved northward movement of a single population from the earliest and southernmost sites on Sapelo Island, Georgia. Site first described by Gregorie (1925). Coll. 1960 and subm. by A. J. Waring, Jr., Savannah, Georgia. Comment (A.J.W.) : this is my Awendaw Complex and is related to but not identical to the Thoms Creek Ceramic Com-
plex (Griffin, 1945). Either the date is too early, or there is a previously unrecognized focus on the South Atlantic seaboard. Pottery is sand-tempered and coil-made. Coils are narrow fillets laid against each other like clap-boarding. Decoration almost universally by finger—pinching, gouging, and jabbing. Bare minimum of punctuating and incising.

**M-1268. Harris Creek Midden, Florida**

Charcoal (Sample 5) from Harris Creek Midden (29° 7' N Lat, 81° 26' W Long), Tick Island, Volusia Co., Florida. From small pit containing Burial #12, partially charred, 6 ft below present surface and 7 1/4 ft below datum. This is a deep and presumably relatively early burial. Date needed to determine if burial is of an Archaic (pre-Orange Period) people, or if much later Indians dug into the Archaic midden and used it as a cemetery. Coll. 1961 and subm. by R. P. Bullen, Florida State Mus. *Comment* (R.P.B.): final interpretation of date awaits results of C¹⁴ runs on other samples from same group of burials (see Bullen, 1961).

**C. Northeastern United States and Canada**

**Wapanucket #8 series, Massachusetts**


**M-1212. Wapanucket #8, Massachusetts**

Charcoal from Feature 18, hearth, in subsoil, but excavated into sand layer below. Extends from 45 cm to 72 cm below surface. Archaic Horizon.

**M-1213. Wapanucket #8, Massachusetts**

Charcoal from Feature 21, hearth, in subsoil, bottom extending into underlying sand. Extends from 64 cm to 88 cm below surface. Archaic Horizon.

**M-1350. Wapanucket #8, Massachusetts**

Charcoal found throughout Feature 66, a pit extending from 52 cm to 82 cm below present surface. Believed to be part of earlier component because of association with a Paleo-Indian graver and several flakes of marine chert invariably used for artifacts by Paleo-Indians at this site. *General Comment* (M.R.): date of M-1350 too late for Paleo-Indian period; Paleo-Indian graver included in Archaic feature. Range of dates, including date of 3910 ± 100 yr B.P. for Y-1168 (Yale VIII, p. 331), extends over a 1000 yr period, which is in agreement with the range of cultural material being found.

**D. United States Great Plains**

**M-1364. Site 25FT31, Nebraska**

Charcoal from Site 25FT31 (40° 21' 16" N Lat, 100° 40' 12" W Long), NE ¼ SW ¼ Sec. 6, T5N, R30W, Frontier Co., Nebraska. From occupational zone and associated features. Dates Spring Creek Complex component,
a Plains Archaic occupation related to Logan Creek Complex. Estimated date: 5000 to 9000 yr ago (Grange, ms.; Kivett, 1961). Coll. 1961 by R. T. Grange, Jr.; subm. by M. F. Kivett, Nebraska State Hist. Soc. Comment (M.F.K. and R.T.G.): this date would appear to be acceptable. The bulk of the projectile points are in the side-notched style of the Logan Creek Complex but the assemblage lacks the side-notched scraper; possibly a chronological or a geographical variation. This is one of the most recent dates for the side-notched tradition in Nebraska which now appears to have lasted for a period of more than 2000 yr.

M-1365. Site 25FT32, Nebraska  
\[ A.D. 1385 \]  
Charcoal from Site 25FT32 (40° 21' 31" N Lat, 100° 40' 39" W Long) NW ¼ Sec. 35, T5N, R30W, Frontier Co., Nebraska. From main house post in NE quadrant of Feature 1, House 1. Should date an Upper Republican Aspect house. Estimated date: A.D. 1200 to 1450 (Grange, ms.; Kivett, 1961). Coll. 1961 by R. T. Grange, Jr.; subm. by M. F. Kivett. Comment (M.F.K. and R.T.G.): the date falls within predicted span and was expected to be late within this time range, as it is. This site produces one of two or three ceramic variants in the Red Willow Reservoir.

M-1366. Site 25CC44, Nebraska  
\[ A.D. 1365 \]  
Charcoal from Site 25CC44 (40° 51' 41" N Lat, 96° 9' 38" W Long), NW ¼ NW ¼ Sec. 2, T10N, R11E, Cass Co., Nebraska. From Feature 2. Should add to range of dates for the Nebraska Aspect. May date A.D. 1000 to 1300. Coll. 1962 by M. F. Kivett and J. Garett; subm. by M. F. Kivett. Comment (M.F.K. and R.T.G.): limited sample from this site suggests mixture of Upper Republican and Nebraska Culture pottery. Date is a little more recent than expected, but acceptable.

M-1367. Site 25CC17, Nebraska  
\[ A.D. 1245 \]  
Charcoal from Site 25CC17 (40° 51' 41" N Lat, 96° 6' 48" W Long), NW ¼ SE ¼ Sec. 6, T10N, R12E, Cass Co., Nebraska. From House D. Site is component of Nebraska Aspect. Coll. 1939 by L. N. Kunkel; subm. by M. F. Kivett for David Gradwohl, 1633 Crestline Drive, Lincoln 6, Nebraska. Comment (M.F.K. and R.T.G.): date would appear to be acceptable for site of Nebraska Aspect.

M-1246. Hart Site, Kansas  
\[ A.D. 1090 \]  
Charcoal from the Hart Site, 140S305 (38° 39' N Lat, 95° 34' W Long), on 110 Mile Creek, Pomona Reservoir, Osage Co., Kansas. Sample recovered from Feature 3, a subfloor pit in the center of House 1. Site shows affinities with both the Upper Republican Aspect and the Late Woodland of the Mississippi Valley. May represent a preliminary stage in the development of Upper Republican and related complexes. Coll. 1959 and subm. by Roscoe Wilmeth for the Kansas State Hist. Soc. Comment (R.W.): date tends to confirm suggestion that Hart Site should be older than Upper Republican sites in Kansas and Nebraska.
M-883. **Gypsum Dunes, New Mexico** 400 ± 130

Charcoal from an aboriginal hearth in the Gypsum Dunes area (34° 55' N Lat, 107° 22' W Long), Sec. 16, T7N, R5W, Valencia Co., New Mexico. Hearth occurred as a resistant erosional remnant on the compact floor of a deflationary depression (blowout). Sandia or Sandia-like points found on the floor of the blowout, one within 15 in. of the hearth, but not necessarily associated. The hearth was cemented by gypsum and stood as a pedestal above the “hardpan” floor (Agogino, 1957). Note: this was a small sample. Coll. 1958 by George Agogino and Vance Haynes; subm. by George Agogino, Eastern New Mexico Univ. *Comment* (G.A.): either the points are not Sandia points and may or may not be associated with the 400 yr old hearth, or the points are Sandia types but are not directly associated with the hearth. It is my current belief that the projectile points, although typologically similar to Sandia, need not be associated with them either chronologically or typologically.

M-988. **Querencia Site, New Mexico** 4680 ± 140

Charcoal from the Querencia Site (35° 28' N Lat, 106° 53' W Long), Sandoval Co., New Mexico. Found in hearth exposed by wind in eolian sand deposit resting on Dakota sandstone. Typical San José and Lobo-type artifacts were found on the surface. Hearth cannot be definitely assigned to either phase, but is probably preceramic. Coll. 1958 by George Agogino, G. C. Shelton, and Vance Haynes; subm. by George Agogino. *Comment* (G.A.): date acceptable. Point types found at this locale fit in well with the San José material.

M-992. **Santa Ana Site, New Mexico** 2460 ± 150

Charcoal from the Santa Ana Site (35° 24' 32" N Lat, 106° 38' 16" W Long), Santa Ana Pueblo Grant, New Mexico. From lowest of four superimposed charcoal layers in slope-wash alluvium. Should be same age as other San Pedro sites in the area (Agogino and Hester, 1953). Note: this was a small sample. Coll. 1958 by George Agogino and Vance Haynes; subm. by George Agogino. *Comment* (G.A.): this date fits very well with previous dates that we have found in the Santa Ana area. Apparently the Santa Ana people were of early Pueblo type, living in the central part of New Mexico from about 1300 to 200 B.C.

**The Power Pole Site series, New Mexico**

Rotted wood from Site LA 4257 (36° 57' 45" N Lat, 107° 36' 00" W Long) NW ¼, NW ¼, Sec. 17, T32N, R7W, left bank of Pine River, San Juan County, New Mexico. Samples date Structures 1 and 3, superimposed cobble ring houses of the Los Pinos Phase, which correlate with the Basket Maker II occupation north of Durango, Colorado. Site described by Eddy (1961). Coll. 1959 by F. W. Eddy; subm. by Fred Wendorf, Mus. of New Mexico.
M-1115D. Power Pole Site, Structure 3 1740 ± 150 A.D. 210

Rotted construction logs obtained by testing under the cobble ring paving of Structure 1. They were located on the SE arch of Structure 3 (Eddy, 1961, Fig. 15) where they had maximum covering from contamination by the overlying paving of Structure 1.

M-1115B. Power Pole Site, Structure 1 1830 ± 150 A.D. 120

M-1115C. Power Pole Site, Structure 1 1690 ± 150 A.D. 260

Rotted logs from different portions of pit (Eddy, 1961, fig. 9). This trench was described with Structure 1 but there is a possibility that it was actually constructed as part of the earlier Structure 3.

General Comment (F.W.E.): regardless of its assignment, this series of three dates is consistent with two C₁⁴ dates obtained from similar structures at Valentine Village, a second Los Pinos Phase site excavated and reported from the Pine River Canyon (Eddy, 1961, p. 103). The Michigan dates are also consistent with the tree-ring dates obtained on Basket Maker II sites excavated N of Durango, Colorado (Morris and Burgh, 1954).

M-1211. Texas Site, 45A5-9, Texas 2170 ± 130 220 B.C.

Human bone from Texas Site (30° 47' N Lat, 104° 46' W Long), Chispa Creek, Jeff Davis Co., Texas. Found eroding from surface of terrace composed of light tan sandy silt, somewhat cemented by disseminated CaCO₃. No evidence of intrusive pit. From S edge of locality with four concentrated Folsom sites spread along head of valley of Chispa Creek. Folsom materials found in same deposit as burial, which consists of shafts of several long bones lacking articular processes, and the cranium lacking the lower jaw (see Lehmer, 1958, p. 122). Carbonization of bones suggests cremation or possibly cannibalism. Coll. 1957 and subm. by J. B. Wheat, Univ. of Colorado. Comment (J.B.W.): date obviously too late to apply to the Folsom occupation. At the two Folsom localities nearest the find of the human bones there are at least two later occupations, one Archaic and one ceramic. Some Archaic fire pits located only about 20 ft away from the burial find spot. Date would appear to correspond to the Archaic complex.

F. Mexico and South America

M-1118. Oztoyahualco, Teotihuacan, Mexico 1805 ± 120 A.D. 145

Charcoal from Mound D (19° 40' N Lat, 98° 50' W Long), found at depth of 1.7 to 1.9 m in SW corner of Pit A2, in sealed deposits between Floors 3 and 2 (Millon and Bennyhoff, 1960, p. 518). Associated with cache of Tzacualli (Teotihuacan I) Phase. Although associated sherds not burned, charcoal was integral part of Cache 3, purposeful offering of major portions of more than eight broken pottery vessels typical of this phase. Charcoal evidently represents burned offering placed with freshly broken vessels on earth floor of a Tzacualli structure prior to second of four known alterations within this first
occupation phase at Teotihuacan. Preliminary ceramic analysis suggests this material represents sub-phase earlier than that encountered within Pyramid of the Sun. Coll. 1959 and subm. by Rene Millon and James A. Bennyhoff, Univ. of California. Comment (R.M.): this is approx. 100 yr younger than expected. For previous Tzacualli phase dates at Teotihuacán, see comment on M-1283 (Michigan VIII).

San Juan Teotihuacan series, Mexico


M-1123. San Juan Teotihuacan, Plazoleta of the Moon 2040 ± 150 90 b.c.

Charred wood from floor of a room attached to S side of structure 1, in the NW corner of the Plazoleta of the Moon, about 60 m S of the Pyramid of the Moon. Sample of remains of roof-beam of this room, which represents the last phase of occupation of the site by the Teotihuacanos.

M-1124. San Juan Teotihuacan, Pyramid of the Sun 1640 ± 150 A.D. 310

Charred wood from a hearth found in a newly excavated N-S tunnel in the Pyramid of the Sun. Tunnel crosses old E-W tunnel about 50 m E of entrance of the latter. Represents date of construction of the Great Pyramid and not that of the small interior structure found 3 yr ago (1959). General Comment (J.R.A.): dates unacceptable, since would suggest that the Pyramid of the Sun was constructed after the city itself had been destroyed.

M-1253. Yayaguala, Teotihuacan, Mexico 1470 ± 120 A.D. 480

Charcoal from Yayaguala (19° 41' 24” N Lat, 96° 51' 06” W Long), Teotihuacan, Mexico. From a large dump, nearly 3 m high, containing about ½ million sherds. Structures and pottery are Teotihuacan III-IV (Séjourné, 1963). Coll. 1961 by Eduardo Noguera and Mme. Laurette Séjourné; subm. by Eduardo Noguera, Liverpool 27, Mexico, D. F. Comment (E.N.): date, in combination with others from Teotihuacan, indicates occupation much earlier than formerly believed.

M-1125. Tula, Mexico 1460 ± 200 A.D. 490

Charred wood from Tula (20° 3’ N Lat, 99° 20’ W Long), Hidalgo, Mexico. From a post found in the interior of a pillar in Hall 2 of the Palacio Quemado. Sample carbonized at time city destroyed by the Mexicans. Coll. 1958 and subm. by J. R. Acosta. Comment (J.R.A.): date approx. 400 yr early, since all historical sources place conquest and destruction of the city between the 11th and 12th centuries A.D.

M-1151. Yagul, Oaxaca, Mexico 1060 ± 150 A.D. 890

Charcoal from Yagul (16° 58’ N Lat, 96° 27’ W Long), Oaxaca, Mexico. From beam, not completely charred, 8 to 10 cm in diam, in Mound 5-W.
Stratigraphically earlier than Tombs 11 and 13, and later than Tomb 10. Tombs 11 and 13 are of Monte Alban V date, have facades with greca decoration. Pottery from Tomb 10 examined by Alfonso Caso, indicates this tomb belongs to last days of Monte Alban III-B or the very beginning of IV, marking end of Classic in Oaxaca. Established date is post-A.D. 800 and pre-A.D. 1350, but range should be reduced by continuing work. Coll. 1955 by G. W. Lowe; subm. by John Paddock, Mexico City College. Comment (J.P.): date not expected to be so early. However, causes no revision of existing ideas, but serves as confirmation of our ideas of Oaxaca chronology. Increased knowledge of Monte Alban V period would now cause us to say this sample should have dated between A.D. 800 and 1250, not 1350, but date still falls well within that range. Was suspected that pottery of Tomb 10 should come closer to A.D. 1000 than to 900. Since this offering comes from a time of slowly evolving styles, mistake is not upsetting.

Yagul Series, Oaxaca, Mexico


M-1248. Yagul, Oaxaca, Mexico  
A.D. 1200
Charcoal from an offering (?) box found in the N side of Room 13. Corresponds to the latest period of occupation of the building.

M-1249. Yagul, Oaxaca, Mexico  
A.D. 1380
Charcoal from Room 16, representing latest occupation of building. Associated with polychrome pottery vessel.

M-1250. Yagul, Oaxaca, Mexico  
A.D. 1580
Charcoal from offering (?) box in N room of Patio A. Also represents latest occupation.

General Comment (I.B.): date of M-1250 seems impossible because no trace of European occupation has been found in excavations at Yagul. All Yagul dates confirm suspicion of rather long period in which Monte Alban V is contemporaneous with Monte Alban IV.

M-1251. Mitla, Oaxaca, Mexico  
A.D. 840
Charcoal from Mitla (16° 54' N Lat, 96° 22' W Long), Oaxaca, Mexico. From Tomb C-3 under eastern mound of the Arroyo group. Should help date the Mixtec occupation of the Valley of Oaxaca. Comment (I.B.): this is only slightly earlier than the dates on M-1248 and M-1249 from Yagul.

M-1257. Las Charcas, Guatemala  
2280 ± 130 330 B.C.
Charcoal and decomposed plant seeds from Las Charcas (14° 18' N Lat, 90° 16' W Long), NW section of Kaminaljuyu site, Finca las Charcas, Guatemala City, Guatemala. Seeds id. by J. A. Steyermark as Nectandra sp., Persea
... gratissima, and Palmaceae. Sample from a jar found imbedded in hard caliche-like clay at the bottom of Pit 2B, a bottle-shaped pit 2 m deep, which also contained sherds, seeds, and refuse (Borhegyi, 1956a, 1956b, 1957). Jar is typical Middle-Pre-Classic Las Charcas Incised pallid red-on-buff ware (cf. Shook, 1951, fig. 1-h). Coll. 1956 and subm. by S. F. de Borhegyi, Milwaukee Pub. Mus. Comment (S.F.B.) : the Michigan date appears to be later than the generally assumed Early Formative (or Early Pre-Classic) date for Las Charcas (1500 to 1000 B.C., see Shook, 1957; C¹⁴ date 1546 B.C. ± 800). The new date obtained from Las Charcas sample M-1257 is more in accordance with the Yale date of 382 B.C. ± 50 (Yale IV, p. 162, Y-384) and seems to confirm Coe’s suspicion (Coe, 1961, p. 127-132 & fig. 12), that Las Charcas is a Middle Formative (700 to 300 B.C.) and not an Early Formative cultural manifestation.

M-1308. El Cangrejal (Site SL-1), Panama A.D. 1020
Charcoal from El Cangrejal (8° 19’ N Lat, 82° 13’ W Long), Dist. of Lorenzo, Panama. From Pit #3, 60 to 70 cm level, in refuse. Associated with sherd assemblage now under study, which includes Coclé Polychrome. Could range from 500 to 1200 A.D. Coll. 1961 by C. R. McGimsey, Olga Linares, and Freeman Mobley; subm. by Clifford Evans for Inst. of Andean Research. Comment (O.L.): within the estimated range.

M-1309. Las Secas Island Site, IS-11, Panama A.D. 1835
Charcoal from Las Secas Is. Site (8° 0’ 30” N Lat, 82° 2’ 30” W Long), Bahia de Muertos, Province of Chiriqui, Panama. From 40 to 50 cm level of Pit 1, in refuse material. In association with tripod bowls unlike the usual well-known Chiriqui ceramics, and with some Coclé Polychrome. Analysis has not as yet determined age of Coclé Polychrome as Early or Late. Could range 500 to 1200 A.D. Coll. 1961 by C. R. McGimsey, Olga Linares, and Freeman Mobley; subm. by Clifford Evans for Inst. of Andean Research. Comment (O.L.): appears to be too recent, for no Spanish trade goods at site and no mention of living Indians in 16th, 17th and 18th century historical documents on Panama. Discrepancy unexplained.

Loma de Lopez series, Colombia
Shell from Loma de Lopez (10° 48’ N Lat, 74° 20’ W Long), Cienaga Grande, Dept. de Atlantico, Colombia. From midden refuse. Lower levels of site show clear-cut relationships to Palmira Phase found on Isla de Salamanca. Coll. 1961 by C. Angulo V.; subm. by Clifford Evans for Inst. of Andean Research.

M-1310. Loma de Lopez, Cut 2, 60 to 80 m A.D. 1125
level
Shell (Protophatca grata Sby.) from Cut 2, 60 to 80 cm level (Level #4).

M-1311. Loma de Lopez, Cut 2, 2.20 to A.D. 1045
2.40 m level
Shell (Protophatca grata Sby.) from Cut 2, 2.20 to 2.40 m level (Level #12).
M-1312. Loma de Lopez, Cut 2, 2.80 to 3.00 m level

Shell (Prothaca grata Sby.) from Cut 2, 2.80 to 3.00 m level (Level #15).

General Comment (C.A.V.) the chronology from the dates agrees with the archaeology, for the dates are consistent within the strata of Cut 2 and the cultural materials correlate closely with the Palmira site of Salamanca Island.

M-1313. Cupica Mound (Site CHP-38), Colombia

Charcoal from Cupica Mound (6° 40' 22" N Lat, 77° 30' 10" W Long), on coast S of Rio Jurado, near Punta Crucés, Dept. de Chocó, Colombia. From 76 cm below surface in refuse, and in first artificial fill in mound. Site has five cultural complexes, Cupica I through V. Sample should date Cupica II level. Coll. 1961 by G. Reichel-Dolmatoff; subm. by Clifford Evans for Inst. of Andean Research. Comment (G.R.-D.): date later than expected, because, although it is associated with materials underlying Coclé-style pottery in Cupica, it corresponds essentially to Late Coclé in Panama. This suggests that time-span of Cupica sequence is shorter than was thought, and that Late Coclé pottery spread S only after ca. 1000 A.D. Similarities between the cultural material from Cupica, dated by this sample, and certain Panamanian materials thought to be “formative”, might indicate that latter are much later than has been supposed. However, the Cupica date fits the upper part of the Sinú sequence, as had been postulated, and also establishes the first clear link between Coclé and Colombia.

M-1314. Rio Anjía Site (CHP-41), Colombia

Charcoal from Rio Anjía Site (6° 0' 10" N Lat, 77° 20' 22" W Long), in Bahía de Salano area, Pacific Coast, Dept. de Chocó, Colombia. From 1.05 m below surface in trench in refuse. Horizon agricultural with metates and grinding stones. Pottery distinct. Study of ceramics will cross-seriate this site with Cupica complexes. Coll. 1961 by G. Reichel-Dolmatoff; subm. by Clifford Evans for Inst. of Andean Research. Comment (G.R.-D.): date coincides with the historical date of 1632-1646 when a Mission was founded among the little-known Idabaesz Indians of the Bahía de Salano area. The incised pottery dated by this sample appears to be derived from the prehistoric complexes to the N and SE which, however, do not seem to be ancestral to the pottery of the modern Chocó Indians. According to early sources on the Idabaesz, their culture seems to have differed from the neighboring tribes and, in the light of this C14 date, the Idabaesz appear to have been a remnant group, surrounded by recent invaders whose prehistoric roots lie outside the Chocó area.

Site M-7 series, Ecuador

Site N of Manta along the coast (0° 57' S Lat, 80° 39' W Long), Esteros, Manabi Prov., Ecuador. Charcoal from Cut A in village refuse. Bahía Culture Complex, about 500 B.C. to A.D. 500. Coll. 1961 by E. Estrada, Clifford Evans, and Betty Meggers; subm. by Clifford Evans for Inst. of Andean Research.
M-1315. Site M-7, 3.20 to 3.40 m level  2050 ± 120 100 B.C.
Charcoal from 3.20 to 3.40 m level.

M-1316. Site M-7, 4.00 to 4.20 m level  2120 ± 120 170 B.C.
Charcoal from 4.00 to 4.20 m level. Bahia I Culture Complex. Should date ca. 500 B.C. to beginning of present era.

M-1319. Site M-7, 4.00 to 4.20 m level  2110 ± 120 160 B.C.
Charcoal from 4.00 to 4.20 m level.

General Comment (C.E.): these dates agree well with the estimates made on pottery analysis and with previous dates; see M-734 (Michigan IV, p. 192) and W-833 and W-834 (USGS V, p. 181).

Valdivia Site (G-31) series, Ecuador
Charcoal and shell from Valdivia Site (1° 56' S Lat, 80° 45' W Long) Guayas Prov., Ecuador. From Cut J in village refuse. Valdivia Culture (Evans, Meggers, and Estrada, 1959). Coll. 1961 by E. Estrada, Clifford Evans, and Betty Meggers; subm. by Clifford Evans for Inst. of Andean Research.

M-1317. Valdivia Site, Zone D, 2.70 to 3.00 m level  4480 ± 140 2530 B.C.
Charcoal from 2.70 to 3.00 m level. Should fall within range of dates for samples W-631, W-632, and W-630, or earlier (USGS V, p. 181).

M-1318. Valdivia Site, Zone D, 3.00 to 3.30 m level  4170 ± 140 2220 B.C.
Charcoal from 3.00 to 3.30 m level. Period A by ceramic analysis.

M-1320. Valdivia Site, Zone E, 3.60 to 3.90 m level  5150 ± 150 3200 B.C.
Charcoal from 3.60 to 3.90 m level. Period A by ceramic analysis.

M-1321. Valdivia Site, Zone E, 3.90 to 4.20 m level  4100 ± 140 2150 B.C.
Shell (Anomalocardia subrugosa Sby.) with all surfaces in excellent condition showing no powdering, from 3.90 to 4.20 m level. Period A.

M-1322. Valdivia Site, Zone E, 4.00 m level  4620 ± 140 2670 B.C.
Charcoal from Hearth B, at 4.00 m level. Period A.

General Comment (C.E.): these new dates must be considered in comparison with the three dates W-630, W-631, and W-632 of 4050 ± 200, 4190 ± 200, and 4450 ± 200 (USGS V, p. 181) from Period B and Period A of the Valdivia culture, based on shell samples. Those wanting to discount the early dates of this Formative period culture objected to the use of shell; with the new dates based on four charcoal and one shell samples and all as early or earlier than the shell dates, we can conclude that the Valdivia Culture dates within the range of the total series of Michigan and USGS dates. The main discrepancy
between shell dates and charcoal is that the charcoal gives the older dates, and in the case of M-1321 and M-1322, the charcoal date is actually 500 yr earlier than the shell date. Thus the evidence shows that the Valdivia Culture is as early as estimated and the pottery sequences in the stratigraphic excavations bear out the dating. Certain dates do not fall in line with their stratigraphic position in the ground, but this is not too disturbing, for in deep middens there is always some slight migration of specimens from people continuing to live on the site. The pottery studies bear this out.

Sambaquí do Forte Marechal Luz series, Brazil

Charcoal, carbonized seeds, and bone from Sambaquí do Forte Marechal Luz (27° 50' S Lat, 48° 50' W Long), Ilha do Sao Francisco, Santa Catarina, Brazil. Coll. 1960 and subm. by A. L. Bryan, Univ. of Alberta.

M-1200. Sambaquí do Forte Marechal Luz, Stratum 1

Charcoal from Stratum 1 within Test Pit No. 1, 2 m N of main trench, and from 10 to 30 cm below the surface. Presumably dates last occupation of site (Zone VIII).

M-1203. Sambaquí do Forte Marechal Luz, Stratum 5

Charcoal from fireplace in Stratum 5. Dates end of Occupation Zone V immediately before introduction of pottery.

M-1204. Sambaquí do Forte Marechal Luz, Stratum 6a

Carbonized seeds found in a large lens in Stratum 6a. Dates Occupation Zone IV.

M-1205. Sambaquí do Forte Marechal Luz, Stratum 6b

Charcoal from fireplace associated with several burials intruded from Stratum 5b into Stratum 6b. Dates Occupation Zone V.

M-1206. Sambaquí do Forte Marechal Luz, Stratum 7

Charcoal found adjacent to unfired modeled clay cooking-bowl features in Stratum 7. Dates Occupation Zone IV.

M-1207. Sambaquí do Forte Marechal Luz, Stratum 10

Burned whale vertebra used as charcoal brazier, Stratum 10. Dates end of Occupation Zone II.

M-1208. Sambaquí do Forte Marechal Luz, Stratum 21

Charcoal from Stratum 21 (lowest shell stratum, just above Occupation Zone I in basal clay). Dates beginning of Occupation Zone II.
General Comment (A.L.B.): the 23 major physical strata have been divided into seven "occupation zones." Because this large shell mound lies on a steep hillside protected from wave erosion and higher sea levels, it was occupied longer than most and has yielded good evidence for cultural change. Absence of intentional bifacial percussion flaking has been noted before from some Brazilian sambaquis, but this one presents a stratified sequence which lacks any evidence for a bifacial percussion flaking industry until Occupation Zone IV, where three examples were recovered. Detritus flakes, some showing evidence of use for working in a suddenly expanded bone industry, and bifacially-flaked leaf-shaped "blanks," were found only in Zones V, VI, and VIII (from the surface through Stratum 5). This and the fact that raw material for flaking the diabase axes came from a dike on the beach near the sambaqui indicates that the three axes from Occupation Zone IV were probably traded in and not made by the occupants of the site. From the dates we can conclude that the people who lived on this sambaqui remained ignorant of the technique of bifacial percussion flaking until about A.D. 1000 and of pottery-making until after A.D. 1300. As only plain pottery (usually black but sometimes oxidized to an orange ware) was found, there is no evidence for contact with Tupi-Guarani groups who occupied the island of Santa Catarina to the S at least by A.D. 1550.

G. Far East and Pacific

Soksil Site series, Korea

Charred wood, id. by R. Yarnell as oak (Black Forest variety) from the Soksil Site (37° 35’ 30” N Lat, 127° 11’ 30” E Long), ½ mi SW of Soksil-li and about 13 mi E of Seoul, on the N bank of the Han River, Kyongge-do Province, Korea (Chase, 1961). Coll. 1960 and subm. by D. W. Chase, Montgomery Mus. of Fine Arts, Montgomery, Alabama.

M-1258. Soksil Site, Test 6, Korea 2230 ± 120
280 B.C.

Charred wood from hearth in Test 6, at a depth of 4 ft, in an occupational lens 7 in. thick, below loose clay talus. Pottery in this lens is Han River types A, B, and C. Should date late Neolithic in Han River Valley, estimated at 2000 yr ago. Comment (D.W.C.): date matches original round-number guess date fairly well. Should pretty nearly date latest occupation of site. Sites of Okkok and Tokso-ri, although featuring Han River Plain types, may be later, however. MacCord (1958) obtained a date from Kapyong Site on Pukhan River of not quite 2000 yr ago (Michigan II, p. 1104-1105, M-303). Site had Han River Plain types plus check- and simple-stamped types found at Tokso-ri. This helps to bear out the late position of terminal Neolithic occupation at Soksil.

M-1259. Soksil Site, Test 8, Korea 2340 ± 120
390 B.C.

Charred wood from Test 8, 1 ft below occupation zone yielding M-1258. Located on W slopes of site between Tests 2 and 6. Zone is a 6 in. layer of dark brown clay overlain by a loose silt bed 5 ft thick. Yangju Plain vessel recovered, as well as a pottery disc with Han River paste and sherds of Han River types A and B. Should date Middle Neolithic in central Korea, estimated
at 2500 yr ago. Comment (D.W.C.): date could give absolute terminus of Yangju Plain. I do not believe it dates any part of what might in time be defined as Middle Neolithic in central Korea. Probably dates climactic occupation of the site and is Late Neolithic but not in its terminal phase.

**M-1430. Komoro Dam Site, Japan**  
11,300 ± 400 9350 B.C.

Carbonized tree trunk from Komoro Dam Hydroelectric Power Plant (36° 19' N Lat, 138° 25.4' E Long), at the S bank of the dam, SE of Komoro City, Nagano Prefecture, Japan. Found close to bottom of Pumice Flow 2 deposit, from Asama volcano. Directly underlain disconformably by Pumice Flow 1. Pumice Flow 2 correlated with Itahana Yellow Pumice Bed, North Kanto. Maebashi peat bed immediately below the Itahana Brown Pumice has been dated at 13,130 ± 230 yr ago (Gakushuin I, p. 89, GaK-159). Many non-ceramic remains placed below Itahana Yellow Pumice and above Itahana Brown Pumice. Itahana Yellow Pumice is below horizon of earliest Jomon Culture (Saishikada) yielding earliest Jomon pottery of the Tsumegatamon style. This predates the Early Jomon Culture of the Natsushima shell mound, which has yielded dates of 9240 ± 500 and 9450 ± 400 yr ago (Michigan V, p. 45, M-769, 770, and 771). Coll. 1960 by Dr. Aramaki; subm. by Kunio Kobayashi, Shinshu Univ. Comment (K.K.): confirms estimates as to the rough date of the borderline between ceramic and non-ceramic cultures in Japan, and also agrees with our conceptions of Japanese Late Quaternary chronology (see Kobayashi, 1957, 1962).

**Iyatayet Ceramic series, Alaska**

Carbonized material from pottery sherds from the Iyatayet Site (64° 13' N Lat, 160° 47' W Long), Cape Denbigh, Alaska. Pottery coll. by J. L. Giddings, samples scraped from interior and exterior of sherds while collection under analysis at Mus. of Anthropol., Univ. of Michigan (Giddings, 1951, 1960; Griffin, 1953). Subm. by J. B. Griffin, Univ. of Michigan and J. L. Giddings, Brown Univ.

**M-1260a. Iyatayet Site, Alaska, Barrow Plain**  
960 ± 100 A.D. 990

Carbonized material from sherds of Barrow Plain. Type associated with Birnirk and Western Thule cultures and persists from time of Birnirk, probably A.D. 600, to time of Ekseavik, A.D. 1400.

**M-1260b. Iyatayet Site, Alaska, Barrow Curvilinear**  
1050 ± 110 A.D. 900

Carbonized material from sherds of Barrow Curvilinear. Same associations as Barrow Plain.

**M-1260c. Iyatayet Site, Alaska, Norton Ware**  
2720 ± 130 770 B.C.

Carbonized material from sherds of Norton ware, assigned to the Norton Complex. Dates available indicate Norton lasted from 500 to 100 B.C., or, in the Near Ipiutak Phase, to about the beginning of our era. There is a previous C14 date of 255 B.C. (Pennsylvania IV, p. 11).

General Comment (J.L.G.): dates of carbonized material from Barrow Ware
coincide very nicely with Western Thule sites at Cape Krusenstern. Since there is no firm trace of Birnirk at Iyatayet Site, but an abundance of cross-typing with the Western Thule houses, I assume that my early Nukleet is the source of these sherds. Date for Norton sample is earlier than other Norton dates, co-inciding with two dates from the Choris Culture (Pennsylvania IV, p. 10). Since sample undoubtedly relates to Norton culture rather than Choris, this suggests Choris Culture at Choris Peninsula is some centuries earlier than previously published C\textsuperscript{14} dates would indicate.

**H. Africa, Europe, and Siberia**

**Lochinvar Hot-Spring Mound Site series, Northern Rhodesia**

Charcoal from Lochinvar Hot-Spring Mound Site (15° 55' S Lat, 27° 16' E Long), Kafue Basin, Southern Province of Northern Rhodesia, Africa. Associated with faunal debris and percussion flaked tools and chipping debris relating to the Later Stone Age (Northern Rhodesian Wilton, Gabel, 1962, 1963). Samples are from lower levels of the site and probably pertain to a relatively early phase of this culture. There is no way of estimating the age of the cultural material associated with these samples, but a maximum age of 5000 to 7000 yr is suggested by C\textsuperscript{14} dates for comparable finds elsewhere in southern and central Africa. Coll. 1961 and subm. by Creighton Gabel, Northwestern Univ.

**M-1323. Lochinvar Hot-Spring Mound Site, Northern Rhodesia**

4450 ± 150

2500 B.C.

Charcoal from grid square 6L17, 96 in. depth.

**M-1324. Lochinvar Hot-Spring Mound Site, Northern Rhodesia**

4650 ± 150

2700 B.C.

Charcoal from grid square 6L24, 96 in. depth.

**General Comment (C.G.):** UCLA obtained dates of 4300 yr ago at the 96 in. depth and 4700 yr ago at the 60 in. depth (UCLA II, p. 18). Univ. of Michigan dates are probably essentially correct.

**M-1345. Kosinj, Yugoslavia**

2590 ± 200

640 B.C.

Charcoal from Kosinj (44° 44' N Lat, 15° 14' E Long), Croatia, Yugoslavia, found in fireplace associated with clay ring believed to be support for smelting pot. Site thought to be remnant of first Croatian printing house, dated A.D. 1483 to 1491. Fireplace and clay ring would be for melting lead for type. Alternative hypothesis places site in pre-Roman times, at about 2500 yr ago. Coll. 1961 and subm. by Zvonimir Kulundžić, Zagreb II, Buconjiceva 19, Yugoslavia.

**M-1330. Atalonga Site, Siberia**

1750 ± 150

A.D. 200

Charcoal from the Atalonga Site (56° 20' N Lat, 104° E Long), Atalonga, Irkutsk Oblast, Siberia, on the Ilim River. Pure Serovo site, according to interpretation of A. P. Okladnikov. Coll. 1929 by G. Debets; subm. by J. B. Griffin, Univ. of Michigan, from the Hermitage collection in Leningrad. **Comment (J.B.G.):** date appears to be too late for Serovo Complex, which probably should be in the 2nd millenium B.C.
Date lists:
- Gakushuin I: Kigoshi, Tomikura, and Endo, 1962
- Michigan I: Crane, 1956
- Michigan II: Crane and Griffin, 1958
- Michigan IV: Crane and Griffin, 1959
- Michigan V: Crane and Griffin, 1960
- Michigan VII: Crane and Griffin, 1962
- Michigan VIII: Crane and Griffin, 1963
- Pennsylvania IV: Ralph and Ackerman, 1961
- USGS III: Rubin and Suess, 1956
- USGS V: Rubin and Alexander, 1960
- UCLA II: Fergusson and Libby, 1963
- Yale IV: Deevey, Gralenski, and Hoffren, 1959
- Yale VIII: Suiver, Deevey, and Rouse, 1963

- 1956b, Summer excavations in Guatemala: Archaeology, v. 9, no. 4, p. 286-287.
Eddy, F. W., 1961, Excavations at Los Pinos Phase sites in the Navajo Reservoir District: Mus. of New Mexico, Papers in Anthropol., no. 4.
Evans, C., Meggers, B., and Estrada, E., 1959, Cultura Valdivia: Publicación no. 6, Museo Victor Emilio Estrada, Guayaquil.


Gregorie, A. K., 1925, Notes on the Sewee Indians and Indian remains: Contributions from Charleston Mus., Charleston, South Carolina.


NATIONAL PHYSICAL LABORATORY
RADIOCARBON MEASUREMENTS II

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The following list comprises measurements made since those reported in NPL I and is complete to the end of November 1963.

Ages are relative to A.D. 1950 and are calculated using a half-life of 5568 yr. The measurements have been corrected for fractionation and referred to 0.950 times the activity of the NBS oxalic acid as a contemporary reference standard. The quoted uncertainty is one standard deviation derived from a proper combination of the parameter variances, viz. those of the standard and background measurements over a rolling twenty-week period, of the sample measurements from at least three independent fillings, of the δC\textsuperscript{13} measurements and of the de Vries effect (assumed to add an additional uncertainty equivalent to a standard deviation of 80 yr). Any uncertainty in the half-life has been excluded so that relative C\textsuperscript{14} ages may be correctly compared. Absolute age assessments, however, should be made using the accepted best value for the half-life and the appropriate uncertainty included. If the net sample activity is less than 4 times the standard error of the difference between the sample and background activities, a lower limit to the age is reported equivalent to a sample activity of 4 times the standard error of this difference.

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

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

A. British Isles

NPL-16. Wybunbury, Cheshire 10,780 ± 162 8830 B.C.

Detritus peat from depth of 5 ft in temporary trench in thick sand bed overlying boulder clay at Lea Farm, Wybunbury (53° 02' 20'' N Lat, 2° 26' 40'' W Long), Cheshire. Coll. 1960 by G. R. Coope and F. Moseley; subm. by F. Moseley, Univ. of Birmingham. Comment (G.R.C. and F.M.) : stratigraphical position of sands and boulder clay is controversial, and a correct understanding is fundamental to interpretation of the drift sequence of a large part of the Cheshire Plain. Age of less than 20,000 yr indicates sequence is in Late Glacial II/III.

Romney Marsh series, Kent

Samples to date natural formation and reclamation of 80 sq mi of marshland on landward side of Dungeness. Accurate date for formation of peat underlying much of the ground will provide (a) earliest date for formation of tidal flat and salting deposits which overlie it, (b) date for beginning of transformation of coastline from shingle-bar to cuspate foreland, (c) information on rate of accumulation of shingle at Dungeness. Coll. 1961 and subm. by J.G.O. Smart, Geol. Survey and Mus., London.
NPL-23. **Appledore Dowels**

Wood (probably birch) from ditch bank in peat layer underlying Estuarine Alluvium, Appledore Dowels (51° 02' 30" N Lat, 0° 49' 20" E Long), Kent.

$$3020 \pm 94$$ 1070 B.C.

NPL-24. **Walland Marsh**

Wood (probably birch) from tree-trunk in new ditch cutting of peat layer underlying Estuarine Alluvium, Wheelsgate (50° 58' 30" N Lat, 0° 53' 20" E Long), Kent. **Comment (J.G.O.S.)**: determinations confirm period of formation of Romney Marsh peat as Bronze Age. Previously dating was by analogy with submerged forest off Pett Level from which a single flint flake of Neolithic to early Iron-Age had been recovered (Milner and Bull, 1925).

$$3340 \pm 92$$ 1390 B.C.

NPL-25. **Wheelsgate**

Shell (**Scrobicularia plana**) from new ditch cutting in creek-ridge sand infilling channel eroded into the peat in Estuarine Alluvium, Wheelsgate (50° 58' 30" N Lat, 0° 53' 20" E Long), Kent. **Comment**: for this sample we have applied a correction of -470 ± 83 yr obtained from measurements on a sample of **Mya arenaria** (A.D. 1660 to 1670) obtained through the courtesy of the Director of the State Service for Archaeol. Inv. in the Netherlands. The $\delta^{13}$C value for the Mya was -5.7 ± 1‰ relative to PDB. **Comment (J.G.O.S.)**: age is younger than anticipated. The creek-ridge (Green and Askew, 1959) from which specimens were obtained is part of a series of such ridges that are widely distributed upon this marshland. If all ridges are contemporaneous much of marshland thought to have been land since Roman time was not deposited until late in that period. The Rhee Wall (Steers, 1948), which many have thought to be Roman, can be shown to postdate ridge system. **General Comment (J.G.O.S.)**: creek-ridges overlie and intersect peat. These three determinations provide first precise dates for variations in sealevel during formation of marshland.

$$1550 \pm 120$$ A.D. 400

NPL-34. **Isleworth, Middlesex**

Stem fragments in silt at base of gravels comprising a low terrace of the Thames at Isleworth (51° 27' 30" N Lat, 0° 20' 00" W Long), Middlesex. Coll. 1959 by F. W. Shotton and A. Sutcliffe; subm. by F. W. Shotton, Univ. of Birmingham. **Comment (F.W.S.)**: fauna associated with plant remains indicate temperate conditions whereas large mammal bones (reindeer, bison, etc.) in overlying gravel indicate marked deterioration of climate. From faunal point of view result fits as late stage of Eemian Interstadial.

$$>43,500$$

NPL-55. **Coleshill, I, Warwickshire**

Grass-sedge peat from layer 2 in. thick beneath 12 ft of sand and gravel of early flood plain or low terrace deposits on Coleshill Industrial Estate (52° 31' N Lat, 1° 42' W Long), Warwickshire. Coll. 1962 by M. R. Kelly; subm. by F. W. Shotton. **Comment (F.W.S.)**: sample provides date for contained sub-
arctic flora and insect fauna and relates these deposits to chronology of Last Glaciation.

NPL-56.  **Whitaere Heath, C 1, Warwickshire**  

10,560 ± 142  
8610 b.c.

Plant detritus from depth of 13 ft near base of terrace gravels overlain by alluvium at Nether Whitaere (52° 32' N Lat, 1° 41' W Long), Warwickshire. Coll. 1962 by M. R. Kelly; subm. by F. W. Shotton.  

*General Comment* (F.W.S.): dates for NPL-27c, Minworth IIb (10,530 ± 156, NPL I), NPL-55, Coleshill I, and NPL-56 were expected to be similar as insect remains in all three strongly support their contemporaneity. Age of 32,000 yr for Coleshill I is close to expectations which would make the result for Whitacre Heath another case of contamination. Like Minworth IIb, it is not impossible for this sample to be contaminated with sewage but it is difficult to believe that two old samples are contaminated to the same extent. They may therefore truly postdate Coleshill I, but this is uncertain.

NPL-57.  **Tweedsmuir, Peeblesshire**  

3440 ± 90  
1490 b.c.

Charcoal from Pit 3 in burial cairn 26 ft × 19 ft × 1 ft 6 in. in greatest height at Tweedsmuir (55° 29' 48" N Lat, 3° 26' 54" W Long), Peeblesshire. The cairn, believed to be Early Bronze Age, and surrounding ground were overlain by layer of peat of 1 ft maximum depth. Coll. 1961 and subm. by A. MacLaren, Royal Comm. of the Ancient and Hist. Monuments of Scotland.  

*Comment* (A. MacL): excavation yielded no direct archaeological dating evidence (e.g. pottery, metal) and as this cairn is first example of its type to be dug, result helps place it in correct chronological context.

**B. Australia**

**Fromm’s Landing series, South Australia**

Wood charcoal from excavation at Shelter 6, Fromm’s Landing (34° 47' S Lat, 139° 34' E Long), South Australia. Coll. 1960 and subm. by D. J. Mulvaney, Univ. of Melbourne.  

*Comment* (D.J.M.): dates permit chronological comparison and check upon dates obtained from Shelter 2, Fromm’s Landing (Mulvaney, 1960, 1961, New Zealand I-V).

NPL-28.  **Fromm’s Landing, 1**  

2950 ± 91  
1000 b.c.

Sample 1 from 4 ft 6 in. below surface in well-stratified deposit, associated with small backed blades, termed ‘Bondi’ points.

NPL-29.  **Fromm’s Landing, 2**  

3170 ± 94  
1220 b.c.

Sample 2 from depth of 7 ft, less than 12 in. beneath skeleton of dingo.  

*Comment* (D.J.M.): this provides first definite chronological data concerning antiquity of the dingo in Australia.

**C. Africa**

NPL-15B.  **Wadi Gan, Libya**  

6500 ± 108  
4550 b.c.

Land snail shells, associated with an Aterian industry, in undisturbed silt of terrace of Wadi Gan, 15 mi E of Garian (32° 20' N Lat, 12° 10' E Long),
Tripolitania. Coll. 1959 by E. S. Higgs and R. Imison; subm. by E. S. Higgs, Univ. of Cambridge. Comment: although age of 6500 yr is younger than expected, ca. 16,000 yr, possibility of contamination is neglible since, after outer 1/3 of sample was removed during pretreatment, two gas samples were prepared from remaining shell (corresponding to intermediate and innermost material respectively) and had same activity.

**Kisese II Rock Shelter series, Tanganyika**

Charred ostrich eggshell from deep deposits in floor of Kisese II Rock Shelter, Kondoa District (4° 25' 15" S Lat, 35° 50' E Long), Tanganyika. Coll. 1956 and subm. by R. R. Inskeep, Faculty of Archaeol. and Anthropol., Cambridge. Samples are directly related to an unbroken succession of Stone Age industries distributed vertically through 20 ft of deposit. Comment (R.R.I.): it was hoped that results would provide beginning of an absolute chronology for the 2nd Intermediate and Late Stone Age in this part of Africa, corresponding to ages between 3000 and 7000 B.P.

**NPL-35. Kisese II/1**

Sample from middle part of Late Stone Age sequence.

**NPL-36. Kisese II/2**

Sample from early Late Stone Age sequence.

**NPL-37. Kisese II/3**

Sample from 1st Intermediate/Late Stone Age transition.

**NPL-38. Kisese II/4**

Sample from middle part of 2nd Intermediate sequence.

*General Comment*: in view of careful pretreatment suitability of ostrich eggshell requires investigation.

**Muchoya Fen series, Uganda**

Peat, separate cores from a Hiller drill, from Muchoya Fen, 8000 ft above sealevel within Echuya Central Forest Reserve (1° 30' S Lat, 30° E Long), Uganda. Coll. 1960 and subm. by M. E. S. Morrison, Makerere Univ. College, Uganda.

**NPL-52. Muchoya Fen, 400-450**

Sample from depth between 400 and 450 cm.

**NPL-53. Muchoya Fen, 600-650**

Sample from depth between 600 and 650 cm.

**NPL-54. Muchoya Fen, 750-800**

Sample from depth between 750 and 800 cm.

*General Comment* (M.E.S.M.): the fen, within area of Bufumbira volcanic
bay, is in equatorial belt and enjoys a somewhat temperate climate throughout the year. The profile was analyzed at consecutive small vertical intervals for its pollen content (Morrison, 1961). Results should be important in correlation of late Quaternary climatic and vegetation sequences in NW Europe and equatorial E Africa.

**Tristan da Cunha series, A**

Organic layers from fossil soil at alt ca. 2000 to 2100 ft from W side of Big Green Hill in Council Gulch (37° 03′ 05″ S Lat, 12° 16′ 25″ W Long), Tristan da Cunha. Coll. 1962 and subm. by J. H. Dickson, Univ. of Cambridge.

**NPL-47. Tristan da Cunha, 1**

10,770 ± 156

8820 B.C.

Sample from layer 12 to 14½ cm below surface of fossil soil overlain by light brown silt, 12 cm thick, and underlain by light brown silty loam, 4 cm thick. Above fossil soil is 4 m of black cinder agglomerate.

**NPL-48. Tristan da Cunha, 2**

11,310 ± 168

9360 B.C.

Sample from layer 18½ to 22½ cm below surface of fossil soil overlain by 4 cm of light brown silty loam that underlies NPL-47, underlain by 3½ cm of light brown silt.

*General Comment* (J.H.D.): section was exposed recently by minor landslide. Results will enable history of previous eruptions and vegetational history to be established (Hafsten, 1960).

**Tristan da Cunha series, B**


**NPL-49. Tristan da Cunha, 3**

39,160 ± 6090

37,210 B.C.

Sample from lignite bed, 5 ft deep, overlain by 30 ft of tuff, underlain by over 100 ft of coarse trachyte.

**NPL-50. Tristan da Cunha, 4**

>36,900

Sample from lignite bed, 6 ft deep, overlain by 25 ft of tuff, underlain by 30 ft of rotting trachytic lava.

*General Comment* (J.H.D.): the history of previous eruptions and vegetational history should be resolved by these measurements.

**D. South America**

**NPL-60. Calima, La Primavera, Colombia**

700 ± 85

A.D. 1250

Wood charcoal, associated with pottery and stone artefacts from shaft grave, Tomb 1, Calima (4° N Lat, 77° W Long), Colombia. Coll. 1962 and subm. by W. M. Bray, Univ. Mus. of Archaeol. and Ethnology. *Comment* (W.M.B.): many classes of pottery were associated in tomb; several have
parallels in other undated cultures and this material probably represents last phase of occupation in valley before coming of Spaniards.

References

Date lists:
- New Zealand I-V Grant-Taylor and Rafter, 1962
- NPL I Callow, Baker and Pritchard, 1962
SOUTHERN RHODESIAN
RADIOCARBON MEASUREMENTS I

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The first series of C\textsuperscript{14} dating measurements made in the Gulbenkian
Radiocarbon Dating Laboratory, which came into operation in October 1962,
are reported in the following list.

INTRODUCTION

All measurements are made in a stainless steel counter of the Houtermans-
Oeschger type, manufactured by Manufacture Belge de Lampes et de Matérial
Electronique, using acetylene as the counting gas. The counter is operated at
760 mm Hg pressure with appropriate corrections for ambient temperature.
The counter is shielded by 1 in. of steel, 3 in. of lead, large paraffin wax blocks
containing 15\% by weight of boric acid, and finally 8 in. of mild steel. Under
these conditions the counter has a background of 1.4 counts/min and an NBS
oxalic count of 15.5 counts/min.

Acetylene is prepared either by the method of Barker (1953) or by the
more direct conversion of wood charcoal to lithium carbide as described by
Swart (1963). In both cases yields of 95\% or better are obtained.

NBS oxalic acid is used as a standard and has been checked and found to
agree within less than 0.5\% with a sample of 1890 wood from a section of
Pinus pinea of known planting date and known felling date which was grown
in Tokai Plantation, South Africa (18° 25' S Lat, 34° 03' E Long).

No correction for isotopic fractionation is made because of the lack of
mass spectroscopic facilities. Samples are normally counted at two weekly in-
tervals, the count being repeated whenever the two counts do not agree within
the statistical error.

The errors reported include the statistical counting error, an estimate of
the error due to possible fractionation (± 30 yr for wood or charcoal) and an
estimate of the error due to the fluctuation of the C\textsuperscript{14} content of the atmosphere
(± 80 yr). The error in the half-life of C\textsuperscript{14} is not included.

Pretreatment of samples: All organic samples are treated with hot 1\%
hydrochloric acid, followed by 1\% sodium hydroxide, followed by 1\% hydro-
chloric acid once again and finally a thorough washing with distilled water. In
some few cases treatment with sodium hydroxide had to be dispensed with as it
removed too much of the organic material. Any rootlets present are handpicked
from the sample.

ACKNOWLEDGMENTS

We gratefully acknowledge a generous grant from the Calouste Gulbenkian
Foundation which enabled us to purchase all the necessary equipment including
a liquid-air plant. We are also pleased to acknowledge the help of Miss E. A.
Heggarty who has carried out the work of preparing and counting the samples.
SAMPLE DESCRIPTIONS

All results are expressed in years before 1950, based on a C\textsuperscript{14} half-life of 5570 yr.

I. TREE SAMPLES

Baobab Tree series

SR-1. Baobab Tree, Lake Kariba \textsuperscript{a}D. 1210

Wood sample of \textit{Adonsonia digitata} L from bush-clearing operations at Lake Kariba (16\textdegree 55' S Lat, 28\textdegree 05' E Long), in Southern Rhodesia. Sample was taken from midway between the center and the outside of a 15 ft in diam baobab tree (Swart, 1963). Coll. and subm. by E. Swart.

SR-2. Baobab Tree, Heartwood \textsuperscript{a}D. 940

Wood from the heart of the same tree as SR-1. \textit{Comment:} since many Baobab trees grow to a diam greater than 20 ft the indications are that many of them are more than 1000-yr old.

SR-3. Estoril Beach Camp, Beira, Mozambique \textsuperscript{a}D. 1390

Wood of \textit{Avicennia marina} found 2 mi N of the Estoril Beach Camp, Beira, Mozambique (19\textdegree 45' S Lat, 35\textdegree 0' E Long). Wood was embedded in lagoon mud and had been exposed by coastal erosion. Coll. by A. D. Boughey, Dept. of Botany, Univ. College of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia. \textit{Comment (A.D.B.):} by analogy with the relationship between the existing coastline and the present lagoon, date gives an estimate of the time taken by this stretch of coast to over-run the lagoon in which this tree once grew.

SR-4. Wonderboom, Pretoria \textsuperscript{a}D. 1600

Wood sample taken 6 ft from the heart of the tree known as the Wonderboom (\textit{Ficus pretoriae} Burtt-Davey) (25\textdegree 36' S Lat, 28\textdegree 12' E Long). Coll. by J. E. Repton; subm. by H. Bruins-Lich, Parks and Recreation Dept., Pretoria.

SR-5. Wonderboom \textsuperscript{a}D. 1200

Wood sample taken 5 ft from the heart of the same tree as SR-4. \textit{Comment:} because of the enormous size of the Wonderboom its age has long been a source of considerable interest (Swart, 1963). In the absence of any extant heartwood, the age of the tree is estimated, on the basis of the above dates and the existing size of the tree, to be about 1000 yr.

II. ARCHAEOLOGIC SAMPLES

A. Africa

Pomongwe Cave series, Southern Rhodesia

Pomongwe Cave, Matopo Hills was excavated by C. K. Cooke, Director of the Comm. for the preservation of Nat. and Hist. Monuments and Relies,

**SR-7. Pomongwe Cave, Matopo Hills**  
$>42,000$

Charcoal sample, exceptionally small for dating purposes, had to be counted at reduced pressure. Resulting statistical error was too large to distinguish it from the background count. Coll. by C. K. Cooke, P. O. Box 3248, Bulawayo, Southern Rhodesia. *Comments*: a further sample of bone from the same layer has been supplied by C. K. Cooke and this will be dated in due course. The cultural affinities of SR-7 are probably Sangoan Industry of the 1st Intermediate Stone Age.

**SR-8. Pomongwe Cave, Matopo Hills**  
$42,200 \pm 2300$

Combination of two charcoal samples. *Comment*: mixing was necessary because of the small amount of charcoal in the deposit. Stratigraphically the samples were one below the other but culturally the same, being the nexus between the Sangoan of the 1st intermediate Stone Age and the still Bay of the Middle Stone Age.

**SR-9. Pomongwe Cave, Matopo Hills**  
$42,200 \pm 2300$

Charcoal from small logs from hearths in the cave. *Comment*: associated with the earliest levels of Still Bay Industry of Middle Stone Age.

**SR-39. Pomongwe Cave, Matopo Hills**  
$35,530 \pm 780$

Charcoal from Pomongwe Cave. *Comment*: associated with the Still Bay Industry of the Middle Stone Age.

**SR-10. Pomongwe Cave, Matopo Hills**  
$21,700 \pm 400$

Charcoal from Pomongwe Cave. Error is larger than usual because sample was small and was counted at reduced pressure. *Comment*: associated with the developing middle Stone Age and Still Bay Industry.

**SR-11. Pomongwe Cave, Matopo Hills**  
$15,800 \pm 200$


**SR-12. Pomongwe Cave, Matopo Hills**  
$9400 \pm 100$


**SR-13. Pomongwe Cave, Matopo Hills**  
$7690 \pm 140$

White ash sample, consisting largely of inorganic carbonates; appears to be younger than SR-12 from the same layer, probably as a result of exchange with atmospheric CO$_2$. *Comment*: associated with Stone Age material of unknown affinities, possibly very early Wilton.
SR-14. Pomongwe Cave, Matopo Hills 7610 ± 110
5660 B.C.
Sample coll. from deposit of ash consisting of burnt nut from the Sclerocaryae caffra tree. Comment: associated with lower levels of the Wilton Culture of the Later Stone Age.

SR-15. Rock Shelter, Dombozanga, Southern Rhodesia 1220 ± 100
A.D. 730
Charcoal coll. throughout the Wilton deposit from 8 to 10 in. below surface. Coll. by K. R. Robinson; subm. by R. Summers, Natl. Mus., P. O. Box 240, Bulawayo, Southern Rhodesia. Comment: total depth excavated 24 in. Above the 8 in. level Wilton deposit was mixed with Iron Age potsherds.

Ziwa Farm series, Inyanga, Southern Rhodesia

SR-17. Grave Site, Ziwa Farm 1650 ± 100
A.D. 300
Charcoal sample from grave site, depth 2 ft 4 in. (18° 12' S Lat, 32° 40' E Long). Coll. and subm. by F. Bernhard, 127 Third Street, Umtali, Southern Rhodesia. Comment: skeleton found in grave was that of young female (± 14 yr old) of Negroid race.

SR-32. Ritual Pit, Ziwa Farm 1100 ± 100
A.D. 850
Charcoal from ritual pit (18° 12' S Lat, 32° 40' E Long).

SR-38. Ziwa Farm 1050 ± 100
A.D. 900
Charcoal found attached to a skull from a grave found on Ziwa Farm (18° 12' S Lat, 32° 40' E Long). Comment: skeleton found in this grave was that of a young male (± 16 yr old) of Negroid race.

General comment: samples SR-17, SR-32, and SR-38 are all related to Ziwa culture, which can now be dated from at least 4th century A.D. to the first half of the 11th century A.D.

Harleigh Farm series, Rusape, Southern Rhodesia

SR-25. Harleigh Farm, Rusape 650 ± 120
A.D. 1300
Charcoal sample (18° 32' S Lat, 32° 05' E Long). Coll. and subm. by P. A. Robins, Univ. College of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia. Comment: carbonised posts overlaid by an early floor of the Zimbabwe Culture settlement. This represents a post quem date for the settlement.

SR-35. Harleigh Farm, Rusape 280 ± 90
A.D. 1670
Charcoal sample. Coll. by J. R. Crawford; subm. by P. A. Robins. Comment: sample was obtained from a pit sealed by deposits of an early occupation of the site and comes from a midden containing pottery of the earliest type found on the site which is the ancestral home of the Chipunza Chieftancy.
Southern Rhodesian Radiocarbon Measurements

SR-26. Tunnel Site, Gokomere, Southern Rhodesia 1420 ± 120 A.D. 530

Midden deposit from 60 to 66 in. level (19° 55' S Lat, 30° 45' E Long). Coll. by K. R. Robinson; subm. by R. Summers. Comment: charcoal recovered from base of iron age midden averaging 36 in. thick and sealed by approx. 18 in. of the 19th century deposit. Below the layer of midden there was natural earth containing Wilton Culture material.

SR-28. Kamusongolo Kopje Cave, Kasempa 800 ± 100 Northern Rhodesia A.D. 1150

Charcoal sample from North Western Province of Northern Rhodesia (13° 27' S Lat, 25° 51' E Long). Subm. by S. G. Daniels, Nat. Monuments Comm., P. O. Box 124, Livingstone, Northern Rhodesia. Comment: dating of this sample will be useful in the dating of comb-stamped pottery from N of the Kafue River and W of the eastern Lunga.

SR-33. Malapati, Southern Rhodesia 1110 ± 100 A.D. 840

Midden deposit 8 in. level (base) (22° 03' S Lat, 31° 25' E Long). Subm. by K. R. Robinson. Comment: charcoal from this Iron Age site was coll. throughout midden deposit averaging 8 in. thick and resting on natural earth. The midden was overlain by 3 to 4 in. of sandy soil.

SR-34. Zoo Park Gardens, Kaiserrasse, Windhoek 5200 ± 140 3250 B.C.

Large piece of elephant tusk (22° 55' S Lat, 17° 05' E Long). Subm. by H. R. Maccalman, Archaeologist, State Mus., P. O. Box 1203, Windhoek, South West Africa. Comment: date of elephant butchery site and quartz stone industry found with the tusk. Important for the analysis of a stone industry relating to a specific industrial activity.

Mutema’s Sacred Grove series, Southern Rhodesia

SR-36. Mutema’s sacred grove, Melsetter 720 ± 120 A.D. 1230

Sample from a wood post found on the surface before the excavation had started (19° 59' S Lat, 32° 33' E Long). Subm. by A. Whitty, Monuments Comm., Mashonaland Office, Box 66, Borrowdale, Salisbury, Southern Rhodesia. Comment: sample comes from an Iron Age site.

SR-37. Mutema’s sacred grove 800 ± 90 A.D. 1150

Wood post from below surface.

III. GEOLOGIC SAMPLES

SR-24. Situmpa Forest Station 1930 ± 100 A.D. 20

Charcoal sample (16° 50' S Lat, 25° 07' E Long) from charcoal levels in the Kalahari sand (Fergusson and Libby, 1963); depth 42 in. Subm. by B. Fagan, Keeper of Prehistory, Rhodes-Livingstone Mus., P. O. Box 214, Livingstone, Northern Rhodesia. Comment: sample is of stratigraphical im-
importance over some distance and ties in with sample C-829 (Libby, 1955).

IV. ATMOSPHERIC SAMPLES

SR-6. Atmosphere—Salisbury, Southern Rhodesia $\Delta^{260}$

Carbon dioxide coll. during January 1963 from atmosphere over Salisbury, by exposure of a solution of sodium hydroxide for four days. An estimated value of $\delta^{13}C$ of 21 per mil, following Godwin and Willis (1961), was used in obtaining the per mil deviation $\Delta$. This value of $\Delta$ appears to be in accord with the data of McMurray and Stander (1963) on atmospheric samples collected over Pretoria which vary between 200 and 300 per mil.

REFERENCES

Date lists:

Cambridge III Godwin and Willis, 1961
UCLA II Fergusson and Libby, 1963


——— 1963c, The Age of the Pretoria Wonderboom: South African Jour. of Sci., v. 60, no. 1, p. 27.
U. S. GEOLOGICAL SURVEY
RADIOCARBON DATES VII*

PATRICIA C. IVES, BETSY LEVIN, RICHARD D. ROBINSON,
and MEYER RUBIN

This date list contains the results of measurements made during 1961, 1962 and 1963. The method of counting, utilizing acetylene gas, remains essentially unchanged, except for the addition of some solid state electronics. The method of computation, using the Libby half-life of 5568 ± 30 yr, is continued. The error listed is always larger than the one-sigma statistical counting error commonly used, and takes into account known uncertainty laboratory factors, and does not include external (field or atmospheric) variations.

Unless otherwise stated, collectors of all samples are members of the U. S. Geological Survey.

SAMPLE DESCRIPTIONS

A. Eastern U. S.

W-1132. Copperas Gap, Arkansas

Fresh-water mussel shells from S side of road cut on State Highway 113, approx. 1 mi SW of Arkansas River, SE\(\frac{1}{4}\) NE\(\frac{1}{4}\) SE\(\frac{1}{4}\) sec. 24, T 5 N, R 16 W (35° 04' N Lat, 92° 42' W Long), Perry County, Arkansas. Most shells are complete, averaging 3 in. in size, and occur in small pockets about 2 ft in diam, indicating shells were not transported. Stratigraphic sequence of alluvial materials in Arkansas Valley is as follows: younger alluvium, (clay and sand in flood plain next to river); older alluvium (second bottom), (brown clay with limestone modules); lower terrace (higher than second bottom), the shell locality, consists of red silty clay with chert pebbles and limestone nodules; upper terrace, consisting of rounded sandstone and chert pebbles. Coll. 1961 by C. G. Stone; subm. by H. D. Miser. Comment: sample is sole organic material found in terraces of Arkansas Valley region. As lower terrace is widespread, age of sample will aid correlation.

W-945. New Haven, Connecticut

Organic material from test boring for Connecticut Turnpike bridge over Quinnipiac River (41° 18' 2" N Lat, 72° 59' 24" W Long), New Haven, Connecticut, near base of estuarine deposits unconformable on glacial outwash, at 30 to 31.5 ft below mean sealevel. Stratigraphy, top to bottom: silt and clay with shell fragments, mainly estuarine but with lenses of peat and other plant material near base; outwash, 126 ft, which rests on bedrock. Sample contained pollen, mostly Tsuga (id. by E. B. Leopold). Subm. 1960 by J. E. Upson. Comment: sample represents a sealevel not lower than -35 to -40 ft, and therefore suggests average relative rise of sealevel since then of between 1.7 and ca. 2 mm/yr (Upson, Leopold, and Rubin, 1964). Tsuga is frequent

* Publication authorized by the Director, U. S. Geological Survey.
Patricia C. Ives, Betsy Levin, Richard D. Robinson, and Meyer Rubin

in early postglacial assemblages in Connecticut, is compatible with a post-glacial age.

**W-1229. Okefenokee Swamp, Georgia**

400 ± 200

A.D. 1550

Brown peat (alt 114 ft) from peat deposit 3 ft below swamp water level, S of Okefenokee Canal, 100 yd from turnoff to Buzzard Roost Lake, W of boat landing at Camp Cornelia (30° 44’ N Lat, 82° 10’ W Long), Georgia. Coll. 1962 by J. T. Callahan and R. L. Wait; subm. by J. T. Callahan. Comment (J.T.C.): swamp is post-Pleistocene. Date indicates slow rate of accumulation.

**Turtle River series, Georgia**

Wood fragments from stumps, possibly cypress, in Recent sediments, from S bank of Turtle River, ca. 4 mi N NW of Brunswick (31° 11’ N Lat, 81° 32’ W Long), Georgia. Coll. 1962 by J. T. Callahan and R. L. Wait; subm. by J. T. Callahan. Comment (J.T.C.): dates indicate that relative sealevel rose about 12 ft in ca. 1000 yr.

**W-1222. Wood, 17 ft**

3670 ± 300

1720 B.C.

Wood from stumps in buried forest about 12 to 17 ft below sealevel.

**W-1223. Wood, 1 ft**

2780 ± 250

830 B.C.

Wood from stump in growth position ca. 1 ft above sealevel, overlain by ca. 3 ft of silt and clay.

**W-961. Gulf of Mexico**

10,600 ± 500

8650 B.C.

Calcite coll. from continental slope off W coast of Florida (25° 41’ N Lat, 84° 20’ W Long), by chain bag dredge across low elongate submerged rock ridge, by U. S. C. and G. S. No. 4 of Explorer expedition (H. B. Stewart, 1962) from 86 to 87 fathoms of water. Coll. 1960 by H. B. Stewart; subm. by P. Cloud, Univ. of Minnesota, Minneapolis. Comment: elongate ridge believed to be a spit formed at a lower sealevel. Algal growth recovered by dredge may veneer a ridge of older solid rock beneath. Date does not prove or disprove the spit hypothesis.

**W-1011. Bangor, Maine**

12,800 ± 450

10,850 B.C.

Shells, consisting of *Astarte subaequilatera* Soerby and *Mya arenaria* Linne, from topset and foreset beds of esker delta 10 mi WNW of Bangor (44° 49’ N Lat, 68° 58’ 10” W Long), Maine. Coll. 1961 and subm. by H. W. Borns, Univ. of Maine, Orono. Comment (H.W.B.): glacier was present when delta was built into the sea. Other shell dates in area were from flanks of wave-washed eskers with no ice front significance (W-947, 11,950 ± 350, this date list; W-737, 11,800 ± 240, USGS V). Date indicates that an ice mass existed in central Maine at this time.

**W-1082. Sixpenny Island, Connecticut**

2850 ± 260

900 B.C.

Peat at NE edge of Sixpenny Island, Mystic Harbor (41° 20’ 6” N Lat, 71° 58’ 43.5” W Long), Connecticut, at base of estuarine deposits overlying
sequence of sand and gravel (glacial outwash?). Coll. at depth of 9.2 to 10.0 ft below mean sealevel. Coll. 1960 by Corps of Engineers; subm. by J. E. Upson. Comment: dates a lower sealevel and helps define curve of apparent sealevel rise along S New England coast (Upson, Leopold, and Rubin, 1964).

W-947. Norridgewock, Maine

11,950 ± 350
10,000 b.c.

Mixed shell and shell fragments of Mya arenaria, Macoma calcarea, Buccinum tenue, Saxicava arctica, Mytilis edulis, Panomya arctica, and Balanus balanoides, from esker 1.2 mi W of Norridgewock (44° 43' N Lat, 69° 48' W Long), Maine. Top of esker was at 320 ft alt before overburden removed. Fossil marine clay stratum approx. 2 ft thick lies between sand (above) and gravel (below) and slopes from approx. 290 ft E to 240 ft. Sample is from 250 ft. This is highest fossil marine clay yet found in Maine. Coll. 1959 by D. W. Caldwell, R. Doyle, and R. L. Dow; subm. by R. L. Dow, Dept. of Sea and Shore Fisheries, Augusta, Maine. Comment: the wood was expected to be much older than the peat in floodplain silt, indicating that basal gravel is of different age and stream regimen. Dates do not show this difference.

Watts Branch series, Maryland

Peat and wood from floodplain alluvium, Watts Branch, 1 mi NW of Rockville (39° 05' N Lat, 77° 09' W Long), Maryland. Peat coll. downstream from wood, was from black organic peat in form of filled channel underlain by gravel on bedrock and overlain by silt. Wood coll. from layer of pebbles just below top of basal gravel; brown silt above showed no sign of disturbance. Coll. 1960 and subm. by G. Dury and L. B. Leopold. Comment: the wood was expected to be much older than the peat in floodplain silt, indicating that basal gravel is of different age and stream regimen. Dates do not show this difference.

W-1064. Peat

<250

Black organic peat about 1/2 mi downstream from Highway 28 bridge over Watts Branch.

W-1065. Wood

<250

Sticks of wood about 200 yd downstream from Highway 28 bridge over Watts Branch, 50 yd below gaging station.

W-992. Edgartown, Martha’s Vineyard, Massachusetts

>38,000

Pieces of charcoal scattered in sandy beds of outwash gravel, from sand pit 1 mi S of Edgartown, just W of Katama Road, Martha’s Vineyard (41° 22' N Lat, 70° 31' W Long), Massachusetts. Coll. 1958 and subm. by C. A. Kaye. Comment (C.A.K.): charcoal probably dates the outwash, but outwash may not be equivalent of younger drift at Gay Head, as previously supposed.

Barnstable Marsh series, Massachusetts

Peat coll. from West Barnstable Great Marsh, Cape Cod, Massachusetts from various depths, to determine rate of vertical accretion of high marsh peat. Results were interpreted to indicate relative change of sealevel in Cape Cod region (Redfield and Rubin, 1962). Coll. 1958 to 1961 and subm. by A. C. Redfield, Woods Hole Oceanographic Inst.
General Comment: age of peat increases with depth below surface. Vertical accretion, controlled by rise of sealevel, has averaged $3.3 \times 10^{-3}$ ft/yr since 2100 B.P., when surface was 7 ft lower than at present. Earlier, rate was $10 \times 10^{-3}$ ft/yr for a period extending back to at least 3700 B.P. Depths are in ft below marsh surface, within 1 ft of mean high water.

W-970. Proctors Crossing, 7.6 ft depth

This sample, W-971, and W-973 consist of Spartina peat over clay and were cored from salt marsh 1000 ft NE of junction of railroad and Highway 6 at Proctors Crossing (41° 31' N Lat, 70° 21' W Long).

W-971. Proctors Crossing, 13.4 ft depth

W-973. Proctors Crossing, 22.8 ft depth

W-1094. Navigation Rd, 4.5 ft depth

This and the following 4 samples consist of Spartina peat. W-1093 is oak wood. Samples, taken with piston corer and considered the most reliable of the series, come from salt marsh 800 ft E of Navigation Rd, leading to West Barnstable Landing on Spring Creek (42° 42' 55" N Lat, 70° 21' 56" W Long).

W-1095. Navigation Rd, 7.5 ft depth

W-1096. Navigation Rd, 10.8 ft depth

W-1098. Navigation Rd, 18.3 ft depth

W-1092. Navigation Rd, 21.3 ft depth

W-1093. Wood, Navigation Rd, 22.8 ft depth

W-1099. Fullers Point

Fresh-water peat from 16.2 ft depth in salt marsh 205 ft N of Fullers Point at E extremity of Scorton Neck (41° 43' 50" N Lat, 70° 23' 04" W Long). Site is at junction of upland and sand spit (Sandy Neck) which shelters greater part of Barnstable marsh from Cape Cod Bay. Age indicates that sand spit was formed at least 3000 yr ago.

W-1098. Boston Common, Massachusetts

Peat from S wall of excavation, Boston Common Garage, Boston (42° 22' N Lat, 71° 04' W Long), Massachusetts, from basal 1 in. of salt-marsh sandy peat lying on till. Base of peat is 1.7 ft below high tide and top of peat is at

**W-991. Boston Common Garage, Massachusetts**

12,170 ± 300
10,220 B.C.

Twigs from peat from SE part of excavation, Boston Common Garage, Boston (42° 22’ N Lat, 71° 04’ W Long), Massachusetts. About a ft of peat and wood fragments lies at contact of marine clay (below) and deeply oxidized drumlin till (above). Peat and wood are slightly carbonized and greatly compressed. Coll. 1960 and subm. by C. A. Kaye. *Comment* (C.A.K.): clay was believed identical to that at West Lynn (W-735, 14,250 ± 250, USGS V), but younger age shows that clay is more recent. Wood must be postglacial and the till is not in place.

**W-1151. Florence, New Jersey**

16,700 ± 420
14,750 B.C.

Bog sample consisting mainly of silty quartz sand with abundant, dispersed comminuted organic matter, from 1.2 mi S of Florence (74° 52’ 30” N Lat, 40° 06’ 00” W Long), New Jersey. Coll. 1961 and subm. by J. P. Owens. *Comment*: sample directly overlies Trenton gravels, so that date gives minimum age for these gravels.

**W-1038. Byron, New York**

10,450 ± 400
8500 B.C.

Twigs and plant material directly beneath a mastodon bone, ca. 2.4 ft below surface, from Byron mastodon excavation, Byron (43° 5’ 11½” N Lat, 78° 4’ 57” W Long), Genesee County, New York, N of Batavia moraine, but well above level of Lake Iroquois. Coll. 1959 by C. Heubusch and M. E. White; subm. by E. H. Muller, Syracuse Univ., New York.

**W-1109. Lake Alice, New York**

10,560 ± 350
8610 B.C.

Shells from gravel pit on E side of ridge 8 mi long, known as Ingraham esker (Woodworth, 1905), 1000 ft N, 29° E of road corner about ½ mi NE of Lake Alice, 14 mi N of Plattsburg (45° 00’ N Lat, 73° 30’ W Long), New York. Shells consist of foraminifera (id. by R. Todd), a characteristically cold, shallow-water marine assemblage, the species widely known in the Arctic and S to Martha’s Vineyard; molluscs and crustacea (id. by Rosewater), characteristic of a shallow marine environment, one species suggestive of lowered salinity; and ostracodes (id. by Sohn), characteristic of cold water environment and containing some of the same elements as in Pleistocene marine clays on Massachusetts and Maine coasts. Unit containing shells consists of coarse-grained, cross-bedded pebbly sand with pockets of almost pure shells in coarse sandy matrix. Coll. 1961 and subm. by C. S. Denny. *Comment*: dates Champlain Sea sediments; in same range as many other Champlain Sea dates.

**Botany Bay Island series, South Carolina**

Samples from Botany Bay Island, on Atlantic Coast ca. 1½ mi SW North Edisto River (32° 35’ N Lat, 80° 15’ W Long), South Carolina. Island is separated from mainland by 0.5 mi of marsh and is currently undergoing rapid
erosion (Neiheisel, 1958). Wave-cut foredunes, densely vegetated, contain layer of pelecypod shells (from which sample W-1041 was obtained) 5 to 7 in. thick, at ca. 5 ft above sea level. A 3-in. layer of shell fragments (W-1042) occurs just above layer of pelecypod shells and may contain reworked older fragments. Mud flats, containing yellowish marsh grass (W-1044) occurs in littoral zone a few ft below. Coll. 1958 and subm. by James Neiheisel, Corps of Army Engineers, Marietta, Georgia. Comment (J.N.): shells appear to correlate with a cold phase at a time when sealevel was lower.

\[
\begin{align*}
\text{W-1041. Pelecypod shells} & & 1550 \pm 300 \\
& & \text{A.D. 400}
\end{align*}
\]

\[
\begin{align*}
\text{W-1042. Shell Fragments} & & 2100 \pm 300 \\
& & 150 \text{ b.c.}
\end{align*}
\]

\[
\begin{align*}
\text{W-1044. Marsh grass} & & <200
\end{align*}
\]

Sample located about 1 mi NE of W-1041.

B. Central U. S.

\textbf{W-1054. Danville, Illinois} \textgreater 37,000

Wood fragments from silt in drainage ditch for a strip mine in SE \(\frac{1}{4}\) NE \(\frac{1}{4}\) sec. 2, T 19 N, R 12 W (40° 09' N Lat, 87° 40' W Long), NW of Danville, Illinois. Section consists of tills interbedded with silt, sand, or gravel (Ekblaw and Willman, 1955). Sample comes from Unit XI of Ekblaw and Willman. Age of 40,000 was previously obtained on wood somewhat higher in the section, Unit IX of Ekblaw and Willman (W-917, USGS VI). Coll. 1959 and subm. by G. E. Ekblaw and H. B. Willman, Illinois Geol. Survey, Urbana. Comment: till was thought to be pre-Shelbyville or Farmdale age, but date places till in Altonian substage of Frye and Willman (1960), of Wisconsin age.

\textbf{W-1144. McHenry County, Illinois} \textgreater 38,000

Peat from test boring along Northwest Illinois Toll Highway, SW \(\frac{1}{4}\) NE \(\frac{1}{4}\) NW \(\frac{1}{4}\) sec. 31, T 43 N, R 5 E (42° 10' N Lat, 88° 42' W Long), McHenry County, Illinois. Stratigraphy: 5½ ft of gravelly, sandy, yellowish brown, calcareous till; 11 ft of gravelly, sandy, brown, calcareous till; 6½ ft of sand, mostly very fine, with ½ in. beds of silt and clay; 5 ft of very silty, sandy, brown, calcareous till containing wood fragments; 4 ft of peat; 2 ft of sandy peat; 2½ ft of peat (from which sample was taken); ½ ft of dark grayish brown till; 1 ft of calcareous till; and 1½ ft of greenish gray, calcareous sand. Coll. 1956 and subm. by J. P. Kempton, Illinois Geol. Survey, Urbana. Comment (J.P.K.): date eliminates possibility that peat might represent the Farmdale stade. Sample probably represents interstadial deposits between Winnebago till and older Altonian drifts of Frye and Willman (1960).

\textbf{Collinsville series, Illinois}

Wood from interstate highway cut through Mississippi bluffs, Collinsville, SE \(\frac{1}{4}\) NW \(\frac{1}{4}\) NE \(\frac{1}{4}\) sec. 29, T 3 N, R 8 W (38° 39' N Lat, 89° 59' W Long), Madison County, Illinois. Cut is ¼ mi S of W-729, snail shells dating 35,200 ± 1000, and a little further S along bluff line of W-730 (within the Peorian
Loess silt), snail shells dating $17,100 \pm 300$ (USGS V). Stratigraphy, a valley fill, consists of a basal zone of gray silt, in part calcareous, with snails, leaves, and wood fragments (W-1055), an overlying zone of loess with snails and wood fragments (W-1053), and a still-higher loess. Coll. 1960 by George Ekblaw; subm. by J. C. Frye. Comment (J.C.F.): lower wood zone was thought Farmdalean and upper zone possibly Two Creeks. However, mineralogy associated with W-1055 is typical of Peoria silt, and fauna immediately above is typical Peoria, agreeing with date of W-1055. Thick calcareous loess, eolian sand, and snail fauna indicate W-1053 must not have been in place.

**W-1055.** Wood, lower zone

17,950 ± 550

16,000 B.C.

**W-1053.** Wood, upper zone

<200

**W-1048.** Princeton Farms, Indiana

Wood from stream-cut bank in dissected outwash of Illinoian Glaciation 300 ft N of County road, near Princeton, SW $\frac{1}{4}$ SW $\frac{1}{4}$, sec. 29, T 2 S, R 10 W (38° 18' 30" N Lat, 87° 33' W Long), Indiana. Stratigraphy: leached gray silt alluvium on calcareous gray silt alluvium on humic muck (wood, leaves, shells); stream surface. Coll. 1958 and subm. by L. L. Ray. Comment: anomalous date is unexplained.

**W-1040.** Switzerland County, Indiana

9140 ± 400

7190 B.C.

Wood from W side of country road, S of bridge over creek, NE $\frac{1}{4}$ SE $\frac{1}{4}$, sec. 16, T 2 N, R 3 W (38° 44' N Lat, 85° 6' W Long), Switzerland County, Indiana, from near creek level under 14 ft of compact, leached oxidized alluvial silty clay of a valley fill younger than that exposed ¼ mi upstream and interpreted as fill of Tazewell Stade (Patton and others, 1953). Coll. 1960 and subm. by L. L. Ray. Comment (L.L.R.): dates alluviation in Ohio River Valley. Similar dates from related points are W-418, 9400 ± 250 (USGS IV) and I-420, 9250 ± 300.

**White Pine Copper Mine series, Michigan**

Wood and organic material from White Pine Copper Mine, N dam of S Tailings Pond, 500 ft E of former bed of Caribou Creek, near center NE $\frac{1}{4}$ NE $\frac{1}{4}$, sec. 2 T 50 N, R 42 W (46° 45' N Lat, 89° 34' W Long), Ontonagon County, Michigan. From fill in kettle in till. Fill is gyttja and peat (5 ft) on silt and clay on collapsed till and gravel. Coll. 1960 and subm. by F. J. Brandtner. Comment (F.J.B.): W-964 dates upper clayey till which represents a last minor readvance subsequent to main advance of Valders stade of Wisconsin Glaciation. W-965 and W-1150 date onset of reoccupation by forest after disappearance of dead ice. W-963 and W-962 date phases of postglacial vegetation development; W-963 is believed to date a short dry period.

**W-964.** Spruce log from till exposed in side of kettle

10,230 ± 280

8280 B.C.

**W-965.** Spruce log from base of gyttja

9600 ± 280

7650 B.C.
W-1150. Gyttja from horizon of W-965  9500 ± 350  7550 B.C.

W-963. Oak log 60 m above base of gyttja  4130 ± 250  2180 B.C.

W-962. Cedar log from peat, 80 cm above base of gyttja  1780 ± 250  A.D. 170

W-1141. Aitkin, Minnesota  11,560 ± 400  9610 B.C.

Wood from S wall of diversion canal of Mississippi River, 3 mi N of Aitkin, NW1/4 NE1/4 sec. 2, T 47 N, R 27 W (46° 34' N Lat, 93° 41' W Long), Minnesota. From top of noncalcareous sandy podzolic soil beneath 7 ft of marl and clay (Glacial Lake Aitkin), and peat. Pollen diagram shows soil and overlying 3 in. of marl are dominated by spruce and Artemisia. Coll. 1959 and subm. by H. E. Wright, Univ. of Minnesota, Minneapolis. Comment: date establishes that red and brown clayey till surrounding and antedating Glacial Lake Aitkin is pre-Two Creeks rather than post-Two Creeks as previously supposed. W-502 (11,710 ± 325) is from same horizon at same site and agrees with date of W-1141. But W-574, from buried peat at W end of same diversion canal, dates 10,620 (USGS V).

W-1059. Cloquet Lake, Minnesota  11,500 ± 600  9550 B.C.

Clay gyttja from Cloquet Lake, 6 mi W of Cloquet, sec. 23, T 49 N, R 18 W (46° 44' N Lat, 92° 27' W Long), Carlton County, Minnesota. Collected immediately above clay at depth of 9.25 m in lake sediments; from transition from spruce-parkland pollen zone (below) to spruce zone (above). Horizon is slightly above equivalent pollen horizon at Weber Lake (W-873, USGS V, 10,550 ± 300). Lake (and base of pollen-bearing sediments) overlies outwash from Superior Lobe representing a distinct stillstand. Coll. 1959 by S. Jelgersma; subm. by H. E. Wright.

W-1028. Lake Bronson, Minnesota  >38,000

Wood from Pleistocene sand and gravel, pumped from depth 137 ft in a well in Lake Agassiz Basin, NE1/4 NW1/4 SE1/4, sec 33, T 161 N, R 46 W, ca. 3 mi SE of Lake Bronson, Kittson County (48° 43' N Lat, 96° 37' W Long), Minnesota. Coll. 1958 and subm. by G. R. Schiner. Comment: geologic age of sediments here is not known.

W-1057. Lake of the Woods, Minnesota  9200 ± 600  7250 B.C.

Piece of tamarack wood from Lake Agassiz beach ridge 4 mi S of Lake of the Woods, NW1/4 SE1/4 sec. 22, T 163 N, R 34 W (48° 53' N Lat, 95° 03' W Long), Lake of the Woods County, Minnesota. Stratigraphy top to bottom: sand and gravel, 20 ft; peat, (sample) 8 in; clay and sand, 2 in; till. Coll. 1960 by M. L. Heinselman; subm. by H. E. Wright. Comment: sample should date Lake Agassiz II (Elson, 1958; Wright and Rubin, 1956).
W-1058. **Madelia, Minnesota**

Clay gyttja from 2.5-ft organic layer at 8 ft depth, underlying clay and sand, in drained swamp 1¼ mi N of Madelia, sec. 14, T 107 N, R 30 W (44° 05' N Lat, 94° 25' W Long), Watonwan County, Minnesota, inside Marshall Moraine, formed by Des Moines Lobe when glacier stood at about Mankato, Minnesota. Coll. 1960 by H. E. Wright and M. Fries; subm. by H. E. Wright. Comment (H.E.W.): sample was chosen with reference to pollen diagram and two other dates from same sediment core (W-825, 9300 ± 350, top of organic layer; W-824, 12,650 ± 350, base of organic layer; USGS V). Pollen diagram begins with NAP zone marking tundra or park-tundra immediately following retreat of Mankato ice. Then a spruce zone (W-824) that marks first forestation, with maximum equivalent to Two Creeks, an *Artemisia* maximum (Valders) and a rise in birch and alder (W-1058 at base); then postglacial rapid rise of hardwoods fully developed at the time of W-825.

W-999. **Plummer mine, Minnesota**

Wood fragments from stratified sediments NE¼, SW¼ sec. 21, T 56 N, R 24 W, 4th P. M. (47° 18' N Lat, 93° 24' W Long), Itasca County, Minnesota. Stratigraphy, top to bottom: gray drift (Mankato); red drift; brownish gray drift; stratified dark brown or gray clay, silt, gravel (sample); yellow outwash; bedrock. Coll. 1959 and subm. by E. I. Roe and M. L. Heinselman, Lake States Forest Experiment Station, Grand Rapids, Minnesota. Comment: date substantiates estimate of age from the flora included in the fragments.

W-993. **Fargo, North Dakota**


W-1021. **Gackle, North Dakota**

Peat from 4.5 ft below surface of gravel pit 0.1 mi N of SE corner of sec. 9, T 134 N, R 68 W (46° 26' N Lat, 99° 16' W Long), 14 mi S SW of Gackle Logan County, North Dakota. Peat occurs as blocks and fragments in thin beds within outwash gravel, contemporaneous with the Streeter end moraine. Coll. 1961 by L. Clayton; subm. by W. Laird, North Dakota Geol. Survey, Grand Forks. Comment: date indicates peat is secondary in the gravel.

W-1045. **Logan County, North Dakota**

Peat and organic clay from exposure at NW¼ NW¼ sec. 24, T 134 N, R 72 W (46° 26' N Lat, 99° 40' W Long), Logan County, North Dakota. Stratigraphy, top to bottom: outwash gravel; iron-cemented till; dark gray to black organic clay with carbonized plant remains in small fragments; peat or
peaty, clayey silt with carbonized fragments; bedrock. Coll. 1960 by J. W. Bonneville; subm. by W. Laird. *Comment*: date does not support an early Wisconsin age for the till.

**W-1019. Fredonia, North Dakota**

9000 ± 300
7050 B.C.

Clam fragments from 21 in. below ground surface of roadcut, 0.4 mi S of NW corner sec. 20, T 135 N, R 67 W (46° 30' N Lat, 99° 08' W Long), 9 mi S of Gackle and N of Fredonia, Logan County, North Dakota. Clams with both valves together, coll. from base of lacustrine silty sand, postdating Streeter moraine, part of “post-Cary No. 1” advance of Lemke and Colton (1958). Coll. by Lee Clayton; subm. by W. Laird. *Comment*: shells date lake deposits, not necessarily exact time when ice left area.

**W-974. McIntosh County, North Dakota**

11,650 ± 310
9700 B.C.

Clam shells and shell fragments from 2 to 3 ft below surface of silty, clayey lake sediments W1/4 corner sec. 20, T 132 N, R 68 W (46° 15' N Lat, 99° 12' W Long), McIntosh County, North Dakota. Sediments were deposited in a basin walled by stagnant ice and by Burnstad end moraine, called the A-1 advance by Flint (1955). Coll. 1961 by J. W. Bonneville; subm. by W. Laird. *Comment*: dates lake and end moraine.

**W-990. Napoleon, North Dakota**

> 38,000

Peat from gravel pit SW corner sec. 32, T 135 N, 72 W, (46° 28' N Lat, 99° 46' W Long) 3 mi S of Napoleon, Logan County, North Dakota, from 5 ft or more below surface of sandy outwash lenses of “peat,” and clay. Coll. 1961 by Lee Clayton; subm. by W. M. Laird. *Comment*: sample dates “Napoleon drift” in this area which is part of “Tazewell” drift of Lemke and Colton (1958).

**W-956. Cleveland, North Dakota**

11,070 ± 300
9120 B.C.


**W-954. Streeter, North Dakota**

9870 ± 290
7920 B.C.

Clam shells from upper part of sandy to silty clay over till, SE1/4 SE1/4 SE1/4 sec. 29, T 137, R 69 W (46° 39' N Lat, 99° 24' W Long), near Streeter, Stutsman County, North Dakota, from stagnation moraine immediately behind proximal edge of Streeter moraine, the terminus of Flint's Mankato B-1 in South Dakota (Flint, 1955). Sample is from upper half of clay unit. Coll. 1960 by C. Huxel and H. C. Winters; subm. by R. W. Lemke. *Comment*: sample will aid in dating two significant stagnation units behind Mankato ice advance and in correlating W-542 (USGS V), from beyond distal edge of Streeter moraine.
W-1020.  **Stutsman County, North Dakota**  
>38,000

Fragments of wood from glaciofluvial sediment underlying 50 ft of till, NE\(\frac{1}{4}\) NE\(\frac{1}{4}\) NE\(\frac{1}{4}\) NE\(\frac{1}{4}\) sec. 21, T 141 N, R 66 W (47° 01' 22" N Lat, 99° 02' 16" W Long), Stutsman County, North Dakota. Coll. 1961 by R. W. Schmitt; subm. by E. Bradley. *Comment:* age was thought to be between Valders and Cary, but date does not support that view.

W-1005.  **Thompson, North Dakota**  
10,050 ± 300 8100 B.C.

Wood from gravel pit 2.4 mi NW of N edge of Thompson, NE\(\frac{1}{4}\) SW\(\frac{1}{4}\), sec. 14, T 150 N, R 51 W (47° 46' N Lat, 97° 07' W Long), Grank Forks County, North Dakota, ca. 5.5 ft below soil. Stratigraphy, top to bottom: sand and gravel; gray clay containing abraded sticks, chips, and twigs (sample), gravel. Coll. 1960 by W. M. Laird and F. D. Holland; subm. by R. W. Lemke. *Comment:* sample was interpreted as driftwood on shore of Glacial Lake Agassiz. Compare date on wood near Grand Forks (W-723, USGS V, 10,960 ± 300).

W-1039.  **Katotawa Creek, Ohio**  
2600 ± 300 650 B.C.

Part of log from base of gravel over silt, bank of Katotawa Creek, SE\(\frac{1}{4}\) NE\(\frac{1}{4}\) sec. 14, Montgomery Township, Ashland County (40° 52' N Lat, 82° 15' W Long), Ohio. Coll. 1960 and subm. by G. W. White, Univ. of Illinois, Urbana. *Comment:* it was thought that sample represented outwash from Wabash moraine, but date indicates gravel is alluvium.

W-1031.  **Seville, Ohio**  
5950 ± 300 4000 B.C.

Wood from sewer trench 200 ft W of corner of Market and East Streets (41° 01' N Lat, 81° 52' W Long), Seville, Ohio. Sample is from unoxidized gravelly outwash from Wabash moraine, 0.25 mi N of the exposure. Calcareous till over gravel is late Cary of the last advance. Coll. 1961 by G. W. White and E. F. Bauer, Univ. of Illinois, Urbana. *Comment:* sample does not date Cary Stade.

W-957.  **London, Ohio**  
>38,000

Part of tree branch, possibly cedar, in sand and gravel, at London water works, about 1/3 mi W of courthouse, Union Township, Madison County (39° 53' N Lat, 83° 27' W Long), Ohio. Sample taken at 93 ft lower Wisconsin (?) outwash, consisting of sand and gravel with clay balls, which underlies upper Wisconsin till and overlies lower Wisconsin till. Coll. 1960 by G. M. Baker and Sons (well drillers); subm. by S. E. Norris. *Comment:* sample indicates that buried outwash is probably associated with lower, rather than upper, Wisconsin till.

**Alpena series, South Dakota**

Pieces of wood from log ca. 16 in. in diam, penetrated at ca. 41 ft by boring in till, 1951, near Alpena, Jerauld County (44° 11' N Lat, 98° 20' W Long), South Dakota. Till from 16 to 47 ft is impervious, the well obtaining its water from glacial sand at depth of 53 ft. Log was in a soil zone that included
2 ft of black soil and 2 ft of oxidized till. W-987 coll. 1951 by property owner; subm. by L. W. Howells. W-983 coll. 1960 and subm. by L. W. Howells. Comment: till exposed at surface has been classified as Cary. No obvious explanation for age differences between freshly collected sample and stored one.

**W-987. Farmer’s wood**

12,530 ± 350
10,580 B.C.

Pieces of log recovered when well was drilled, and stored in dry container by property owner.

**W-983. Survey wood**

10,350 ± 350
8400 B.C.

Pieces of log recovered by U. S. Geol. Survey in new hole, apparently from same log.

**W-1189. Menno, South Dakota**

12,050 ± 400
10,100 B.C.

Wood fragments from between gravel and overlying till at depth 192 ft, Menno, Hutchinson County, NW¼ sec. 9, T 97 N, R 57 W (43° 25' N Lat, 97° 55' W Long), South Dakota. Coll. 1961 by R. H. Schoon; subm. by A. F. Agnew, South Dakota Geol. Survey, Vermillion. Comment (R.H.S.): previous dates in area are W-801, 12,200 ± 400, 60 mi N (USGS V); W-987, 12,530 ± 350, 70 mi NNW (this date list); Y-452, 12,330 ± 180, 25 mi NE (Yale III); and Y-595, 12,760 ± 120, 30 mi E (Yale IV). Samples W-801 and W-987 are from drift mapped as Mankato, Y-452 and Y-595 from drift mapped as Cary (Flint, 1955).

**W-1033. Sanborn County, South Dakota**

10,060 ± 300
8110 B.C.

Shells from clay in cattle dugout, SW¼ SE¼ sec. 3, T 107 N, R 62 W (44° 06' N Lat, 98° 15' W Long), Sanborn County, South Dakota. Coll. 1959 and subm. by F. V. Steece, South Dakota State Geol. Survey, Vermillion. Comment: sample comes from area mapped by Flint (1955) as Mankato, on W side of James R. Valley. Age was thought to be Cary, but date is too young.

**W-1110. De Pere, Wisconsin**

11,640 ± 350
9690 B.C.

Tamarack log from gravel pit 8 mi W of De Pere, SW¼ SE¼ sec. 19, T 23 N, R 19 E (44° 27' N Lat, 88° 14' W Long), Wisconsin, from 8 to 12 ft below surface in organic layer at ca. 710 ft alt. Sample is from sand and silt with tamarack needles, beneath till and kame gravel. Coll. 1961 and subm. by R. F. Black, Univ. of Wisconsin, Madison. Comment (R.F.B.): date helps to establish site as of Two Creeks age, lying beneath Valders Till and upon a Cary kame.

**W-1017. Kenosha, Wisconsin**

6340 ± 300
4390 B.C.

Wood from log lying in pond silt and sands above soil developed in till, 100 yd S of city limits of Kenosha, on shore of Lake Michigan, NW¼ SW¼ sec. 8, T 1 N, R 23 E (42° 33' N Lat, 87° 49' W Long), Wisconsin. Coll. 1961 and subm. by R. B. Black. Comment: dates the buried soil.
Portage series, Wisconsin


W-1138. Stump

Base of stump, depth 20 ft, undercut by lateral migration of Wisconsin River and immediately covered during aggradation.

W-1139. Log of driftwood

Log, depth 7 ft, deposited in backwater swamp with other organic material during aggradation.

W-1183. Winnebago County, Wisconsin

Black clayey peat with well-preserved remains of spruce trees about 2000 ft W of Highway 47 and 200 ft N of Airport Road, SE1/4 SW1/4 NE1/4, sec. 11, T 20 N, R 17 E (44° 13' 05" N Lat, 88° 25' 47" W Long), Winnebago County, Wisconsin. Sample from a 3- to 6-in. layer overlain by ca. 10 ft of till. Coll. 1962 by P. G. Olcott; subm. by C. L. R. Holt, Jr. Comment (C.L.R.H.): date compares with dates of wood from Two Creeks Interstade at Two Creeks, Wisconsin, 60 mi E. Sample probably represents end of Two Creeks Interstade and advance of Valders ice. Lake clays overlying sampled material are therefore younger than Two Creeks Interstade and are probably Valders.

C. Western U. S.

W-939. Meteor Crater, Arizona

Snail shells from marl on dump of main shaft in Meteor Crater (35° 0' N Lat, 111° 0' W Long), Coconino County, Arizona. Coll. 1960 by E. E. T. Chao. Comment: sample was diluted with dead carbonate to obtain sufficient carbon for a run. Shells believed to come from basal part of lake sediments filling crater, thus approximating minimum age of crater.

W-1069. Antelope Springs, California


Burnt Lava Flow series, California

Charcoal from trees within Burnt Lava Flow, S of Medicine Lake T 42 N, R 11 E (41° 32' N Lat, 121° 24' W Long), California (Anderson, 1941).
Sample flow is youngest stratigraphic unit in area. W-936 is from standing pine tree with base immersed in thin part of flow at edge of a kipuka. W-934 is from cedar tree burned off at base by flow, and then fallen onto flow. Coll. 1957 by G. A. MacDonald.

W-936. Pine tree charcoal A.D. 1750
Charcoal coll. ca. 500 ft W of E edge of flow, E-SE of High Hole Crater.

W-933. Cedar log charcoal A.D. 1730
Charcoal coll. 30 ft from NE edge of flow, NE of High Hole Crater.

W-935. Cedar tree charcoal A.D. 1630
Charcoal from surface of flow, 15 ft from edge, E of High Hole Crater.

W-934. Cedar tree charcoal A.D. 1750
Charcoal coll. 10 ft from NE edge of flow, NE of High Hole Crater.

W-1034. Potrero Canyon, California >35,000
Small charcoal fragments (carbonized plant material) from sand of upper Pleistocene marine terrace deposits, from cut bank 20 ft W of Flagg’s Restaurant and ca. 200 ft W of mouth of Potrero Canyon, Pacific Palisades area (34° 01’ 55” N Lat, 118° 31’ 33” W Long), Los Angeles, California. Sample is from ½-in. layer of charcoal fragments ca. 13 ft above base of sand which underlies gravel and overlies marine Pliocene. Coll. 1960 and subm. by J. T. McGill, Univ. of California, Los Angeles. Comment: it was hoped date would correlate sand with nearby marine upper Pleistocene terrace deposits in contrast to theory that it is upper Pliocene or lower Pleistocene.

W-1201. Salt Wells Canyon, California 13,300 ± 500 11,350 b.c.
Lacustrine tufa from S side of wash issuing from Salt Wells Canyon, Searles Valley, San Bernardino County (35° 40’ N Lat, 117° 24’ 50” W Long), California. Sample coll. 3 ft above base of white marly silt, which is basal member of sequence correlated with upper Wisconsin parting mud in subsurface section of Searles Lake. Upper Wisconsin sequence consists of greenish micaceous sand 0 to 30 ft thick, overlain by this sequence of silt and sand beds, in this area ca. 50 ft thick (Flint and Gale, 1958; Smith, 1962). Coll. 1962 and subm. by G. I. Smith. Comment (G.I.S.): sample probably formed in shallow water which should have been as near equilibrium with atmospheric CO₂ as any in the lake. Date is ca. 6000 to 8000 yr younger than expected, but is not in conflict with field evidence. Parting mud has dates ranging from ca. 10,000 at top to 23,000 at base.

W-942. Searles Lake, California 11,800 ± 1000 9850 b.c.
Core from Searles Lake, ¼ mi W of NE corner of sec. 2, T 26 S, R 43 E (35° 42’ 30” N Lat, 117° 19’ 00” W Long), California, from material between depths of 22.0 ft to 22.7 ft. Core represents base of “Overburden Mud” de-
posed after earlier lake had desiccated to form “Upper Salt.” Interval sampled consists of carbonaceous mud and pirssonite crystals in upper half, and mud and rounded halite crystals in lower half. Coll. 1958 by F. J. Dluzak, American Potash and Chemical Corp., Trona, California; subm. by G. I. Smith. Comment: sample repeats W-892, USGS VI, 12,390 ± 400 and confirms suspicion that overburden mud here contains reworked carbonaceous matter from older lake sediments exposed around the edges.

**W-981. San Nicolas Island, California**

5070 ± 250
3120 B.C.

Abalone shells (*Haliotis rufescens* Swainson) from oldest occupation layer in extensive kitchen midden on high point near NW end of San Nicolas Island (33° 16' N Lat, 119° 32' W Long), California. About 4 ft of barren eolian sand immediately overlies occupation layer, and a much younger occupation layer caps the hill. Coll. 1957 and subm. by J. G. Vedder. Comment (J.G.V.): this species of abalone is abundant only in older, partially lime-cemented occupation layers. Other marine invertebrate species in this layer suggest that water temperatures were approx. the same as now, but abundant large rhizomorphs (root casts) and numerous terrestrial snail shells in middens of similar aspect presumably indicate relatively dense vegetation and higher humidity at time of occupation. Seasonal habitation of island at this time may be indicated by scarcity of artifacts and burials associated with these mounds.

**San Joaquin Valley series, California**


**W-1192. San Joaquin**

>38,000

Sample from peat bed from central part of San Joaquin Valley, 22 mi SW of Fresno and 2 mi N of San Joaquin, NE 1/4 NW 1/4 sec. 12, T 15 S, R 16 E (36° 38' N Lat, 120° 10' W Long).

**W-1200. Shafter**

>38,000

Sample from peat interbed, associated with volcanic ash, at depth 449.5 to 450.0 ft in S part of San Joaquin Valley, 19 mi W of Shafter, NE 1/4 NW 1/4 sec. 9, T 28 S, R 22 E (35° 31' N Lat, 119° 37' W Long).

**W-1129. Gypsum, Colorado**

4150 ± 300
2200 B.C.

Charcoal from East Rim Blowout, Eagle River near Gypsum (39° 38' N Lat, 107° 02' W Long), Colorado, from small juniper or pinon tree (basal trunk diam 3 to 4 in.), burned and buried by volcanic ash, overlying alluvial fans. Coll. 1961 by R. F. Giegengack; subm. by W. C. Bradley, Univ. of Colorado, Boulder. Comment: volcanic eruption consisted in part of basalt flow which reached floor of Eagle River and deflected river but did not dam it. Other phase of eruption is explosion crater with ash at same vent from which basalt was erupted. Sample represents most recent volcanism dated in Colorado.
W-1133.  Horse Creek, Colorado  

1500 ± 250  
A.D. 450

Fragments of partially rotted log from bank of Horse Creek, approx. halfway between Horse Park and confluence of Horse Creek and Illinois Creek (40° 24' N Lat, 106° 01' W Long), Colorado, probably emplaced when drainage was blocked by recessional moraine. Coll. 1960 and subm. by K. L. Pierce, Yale Univ., New Haven, Connecticut. Comment: wood was expected to correlate with Silver Creek glaciation of Eschman (1955), but date contradicts this.

W-1135.  Jack Creek, Colorado  

7830 ± 350  
5880 B.C.

Wood from near head of tributary to Jack Creek, 1/2 mi S of Jack Creek and just below three cirque lakes, SE North Park (40° 24' N Lat, 105° 56' W Long), Jackson County, Colorado, from clay of 10-ft stream bank, underlain by gravel and sand, cut by stream alpine meadow, alt 11,320. Coll. 1960 and subm. by K. L. Pierce. Comment: deposit probably formed when ice extended into lower parts of cirques.

W-1018.  Jarre Creek, Colorado  

900 ± 250  
A.D. 1050

Charcoal from top of pediment, NW1/4 NW1/4 sec. 4, T 8 S, R 68 W (39° 22' N Lat, 105° 00' W Long), Douglas County, Colorado, from 10-in. thick deposit of Recent loess overlying Rocky Flats alluvium (Nebraskan?). Coll. 1961 and subm. by G. R. Scott. Comment (G.R.S.): pottery associated with charcoal is referred to the Franktown Focus, which A. M. Withers considers transitional between Woodland and Upper Republican cultures. Two types of pottery are found in area. Older sites have strongly corrugated pottery. Charcoal from an older site referred to Parker Focus of Woodland culture was dated at 1360 ± 200 yr. Younger sites have weakly corrugated pottery. Date obtained on charcoal from younger site establishes chronology of Woodland and post-Woodland cultures.

W-989.  Salida, Colorado  

<200

Carbonized wood fragments from Gas Creek, N of Salida, sec. 27, T 15 S, R 78 W (38° 32' N Lat, 106° 00' W Long), Colorado, from peat, underlain by outwash. Coll. 1958 and subm. by R. E. Van Alstine. Comment: it was hoped that sample could be correlated with associated vertebrate bones and fossil plant material, but age suggests intrusion.

W-932.  American Falls, Idaho  

>38,000

Well-bedded fine peat from large chunk of peat ca. 3 by 4 ft incorporated in coarse Michaud Gravel, near top of bluff overlooking American Falls Reservoir, SE1/4 SW1/4 sec. 29, T 5 S, R 33 E (42° 57' N Lat, 112° 37' 30'' W Long), Idaho. Coll. 1960 by D. E. Trimble and W. J. Carr; subm. by W. J. Carr. Comment: peat was probably ripped out of underlying American Falls Lake Beds by Lake Bonneville overflow waters and deposited in Michaud Gravel. W-358, >32,000 (USGS IV) is from gravel at base of lake beds from which present sample comes; W-731, 29,700 ± 1000 (USGS V) is from terrace deposits somewhat younger than Michaud Gravel.
W-1221. Bannock City, Idaho. 32,500 ± 1500
30,550 b.c.

Shells of freshwater mollusks from possible lake sediments consisting of marl and marly clay and silt, ca. 75 yds W of Arimo gas station of highway over Marsh Creek, E1/2 SW1/4 sec. 12, T 10 S, R 37 E (42° 33' N Lat, 112° 05' W Long), Bannock County, Idaho. Coll. 1962 by R. C. Bright, M. Rubin and R. Rubin; subm. by M. Rubin. Comment (R.C.B.): sediments containing shells underlie a terrace that might represent Provo overflow of Lake Bonneville. Date would then be maximum for Provo Formation.

Bear River series, Idaho

Travertine-coated twigs from culvert from a hot spring just W of large meander of Bear River ca. 3 mi NW of Preston, SW1/4 NW1/4 sec. 17, T 15 S, R 39 E (42° 07' N Lat, 112° 56' W Long), SE Idaho. Coll. 1962 by R. C. Bright, M. Rubin and R. Rubin; subm. by M. Rubin. Comment (R.C.B.): twigs are probably less than 10 yr old. Sample was coll. to compare age of wood with that of travertine to test possibility of using travertine to date older sediments.

W-1226. Twigs. <200
W-1225. Travertine. >39,000

W-1128. Bitten’s Ranch, Idaho. 34,000 ± 1600
32,050 b.c.

Mollusk shells from road cut ca. 1/5 mi W of Bitten’s Ranch, on divide separating E fork of Whisky Creek and W fork of Trout Creek, SW1/4 SW1/4, sec. 8, T 11 S, R 41 E (42° 29' 30'' N Lat, 111° 41' 30'' W Long), SE Idaho. Sample from near shore, cross-bedded sand of extinct Lake Thatcher, alt ca. 5270 ft. Coll. 1961 and subm. by R. C. Bright, Univ. of Minnesota, Minneapolis. Comment: date is minimum for Lake Thatcher.

W-1125. Harris Ranch, Idaho. 27,000 ± 900
25,000 b.c.

Snail shells (Fluminicola, id. by R. C. Bright) from beach sands of highest beach formed by Pleistocene Lake Thatcher, from 5425 ft alt, ca. 1/5 mi NW of Harris Ranch, C NW1/4 NE1/4 NW1/4 NW1/4 sec. 32, T 10 S, R 40 E (42° 31' N Lat, 111° 49' W Long), SE Idaho. Coll. 1961 and subm. by R. C. Bright. Comment: date is minimum for high stand of Lake Thatcher and approximates date of spillover into Bonneville Basin. Three related samples previously run were: W-898 (USGS VI), 33,700 ± 1000 yr from 4935 ± 5 ft alt; W-855 (USGS V), 27,500 ± 1000 yr from 5170 ± 5 ft alt; and W-704 (USGS V), 32,500 ± 1000 yr from 5290 ± 5 ft alt.

W-1191. Cottonwood Creek, Idaho. 2050 ± 300
100 b.c.

Tufa from deposit on E side of valley at head of Cottonwood Creek, NE1/4, sec. 7, T 11 S, R 39 E (42° 29' 20'' N Lat, 111° 56' 45'' W Long), Idaho. Coll. 1962 and subm. by S. S. Oriel. Comment (S.S.O.): fossil leaf impressions of willow and aspen in the tufa are indistinguishable from living plants in area now. This and similar pollen data confirm the date as modern.
McCammon series, Idaho

“Baked” organic soil exposed in bluff adjacent to Marsh Creek, 3 mi S SW of McCammon, NW\(\frac{1}{4}\) SW\(\frac{1}{4}\) sec. 26, T 9 S, R 36 E (42\(^\circ\) 36' N Lat, 112\(^\circ\) 14' W Long), Idaho, from black “baked” horizon, beneath basalt flow, believed to be organic debris cooked by lava. Alluvium underlies the flow. Coll. 1961 and 1962 and subm. by R. C. Bright, M. Rubin and R. M. Rubin. **Comment:** these basalts are thought to be of same sequence as basalts in Gem and Gentile Valleys which flowed down Portneuf and into Marsh Valley. Date should be maximum for flows of Marsh Valley and aid in correlating extrusions, Lake Thatcher, and overflow of Lake Bonneville. Sediments of Lake Bonneville overlie this flow. Importance of date made it advisable to re-collect sample and make completely new run.

**W-1121.** McCammon flow, slide area

33,000 \(\pm\) 1600

31,050 B.C.

Organic material from beneath flow, exposed by recent landslide.

**W-1177.** McCammon flow, gravel pit

35,000 \(\pm\) 3000

33,050 B.C.

Organic material from beneath flow, exposed in gravel pit few hundred ft N of W-1121. Although a few rootlets in the low-C sample horizon were avoided, contamination by modern C is possible. Samples may be much older than dates given.

**W-929.** Portneuf pumping station, Idaho

> 42,000

Peat from near bottom of trench for Portneuf pumping station pipeline, SE\(\frac{1}{4}\) SW\(\frac{1}{4}\) sec. 36, T 5 S, R 33 E (42\(^\circ\) 56' N Lat, 112\(^\circ\) 33' W Long), Idaho. Sample from layer of peat ca. 1 ft thick in upper part of American Falls Lake Beds, is overlain conformably by ca. 13 ft of silty clay and then by Michaud Gravel deposited during spillover of Lake Bonneville. **Comment:** layer is probably source for W-932 (this date list).

**W-982.** Ramsbottom Ranch, Idaho

18,900 \(\pm\) 500

16,950 B.C.

Shells of fresh-water gastropod *Stagnicola* from pit on Ramsbottom Ranch, sec. 5, T 16 S, R 40 E (42\(^\circ\) 4' N Lat, 111\(^\circ\) 59' W Long), ca. 4.5 mi SE of Preston, Franklin County, Idaho. Coll. 1960 and subm. by R. C. Bright. **Comment** (R.C.B.): date is highest (Bonneville) stillstand and spillover of Lake Bonneville.

**W-1160.** Trout Creek, Idaho

33,000 \(\pm\) 1500

31,050 B.C.

Snail shells from sandy, near-shore facies of Pleistocene Lake Thatcher, alt 5340 ft ca. 100 ft below well-developed beach, S side of mouth of main fork of Trout Creek Canyon, SW\(\frac{1}{4}\) NW\(\frac{1}{4}\) SW\(\frac{1}{4}\), sec. 16, T 11 S, R 41 E (42\(^\circ\) 28' N Lat, 111\(^\circ\) 40' W Long), Preston quadrangle, Idaho. Coll. 1961 and subm. by R. C. Bright. **Comment** (R.C.B.): clam shells (*Gonidea angulata*) associated with sample suggest connection with Snake River; sample should date connection.
W-1112. **Boomerang Gulch, Montana**

5020 ± 260
3070 B.C.

Plant stems and fragments, partly charcoal, from valley wall of upper part of Boomerang Gulch, SE of Sugarloaf Mountain, SE ¼ NW ¼ sec. 18, T 6 N, R 4 W (46° 16' 34" N Lat, 112° 9' 24" W Long), Jefferson County, Montana. From section of silt with sandstone and tuffaceous silt, directly overlain by 2 in. of clean ash and then more silt. Coll. 1961 and subm. by H. W. Smedes. Comment: dates overlying ash layer. Ash in similar geomorphic setting is common throughout Boulder batholith region.

W-1135. **Rigler Bluffs, Montana**

4900 ± 300
2950 B.C.

Charcoal from rock-lined, prehistoric Indian hearth exposed by collapse of a gully wall, Rigler Bluffs, SW ¼, NW ¼, sec. 19, T 8 S, R 8 E (45° 08' N Lat, 110° 43' W Long), Montana. 25 ft above low-water stage of Yellowstone River at 5095.5 ft, 6 ft above drain bottom of gully and 22 ft below level of alluvial fan in which gully is incised. Coll. 1962 by A. L. Haines; subm. by J. M. Good, Yellowstone Nat. Park, Yellowstone Park, Wyoming. Comment (J.M.G.): date falls near center of little-known “Middle Prehistoric” period. Dated sites of occupation by Forager peoples are very rare. This one appears to have been established as a camp on silt margin of landslide-created lake, afterwards engulfed by continued deposition of silt. Similar sample run by D. Frey, Sheridan College, Sheridan, Wyoming, gave age of 5040 ± 150, which is oldest date for occupation of upper Yellowstone Valley by man.

**Little Valley series, Utah**

Wood and shells from Promontory Point, sec. 1, T 6 N, R 6 W (41° 14' N Lat, 112° 29' W Long), Little Valley, Utah. From silt and marl overlying recessional lake gravel on clay. Coll. 1960 by R. C. Bright, M. Rubin, W. Carr, and H. D. Goode; subm. by H. D. Goode, Univ. of Utah, Salt Lake City. Comment: recessional lake gravel is bracketed by the two dates.

W-941. **Wood from clay at base of section**

20,300 ± 500
18,350 B.C.

(See W-876, USGS V).

W-943. **Mollusks from silt near top of section**

12,780 ± 350
10,830 B.C.

(See W-875, USGS V), alt 4725 ft.

W-1037. **Promontory Point, Utah**

11,600 ± 400
9650 B.C.

Carbonate carbon from calcareous clay from Southern Pacific R. R. fill project across Great Salt Lake between Promontory Point and Lakeside (41° 14' N Lat, 112° 26' W Long), Utah, at milepost 745, from just below top of salt bed with thin clay layers underlying lake clay. Salt bed (mainly Na₂SO₄·10 H₂O) is ca. 25 ft below bottom of G. S. Lake (Eardley, 1962). Coll. 1958 by E. S. Smith; subm. by A. J. Eardley, Univ. of Utah, Salt Lake City. Comment: salt bed was believed to be Hypsithermal but date is that of Two Creeks Interstade.
W-996. **Bellingham, Washington**

11,660 ± 350
9710 B.C.

Marine shells from sea cliff at Cement Plant, Bellingham, sec. 44, T 38 N, R 2 E (48° 45' N Lat, 122° 28' W Long), Whatcom County, Washington, from pebbly blue-clay till underlying sand and gravel, overlain by clay. Coll. 1960 by D. J. Easterbrook; subm. by D. R. Crandell. *Comment:* till was thought to correlate with till at North Bellingham dated 12,090 ± 350 (this report, W-984). Dates a glacial advance that reached Georgia Strait.

W-940. **Cedarville, Washington**

11,640 ± 275

Wood from logs embedded in peat and clay at base of lacustrine sediments, between two marine tills, from stream-bank exposure along Nooksack River, SW1/4 NE1/4 NE1/4 sec. 34, T 39 N, R 4 E (46° 52' N Lat, 123° 17' W Long), Whatcom County, Washington. Coll. 1960 and subm. by D. R. Crandell. *Comment* (D.R.C.): date indicates that underlying glacio-marine drift is Vashon in age, and overlying drift is equivalent to Sumas drift of Armstrong (1960) which according to him is post-Two Creeks in age.

W-1118. **Kautz Creek, Washington**

2980 ± 250
1030 B.C.

Carbon from duff layer in W bank of Kautz Creek, Mount Rainier National Park, SE1/4 NW1/4 NE1/4 sec. 16, T 15 N, R 8 E (46° 46' N Lat, 121° 49' W Long), Washington. Stratigraphy, top to bottom: debris flow; gravel; debris flow; gravel; debris flow; pumice; duff layer (sample); coarse sand-size pumice Y; debris flow. Coll. 1961 by D. R. Crandell and R. D. Miller; subm. by D. R. Crandell. *Comment:* age is minimum for Y pumice in Kautz valley and agrees with age of W-930 (2550 ± 200), from above Y pumice in White River valley (Crandell and others, 1962).

W-1103. **Lake City, Washington**

>38,000

Silty peat from layer interbedded with silt, clay, and pumiceous sand, on cutbank of Lake Washington, 12 ft above railroad track, Lake City district, SE1/4 SW1/4 sec. 15, T 26 N, R 4 E (47° 42' N Lat, 122° 19' W Long), Seattle, Washington. Coll. 1962 and subm. by D. R. Mullineaux. *Comment:* age is too great to permit correlation with similar sequence in W Seattle (W-1091, this date list).

**Mount Rainier series, Washington**

Wood from duff layer on E bank of Kautz Creek, Mount Rainier National Park, NE1/4 NW1/4 sec. 21, T 15 N, R 8 E (46° 47' N Lat, 121° 48' W Long), Washington. Stratigraphy, top to bottom: debris flow (A.D. 1947); duff; debris flow; sand and silt; duff (W-1120); sand; ash W (Crandell and others, 1962); sand; duff (W-1119); sand; debris flow; sand containing balls of pumice Y. Coll. 1961 by D. R. Crandell and R. D. Miller; subm. by D. R. Crandell. *Comment:* dates bracket ash layer W, and substantially agree with W-925 and W-926 (USGS VI; also Hopson and others, 1962).  

W-1120. **Wood, upper duff layer**

290 ± 200
A.D. 1660
V. S. Geological Survey Radiocarbon Dates VII

W-1119. Wood, lower duff layer 320 ± 200 A.D. 1630

W-1116. Nisqually River, Washington 4000 ± 250 2050 B.C.
Carbon from duff layer from highway cut at W end of bridge over Nisqually River between Longmire and Paradise, Mount Rainier National Park (46° 47’ N Lat, 121° 45’ W Long), Washington. Stratigraphy, top to bottom: till of 1840 moraine of Sigafoos and Hendricks (1961); sand, silt, and charcoal (W-922, USGS VI); mixed sand, silt, pumice Y (W-930 and W-1115, this date list); duff containing charcoal (sample) mudflow, possibly equivalent to Osceola; duff; till; bedrock. Coll. 1961 by D. R. Crandell and R. D. Miller; subm. by D. R. Crandell. Comment: age is maximum for pumice Y (Crandell and others, 1962) and minimum for underlying mudflow, which may be equivalent of Osceola mudflow.

W-984. North Bellingham, Washington 12,090 ± 350 10,140 B.C.

W-1029. Renton, Washington >38,000
Compressed wood fragments from peaty clay exposed at top of scarp of Gladding McBean clay pit, SW1/2 SE1/2 sec. 17, T 23 N, R 5 E, on S side of Cedar River, Renton (47° 28’ N Lat, 122° 12’ W Long), Washington. Peaty clay underlies Vashon Drift and overlies unoxidized silty till that forms part of a complex of lacustrine deposits and till. Coll. 1960 and subm. by D. R. Mullineaux. Comment: this was an attempt to date beginning of Vashon glaciation.

W-1030. South Cascade Glacier, Washington 4700 ± 300 2750 B.C.
Stem of tree, probably alpine fir, with roots extending into a weathered zone in bedrock, adjacent to S margin of South Cascade Glacier (48° 22’ 13” N Lat, 121° 04’ 04” W Long), Washington, ca. 100 ft above terminus. Tree became exposed below melting ice surface in summer 1958. Coll. 1958 and subm. by M. F. Meier. Comment (M.F.M.): as site is completely inhospitable to plant life now, South Cascade Glacier was probably much smaller when tree was alive. The glacier then advanced, striated the bedrock, and broke off the tree.

W-1114. Tipsoo Lake, Washington 2660 ± 250 710 B.C.
Peat from near base of ash sequence, from roadcut S side of Highway 410, 150 yd E of first switchback W of Tipsoo Lake, Mount Rainier National Park (46° 52’ N Lat, 121° 31’ W Long), Washington. Coll. 1961 by D. R.
Crandell and R. D. Miller; subm. by D. R. Crandell. Comment: sample higher in sequence gives a conflicting date of 8750 ± 280 (W-950, this date list; also Crandell and others, 1962); the problem is not resolved.

**West Point Light series, Washington**

Wood and plant fragments from sea cliff 3000 ft SE of West Point Light, Seattle, sec. 16, T 25 N, R 3 E (47° 38' N Lat, 122° 25' W Long), Washington. Samples are from sequence known locally as Lawton formation, overlain by Vashon Till. Coll. 1961, 1962 and subm. by D. R. Mullineaux. Comment (D.R.M.): sampled sequence was deposited late in nonglacial interval (other dates ca. 28,000 to 35,000 yr, Dorn and others, 1962). W-1186 is minimum for advance of Vashon Puget lobe to Seattle. Lacustrine silt and clay above sample horizon relate to a lake formed as Puget Lobe blocked Strait of Juan de Fuca.

**W-1091. Wood fragments 1**

Sample coll. 3 ft above beach of Puget Sound, from lacustrine sand with organic fragments and overlain by silt and clay (horizon of W-1186).

W-1181. Wood fragments 2

Sample W-1091, re-collected and re-run because of importance of date.

**W-1186. Plant fragments**

Sample coll. from lacustrine silt and clay 16,150 B.C., ca. 20 ft above beach, overlain by silt and sand, lacustrine silt and clay, sand, and Vashon Till.

**W-1182. West Seattle, Washington**

Peat from beach about 100 ft W of intersection of Beach Drive and Oregon Streets (47° 34’ N Lat, 122° 24’ W Long), West Seattle, interbedded with clay, silt, and sand that underlie Lawton formation of local usage. Coll. 1962 and subm. by D. R. Mullineaux. Comment (D.R.M.): peat dates nonglacial interval (elsewhere preceding ca. 28,000 to 35,000 yr, Dorn and others, 1962). Overlying sediments make up W flank of hill under West Seattle, and are banked against older Pleistocene sediments to E. Peat is slightly older than W-1091 and W-1186 from farther N in Seattle (this date list).

**W-997. Whatcom County, Washington**

Shells from seaciff in middle of SW¼ sec. 20, T 39 N, R 1 W (48° 52’ N Lat, 122° 45’ W Long), Whatcom County, Washington, from silty clay, about 20 ft below base of marine till that forms present upland topography. Coll. 1960 by D. J. Easterbrook; subm. by D. R. Crandell. Comment: date is maximum for Wisconsin glacial advance that terminated in Georgia Strait.

**White River series, Washington**

Samples from cut in S valley wall of White River at mouth of Fryingpan Creek, Mount Ranier National Park (46° 54’ N Lat, 121° 36’ W Long),

W-930. Wood from log $2550 \pm 200$
600 B.C.

W-1115. Carbon from peaty clay $3500 \pm 250$
1550 B.C.

W-950. Yakima Park, Washington $>38,000$
Carbonized wood fragments from cut adjacent to highway between White River entrance and Yakima Park 200 yd W of exposure of columnar andesite (46° 55' N Lat, 121° 36' W Long), Mount Rainier National Park, Washington. Sample is from volcanic ash layer overlying till of older valley glacier and underlying till of youngest valley glacier. Coll. 1960 by D. R. Crandell and R. D. Miller; subm. by D. R. Crandell. Comment (D.R.C.): date shows older drift is not middle Wisconsin. Late Wisconsin here apparently is represented by short glacial advances.

W-1000. Beartooth Mountains, Wyoming $8600 \pm 300$
6650 B.C.
Peat from just above base of peat deposit overlying granitic wash, 1 mi SE of Sawtooth Lake, at top of Beartooth Mountains at alt 9700 ft (44° 54' N Lat, 109° 27' W Long), Deep Lake quadrangle, Wyoming. Deposit is within a permafrost zone; "fossil" ice is found 18 in. below surface of peat. Coll. 1957 and subm. by W. G. Pierce. Comment: dates beginning of peat deposition; together with sample (W-459, USGS IV) from top of deposit, can be used to determine rate of accumulation.

Bill Dew Ranch series, Wyoming
Calcereous clay cores from Lake 5923, Wind River Mountains, 1 mi N of Bill Dew Ranch, ca. 21 mi NNW Pinedale, Sublette County, sec. 26, T 37 N, R 110 W (43° 31' N Lat, 110° 01' W Long), Wyoming. Sediment consists of calcereous and organic clay. Coll. 1959 and subm. by R. C. Bright and H. E. Wright. Comment: samples bracket a pronounced climate fluctuation, seen in a pollen diagram by Bright (unpub.). Bottom sample comes from base of a pine minimum, the beginning of the last glaciation of Wind River Mountains. Lower sample was diluted with dead acetylene. Upper sample dates top of pine minimum. See W-914 (USGS VI).

W-998. Core at 808 to 838 cm $20,800 \pm 1200$
18,850 B.C.

W-995. Core at 558 to 578 cm $10,230 \pm 600$
8280 B.C.

W-1290. Fremont County, Wyoming $>40,000$
Travertine overlying terrace gravel with layers of ash in Wind River Basin, Fremont County CSL sec. 13, T 5 N, R 6 W (43° 34' N Lat, 109° 25' W Long), Wyoming. Gravel, on a surface slightly older than Blackwelder's

**W-1199. Grass Creek, Wyoming**

Charcoal from fire pit banked by rock, Grass Creek, NE\(\frac{1}{4}\) SW\(\frac{1}{4}\) SE\(\frac{3}{4}\), sec. 29, T 46 N, R 98 W, 6th P.M. (43° 55’ N Lat, 108° 38’ W Long), Hot Springs County, Wyoming. Pit exposed 6 ft below surface by bulldozer trench cut in a fan. Coll. 1962 and subm. by W. L. Rohrer. Comment: sample was thought to represent a site of early man, but date is contradictory.

**W-1070. Johnny Counts Flat, Wyoming**

Molusk shells from fresh-cut trench intersecting 2-ft shell bed at depth 3 ft on Johnny Counts Flat, NW\(\frac{1}{4}\) NE\(\frac{1}{4}\) SE\(\frac{3}{4}\) sec. 32, T 39 N, R 116 W (43° 19’ N Lat, 110° 46’ W Long), Teton County, Wyoming. Coll. 1959 and subm. by J. D. Love. Comment: date is minimum for development of flat and maximum for downcutting of Snake River from flat to present river level.

**W-1060. Wheatland, Wyoming**

Snail shells (*Oreohelix subrudis*) in bank of Brush Creek, SW of Wheatland, NE\(\frac{1}{4}\) NE\(\frac{1}{4}\) SE\(\frac{3}{4}\) sec. 22, T 22 N, R 69 W (41° 51’ N Lat, 105° 06’ W Long), Wyoming. Shells in a layer of dark alluvium overlain by alluvium and gravel, and underlain by coarse gravel, sand, and silt. Alluvium in stream bottom is coarse gravel, sand, and silt. Coll. 1958 and subm. by L. W. McGrew. Comment: dates downcutting by present drainage system and, as sequence appears to be faulted, age of the fault.

**D. Alaska**

**W-1180. Anangula Island, Alaska**

Charcoal from Anangula Island, Aleutian Islands (52° 55’ N Lat, 168° 55’ W Long), Alaska, at depth 213 cm in ash with charcoal and obsidian flakes overlying till(?). Coll. 1963 and subm. by R. F. Black, Univ. of Wisconsin, Madison. Comment (R.F.B.): date is considered too young; charcoal from same locality dated 8425 ± 275 (I-715). Upper portion of ash was estimated ca. 5000 yr old at Nikolski by a variety of evidence, implying that 125 cm of ash with several paleosols would have had to form on this 5000-yr ash in about 3000 yr. Site is oldest paleo-Aleut site known in Alaska or North American Arctic.

**W-1287. Bethel, Alaska**

Wood from well No. 2, U. S. Air Force Station 5 mi W of Bethel (60° 50’ N Lat, 161° 55’ W Long), Alaska, from sand that heaved up hole under pressure when drilling reached base of permafrost at 603 ft. Presumably from depth of 603 to 605 ft in deposits of Kuskokwim delta, approx. 430 ft below modern sealevel. Coll. by Alaska District, Corps of Engineers, U. S. Army 1962; subm. by A. J. Feulner. Comment (A.J.F.): this is first date obtained from sediments of Yukon-Kuskokwim delta, about 1000 ft thick W of Bethel.
W-1175. Bitters Creek, Alaska  

Peat from middle section of high bluff along Tanana River near Bitters Creek, 1/4 mi back from face of bluff along deeply eroded creek valley (63° 10' N Lat, 142° 07' W Long), Alaska. Bluff exposes dune sand on alluvial and lacustrine sediments on muck. Coll. 1961 and subm. by A. T. Fernald. Comment (A.T.F.): date indicates sample was taken from slumped material probably from near top of bluff.

W-978. Bitters Creek junction, Alaska  

Layered peat from low cutbank of Tanana River floodplain, 1.5 mi above its junction with Bitters Creek (63° 08' N Lat, 142° 06' W Long), Alaska, from 7 ft down from top, from 6-in. peat bed underlying volcanic ash and gray silt. Coll. 1959 and subm. by A. T. Fernald. Comment (A.T.F.): dates floodplain and antedates widespread ash in E Alaska (Fernald, 1962).

W-1089. Copper Center area, Alaska  

Decomposed and iron-stained log from gravel pit in intermediate terrace of Copper River at Milepost 103.9, Richardson Highway, 3 mi N of Copper Center (61° 55' 30" N Lat, 145° 20' 00" W Long), Alaska. Sample coll. 3.5 ft below terrace surface in 5-ft sand and gravel overlying older sand and gravel dated at >38,000 (W-969, this date list). Coll. 1958, subm. and interpreted by D. R. Nichols. Comment: sample postdates period of downcutting and indicates slightly more recent age of alluviation, possibly result of a postglacial climatic fluctuation.

W-1155. Copper River, Alaska  

Log from 50-ft gravel terrace on S side of Copper River, ca. 11 mi SW of Chistochina (62° 27' N Lat, 145° 50' W Long), Gulkana B-2 quadrangle, Alaska. Sample coll. from 4 ft below gravel unit overlain by gravel and silt, then alluvium with organic material. Coll. 1955 and subm. by O. J. Ferrians, Jr. and H. R. Schmoll. Comment (O.J.F.): sample dates an aggradation by Copper River.

W-1163. Gakona River, Alaska  

Peat from base of surface peat unit at top of bluff on E side of Gakona River about 26 mi from its mouth (62° 37' 43" N Lat, 144° 40' 00" W Long), Alaska. Surface peat unit, 3 ft thick, overlies unsorted sandy silt with numerous scattered pebbles, cobbles, and boulders (lacustrine diamicton). Coll. 1955, subm., and interpreted by O. J. Ferrians, Jr., and H. R. Schmoll. Comment: date is minimum for regression of lake water that covered site during last major glaciation.

W-967. Gulkana Hills area, Alaska  

Compressed woody particles (cedar?) from W bank of unnamed stream that drains S and is E of Keg Creek, Gulkana Hills area (62° 47' 10" N Lat, 146° 04' 00" W Long), Alaska. Sample coll. from fine sandy silt with pebbles
and scattered wood fragments, overlain by gravelly sand and underlain by oxidized gravel on till. Coll. 1960 and subm. by D. R. Nichols. Comment (D.R.N.): it was expected that date would be minimum for a supposed outwash. Young date, however, suggests that organic material probably was incorporated with gravelly silt by colluvial activity.

W-1213. Imuruk Lake, Alaska  
9990 ± 400  
7950 B.C.

Wood from N shore of Granite Bay, Imuruk Lake, Seward Peninsula (65° 37' N Lat, 163° 07' W Long), Alaska, from intermediate terrace of Imuruk Lake terrace sequence (Hopkins, 1960), consisting of driftwood in lacustrine peat covered by colluvial (?) sand, silt, and roots. Base of lacustrine peat is 1 to 2 ft above present lake level. Coll. 1961 and subm. by D. M. Hopkins. Comment (D.M.H.): intermediate terrace at Imuruk Lake was thought to have been deposited during last (presumably Wisconsin) glaciation (Hopkins, 1960); a beach deposit and wave-cut scarp found higher on slopes was thought to have been covered during a presumably Illinoian glaciation. Both wave-cut scarp and terrace are warped, and outlet of Imuruk Lake was shifted by crustal warping. C¹⁴ date indicates that faulting that warped terrace and that shifted outlet of Imuruk Lake took place less than 10,000 yr ago.

W-1154. Itivlik Lake, Alaska  
4470 ± 300  
2520 B.C.

Wood from north-central Brooks Range, Itivlik Lake (68° 07' N Lat, 156° 05' W Long), N Alaska, clayey peat 6 ft below surface of a fan. Fan underlies an important archaeological site along N shore of Itivlik Lake. Coll. 1961 and subm. by T. D. Hamilton, Univ. of Wisconsin, Madison. Comment (T.D.H.): date is maximum for North Point archaeological site (Irving, 1962) and minimum for Eschooka glaciation—considerably younger than 8000 minimum date cited by Detterman and others (1958). Date supports hypothesis that fan development is related to Hypsithermal recession of permafrost.

W-1157. Kotsina River, Alaska  
<200

Wood from log in clayey silt in low bank E side Kotsina River, 1.2 mi W SW of mouth of Long Glacier River (61° 42' 45" N Lat, 144° 17' 16" W Long), Alaska. Coll. 1961, subm. and interpreted by L. A. Yehle. Comment: mass of silt presumably slid over river bank from adjacent upstream bluff, and incorporated woody material in its basal part.

W-977. Lower Chitina Valley, Alaska  
>40,000

Wood fragments from "massive till" overlain by eolian silt and sand, E side Copper River, 0.3 mi N of mouth of Chitina River, (61° 31' 10" N Lat, 144° 23' 30" W Long), near Chitina, Alaska. Fragments are predominately lignitized, surrounded to well-rounded, and liberally scattered through the "massive till", which is that described as underlying woody material dating 6330 ± 240 yr (W-844, USGS V). Coll. 1960, subm., and interpreted by L. A. Yehle. Comment: date is minimum age from drift at topographically lowest part of Copper River Basin.
W-1159. Lower Chitina Valley, Alaska 4300 ± 300 2350 B.C.

Wood fragments from near top of 525-ft bluff on N side of Chitina River 1 mi E of mouth of Tebay River (61° 23’ 37” N Lat, 143° 57’ 36” W Long), Alaska, alt ca. 1200 ft. Sample is from eolian silt with logs, branches, and various woody fragments, overlying thick section of till, gravel, and sand. Coll. 1961, subm., and interpreted by L. A. Yehle. Comment: date is minimum for retreat of Chitina Valley trunk glacier and cessation of local alluviation.

W-1161. Mentasta Basin, Alaska 9650 ± 370 7700 B.C.

Wood fragments from gravel pit, Mile 76.4 Tok Cutoff section of Glenn Highway, just S of Slana River bridge (62° 51’ N Lat, 143° 42’ W Long), Alaska. Sample is from peat and silt on fine sand on sand and gravel. Coll. 1961, subm., and interpreted by H. R. Schmoll. Comment: date is minimum for glacio-alluvial and/or glacio-lacustrine environment in Mentasta Basin. Age is consistent with minimum dates previously obtained in adjoining Copper River Basin, and indicates at least partial contemporaneity of peat deposition here and at Ahtell Creek 12 mi SW.

W-1202. Middleton Island, Alaska A.D. 1250 700 ± 250

Peat from beach cliff at 15 ft alt on NW shore of Middleton Island (59° 28’ N Lat, 146° 19’ W Long), Alaska, from thin peat bed about 2 ft below surface of Stage V terrace deposit (Miller, 1953), underlain and overlain by beach gravel and sand. Coll. 1956 by N. J. Willimovsky; subm. by D. J. Miller; interpreted by George Plafker. Comment: date is minimum for Stage V terrace deposits on Middleton Island. Based on date, average rate of uplift in past 700 yr is ca. 0.021 ft/yr, comparing with ca. 0.04 ft/yr calculated from C14 dates of marine terrace deposits on tectonically active mainland (W-369 and W-405, USGS IV). If rate of uplift was uniform, Middleton Island cannot have emerged less than 5000 yr ago.

W-1205. Middleton Island landing field, Alaska A.D. 1350 600 ± 250

Peat from NW end of landing field at alt ca. 65 ft (59° 27’ N Lat, 146° 18’ W Long), Middleton Island, Alaska, from 14-in. peat bed in Stage III terrace deposits (Miller, 1953), overlain by gravel and underlain by gravel and sand. Coll. 1956 by N. J. Willimovsky; subm. by D. J. Miller; interpreted by George Plafker. Comment: sample was expected to date Stage III terrace on Middleton Island, at alt 65 ft, but is too young (cf. W-1202, 700 ± 250 on this date list). It suggests one formed long after Stage III terrace emerged from sea and approx. 100 yr before accumulation of peat on Stage V terrace.

W-1210. Moose Creek, Alaska 2560 ± 250 610 B.C.

Peat from cutbank of Moose Creek floodplain, 1.3 mi S of Northway Airport (62° 57’ N Lat, 141° 56’ W Long), Alaska, from peat bed, 4.3 ft down from top of bank, which underlies silt, clay, and organic material, in part a pond or lake deposit. Coll. 1961 and subm. by A. T. Fernald. Comment
(A.T.F.): dates floodplain at this locality, which continued until after deposition of widespread volcanic ash (Fernald, 1962).

W-1206. Nabesna River, Alaska

8200 ± 300
6250 B.C.

Woody material from 6.5 ft down from top of 60-ft bluff in 2-in. organic layer that overlies and underlies dune sand, along Tanana River 3 mi NW of its junction with Nabesna River (63° 04' N Lat, 140° 57' W Long), Alaska. Coll. 1959 and subm. by A. T. Fernald. Comment (A.T.F.): dates local stabilization of dunes at this place, postdates thick accumulation of dune sand, and antedates continued eolian activity.

W-980. Nabesna River junction, Alaska

10,230 ± 300
8280 B.C.

Brown peat from 6-in. bed of peat with clam shells 14 ft below top of 40-ft bluff along Tanana River, 5 mi NW of its junction with Nabesna River (63° 05' N Lat, 141° 59' W Long), Alaska. Bed is overlain by silt, sand, organic material, and fine rubble; volcanic ash near top. Coll. 1961 and subm. by A. T. Fernald. Comment (A.T.F.): previous dates on the ash (Fernald, 1962) are 1520 ± 100 (1-276), 1750 ± 110 (1-275), and 2000 ± 250 (W-978, this date list). This date and date of ash bracket upper strata in bluff. Sample existence of pond or lake here.

W-1165. Northeastern Copper River basin, Alaska

1630 ± 350
A.D. 320

Peat from eolian deposits at top of bluff on W side of Gakona River 0.3 mi upstream from its mouth (62° 18' N Lat, 145° 18' W Long), Alaska. Stratigraphic section, from base upward, is as follows: lacustrine diamicton; 16 in. of peat with interbedded eolian fine sand (lowermost peat from this unit previously dated at 9400 ± 300, W-714, USGS V); 6 ft of eolian fine sand; 14 in. of peat with interbedded eolian fine sand (W-1165 is from uppermost 1 in. of this unit); 4 ft of eolian fine sand; and at surface, 3 ft of peat and woody material interbedded with eolian fine sand. Coll. 1958, subm., and interpreted by O. J. Ferrians, Jr., and H. R. Schmoll. Comment: sample dates beginning of period of accelerated eolian deposition.

Old Slana Roadhouse series, Alaska

Wood and peat from exposure on N side of Copper River, 0.65 mi W of mouth of Slana River, near abandoned buildings of Old Slana Roadhouse (62° 42' N Lat, 143° 59' W Long), Alaska. Section from River upward is lacustrine: (1) 30 ft massive silt; (2) and (3) 25 ft and fine sand with graded beds; (4) 10 ft laminated silt; (5) and (6) 50 ft sand grading upward into gravel; (7) 5 ft laminated sand; and (8) surface peat. W-1134 was coll. from lower part of unit (5); W-1162 was coll. from top of unit (3). Coll. 1960 and 1961 by H. R. Schmoll, R. H. Bennett, and O. J. Ferrians, Jr.; subm. and interpreted by H. R. Schmoll. Comment: W-1134, believed contemporaneous with inclosing sediments, indicates that upper part of section (units 5 to 7) was deposited during last major glaciation. Site, approx. 35 mi in front of present-day Copper Glacier, was thus occupied by glacial lake rather than glacier ice during much, if not all, of this glaciation. Consequently, a similar environment
prevailed in Copper River Basin to W and lower Slana Valley to N. W-1162 probably represents older, reworked material since the peat had been compressed and hardened prior to being rounded.

W-1134. Wood  
17,600 ± 400  
15,650 b.c.

Small fragments of wood, scattered through lower part of unit (5).

W-1162. Peat  
>42,000  
Two rounded fragments of compacted peat, from top of unit (3).

W-1169. Pickerel Lakes, Alaska  
2000 ± 300  
50 b.c.


Poplar Grove series, Alaska

Peat from deep excavation in gravel pit at Poplar Grove, Mile 136.7, Richardson Highway, NE Copper River basin (62° 23' 54" N Lat, 145° 22' 48" W Long), Alaska. Stratigraphy, base to top: sandy silt; peat with interbedded silt and sand (W-1164 is from lowermost 2 in. of peat bed and W-985 from topmost 2 in.); gravel and sand. Coll. 1958, subm., and interpreted by O. J. Ferrians, Jr. and H. R. Schmoll. Comment: samples bracket peat accumulation preceded and followed by alluviation. Other samples from this area are W-297 (USGS III), W-377 and W-487 (USGS IV), W-531 and W-714 (USGS V).

W-985. Top of peat unit  
6960 ± 290  
5010 b.c.

W-1164. Base of peat unit  
7880 ± 400  
5930 b.c.

W-1207. Porcupine Creek, Alaska  
10,150 ± 400  
8200 b.c.

Peat from cut bank of local terrace along Porcupine Creek, between Tanana River and Taylor Highway, 1.8 mi above its junction with Tanana River (63° 23' N Lat, 142° 38' W Long), Alaska, from 8-in. peat layer, 22 ft below top of bank overlying sand and underlying peat, sand, and rubble. Volcanic ash lies near top. Coll. 1961 and subm. by A. T. Fernald. Comment: dates on the ash (Fernald, 1962) are 1520 ± 100 (I-276), 1750 ± 110 (I-275), and 2000 ± 250 (W-978, this date list). Development of local terrace is bracketed between dates of W-1207 and age of ash.

W-1168. Porcupine Creek junction, Alaska  
>38,000

Wood fragments from high bluff along Porcupine Creek 1 mi above its junction with Tanana River between Tanana River and Taylor Highway (63°
23° N Lat, 142° 40' W Long), Alaska, from silt, sand, and fine granite rubble 55 ft below top of 75-ft bluff. Coll. 1961 and subm. by A. T. Fernald. Comment (A.T.F.): date is minimum for aggradation.

**Riverside bluff series, Alaska**

Wood and organic material from 115-ft bluff (Riverside bluff) along Tanana River near Bitters Creek (63° 10' N Lat, 142° 06' W Long), Alaska. Coll. 1959, 1961 and subm. by A. T. Fernald. Comment: samples date major aggradation. W-979 and W-1167 bracket deposition of uppermost part of section; W-976 dates base of section.

**W-979. Tree stump**

Coll. ¼ mi back from bluff face, along deep valley, 9.7 ft below top of bluff. In 8-in. organic layer that overlies and underlies silt, sand, organic material, and fine granite rubble with volcanic ash near top. These units overlie dune sand.

**W-1167. Peat and wood**

Peat and woody material 16 ft below top of same bluff from 1-in. layer within silt, sand, organic material, and fine granite rubble.

**W-1174. Organic debris**

Fine organic debris from 45 ft below top of same bluff within thick section of stratified silt, sand, and fine to coarse rubble overlain by dune sand.

**W-976. Wood**

Wood from basal section of bluff, in 2.5-ft layer of muck unconformably overlain by thick section of stratified silt, sand, and fine to coarse rubble.

**W-1075. Slana—Tok area, Alaska**

Wood from small pit E side of dissected fan about 1½ mi W of Mineral Lake, Mile 88.4 Tok Cutoff section of Glenn Highway (62° 56' N Lat, 143° 25' W Long), Alaska. Two organic zones are interbedded in angular sandy gravel, upper zone ca. 5 ft and lower zone ca. 12 ft below surface. Vertical tree stumps as much as 6 ft high and 12 in. in diam (larger than modern trees) extend upward through gravel from each zone. Sampled wood is from vertical member of lower zone. Coll. 1958 by O. J. Ferrians, Jr., and H. R. Schmoll; subm. and interpreted by H. R. Schmoll. Comment: dates inundation of a forest by renewed fan deposition, possibly during “lesser ice age”—Tunnel II glacial advance of Karlstrom (1960).

**W-968. Southeastern Copper River Basin, Alaska**

Peat from top of morainal hillock 9 mi E of Chitina (61° 31' 04" N Lat, 144° 10' 15" W Long), Alaska, from lentil in sand overlying silty sand with an 18-in. soil, and underlying gravelly silt with a thin soil and 18 in. of peat. Coll. 1958 and subm. by D. R. Nichols. Comment (D.R.N.): dates deposition that followed a long period of stabilization.
W-969. **Southeastern Copper River Basin, Alaska**  
\[38,000\]

Partially decomposed, iron-stained spruce (?) log from pit in terrace gravel at Mile 103.9 Richardson Highway, 2 mi N of Copper Center (62° 59' 20" N Lat, 145° 20' 00" W Long), Alaska. From near base of coarse sand and gravel; underlain by coarse sand and gravel and overlain by a boulder bed, sand and gravel, with iron staining, and with twigs and worn pieces of wood. Coll. 1958 and subm. by D. R. Nichols. *Comment* (D.R.N.): dates outwash or alluvium antedating last major glaciation.

**Sullivan Creek series, Alaska**

Wood from drain at SE corner of Sullivan placer pit (65° 05' N Lat, 150° 53' W Long), central Alaska. Stratigraphy, top to base: (A) peaty silt; (B) channel deposits sand and fine gravel; (C) peaty silt; (D) pebble gravel; bedrock. Coll. 1959 to 1961 by Bond Taber and D. M. Hopkins; subm. by Hopkins. *Comment*: a fossil tundra rodent fauna, and bones of extinct large mammals including horse, bison, and mammoth were found in Units A and B. Dates indicate that fossils were deposited in present positions very recently, but must originally have been derived from upper Pleistocene sediments in immediate area (Repenning and others, in press).

W-1108. **Sullivan Creek, birch log**  
\[6730 \pm 260\]

Beaver-gnawed wood from (A) (W-733, USGS V, 6820 ± 200 from same horizon).

W-1113. **Sullivan Creek, base of unit**  
\[38,000\]

Wood from 1 ft above base of (A).

W-1106. **Sullivan Creek, spruce stump from (B)**  
\[<200\]

W-1111. **Sullivan Creek, beaver-chewed wood (B)**  
\[<200\]

W-937. **Sullivan Creek, wood from (B)**  
\[200 \pm 200\]  
A.D. 1750

From same horizon as W-891, USGS VI, 2520 ± 200.

W-1170. **Tanana River Valley, Alaska**  
\[6930 \pm 300\]

Organic silt from 4-in. bed 15 ft down from top of 40-ft bluff at junction of Porcupine Creek and Tanana River (63° 23' N Lat, 142° 41' W Long), Alaska. Upper part is wind-blown silt with 3 in. of volcanic ash 1.5 ft below top; lower part is stratified sand and granite rubble. Coll. 1961 and subm. by A. T. Fernald. *Comment* (A.T.F.): dates of the ash (Fernald, 1962) are 1520 ± 100 (I-276), 1750 ± 110 (I-275), and 2000 ± 250 (W-978, this date list). Upper section of bluff is bracketed by dates of W-1170 and of the ash.

W-975. **Tangle Lakes area, Alaska**  
\[9720 \pm 320\]

Compressed twigs and branches at base of sandy bed in exposure on N bank of Rock Creek, about 2000 ft above its mouth in Tangle Lakes (63° 02' 36" N Lat, 146° 03' 40" W Long), Alaska. Bed consists of laminated sand with organic zones; it is overlain by massive sand with organic and oxidized zones,
and overlies sand, silt, and clayey silt, and, at river level, gravel. Coll. 1960 and subm. by D. R. Nichols. *Comment* (D.R.N.): sample probably is part of a lake filling in ice-contact deposits of last major glaciation.

**W-1212. Tenmile Creek, Alaska**

12,400 ± 450
10,450 B.C.


**W-1173. Tetlin River, Alaska**

6170 ± 300
4220 B.C.

Wood fragments from along Tetlin River, 2 mi SW of Tetlin Village (63° 07' N Lat, 142° 34' W Long), Alaska, 9.5 ft below top of bluff, in sand and gravel overlain by lacustrine silt and clay. Coll. 1959 by A. T. Fernald. *Comment* (A.T.F.): dates floodplain development and antedates a pond or lake.

**W-1171. Tetlin Village, Alaska**

1550 ± 300
A.D. 400

Peat from 5-ft bluff bordering lake in flatlands along Kafukna River, 2.5 mi SE of Tetlin Village (63° 07' N Lat, 142° 28' W Long), Alaska, from peat layer, 2.5 ft below top of bluff, overlying sand and underlying lacustrine silt and clay. Coll. 1961 and subm. by A. T. Fernald. *Comment* (A.T.F.): dates pond or lake.

**W-1209. Scottie Creek Lodge, Alaska**

3120 ± 250
1170 B.C.

Organic silt from road cut along Alaska Highway in re-entrant valley on side of bedrock hill, 2 mi W NW of Scottie Creek Lodge (62° 41' N Lat, 141° 07' W Long), Alaska. From 3 ft below top, in irregular zone within reworked windblown silt and fine rubble on E side (leeward) of bedrock spur. Volcanic ash lies near top. Coll. 1961 and subm. by A. T. Fernald. *Comment*: dates of the ash (Fernald, 1962): 1520 ± 100 (I-276), 1750 ± 110 (I-275), and 2000 ± 250 (W-978, this date list). Upper section is bracketed between date of 1209 and that of the ash.

**W-1086. Upper Susitna River area, Alaska**

3510 ± 250
1560 B.C.

Stump from base of peat bed exposed on W tributary of lower Nowater Creek (63° 03' N Lat, 147° 23' W Long), Alaska. Peat underlies volcanic ash and organic zones in silt 5 ft below terrace surface, and is thought to overlie till. Till forms hummocky ground moraine behind a major end moraine of last major glaciation. Coll. 1953 by D. M. Hopkins; subm. and interpreted by D. R. Nichols. *Comment*: probably dates alluviation that occurred long after last major glaciation, rather than near-minimum date of retreat, as previously thought.

**W-980. Upper Tanana River Valley, Alaska**

10,230 ± 300
8280 B.C.

Brown peat from 40-ft bluff along Tanana River (63° 05' N Lat, 141° 59' W Long), Alaska. Peat layer, containing aquatic shells, is 14 ft below top of
bluff and is overlain by lacustrine silt with shells, sand, and granitic grit and overlies sand. Coll. 1959 and subm. by A. T. Fernald. Comment: dates lake that existed here ca. 25 ft above present river.

W-978. Upper Tanana River Valley, Alaska 2000 ± 250 50 B.C.

Peat from low floodplain terrace along Tanana River (63° 08' N Lat, 142° 06' W Long), Alaska. Peat, in alluvium, immediately underlies Capp's ash 2.5 ft thick, and more peat and alluvium. Coll. 1959 and subm. by A. T. Fernald. Comment: dates formation of Tanana River floodplain and is maximum age for Capp's ash (Fernald, 1962).

Clear Creek series, Kuskulana River, Alaska

Wood from three different discontinuous lenses in a 125 ft high river bluff ¼ mi SW of mouth Clear Creek along NW side of Kuskulana River (SW1/4, SE1/4, sec. 29, T 3 S, R 9 E, Copper River Meridian, McCarthy C-3 1:63,360 scale quadrangle) (61° 34' 39" N Lat, 143° 48' 45" W Long), Alaska, 21 mi ENE of Chitina, Alaska. Partial section: (C) moss and peat; (B) outwash gravel and sand with wood near base; (A) lacustrine silt with organic matter near top. Coll. 1961 by L. A. Yehle; subm. 1962 by L. A. Yehle. Comment (L.A.Y.): deglaciation following last major glacial maximum created a lake behind a moraine. W-1247 dates closing stages of the lake. W-1246 is minimum date for post-lake outwash. Vegetation was established on the outwash before date of sample W-1156. Accumulation of surficial peat on floor of master Chitina Valley began before 4300 ± 300 yr B.P. (W-1159, this list).

W-1156. Wood from near base of Unit C 1420 ± 280 A.D. 530

W-1246. Wood from near base of Unit B 3890 ± 300 1940 B.C.

W-1247. Wood from top of Unit A 7010 ± 350 5060 B.C.

E. Miscellaneous

W-949. La Paz, Bolivia >38,000

Lignitic material from Purapurani Formation from best exposed section in upper part of La Paz River valley (16° 30' S Lat, 68° 25' W Long), La Paz, Bolivia. Section, from top to bottom, is as follows: Milluni Drift; Purapurani Formation; Calvario Drift; Chijini Ash; La Paz Formation. Coll. 1960 by Ernest Dobrovolny and R. W. Lemke; subm. by Ernest Dobrovolny. Comment: section will become the type from the Pleistocene of Bolivia.

W-948. Puerto Montt, Chile 15,400 ± 400 13,400 B.C.

Wood from road cut along shore near East Pelluco Creek, 3 km SE of Puerto Montt (41° 31' S Lat, 73° 30' W Long), Chile (Dobrovolny and Lemke, 1961). Coll. near base (1 m above road) of lacustrine laminated silt and clay underlain by gravel and locally by till. Coll. 1960 by R. W. Lemke and Ernest Dobrovolny; subm. by R. W. Lemke. Comment (R.W.L.): sample is related to latest glaciation of area.
W-1023. Gernmuhle am Sammerberg, Germany  >35,000

Compressed peat from re-entrant of slope above E side of canyon of Inn River where it debouches onto Alpine foreland at alt 585 m, Gernmuhle am Sammerberg, Oberbayern (47° 40' N Lat, 12° 15' E Long), Germany. Sample coll. from peat at base of lake clay (varved in part) that are overlain by Hauptwurm till and Wurm recessional deltaic gravel. Coll. 1960 and subm. by G. Richmond.

W-1008. Grossweil, Germany  >38,000

Wood from Grossweil near Kochel See, Oberbayern (47° 40' N Lat, 11° 20' E Long), Germany, from upper 2-ft layer of compressed peat and wood underlying gravel beneath Wurm till. Layer overlies, successively, clay, lower peat layer, sand and gravel, and Riss (?) till. Pollen of upper layer suggests Wurm glaciation, that of lower layer a cool Riss/Wurm interglacial (Reich, 1953). Coll. 1960 and subm. by G. Richmond.

W-1002. Hormating, Germany  >38,000

German alpine foreland compressed wood from Hormating, Oberbayern (47° 55' N Lat, 12° 00' E Long), Germany, from peat bed at base of water-laid silt that overlies Laufen gravel and is overlain by upper Laufen gravel, in drumlin covered with Hauptwurm till (Ebers, 1960). Coll. 1960 and subm. by G. Richmond. Comment (G.R.): peat may not be in same stratigraphic position as that from this locality dated 45,300 ± 1000 (Gro-2593). In another part of exposure a layer of soil reworked by solifluction separates upper from lower gravel. Peat is believed to be slightly younger than soil layer.

North Greenland series

Marine shells and driftwood from emerged marine terraces along E and NE of Greenland from Hekla Sund (80° N) to N end of Greenland. Coll. 1957, 1960 and subm. by W. E. Davies. Comment (W.E.D.): well-developed marine terrace systems show variations in crustal uplift with maximum uplift extending from western Independence Fjord SE to Ingolf Fjord, parallel to and about 50 mi beyond the present front of the Greenland Ice sheet. Uplift in the Independence Fjord area is about 265 ft, dropping to 190 ft in the Ingolf Fjord area. The isobasic gradient SW of the maximum is 4 to 5 ft per mi; to the N it is 1 ft per mi with maximum uplift of 30 ft or less along the Arctic Ocean.

W-1072. Ingolf Fjord

Marine shells, primarily Hiatella arctica and Mya truncata, from marine terrace, 2 mi S of Naesen, Ingolf Fjord (80° 25' N Lat, 20° 07' W Long), NE Greenland. Shells were from upper 4 ft of marine silt at alt ca. 175 ft.

W-1063. Danmark Fjord

Marine shells, Hiatella arctica, 1 mi N of Kap Renaissance on marine terrace at alt 135 ft (81° 05' N Lat, 21° 50' W Long), N Greenland. From uppermost 4 ft of marine clayey silt.
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W-1066. Station Nord 4200 ± 320 2250 B.C.
Driftwood from marine terrace adjacent to airstrip at Station Nord (81° 36' N Lat, 16° 41' W Long), N Greenland; imbedded in gravel at alt 20 ft.

W-1073. Brønlund Fjord 4970 ± 260 3020 B.C.
Driftwood from alt 35 ft on surface of marine terrace, 2 mi NE of Kap Harald Moltke (82° 10' N Lat, 29° 50' W Long), E end of Brønlund Fjord, N Greenland. Terrace is formed of silt with thin veneer of stones.

W-1067. Kap Clarence Wyckoff, 30 ft 6100 ± 1000 4150 B.C.
Marine shells, Hiatella arctica, SE side of Kap Clarence Wyckoff (82° 48' N Lat, 22° 58' W Long), N Greenland, imbedded in gravel at alt 30 ft.

W-1076. Kap Clarence Wyckoff, 25 ft 6880 ± 300 4930 B.C.
Marine shells, primarily Hiatella arctica, from N side of Kap Wyckoff from storm ridge of beach (82° 50' N Lat, 23° 00' W Long), N Greenland, imbedded in gravel at alt 30 ft.

W-1083. Kap Clarence Wyckoff, 40 ft 7060 ± 300 5110 B.C.
Marine shells, Hiatella arctica and Mya truncata, from locality of W-1076 at alt 40 ft.

W-1084. Depot Bay 5980 ± 300 4030 B.C.
Marine shells, primarily Hiatella arctica, on marine gravel beach at alt 53 ft 300 ft E of head of Depot Bay, Frederick E. Hyde Fjord (83° 08' N Lat, 26° 25' W Long), N Greenland.

W-1090. Kaffeklubben, Ø, 35 ft 7730 ± 400 5780 B.C.
Marine shells, Hiatella arctica, from NE side of Kaffeklubben Ø at alt 35 ft (83° 36' N Lat, 30° 30' W Long), N Greenland, imbedded in gravel on small marine terrace.

W-1088. Kaffeklubben, Ø, 10 ft 1200 ± 300 A.D. 750
Shells, primarily Mya truncata and Astarte elliptica, from uppermost 2 ft of marine silt in marine terrace at S end of Kaffeklubben Ø, alt 10 ft (83° 36' N Lat, 30° 30' W Long), N Greenland.

Kau series, Hawaii

Fragments of charcoal coll. on Mamalahoa Highway, 0.5 mi SW of Kau boundary of Hawaii Natl. Park (19° 21' 54'' N Lat, 155° 23' 06'' W Long), Island of Hawaii, in sandy, silty ash in uppermost 6 in. of Pahala ash, the principal marker bed of Island of Hawaii, overlain by black sandy ash. Coll. 1956 and subm. by G. A. MacDonald, Univ. of Hawaii, Honolulu. Comment (G.A.M.): it was believed that samples were from same horizon, but either W-1046 must have come from lower in the section or W-1047 was contaminated with younger C.
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W-1046. Charcoal, early collection 4030 ± 350
2080 B.C.
Coll. 1926 by T. A. Jaggar and W. C. Mendenhall; subm. by G. A. MacDonald.

W-1047. Charcoal, later collection 600 ± 250
A.D. 1350

Pianico-Sellere series, Italy

Wood and mard from Pianico-Sellere, NW of Lago d’Isco, at foot of Alps (45° 50’ N Lat, 10° E Long), N Italy, from lower part of Riss/Würm interglacial lake marl (coll. at stream level) containing leaves of box, apple, rhododendron, sycamore, and hornbeam. Marl is overlain by Würm till and grades laterally into sliderock and fan alluvium on valley slopes. Coll. 1960 and subm. by G. Richmond.

W-1009. Wood >38,000

W-1010. Marl >35,000

W-1166. Sperlonga, Italy 1650 ± 350
A.D. 300

Charcoal from a hearth in cave above Via Flacca and Galleria Capovento near Sperlonga, Province of Latina (41° 20’ N Lat, 13° 30’ W Long), Italy. Sample was coll. on surface of cave deposit consisting of cultural complexes belonging to neoeolith (Segre and Ascensi, 1956; Alciati and Natali, 1962). Coll. 1958 and subm. by A. Ascensi, Citta Univ., Rome, Italy. Comment (A.A.): C14 date, too young by several thousand years, indicates that material of Sperlonga cave has been reworked. Sample was dated as cross-check on obsidian dating method.

Panama Canal Zone series, Panama

Black organic muck and wood from Canal Zone, Panama (Woodring, 1957), coll. from core holes within Pleistocene muck, generally saturated with water. Coll. 1957 and 1958 by R. H. Stewart; subm. by W. P. Woodring.

W-958. Core Hole BBR-53, depth 32.7 ft 6720 ± 300
4770 B.C.
Black organic muck from W side of Pacific entrance of Panama Canal, 0.6 mi WNW of Point Farfan (8° 56’ N Lat, 79° 34’ W Long), Canal Zone, from 13.7 ft below top of Pleistocene muck which is 32.5 ft thick.

W-959. Core Hole BBR-125, depth 73.2 to 7680 ± 300
73.5 ft
5730 B.C.
Black organic muck from E side of Pacific entrance of Panama Canal, 0.3 mi E of terminus of Thatcher Ferry (8° 57’ N Lat, 79° 34’ W Long), Canal Zone, from 4.8 to 5.1 ft above base of Pleistocene muck which is 34.7 ft thick.

W-960. Core Hole 2, depth 35 ft 7240 ± 300
5290 B.C.
Wood from Mindi Road Bridge Exploration Core Hole 2, depth 35 ft, Mindi Dairy Farm, 0.15 mi E of Bolivar Road, 4 mi S of Colon (9° 18’ N Lat,
79° 54' W Long), Canal Zone, from 5 ft below top of Pleistocene muck which is 10 ft thick.

*General Comment*: samples record rate of sealevel rise, as sediment is believed to represent basin filling. Rates and depths agree with results from similar samples from Gatun Lake (UCLA 183, 184, 185, 186, UCLA II) and compares favorably with studies along Atlantic coast.

**W-1036. Rio Grande de Manati, Puerto Rico**

3300 ± 300

1350 B.C.

Carbonized wood from black organic muck from E side of Rio Grande de Manati, near Punta Manati (18° 29' N Lat, 66° 31' W Long), Puerto Rico, from two logs ca. 6 ft below water level (approx. sealevel) and ca. 10 ft below land surface. Logs were in black organic muck which formed in old river channel. Coll. 1959 and subm. by R. P. Briggs. *Comment* (R.P.B.): because deposits in which logs were found are associated with alluvium near present sealevel and with existing swamps, deposition took place after Puerto Rican land mass assumed its present position relative to sealevel.

**W-1035. Ishigaki, Ryukyu Islands**

8500 ± 600

6550 B.C.

Mamal bones probably from domesticated pig, from Todorokigawa fossil site, Ishigaki-shima (24° 30' N Lat, 124° 15' E Long), Ryukyu Islands, from stream terrace of silt built onto a nip in the post-Miocene limestone cliffs. Sediments contain layers of small land snails and mammal bones. Since deposition, the river has cut down 40 ft. Coll. 1956 by Helen L. Foster and H. G. May; subm. by F. C. Whitmore. *Comment*: this may be one of earliest examples of domestication. Same locality was dated by bones (W-588, 8500 ± 500, USGS V) previously; this sample was run as a check.

**Saudi Arabian ground water series**

Bicarbonate and CO₂ extracted from deep well water from Saudi Arabia, analyzed to determine rate of recharge. Samples are part of series of well waters previously dated (W-887 to 889, 894, 904, USGS VI) and discussed (Thatcher, Rubin, and Brown, 1961). Coll. 1960 by Arabian-American Oil Co.; subm. by G. F. Brown. *Comment*: W-953 agrees with ages of other samples of series, representing charging of aquifers by high rainfall of pluvial occurring at climax of Wisconsin Glaciation. W-955, however, must represent later recharge.

**W-953. Jalamid**

21,500 ± 1500

19,550 B.C.

Well water from tapline WW 5A-2, in area of Jalamid (31° 17' N Lat, 40° 05' E Long), Saudi Arabia, depth 1161 to 1431 ft in sandstone thought to be of Cretaceous age; water, 86° F.

**W-955. Wadi al Batin**

6300 ± 1000

4350 B.C.

Well water from Tapline WW 3-5, in area of Wadi al Batin (28° 22' N Lat, 45° 56' E Long), Saudi Arabia, depth 190 to 345 ft in sand of Miocene age.
Kingston series, South Australia

Fine-grained mixture of dolomite and calcite from Lagoon M, N of Kingston (36° 40' S Lat, 139° 54' E Long), South Australia (Alderman and Skinner, 1957). Coll. 1957 by H. C. W. Skinner; subm. by B. J. Skinner. Comment: samples are believed to be primary precipitates from saline lake water. Age equivalents indicate accumulation rate of ca. 0.2 mm of carbonate sediment per yr (Skinner, Skinner, and Rubin, 1963). No C\textsuperscript{13} measurements made, no Δ estimate given.

W-1101. Carbonate, 1 to 2 in. interval \( \delta C_{14} = -75\% \)
Calcite and dolomite from interval 1 to 2 in. below surface. Age equivalent to less than 600 yr. Small sample.

W-1100. Carbonate, 19 to 20 in. interval \( \delta C_{14} = -312 \pm 75\% \)
Calcite with some dolomite from interval 19 to 20 in. below surface. Age equivalent to 3000 ± 600 yr. Small sample.

W-1016. Taipei, Taiwan \( 4800 \pm 300 \) yr
Dried, porous, carbonized wood plus smaller, flatter carbonaceous remnants of wood from water purification site S side of Taipei, along margin of former lake (25° 01' N Lat, 121° 32' E Long), Taiwan, from mud ca. 3 m below surface. Coll. 1960 and subm. by Sam Rosenblum. Comment (S.R.): uppermost portion of the Taipei Basin lake deposits is related to a lake formed by volcanic mudflow now standing as a water gap between basin and Taiwan Strait. Date is minimum for mudflow that may represent last mobile volcanism in area.

References

Date lists:

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| USGS IV | Rubin and Alexander, 1958 |
| USGS V | Rubin and Alexander, 1960 |
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UNIVERSITY OF ROME CARBON-14 DATES II

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A first list of datings by our laboratory was published in 1957 (Bella and Cortesi, 1957). The measurements were performed with a solid Carbon counter (Ballario et al., 1955). Between the beginning of 1958 and December 1961 laboratory apparatus was completely renewed and proportional gas-counters were introduced. At present four counters are available. Measurements are carried out with CO₂ at 3 atm pressure.

Only two counters have been used for datings, the first one of 1.5 L, a model already described (Bella and Cortesi, 1960), with present background 3.66 ± 0.11 counts/min, and counting rate for modern carbon 30.56 ± 0.18 counts/min. The characteristics of the second one are efficient volume 1 L, length of wire 360 mm, diam of wire 0.05 mm, internal diam of the counter 60 mm, supply voltage 8,600 volts, background 12.88 ± 0.14 counts/min, counting rate for modern carbon 30.65 ± 0.18 counts/min. The high background of this counter is due to the insufficient length of the G.M. anticoincidence counters. In fact, the counter was designed for insertion in a particular circuit for the purification of the filling gas. This circuit is still at an experimental stage and will be described in a forthcoming paper. The shielding is the same as that used in the 1.5 L counter. The dates obtained with the two counters agree completely within the errors.

Three new independent channels of electronic recording have been built; they are similar to the one already described (Bella and Cortesi, 1960) except that a few modifications have been introduced to provide greater stability of the pulse length.

Some minor modifications in the way CO₂ is prepared have been introduced; purest CO₂ is obtained by means of the purification method already described (Bella and Cortesi, 1960) combined with initial precipitation as CaCO₃ of the CO₂ resulting from the combustion of samples.

All samples undergo standard pre-treatment by boiling with 2 to 5% HCl. If necessary, an additional leaching with 6% NH₄OH is made, followed by a new HCl treatment of the sample, which is finally washed with distilled water.

In accordance with the instructions of the editors, ages have been calculated using Libby’s half-life average for C¹⁴ 5568 ± 30 yr with 1950 as the standard year of reference. A modern wood grown near Rome between 1949 and 1953 has been used as modern standard. Its activity was checked by measurements of known age samples and judged satisfactory.

The list comprises age measurements carried out between January 1962 and July 1963; the samples dated are of archaeological and geological interest and are almost exclusively drawn from Italian territory.
ACKNOWLEDGMENTS

We wish to express our thanks to the Consiglio Nazionale delle Ricerche which has provided partial financial support. The help of Dr. Fiorella Bachechi, an assistant in our laboratory, in carrying out measurements is gratefully acknowledged.

SAMPLE DESCRIPTIONS

1. CROSS-CHECK SAMPLES

R-1. Lake of Nemi, Italy

Externally charred wood from remains of one of two Roman vessels that, until 1927, were lying at the bottom of the Lake of Nemi, Alban Hills, near Rome (40° 43' N Lat, 12° 42' E Long). As a result of warfare in the neighbourhood in May 1944, a fire broke out, destroying the lakeside museum housing these vessels, of which only a few timber beams survived. Through the interest and with the authorization of the Soprintendente alle Antichità Roma I, S. Aurigemma in 1952, and of his successor, P. Romanelli in 1954, two pieces of wood from the same beam were submitted to our lab. The wood in question is Pinus (probably Pinus laricio) and in an excellent state of preservation. In the section 30 tree-rings were visible but these do not establish the age of the tree owing to absence of central portion and the combustion of outer part. Comment: historical date of this wood is known since construction of ships can be assigned with fair certainty to the reign of Caligula (A.D. 37 to 41). In 1955 it was distributed by our lab. as a cross-check sample, after being dated several times with a solid carbon counter, the average of six measurements being 2125 ± 75 (Bella and Cortesi, 1957). The date given above is closer to the historical age and was measured with a CO₂ proportional counter. Dates obtained by other labs.: T-9, 1880 ± 130 (Nydal and Sigmond, 1957); St-103A/B, average: 2010 ± 65 (Stockholm I); BM-15, 2080 ± 150 (British Museum I); Q-112, 1904 ± 95 (Cambridge I); U-68, 1980 ± 70 (Uppsala I). A preliminary date (2290 ± 100 yr) was obtained by the Radiocarbon Dating Lab., Inst. of Applied Sci. of Victoria, Australia (Focken, 1960).

R-64. Ruds Vedby

Wood from a thin dark layer of peaty lake mud forming pollen zone boundary II/III, Allerød-Younger Dryas; Ruds Vedby, Zealand, Denmark (55° 32' N Lat, 11° 22' E Long). Comment: distributed by H. Tauber as cross-check sample (K-101) and dated by many European labs. and by USGS lab. Dates obtained range from 10,200 to 11,500 yr: K-101bis, K-102bis, K-103bis, average: 11,030 ± 200 (Copenhagen III); Gro-454, 10,995 ± 250 (Groningen II); St-18, 10,200 ± 370 (Stockholm I); U-20, 10,830 ± 130 and U-75, 10,680 ± 130 (Uppsala I); H-105, 11,500 ± 300 (Heidelberg I); BM-19, 11,333 ± 300 (British Museum I); W-82 and W-84, average: 10,400 ± 160 (USGS I). Ages obtained by U. S. Geol. Survey are reckoned too young. Our measurement results in a somewhat older age comparable only with that obtained by Heidelberg. The boundary between the phase of Allerød and Younger-Dryas has been fixed, especially by Copenhagen and Groningen dates, around 11,000 yr.
R-106. Usselo

Wood (Betula) found in peat from the section near Usselo (52° 10' N Lat, 6° 50' E Long), province of Overijssel, Netherlands. Sample given us by Hl. De Vries at Groningen in November 1957. Belongs to same level as samples Gro-933 and Gro-948 (Alleröd phase) and, like them, was obtained during Usselo 1955 excavations by C. C. W. J. Hijszeler, Rijksmuseum Twenthe, Enschede. Comment: the Usselo section corresponds to Profile B of van der Hammen (van der Hammen, 1951) (Groningen II). In the succession of layers made up of moss peat mixed with dune sand, pollen analysis has allowed identification of zones belonging to well-known succession of late Würm stadials and interstadials already distinguished in Denmark: Oldest Dryas—Bölling—Older Dryas—Alleröd. Sample R-106 belongs to Alleröd phase, and date obtained agrees well with Gro-933, 11,875 ± 120 and Gro-948, 11,515 ± 120, average: 11,700 ± 90 (Groningen II). Samples from section near Usselo, corresponding to the van der Hammen profile and Alleröd phase, but obtained during preceding excavation campaign and submitted in 1951 by R. D. Crommelin, have been dated by Yale Lab. Y-139/1/2/3 (Yale III). The whole Usselo series has been dated also by Copenhagen Lab., samples K-541 to K-547, K-552 and K-553 (Copenhagen IV). Dates obtained at Copenhagen agree well with those of Groningen.

II. ARCHAEOLOGIC SAMPLES

A. Italy

R-83. Palidoro

Charred bones from lower level of Palidoro deposit, Via Aurelia, 30 km W of Rome (41° 55' N Lat, 12° 11' E Long). Coll. and subm. by V. G. Chiapella, Ist. Italiano di Paleontologia Umana, 1956. Excavation between 1956 and 1959 at N edge of a travertine quarry revealed archaeological layers containing in the higher levels bones of domestic animals and potsherds belonging to the Middle Age, the Roman period, the Iron and Bronze Ages and Middle Neolithic period. A bone-breccia with charred bones (Bos, Equus, Cervus, Sus) containing flint implements of a fine Upper Paleolithic industry of Gravettian type formed the lower level and was considered to be part of a deposit in a small cave or shelter destroyed by quarry-working (Chiapella, 1956 and 1962). Comment: owing to the plentiful supply of charred bones only bits of compact bone tissue, less liable to contamination, have been used for dating purposes. After careful washing, the bone’s mineral components were completely destroyed by repeated treatment with 10% HCl; measurement was carried out on blackish humic matter which was wholly soluble by 6% NH4OH. The calculated age agrees with the type of industry at this level.

R-58. Grotta Romanelli

Charcoal found at ca. 30 cm below surface in upper Level A of the “terra bruna” formation of the deposit in Grotta Romanelli, Costiera Salentina, 2 km from Castro toward S. Cesarea, province of Lecce, Apulia (40° 01' N Lat, 18° 24’ E Long). Coll. and subm. by the late A. C. Blanc and L. Cardini,
Ist. Italiano di Paleontologia Umana, 1954. Comment: fresh excavation carried out in Grotta Romanelli to collect series of “terra bruna” samples in unexplored area of the formation so as to use the humus for dating purposes. Since “terra bruna” contains industry of the Romanellian culture of Upper Palaeolithic Age, charcoal resulting from human activity was carefully looked for and found. According to G. A. Blanc’s interpretation (Blanc, G. A., 1920, 1928; Blanc and Cortesi, 1941), the “terra bruna” and underlying “terra rossa” of the deposit were brought into the cave by the wind from the coastal plain, which at that time stretched out in front of the cave, remaining unchanged till the present day. The two formations are, then, termed “palaeosols” since they represent two types of climatic soil appearing successively in this area. The idea occurred of dating the “terra bruna” by means of the humus extracted from it (Blanc, A. C. and Blanc, G. A., 1958). Dating of humic acids at intermediate Level B of the “terra bruna” was carried out by this lab. with a solid-carbon counter (R-56, 11,960 ± 320); the method of humus extraction has been described and the age commented on (Bella, Blanc, A. C., Blanc, G. A., and Cortesi, 1958). The agreement with the age obtained for sample R-58 (charcoal) is particularly significant as the charcoal does not belong to the soil but was deposited contemporaneously with it. Moreover, the age is that expected for Romanellian culture.

A number of charcoal samples from levels A, C, and D of the “terra bruna,” also found during 1954 excavation, have been dated at Groningen: A2, GrN-2056, 9880 ± 100; A3, GrN-2305, 10,320 ± 130; C1, GrN-2153, 10,390 ± 80; C2, GrN-2154, 9790 ± 80; D, GrN-2055, 10,640 ± 100 (Groningen IV). Ages obtained at Groningen are in every case younger than those of our lab., and all but one (GrN-2154) follow the stratigraphical order.

Grotta del Pertusello series

Excavation of the Grotta del Pertusello deposit, Val Pennavaira, province of Savona, Liguria (44° 06’ N Lat, 7° 59’ 16” E Long) was begun by V. G. Chiappella and concluded by M. Leale Anfossi, Ist. Italiano di Paleontologia Umana. Samples coll. in 1957 and 1958 and subm. at that time by M. Leale Anfossi. Throughout the deposit numerous hearths have been found together with charred bones of domestic and wild animals and ash-heaps. Three layers (II, III, IV) have been identified, containing pottery that can be assigned to late Neolithic (Layer IV) and the Iron Age (upper Layers III and II). Only at Layer IV were flint implements found (M. Leale Anfossi, 1958-61a,b). The Grotta del Pertusello (No. 304 in the “Catalogo Speleologico Ligure”) is the first of numerous Ligurian prehistoric settlements to be dated.

R-113. Pertusello II

Charcoal, 10 to 38 cm below surface. Brownish earth with coarse corded pottery of Iron Age.

R-114. Pertusello III

Charcoal, 38 to 63 cm below surface. Light-brown earth, with polished pottery of “Lagozza” type of Late Eneolithic.
R-122. Pertusello IV

Charcoal 63 to 70 cm below surface. Grey ash with whitish clay, containing pottery with hemispheric bottom and cardial decoration, and flint blades of Upper Neolithic. 

General Comment: the ages obtained seem to agree with those expected for industries discovered in the layers.

R-78. Lagozza di Besnate

Part of a Neo-Eneolithic wooden pile from the Lagozza di Besnate, province of Varese, Lombardy (45° 42' N Lat, 8° 46' E Long). Coll. 1953 and subm. 1956 by O. Cornaggia-Castiglioni, Soprintendenza ai Monumenti, Milan. Comment: in this area the lake dwellings excavated and illustrated by O. Cornaggia-Castiglioni (Cornaggia-Castiglioni, 1955) revealed a typical Upper Neolithic culture (Lagozza Culture). Another pile sample from same area has been dated at Pisa: Pi-34, 4794 ± 90 (Pisa II).

R-66. Grotta del Fauno

Powdered charcoal and minute charcoal fragments from a lime-mould forming a bed, 50 cm thick, underlying rubble layer, 1.5 m thick, of deposit in Grotta del Fauno, Parco Nazionale degli Abruzzi, 13 km SE Pescasseroli (41° 44' N Lat, 13° 50' E Long). Deposit made up of rubble with bed of charcoal and ash. Upper part is of Roman period; lower part contains pre-Roman and Iron Age pottery. Bottom of deposit not yet explored. Coll. and subm. 1955 by A. M. Radmilli, Ist. di Antropologia e Paleontologia Umana, Univ. of Pisa. Comment: charcoal taken from upper section of pre-Roman stratum has been dated at Pisa, Pi-1, 2318 ± 105 (Pisa II).

R-29A. Grotta Polesini

Charcoal from the Grotta Polesini deposit on bank of river Aniene, Ponte Lucano, near Tivoli, Lazio (41° 57' N Lat, 12° 46' E Long). Deposit contains Iron Age, Bronze Age and Upper Paleolithic levels with industry of Romanellian type (Radmilli, 1953). Charcoal subm. for dating was thought to be contemporary with latter level. Coll. and subm. 1953 by A. M. Radmilli. Comment: material is more recent than supposed, and probably belongs to a section deposited or altered by the river Aniene.

R-9. Grotta Misa

Charcoal from the Grotta Misa deposit, Ischia di Castro, province of Viterbo, Lazio (42° 30' N Lat, 11° 38' E Long). Charcoal found together with burnt beans and millet. A Late Bronze Age culture represented in the deposit by bronze objects and pottery. Excavated 1947 by L. Cardini, F. Rittatore and E. Tongiorgi; subm. 1951 by E. Tongiorgi, Lab. di Geologia Nucleare, Univ. of Pisa. Comment: charcoal from same deposit has been dated at Pisa Pi-54, 3030 ± 75 (Pisa II).
R-10. Etruscan ovens

Charcoal from Etruscan ovens, Valle del Temperino 1 km N Campiglia Marittima, province of Leghorn, Tuscany (43° 03' N Lat, 10° 10' E Long). Coll. 1936 and subm. 1951 by E. Tongiorgi. Comment: Commission for the study of Old Mine Working Activities of the Soprintendenza alle Antichità dell' Etruria, excavated six Etruscan ovens here in 1936. They were identified, through study of the slag, as copper manufacturing furnaces. Charcoal belongs to Quercus robur, Quercus cerris and Pyrus aucuparia (Tongiorgi, 1937). Other archaeological finds have afforded no sure indication of historical age (D'Achiardi e Stefanini, 1937). Date obtained corresponds to last phase of Etruscan civilization.

R-7. Lago di Ledro

Charcoal found next to Layer III under remains of stacked platform of lake dwellings in Lago di Ledro 7 km SE Riva del Garda, province of Trento (45° 51' N Lat, 10° 43' E Long) (Battaglia, 1953). Comment: part of wooden piling of lake dwelling dated in Pisa: PI-88, 3137 ± 105 (Pisa II).

R-3. Sarsina

Charred wood found during excavations of necropolis of Pian di Bezzo, Sarsina, province of Forli, Romagna (43° 56' N Lat, 12° 08' E Long). Subm. 1952 by S. Aurigemma, formerly Soprintendente alle Antichità, Roma I. Comment: necropolis belongs to Roman epoch and date obtained agrees with this.

R-63. Sardinia

Wood from oak beam thought to belong to structure of Sardinian Roman bridge (locality unspecified) and housed in Museo delle Navi Romane, Lake of Nemi, Rome. Subm. 1954 by P. Romanelli, formerly Soprintendente alle Antichità, Roma I. Comment: age obtained refutes attribution, the object being of recent date.

R-92A. Fiumicino

Portion of wooden pile forming part of foundations of Roman port of time of Emperor Claudius (41 to 54 A.D.) at Fiumicino, Rome (41° 46' N Lat, 12° 15' E Long). Subm. 1957 by G. Iacopi, Soprintendente alle Antichità Roma I. Comment: supporting piles and boards of a palisade came to light in sandy terrain at about 8 m depth during excavation directed by G. Iacopi. The pile in question was ca. 20 cm in diam, the inner part very well preserved, the outer part impaired to a depth of 5 to 8 cm. Hence two different samples were prepared: R-92A, wood from the impaired section, and R-92B, well-preserved wood. The identical ages obtained show that no contamination occurred in the impaired portion (see also R-22A and R-22B, this date list).
The archaeologists had thought piling and planking belonged to Roman port. However, some doubts expressed owing to excellent state of preservation of palisade. The two dates for the pile and that of a plank of the palisade (measured at Pisa, Pi-3A, 1863 ± 135; Pisa I), have cleared up all doubts.

**Roman Forum series**

Samples of varying interest have been found during excavations carried out at different times in the Roman Forum, Rome (40° 54' N Lat, 12° 27' E Long). Subm. 1952 by P. Romanelli and G. Caretoni, Soprintendenza alle Antichità, Roma IV, Foro Romano, and S. Puglisi, Soprintendenza alle Antichità, Roma V.

### R-17. Roman Forum 1

2120 ± 190
170 B.C.

Wood fragment of beam from roof of Basilica Emilia. Subm. by P. Romanelli and G. Caretoni. *Comment:* date obtained agrees with historical age of the building of the Basilica.

### R-19. Roman Forum 3

2600 ± 150
650 B.C.

Fragment of oak sarcophagus from a Roman Forum tomb belonging to the second Latial phase. Subm. by S. Puglisi. *Comment:* presumed historic age (ca. 580 B.C.) agrees with the date obtained.

### R-20. Roman Forum 4

2280 ± 250
330 B.C.

Wood from the foundations of Republican buildings near the Temple of Antonino and Faustina. Subm. by P. Romanelli. *Comment:* expected age: 2nd half of 1st century B.C.; date obtained agrees satisfactorily.

### R-21. Roman Forum 5

2360 ± 85
410 B.C.

Charred wheat and barley found in archaic well in area sacred to Vesta by A. Bartoli during the 1930 excavations (Bartoli, 1961) and subm. by S. Puglisi. *Comment:* the presumed historical age (ca. 550 B.C.) is in agreement with the date obtained.

### R-22A. Roman Forum 6a

2280 ± 90
330 B.C.

### R-22B. Roman Forum 6b

2260 ± 80
310 B.C.

Wood recognized as a beam from foundations of Temple of Divus Julius found during excavations by R. Camberini Mongevet and subm. by P. Romanelli. *Comment:* sample R-22A was taken from the impaired outer part of the wood, sample R-22B from the well-preserved inner part. Both samples were treated with 5% HCl (see R-92A and R-92B). The two dates coincide, but are somewhat older than the historical age expected (ca. 40 B.C.). It is thought that the foundations are likely to be older.

*General Comment:* the above samples, and pieces of charcoal from a layer in the road foundations of Sacra Via, dated at Stockholm (St-315, 2525 ± 75; Stockholm II), are the only materials from the different archaeological layers of the Roman Forum that have been dated as yet.
R-35. Asyut, Egypt

Shapeless fragment of wooden basket in excellent state of preservation forming part of statue bearing offerings, Asyut, Upper Egypt (27° 10' N Lat, 31° 10' E Long) lodged in Museo Egizio of Turin. Subm. 1954 by E. Scamuzzi, Soprintendente alle Antichità, Egittologia, Turin II. Comment: statuette is classified as belonging to Middle Dynasty, dated, according to new Egyptian chronology, 1800 to 2000 B.C. Date obtained agrees well with, and confirms, the expected historical age.

R-37. Egypt

Wooden fragment from coffin from Egyptian Ptolemaic period; original location in Egypt is not known. Sample used to belong to the Drovetti Collection at the Museo Egizio of Turin. Subm. 1954 by E. Scamuzzi. Comment: accepted age: 3rd to 4th century B.C.; date obtained agrees satisfactorily. Wood from another coffin of the Ptolemaic period has been dated by Libby: C-62, 2190 ± 450 (Chicago I), and the same sample was more recently dated by the Univ. of California: UCLA-109, 2360 ± 75 (UCLA I).

R-23. Philip Cave, Southwest Africa

Charcoal fragments, 2 to 3 cm in diam, found on surface, Philip Cave (Ameib) SE of Erogo Mountains, Windhoek region, SW Africa (ca. 22° 00' S Lat, 16° 20' E Long). Coll. 1950 and subm. 1952 by the late H. Breuil. Comment: owing probably to a spring that in the past had deposited calccareous tufa, this charcoal was so strongly lithified by CaCO₃ that the fragments had to be reduced to fine powder before the carbonate could be wholly eliminated by repeated treatment with 10% HCl. In spite of his doubts about such surface samples, H. Breuil asked for them to be dated since, as well known, the walls of Philip Cave are covered with paintings of great interest. Age obtained showed that the material was fairly recent. Another charcoal sample from Philip Cave was carefully taken during regular excavation and subm. by H. Breuil to the Chicago Lab. for dating: C-911, 3368 ± 200 (Chicago V). This date was accepted by H. Breuil (1954) as an indication of the age of the principal cycle of paintings in the cave.

C. Asia

Andaman Islands series, Indian Ocean

The Italian anthropologist and explorer, Lidio Cipriani, who died in October 1962, made several visits to the Andaman Islands between 1951 and 1955, carrying out risky but successful explorations for anthropological, ethnological, and palaeo-ethnological studies of the native Andaman population. The people, now nearly extinct, belong to the Asian group of pygmies or Negritos. As is well known, they are nomads and very fierce and primitive, still living today exclusively by hunting, fishing and food-gathering. Cipriani attached great importance to the excavation of the many kitchen-middens, evidently of different periods, that are widely scattered throughout the archipelago.
The nomadic populations made and abandoned these middens over an undefined and, it would seem, extensive period of time (Cipriani, 1955, 1958-61, 1962).

In August 1956, through G. A. Blanc, L. Cipriani subm. to our lab. charcoal samples that he had coll. at well-defined levels during the excavation of two kitchen-middens in 1953.

**R-84. North Andaman Island (Great Andaman)**

Charcoal found in midden in Maya Bander area (ca. 13° 15' N Lat, 93° 00' E Long), from Section II NS in deeper layer with *Arca*, extending downward to virgin soil ca. 2.5 m below surface level of excavation. Original depth of the layer was greater, as the middens were reduced by erosion. Coll. 1953 by L. Cipriani; subm. 1956.

**R-85. North Andaman Island (Great Andaman)**

Charcoal from same midden as R-84, from section EW in the upper layer with *Arca*, ca. 1.60 m below surface level of excavation. Coll. 1953 by L. Cipriani; subm. 1956.

**R-86. Middle Andaman Island (Great Andaman)**

Charcoal from kitchen-midden on W coast near Long Island at foot of Golpahar (Beehive Hill) (ca. 12° 40' N Lat, 92° 40' E Long) at depth of 3 m below surface level of excavation. Coll. 1953 by L. Cipriani; subm. 1956.

*General Comment*: ages obtained show that the two middens are of fairly recent date. Moreover, the identical ages of R-84 and R-85 reveal the rapid growth of the middens and the frequent shifting of the population. Cipriani inferred that the two middens went back some thousands of years (Cipriani, 1962). When informed of the measurements (September 1962), he recognized that his deductions had been wrong, but believed that older middens must certainly be scattered about the Andaman Islands. In his view, however, their identification would be more difficult because they were abandoned for a longer time and were now most likely hidden by tropical forest.

**III. GEOLOGIC SAMPLES**

**A. Italy**

With the exception of R-39, the samples dated so far are peats of Holocene age from localities in the Alps and the Italian coastal plains. Systematic dating of other Italian formations is planned.

**Val di Susa and Val Chisone series, Alpi Cozie, Piedmont**

A stratigraphical, palaeontological and palynological survey of the post-Würm lacustrine formations of Val di Susa and the nearby Val Chisone is being carried out by G. Charrier, Ist. di Giacimenti Minerari, Politecnico, Turin. The aim is to establish correlations with the scattered remains of these formations, and explain some singular characteristics of present-day vegetation in the Western Alps.
R-52.  **Novaretto, Val di Susa, Piedmont**  7780 ± 100
5830 B.C.

Peat from the old Novaretto peat-bog, 2 km from Comune of Chiavrie, Val di Susa, Piedmont (45° 07′ N Lat, 7° 21′ E Long, 362 m above sealevel). Sample extracted from peat layer 1 m thick, at depth of 2 to 3 m below surface in post-Würm formation preserved in small units in Lower Val di Susa, on left (orographic) side of river Dora Riparia. Profile of bog is as follows: 0 to −50 cm, agricultural soil; −50 to −200 cm, lacustrine clay with mollusc remains; −200 to −300 cm, sedge (Carex) peat, very compact. Coll. 1947 by Mr. Bronzino who was then working the peat-bog; subm. 1954 by G. Charrier.

R-53.  **Colle del Sestrière, Val Chisone, Piedmont**  2020 ± 100
70 B.C.

Peat from upper peat bed of peaty depression E of Albergo Duchi di Aosta, Colle del Sestrière, Val Chisone, Piedmont (44° 57′ N Lat, 6° 53′ E Long, 2020 m above sealevel). A section of the formation 2 m in depth reveals the following profile: 0 to −50 cm, peaty agricultural soil; −50 to −60 cm, *Sphagnum*-peat; −60 to −150 cm, fluvial-lacustrine, clayey-sandy sediment; −150 to −158 cm, *Sphagnum*-peat. Coll. and subm. 1954 by G. Charrier.

*General Comment*: dates of R-52 and R-53 are in agreement with expected ages of the two peat-bogs which, according to Charrier, represent two stages of bog growth, well separated in time, that interrupted the lacustrine sedimentation on the valley-floor. The Novaretto peat-bog dates from the time of mixed forest (abundant *Pinus* together with broad-leaved trees) transitional between the Boreal and Atlantic. The Colle del Sestrière peat-bog represents an interesting climatic oscillation in Roman times.

**M. Cervino series, Alta Valtournanche, Piedmont**

Peat and wood from an old peat-bog ca 1 km SW of Albergo-Rifugio Lo Riondé, Alta Valtournanche at foot of the M. Cervino, province of Aosta, Piedmont (45° 57′ N Lat, 7° 38′ E Long, 2250 m above sealevel). Small peat-bog crossed by stream at foot of high rock wall. Two samples coll. 1954 at same level ca. 85 cm, in newly-made section, by G. Isetti, Ist. Italiano di Paleontologia Umana; subm. 1956 by E. Tongiorgi.

R-81.  **Peat, Monte Cervino**  3200 ± 75
1250 B.C.

R-82.  **Wood, Monte Cervino**  3600 ± 60
1650 B.C.

*Comment*: dates a Holocene time when forest grew at higher altitude than at present. Pollen analysis of peat being carried out by E. Tongiorgi.

**Lago Pirola series**

Peat and wood from old peat-bog on terrace ca. 150 m E of Lago Pirola, 1 km S of Chiareggio, Val Malenco, province of Sondrio, Lombardy (46° 10′ N Lat, 9° 47′ E Long, 2284 m above sealevel). Peat, ca. 0.90 m thick, at present covered with detritus, was sampled at equidistant levels in section cut by stream crossing the terrace. Samples dated are listed in order from bottom to top of section. Coll. and subm. 1952 by E. Tongiorgi.
11-11. Lago Pirola 1
Lower peat, 5 cm above the bottom.

11-12. Lago Pirola 2
Peat, 30 cm above bottom.

11-13. Lago Pirola 3.1
Peat, 60 cm above bottom.

878000 ± 100
6050 B.C.

6400 ± 200
4450 B.C.

5630 ± 70
3680 B.C.

5210 ± 150
3260 B.C.

average: 5550 ± 70
3600 B.C.

11-14. Lago Pirola 3.2
Wood close to Level 3 where numerous tree trunks and branches were found.

4590 ± 90
2640 B.C.

4850 ± 150
2900 B.C.

average: 4660 ± 80
2710 B.C.

11-15. Lago Pirola 4
Upper peat, 5 cm below the top.

Comment: the peat, and in particular the wood, were measured to ascertain the time when upper limit of forest was higher than at the present day. Pollen analysis of the peat is being carried out by E. Tongiorgi.

R-39. Massaciuccoli, peat pebble
Pebble of compressed and hardened peat perforated by pholads, Lago di Massaciuccoli near Torre del Lago, Bassa Versilia, Tuscany (43° 50' N Lat, 10° 09' E Long). Subm. 1954 by the late A. C. Blanc. Comment: pebble was brought to surface by suction pumps installed on floating platforms on the lake to extract sand for commercial purposes. Pebble's roundness assumed to have been caused by sea waves on a Pleistocene beach, where it was imbedded with Purpura haemastoma L. var. consul. The beach, at 12 to 26 m below present sealevel, is inferred from litoral marine sand underlying aeolian sand which has a covering of peat (Blanc A. C., 1937; Blanc, Settepassi, and Tongiorgi, 1953). Pollen analysis of pebble indicated a cool-temperate forest, with Pinus predominating over Abies, Picea and Betula such as is found at present in sub-alpine areas (Marchetti and Tongiorgi, 1936). Shells of Purpura imbedded in the sand of the same beach have been dated at Pisa: Pi-116, 5646 ± 220 (Pisa II). Age of pebble shows that the eroded and transported peat is much older and belongs to the Main Würm phase. Another piece of the pebble was dated by the Lamont Geol. Observatory: L-246, 18,350 ± 350 (Lamont III). The same age (ca. 18,000 yr) was obtained at Pisa (Tongiorgi, 1963, private communication).
Lake of Massaciuccoli series

Humified Phragmites-peat from upper peaty layers of Lago di Massaciuccoli, near Torre del Lago, Bassa Versilia, Tuscany (43° 50' N Lat, 10° 19' E Long). Peaty layers still being formed, extend over whole marsh of Massaciuccoli, varying in thickness from 1 to 17 m. Samples were taken when peat was removed to extract underlying sand for commercial purposes. At Torre del Lago upper peat is only 2 to 3 m thick and rests directly on sand (A. C. Blanc, 1937; Blanc, Settepassi and Tongiorgi, 1953). Its entire thickness, from −0.50 to −3.30 m below sealevel, is represented by samples coll. at two points not far from each other. Subm. 1954 by the late A. C. Blanc.

Sampling I

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-40.</td>
<td>Peat, −0.50 m</td>
<td>4400 ± 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2450 B.C.</td>
</tr>
<tr>
<td>R-41.</td>
<td>Peat, −1.00 m</td>
<td>2950 ± 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 B.C.</td>
</tr>
<tr>
<td>R-42.</td>
<td>Peat, −1.50 m</td>
<td>4200 ± 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2250 B.C.</td>
</tr>
<tr>
<td>R-43.</td>
<td>Peat, −2.00 m</td>
<td>5600 ± 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3650 B.C.</td>
</tr>
<tr>
<td>R-44.</td>
<td>Peat-browned siliceous sand, −2.50 m</td>
<td>Not dated</td>
</tr>
</tbody>
</table>

Sampling II

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-45.</td>
<td>Peat, −0.50 m</td>
<td>1300 ± 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.D. 650</td>
</tr>
<tr>
<td>R-46.</td>
<td>Peat, −1.00 m</td>
<td>1750 ± 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A.D. 200</td>
</tr>
<tr>
<td>R-47.</td>
<td>Peat, −1.50 m</td>
<td>2400 ± 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>450 B.C.</td>
</tr>
<tr>
<td>R-48.</td>
<td>Peat, −2.00 m</td>
<td>4800 ± 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2850 B.C.</td>
</tr>
<tr>
<td>R-49.</td>
<td>Peat, −2.50 m</td>
<td>2400 ± 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>450 B.C.</td>
</tr>
<tr>
<td>R-50.</td>
<td>Peat, −3.00 m</td>
<td>2750 ± 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>800 B.C.</td>
</tr>
<tr>
<td>R-51.</td>
<td>Peaty siliceous sand, −3.30 m</td>
<td>2850 ± 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>900 B.C.</td>
</tr>
</tbody>
</table>

Comment: two discrepancies between stratigraphical level and age (see samples R-40 and R-48) may be ascribed to defective sampling; doubts about this were expressed by A. C. Blanc when he subm. the samples. It should also be noted that the peats in Sampling I are older at every level than those of Sampling II. Nevertheless, the dates as a whole from the youngest to the oldest give an indication of the overall duration of the upper peat sedimentation.
Date lists:

British Museum I Barker and Mackey, 1959
Cambridge I Godwin and Willis, 1959
Chicago I Arnold and Libby, 1951
Chicago V Libby, 1954
Copenhagen III Tauber, 1960
Copenhagen IV Tauber, 1960
Groningen II De Vries, Barendsen, and Waterbolk, 1958
Groningen IV Vogel and Waterbolk, 1963
Heidelberg I Münnich, 1957
Lamont III Broecker, Kulp, and Tucek, 1956
Pisa I Ferrara, Reinhartz, and Tongiorgi, 1959
Pisa II Ferrara, Fornaca-Rinaldi, and Tongiorgi, 1961
Stockholm I Östlund, 1957
Stockholm II Östlund, 1959
UCLA I Fergusson and Libby, 1962
Uppsala I Olsson, 1959
USGS I Suess, 1954
Yale III Barendsen, Deevey, and Gralenski, 1957


ARIZONA RADIOCARBON DATES V*

PAUL E. DAMON, C. VANCE HAYNES and AUSTIN LONG

Geochronology Laboratories, University of Arizona, Tucson, Arizona

INTRODUCTION

With few exceptions the C\textsuperscript{14} measurements reported here were made in this laboratory between October 1, 1962 and November 1, 1963. Sample descriptions are classified as follows:

I. Geochemical Samples.
II. Geologic-Paleoclimatic samples.
III. Early man-alluvial stratigraphy samples.
IV. Archaeologic samples.

The geochemical samples include more results on the tree ring series which were previously reported (Arizona IV). In addition, a number of bristlecone pine samples have been measured but will not be reported until an accurate tree ring chronology is available. A number of modern aquatic plants growing within a sink in Plio-Pleistocene limestone, Montezuma Well, were also measured to establish the initial C\textsuperscript{14} content within a limnocrene environment. The amazingly low C\textsuperscript{14} content of these plants further emphasizes the necessity for the careful evaluation of the initial C\textsuperscript{14} content of samples. Other geochemical samples consist primarily of materials chosen to evaluate the biospheric uptake of nuclear technology-produced C\textsuperscript{14}.

The second group of samples consists of organic material and carbonates chosen to evaluate the paleoclimatology of lakes and playas. The large number of playa samples from SE Arizona and SW New Mexico have been studied by one of the authors, A. Long, in connection with his doctoral research. The second author, V. Haynes, has been particularly concerned with research on the antiquity of man in North America and in the use of C\textsuperscript{14} to evaluate the stratigraphy of alluvial sites. The fourth group of samples includes, in addition to North American archaeologic samples, a number of Egyptian samples which add to the evidence for a serious discrepancy between the C\textsuperscript{14} chronology and the Egyptian archaeologic chronology.

Increasing attention has been given this year to the problem of sample pretreatment. The following is our present pretreatment technique: After decantation and hand-picking to remove roots, all non-carbonate samples are treated with 5\% NaOH to extract humic acids and soluble lignins. If these fractions are found to represent a major proportion of the total sample they are precipitated in acid solution and converted to CO\textsubscript{2} in the standard way. If the carbonaceous residue from the NaOH treatment is of sufficient size for dating, it is leached with 6N HCl to remove all carbonates, checked again for root contamination, and converted to CO\textsubscript{2} in the standard way. In most cases, the insoluble C is the fraction desired for dating. The humate-lignin fraction is dated only if the other is unsuitable. In some cases both fractions are dated and reported.

* University of Arizona Geochronology Contribution No. 88.
A special nitration method of pretreating samples of finely divided charcoal to remove contamination by fine vegetable matter has been developed and successfully tested, and is reported with geochemical samples (A-486).

Carbonate samples are hydrolysed in the standard way with phosphoric acid after the leaching of surface contaminants.

Standard deviations are computed from random counting errors only. In the opinion of the authors, the problem of the evaluation of the initial C\textsuperscript{14} content of samples is too complex, at present, to warrant the use of anything but this measure of precision.

ACKNOWLEDGMENTS

The authors are indebted to W. G. McGinnies and C. W. Ferguson of the University of Arizona Laboratory of Tree Ring Research for their continued cooperation in supplying dendrochronologically dated wood specimens. W. Y. Adams, UNESCO Programme Specialist, Khartoum, Sudan, has continued to supply archaeologic samples from the Wadi Halfa area of Sudan. E. J. Trueblood supplied a large number of samples from the Tucson Sewage System. M. A. Massengale of the University of Arizona Agriculture Experiment Station supplied alfalfa samples grown under controlled test plot conditions.

Gerald A. Cole, Life Science Center, Arizona State University, is studying the limnology of Montezuma Well and has cooperated with us in our study of samples from this locality. In this connection, we would also like to acknowledge the cooperation of the National Park Service.

Donald Grey, Catheryn MacDonald, Jack Allen and Fred Cagle assisted in laboratory analyses. Joyce Watson assisted in manuscript preparation.

SAMPLE DESCRIPTIONS

1. GEOCHEMICAL SAMPLES

Sequoia No. 3 series, California

Wood, Sequoia gigantea, from Giant Forest, Sequoia Natl. Park (36° 35' N Lat, 118° 48' W Long). Coll. 1959 by H. N. Michael, Univ. of Pennsylvania; subm. by M. A. Stokes. Comment: tree began growth ca. 215 B.C. and was cut in A.D. 1950. These samples were from the 10 B.C. to 50 B.C. age span.

A-255:7. Tree rings—Whole wood

\[ \delta C^{14}, \%_{o} \delta C^{13}, \%_{o} \Delta, \%_{o} \]

-24 ± 5 — —

Sample ground to approx. 40 mesh but not pretreated chemically.

A-255:10. Tree rings—Cellulose

-8 ± 5 — —

A-255:11. Tree rings—Lignin

-8 ± 5 — —

Comment: the average of the three samples is 13 ± 5\%\textsubscript{o}. The average \( \delta C^{13} \) for four other analyses of Sequoia No. 3 is -20.2\%\textsubscript{o} (Arizona IV). These four samples for C\textsuperscript{13} analyses were first leached in hot NaOH followed by HCl. The value of \( \delta C^{13} \) obtained from these samples is not necessarily identical to the value for untreated wood, cellulose and lignin. Therefore no attempt was made to estimate \( \Delta \). Another sample will be analyzed to see if the \( \delta C^{14} \) difference between cellulose-lignin and whole wood is real.
Sequoia D-21 series, California


### A-476. Tree rings

1033 B.C. to 990 B.C.

<table>
<thead>
<tr>
<th>Date</th>
<th>δC(^{14})/‰</th>
<th>δC(^{13})/‰</th>
<th>Δ%/‰</th>
</tr>
</thead>
<tbody>
<tr>
<td>1033 B.C. to 990 B.C.</td>
<td>56 ± 6</td>
<td>-20.2</td>
<td>46 ± 6</td>
</tr>
</tbody>
</table>

*Comment*: δC\(^{13}\) value is the average of two determinations for Sequoia D-21.

### Montezuma Well series, Arizona

Organic material from core in sediment, modern aquatic plants, and CO\(_2\) evolved from water from Montezuma Well, Montezuma Castle Natl. Monument, ca. 10 mi. N of Camp Verde, Yavapai Co. (34° 39' N Lat, 110° 45' Long). Coll. 1961-1963 by G. A. Cole, P. S. Martin and R. H. Hevly; subm. 1963 by P. S. Martin and R. H. Hevly, Geochronology Labs., Univ. of Arizona, Tucson. *Comment*: Montezuma Well, elevation 3600 ft, is a unique limnocrene habitat in arid region of sub-Mogollon Arizona (Cole, 1963). It is a sink in Plio-Pleistocene fresh water limestone, with diam of ca. 400 ft and depth of 130 ft including 55 ft from the bottom to water level. Water enters through at least three deep fissures, 125 ft below water surface, at rate of ca. 5600 m\(^3\)/day. An outlet through the rim wall maintains water at a level approaching constancy. A modified ancient Indian irrigation ditch carries the water away; other old ditches may still be observed at slightly higher levels.

Chemically, Well is hard carbonate water, with calcium the principal cation. Major anions are carbonate, chloride, and sulfate in that order, while cations are calcium, sodium, magnesium and potassium in sequence. The sum of the principal ions is about 840 mg/1.

pH ranges from 6.2 at night and on some cloudy days to 6.9 on bright sunny days; there is no residual acidity. Total alkalinity, which is due entirely to bicarbonate, varies from 560 to 600 mg/1. These data, implying a theoretical free CO\(_2\) content ranging roughly from 150 to 700 mg/1, indicate charging from a subsurface reservoir.

### A-395. Organic Material from Core  

<table>
<thead>
<tr>
<th>Date</th>
<th>% modern</th>
<th>δC(^{14})/‰</th>
<th>δC(^{13})/‰</th>
<th>Δ%/‰</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.07 ± 0.60% modern</td>
<td>8C14,0 8C13,0</td>
<td>56 ± 6</td>
<td>-20.2</td>
<td>46 ± 6</td>
</tr>
</tbody>
</table>

*Comment*: apparent C\(^{14}\) age of 21,300 ± 750 yr B.P. cannot be accepted because modern aquatic plants in the Well contain similar amounts of C\(^{14}\).

### A-438. Modern Aquatic Plant  

<table>
<thead>
<tr>
<th>Date</th>
<th>% modern</th>
<th>δC(^{14})/‰</th>
<th>δC(^{13})/‰</th>
<th>Δ%/‰</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.61 ± 0.57% modern</td>
<td>8C14,0 8C13,0</td>
<td>33 ± 5</td>
<td>-20.2</td>
<td>23 ± 6</td>
</tr>
</tbody>
</table>

*Comment*: apparent C\(^{14}\) age of these modern aquatic plants is 17,300 ± 400 yr B.P.
**A-439. Modern Aquatic Plant**

*Potamogeton illinoensis* rooted on bottom at depth of 25 ft, but uppermost leaves reach water surface. Coll. March 24, 1963. *Comment:* apparent C\(^{14}\) age of these modern aquatic plants is 24,750 ± 400 yr B.P.

**A-440. Water**

CO\(_2\) extracted from Montezuma Well water sample. *Comment:* apparent C\(^{14}\) age of the well water is 21,420 ± 220 yr B.P.

*Comment:* results illustrate the effect of the utilization of old carbon by submerged aquatic plants. Apparent age of 22,000 ± 600 yr for organic substances associated with the pollen record is not meaningful. Actual age of the organic material in the core at the 26.5 to 41.5 cm level could be 4000 B.P. or less.

**Tucson Sewage series**

Sludge, dried primary and digested sewage effluent samples from Tucson City Sewerage Disposal Plant on Casa Grande Highway (32° 18' N Lat, 110° 57' W Long). Samples coll. and subm. 1962 to 1963 by E. J. Trueblood of Tucson City Sewerage Div., P. O. Box 5077, and F. Cagle, Geochronology Labs., University of Arizona.

**A-390. Dried Digested Sludge**

Composite sludge from months of May, June, July 1962.

**A-391. Thickened Primary Sludge**

(\textit{volatiles})

Primary sludge sample coll. Sept. 10, 1962. Heated to 300° C to drive off volatiles which were then collected, purified and counted. *Comment:* 7.0 L of CO\(_2\) were obtained from 10.69 g of sample.

**A-392. Thickened Primary Sludge**

(\textit{nonvolatiles})

Sample obtained by burning A-391 after first collecting volatiles at 300° C. *Comment:* 2.3 L of CO\(_2\) were obtained. Composite of A-391 and A-392 representing the weighted average of the volatile and nonvolatile components yields 97.5% modern.

**A-394. Dried Digested Sludge**

Composite sludge from month of Aug. 1962.

**A-402. Thickened Primary Sludge**


**A-403. Dried Digested Sludge**

Composite sludge for the month of Sept. 1962.

**A-407A. Thickened Primary Sludge**

(\textit{volatiles})

**A-407B. Thickened Primary Sludge**

(\textit{nonvolatiles})

Volatile and nonvolatile fractions obtained as for A-391, 392, from sludge
coll. Nov. 29, 1962. Comment: weighted average of 1.53 L of nonvolatiles and 3.3 L of volatiles yields 103.9% modern.

**A-408. Dried Digested Sludge**  
98.0 ± 0.7% modern  

**A-454. Sewage Effluent**  
115.1 ± 2.5% modern  
Dissolved CO₂ and bicarbonate released by acidification and agitation, coll. at entrance to holding ponds May 2, 1963. Water temp 23.8° C. Comment: effluent has picked up C₁⁴ from atmosphere upon aeration but it still lags behind the atmospheric C₁⁴ resulting from nuclear technology. 

**Comment:** the six month average for sludge samples from June to Nov. 1962 is 102 ± 2% modern. Definite evidence for an increase during this time was not observed, although the average C₁⁴ content of atmospheric samples increased from about 135% to 140% modern during this period (I. Olsson, Upsala Univ., personal communication, April 23, 1963). Thus Tucson's Digested Sewerage Sludge is lagging significantly behind the C₁⁴ content of the atmosphere (Broecker and Walton, 1959). The sludge can be separated into two components, an older nonvolatile fraction and a younger volatile fraction with the volatile fraction averaging about 3.5 times larger, by volume of CO₂, than the nonvolatile fraction. The sludge may have equilibrated in part with older ground water (see A-424, this paper). It also contains a mixture of older cellulose from paper products and dead petroleum products, which must reduce the C₁⁴ content of vegetable and animal products that have been contaminated by nuclear technology.

**Tucson Alfalfa series**


**A-400. Alfalfa Leaves**  
362 ± 7  
Medicago sativa moapa variety, designated as sample I-M-3 by M. A. Massengale.

**A-401. Alfalfa Stems**  
358 ± 6  
Medicago sativa moapa variety, designated as sample I-M-3 by M. A. Massengale.

**A-409. Alfalfa**  
365 ± 5  
Medicago sativa African variety, designated as sample 1-A-3 by M. A. Massengale. Total plant including leaves and stem. 

**Comment:** there is no significant difference between leaves and stem or between the two varieties. The average δC₁⁴ is 362 ± 4%.

**A-446. Tucson, Arizona**  
508 ± 9  
Leaves from mulberry tree growing in residential area on outskirts of Tucson (32° 14' N Lat, 110° 53' W Long). Coll. April 7, 1963 and subm. by P. E. Damon. Comment: these leaves are from the same tree as L-253 (Lamont VIII) coll. April 4, 1959 (Δ = 187 ± 8%), and A-329 (Arizona IV) coll. May 20, 1962 (Δ = 303 ± 6%).
A-486. Artificial Mixture

Dead charcoal (A-482) weighing 8.181 g was mixed with 0.466 g of post-bomb (Aug. 1963) grass roots. Sample, consisting of 94.61% charcoal and 5.39% roots, was ground, boiled in 15% NaOH for 1 hr, washed and filtered; to the residue 200 ml 6N HCl and 150 ml clorox were added slowly with stirring and boiled for 20 min; sample was again filtered and washed with distilled water; to residue, 400 ml of 50/50 HNO₃ and H₂SO₄ were added with stirring and boiled for 10 min; sample was then filtered and washed with distilled water, and dried; following this, sample was leached with nine 200 ml portions of acetone, dried in air with aspirator and washed with distilled water; lastly it was oven-dried. Comment: this analysis demonstrates that 5.39% of C¹⁴-enriched roots can be removed from charcoal, leaving no detectible C¹⁴ that could affect the dating.

A-424. Tucson, Arizona


II. GEOLOGY-PALEOCLIMATOLOGY

A-388. Chuska Mountains, New Mexico

Organic material from core No. 6101, 160 to 180 cm depth, in Dead Man Lake (36° 15' N Lat, 108° 55' W Long), Chuska Mts., San Juan Co. Pollen pattern in this core is similar to that in No. 5826c, which shows at this level an Artemisia-Picea-Pinus assemblage interpreted as a record of alpine vegetation during last glacio-pluvial phase. Core coll. 1961 by H. E. Wright, Jr., Univ. of Minnesota, Minneapolis (Bent and Wright, 1963). Comment: large standard deviation due to small CO₂ yield when burned. Other samples from Dead Man Lake core No. 5826c as follows: A-268, 312-318 cm, 24,700 ± 3900, Arizona IV; A-213, 725-735 cm, 28,000, Arizona III. Core No. 5825a, nearby: L-515A, 9-12 cm, 3900 ± 300.

A-482. Bodega Bay, California

Wood from near sealevel, part of a forest, now ca. 40 ft below land surface in reactor pit excavations (38° 18' N Lat. 123° 3' W Long), Bodega Head, California. Coll. 1963 by Lu Waters, Cotati, California; subm. 1963 by Pierre St. Amond, China Lake, California.

A-451. China Lake Pelecypod shell

Shell of Anodonta oregonensis in drill core from 24.5 ft below surface of China dry lake, 10 ft N of core MD-1 (Smith and Pratt, 1957), (35° 43' N Lat, 117° 38' W Long), China Lake, California. Coll. 1963 by R. Von Huene, U. S. Naval Ordnance Test Station; subm. by P. S. Martin, Geochronology Labs., Univ. of Arizona. Comment: a 200-grain pollen count from mud enclosing the shell yielded 38% sedge, 9% cattail and other pollen of shallow-water aquatic plants.

Willeox playa series, Arizona

CaCO₃ coll. on or near surface E of present playa (32° N Lat, 110° W
Arizona Radiocarbon Dates V

Long), and 5 to 10 mi S of town of Willcox. Material dated with purpose of establishing water level chronology for the pluvial lake Cochise, of which Willcox playa is a remnant. All samples washed in dilute HCl before hydrolysis. Coll. 1962, and subm. by Austin Long. Comment: although Lake Cochise undoubtedly had hard water, and the problem of initial C\textsuperscript{14} content is a real one (Oana & Deevey, 1960; Broecker & Walton, 1959; Montezuma Well series, this date list), the results are reported in terms of yr B.P. with the understanding that the numbers are maximum ages. Nevertheless, the results indicate lake levels responding to known climatic fluctuation during the Late Pleistocene. All elevations given in ft.

Table shows tufa collected on surface:

<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Altitude, ft</th>
<th>Uncorrected date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-311</td>
<td>NE 1/4, sec. 14 T15S, R25E</td>
<td>4180</td>
<td>7350 ± 130</td>
</tr>
<tr>
<td>A-339</td>
<td>SE 1/4, sec. 24 T14S, R25E</td>
<td>4220</td>
<td>10,400 ± 100</td>
</tr>
<tr>
<td>A-335</td>
<td>NE 1/4, sec. 12 T16S, R25E</td>
<td>4212</td>
<td>11,100 ± 100</td>
</tr>
<tr>
<td>A-315</td>
<td>SE 1/4, sec. 13 T15S, R25E</td>
<td>4220</td>
<td>11,150 ± 180</td>
</tr>
<tr>
<td>A-314</td>
<td>NE 1/4, sec. 14 T15S, R25E</td>
<td>4190</td>
<td>11,300 ± 180</td>
</tr>
<tr>
<td>A-313</td>
<td>SE 1/4, sec. 14 T15S, R25E</td>
<td>4200</td>
<td>11,470 ± 180</td>
</tr>
<tr>
<td>A-361</td>
<td>NW 1/4, sec. 2 T14S, R24E</td>
<td>4175</td>
<td>12,890 ± 420</td>
</tr>
<tr>
<td>A-338</td>
<td>NW 1/4, sec. 12 T16S, R25E</td>
<td>4173</td>
<td>13,600 ± 450</td>
</tr>
<tr>
<td>A-310</td>
<td>SW 1/4, sec. 14 T15S, R25E</td>
<td>4175</td>
<td>17,600 ± 1200</td>
</tr>
<tr>
<td>A-312</td>
<td>NE 1/4, sec. 14 T15S, R25E</td>
<td>4200</td>
<td>18,300 ± 900</td>
</tr>
<tr>
<td>A-337</td>
<td>NW 1/4, sec. 12 T16S, R25E</td>
<td>4177</td>
<td>20,400 ± 370</td>
</tr>
<tr>
<td>A-309</td>
<td>NW 1/4, sec. 36 T14S, R25E</td>
<td>4180</td>
<td>20,500 ± 370</td>
</tr>
<tr>
<td>A-336</td>
<td>NE 1/4, sec. 12 T16S, R25E</td>
<td>4190</td>
<td>21,500 ± 370</td>
</tr>
<tr>
<td>A-319</td>
<td>NE 1/4, sec. 13 T16S, R25E</td>
<td>4241</td>
<td>21,600 ± 1800</td>
</tr>
<tr>
<td>A-305</td>
<td>NE 1/4, sec. 11 T14S, R25E</td>
<td>4225</td>
<td>22,600 ± 2600</td>
</tr>
</tbody>
</table>

The following two samples were coll. from sand dunes and are presumed to be caliche formed by dissolution and re-deposition of loess, probably derived from the dried playa surface.

A-291. Caliche

40.6 ± .4\% modern

(7160 yr)

Large stabilized dune, NE 1/4, sec. 14, T14S, R25E, alt 4200 ft.

A-304. Caliche

63.4 ± 3.8\% modern

(3660 yr)

Apparently young active dune, SW 1/4, sec. 10, T14S, R25E, alt 4175 ft. Two samples from limestone deposit, especially well exposed in a quarry E of the playa (32° 08' N Lat, 109° 45' W Long).

A-318. Quarry limestone

17,900 ± 270

Top of lime layer 2 ft below surface of ground.

A-360. Quarry limestone

27,600 ± 900

Bottom of lime layer 10 ft below surface of ground.

A-316A. Limestone, Carbonate fraction

13,700 ± 150

Limestone outcropping, alt 4190 ft, thought to be equivalent to lime in quarry; in light of data, it may be a more recent deposit.
Paul E. Damon, C. Vance Haynes and Austin Long

A-316B. Limestone, organic fraction 19,100 ± 3500

Unidentified organic material from A-316, possibly younger but probably deposited contemporaneously with it.

A-458. Quarry limestone, organic fraction 10,690 ± 650

Organic material from specimen coll. near A-360. Apparently represents post-carbonate deposition of soil humus.

A-355. Playas Lake, New Mexico 3190 ± 160

Carbonate deposited at or near margin of intermittent lake (31° 55' N Lat, 180° 35' W Long). Material probably recently formed, and still forming today at places nearer the center of the basin. Coll. 1962 and subm. by A. Long. Comment: if carbonate age is calculated on basis of continuous, uniform rate of carbonate accumulation until present, it is 7300 B.P. (see A-250, p. 299, Arizona IV).

San Agustin Plains series
Carbonate samples related to the final shrinking of the extinct lake, deposits of which were described by Clisby and Foreman (1958), with C14 dates as published by the Yale lab. (Yale VII). Tufa deposits are most prominent on each of a series of terraces, and diminish or disappear between terraces. Coll. 1962 and subm. by A. Long.

A-393. Tufa, 6800 ft 10,500 ± 130
Tufa just beneath wave-cut cliffs in NW ¼, sec. 16, T5S, R14W, alt 6800 ft (33° 52' N Lat, 108° 16' W Long).

A-404. Tufa, 6850 ft 10,680 ± 170
Tufa on lowest major terrace on SW "shore" (33° 43' N Lat, 108° 18' W Long) SW ¼, sec. 3, T7S, R14W, alt 6850 ft.

A-405. Tufa, 7000 ft 13,500 ± 650
Tufa on highest major terrace (alt 7000 ft) 1.8 mi SW of A-404 (33° 42' N Lat, 108° 19' W Long) NW ¼, sec. 14, T7S, R14W.

A-406. Lime crust, 7300 ft 1.6% modern
Calcareous crust on basalt cobbles coll. on continental divide just NW of San Agustin Plains (33° 57' N Lat, 108° 30' W Long), alt 7300 ft.

Lordsburg series, New Mexico
Carbonate samples from near Lordsburg Playa, Grant Co., New Mexico. Coll. 1962 and subm. by A. Long.

A-417. Lordsburg, caliche 28.8% modern
Caliche 6 in. below surface (32° 18' N Lat, 108° 50' W Long), alt 4200 ft, coll. E margin of Playa, interbedded with clay and gravel, overlain by gravel of probable recent age. Comment: C14 content is consistent with origin during last pluvial episode (Arizona IV).

A-418. Lordsburg, carbonate 4560 ± 90
Carbonate formed in stream bed (32° 17' N Lat, 108° 57' W Long),
presently covered by 1 to 3 ft soil zone which has been cut by more recent stream action. Comment: carbonate date provides maximum age for overlying soil and thus indicates post-altithermal down-cutting on W side of Lordsburg playa.

**Avra Valley, Arizona**


**A-397. Avra Valley, 38 to 44 in. depth** 79.6 ± 1.1% modern CaCO₃ content of soil zone is 1.5% by weight.

**A-398. Avra Valley, 60 to 66 in. depth** 29.6 ± 0.4% modern CaCO₃ content of soil zone is 9.3% by weight.

**A-399. Avra Valley, 84 to 90 in. depth** 0.88 ± .45% modern CaCO₃ of soil zone is 9.3% by weight. Comment: the chemical discontinuity at the 60 in. level is corroborated by petrographic analyses (Yesilsoy, 1962). Assuming an instantaneous origin for the carbonate in the 38 to 44 in. zone, and initial \(^{14}C/^{12}C\) the same as contemporary atmosphere, the age would be 1840 B.P. If the initial \(^{14}C/^{12}C\) were less than its contemporary atmosphere, the age would be still younger. Assuming continuous formation of carbonate, at constant rate, from some time in the past to the present time, with each layer deposited at 100% modern at the times of deposition, the time of first deposition of A-397 was 2300 yr ago (see A-250, Arizona IV, p. 299). Any assumption of less than 100% modern initial concentration of \(^{14}C\) would make the age even younger. Thus, we may conclude that the age of the carbonate in A-397 is \(\leq 2300\) B.P. The approximate rate of caliche formation, ca. 1 in./1000 yr, in this locality is similar to the rate in the neighboring Santa Cruz Valley (eg. see Oracle Junction Series, Arizona IV, p. 297). Thus A-398 represents carbonate accumulated over, very approximately, a 6000 yr span of time. An “average age” for the A-398 carbonate (or caliche) is 9800 B.P.

**A-387. Newport Mesa, California**  >44,000

Marine shell, *Schizothaerus nuttallii*, from member of lakewood formation (33° 30' N Lat, 117° 50' W Long). Coll. 1950 by George Kanakoff, Los Angeles County Mus.; subm. by J. F. Lance, Univ. of Arizona, Tucson, and W. E. Miller, Long Beach State College, California. Comment: beds of Newport Mesa have long been correlated with the Palos Verdes formation of the Palos Verde Hills which contains an abundant invertebrate fauna and a few mammalian fossils in some places. The vertebrate fossils are similar to those from Rancho La Brea but could be somewhat older from a paleontological standpoint (Lance, 1948; Kanakoff and Emerson, 1959). Kulp and others (1952) have dated a specimen (L-144A) of the same species from the Palos Verdes formation of the Palos Verdes Hills area at >30,000 yr.
III. Early Man-Alluvial Stratigraphy

A. Southwestern States

Lehner Ranch series, Arizona

Lehner site, San Pedro Valley (31° 25' 23" N Lat, 110° 06' 48" W Long), Cochise County, Arizona, is an elephant-kill site in which Clovis fluted points were found in association with charcoal, bones of nine immature mammoths, and remains of horse, bison and tapir (Haury et al., 1959; Lance, 1959; Antevs, 1959).

A-378. Charcoal

10,940 ± 100
8990 B.C.

Charcoal from sand and gravel unit (Clovis level) immediately below unit k and stratigraphically equivalent to unit i or j of Antevs (1959). Equivalent to pollen sample 13 of Mehringer pollen profile 2 (in preparation). Coll. and subm. 1962 by P. J. Mehringer and C. V. Haynes, Geochronology Labs. Comment: sample dates the base of a pollen profile which should provide an estimate of the vegetation when the San Pedro Valley was occupied by mammoth, tapir, bison, horse, and people of the Llano complex. Date falls within one standard deviation of the average of 11,260 ± 360 B.P. for six dates (A-40a, 40b, and 42; K-554; M-811; and A-378) from this level. Overlying unit k has been dated as 10,410 ± 190 (A-33 bis., Arizona III).

A-450a. Charcoal

2550 ± 160
600 B.C.

Charcoal from rock-lined hearth 110 cm below present surface in alluvial sand subunit of unit o (Antevs, 1959) in N bank of Lehner arroyo. Corresponds to pollen samples 4 to 6 of Mehringer pollen profile 5 (in preparation). Comment: date establishes a late Chiricahua or early San Pedro age for the hearth and dates the vegetation indicated by the pollen samples.

Blackwater No. 1 series, Clovis, New Mexico

The Blackwater No. 1 locality (34° 17' N Lat, 103° 19' W Long), Roosevelt Co., New Mexico is described by Sellards (1952, p. 29-31) and by Wendorf (1961, p. 115-117). Other C14 dates are 6230 ± 150 (0-170) and 6300 ± 150 (0-169) on burned and unburned bone from the “carbonaceous silt” unit; and 4950 ± 150 (0-157) on burned bone from the “jointed sand” unit (Humble I, p. 149). Coll. 1962 by Vance Haynes, Jerry Harbour and James Hester; subm. by Fred Wendorf and J. Hester, Mus. of New Mexico, Santa Fe.

A-386. Diatomite unit, Folsom occupation

10,490 ± 900
8540 B.C.

Humic acids and lignins extracted from fossil plant remains in diatomite between carbonaceous silt above and gray sand below. Comment: date is comparable to Folsom dates at other sites.

A-379. Fine-grained carbonaceous matter

9900 ± 320
7950 B.C.
<table>
<thead>
<tr>
<th>Date Code</th>
<th>Description</th>
<th>Radiocarbon Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-380.</td>
<td>Humic acid and lignin fractions</td>
<td>10,600 ± 320</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8650 b.c.</td>
</tr>
<tr>
<td>A-380.</td>
<td>Average:</td>
<td>10,250 ± 320</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8300 b.c.</td>
</tr>
</tbody>
</table>

A transitional zone of interbedded silt and diatomite layers between silt above and diatomite below was sampled to provide a maximum age of carbonaceous silt deposition and a minimum age of diatomite deposition. *Comment:* dates are comparable to A-386 and suggest that the transitional zone is part of the diatomite unit.

<table>
<thead>
<tr>
<th>Date Code</th>
<th>Description</th>
<th>Radiocarbon Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-481.</td>
<td>Llano occupation</td>
<td>11,170 ± 360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9220 b.c.</td>
</tr>
</tbody>
</table>

Humates and lignins from carbonized plant remains in the Clovis level. Coll. 1963 by G. A. Agogino, subm. 1963 by Agogino and C. V. Haynes. *Comment:* sample occurred as a silt-clay lens 1 in. thick, extending in and around the skull of mammoth No. 1 and indicating deposition soon after emplacement of the mammoth remains and associated Clovis artifacts. Sediments are free from contamination by roots or humic acids derived from soils, and hence the sample consists entirely of humic acids and soluble lignins extracted from the fossil plants during laboratory pretreatment. Date is consistent with dates (see A-386, 379, and 380 this date list) obtained from stratigraphically higher diatomite containing Folsom artifacts. Date also falls within time range established for Llano complex at the Lehner site (11,260 ± 360; see discussion for A-378, this date list) and at the Dent site (11,200 ± 500, I-622 Isotopes, Inc., unpub.).

<table>
<thead>
<tr>
<th>Date Code</th>
<th>Description</th>
<th>Radiocarbon Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-375.</td>
<td>McCullum Ranch, New Mexico</td>
<td>15,750 ± 760</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13,800 b.c.</td>
</tr>
</tbody>
</table>

Fine-grain free carbon from well-sorted gray sand exposed in deflated depression (blowout) on the Curtis McCullum ranch, Blackwater Draw, E New Mexico (34° 16' N Lat, 103° 16' 30'' W Long). Coll. 1962 by V. Haynes and J. Hester; subm. by F. Wendorf and J. Hester. The carbon was washed from the sand by decantation in distilled water. Standard pretreatment showed no humic acids. This and the absence of artifacts suggest that the free carbon is the remains of a natural fire. The carbonaceous lens occurs within friable well-sorted quartz sand and is stratigraphically equivalent to a calicium carbonate duricrust believed to represent an ancient interdunal pond. Associated with the pond unit and the basal part of the overlying gray eolian sand are fossil remains of mammoth, horse, bison, camel and sloth. The pond unit contains numerous molluscs. No evidence of human occupation was found. *Comment:* dates a relatively wet late-Wisconsin episode on the High Plains, and a contemporary fauna.

<table>
<thead>
<tr>
<th>Date Code</th>
<th>Description</th>
<th>Radiocarbon Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-396.</td>
<td>North Palo Duro Creek, Texas</td>
<td>6120 ± 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4170 b.c.</td>
</tr>
</tbody>
</table>

Burned bone from test excavation in alluvium at base of an exposed arroyo wall of North Palo Creek, T. Dooley ranch near Sunray, Texas (36° 15' N Lat, 102° 45' W Long). This horizon produced Plainview points and other artifacts representing a single period of occupation. Coll. 1959 by Keith Glasscock; subm. by F. Wendorf. *Comment:* the date is considerably younger
than the Plainview level at the type site \((9800 \pm 500 \text{ B.P., L-303, Lamont IV, p. 1329})\) and unfortunately there is insufficient data to evaluate the date on geological grounds.

**B. Wyoming Alluvial Stratigraphy**

Since 1959 the Pleistocene and Recent alluvial stratigraphy associated with Early Man sites in Wyoming has been investigated by V. Haynes in collaboration with archaeologists H. T. Irwin, Peabody Mus., Harvard Univ.; Cynthia Irwin-Williams, Am. Mus. of Nat. History; and G. A. Agogino, Eastern New Mexico Univ. Attention is being focused upon the Hell Gap area where the archaeologists have demonstrated a remarkably complete record of human occupation from 11,000 B.P. to the present. A consistent record of human occupation, vertebrate fossils, and \(^{14}C\) dates controlled by detailed stratigraphy is being developed and will be reported elsewhere.

**A-364. Lance Creek Bison Fall**

Charcoal from aboriginal hearth in middle portion of an alluvial fill and associated with numerous bison remains and triangular side-notched points. The alluvium occurs below bluffs of Tertiary rocks adjacent to Lance Creek \((42^\circ 59' \text{ N Lat, } 110^\circ 53' \text{ W Long}), \text{ Niobrarra Co., Wyoming. Coll. and subm. 1962 by C. V. Haynes. Comment: the alluvium is the Kaycee formation of Leopold and Miller (1954) and the \(^{14}C\) date confirms their estimate of its age.**

**A-365. Rawhide Creek Site**

Charcoal from bottom of laminated silt, overlying massive silt and sand, exposed in left bank of Rawhide Creek, Goshen Co., Wyoming \((42^\circ 33' \text{ N Lat, } 104^\circ 30' \text{ W Long}), \text{ Coll. 1961 by G. Agogino and subm. 1962 by C. V. Haynes. Comment: provides maximum date for deposition of laminated silt. Underlying unit contains flint workshop debris including bifacial forms broken in the process of manufacture. Date is therefore minimal for human occupation of the site.**

**A-366. Rawhide Butte Mammoth Site**

Charcoal on erosional contact between two silt units \((42^\circ 37' \text{ N Lat, } 104^\circ 29' \text{ W Long}) \text{ NE foothills of Rawhide Buttes, Niobrarra Co., Wyoming. Coll. 1960 and subm. 1962 by C. V. Haynes. Comment: the lower silt contains the articulated remains of mammoth that were exposed in antiquity by erosion. The top portions of several articulated vertebrae were charred. The \(^{14}C\) date is, therefore, that of the contact between the two units and is later than the mammoth. No artifacts were found in direct association.**

**A-372. Sisters’ Hill site, Wyoming**

Fossil plant remains in silt of channel fill exposed at the Sister’s Hill site \((44^\circ 16' \text{ N Lat, } 106^\circ 46' \text{ W Long}), \text{ Johnson Co., Wyoming. Coll. and subm. 1962 by C. V. Haynes. Comment: dates alluvial deposition that postdates a deposit containing Agate Basin and Hell Gap artifacts. A composite charcoal sample from the occupational levels has been dated at 9650 \pm 250 (I-221,}
The indicated 50-yr difference between the two periods of alluvial deposition is believed to be too small, but the dates are in proper stratigraphic order and of the right magnitude if the statistical errors are considered.

A-431. Hell Gap, Site 2, Wyoming  

\[13,060 \pm 600 \text{ B.C.}\]

Disseminated charcoal in greenish-gray silty clay, forming the upper foot of graded alluvial gravel, sand and silt, Hell Gap, Site 2 \((42^\circ 24' 35'' \text{ N Lat, 104^\circ 38' 25'' W Long})\), Goshen County, Wyoming. Coll. 1960 and subm. 1963 by C. V. Haynes. \textit{Comment}: alluvial unit is tentatively correlated with the Ucross formation of Leopold and Miller (1954). Date is commensurate with the late Wisconsin age assigned that formation, and predates occupation of the site by makers of Hell Gap, Folsom, and Midland artifacts.

A-432. Hell Gap Site, Wyoming  

\[1000 \pm 160 \text{ B.C.}\]

Charcoal from rock-filled fire pit excavated from a buried erosion surface at the Hell Gap site, pump locality \((42^\circ 24' 30'' \text{ N Lat, 104^\circ 38' 8'' W Long})\), Goshen County, Wyoming. Coll. 1962 and subm. 1963 by C. V. Haynes. \textit{Comment}: no diagnostic artifacts were found in association with the hearth, but the stratigraphic position and the date confirm a late prehistoric age.

IV. ARCHAEOLOGY

Casas Grandes series, Mexico

Corn kernels, wood and charcoal from Casas Grandes Archaeological Site \((30^\circ 22' \text{ N Lat, 107^\circ 58' W Long})\) NW Chihuahua, Subm. 1962 by C. C. Di Peso, Amerind Foundation, Inc., Dragoon, Arizona. \textit{Comment}: a tree ring chronology has been established which covers a period of 486 yr from A.D. 851 to A.D. 1336 (Scott, 1963).

A-412. Charcoal, CG(C) 6  

\[640 \pm 30 \text{ A.D. 1310}\]

From Pit Oven 4-1, 200 cm below surface in fill of stone-lined pit; archaeologic site CHIH: D:9:1; associated with Diablo Phase of Tardio Period. Coll. 1958 by B. N. Wettlaufer.

A-415A. Wood, CG(D) 262  

\[820 \pm 50 \text{ A.D. 1130}\]

A-415B. Wood, Humus fraction  

\[560 \pm 180 \text{ A.D. 1390}\]

From upright wood post No. 1, Room 38-11, CHIH: D:9:1; associated with Buena Fe Phase of Medio Period. Coll. 1960 by R. C. Trujillo. \textit{Comment}: wood was leached with hot dilute NaOH, followed by 3N HCl, and washed in distilled water. Wood and humic acid fractions were then measured separately.

A-411. Charcoal, CG(C) 189  

\[710 \pm 40 \text{ A.D. 1240}\]

From 1st floor ceremonial House 1, charcoal in contact with floor in burned room, CHIH: D:9:14; associated with Reyes Phase of Medio Period. Coll. 1959 by R. C. Trujillo.
A-413. Charcoal, CG(C)175  
890 ± 190 A.D. 1060  

A-410A. Corn Kernels, CG(P)53  
1130 ± 100 A.D. 820  
950 ± 160 A.D. 1000  
Corn kernels from under 10 cm of fill on floor of House K, CHIH: D:9:2; associated with Convento Phase of Viejo Period. Coll. 1959 by R. C. Trujillo.  
Comment: House K was overlapped by House J, also of Convento phase, which was overlapped by House S of Pilon Phase. The C¹⁴ chronology of these and other dates at the site agrees within experimental error with the tree-ring chronology.

Carter Ranch series, Arizona  
Charcoal and humates from Site LS-199A along Hay Hollow Wash, Carter Ranch (34° 30’ N Lat, 110° 5’ W Long), ca. 9 mi SE of Snowflake, Navajo County, Arizona. Coll. 1962 by W. A. Lonacre, R. H. Hevly and James Hill; subm. by P. S. Martin, Chicago Nat. History Mus.

A-425a. Pithouse, charcoal  
1020 ± 40 A.D. 930  
A-425b. Pithouse, humates  
1170 ± 180 A.D. 780  
Comment: the archaeological estimate for age of the pithouse is A.D. 600 to 800 and probably the first half of this period; hence the C¹⁴ dates appear too young. This suggests that the C¹⁴/C¹² ratio may have been anomalously high at the time, as is also indicated by recent investigations of Damon and Long (1963). Sample is associated with the floor level of Hevly’s pollen profile LS-199A (Hevly, 1963).

A-427. Lava Beds National Monument  
1160 ± 160 A.D. 790  
House pit timber from Univ. of California Archaeol. Survey Site Sis-101 (41° 49’ 35” N Lat, 121° 29’ 50” W Long), lakeshore bluff about 300 yd NE of Captain Jack’s stronghold, Lava Beds Natl. Monument, California. Coll. and subm. 1962 by B. K. Swartz, Jr., Univ. of Arizona. Comment: the wood beam is directly associated with a component of the Tule Lake Phase, estimated archaeologically to have begun ca. A.D. 1500. The C¹⁴ date appears to be too old, but may mean that an old log was used in pit house construction.

A-389. El Doctor Mining District, Mexico  
1220 ± 65 A.D. 730  
Outer rings of small tree trunk found with stone implements and sandal made of maguey fiber in Ampliacion del Santo Palo mercury mine, in excavation 20 m below surface, covered by debris, El Doctor mining district, municipality of Cadereyta, Queretaro (20° 55’ 00” N Lat, 99° 33’ 30” W Long). Coll. 1962 by Eduardo Sanchez-Garcia; subm. by Carl Fries, Jr. and E. Schmitter,
Inst. de Geol. Univ. Nac. Autonoma de Mexico, Mexico, D. F. Comment: date apparently demonstrates that the Indians of the region mined cinnabar from underground workings in pre-Columbian times. Cinnabar was used as red paint in many murals in pre-Columbian structures in central Mexico.

Wadi Halfa series, Sudan

Wood and charcoal samples from fortresses and habitations along the banks of the Nile in the Wadi Halfa district of Sudan. Subm. 1963 by W. Y. Adams, UNESCO Programme Specialist, P. O. Box 131, Wadi Halfa, Sudan.

A-433. Semna I 3670 ± 60 1720 B.C.

A reinforcing timber built into the wall, 100 cm above present ground level, W portal of N fortress gate, Semna West Fortress (21° 29' N Lat, 30° 58' E Long). Coll. 1962 by Alexander Badawy of U.C.L.A. Expedition to Nubia. Comment: sample from main girdle wall considered to be one of the original features of the fortress built in the reign of Sesostris (=Senusret) III. His reign has been determined by the astronomically fixed chronology as beginning 1887 B.C. and ending 1849 B.C. The timber is badly decayed and termite-ridden. The discrepancy between the expected date and C\(^{14}\) date is in the same direction but not as great as that for another Semna I sample, A-205 (Arizona IV). The difference in the C\(^{14}\) dates for A-433 and A-205 may be due, in part, to the age of the wood at the time of construction of the fortress. The fortress has been described by Dunham (1960).

A-434. Askut II 3560 ± 50 1610 B.C.

A reinforcing timber built into inner face of N girdle wall about 50 cm above present ground level, Fortress of Askut (21° 37' N Lat, 31° 06' E Long). Coll. 1962 by W. Y. Adams. Comment: Askut Fortress is not historically recorded, but on the basis of location, layout and contents it belongs to the well-known Middle Kingdom chain of fortresses built chiefly during the reign of Sesostris III. Askut, like the other fortresses, had a substantial New Kingdom re-occupation, beginning probably in the time of Thutmose III (1501-1447 B.C.). However, the girdle wall from which the sample was taken is of Middle Kingdom construction and is presumed to be part of the original fortress structure. Wood is badly decomposed.

A-435. Mirgissa II 3460 ± 70 1510 B.C.

Wood from horizontal timber built into top of mud-brick wall, part of outer girdle near SE corner of the upper fortress, Mirgissa (21° 48' N Lat, 31° 10' E Long). Coll. 1962 by W. Y. Adams. Comment: one end of the timber was found protruding from the eroded top of the wall, about 3 m above the present ground level. After the overlying bricks were removed a considerable portion of the timber was removed from the wall. Sample is from a point which was 1 m within the wall. Mirgissa Fortress is the only one of the Second Cataract fortresses which has a double girdle wall. Prof. Emery of the Egypt Exploration Society has suggested that the outer wall may have been added in New Kingdom times to strengthen the fortress. However, the outer girdle wall is
architecturally identical to the inner wall and it seems more probable, according to W. Y. Adams, that they were both built during the Middle Kingdom. The construction of the walls is typical of Middle Kingdom Military architecture.

A-437. Buhen III

Wood fragments from inner Middle Kingdom fortification associated with portion of Buhen Fortress (21° 51' N Lat, 31° 17' E Long). Coll. 1962 by W. Y. Adams. Comment: the fortification walls were probably built during the reign of Sesostris II (1903-1887 B.C.).

A-436. Service Site 6-G-25

Charcoal from habitation refuse about 10 cm beneath surface consisting of windblown sand, about 100 m distant from nearest vegetation, Sudan Antiquities Service Site 6-G-25, Unit A-1, Level 1 (21° 55' N Lat, 31° 18' E Long). Coll. 1962 by Hans-Ake Nordstrom.

References:

Date lists:

| Arizona III | Damon and Long, 1962 |
| Arizona IV | Damon, Long, and Sigalove, 1963 |
| Humble I | Brannon et al., 1956 |
| Isotopes IV | Trautman, 1964 |
| Lamont IV | Broecker and Kulp, 1957 |
| Lamont VIII | Broecker and Olson, 1961 |
| Yale VII | Stuiver and Deeeve, 1962 |


Anteves, Ernst, 1959, Geological age of the Lehner Mammoth site: Am. Antiquity, v. 25, p. 31-34.


SHARP LABORATORIES MEASUREMENTS I

JOHN G. ELLIS and RODMAN A. SHARP

Sharp Laboratories Division, Beckman Instruments, La Jolla, California

Radiocarbon measurements were begun at Sharp Laboratories in the spring of 1962 with the construction of a complete C\(^{14}\) dating laboratory. This first system used the method described by Fairhall, Schell, and Takashima (1961) for the conversion of CO\(_2\) to methane via ruthenium catalyst. This system proved to be fast and reliable, giving overall yields of solid sample to counting gas of better than 90% for the total conversion and purification (the conversion yield of CO\(_2\) to methane is quantitative). The detector in present use is 2 L, with construction materials consisting solely of O.F.H.C. copper, teflon, and epoxy resin. The shield consists of 4 in. of high purity lead (specially prepared), 4 in. of borated hydrogenous neutron moderator, a guard counter (cosmic ray detector), and 1 in. of ultra pure mercury. The gross to net ratio obtained with this system averages about 53. The background, for P in cm methane pressure, is:

\[
\text{Background} = 3.95 \pm 0.008 + 0.00705P
\]

To avoid radon and tritium contamination problems with methane, CO\(_2\) and H\(_2\), all gases are specially prepared for us by Victor Equipment Company with only new cylinders and petrochemical sources for CH\(_4\) and H\(_2\). Ruthenium catalyst used for CO\(_2\) to methane conversion has sometimes been blamed by other workers for contamination problems in the final methane. However, this laboratory has investigated this possibility extensively and has never been able to trace contamination to this catalyst (Ellis and Sharp, unpub. ms.).

Presently under construction is a new system for C\(^{14}\) dating and low level tritium counting which will reduce the shield size and weight, reduce the background, and make available a rapid conversion to methane of both C\(^{14}\) labeled CO\(_2\) and H\(^3\) labeled H\(_2\)O (Anand and Lal, unpub. ms.).

This new system is based on the reaction:

\[
4 \text{Zn} + \text{CO}_2 + 2 \text{H}_2\text{O} \rightarrow \text{CH}_4 + 4 \text{ZnO}
\]

This reaction is also quantitative and yields of better than 90% from solid sample to counting gas are obtained. At the present time we can measure 20 T.U. without enrichment, with an accuracy of 10%, and hopefully this will improve as more data is accumulated.

Measurements made by this laboratory are based on the value 5570 \(\pm\) 30 yr for the half life of C\(^{14}\), and 95% the activity of oxalic acid as the modern standard, in agreement with the decision of the Fifth Radiocarbon Dating Conference. The Heidelberg Na\(_2\)CO\(_3\) standard solution with an absolute specific activity of 139.6 \(\pm\) 1.3 DPM C\(^{14}\) per g of C gave a corrected counting rate of 128.1 \(\pm\) 0.039 cpm. This gives a counting efficiency of 92% and a conversion factor to NBS oxalic acid of 9.65.

All samples dated by this laboratory so far have been measured for the purpose of intercomparison with other established laboratories. Two of these samples are 1710 wood and wood from the tomb of King Zoser.
SAMPLE DESCRIPTIONS

SL-3.  Sequoia  239 ± 52  
        A.D. 1711

Wood from between the 230th and 250th growth rings. Tree was cut 26 February 1961. Sample supplied by Scripps Inst. of Oceanography.

SL-8.  Zoser’s Tomb, Egypt  4020 ± 100  
        2070 B.C.

Sycamore wood from roof of tomb of S enclosure, of the step pyramids of Sakkara, the time of King Zoser. Sample supplied by A. E. Bainbridge.

Comment: this sample (Kusumgar et al., 1963) previously dated by:

(1) Bombay  3990 ± 110
(2) La Jolla  4080
(3) Arizona  4240 ± 150
(4) Chicago  3979 ± 350

REFERENCES
GEOLOGICAL SURVEY OF FINLAND
RADIOCARBON MEASUREMENTS III
E. HYYPPÄ, A. V. P. TOIVONEN and A. ISOLA

C14-Laboratory, Geological Survey of Finland, Otaniemi, Finland

The following results represent measurements carried out since our second date list was prepared. The pretreatment of the samples and the production of pure CO2 followed the method described in Finland I.

SAMPLE DESCRIPTIONS

GEOLOGIC SAMPLES

Su-26. Pello, Finnish Lapland 3830 ± 130 1880 B.C.
Carex-Sphagnum peat from hand-dug section, depth 2.0 to 2.1 m, surface alt 84 m, Tornio River Valley (66° 46' N Lat, 24° 04' E Long). Coll. 1955 by Esa Hyyppä. Comment: dating made from the basal part of the same section as Su-25 (Hyyppä and others, 1962).

Su-27. Pori, W Finland, Kiikoinen 1350 ± 140 A.D. 600
Wood from a trough, found in peat bog, depth 0.60 to 0.65 m, surface alt 80.7 m, Kiikoinen, Jylhamaa (61° 30' N Lat, 22° 31' E Long). Coll. 1961 Mus. of Satakunta, Pori. Comment: according to pollen analysis, horizon represents approx. the middle of Sub-Atlantic period.

Su-28. Metsäpirtti, Karelian Isthmus USSR 7110 ± 170 5160 B.C.
Wood from upper part of peat section under silt and fine sand, bank of Viisjoki river (Hyyppä, 1942, p. 158-159) (60° 34' N Lat, 30° 35' E Long). Coll. 1937 by Esa Hyyppä. Comment: according to pollen analysis, horizon roughly corresponds to beginning of Littorina I; the Ladoga transgression seems to have begun at this time, and its water was in the initial stage only 1 to 2 m above the sealevel of Littorina I.

Su-29. Saarijärvi, Middle Finland 4400 ± 130 2450 B.C.
Deciduous-Polypodiaceae peat, depth 0.3 m, alt 127.2 m, Mahlu Her-rainkorpi peat bog (62° 40' N Lat, 25° 20' E Long). Coll. 1962 by Martti Salmi. Comment: according to pollen analysis, horizon represents beginning of spread of spruce (Salmi, 1963a).

Su-30. Saarijärvi, Middle Finland 8490 ± 200 6540 B.C.
The same peat bog as Su-29, Phragmites-Equisetum peat, depth 1.3 m, alt 126.2 m. Coll. 1962 by M. Salmi. Comment: according to pollen analysis, horizon represents Boreal Pinus maximum (Salmi 1963a, b).

Su-31. Pello, Finnish Lapland 6170 ± 160 4220 B.C.
Coarse detritus, depth 3.9 to 4.0 m, surface alt 91.6 m, Pello (66° 46' N Lat, 24° 04' E Long). Coll. 1962 by E. Hyyppä. Comment: according to pollen
analysis, horizon belongs to first half of Littorina stage, when the sea shore had already retreated below the local Littorina maximum (LI). Local LI 94 m above sealevel (Hyyppä, 1963).

**Su-32. Ylöjärvi, W Finland**

7080 ± 140

5130 B.C.

Peat on top of clayey ooze, depth 0.6 m, surface alt 100 m (61° 42' N Lat, 23° 35' E Long). Coll. 1962 by E. Kae. Comment: according to pollen analysis, the peat represents beginning of Littorina period and the underlying ooze represents transgression of Lake Näsijärvi, due to land uplift.

**Su-33. Isokyrö, W Finland**

500 ± 100

A.D. 1450

Betula wood from the foundation pile of a stone church, Isokyrö (63° 60' N Lat, 22° 20' E Long). Comment: C¹⁴ date agrees with historical documents.

**References**

Date lists:

Finland I Hyyppä, Hoffren, Isola, 1962
Finland II Hyyppä, Isola, Hoffren, 1963


RIKEN NATURAL RADIOCARBON MEASUREMENTS I
FUMIO YAMASAKI, TATSUJI HAMADA and CHIKAKO FUJIYAMA
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Natural C\(^{14}\) measurements at the Institute of Physical and Chemical Research (RIKEN) became routine in 1962. The counters presently used are made of stainless steel with a volume of about 2.7 L. They are surrounded by 2.5 cm of pure lead, a ring of 22 propane gas-flow anticoincidence counters, about 10 cm of boric acid and 20 cm of iron. When filled with dead CO\(_2\) up to 2 atm, they gave a background counting rate of about 9 cpm (Hamada, 1960).

In this article, results obtained for geologic and archaeologic samples since 1962 are described. Dates have been calculated on the basis of the C\(^{14}\) half-life of 5568 yr, and 95\% of NBS oxalic acid as modern standard. Correction for isotopic fractionation was not applied.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Daisen series
Carbonized wood and charcoal samples found at various sites around the volcano Mt. Daisen. Coll. and subm. 1961 by Tsurunaga Kimachi.

N-93. Katori 17,710 ± 750 15,760 b.c.
Charred wood of a coniferous tree from Katori, Nawa-machi, Saihaku-gun, Tottori Pref., N side of Mt. Daisen (35° 26' N Lat, 133° 32' E Long), coll. from top of gravel layer (A layer, Misen series), 0.7 m below ground surface, overlain by volcanic sand.

N-95. Shintakata >36,800
Charred wood of a latifoliate tree from Shintakata, Nawa-machi, Saihaku-gun, Tottori Pref., N side of Mt. Daisen (35° 27' N Lat, 133° 31' E Long), coll. from bottom of gravel layer (E layer, Misen series), 3 m below ground surface, overlain by clayey sand.

N-96-1. Shuki 1 >36,800
Charcoal from Shuki, Kurayoshi City, Tottori Pref., E side of Mt. Daisen (35° 25' N Lat, 133° 48' E Long), coll. from charcoal layer 6.0 m below ground surface, overlain by pumice and gravel.

N-96-2. Shuki 2 21,470 ± 1130 19,520 b.c.
Charred wood (Fraxinus verecunda?) from the layer mentioned above.

N-97-1. Ohara 1 22,720 ± 800 20,770 b.c.
Charcoal from Ohara, Kishimoto-machi, Saihaku-gun, Tottori Pref., W
side of Mt. Daisen (35° 23' N Lat, 133° 28' E Long), coll. from charcoal layer, 1 m thick, 25 m below ground surface, overlain by andesite gravel layer.

**N-97-2. Ohara 2**

Charred wood from the layer mentioned above. 
*Comment* (T.K.): samples date the last stages of a major eruption of Mt. Daisen. Dates of N-95 and N-93 are stratigraphically reasonable. N-95 is from same layer as Gak-225 (Gakushuin II). Much younger age previously found (Gak-163, Gakushuin I) is supposed due to a landslide, not to an eruption. Discrepancy between dates of N-96-1 and N-96-2 is unreasonably large.

### II. Archaeologic Samples

**Toro and Utoh series**

Wood, mostly worked, from dwelling sites at Toro (34° 57' N Lat, 138° 25' E Long) and Utoh (34° 58' N Lat, 138° 24' E Long), Shizuoka City, Shizuoka Pref., excavated during 1945 to 1950. Samples were found 1 to 2 m below ground surface, in alluvial sand and clay at ancient bed of Abe River and associated with Yayoi pottery. General description about Toro remains is given by Japan Archaeol. Assoc. (1954). Coll. by K. Mochizuki; subm. 1962 by O. Yamada.

**N-70. Toro 1**

Part of wooden bowl.  
1950 ± 130  
A.D. 0

**N-71. Toro 2**

Wooden warp beam.  
1940 ± 120  
A.D. 10

**N-73. Toro 3**

Part of wooden construction.  
1940 ± 100  
A.D. 10

**N-76. Utoh 1**

Wooden stake.  
2280 ± 120  
330 B.C.

**N-77. Utoh 2**

Unfinished wooden farming tool.  
1990 ± 120  
40 B.C.

**N-79. Utoh 3**

Wooden base plate.  
2110 ± 120  
160 B.C.

**N-81-2. Utoh 4**

Wooden rod for unknown use.  
1970 ± 120  
20 B.C.

**N-52. Kuriu**

1490 ± 160  
A.D. 460

Charcoal from a ceramic kiln of historic age at Kuriu, Mashiko-machi, Haga-gun, Tochigi Pref. (36° 26' N Lat, 140° 8' E Long). Kiln used for firing

**N-53. Nishippara**

Charcoal from a dwelling site of Jomon period at Owasu, Nasu-machi, Nasu-gun, Tochigi Pref. (36° 57' N Lat, 140° 10' E Long). Excavated 1954 by R. Watanabe and S. Tatsumi of Gunma Univ. Material found together with pottery vessels, hearths, and stones in black soil layer at a level of 30 to 40 cm below ground surface. Pottery of Obora C-2 type. Coll. and subm. 1959 by N. Watanabe.

**N-57. Ochiai**


**N-59. Horinouchi**

Charred timber of a burnt house at Horinouchi shell mound, type site of Horinouchi type of Jomon pottery, located at Kokubun-machi, Ichikawa City, Chiba Pref. (35° 44' N Lat, 139° 55' E Long). Material from one of two dwelling pits unearthed 1954 by M. Nishimura of Waseda Univ. Pottery of Horinouchi I type. Coll. by M. Nishimura; subm. 1959 by N. Watanabe.

**N-61. Yoto**


**N-68. Goryo**


**N-91. Yarimizu**

Charred wood from a kiln-like structure of unknown use at Yarimizu, Yugi-mura, Minami-Tama-gun, Tokyo (35° 37' N Lat, 139° 21' E Long). Excavated 1958 by I. Kono of Kunitachi Music College. Charred timbers found lying parallel to each other on the base of a rectangular pit, measuring 1.5 m × 0.5 m, and 40 cm deep. No potsherds in the pit. Coll. and subm. 1959 by N. Watanabe.
N-94. Ishigami

Charcoal from a shell layer of shell mound at Ishigami, Kawaguchi City, Saitama Pref. (35° 51' N Lat, 139° 44' E Long). Excavated 1954 by T. Kubo of Rissho Univ. Jomon pottery from the shell layer of Angyo II type. Coll. and subm. 1959 by N. Watanabe.

Date lists:
Gakushuin I Kigoshi, Tomikura and Endo, 1962
Gakushuin II Kigoshi and Endo, 1963
CAMBRIDGE UNIVERSITY
NATURAL RADIOCARBON MEASUREMENTS VI
H. GODWIN and E. H. WILLIS
Cambridge University*

INTRODUCTION

The dates and activity measurements given below have been obtained during 1962 and 1963, and have been made with CO2 at 3 atm pressure in a proportional gas-counter very little modified from those described in previous contributions from this laboratory.

As hitherto, we have concentrated largely upon determinations essential to research projects being pursued in the University Sub-department of Quaternary Research. We have also undertaken a series of measurements of C14 in the lower stratosphere over the period March 1962 to April 1963 following resumption of testing of thermo-nuclear weapons in late 1961; this work was done in conjunction with Dr. A. G. Maddock of the University Department of Chemistry, and with the assistance of Dr. F. Alonso.

We particularly wish to acknowledge the help of R. J. F. Burleigh, Technical Assistant in the Radiocarbon Dating Laboratory until November, 1962 and G. A. Sutton, who has succeeded him.

SAMPLE DESCRIPTIONS

BRITISH ISLES

A. Weichselian (Last Glaciation)

Radiocarbon dates have been sought for several plant-bearing organic deposits in SE England. The question is whether the C14 dates appear to cluster upon periods hitherto associated with climatically determined interstadia, or are so scattered as to suggest that deposits are local incidents of incorporation. If the latter, then the abundant floristic and faunal remains can be taken as representative of organic life that persisted through the last British glaciation south of the ice margin.

Q-590. Barnwell Station, Cambridge 19,500 ± 650 17,550 B.C.

Plant detritus washed from calcareous marl and leached with HCl (50° 11’ N Lat, 0° 07’ E Long). Gravels of the lowest terrace of the River Cam contain bones of reindeer and mammoth and are overlain by sandy marls with peaty seams rich in plant material from which Miss Chandler (1921) id. a rich periglacial flora including arctic birch and willow. Columella columella is also characteristic of deposits. Biotic assemblages resemble those of Lea Valley Arctic plant bed (Q-25, 28,000 ± 150 B.P., Cambridge II), although perhaps indicative of somewhat colder conditions. Deposits are now destroyed; sample had been coll. and stored many years previously. Coll. by H. Godwin.

* Radiocarbon Dating Laboratory, 5 Salisbury Villas, Station Road, Cambridge, and University Sub-department of Quaternary Research, Botany School, Cambridge, England.
Q-657.  **Broome Heath, Norfolk. Sample A**

29,500 ± 1500

**27,550 B.C.**

Drift mud with twigs, leaves etc., and laminae of silt (52° 28' 40" N Lat, 1° 27' 45" E Long). Found on surface after excavation by mechanical digger from below 10 to 30 ft of gravel. Probably a fluvioglacial deposit of the last or penultimate (Gipping) glaciation. Plant remains show rich periglacial flora. Coll. 1959 by R. G. West, Botany School, Cambridge. *Comment*: see note on Q-740.

Q-740.  **Broome Heath, Norfolk. Sample B**

>40,000

Organic remains sieved out from drift mud with twigs, leaves etc., and laminae of silt (52° 28' 40" N Lat, 1° 27' 45" E Long). Same provenance as Q-657 above. Coll. 1959 by R. G. West. *Comment*: sieved and washed plant remains will be more trustworthy than unsorted and possibly contaminated unsieved material of Q-657; therefore an age greater than 40,000 yr is probable for both samples.

**B. Late Weichselian**

**Roddan's Port Series, Co. Down, Northern Ireland**

During 1957 and 1958 research workers at Queen's Univ., Belfast investigated a coastal exposure of organic deposits laid down in inter-drumlin hollows and subsequently covered by lagoon clay, sands and gravels of the 25 ft raised beach. Site is at Roddan's Port (54° 31' N Lat, 5° 31' W Long), in Co. Down. Characteristic tripartite stratigraphy of W European Late-glacial was exhibited in a sequence from below upwards of grey clay, organic muds (40 to 50 cm), and solifluxion clay (80 to 90 cm), succeeded by organic muds going over into *Phragmites* peat. After preliminary pollen-analyses had confirmed age of deposits, a substantial monolith was taken through the beds; careful pollen-analyses were made at Belfast by M. E. S. Morrison at close intervals all through it. With the completed pollen diagrams before us, slices, usually 1 or 2 cm thick, were cut from chosen levels in the monolith and were brought for C\(^{14}\) assay to Cambridge. It was hoped that samples through lower organic mud would give date and length of the mild Allerød interstadial, and that samples from upper organic bed would give local dates of pollen zone boundaries. Samples are given in strict stratigraphic sequence from below upwards, with local index numbers appended; these are based on centimeter measurements but do not follow a strict sequence.

**Q-360. Roddan's Port, Co. Down (R 2962 + 2963)**

12,110 ± 190

**10,160 B.C.**

Grey freshwater or brackish water clay with some organic content, near top of Zone I, periglacial flora with *Salix* pollen maximum and abundant *Potamogeton* pollen.

**Q-358. Roddan's Port, Co. Down (R 2967 + 2968)**

11,950 ± 190

**10,000 B.C.**

Compressed detritus mud from bottom 2 cm of organic layer, taken as top of Zone I (pollen) or base of Zone II (lithology). Beginning of rise of pollen curves of *Juniperus* and *Empetrum*: high *Rumex*. 
Q-359. Roddan’s Port, Co. Down (R 2969 + 2970) 11,845 ± 190
11,830 ± 190 9895 B.C.
9880 B.C.

Organic mud from base of Zone II and immediately above Q-358.

Q-361. Roddan’s Port, Co. Down (R 2980 + 2981) 12,090 ± 190
10,140 B.C.

Organic mud about two thirds down Zone II muds at horizon of Rumex pollen decrease.

Q-362. Roddan’s Port, Co. Down (R 2982 + 2983) 11,390 ± 190
9440 B.C.

Organic mud, immediately above Q-361.

Q-363. Roddan’s Port, Co. Down (R 2991) 11,450 ± 190
9500 B.C.

Organic mud from near middle of Zone II, horizon of decrease of Juniperus.

Q-364. Roddan’s Port, Co. Down (R 3004) 11,770 ± 190
9820 B.C.

Organic mud from near top of Zone II, marked lithologically and by rise of pollen of Cruciferae and Caryophyllaceae.

Q-365. Roddan’s Port, Co. Down (R 3006) 11,480 ± 150
9520 B.C.

Transition from organic mud to solifluxion clay at Zone II/III transition, and 2 cm above Q-364.

Q-369. Roddan’s Port, Co. Down (R 2944) 11,660 ± 170
11,370 ± 170 9720 B.C.
9420 B.C.

Boundary between solifluxion clay and overlying organic mud, base of Morrison’s transition Sub-zone III/IV in which pollen of open habitats remains abundant before the expansion of birch woodland.

Q-370. Roddan’s Port, Co. Down (R 2945 + 2946) 10,070 ± 150
8120 B.C.

Organic mud at base of Sub-zone III/IV as Q-369 and immediately above that sample.

Q-371. Roddan’s Port, Co. Down (R 2954) 10,130 ± 170
8180 B.C.

Phragmites peat from base of Morrison’s Zone IV marked by rise in pollen frequencies of Betula, Juniper, Salix and Tree-shrub/Herbaceous pollen ratio.

Q-368. Roddan’s Port, Co. Down (R 2955) 10,210 ± 150
8260 B.C.

Phragmites peat from middle of Zone IV, marked by fall in Betula and Salix curves and rise in Gramineae—possibly only local.
Q-366.  Roddans Port, Co. Down (R 13)  \[9430 \pm 150\] 7480 B.C.

*Phragmites* peat at Zone IV/V transition, marked by sudden expansion of *Corylus* pollen to maintained high frequencies and some rise of *Pinus* and fall of *Betula*: rise of tree and shrub pollen to complete dominance.

Q-367.  Roddans Port, Co. Down (R 10)  \[9090 \pm 150\] 7140 B.C.

*Phragmites* peat at Zone V/VI transition at beginning of curves for *Ulmus* and *Quercus* pollen.

Comment: the last four samples in series, all in *Phragmites* peat, yield values generally in accord with dates hitherto found in Britain for the earliest postglacial pollen-zones: thus Scaleby Moss (Cambridge I; Godwin, Walker and Willis, 1957).

V/VI transition — Q-161, 9009 \(\pm\) 194 and Q-162, 8816 \(\pm\) 192.

IV/V \(\rightarrow\) — Q-155, 9747 \(\pm\) 193 and Q-154, 9564 \(\pm\) 209.

III/IV \(\rightarrow\) — Q-152, 10,160 \(\pm\) 193, Q-151, 10,264 \(\pm\) c. 350, and

Q-153, 10,325 \(\pm\) 215 B.P.

The two adjacent samples Q-369 and Q-370 have yielded dates widely out of agreement despite repeated checks. That for Q-370 is closest to expectation of Zone III/IV boundary date, but low assay of Q-369 is unexplained.

Samples Q-360, Q-358, Q-359 that cover the I/II Zone boundary give the expected date ca. 12,000 B.P. Likewise Q-362 and Q-363 have given dates expected for middle of Zone II. Sample Q-361, subjacent to Q-362, yields a far older date, and likewise samples Q-364 and Q-365 are older than expected, Q-364 having a determined age greater than that of samples considerably below it in the section. These unexpectedly great ages are probably the result of incorporation of inactive carbon in the organic muds, the ‘hard-water error’, a suggestion borne out by presence of *Chara* and fresh water mollusca in these open water muds. Erratic incidence of this presumed error is noteworthy, and reinforces the untrustworthiness of some organic muds for dating purposes.

Although close dating of late-glacial zone boundaries has not been realized, and although method lacks the sensitivity needed to date small sub-zones, such as the suggested III/IV transition zone, there is a good deal of correspondence with late-glacial zone boundary hitherto obtained for Britain (Godwin and Willis, 1959).

**Bigholm Burn series, Dumfriesshire, Scotland**

Stream erosion exposed an important section on E bank of Bigholm Burn, Dumfriesshire (55° 07' 15" N Lat, 3° 04' 30" W Long) Natl. Grid Ref. 316812, alt ca. 480 ft O.D., 4 mi SW of Langholm. It has been fully investigated by Neville T. Moar of Cambridge Sub-dept. of Quaternary Research, who coll. the samples in 1962.

Oldest beds in section are varved clays; as the lake shallowed these were replaced by a thin layer of organic muds (No. 1). This stage ended with deposition of solifluxion gravels ca. 1 m thick, enclosing a lens of silty organic mud 70 cm from its base (No. 2). On the surface of the solifluxion gravels
organic muds were laid down, the earliest represented by sample No. 4, and these (8 cm) pass upwards into dark *Phragmites* peat (40 cm) and then compressed wood peat (No. 8) 70 cm thick. These upper muds and peats have total thickness of ca. 2.5 m, but attention was concentrated on lower beds, for which lithological sequence and pollen analyses indicated a Late-glacial age with the solifluxion gravels possibly referable to Zone III.

**11,820 ± 180**  
**11,580 ± 180**  
**9870 B.C.**  
**9630 B.C.**

Q-694. Bigholm Burn, Dumfriesshire No. 1

Organic mud from 13 cm layer below thick solifluxion gravels. Extremely low tree pollen frequencies, very high local frequency of carices; open vegetation of periglacial type indicated. *Comment*: date corresponds with that of Zone II (Allerød) deposits elsewhere in Britain.

**10,820 ± 170**  
**8870 B.C.**

Q-695. Bigholm Burn, Dumfriesshire No. 2

Basal 6 cm of silty organic mud lens 10 cm thick in the solifluxion gravels. Pollen spectra similar to those of Q-694. *Comment*: date corresponds with middle Zone III dates in Britain.

**9590 ± 170**  
**9470 ± 170**  
**7640 B.C.**  
**7520 B.C.**

Q-697. Bigholm Burn, Dumfriesshire No. 4

Brown organic mud layer, 8 cm thick, directly overlying solifluxion gravels, with pollen representing a rich but open periglacial vegetation including much *Juniperus* and *Salix*, but few trees; high frequencies of pollen of *Myriophyllum alterniflorum*. *Comment*: date is considerably younger than Zone III/IV transition, and may indicate local delay in deposition of organic muds after the cold period represented by solifluxion gravels.

**7640 ± 160**  
**5690 B.C.**

Q-701. Bigholm Burn, Dumfriesshire No. 8

Dark brown woody peat (*Betula*) from basal part of wood layer. Beginning of rise of pollen curves of *Quercus* and *Ulmus* and just before maximum of *Corylus*, i.e., opening of Zone VI. *Comment*: date is much younger than V/VI Zone transition previously recorded (e.g. Scaleby Moss) and it is possible that growth of birch trees *in situ* in Zone VIc has led to disappearance of a large part of Zone VI.

Q-673. Kirkmichael, Isle of Man. Site 3

**10,270 ± 170**  
**8320 B.C.**

"Peat" from coastal cliff section (54° 17' N Lat, 4° 35' W Long) Natl. Grid Ref. 312909. The section reported by G. F. Mitchell of Trinity College, Dublin is as follows: 0 to 1450 cm, gravels forming terrace at top; 1450 to 1458 cm, sandy clay with vegetable debris (dated sample); 1458 to 1565 cm, sandy chalk mud; 1565 to 1567 cm, non-calcareous organic mud; 1567 to 2177 cm, cryoturbated gravel; 2177 to 2377 cm, boulder clay cryoturbated on top; 2377 to 4077 cm, gravels and boulder clays, the lowermost believed to be of Gipping age.
Macroscopic plant remains in vegetable layer indicate periglacial conditions including *Salix herbacea*, *Selaginella selaginoides*, etc. Sample will test age of gravel infill. Coll. 1962 by G. F. Mitchell, Trinity College, Dublin. *Comment:* C\(^{14}\) age is very close to that generally found for the end of Zone III. The great depth of gravel above it indicates remarkable infilling activity that correlates best with Zone III itself.

**Q-758. Blelham Tarn, Lancashire, W Kettlehole, 432/9 cm**

Detritus nekron mud from NW margin of Blelham Tarn (54° 23′ N Lat, 2° 59′ W Long), Natl. Grid Ref. 35/365006, alt 138 ft O.D., 13/4 mi NE of Hawkshead. Stratigraphy, first recognized by Frank Oldfield, was checked by a second Hiller boring by G. H. Evans, who later recovered it in a C\(^{14}\) corer of wider diam. Sequence is as follows: to 400 cm, Postglacial nekron muds and peats and Zone III grey clay; 400 to 427 cm, fine detritus silty nekron mud (presumed Zone II); 427 to 432 cm, grey silt (presumed Zone I); 432 to 438 cm, greasy micro-laminated detritus silty nekron mud (C\(^{14}\) sample); 438 to 450 cm, blue-grey clay; 450 cm on, gravels.

Pollen analyses carried out by Mr. Evans (in conjunction with diatom analyses) clearly indicate presence of Zone II and Zone III deposits beneath early postglacial muds. The microlaminated mud (432 to 438 cm) differs lithologically and pollen-analytically from Zone II deposits here and elsewhere in the region and should probably be referred to Zone I. This is supported by the very high ratio for *Rumex* pollen in it along with the usual periglacial assemblage, and by the great decrease in the AP/NAP ratio in the grey silty layer overlying it (427 to 432 cm). Coll. summer 1963 by G. H. Evans of Sub-dept. of Quaternary Research, Cambridge. W. Tutin of Univ. of Leicester is pursuing more detailed pollen analyses on these deposits. *Comment:* C\(^{14}\) date unequivocally places sample in Zone I, ca. 1000 yr before any part of Zone II; deposit is quite non-calcareous and possibility of a hard-water error is slight.

**Q-643. Roberthill, near Lockerbie, Dumfriesshire 12,940 ± 250 10,990 b.c.**

Wood (55° 06′ N Lat, 3° 24′ W Long), Natl. Grid Ref. 35/110794, from a 1 ft bed of silty detrital peat occurring 3 ft from the base and within parallel bedded grey clays, silts and fine sands, at least 14 ft in thickness, exposed in E bank of River Annan at Roberthill. These still-water deposits probably originated in a former “Loch Maben,” remnants of which can be seen locally; they become sandier towards the top and overlie clean unconsolidated ochreous gravels possibly of fluvio-glacial origin. Pollen-analyses by Neville Moar from four levels in the peat indicate an open landscape with stands of *Betula* (and much *B. nana*), *Salix* and *Juniperus*, with an assemblage of plants characteristic of the British Late-glacial, such as *Hippophae rhamnoides*, *Armeria maritima* and the genera *Helianthemum*, *Thalictrum* and *Urtica*. Coll. 1961 by W. W. Bishop, Uganda Mus., Kampala. *Comment:* C\(^{14}\) age suggests reference to Pollen Zone I and this agrees well with lithology and pollen-analytic indications. Accumulation of peat layer may point to temporary climatic
amelioration or merely to local conditions permitting growth of aquatic vegetation.

C. Postglacial Vegetational history

A primary objective of the Cambridge Sub-dept. of Quaternary Research has been to establish by pollen analysis the detailed picture of postglacial vegetational history in Britain, and it is thus essential to secure C\(^{14}\) dates on pollen-zone boundaries at widely spread sites. We have made use of an extracted monolith wherever possible (as in the Roddan’s Port series, see above) or of the core from a wide diam borer, from which a transverse slice 1 or 2 cm thick will yield a clean sample big enough for C\(^{14}\) assay. We are often able to date vegetational zones by series of pollen-dated samples secured in investigations also involving other major correlations, such as Mesolithic archaeology in the Thatcham series which follows, and land-sea level changes in the Port-Talbot sequence.

Thatcham, Berkshire series

From 1922 onwards the gravel terrace beside the River Kennet 1 mi ESE of Thatcham, Berkshire (51° 24’ N Lat, 1° 17’ W Long), has yielded abundant evidence of occupation by Mesolithic man. Although artifacts were abundant on the terrace surface itself, dating of them depended largely upon their recovery from a stratified deposit; thus during the summer of 1961 a coffer dam was sunk into swamp sediments at the foot of the terrace and contents were excavated by a team led by J. J. Wymer of the Reading Mus. D. M. Churchill (Sub-dept. of Quaternary Research, Cambridge) worked out the stratigraphy. Calcareous marls of the channel permitted pollen-analytic reference to a series of zones, and although the marls themselves were unsuitable for C\(^{14}\) assay, they yielded satisfactory samples of embedded wood (samples Q-650, 651, 652, 677). Hearth sites on the terrace were eventually covered by silt and by fen peat which at a later stage dried out to form a hard black aggregate wrongly described in earlier work as ‘charcoal’; a C\(^{14}\) date for this peat has already been published (BM-65, 8090 ± 180 B.P.). For dating of Mesolithic hearths on the terrace it was important to avoid confusion with this dried peat, and Q-658 and 659 consisted only of partly combusted wood and shells of hazel nuts.

Q-651. Thatcham, Berkshire. Site 5, No. 3

Wood of *Betula* and *Pinus* from level 2 ft 5 in. to 2 ft 11 in. below top of white algal marl, lowest horizon at which artifacts were found. Pollen analyses indicate Zone IV. Coll. June 1961 by D. M. Churchill.

Q-650. Thatcham, Berkshire. Site 5, No. 2

Black disintegrated wood 2 ft below top of white algal marl. Level contained (Mesolithic) birch bark roll, and pine cones (not combusted). Pollen Zone V. Coll, June 1961 by D. M. Churchill.

Q-677. Thatcham, Berkshire. Site 5, No. 4

Fresh wood from same level as Q-650, Pollen Zone VI. Coll. June 1961 by D. M. Churchill.
Cambridge University Natural Radiocarbon Measurements VI

Q-652. Thatcham, Berkshire. Site 5, No. 1

9480 ± 160
9500 ± 160
7530 B.C.
7550 B.C.


Q-658. Thatcham, Berkshire. Site 3, No. 1

10,030 ± 170
8080 B.C.


Q-659. Thatcham, Berkshire. Site 3, No. 2

10,365 ± 170
8415 B.C.

Charcoal from another Mesolithic hearth in occupation layer on river terrace (Churchill, 1962; Wymer, 1962). Coll. June 1961 by J. J. Wymer. Comment on Thatcham series: evidence of the terrace hearths and of the coffer dam samples together indicates that Mesolithic occupation extended at least from ca. 10,365 to ca. 9480 B.P. Dates from samples within the coffer dam are self-consistent, duplicate runs of Q-652 agree closely, and Q-650 and Q-677 from the same level have given similar dates to one another. When we come to consider the bearing of these dates upon the ages of pollen zones it has first to be noted that the algal marls were so poor in pollen that analyses could be made at only five levels. Thus although the C¹⁴ samples fairly certainly refer to Zones IV, V and VI we do not know from what part of the zone each comes; Q-650 and Q-677 may be early in Zone V (which is known to persist 6 in. higher) but we cannot place Q-652 within Zone VIa, or Q-651 within Zone IV. This contrasts sharply with Scaleby Moss (Cambridge I; Godwin, Walker and Willis, 1957) where pollen analyses were at very close intervals and C¹⁴ samples were taken in very close relation to zone boundaries. With this in mind we note that date for Zone IV Q-651 (9840 B.P.) corresponds closely with the mean of oldest and youngest dates for Zone IV at Scaleby; (early) Zone V dates for Q-650 and Q-677 (9670 and 9780 B.P.) correspond with date for base of Zone V at Scaleby (Q-155, 9747); Zone VIa date for Q-652 (9480 and 9500 B.P.) falls about 500 yr earlier than the opening of Zone VI at Scaleby (Q-161, 9009 B.P.). This therefore seems good evidence that Zone VI opened earlier in S Britain than in the north, and that Zone V lasted longer in the north.

Port Talbot, Glamorgan Series

Messrs. George Wimpey & Co. Ltd. in 1960/61 made exploratory borings for a harbour development scheme at Baglan Burrows, near Port Talbot, South Wales (51° 52' N Lat, 3° 48' W Long), and in several bores encountered peat beds at considerable depths below present sealevel. They sent us boring logs and peat from some of the cores; we selected two cores (19 and 4) as particularly promising and investigated basal peat from each by pollen-analysis,
extraction of fruits and seeds, and C\textsuperscript{14} dating. The basal compacted peat, ca. 20 cm thick, from bore 19 rested upon dense rounded gravel in a matrix of sandy silt at \(-63.1\) ft O.D., and was covered by sands and silty clays (result of postglacial marine transgression) to a height of \(+24.4\) ft O.D. Closely spaced pollen samples through the peat layer showed that it extended from the opening of Pollen Zone IV into Zone VI; samples for C\textsuperscript{14} dating were therefore taken from four horizons including the three pollen-zone boundaries. Borehole 4 also terminated in a similar gravel at similar depth (\(-64.6\) ft O.D.) on which rested a peat bed 5 ft thick, succeeded by sands, clays and silts to a height of \(+28.4\) ft O.D. Unfortunately we do not know from what part of the peat bed came the 15 cm section sent to us; it was remarkable in that continuity of the peat was broken by an irregular transverse wedge of pebbly sand. Again samples for pollen-analysis, fruit and seed extraction, and C\textsuperscript{14} dating were taken.

Q-660. Port Talbot, Glamorgan, Bore 19, 4.5 to 6 cm 10,350 \pm 170 8140 b.c.
Compressed fresh-water Phragmites peat with bud-scales of Salix and nutlets of Lycopus europaeus, taken at pollen zone boundary III/IV.

Q-661. Port Talbot, Glamorgan, Bore 19, 8.5 to 10 cm 9920 \pm 170 7970 b.c.
Compressed fresh-water peat across pollen zone boundary IV/V.

Q-662. Port Talbot, Glamorgan, Bore 19, 12.5 to 14 cm 8990 \pm 170 7040 b.c.
Compressed fresh-water peat across pollen zone boundary V/VI.

Q-663. Port Talbot, Glamorgan, Bore 19, 20 to 21 cm 8970 \pm 160 7010 b.c.
Compressed fresh-water peat within Pollen Zone VI.

Comment on samples from Bore 19: ages for the III/IV and V/VI boundaries are close to those obtained from Scaleby Moss, but that for the IV/V boundary is older than corresponding Scaleby date and closer to that indicated for Thatcham by Q-650 and Q-677 (see above). Date for Q-663 is surprisingly close to that of Q-662, which is (in this compressed material) substantially below it. Sample Q-663 indicates that the postglacial eustatic rise of sealevel above—62 ft O.D. on this coast must have taken place after 8970 \pm 160 b.p., or at this date if no depositional gap exists between the top of this peat bed and overlying marine deposits. Latter view is closely in accord with the identification of a submergence of peat at—52 ft O.D. in Swansea Bay as within Pollen Zone VIb (Godwin, 1940a) and supplements the general curve of eustatic rise of sealevel which is being progressively defined (Godwin, Suggate and Willis, 1958).

Q-664. Port Talbot, Glamorgan, Bore 4, 12 cm 11,980 \pm 180 10,030 b.c.
Compressed fine-detritus mud from 5 ft peat bed resting on gravel at \(-64.6\) ft O.D., containing macroscopic remains of Phragmites, tree birch, Typha, Valeriana officinalis, frequent Carex rostrata, Potentilla palustris and abundant Menyanthes trifoliata (i.e., a fen community). Pollen of general late-
glacial character, a high N.A.P./A.P. ratio and characteristic range of herbaceous pollen types.

**Q-665. Port Talbot, Glamorgan, Bore 4, 3 cm**  
11,260 ± 170 9310 B.C.

Compressed fine-detritus mud taken 9 cm above Q-664, again with abundant seeds of *Menyanthes trifoliata*, and a characteristic late-glacial pollen assemblage, but with a higher Betula/Pinus ratio than in lowest sample of bed. *Comment on samples from Bore 4*: the 4 pollen spectra from this 15 cm peat bed suggest a late-glacial deposit, presumably of Alleröd age, and this is borne out by the two C\(^14\) dates which seem to span the dates given for this stage (Zone II) in the British deposits (Godwin and Willis, 1959). Results do not conflict with the conclusion derived from the Bore 19 samples, that the eustatic rise in ocean level did not affect levels of −60.0 ft O.D. on this coast until well into the postglacial period. They reinforce conclusions of pollen analysis from Swansea Bay (Godwin, 1940a) and of basal peat layers from other bores at Port Talbot, that upon an irregular surface of drift fresh-water organic muds and peats accumulated locally from Zone II to Zone VI, when the eustatic rise of sealevel intervened. This parallels the development for the drumlin moraine territory of the coast at Roddan’s Port (Q-364 to 371). The irregular wedge of pebbly sand that in the core separated Q-664 and Q-665, may be solifluxion material introduced in the succeeding cold Zone II, but precise evidence is lacking.

**D. Archaeologic Samples**

**Q-707. Ickornshaw Moor, West Riding, Yorkshire**  
8100 ± 150 6150 B.C.

Charred hazel nuts (*Corylus avellana*) (53° 50' N Lat, 2° 3' W Long) Natl. Grid Ref. 959406, 1125 ft O.D. on Aire-Ribble watershed. Closely associated with a Mesolithic industry in chert on surface of mineral soil. Although living roots penetrate to the mineral soil they seem not to affect the nut shells. Coll. Oct. 1962 by J. Davies, 91 Emm Lane, Bradford. *Comment*: basal peat gives only terminal date for underlying Mesolithic industry on Pennine Hills and strictly contemporary dating material such as this is infrequent. The Mesolithic industry below blanket peat at Stump Cross, near Grassington, Yorkshire (Q-141) had similar age (6500 ± 310 B.C.).

**Q-669. Catcott Burtle, Somerset, yew bow**  
3270 ± 110 1320 B.C.

Yew wood (51° 12' N Lat, 2° 48' W Long), segment cut from a bow now in Taunton County Mus., from peat diggings near Catcott Burtle. Bow is a tapering main stem of yew showing the bases of several whorls of lateral branches (Clark, 1963).

**Q-684. Cambridge, yew bow**  
3680 ± 120 1730 B.C.

Q-760.  **Weston Wood, Albany, Surrey, W.W.63; 2460 ± 110 A12(P)**

Carbonized cereal grains (51° 13' N Lat, 0° 28' W Long) from storage pit of Late Bronze Age homestead, associated with 20 ft diam house, quern house, working floor, cultivated plots, copper, bronze and flint flake tools, and pottery assigned by C. Hawkes to one period ca. 800 to 750 B.C. Cereals include *Triticum dicoccum* and other sp, and a six-rowed barley (*Hordeum*). Excavated in May to July 1963, and coll. by Miss J. M. Harding, 57 The Green, Elwell, Surrey for the Surrey Archaeol. Soc.; forwarded by A. H. Bunting. Univ. of Reading. **Comment:** In good general agreement with expectation, but may point to some small (local) modification of Late Bronze Age chronology.

**Monamore, Isle of Arran series**

Euan MacKie of Hunterian Mus., Univ. of Glasgow during June and Sept. 1961 excavated a Neolithic chambered tomb at Monamore, Arran, Buteshire (55° 30' 49'' N Lat, 5° 8' 24'' W Long), Natl. Grid Ref. NS/0172 2887. The Neolithic cairn was built on undisturbed soil, but as result of soil erosion on slopes above, the forecourt was gradually filled with earth so fires periodically lit there were stratified one above the other. Charcoal samples coll. from various levels from base to top, so as to cover whole time of construction and use, but only two proved large enough for C¹⁴ assay. Termination of occupation is indicated by the laying down of a stone blocking pavement, which greatly lessens the chance of any subsequent root penetration from above into the forecourt deposits now assayed. Publication by E. MacKie will be in *Proc. Soc. Antiq. Scotland*, and *Antiquity*, 1963.

Q-675.  **Monamore, Arran, Buteshire, No. 2 5110 ± 110 3160 B.C.**

Charcoal from Hearth 22, at 2 ft 10 in., half way down the black colluvi-um of the forecourt and beneath stones of blocking pavement.

Q-676.  **Monamore, Arran, Buteshire, No. 3D 4190 ± 110 2240 B.C.**

Charcoal from Hearth 25, at depth of 2 ft 4 in. and immediately below stones of blocking pavement, i.e. at end of occupation.

**General Comment** (E.M.): both charcoal samples, probably from the remains of fires, came from deposits which had accumulated in the forecourt after the construction of the cairn and there is therefore little doubt that they date the period of its construction and use. A late 4th millennium B.C. date for the arrival of some of the first agricultural immigrants in southwest Scotland is of interest in that it is closely comparable with the earliest Neolithic dates obtained in southern England. The second date, from just before the final closure of the tomb, seems to imply that this burial cairn was in use for perhaps as much as a thousand years.

Q-672.  **Westward Ho, Devonshire No. 1 6585 ± 130 4635 B.C.**

Peat (51° 2’ 30’’ N Lat, 4° 13’ 50’’ W Long), uppermost 3 in. of an 8 in. peat bed accumulated on the foreshore above a Mesolithic midden, and part of the submerged forest exposed below mean tide-level. Peat now stands at −7.0 ft
Q-770. Ringneill Quay, Co. Down. Occupation No. 3 5380 ± 120 3430 B.C.

Charcoal (54° 32' N Lat, 5° 30' W Long) from Mesolithic kitchen midden within 25 ft raised beach on NW shore of Strangford Lough, Northern Ireland. Deposits excavated by Stephens and Collins (1960) and three C14 dates from the site have already been published (Cambridge V). Occupation layer associated with abundant bones of ox, pig, and sheep, lies immediately above lagoon clays, assigned to near pollen zone boundary VI/VII and already C14 dated (Q-632, 7345 and 7500 ± 150 B.P.). Coll. 1963 by M. Jope, Dept. of Archaeol., The Queen's Univ., Belfast. Comment: dates previously obtained from 'the occupation layer' (Q-663, 3680 ± 120 B.P.) and from shells of midden on crest of beach (Q-635, 2660 ± 110 B.P.) indicate that beach surface was occupied for a long period but neither date was old enough to correspond with Mesolithic character of the industry described by Stephens and Collins. Therefore, M. Jope sought to recover material unequivocally from Mesolithic occupation level; date now obtained would correspond with Mesolithic/Neolithic transition, as also exhibited by the raised-beach settlement at Dalkey Island, Co. Dublin (D.38, 5300 ± 170 B.P., and as perhaps pointed to by the nature of the animal bones (M. Jope's appendix to Stephens and Collins, 1960).

Q-530. Freshwater West, Pembrokeshire. 4 to 7 cm 5960 ± 120 4010 B.C.

Wood peat (51° 39' N Lat, 05° 05' W Long) from submerged peat at low tide mark on the foreshore, resting upon boulder clay, and associated with a microlithic (Mesolithic) industry (Wainwright, 1960; Leach, 1918; Clark, 1955). Pollen analyses confirm this is a post-Boreal peat (Zone VII or later); macroscopic plant remains indicate fen-wood conditions. Artifacts mostly occurred on clay surface but some were in the basal few cm of the peat, possibly worked up into it. Coll. 1960 by Geoffrey Wainwright, Inst. of Archaeol., Univ. of London. Comment: C14 date may give actual date of Mesolithic culture, in which case it is quite late (cf. Q-770, Ringneill Quay) or it may give youngest limit only as with Q-672, Westward Ho. Date, however, does not conflict with archaeological or pollen analytic evidence; its bearing on land and sealevel changes is referred to on p. 126-127.

E. Land- and Sealevel Changes

Changes of relative land- and sealevel affecting British coasts have been investigated for several years by members of Univ. Sub-dept. of Quaternary Research, Cambridge, with the primary objective of defining and separating the eustatic and other components of such changes (see Cambridge I, III, V and Godwin, 1960). Series reflects the researches of D. M. Churchill upon the relatively recent marine trangressions in S half of Britain.

Rhizomatous peat (52° 30' 55" N Lat, 4° 1' 43" W Long) between Ty-mar-Mochno and Ynys-las cottage. Sheltered from Cardigan Bay on W by big coastal dune ridge, and in large raised bog whose stratigraphy has been briefly reported (Godwin, 1943). To N however bog approaches tidal marshes of the River Dovey and borings have established that a wedge of clayey peat with abundant Juncus maritimus rhizomes above Phragmites peat extends at about +7.5 to +8.5 ft O.D. for some few hundred yards into raised bog peats. Sample is from base of the clayey J. maritimus peat and represents a time near the culmination of a marine transgression. Estuarine origin of the clay is proved by presence of several species of foraminifera (det. Terry Adams, Dept. of Geology, Univ. of Aberystwyth). Coll. April 1963 by D. M. Churchill. Comment: base of raised bog deposits overlies marine clays close to mean sealevel and is taken to be the product of the main eustatic rise in ocean level. Basal layers of the bog have been dated by wood-peat now exposed on the foreshore (Q-380, 6026 ± 135; Q-382, 5898 ± 135). Transgression now dated appears to fall in early part of Pollen Zone VIII (increased frequencies of Betula, loss of Tilia, low but maintained values for Fagus). It also overlies a pronounced recurrence surface; C¹⁴ date suggests that this cannot be RY III; it might be RY IV or might merely reflect onset of marine transgression.

Q-691. Llanwern, Nr. Newport, Monmouthshire. No. 1 2660 ± 110 710 b.c.

Peat (51° 34' N Lat, 2° 54' W Long) at site of new steel mills of Richard Thomas and Baldwins Ltd. from the contact with an overlying marine clay at +9 ft 6 in. to +10.0 ft O.D. Stratigraphic sequence: surface at +18.5 ft O.D.; made ground, 4 ft; silty marine clay, 5 ft; peat, 9 to 10 ft; grey-blue clay, ca. 12 ft; sand and gravel. Evidence for sequence was found parallel with coast for more than ½ mi. Marine origin of clays was proved by abundance of marine diatoms (det. G. H. Evans). Coll. 1962 by Judith Turner, Botany School, Cambridge. Comment: marine beds overlying peat at comparable heights above O.D., have been reported from various sites on neighbouring coast of S Wales, but only the pollen-analyses of von Post from peat at Blackpill have so far suggested a date, in this case the Iron Age (Godwin, 1940a).


Phragmites peat (50° 55' 20" N Lat, 0° 31' 50" W Long). Amberley Wild Brooks is an extensive tract of alluvium lying within chalk ridge of South Downs where it is cut by the Arun Gap. A. R. Clapham and H. Godwin have established that area is occupied by deep silty clays extending to height of ca. +3 to +8 ft O.D., capped by residue of a former raised-bog. Silty clays were product of a marine transgression, a tentative date for which (the beginning of transition Zone VII/VIII) was provided by pollen-analyses (Godwin, 1943). Sequence then described was: 0-100 cm, Molinia—moss peat; 100-250 cm, Phragmites peat with abundant Betula in upper part; 250-385 cm, blue clay; 385 cm, sand.
Sample is from contact of *Phragmites* peat and underlying blue clay at +5 ft O.D. Coll. April 1962 by D. M. Churchill. *Comment:* C\(^{14}\) date corresponds with Late Bronze Age and agrees with pollen-analytic inference; it confirms that local expansion of the beech (*Fagus*) on the South Downs was Iron Age or later.

**Chapel Point, Lincolnshire series**

H. H. Swinnerton of Nottingham Univ. established stratigraphic sequence of postglacial beds exposed on foreshore near Chapel Point, near Chapel St. Leonards, Lincolnshire (53° 14' N Lat, 0° 21' W Long). A basal peat bed with oak trees *in situ* lies upon boulder clay and is separated by erosion surface from overlying ‘Triglochin Clay,’ a salt marsh deposit which passes upwards through *Phragmites* clays (brackish water) to a thin upper peat bed containing wood of *Salix* and *Taxus*. Upper peat surface, which lies close to mean sea level, bears remains of salt-making industry of Halstatt type (opening of the Iron Age). A strong erosion cut channels through upper peat (and beds below) and was succeeded by ‘Scrobicularia Clays,’ more marine in character than ‘Triglochin Clay.’ Pollen-analyses of these peat beds were made during studies of deposits of Fenland basin (of which Lincolnshire coast deposits can be considered an extension) by Godwin and Clifford (1938) and subsequently in relation to deposits of Anholme valley (Smith, 1958). Wood from upper peat bed coll. 1953 by Smith has been dated, Q-81, 2455 ± 110 B.P. (Cambridge III). D. M. Churchill has now coll. further material to date more precisely the marine contacts.

**Q-687. Chapel Point, Lincolnshire. No. 3** 2630 ± 110 680 B.C.

*Scrobicularia plana* shells coll. from Scrobicularia Clay where it truncated, in a narrow channel, the Upper Peat, at +1.3 ft ft O.D. Shells were in position of growth with *Cardium edule* and *Macoma balthica*; they probably grew at a level within contemporary neap tide range and should date the transgression that laid down the Scrobicularia Clay. Coll. Sept. 1962.

**Q-688. Chapel Point, Lincolnshire. No. 4** 2630 ± 110 680 B.C.

*Scrobicularia plana* shells coll. from Scrobicularia Clay at bottom of erosion channel cut down into leached Chalky Boulder Clay at −9 ft O.D. Base of channel probably lies near base level for channel erosion and corresponds with contemporary limit of low spring tides. If so it represents a contemporary sea-level some 7 ft higher than that of today. Coll. Oct. 1961.

**Q-686. Chapel Point, Lincolnshire. No. 2** 3340 ± 110 1390 B.C.

Salt-marsh peat from base of upper peat at contact with underlying *Phragmites* clay (0 ft. O.D.). Presence of such such plants as *Suaeda maritima* and *Salicornia* sp in Triglochin Clay suggests deposition near high spring tide level: today high spring tide is some 16 ft higher. Coll. Oct. 1961.

*Comment on Chapel Point series:* dates for Q-687 and Q-688 are identical and indicate that little time, if any, elapsed between cutting the erosion channels and deposition of the Scrobicularia clay. Terminal date provided for upper
peat agrees reasonably well with age determination Q-81 (see above) and accords with record of Halstatt industry upon it; the peat cannot be Romano-British. Q-686 indicates that formation of upper peat began in middle Bronze Age time; thus upper peat here falls within period of formation of upper peat of Fenland basin, a period thought to have seen at least local marine retrogression (Godwin, 1940b). In Humber-Ancholme estuary is good evidence (Smith, 1958) that a marine transgression took place close to Bronze-Age/Iron-Age transition, for on brush-wood peat surface below estuarine clays pottery of this period has been found, and a wooden trackway dated 2552 ± 120 (Q-77). Also within these clays were found two monoxylous boats dated 2796 ± 100 (Q-79) and 2784 ± 100 (Q-78), whilst the sewn boat from N. Ferriby appeared to rest on upper surface of same clays and had date of 2700 ± 150 B.P. (BM-58). Aggregation of these dates strongly indicates short marine transgression close to Bronze Age/Halstatt transition and Scrobicularia clays can be referred to this episode between ca. 2800 and 2550 B.P.

Q-620. Moreton, Cheshire. No. 1

Wood from 14 ft tree trunk (53° 24' 30" N Lat, 3° 7' W Long), found at Reeds Lane, Moreton, near Leasowe, Cheshire, lying horizontally in peat bed at +10 ft O.D., with roots projecting into overlying bed of silty clay extending to surface at +14 ft. O.D. Twenty yards E the same peat bed was overlain by grey clay containing Scrobicularia plana. Tree may thus date a relatively late rise in sealevel. Coll. G. R. Tresise, City of Liverpool Mus. Comment: result shows that marine transgression at +10 ft must have taken place here not before early Bronze Age. Site is within 1200 yd of present coast line and is probably related to peat beds exposed on foreshore at Leasowe; on nearby coast of N Wales two coastal peat beds occur on the shore separated by estuarine clays from which both Neolithic stone axes and bronze artifacts have been reported.

Q-736. La Grande Mare, Guernsey, C.I. No. 1

Phragmites peat (49° 27' 58" N Lat, 2° 36' 20" W Long), from top of peat which fills the valley and is overlain by sands, silts, and minor peat bands; taken from the contact at +6 ft O.D., with the overlying grey silty clay, which has a brackish water diatom flora that reflects the rise in sealevel. Coll. March 1963 by D. M. Churchill.

General Comment on Land- and Sealevel series: some evidence now presented indicates a general rise in sealevel in S and W Britain during Late Bronze Age (950 to 670 B.C.). Estimation of absolute height of sealevel is made difficult by large and variable tidal ranges on British coasts, although it is clear that marine influence at this time extended to about +10 ft O.D. in some places.

BRECKLAND SOIL PROFILES

R.M.S. Perrin of Univ. School of Agriculture, Cambridge, in the course of research into the pedogenesis of humus podsolic soils in the Breckland region of East Anglia, has submitted two series of samples with the object of learning
something of the age of the podsolisation. Soils are mostly derived from till and outwash deposits of the Gipping glaciation or reworked products of that calcified till, but all are very sandy. Pollen-analytic evidence suggests that podsolisation in the region may have accelerated with the Neolithic and subsequent disforestation. Each air-dried sample from the B2 (illuviation) horizon was extracted with 5% NaOH; the colloids were flocculated with HCl, washed, filtered, dried and ultimately combusted.

Although the activity of each soil sample is expressed as a C14 age, this age does not date the podsol so much as demonstrate minimum age for commencement of podsolisation in the profile from which it was taken, since downward movement of humus colloids and their breakdown must be going on together. Of the two series Brandon series represents the most strongly developed (and hence perhaps oldest) humus-iron podsol of the region; in Santon series the podsolisation is less well developed. Coll. by R. M. S. Perrin, A. Hodge and E. H. Willis (Perrin, Willis and Hodge, 1964).

**Brandon series**

**Q-716. Brandon, Suffolk. No. 1**

1583 ± 180 b.p.

Humus from B horizon of podsol (52° 26' N Lat, 0° 36' E Long).

**Q-717. Brandon, Suffolk. No. 2**

2856 ± 180 b.p.

Humus from B horizon of podsol (52° 26' N Lat, 0° 37' E Long).

**Q-771. Brandon, Suffolk. No. 3**

2460 ± 200 b.p.

Humus from B horizon of podsol.

**Santon series**

**Q-718. Santon, Elveden, Suffolk**

2854 ± 180 b.p.

Humus from B horizon of podsol (52° 24' N Lat, 0° 39' E Long).

**Q-719. West Tofts, Norfolk**


Humus from B horizon of podsol (52° 29' N Lat, 0° 43' E Long).

*Comment:* C14 assays confirm the field impression that these are old soils. Podsolisation clearly must have been initiated at least as early as 2500 b.p., and is likely to have been advanced by then, as the effect of contamination by normal soil-forming processes would be to reduce apparent age.

**France**

**Le Moura, Biarritz series**

F. Oldfield of Univ. Dept. of Geog., Leicester in August 1958 studied the developmental history of a postglacial valley mire, near the Gare de la Nègresse, Le Moura near Biarritz in SW France (43° 25' N Lat, 1° 32' W Long). Having determined by pollen analyses secured by Hiller peat auger in center of mire, that deposits embraced a considerable part of the postglacial period, Mr. Oldfield dug a deep pit near the boring and extracted a continuous peat monolith in which the main pollen-analytic horizons were id. by supplementary analyses. Slices of peat 3 cm thick from three such horizons were sent to us for C14 assay. Depth in cm from the surface is given in each heading.
Q-617. Le Moura, FPM 20 (274 cm) 9960 ± 160
8010 B.C.

Cladium peat with remains of Potentilla palustris and Hydrocotyle palustris, immediately after first postglacial maximum of Corylus in the pollen analyses and possibly equivalent to beginning of British Zone VI. Comment: result is as old or older than that for the Zone IV/V boundary in Britain (cf. Scaleby Moss, Q-154, 155; Thatcham, Q-650, 677; Port Talbot, Q-661; Star Carr, Q-14).

Q-614. Le Moura, FPM 13 + 14 (172 cm) 7680 ± 140
5740 B.C.

Humified Cladium peat immediately below a very humified Calluna layer 50 to 60 cm thick, just below a sharp rise in pollen of Pinus sylvestris to a late Zone VI maximum (in terms British pollen zone sequence). Both events may register a Late Boreal drying out of the mire. Comment: conjecture is supported.

Q-612. Le Moura, FPM 8 (109 cm) 6295 ± 130
4345 B.C.

Very oxidised and woody Sphagnum-Calluna peat, at bottom of rise in Alnus pollen curve, just below a suspected hiatus in the sequence. May represent the Boreal/Atlantic transition. Comment: C14 date makes this horizon synchronous with the British Zone VIIa (Atlantic).

Q-610. Le Moura, FPM 4 (98 cm) 5865 ± 120
3915 B.C.

Fresh sedge peat from flooding horizon with Potamogeton sp., Potentilla palustris, and Cladium mariscus above a highly humified peat with oxidized remains of Calluna. Comment: would be synchronous with later part of British Zone VIIa (Atlantic).

POLAND

Q-709. Lake Pilakno, Rybno, Mragowo 2180 ± 100
230 B.C.

Wood (53° 47' N Lat, 21° 10' E Long), 143 m above sealevel, part of wooden post from an archaeological site (AR 1; METR, 13; WARSTWA II). Although post is associated with Late Bronze Age in Poland, pollen-analytic studies of Michael Dąbrowski indicate that it may correspond in age with Early Iron Age in W Europe. Coll. July 1961 by M. Dąbrowski, Univ. Sub-dept. of Quaternary Research. Comment: expectation is supported by C14 determination, which also gives absolute age at one horizon in local pollen-analytic sequence.

MISCELLANEOUS SAMPLES

Lotus Seeds

Biologists are deeply interested in longevity of seeds; the greatest fully authenticated ages for germinating seeds are believed to be for Albizia sp. (147 yr), seeds of which, coll. in China in 1793, germinated on British Mus. herbarium sheets after soaking in the air raid fire of Sept. 1940, and for Nelumbium sp. (237 yr), a ‘seed’ of which from the Hans Sloane collection of
the British Mus. (1705) was germinated in 1942. Claims were however made by I. Ohga of a very much greater age than this for ‘seeds’ of *Nelumbium nucifera* recovered from the muds of a drained lake in Southern Manchuria. A sample of these ‘seeds’ was dated in Dr. Libby’s Chicago Lab. (C-629, 1040 ± 210 B.P.: Libby, 1955). A check determination seemed advisable, and Professor Libby kindly sent us the residue of the charcoal from which his determinations had been made: this is the material for Q-679.

Professor Libby also sent us the charcoal of his determination (C-688, 3075 + 180) of wood from a prehistoric canoe found in lake deposits along with receptacles and some viable seeds of *Lotus*: this charcoal constitutes Q-704.

**Q-704. Kemigawa, nr. Tokyo, canoe (Chaney seeds)**

Charcoal on which Libby based his C-688 date (3075 ± 180 B.P.). Wood from prehistoric canoe found 20 ft below surface. “Associated with the remains of the canoe.” I. Ohga found three viable seeds of *Lotus nucifera* and many receptacles of that plant in 1951, and the sample was forwarded through R. W. Chaney. *Comment*: our age determination of Q-704 corresponds very well with that reported by Libby and satisfactorily dates the boat. Even jointly however they yield no evidence of the age of the three *Lotus* seeds that Dr. Ohga grew. We are not told of the circumstances of the recovery and we are all familiar with the way in which ancient tree-stumps and similar cumbrous wreckage may lie on a lake bed and come to be associated with the modern plant and animal life of a lake or estuary when the muds are moved by current action.

**Q-679. Manchurian Lotus ‘seeds’**

**A.D. 1850**

Charcoal on which Libby based his C-629 date: forwarded to us 21 August 1962. Prepared from combustion of fruits of *Nelumbium nucifera* recovered by I. Ohga from peat deposits in Pulantien basin of S Manchuria. Similar seeds were shown by him to retain a high germinative capacity. *Comment*: activity of Q-679 could not be distinguished from that of our 1854 standard oak wood; we measured Professor Libby’s own charcoal and cannot explain the discrepancy. None the less our result indicates that age of these Manchurian ‘Seeds’ is not yet known beyond doubt. Ohga found cause in the lake bed stratigraphy and local history to make him attribute (before a C\(^{14}\) dating was possible) a very considerable age to the *Lotus* seeds, and he was supported by R. W. Chaney who subm. the seeds to Dr. Libby. Having by the courteous assistance of Professor T. Jimbo, consulted published accounts of the provenance of the *Lotus* seeds we cannot exclude the possibility that the Manchurian lake, now cultivated, was drained quite recently and that the seeds are the product of modern growth of lilies in the lake buried partly by natural sinking into the soft lake sediments and partly by the flooding associated with the river diversion and drainage and duly recorded by Ohga. Should it again become possible to collect from the same site it would be of great interest to germinate a few score of the ‘seeds’ and then to dry and submit for further C\(^{14}\) assay the dried seeds that had individually germinated.
CHECK SAMPLES

Q-771. Bar Kochba Cave, Israel 1795 ± 100

A.D. 155

Redetermination of sample from which Q-621 was taken (1649 ± 100 b.p.). Matted blood, flesh and cloth from Bar Kochba Cave in W Judea (Cambridge V). Dated historically at second Jewish rebellion of A.D. 135. Purpose is to establish local age reference against which to judge samples thought to be approx. Roman in age; such procedure would help reduce errors due to past variation in atmospheric C14 activity (Willis, Tauber and Münich, 1960).

Q-720. Ingombe Ilede Mound, Lusith, N. Rhodesia 965 ± 100

A.D. 985


Q-689. Gibraltar Point, Lincolnshire, Scrobicularia plana C14 δ = +95.4%

C14 δ = +95.4%

Shells of living Scrobicularia plana coll. between neap tide limits on mud flat. Coll. Oct, 1961 by D. M. Churchill. Comment: high Δ value shows that such material cannot be used to provide recent standard for shell age determinations, presumably because of enrichment by C14 from recent rise in atmospheric activity.

ATMOSPHERIC RADIOCARBON

A series of measurements was made of lower stratospheric C14 activity from early March 1962 to April 1963. From March to June 1962, sampling was made weekly, thence monthly until February 1963 when intervals were reduced to two weeks. Latter period coincided with the breaking up of the circumpolar vortex in 1963 and the consequent injections of air from higher altitudes. Twenty-four flying sorties were made, two being devoted entirely to control measurements to determine what leakage, if any, occurred during the climb to altitude and the subsequent descent. Atmospheric CO2 was absorbed onto 1/16th in. pellets of molecular sieve, Linde Type 4A (sodium aluminium silicate) enclosed in copper mesh baskets. Eight baskets could be fitted into each sampling duct, built as extension to the wing-tip fuel tanks of a Canberra bomber of the R.A.F. On most occasions, only one duct was opened, the other acting as control. The duct could be opened at altitude by an electrically operated rubber-covered ram controlled from the cockpit. On three sorties each duct was opened for 3/4 hour at altitudes ca. 2 km apart.

Each basket contained 400 g of sieve material, and CO2 was extracted from it after sampling by baking in a radiant heat furnace at 300°C for 3 hours in vacuum. With the ducts open for 1 hour, an average of 4.5 L of CO2 per kg of sieve was recovered. With a partial pressure of 0.033 mm of CO2 at 14 km, and average temperature of -55°C, the amount recovered represents
half the saturation value for the amount of sieve used. The possibility of the sieve having a memory effect from sample to sample was investigated by adsorbing inactive CO₂ onto the sieve after processing. On recovery, the gas was still inactive, showing that the previous active sample had been totally recovered. The quantity of CO₂ recovered did however depend to some extent on the amount of water also adsorbed, since both are competitors for the pore spaces.

Since the counting and flying facilities were both limited, the investigation was confined to one area in space. The height was 14 km (46,000 ft), the nominal isobaric surface 150 mb, and the geographical location 54° N and from 2° E to 5° W. Results are expressed as a permillage excess over the standard activity of 0.95 x NBS oxalic acid. No attempt has been made to study isotopic fractionation, and no corrections for this have been made. The effects observed were of such a magnitude that corrections for fractionation might not be helpful.

Stratospheric Sampling Series 1962/63

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Flight Date</th>
<th>Altitude (Kilometers)</th>
<th>Tropopause Height (Kilometers)</th>
<th>Stratospheric Sampling Height (Kilometers)</th>
<th>( \delta^{14}C ) per mil</th>
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<tr>
<td>Q HF/62/0</td>
<td>13-3</td>
<td>14.2</td>
<td>9.4</td>
<td>4.8</td>
<td>3529</td>
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Comment: the break up of the circumpolar vortex in the spring of 1962 was particularly late, occurring around 10 May. During this period, wide variations in activity were recorded. This might be due to the passage of discrete clouds of activity entering the lower stratosphere from higher altitudes, or it might be a function of the height above the tropopause of the sampling altitude. The tropopause height varied considerably from sortie to sortie and there is some
correlation between the activity and the height of the tropopause. Sampling at two altitudes on three sorties showed a significant vertical stratification which might be important in view of the variations observed.

From late June to November 1962, the average excess value of the activity in the lower stratosphere was little more than two to three times the excess at ground level, at that time about $+400\%\epsilon$, despite the fact that intensive weapon testing was in progress during this time. This would imply that debris from current tests was being taken up to very high altitudes where it remained as a reservoir for injections into the lower stratosphere in the following spring. From December onwards, the activity steadily grew until a record peak was observed in late February. This peak had a $\delta^{14}C$ value of $+9022\%\epsilon$, but fell to more nearly 5000 in the three subsequent sorties.

Acknowledgment

We would like to acknowledge the courtesy and co-operation of the Air Ministry, the Royal Air Force, members of No 58 Squadron R.A.F. Wyton, and in particular Squadron Leader I. Pattinson of A.W.R.E. Aldermaston.

Troposphere

Measurements of ground level $^{14}C$ activity were made at two-monthly intervals through 1961. In 1962, while the stratospheric measurements were in progress, ground-level sampling was less frequent and in 1963 only the summer crop level was assayed. All other sampling was carried out by direct absorption onto 1N Na OH (Cambridge IV). An average $\delta^{13}C$ value of $-21\%\epsilon$ is assumed.

<table>
<thead>
<tr>
<th>Date</th>
<th>$\Delta$ value, %o</th>
</tr>
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<tr>
<td>Q A/61/1</td>
<td>Jan. 168 ± 10</td>
</tr>
<tr>
<td>Q A/61/2</td>
<td>March 213 ± 10</td>
</tr>
<tr>
<td>Q A/61/3</td>
<td>May 189 ± 10</td>
</tr>
<tr>
<td>Q A/61/4</td>
<td>July 240 ± 10</td>
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<td>Q A/61/5</td>
<td>Sept. 216 ± 10</td>
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<tr>
<td>Q A/61/6</td>
<td>Nov. 198 ± 10</td>
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<td>Q A/62/1</td>
<td>Feb. 237 ± 10</td>
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<tr>
<td>Q A/62/3</td>
<td>March 240 ± 10</td>
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<tr>
<td>Q A/62/4</td>
<td>June 337 ± 10</td>
</tr>
<tr>
<td>Q A/63/1</td>
<td>July 860 ± 20</td>
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</table>


Q-423. Shapwick Heath, Neolithic axe site, 284/7 cm.

The coordinates should read (51° 9' 13" N Lat, 2° 48' 37" W Long).


Q-141. Stump Cross, near Grassington, Yorkshire

$8450 \pm 310$

The date was inadvertently given in years B.C. and should be corrected as above. Comment: date modifies the remarks originally made; it agrees well
with expectation for age of the Mesolithic industry and considering the large
error is not unreasonable for the early part of Pollen-Zone VIIa.

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UNIVERSITY OF TEXAS RADIOCARBON DATES II

M. A. TAMERS, F. J. PEARSON, JR., and E. MOTT DAVIS

Radiocarbon Dating Laboratory, Balcones Research Center
The University of Texas

The Radiocarbon Dating Laboratory of the University of Texas was re-organized in late 1962. The dates reported in this list were obtained from February to November, 1963. The laboratory uses liquid scintillation counting with benzene solutions (Tamers, Stipp, and Collier, 1961; Noakes et al., 1963). The chemical synthesis has been modified and improved in several ways in order to permit one worker to produce a sample per day.

The counting is done with a Packard “Tri-Carb” liquid scintillation spectrometer equipped with two counting channels and a print-out recorder. The solutions used are half benzene and half toluene. The toluene is a commercial product in which the scintillators PPO (0.4% by total scintillator solution volume) and POPOP (0.01% by total scintillator solution volume) are dissolved. The toluene solution is pipetted into the counting cell. The benzene is synthesized from the sample to be dated and the amount determined by weighing the filled cell. In those cases where the sample sizes are too small to produce a sufficient amount of benzene, the cell is brought up to volume with commercial benzene. The counting bottles were constructed by us and are of a special metal-glass arrangement to minimize the background. The solutions are cooled to −20°C during the counting to reduce thermal noise in the photomultipliers and to prevent loss from evaporation of the solution.

The counting cell used for most of the measurements made in this list holds 4 cc of solution (2 cc benzene). This size has been chosen for convenience in handling the smaller samples, but it is still large enough to give good statistics for samples of ordinary size. The background is 4.5 cpm at 53% counting efficiency. No barometric effect has been seen. The contemporary reference has been taken as 95% of the activity of the NBS oxalic-acid standard and shows 7.35 ± 0.04, cpm/gm carbon. This activity is statistically indistinguishable from that of our 100 yr old wood corrected to 1950 (see Tx-43, this date list). As recommended by the last Radiocarbon Dating Conference (Godwin, 1962), a C¹⁴ half life of 5568 yr has been used in the date calculations. The errors quoted with the dates are the standard deviation.

Our 4 cc cell has a limit of detection of about 40,000 yr (2σ statistics, 48 hours counting). Several other types and sizes of cells have also been used. Up to a point, the figure of merit increases with the volume, and the benzene method should be capable of dating 60,000 yr old samples if sufficient material is available for 50 cc of benzene (Léger and Tamers, 1963).

Three possible sources of error have been made the object of special studies.

1. Radon. This impurity has been looked for many times, but has never been seen to contaminate the solutions. It should be removed by the procedure of pumping during and after the strongly exothermic reaction which produces the strontium carbide mixture. Furthermore, the alpha particles from the radon
disintegration would give pulse heights approximately five times larger than those of the highest energy C\textsuperscript{14} beta particles. The high pulses are discriminated against by the counter.

2. Isotope effect. Since the chemical yield of the benzene method is not 100% and may vary considerably from its average of 50%, an isotope effect is possible. However, it will not introduce errors into the dating if it can be shown to be reproducible. From studies carried out this past year, it seems that this criterion is met. The four measurements of Tx-43 illustrate the reproducibility obtained. As expected, one of the four dates has its 1\(\sigma\) limits of error outside of the known age and average of the four measurements, but all of these activities are within the 2\(\sigma\) limits.

There are also several other samples in this list which were run twice and show that the isotope effect is reproducible or small. Samples Tx-91, Tx-93, Tx-94, and Tx-95 of the ground water series and Smith Shelter samples Tx-23 and Tx-26 were all split and run twice. All agree within 1\(\sigma\) limits except Tx-91 which is within 2\(\sigma\). Likewise, the Bonfire Shelter pair Tx-47 and Tx-106 and the Candelaria Cave pair Tx-50 and Tx-51, which, on strong field associations, should be identical in age, give essentially the same date.

Not only is the isotope effect reproducible within the limits of precision of our counting statistics, if it exists it cannot be too large. With the counter calibrated as 53% efficient (by a standard good to within 2%), our measured contemporary standard indicates that the activity of uncontaminated modern carbon should be 13.9 \(\text{cpm/gm}\), which is reasonable. Using this figure, it can be said that the isotope effect is probably less than \(\pm 10\%\) and is constant.

3. Quenching. A common difficulty encountered in liquid scintillation counting is the presence of small amounts of impurities which cause significant decreases in solution scintillating efficiencies. The resulting smaller pulse heights are eliminated by the discriminator and the observed counting rate is lower than it would be otherwise. Serious quenching occurs in benzene solutions synthesized by pyrolysis, because of concentrations on the order of 1% of 1, 3-cyclohexadiene. In earlier work, this impurity was successfully removed by a purification procedure and the resulting benzene solutions had scintillation efficiencies close to that of pure commercial benzene (Léger and Tamers, 1963).

In our present benzene synthesis, we solve this problem by purifying the acetylene before it is reacted catalytically to form benzene. We have found that without acetylene purification the majority of the benzene solutions synthesized are quenched to the extent that the observed counting rates are lowered from a few percent to more than 50%. Our acetylene purification eliminates this quenching. However, we feel it advisable to verify the absence of quenching in every synthesis, either by the external source method (Léger and Tamers, 1963) or by comparison of the ratio of counting rates observed in the two channels of the counter. Both of these methods can detect as little as 1% quenching. C\textsuperscript{14} dating with the liquid scintillation counter must use routine quenching checks if maximum reliability of results is to be maintained.

In the samples reported by previous workers at the University of Texas laboratory (Texas I), lack of quenching was not verified, and there is now
reason to believe that it was present in some of the cases. It is recommended that those dates not be used until it can be ascertained which ones are correct.

ACKNOWLEDGMENTS

Technical assistance in the preliminary treatment of the samples was provided by James Crowhurst, whose support was contributed to our laboratory by the Texas Archeological Salvage Project and the Geology Department of the University of Texas. We are especially grateful to the Packard Instrument Company of La Grange, Illinois, for the loan of our first counter, and to Mr. J. J. Stipp, head of Packard’s Low Level Counting Laboratory, through whose good offices the loan was made and who has helped us in many other ways.

SAMPLE DESCRIPTIONS

1. CHECK SAMPLES

Under the heading of “check samples” are those samples whose age is already known or approximately known. They have been run to check the stability of the system and the possibility of fractionation.

**Tx-43. Greenwade House, Texas**

A.D. **1850**


The above date represents an average from 4 completely separate syntheses and countings in order to check fractionation and stability of the system. Individual runs are as follows:

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<th>Synthesis No.</th>
<th>cpm/gm carbon</th>
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</tr>
</thead>
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<tr>
<td>1</td>
<td>7.09 ± 0.11</td>
<td>260 ± 125</td>
</tr>
<tr>
<td>2</td>
<td>7.32 ± 0.11</td>
<td>&lt;150</td>
</tr>
<tr>
<td>3</td>
<td>7.30 ± 0.10</td>
<td>&lt;160</td>
</tr>
<tr>
<td>4</td>
<td>7.24 ± 0.09</td>
<td>&lt;200</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>7.24 ± 0.05</td>
<td>100 ± 80</td>
</tr>
</tbody>
</table>

For comment, see the introductory statement to this list.

**Tx-48. Fort St. Louis 26, Texas**

A.D. **1755**

Charcoal from the large mound at site of old Fort St. Louis on Garcitas Creek in Victoria County, Texas (28° 45’ 50” N Lat, 96° 40’ 30” W Long). This site was first occupied by the French in the 1680’s and later by the Spanish. The sample should date between about 1684 and 1730. Coll. 1950 by Glen Evans; subm. by W. W. Newcomb, Jr., Texas Memorial Mus., Austin. 

**Comment:** date correct within 1σ statistics.
University of Texas Radiocarbon Dates II

Tx-49. San Lorenzo, Texas

380 ± 100
A.D. 1570
Charcoal (burned roof material) from Structure No. 10, Mission San Lorenzo de la Santa Cruz, at Camp Wood, Real County, Texas (29° 41' N Lat, 100° 01' W Long). The mission was occupied by the Spanish between A.D. 1762 and 1769 and the sample should date in that interval. Coll. 1962 and subm. by C. D. Tunnell, Texas Memorial Mus., Austin. Comment: date correct within 2σ statistics.

Tx-45. Sambrido, Pit House 17, New Mexico

1360 ± 100
A.D. 590
Juniper post, specimen 42 from SW part of pit house 17 in Sambrido site, LA4195, W side of San Juan River in Navajo Reservoir, Rio Arriba County, New Mexico (36° 58' 00" N Lat, 107° 26' 15" W Long). Pit house 17 was a Piedra Phase house, dated by pottery associations, and through that by dendrochronology, at A.D. 850 ± 25. Coll. 1961 by Dittert and Davis; subm. as check sample by A. E. Dittert, Jr., Mus. of New Mexico, Santa Fe. Comment: date outside of 2σ statistics of predicted age. Date appearing on the early side might be explained by the observed variation of the rate of deposition of C14 on the earth.

Tx-44. Appleton, Wisconsin

10,700 ± 210
8750 B.C.
Wood, spruce (Picea) from Appleton, Wisconsin, 14 ft below the plain of glacial Lake Oshkosh, in SE1/4, Sec. 28, T 21 N, R 17 E (44° 20' N Lat, 88° 25' W Long). This was a log imbedded in a diagonal position in clayey red Valders till; should be same age as Two Creeks Forest Bed. Wood from this same find was previously dated as C-800, 10,856 ± 410 (Chicago IV) and Lamont has an Appleton date, L-698D, of 11,830 ± 100 and an average of 11,840 for this and five other Two Creeks dates (Broecker and Farrand, 1963).

II. GROUND-WATER SAMPLES

The following samples are ground water from wells in the Carrizo Sand in Atascosa and surrounding counties, south central Texas. This is one of the principal aquifers of the region and is now being studied in detail by the Texas Water Comm. and the U. S. Geol. Survey. These C14 measurements are the first of a series being taken to investigate the effect of factors other than time on the C14 content of ground water. No interpretation of the data is given here, as the sampling program has not been completed, nor will the characteristics of the aquifer be known until the study mentioned above is complete.

Samples coll. the late summer and fall of 1963 by O. C. Dale and F. J. Pearson, Jr.; subm. by Pearson. C content given is the total of dissolved carbonate species, CO3(aq), HCO3(aq), and CO2(aq), expressed as equivalents per million (epm). The δ13C values, which were determined by Nuclides Associates, are those of the dissolved carbonate, not of the benzene counted. Since the variation in δ13C is probably due as much to the introduction of carbonate from the aquifer as to natural fractionation, the C14 results are reported as % of modern rather than as Δ, which would be misleading.
<table>
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<th>Number</th>
<th>Owner</th>
<th>County—Well number</th>
<th>Lat</th>
<th>Long</th>
<th>Depth</th>
<th>Total C</th>
<th>$\delta^{13}C$</th>
<th>$C^{14}$ of Modern</th>
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<td>Tx-90</td>
<td>M. W. Parchman</td>
<td>Atascosa—AL6851803</td>
<td>29°08'</td>
<td>98°41' W</td>
<td>166'</td>
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<td>R. L. Bruce estate</td>
<td>Atascosa—AL6860302</td>
<td>29°07'</td>
<td>98°31' W</td>
<td>104'</td>
<td>1.90</td>
<td>-17.87</td>
<td>74.9±0.7</td>
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<td>(C$^{14}$ average of two syntheses: 76.1±1.0% and 73.7±0.9%)</td>
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<td>Atascosa—AL6859504</td>
<td>29°03'</td>
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<td>28°58'</td>
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<td>Atascosa—AL7812201</td>
<td>28°51'</td>
<td>98°34' W</td>
<td>2075'</td>
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<td>Tx-95</td>
<td>J. T. Harris</td>
<td>Wilson—J-5 (Anders, 1957)</td>
<td>28°57'</td>
<td>98°15' W</td>
<td>2500'</td>
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<td>(C$^{14}$ average of two syntheses: 2.38±0.40% and 2.88±0.41%)</td>
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<td>98°11' W</td>
<td>4789'</td>
<td>15.60</td>
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III. GEOLOGIC AND PALEONTOLOGIC SAMPLES

A. Texas

**Tx-69. Miller's Cave**

7290 ± 260
5340 B.C.

Unburned bone fragments from travertine unit, S chamber of Miller's Cave, Llano County, Texas (30° 35' 12" N Lat, 98° 38' 12" W Long). Much CaCO$_3$ was deposited on and in the bone material. Patton (1963) reports that associations are with *Synaptomys cooperi*, *Microtus ochrogaster*, and other forms indicating that rainfall was then greater and more evenly distributed...
throughout the year, in contrast to semiarid conditions prevailing today. A preliminary date was publ. by Patton (1963, p. 37) as sample A-326, 7200 ± 300; the figure cited here represents the final calculation. Coll. 1961 and subm. by T. H. Patton, Dept. Geology, Univ. of Texas, Austin. Comment (T.H.P.): faunas elsewhere in Texas and the Great Plains with which the Miller's Cave fauna has been correlated are older. The date indicates that withdrawal of these animals from the Llano region may have been much more recent than had been expected.

**Barton Springs Road Site series**

Charcoal from Barton Springs Road Site (41 TV 87), 1 block W of Lamar Blvd., Austin, Texas (30° 15’ N Lat, 97° 46’ W Long). Site was the rear part of a rock shelter, most of which had fallen away. Samples are from three stratigraphic zones in Square N95-W95. Zone III (lower) contained bones of mammal species no longer living in this area, including Blarina brevicauda, Geomys bursarius, and Pitymys pinetoreum. Zones V and VI contained a fauna of microtines and other species (yet to be identified), different from the fauna in Zone III; and a Scallorn arrow point was found in Zone V. Coll. 1960 by C. D. Tunnel; subm. by E. L. Lundelius, Jr., Univ. of Texas, Austin.

**Tx-73. Barton Springs Road, Zone III**

3480 ± 1060
1530 B.C.

Chemical yield on this sample was small; hence the large error quoted. Comment (E.L.L.): this fits dates on similar faunas from other sites in central Texas.

**Tx-74. Barton Springs Road, Zones V-VI**

1040 ± 120
A.D. 910

Sample from Zones V and VI mixed. Comment (C.D.T.): date is reasonable for Scallorn point type.

**B. Western Australia**

**Tx-31. Mammoth Cave**

>31,500

Charcoal from Mammoth Cave, SW corner of the state of Western Australia (34° 04’ S Lat, 115° 01’ E Long). Coll. from top of Glauert excavation, from immediately below to 4 ft below a dripstone floor. A sample from the same spot was dated at >37,000 yr (0-657; Merrilees, personal communication). The Mammoth Cave deposit, at present the main source of information on the Pleistocene fauna of western Australia, has yielded a number of extinct forms, several of them not recorded elsewhere. Coll. 1961 by Cliff and Merrilees; subm. by Duncan Merrilees, Western Australian Mus., Perth. Comment (D.M.): the date being a limiting one rather than a probable point in time, it is doubtful if there is any significance in the difference between Tx-31 and 0-657.

**Perth series**

Specimens from vicinity of Perth (and one from near Madura), Western Australia, collected in a study of sealevel changes and paleoclimatological variations. Shell identifications by Judith Lundelius. Coll. 1955 and subm. by Judith Lundelius, Austin, Texas, unless otherwise stated; comments by J. L.
**M. A. Tamers, F. J. Pearson, Jr., and E. Mott Davis**

**Tx-33. Swan River, Blackwall Reach #1**

$3100 \pm 260$

$1150$ B.C.

Charcoal from cliff of Swan River, Blackwall Reach #1 (32° 02' S Lat, 115° 46' E Long), 12 ft above river level. May possibly date postglacial 10 ft beach. Coll. 1955 by A. R. Main, Dept. Zoology, Univ. W. Australia. **Comment:** date within the range expected.

**Tx-34. Mt. Hershell, lower layer**

$4950 \pm 160$

$3000$ B.C.

Shell of oyster (*Ostrea angasi*) from lower layer of fossil section, foot of Mt. Hershell, Rottnest I., 12 mi offshore from Perth (32° 0' S Lat, 115° 30' E Long). Sample may date time of deposition of marine shells in what is now a brackish inland lake. **Comment:** see Tx-35, below.

**Tx-35. Mt. Hershell, upper layer**

$5660 \pm 220$

$3710$ B.C.

Shell (*Katelysia* sp.) from upper layer of fossil section, foot of Mt. Hershell (see Tx-34, above). It was hoped the sample, from layer of reworked brackish water shells, would date the approximate time of cut-off of lake from open ocean by dune deposition. **Comment:** Tx-34 and Tx-35 are in reverse order of stratigraphy (although they are within 2σ statistics of each other) and hence the hope of bracketing the time of cut-off was not fulfilled.

**Tx-36. Minum Cove, lower layer**

$>32,000$

Marine shell in living position from lower layer of shell deposit in Minum Cove in bank of Swan River, Perth (32° 02' S Lat, 115° 46' E Long). Top of the shell bed 25 ft above sealevel. Layer may date from the 3rd Interglacial Age (Kendrick, 1960). **Comment:** date confirms antiquity of the deposit.

**Tx-37. Madura Cave**

$>35,000$

Shell (*Glycymeris radians*) from uppermost level of cave entrance, Madura Cave, 6 mi S of Madura in SE Western Australia (32° 02' S Lat, 127° 03' E Long). Sample from a large assemblage of marine shells, 100 ft above sealevel, in the Pleistocene Roe Plains Formation. **Comment:** date confirms antiquity of the deposit.

**Tx-52. Causeway Bridge**

$8270 \pm 170$

$6320$ B.C.

Charcoal from depth of 60 ft at site of new Causeway Bridge, Perth (31° 57' S Lat, 115° 51' E Long). Sample, from approximate depth of fossil shell beds, will help in dating shell layer. Coll. 1955 by M. Carrigy, Alberta Research Council. **Comment:** date is in line with current thinking regarding probable age of shell layer.

**IV. ARCHAEOLOGIC SAMPLES**

**A. Central Texas**

The following series represent a continuation of the program to determine the absolute chronology of the cultural sequence in central Texas (see statement in Texas I, p. 46). The standard of acceptability used by those comment-
ing on the dates is the present agreed-on framework of local prehistory, which is based on recent stratigraphic work and on parallels with neighboring areas. This sequence is as follows: the Paleo-Indian Stage, with Angostura points, gave way to the Archaic Stage (Edwards Plateau Aspect) at a time presumed to be no less than 6000 yr ago. No absolute chronology is available within the Archaic, but the general sequence of dart point types is as follows: Nolan, Bulverde, Pedernales, Montell, Frio, Ensor, Darl, with some overlap in the time spans of the types. The Archaic Stage was succeeded by the Neo-American Stage (Central Texas Aspect) at a time believed to be between A.D. 200 and A.D. 800. The early Neo-American Stage is the Austin Focus, with Scallorn arrowpoints; the late Neo-American is the Toyah Focus, with Perdiz arrowpoints; and the Toyah Focus was followed by the Historic Stage with White trade materials. The date of the change from Austin to Toyah focus is not known, and the change to the Historic Stage was probably some time in the 17th century. Opinions differ, but not markedly, regarding how long it may have taken for certain changes to occur within the framework of this sequence, and the comments on the dates below sometimes reflect these variations in viewpoint. In the present state of knowledge, it is often possible to say whether a date agrees or disagrees with current archaeological evidence, but in case of disagreement it is rarely possible to state how great the discrepancy is: one can only say “too old” or “too recent.”

One archaeological sample, Tx-74, from the Barton Springs Road site, is listed earlier under “Geologic and Paleontologic samples.”

**Smith Shelter series**

Charcoal samples from Smith Rockshelter (41 TV 42) on Onion Creek S of Austin, Travis County, Texas (30° 12′ N Lat, 97° 43′ W Long). As reported by Suhm (1957), site has a stratified sequence of eleven layers divided into three major cultural periods. The earliest period (Layer I) is represented by a late manifestation of the Edwards Plateau Aspect, currently called Transitional Archaic; the middle and possibly longest period (upper part of Layer II through Layer X) is represented by the Austin Focus; the most recent period (Layer XI) is represented by the Toyah Focus. The samples dated here are relevant to the chronology of the late Edwards Plateau Aspect and the Austin Focus. Coll. 1954-55 and subm. by Dee Ann Suhm, Univ. of Texas, Austin.

**Tx-21. Smith Shelter 7**

A.D. 1710

From Square N1-N2:B-C, 18 to 24 in. below surface. Layers IX-X, late Austin Focus.

**Tx-22. Smith Shelter 8**

A.D. 1740

From Square N1-N2: B-C, 12 to 18 in. below surface. Layer X, associated with Eddy points. Late Austin Focus.

**Tx-23. Smith Shelter 61**

A.D. 1245

From Square 0-N1: C-D, 72 to 91 in. below surface. Mostly in Layer I, partly in Layer II; Transitional Archaic. Sample was split and the two portions
were prepared and counted separately, and the results averaged. The individual ages were $680 \pm 150$ and $730 \pm 170$.

**Tx-24. Smith Shelter A**  
A.D. 1365

From Square 1N-0:C-D, 54 to 60 in. below surface. Layer III, above the lowest Scallorn points. Early but not earliest Austin Focus.

**Tx-25. Smith Shelter 51**  
A.D. 1410

From Square N1-N2:A-B, 36 to 42 in. below surface. Layers VI-VII, middle Austin Focus.

**Tx-26. Smith Shelter 54**  
A.D. 1245

From Square N1-N2:A-B, 48 to 54 in. below surface. Layers III-IV, associated with a Scallorn point. Early middle Austin Focus. Sample was split and the two portions were prepared and counted separately, and the results averaged. The individual ages were $685 \pm 85$ and $725 \pm 170$.

**Tx-27. Smith Shelter 23**  
A.D. 770

From Square 0-S1:D-E, 84 to 90 in. below surface. Layer I, Transitional Archaic.

**Tx-28. Smith Shelter 24**  
A.D. 785

From Square 0-S1:D-E, 90 to 96 in. below surface. Layer I, Transitional Archaic.

Comment (D.A.S.): in terms of sequence, these dates agree reasonably well with the site stratigraphy. They also confirm the field interpretation of the sediments which was that the middle part of the section, about 60 to 30 in. below surface, accumulated more rapidly than the parts above and below. However, the dates are consistently 300 to 400 yr younger than would be expected from the lack of European trade material and from comparisons with dates obtained by the Socony-Mobil laboratory on six samples, with archaeological associations comparable to the present series, from the Kyle Site 130 m N of Smith Shelter (Jelks, 1962, p. 98; samples SM-495 through -499, -501; see also Tx-98 and Tx-99, this date list).

**Kincaid Shelter series**

Charcoal samples from the Kincaid Shelter (41 UV 2) at the edge of the Sabinal River valley, 3 mi N of Sabinal, Uvalde County, Texas (29° 22' N Lat, 99° 28' W Long). Samples are from top two zones, Zones 5 (lower) and 6 (higher). Zone 5 was the major zone in the site and contained artifacts of the Edwards Plateau Aspect, Archaic Stage. Zone 6 contained both Edwards Plateau and Central Texas Aspect artifacts, with a few historic White materials at the top. Coll. 1953 and subm. by T. N. Campbell, Univ. of Texas, Austin; all comments by T.N.C.

**Tx-58. Kincaid 10**  
A.D. 1405

Square E-F:8-9, 60 to 66 in. below datum. Sample from alluvial deposit
in front of the shelter, from the lower part of Zone 5. All diagnostic artifacts from lower Zone 5 in this excavation unit are Archaic in style. In level 60 to 66 in. only one artifact was recovered, a fragment of what appears to be an Abasolo point. Just below in the next 6 in. level, two Clear Fork gouges were found. Comment: the stratigraphy and cultural contents suggest that this date should be much earlier than that measured.

**Tx-59. Kincaid 17**

Square E-F:2-3, 32 to 48 in. below datum. This excavation unit was a test block inside the shelter, left by previous investigators. The artifacts from this lower part of Zone 5 were few and nondiagnostic, consisting of two scrapers, a large scraper-graver, a crude gouge or chopper, a large biface fragment, and a cobble covered with red pigment. One side scraper was embedded in travertine formed from seepage of water down the wall to consolidate the base of Zone 5. The artifacts are considered to be Archaic. Comment: as the natural stratigraphy also indicates an early Archaic position in time, the date is considered reasonable.

**Tx-60. Kincaid 18**

Square C-D:8-9, 42 to 48 in. below datum. Sample from the alluvial deposit in front of the shelter and from the upper part of Zone 5. A fragment of a probable Bulverde point occurred in this level. Just above this level was a Castroville point, and just below (level 60 to 66 in.) were a Pedernales point and a Clear Fork gouge. A Frio point was at 114 to 120 in. Comment: as all cultural evidence indicates the Archaic, the date measured is too recent.

**Tx-61. Kincaid 22**

Square C-D:7-8, 24 to 30 in. below datum. Sample, which comes from the alluvial deposit in front of the shelter, is from a level that includes the top of Zone 5 and the base of Zone 6. This particular level yielded one Perdiz point (found on screen—may have fallen from higher level) and one fragment of a Frio point. Actually the dominant artifacts in the levels above this one are Archaic (Bulverde, Pedernales, and Tortugas dart points), which suggests mixture of the deposit. Comment: date appears to be somewhat later than might be expected. It is consistent with Tx-60, but, as pointed out above, Tx-60 is too recent for the Archaic assemblage with which it is associated.

**Tx-62. Kincaid 37**

Test Pit 2, 18 to 30 in. below datum, in terrace deposits just E of the opening of the shelter. No artifacts were in this level. In the level immediately above, a Scallorn arrowpoint was found. Below this level the artifacts were of Archaic types. Comment: date appears to be too late for a level that seems to be earlier than a Scallorn point. See also Tx-65, below.

**Tx-63. Kincaid 38**

Square C-D:1-2, 42 to 54 in. below datum. Sample from a test block at rear of shelter left by earlier investigators and subsequently damaged by un-
known excavators. Deposit was indurated so the remnant was carefully swept clean with a broom and excavated. Portion excavated is considered part of lower levels of Zone 5. This conclusion is supported by the recovery of the midsection of a projectile point with Angostura outline. The lateral edges of the point are ground and the distal portion is alternately beveled. There were no other diagnostic artifacts. Comment: date appears reasonable.

** Tx-64. Kincaid 49  

A.D. 640

Test Pit 4, 48 to 54 in. below datum, in the alluvial deposit just E of the opening of the shelter. In the test unit, arrowpoints and pottery were found downward to the 30 in. level. Below that, one Young arrowpoint was found at 48 to 54 in., and from there on downward only Archaic styles of dart points occur (Pedernales, Castroville, and Kinney). Comment: date is acceptable.

** Tx-65. Kincaid 68  

A.D. 1685

Test Pit 2, 78 to 84 in. below datum, in the alluvial deposit E of the opening of the shelter. Sample from a level correlated with the lower part of Zone 5 in front of the shelter. Arrowpoints appeared as low as 54 in. in this pit, but only dart points occurred below (one Abasolo point was identifiable). Comment: date is similar to Tx-62, which came from a level 4 ft higher in the same unit. Judging from this fact and from the evidence of the few artifacts found in this test pit, this sample should be much older than the date determined. Tx-6, 1120 ± 60 (Texas I), from 30 to 36 in. in this same unit, is a more reasonable date for its level in terms of current thinking.

** Tx-66. Kincaid 71  

A.D. 825

Square C-D:9-10, 78 to 96 in. below datum. From the alluvial deposit in front of the shelter. All artifacts below 12 in. here are Archaic in form. Comment: since Ensor and Frio points occurred as low as 90 to 96 in., this date is acceptable.

** Tx-67. Kincaid 74  

A.D. 800

Square E-F:8-9, 90 to 96 in. below datum. From Zone 5, in the alluvial deposit in front of the shelter. Artifacts from this level include one identifiable Refugio point. Comment: date is in proper sequence with Tx-58 (this date list) from the same excavation unit, and is reasonable. It is not in sequence with Tx-12, 1765 ± 145 (Texas I) from 66 to 72 in. in this excavation unit; but not enough information is available yet on absolute chronology to tell which might be nearer the actual age. Tx-17, 10,025 ± 185 (Texas I), snail shells from 84 to 90 in., is certainly too old.

** Tx-68. Kincaid 84  

4070 B.C.

From a test block left by previous excavators against the rear wall of the cave, in the base of Zone 5. No diagnostic artifacts were associated, only side scrapers, choppers, and ovate bifaces. Comment: date is reasonable in view of the stratigraphic position at the base of Zone 5 and immediately above Zone 4, which yielded extinct fauna.
Kyle Site series
Charcoal samples from the Kyle Rockshelter (41 HI 1), E edge of Brazos valley SW of Blum, Hill County, Texas (32° 02' N Lat, 97° 25' W Long). The site, reported by Jelks (1962), had six strata. Strata 1 (lowest) and 2 contained Austin Focus materials; Stratum 3 had approximately equal amounts of Austin and Toyah Focus materials; Stratum 4 was predominantly Toyah Focus; Stratum 5 was exclusively Toyah Focus; Stratum 6 was sterile. A series of samples from this site was previously dated by the Socony-Mobil laboratory (Jelks, 1962, p. 97-98 and see below) and the samples reported here were dated to add to the series as a further check. Coll. 1959-60 and subm. by E. B. Jelks, Texas Archeol. Salvage Project, Univ. of Texas, Austin.

**Tx-98. Kyle 138**  
A.D. 1390  
560 ± 80  
From upper Stratum 5, late Toyah Focus; should be slightly more recent than SM-498, 400 ± 130 (cited in Jelks, 1962, p. 97, as sample C-5).

**Tx-99. Kyle 116**  
A.D. 1390  
560 ± 80  
From lower Stratum 5, middle to late Toyah Focus; should be slightly earlier than SM-498 (cited above).

**Tx-100. Kyle 127**  
A.D. 50  
1900 ± 160  
From upper Stratum 4, probably early to middle Toyah Focus; should fall between SM-501, 685 ± 165, and SM-495, 670 ± 150 (cited in Jelks, 1962, p. 97, as samples C-8 and C-1).  
Comment (E.B.J.): Tx-98 and Tx-99 agree well with the assignment to the Toyah Focus, and support the Socony-Mobile dates. Tx-100 is too early, perhaps by as much as 1000 yr, in terms of both archaeological evidence and other C14 dates.

Oblate Shelter series
Charcoal samples from the Oblate Rockshelter (41 CM 1) in the Canyon Reservoir on the Guadalupe River, Comal County, Texas (29° 55' N Lat, 98° 17' W Long). Tunnell (1962) reported that the site has three main zones: Zone I (lowest) is Middle Archaic with Pedernales, Bulverde, and other point types; Zone II is Late Archaic, with expanding stem points such as Ensor and Frio; Zone III is mixed Austin and Toyah foci.

**Tx-29. Oblate 8**  
A.D. 1795  
155 ± 90  
Seven small samples from different parts of the site, but all from lower Zone III, were combined to make this sample large enough to be counted. Lower Zone III is mainly Austin Focus. Coll. 1959-60 by C. D. Tunnell; subm. by E. B. Jelks  
Comment (C.D.T.): since stratigraphic evidence from several central Texas sites shows that the Austin Focus preceded the Toyah Focus and both were prehistoric, this date is considered much too recent to represent the Austin Focus.

**Tx-30. Oblate 271**  
20 B.C.  
1970 ± 150  
From Square N215-W105, 91.0 ft above site datum. Mixed Zones I and
II, late Middle Archaic or early Late Archaic. Coll. 1960 by C. D. Tunnell; subm. by E. B. Jelks. Comment (C.D.T.): date seems too recent, but this opinion is based more on impression than on evidence (see also comments on Tx-104, this date list).

**Tx-103. Oblate 105X**

3570 ± 650  
1620 B.C.

Very small sample from bottom of fire hearth, Square N235-W120, 85.5 to 85.0 ft above site datum, in Zone I, about 2½ ft below bottom of Zone II. A Pedernales point was found in this level and one in the level below; hence this level is interpreted as being Middle Archaic. Should be earlier than Tx-30, this date list. Coll. 1963 by Texas Archeol. Soc. summer field school; subm. by E. M. Davis. Comment (E.M.D.): even though the error is large because of small sample size, this date gives us a preliminary idea of the age of Pedernales points. The date, relative to other dates, is consistent with archaeological data.

**Tx-104. Oblate 125X**

2900 ± 180  
950 B.C.

From Square N205-W105, 94.0 to 93.5 ft above site datum. Interpretation of the stratigraphy here is not yet complete, but this is probably the lower part of Zone II, with a slight possibility that it is the top of Zone I. Nothing diagnostic in this level, but an expanding-stem point was found in the level above. Should be early Late Archaic or late Middle Archaic, roughly comparable in age to Tx-30, this date list. Coll. 1963 by Texas Archeol. Soc. summer field school; subm. by E. M. Davis. Comment (E.M.D.): significantly earlier than Tx-30. In terms of most current estimates of the rate of cultural change within the Middle and Late Archaic, Tx-104 is more likely than Tx-30 to be near the actual age, but these estimates are hypotheses which can be verified only by more C\(^{14}\) dating.

**Penny Winkle series**

Charcoal samples from Penny Winkle site (41 BL 23), on S bank of Stampede Creek 12 mi NW of Temple, Bell County, Texas (31° 15’ N Lat, 97° 27’ W Long). This is a buried alluvial terrace site in which the stratigraphy was complex and not sharply defined. In general, Toyah Focus materials occurred above those of the Austin Focus, both being in Zone 3; these materials, in turn, were above Edwards Plateau Aspect artifacts, which were in Zone 4. Coll. 1962 by J. D. Scurlock; subm. by E. B. Jelks and Dee Ann Suhm; comments by D.A.S.

**Tx-70. Penny Winkle A**

1040 ± 85  
A.D. 910

From test Square VV, 28 to 34 in. below surface. Lower Zone 3, Austin Focus. Comment: date agrees well with present ideas as to the age of the Austin Focus.

**Tx-71. Penny Winkle B**

290 ± 95  
A.D. 1660

From Square II, 1.0 to 1.5 ft below surface. Upper Zone 3, predominantly Toyah Focus. Sample made up of charcoal flecks scattered in the soil, and material looked unusually fresh; there was suspicion in the field that it might
represent recent carbonized roots. Comment: within early part of 1σ range, date could apply to Toyah Focus.

**Tx-72. Penny Winkle C**

1080 ± 110

A.D. 870

From Square YY, 27 to 33 in. below surface, in a fire hearth, Feature 1, from a level including lower Zone 3 and upper Zone 4, with Austin Focus material and a few late Edwards Plateau artifacts. Comment: date satisfactory for Austin Focus.

**Tx-75. Punkinseed A**

920 ± 200

A.D. 1030

Charcoal from Punkinseed Shelter (41 TV 48) on Lick Creek, a tributary of the Pedernales River about 27 mi W of Austin in western Travis County, Texas (30° 22' N Lat, 98° 05' W Long). Sample from Square 100, 0.5 to 1.0 ft below surface, associated with Scallorn points. Another portion of this same sample was previously dated as Tx-7, 2355 ± 185 (Texas I). Coll. 1961 and subm. by J. D. Scurlock, Univ. of Texas. Comment (E.M.D.): date fits present thinking; Tx-7 does not.

**B. Amistad Reservoir, Texas**

The following samples have been obtained in the course of archaeological salvage in the Amistad Reservoir area, on the Rio Grande and its tributaries in the vicinity of the mouth of the Pecos, in Val Verde County, Texas. This region is immediately southwest of central Texas (see above), and there is no sharp archaeological break between the two, but nevertheless the histories are distinct. The sequence of projectile point types which is assumed in the discussions of the samples is, briefly, as follows (Johnson, 1964): Lerma and Golondrina points (the latter being a variety of the Plainview type) are found in the late Paleo-Indian stage; in the Early Archaic are early barbed points and Pandale points, the latter type extending into the Middle Archaic in which contracting-stemmed points of the Langtry and Shumla types are characteristic; in the late Archaic expanding-stem or side-notched points are characteristic, in particular the Ensor type. Arrowpoints, especially the Perdiz type, appear in the Neo-American stage. The absolute chronology of this sequence is not yet known, and the evaluations of the dates given below are based primarily on comparisons with sequences in neighboring areas.

Unless otherwise stated, the samples were subm. by E. B. Jelks.

**Centipede Cave series**

Samples from Centipede Cave (41 VV 191) on the Rio Grande about 5½ mi NW of the mouth of the Pecos R. (29° 45' N Lat, 101° 27' W Long). Epstein (1963) reports 3 projectile-point zones in this site. The lower zone contains contracting-stem dart points, the intermediate zone has a mixture of contracting-stem and side-notched dart points, and the upper or most recent zone is characterized by side-notched dart points, arrowpoints, and wood and fiber artifacts of the Pecos River Focus. All the samples dated here came from a single column 2 ft square which was dug to a depth of 59½ in. Coll. 1959
and subm. by J. F. Epstein, Univ. of Texas, Austin; all comments by J.F.E. except where noted.

**Tx-38. Centipede Cave 2**

Charcoal from 8 to 14 in. level, associated with Ensor and Frio dart points, arrowpoints of Perdiz, Clifton, and Bonham types, and Pecos River Focus perishable artifacts. *Comment:* probably dates arrowpoint occupation of the upper zone as well as perishable artifacts.

**Tx-39. Centipede Cave 5**

Charcoal from base of deposit (48 to 59½ in. level). Should date earliest occupation of cave. Associated with Langtry, Almagre, and Shumla dart points of lower zone. *Comment:* date much too recent. Nothing in the soil profile indicates why the date should be recent.

**Tx-40. Centipede Cave 6**

Snail shells from base of deposit (48 to 59½ in. level). See Tx-39. *Comment:* much too recent; see comment for Tx-39. (M.A.T.): The difference in dates between Tx-39 and Tx-40 does not conflict with the positive archaeological evidence that they are the same age, since it was shown by Rubin et al. (1963) that snail shells can give dates that are 1000 yr too old. The possibility of a counting error is thus precluded. Also there was definitely no sample mix-up either in the laboratory or in the field.

**Tx-41. Centipede Cave 4**

Charcoal from 36 to 48 in. level. Associated with contracting-stem points of Almagre, Langtry, and Shumla types. *Comment:* date acceptable and as predicted. May date the more recent contracting-stem points of the upper part of the lower zone.

**Tx-42. Centipede Cave 3**

Charcoal from 23½ in. depth. Associated with mixture of contracting-stem and side-notched dart points. Should be later than Tx-39, -40, -41, and earlier than Tx-38. *Comment:* acceptable. Slightly older than predicted.

**Coontail Spin series**

Samples from Coontail Spin site (41 VV 82), a rock shelter on the left bank of the Rio Grande about 5 mi NW of Comstock (29° 39' N Lat, 101° 18' W Long). This is a stratified site with a dart point sequence beginning with Lerma and ending with Ensor and other Late Archaic types. Coll. 1962 by J. P. Nunley; comments by J.P.N. and E.B.J.

**Tx-76. Coontail Spin 297**

Charcoal from Area A, Square B-160, 5.5 ft below datum. Scattered through a zone containing both Ensor and Shumla points, with Ensor predominating. Should date early Ensor or late Shumla. *Comment:* date seems appropriate in terms of current knowledge.
University of Texas Radiocarbon Dates II

Tx-77. Coontail Spin 301

Charcoal from Area B, Square B-165, 4.5 ft below datum. Scattered in an area disturbed by a sotol pit and several burials. Associations were predominantly with late Archaic (Ensor) projectile points, but some Middle Archaic points also were present, and there was a possibility that post-Ensor materials might have intruded. Comment: date indicates very late Archaic.

Tx-78. Coontail Spin 310A

4430 ± 140
2480 B.C.

Tx-79. Coontail Spin 310B

3950 ± 120
2000 B.C.

Tx-80. Coontail Spin 258

10,300 ± 400
8350 B.C.

Charcoal from Area A, Square E-20, 12 ft below datum. Earliest occupation of site, just below Lerma points. No direct association with diagnostic artifacts. Comment: seems appropriate for general Lerma period, in view of a date of 9270 ± 500 from Lerma occupation in the Sierra de Tamaulipas, Mexico (M-499, Michigan II), and dates of 8200 ± 450 and 8540 ± 450 for immediately post-Lerma occupation in SW Tamaulipas (M-498, M-500, Michigan II; for discussion of these dates see MacNeish, 1958, p. 194).

Tx-81. Coontail Spin 62

1270 ± 110
A.D. 680

Unburned grass bundle from Area A, Square E-10, upper Zone “C”. Associated primarily with Ensor points, and should constitute a firm Ensor date. Comment: date is appropriate for Ensor.

Bonfire Shelter series

Samples from Bonfire Shelter (41 VV 218) near Langtry (29° 48’ N Lat. 101° 33’ W Long). Initial testing in this site showed an unusual layer of heavily burned bones which might have resulted from disposal of cattle within the present century. However, there were signs of aboriginal occupation above the bone layer, and a Montell point was in the layer. Tx-46 and Tx-47, below, were dated to see whether the bones were recent or not, and hence whether further investigation was merited. Subsequently, full-scale excavation was undertaken, and was under way at the time this list went to press. Tx-106 derives from the early stages of this latter work.

Tx-46. Bonfire Shelter A

2310 ± 210
360 B.C.

Bone fragments from bone layer in preliminary test pit. These pieces were so heavily burned that little but the inorganic shell was left. Coll. 1962 by Jelks, Duffield, and Nunley. Comment: these bones were simply acid washed.
The C obtained by burning the sample amounted to 0.7% of the weight of the untreated bones. An acid dissolving of a large amount of bones from the same area of the shelter and subsequent burning showed that the sample had less than 0.06% organic C. The bones were probably originally burned in a very hot fire. This date should be less reliable than Tx-47.

**Tx-47. Bonfire Shelter 6**

Bone fragments from Test Excavation IV, Zone D (bone layer). They had a blackish color and appeared to be charred. Coll. 1962 by Mark Parsons. *Comment*: these bones were dissolved in HCl and the solution taken to dryness. The burning of the resulting solid material showed they contained 0.6% organic C. This date considered more reliable than Tx-46. *Comment on Tx-46 and Tx-47 (E.B.J.)*: both of these dates are reasonable in terms of current thinking regarding the possible age of Montell points.

**Tx-106. Bonfire Shelter B**

Charcoal from Square N98-W40, ca. 0.5 to 1.0 ft deep, in upper bone layer. This is composite sample made up of charcoal flecks collected from the same bone layer as Tx-46 and Tx-47, but from a different part of the site. Coll. 1963 by Tunnell and Dibble; subm. by C. D. Tunnell, Texas Memorial Mus., Univ. of Texas, Austin. *Comment (C.D.T.)*: identity of age with Tx-47 agrees with stratigraphic evidence, and is reasonable for Montell point type.

**Tx-82. Black Cave**

Charcoal embedded in a travertine deposit against the back wall of Black Cave, a cave remnant in Pressa Canyon (29° 39’ N Lat, 101° 18’ W Long). This was oldest deposit in the cave. The material was submitted to find out whether the presence of the charcoal in travertine signified occupation of the cave in relatively early times. Coll. 1962 by J. P. Nunley. *Comment (E.B.J.)*: evidently the travertine does not signify great antiquity.

**C. Caddoan Area**

The following samples pertain to the chronology of the Caddoan archaeological area in adjoining parts of Texas, Oklahoma, Arkansas, and Louisiana. Early Caddoan sites are grouped in the Gibson Aspect, and late Caddoan sites in the Fulton Aspect which extends into the historic period. There have long been two schools of thought concerning the length of the Caddoan sequence, one school favoring a short chronology in which the Gibson Aspect begins around A.D. 1200, and the other school favoring a longer time span beginning around A.D. 800 or earlier. Both schools have based their beliefs on cross-ties with sequences in neighboring areas. C14 dating is now beginning to influence the picture, although not decisively as yet, since not many samples have yet been run from a variety of Gibson Aspect Caddoan sites (a summary of Caddoan dates is given by Campbell, 1961).

**Mounds Plantation series, Louisiana**

Logs from Mounds Plantation site (16 CD 12), Caddo Parish, NW Louisiana, about 11 mi N of Shreveport (32° 38’ N Lat, 92° 46’ W Long).

**Tx-55. Mounds Plantation Log 1**

<table>
<thead>
<tr>
<th>Date</th>
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<td>860 ± 120</td>
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**Tx-56. Mounds Plantation Log 6**

<table>
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</tr>
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<tr>
<td>475 ± 110</td>
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**Comment (E.M.D.):** although the dates overlap within 2σ statistics, they are different enough so that it will take more dating to determine the age of the site satisfactorily.

**Tx-57. Spiro site, Oklahoma**

**A.D. 1420**

Wood from timber removed from central tomb in Craig mound, Spiro site, Le Flore County, Oklahoma (35° 15' N Lat, 94° 20' W Long). This is a classic site of the Gibson Aspect. Sample is from the same lot, but not necessarily the same log, previously dated as Tx-4, 1144 ± 165 (Texas I); but see comments at end of introduction to present list. Coll. about 1935 by F. E. Clements; subm. by R. E. Bell, Univ. of Oklahoma, Norman. **Comment (E.M.D.):** date is in significant agreement with most of those previously determined for the Spiro site (see summary of Spiro and Spiro-related dates in Texas I, sample Tx-4; and dates determined more recently in Michigan VIII, samples M-815, -858, -859, -860). Samples relating directly or indirectly to Spiro have varied considerably in C14 age, but those from the Spiro site itself indicate a post-A.D. 1200 date for the tomb in the Craig mound, and thus lend support to the short chronology for the Caddoan sequence.

**Tx-105. Davis site 5888, Texas**

**A.D. 830**

Charred corn screenings and charcoal from Davis site (41 CE 19), on Neches R SW of Alto, Cherokee County, Texas (31° 35' N Lat, 95° 10' W Long). From floor of cache pit in Feature 31, under mound. Should date Phase 1 of Alto Focus occupation of site (Newell and Krieger, 1949). Sample is from the same lot as that dated by Libby as C-153, 1553 ± 175 (Chicago II), and is from a different lot but from the same house, and hence should be the same age, as M-1186, 655 ± 75 (Michigan VIII; Griffin and Yarnell, 1963, discuss the Chicago and Michigan dates). A. D. Krieger sent the Davis Site corn to V. Jones of the Univ. of Michigan Ethnobotanical Lab. Jones treated the identifiable material with preservative, retaining untreated the screenings and siftings, of which part of cat. no. 5888 (Ethnobotanical Lab. No. 3497) was sent to Libby who obtained the C-153 date, and the remainder was returned to Krieger in 1953. Part of this remainder was used in obtaining the present date Tx-105. Coll. 1940-41 by H. P. Newell; subm. by E. M. Davis, Univ. of Texas, Austin. **Comment (E.M.D.):** date, falling between the previous two, is in line with the longer chronology favored by Caddoan archeologists. However, the significant discrepancy between it and the other two dates makes it clear that more samples from this key site must be dated if possible. We do not yet have a consistent pattern of C14 dates for the Alto Focus.
Tx-83.  **Dalton Mound, no. 173, Texas**\[480 ± 110\] A.D. 1470

Charcoal from Dalton Mound (41 UR 11), NE of Ore City, Upshur County, Texas (32° 50' N Lat, 94° 42' W Long). The mound covered remains of two ceremonial structures which had been used and then burned, one after the other. Charcoal is from remains of the later structure. Associated artifacts were those of the “Whelan Complex,” early Titus Focus, Fulton Aspect. The Whelan Complex was followed by the classic Titus Focus in which a number of significant changes took place in pottery types, and mound-building was abandoned. Still later, European trade goods appeared, probably in the 17th or early 18th century. It is not known how long it took for these changes to take place. Coll. 1958 and subm. by E. M. Davis. Comment (E.M.D.): the earlier part of the time span indicated seems feasible for the site.

Tx-84.  **Harroun Site, Mound D, Texas**\[490 ± 100\] A.D. 1460

Charcoal from Mound D, Harroun Site (41 UR 10), NE of Ore City, Upshur County, Texas (32° 50' N Lat, 94° 41' W Long). Coordinates of sample within site, N97.1/W102.4, elev. 97.76. Site has been reported by Jelks and Tunnell (1959). Mound D covered remains of a burned structure and charcoal was from a beam above the house floor. Associated artifacts were those of the early Titus Focus (Whelan Complex), and the date should be similar to Tx-83 from the Dalton Mound. Coll. 1958 and subm. by E. B. Jelks. Comment (E.M.D.): same date as Tx-83. Strengthens the case for this dating of the Whelan Complex.

**D. Utah**

**Danger Cave series**

Sample from Level I of Danger Cave (41 TO 13), near Wendover, Tooele County, western Utah (40° 45' N Lat, 114° 00' W Long). Level contains evidences of early Desert Culture occupation (Jennings, 1957). Coll. 1951 and subm. by J. D. Jennings, Univ. of Utah, Salt Lake City, as further check on C\(^14\) dates from the same level previously determined by other laboratories (Jennings, 1957, p. 93-98, and references below). All samples were expected to be between 10,000 and 11,000 yr old.

Tx-85.  **Danger Cave 694**\[10,600 ± 200\] 3650 b.c.

Twigs from Feature 108, a fireplace in a thin layer of trash lying on the surface of the lower sand component. A very limited amount of charcoal also found in this fireplace has been dated as M-202, 10,270 ± 650 (Michigan I).

Tx-86.  **Danger Cave 695**\[8970 ± 150\] 7020 b.c.

Charred rat dung and twigs collected by sifting sands (Feature 108/109) immediately adjacent to and under fireplace, Feature 108. Dung charred by heat from the fireplace. Should be approx. the same age as Tx-85. Other dates from the sands under the fireplace are M-204, slightly charred sheep dung, 10,270 ± 650 (Michigan I) and C-610, uncharred wood, 11,151 ± 570 (Chicago II).
Tx-87. Danger Cave 735

10,150 ± 170
8200 B.C.

Charcoal and vegetal material from same stratigraphic position as Tx-85, but scattered over a more extensive area; should be same age.

Tx-88. Danger Cave 730

9050 ± 180
7100 B.C.

Sheep dung sifted from lower part of Sand 2 (Feature 19), immediately overlying the fireplace, Feature 108. Should be slightly younger than Tx-85, 86, and 87. This material came approx. 20 ft from the dung dated as C-609, 11,453 ± 600 (Chicago II) and should be equivalent to it in age. However, the date of C-609 was older than that of samples from deeper positions (M-204 and C-610; see Tx-86, above). Also from the same stratigraphic position are M-118, sheep dung, 11,000 ± 700, and M-119, twigs and leaves, 10,400 ± 700 (Michigan I).

Tx-89. Danger Cave 731

9740 ± 210
7790 B.C.

Twigs and sticks associated with the sheep dung of Tx-88; should be same age.

Comment on Danger Cave Dates (J.D.J.): Tx-86 is closest to our preconceptions. (E.M.D.): Texas dates run younger than the others, but within 2σ statistics (and often within 1σ) there is substantial overlap among most of the dates. As a general statement, 9,000 to 11,500 B.P. seems to cover most of the interval involved.

E. Mexico

La Candelaria Cave

Textile material and associated human bone fragments from La Candelaria Cave, Las Delicias basin, near San Pedro de las Colonias in southwestern Coahuila, Mexico (approx. 25° 01' N Lat, 102° 46' W Long). The cave contained an extremely rich mortuary deposit, very important for the archeology of Arid America, but without stratigraphy. Materials recovered as funerary offerings show some similarities with cultural elements of the Pecos and Big Bend Cave-Dwellers and similar developments of the Arid Southwest. On typological grounds it was concluded that the cave was used during the last four or five centuries before the Spanish colonization of the area, and in any case not previous to A.D. 1000 (Aveleyra et al., 1956). Coll. 1953 by Aveleyra and others; subm. by the late P. Martinez del Rio, Inst. Nac. de Anthropol. e Historia, Mexico, D.F.

Tx-50. Candelaria cloth

745 ± 110
A.D. 1205

Tx-51. Candelaria bone

745 ± 95
A.D. 1205

The bone sample was freed of inorganic carbonates by dissolving in HCl and was found to contain 9% organic C, the highest percentage for bone that we have seen. Comment (Luis Aveleyra A. de Anda): C14 date checks very well with the previous conclusion as to the age of the deposit.
El Jaral series

Samples from El Jaral site, municipio of Rioverde, south-central San Luís Potosí, Mexico (21° 54' N Lat, 100° 03' W Long). Both specimens are from Mound 14, Pit 1, Level 5, 292-301 cm below the top of the mound. Associated cultural materials are Huastec, representing the transition between late Classic and early Postclassic. The area of this site (Troike, 1962) represents the westernmost known expansion of the Huastec culture, and the samples should help to date this expansion. These are also the first dates obtained for any Huastec material. Coll. 1957 and subm. by R. C. and N. P. Troike, Univ. of Texas, Austin.

**Tx-101. El Jaral charcoal**

1680 ± 90
A.D. 270

**Tx-102. El Jaral burned corncob**

1160 ± 100
A.D. 790

*Comment (N.P.T.):* In terms of current knowledge of the change from Classic to Postclassic in Mesoamerica, Tx-101 is at least 400 yr too early for the Rioverde area, whereas Tx-102 is entirely appropriate and helps validate the cultural assignment. The early date of Tx-101 suggests that the charcoal was part of the mound fill, and a recheck of the excavation records indicates that this may have been the case.

E. Dominican Republic

**Tx-53. La Isabela**

800 ± 390
A.D. 1150

Charcoal from top zone (0.25 to 0.50 m level) of a mound with aboriginal pottery, at site of La Isabela, founded by Columbus in 1493 on his second voyage, on N coast of Dominican Republic (19° 54' N Lat, 71° 06' W Long). Zone should represent the culture of the Indians whom Columbus met, but it is not known how long they had lived there. Charcoal sample was quite small; hence the size of the quoted error. Coll. 1963 by Cruxent, Chanlate, and Ortega; subm. by J. M. Cruxent, Inst. Venezolano de Inv. Cient., Caracas. *Comment (J.M.C.):* date confirms the belief that the Indians who lived at this site were those whom Columbus met.

**Tx-54. Mordan**

4140 ± 130
2190 B.C.

Charcoal from top level (0.75 to 1.0 m) of Mordan site in province of Azua, Dominican Republic (18° 22' N Lat, 71° 06' W Long). Zone is non-ceramic, and this is the first date on a Meso-Indian complex in the Dominican Republic. Coll. 1963 by Cruxent, Chanlate, and Ortega; subm. by J. M. Cruxent. *Comment (J.M.C.):* date seems correct.

**References**

Date lists:

- Chicago II Libby, 1951
- Chicago IV Libby, 1954
- Michigan I Crane, 1956
- Michigan II Crane and Griffin, 1958
- Michigan VIII Crane and Griffin, 1963
- Texas I Stipp *et al.*, 1962
LOUVAIN NATURAL RADIOCARBON MEASUREMENTS II

J. M. DEUMER, E. GILOT and P. C. CAPRON

Department of Nuclear Chemistry, University of Louvain, Louvain, Belgium

The measurements reported in this list were made in the Louvain C\textsuperscript{14} dating laboratory from July 1962 to October 1963.

INTRODUCTION

The C\textsuperscript{14} dates given below are a continuation of the work presented in our first list (Louvain I). Sample preparation, counting procedure and calculations were obtained by using a 0.6 L CH\textsubscript{4} proportional counter, operating at 3 atm pressure. Each sample was measured at least twice for a counting period of 21 hr at a minimum time of 30 days after combustion. Our standard samples for calibration are 63-yr-old oak tree samples. These, when corrected for age, have C\textsuperscript{14} contents equal to 94\% of the NBS oxalic-acid standard. Data have been calculated on the basis of a C\textsuperscript{14} half life of 5570 yr in agreement with the decision of the Fifth Radiocarbon Dating Conference (Godwin, 1962) and expressed in years B.P. (before A.D. 1950) and also in terms of the Christian calendar.

The error in the given ages includes experimental standard deviation resulting from the counting of the modern standard, of the unknown sample and of the background corrections (Crèvecœur, Vander Stricht and Capron, 1959).

By the decision taken at the Fifth Radiocarbon Dating Conference (Cambridge, July 22-26, 1962), all dates and C\textsuperscript{14} measurements are to be reported in terms of the Libby half life, 5570 yr. In order to prevent confusion we give here all data, found on the basis of the Libby half life, for samples referred to in Louvain I. In the latter paper dates were based on the NBS half life of C\textsuperscript{14} (5760 yr).

<table>
<thead>
<tr>
<th>Lab. no.</th>
<th>Corrected age according to Libby half life</th>
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<tbody>
<tr>
<td>Lv 100</td>
<td>11,250 ± 240 9300 B.C.</td>
</tr>
<tr>
<td>Lv 101</td>
<td>11,900 ± 330 9950 B.C.</td>
</tr>
<tr>
<td>Lv 6</td>
<td>10,040 ± 400 8090 B.C.</td>
</tr>
<tr>
<td>Lv 56</td>
<td>1090 ± 180 A.D. 860</td>
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<tr>
<td>Lv 73</td>
<td>10,560 ± 520 8610 B.C.</td>
</tr>
<tr>
<td>Lv 74</td>
<td>11,550 ± 410 9600 B.C.</td>
</tr>
<tr>
<td>Lv 75N</td>
<td>11,750 ± 400 9800 B.C.</td>
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<td>Lv 75</td>
<td>10,340 ± 450 8390 B.C.</td>
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<tr>
<td>Lv 10</td>
<td>3940 ± 150 1990 B.C.</td>
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<tr>
<td>Lv 43</td>
<td>840 ± 130 A.D. 1110</td>
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<tr>
<td>Lv 44</td>
<td>&gt;30,000</td>
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<tr>
<td>Lv 45</td>
<td>5830 ± 180 3880 B.C.</td>
</tr>
<tr>
<td>Lv 46</td>
<td>2980 ± 160 1030 B.C.</td>
</tr>
<tr>
<td>Lv 47</td>
<td>&gt;30,000</td>
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<tr>
<td>Lv 54</td>
<td>1710 ± 100 A.D. 240</td>
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<tr>
<td>Lv 55</td>
<td>&lt;200</td>
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<tr>
<td>Lv 93</td>
<td>2660 ± 200 710 B.C.</td>
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ACKNOWLEDGMENTS

The participation of N. Ancion in the operations of the laboratory and the maintenance of electronics by G. Michotte and B. Pirotte are gratefully acknowledged. The description of each sample is based on information provided at the time of application by the person submitting the sample to the laboratory. Financial support was provided by the “Institut Interuniversitaire des Sciences Nucléaires.”

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Lv 27. Vuylbeek  
680 ± 160  A.D. 1270
Charcoal from charcoal layer, 10 cm thick, at depth of 40 cm below surface, at the Forêt de Soignes (50° 47' N Lat, 4° 24' E Long), Prov. of Brabant, Belgium. Charcoal is between two layers of alluvium in the valley of a tributary to the Vuylbeek. Coll. 1962 and subm. by O. De Bontridder, Univ. of Louvain. The measurement allows the dating of a new erosion period of the river.

Tourbière du Grand Passage series

Peat from Tourbière du Grand Passage, near Les Tailles (50° 17' 31'' N Lat, 5° 45' 12'' E Long), Prov. of Luxembourg, Belgium, alt 605 m. Coll. 1962 and subm. by W. Mullenders, Univ. of Louvain, Lab. of Palynology.

Lv 57. Grand Passage 25 cm  
360 ± 90  A.D. 1090
Peat from 25 cm, Sub-Atlantic horizon. Pollen analysis indicates the 3rd beech maximum (Fagus silvatica—F III), shown in published pollen diagram (Mullenders and Knop, 1962). This maximum had not yet been dated in Belgium.

Lv 58. Grand Passage 110 cm  
1100 ± 90  A.D. 850
Peat from 110 cm, Sub-Atlantic horizon. Pollen analysis indicates a level between two beech increases (Fagus silvatica), the 2nd and 3rd maximum (F II and F III) (Mullenders and Knop, 1962).

Lv 59. Grand Passage 155 cm  
2770 ± 100  820 B.C.
Peat from 155 cm, Sub-Boreal level. Pollen analysis indicates a level (about 350 cm in the diagram of Mullenders and Knop, 1962) between the 4th and 5th hazel maxima (Corylus avellana—C III and C IV).

Lv 60. Grand Passage 155 cm  
2790 ± 90  840 B.C.
This sample is taken from the same level as Lv 59.

Col de la Furka series

Peat from alt 2280 m, Col de la Furka, Aelpetli (46° 37' N Lat, 8° 27' E Long), near Realp, Canton of Uri, Switzerland. Coll. 1962 and subm. by W. Mullenders. Site is above present-day tree line; pollen analysis shows that it was already above tree line at the times of the dates, but does not indicate possible fluctuations of forest limits.
Lv 66. Col de la Furka  40 cm  2430 ± 140
Peat from 40 cm below ground surface, limit Sub-Boreal-Sub-Atlantic.

Lv 67. Col de la Furka  60 cm  2680 ± 130
Peat from 60 cm below ground surface, Sub-Boreal level.

Darse 5 series
Peat from Darse 5, Polder Austruweel (51° 14' 46" N Lat, 4° 24' 30" E Long), Prov. of Antwerp, Belgium. Coll. 1959 and subm. by W. Mullenders.

Lv 94. Darse 5, 162 cm  2900 ± 120
Peat from 162 cm below ground surface, Sub-Boreal level. C¹⁴ date agrees with the pollen analysis.

Lv 95. Darse 5, 175-180 cm  3280 ± 150
1330 B.C.
Peat from 175 to 180 cm, Sub-Boreal level. Date corrects the palynological interpretation which assigned an older age to that level.

Lv 96. Darse 5, 230 cm  3890 ± 150
1940 B.C.
Peat from 230 cm, limit Atlantic-Sub-Boreal. Date shows that the hazel maximum (Corylus avellana) at 230 cm is the 4th maximum (C III).

Lv 108. Darse 5, 263 cm  5160 ± 160
3210 B.C.
Peat from 263 cm, Atlantic level. Date shows that hazel increase (Corylus avellana) at level 263 cm is the 3rd maximum (CX). The decrease of Ulmus, characteristic of that period in other parts of NW Europe, is not observed here.

Lommel series
Peat layer from 200 to 210 cm below surface of plain of Weyerkense Bergen (51° 15' N Lat, 5° 18' E Long), near Lommel, Prov. of Limbourg, Belgium, alt 46 m. Overlies frost contorted sand correlated with the Würm glacial age; overlain by colian sand of Younger Dryas and Holocene ages. Coll. 1963 and subm. by W. Mullenders. Pollen analysis indicates a temperate climate between two cold periods; the oscillation is incontestably Tardiglacial, but could imply either Bölling or Allerød. The C¹⁴ dating shows it to be Allerød (Gullentops, Mullenders, Deumer and Gilot, in preparation). The dates agree with Lv 100 and Lv 101 (Louvain I) from the same locality.

Lv 102. Lommel  210 cm  11,680 ± 240
9730 B.C.
Peat from 210 cm, taken from same level as Lv 101.

Lv 103. Lommel  200 cm  8620 ± 160
6670 B.C.
Peat from 200 cm, taken from same level as Lv 100. Comment: date is much too young; contamination by roots is assumed.

Alpes de Venosc series
Peat overlying gyttja from Venosc (45° 00' N Lat, 6° 07' E Long), in French Alps, alt 1644 m. Coll. 1962 and subm. by Couteaux, Univ. of Louvain,
Lab. of Palynology. By pollen analysis, layer was dated as Alleröd, but with substantial reservations (Couteaux, 1962); the curve of Cyperaceae pollen was thought to be possibly misleading, as were earlier data of local literature. C¹⁴ dates indicate an early Pre-Boreal age.

Lv 106. Venose 175-181 cm  
10,130 ± 250  
8180 B.C.

Peat from 175 to 181 cm.

Lv 107. Venose 181-187 cm  
9670 ± 240  
7720 B.C.

Peat from 181 to 187 cm.

Terneuzen series

Peat and wood from fossil pine stand covered by Sub-Boreal peat, 150 cm thick, and then by Sub-Atlantic clay, 100 cm thick, Terneuzen (51° 19' N Lat, 3° 48' E Long), Zealand Flanders, The Netherlands. Coll. 1962 and subm. by Munaut, Univ. of Louvain, Lab. of Palynology and Dendrochronology.

Lv 114. Terneuzen pine  
4570 ± 130  
2620 B.C.

Wood from pine stub in situ (Pinus sylvestris, id. by E. Frison) in peat at 180 cm below ground surface.

Lv 115. Terneuzen pine  
4380 ± 120  
2430 B.C.

Wood from pine stub in situ (Pinus sylvestris, id. by E. Frison) in peat at 180 cm below ground surface. Dendrochronology indicates that the two pines (Lv 114 and Lv 115) are contemporary.

Lv 116. Terneuzen 110-115 cm  
4280 ± 130  
2330 B.C.

Peat from 110 to 115 cm below surface of peat layer. Presence of upper part of Pinus zone shows sample to be Sub-Boreal, in agreement with Lv 114 and Lv 115.

Lv 117. Terneuzen 0-10 cm  
2270 ± 100  
320 B.C.

Peat from 0 to 10 cm below surface of peat layer. Date agrees with pollen analysis in giving a late Sub-Boreal age.

Lv 118. Terneuzen 51-58 cm  
3500 ± 110  
1550 B.C.

Peat from 51 to 58 cm below surface of peat layer. The decrease of Ulmus observed at this level is not correlative with the classical decrease, dated at 3000 B.C. in many localities.

Lv 119. Terneuzen oak  
4150 ± 90  
2200 B.C.

Wood from oak stub in situ (Quercus, id. by E. Frison) in peat 180 cm below ground surface. The small stratigraphic difference seen between the oak and the two pines (Lv 114 and Lv 115) is evidently not significant.

Lv 120. Terneuzen oak  
4210 ± 90  
2260 B.C.

Wood from oak trunk (Quercus, id. by E. Frison) from peat 180 cm below ground surface.
### II. ARCHAEOLOGIC SAMPLES

**Lv 8. Waha**

Burned wood from the construction of the St. Etienne Church Waha (50° 13' N Lat, 5° 20' E Long), Prov. of Luxembourg, Belgium. Coll. 1957 and subm. by J. Mertens, Service des Fouilles, Bruxelles. This church dates, according to the historians, from A.D. 1050 (Mertens, 1957).

**Lv 11. Via Mansuerisca**

Wood from the Via Mansuerisca leading from Trèves to Maastricht across the Hautes Fagnes (50° 31' N Lat, 6° 03' E Long), Belgium. Subm. by J. Mertens, Service des Fouilles, Bruxelles, to help fix the controversial age of this road (Bastin, 1935; Dricot, 1960; Louvain I: Lv 10).

**Lv 17. Congo 1**

Fossil wood from dried-out fen, coll. during construction of a road at Lemba (4° 23' S Lat, 15° 20' E Long), Prov. of Leopoldville, Congo. Coll. 1957 and subm. by W. Van Pée, Lovanium Univ., Leopoldville, Congo. Comment: date indicates a time when the site, presently a desert, was occupied by equatorial forest.

**Faascht III series**

Wood samples, id. by J. Heim, from road supposed to be Roman, at Grendel (49° 44' N Lat, 5° 48' E Long), Prov. of Luxembourg, Belgium, 50 cm below surface. Coll. 1962 and subm. by Couteaux. Pollen analysis shows at this horizon, a period which can be either Roman or recent. C¹⁴ dates undoubtedly indicate recent period.

- **Lv 20. Fir wood (Abies)**  
  - <240
- **Lv 21. Pine wood (Pinus)**  
  - <220
- **Lv 22. Pine wood (Pinus)**  
  - <140

**Busenol series**

Samples from site rich in archaeological remains at Busenol (49° 38' N Lat, 5° 36' E Long), Prov. of Luxembourg, Belgium. Coll. 1958 and subm. by J. Mertens, Service des Fouilles, Bruxelles.

- **Lv 23. Tr XXVIII**  
  - 1950 ± 110  
  - 1 B.C.
  
  Wood from pre-Roman rampart.

- **Lv 24. Tr XXIII**  
  - 930 ± 110  
  - A.D. 1020
  
  Charcoal from a burned horizon, remains of medieval dungeon.

- **Lv 25. Tr XXIII**  
  - 1040 ± 90  
  - A.D. 910
  
  Charcoal from same level as Lv 24.
Lv 29. St. Hubert

Charcoal from St. Hubert Abbey at St. Hubert (50° 01’ N Lat, 5° 22’ E Long), Prov. of Luxembourg, Belgium. Coll. 1957 and subm. by J. Mertens, Service des Fouilles, Bruxelles. Date gives the first occupation age of the St. Hubert site.

Bruges series

Peat from horizon below oldest occupation level at Bruges (51° 13’ N Lat, 3° 14’ E Long), Prov. of West Flanders, Belgium. Coll. 1955 and subm. by J. Mertens, Service des Fouilles, Bruxelles (Mertens, in preparation; Louvain 1: Lv 43).

Lv 38. Bruges 1

Pollen analysis by W. Mullenders shows the site to have been forested, with much lime (Tilia), corresponding to the Atlantic zone.

Lv 39. Bruges 2

Pollen analysis at this level by W. Mullenders shows deforestation accompanied by very extensive agricultural activity.

Lv 42. Orval

Wood from a construction earlier than Orval abbey near Villers-devant-Orval (49° 38’ N Lat, 5° 21’ E Long), Prov. of Luxembourg, Belgium. Coll. 1962 and subm. by J. Mertens, Service des Fouilles, Bruxelles.

Lv 48. Alba

Charcoal from Hercules temple at Massa d’Albe (42° 05’ N Lat, 13° 25’ E Long), Prov. of Aquila, Italy. Coll. 1962 and subm. by J. Mertens, Univ. of Louvain. Date confirms archaeological date: 1st half of 1st century b.c. (De Visscher, Mertens and Balty, 1962).

Lv 50. Bouillon

Wood from cross in feudal castle at Bouillon (49° 47’ N Lat, 5° 04’ E Long), Prov. of Luxembourg, Belgium. Coll. 1961 and subm. by J. Mertens, Univ. of Louvain. Date definitively shows the cross to have no bearing on the history of the castle.

Lv 53. Perk

Wood from road 1.75 m below surface at Perk (50° 57’ N Lat, 4° 30’ E Long), Prov. of Brabant, Belgium. Coll. 1951 and subm. by J. Mertens, Univ. of Louvain. Date shows an important alluvium in this site.

Lv 65. Mesvin

Charcoal from Sans Pareil mine 3.65 m below surface at Mesvin (50° 25’ 37” N Lat, 3° 57’ 58” E Long), Prov. of Hainaut, Belgium. Coll. and subm. by Moisin, Société de Recherche Préhistorique en Hainaut. C14 dating gives age of mine embankment (Lefrancq et al., 1957).
Lv 82. Stree

Wood from Roman road at Stree (50° 17' N Lat, 4° 16' E Long), Prov. of Hainaut, Belgium. Coll. 1960 and subm. by J. Mertens, Service des Fouilles, Bruxelles. Comment: road is certainly older than the wood, which may have come from recent repair; another sample is needed.

Neuchatel lake series

To compare difference in time between prehistoric constructions in S bank and N bank of Neuchatel lake, two samples were coll. (1960) by Grandjean, Prehist. Mus. Neuchatel, and subm. by E. Borel, member of Prehist. Commission Neuchatel Canton.

Lv 87N. Montbec

Wood from piling 1.5 m below surface of South Neuchatel lake near Chabrey (46° 56' N Lat, 6° 58' E Long), Canton of Vaud, Switzerland.

Lv 87. Montbec

Sample from same level as Lv 87N. Comment: no pretreatment.

Lv 88. Champreveyres

Wood from piling 2 m below surface of North Neuchatel lake, near St. Blaise (47° 03' N Lat, 6° 58' E Long), Canton of Neuchatel, Switzerland.

Lv 89. Motier

Wood from tree trunk (fir) used in basement of Motier castle at Motier-Travers (46° 55' N Lat, 6° 37' E Long), Canton of Neuchatel, Switzerland. Date shows absence of construction before the recent castle.

Lv 93 bis. Deir el Bahari

Wood from lid of Egyptian mummiform coffin, from Deir el Bahari, W of Thebes (Luxor) Egypt. Coll. by Musee Biblique Inst. d'Archéologie, Univ. of Louvain; subm. by J. Mertens. Comment: sample not pretreated. Measurement repeated to test reliability of the dates from Louvain I (Lv 93: 2750 ± 210-800 B.C.).

References

Date lists:

Louvain I Dossin, Deumer and Capron, 1962
Lefrancq et al., 1957, Fouilles S.R.P.H.
INTRODUCTION

All C\textsuperscript{14} measurements in this date list were made with the 2 L counter described in our first date list (GSC I). Ages were calculated on a C\textsuperscript{14} half life of 5570 ± 30 yr and 0.95 of the activity of the NBS oxalic-acid standard, and are quoted in years before 1950.

In addition to the counting errors of sample, background, and standard, and the errors in the half life, all age errors starting with sample GSC-120 include an error term to account for the average variation of ± 1.5\% in the C\textsuperscript{14} concentration during the past 1300 yr as measured by Willis, Tauber, and Münnich (1960) in sequoia tree rings. Similar results have been obtained by the author in work on an 1100-yr old Douglas fir from Vancouver Island, now nearing completion. The error term inserted to cover this variation makes little difference to the resultant error of older samples but gives a more realistic error for the young samples. For instance, in samples up to 1000 yr old, this correction generally accounts for about 50\% of the age error, in a 10,000 yr sample about 30\%, and in a 20,000 yr sample about 5\%.

No changes were made in the routine chemical pretreatment and CO\textsubscript{2} preparation of organic samples. Sea shells with GSC numbers greater than 149 were treated with HCl to remove the outer 20\% before the CO\textsubscript{2} was collected for dating, rather than the outer 10\% as in our earlier procedure. Occasionally, more or less of a shell sample was removed depending on the size and condition of the sample. Deviations from the routine procedure are listed under the respective samples. This change in the shell pretreatment was prompted by the results of four samples that were analyzed in two fractions after the usual 10\% preleach, and of one sample that was prepared twice. The two fractions and the corresponding dates of these samples are listed in the following table.

<table>
<thead>
<tr>
<th>Date No.</th>
<th>Fraction, %</th>
<th>Age, years</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSC-61</td>
<td>10-50</td>
<td>10,360 ± 240</td>
</tr>
<tr>
<td></td>
<td>51-100</td>
<td>10,540 ± 210</td>
</tr>
<tr>
<td>GSC-111</td>
<td>11-50</td>
<td>30,300 ± 1600</td>
</tr>
<tr>
<td></td>
<td>51-100</td>
<td>36,300 ± 2000</td>
</tr>
<tr>
<td>GSC-119</td>
<td>11-70</td>
<td>10,460 ± 160</td>
</tr>
<tr>
<td></td>
<td>71-100</td>
<td>10,740 ± 170</td>
</tr>
<tr>
<td>GSC-146</td>
<td>13-55</td>
<td>7620 ± 210</td>
</tr>
<tr>
<td></td>
<td>56-100</td>
<td>8200 ± 220</td>
</tr>
<tr>
<td>GSC-134 (1st prep)</td>
<td>11-100</td>
<td>29,430 ± 680</td>
</tr>
<tr>
<td>(2nd prep)</td>
<td>63-100</td>
<td>29,800 ± 220</td>
</tr>
</tbody>
</table>

* The introductory part of this paper has been prepared by the first author who operates the laboratory. The date list has been compiled by the second author from descriptions of samples and interpretations of dates by the various collectors.
The innermost fraction is consistently older in all five samples suggesting slight contamination, although the differences between the two fractions are smaller than the sum of the absolute errors of the two fractions in all but two samples. While the errors are within statistical limits the differences between the two fractions are not those predicted by chance. If chance alone were operative there should be just as many samples in which the inner fraction is younger.

No measurements like those listed in the table above have been made with samples from which the outer 20% were removed, but it is expected that this procedure will remove most of the remaining contamination. It is not impossible, however, that in very old shells the contaminating C has penetrated the whole thickness of the shell.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Eastern Canada

GSC-160. Tignish Shore, Prince Edward Island 12,670 ± 340 10,720 B.C.

Marine shell fragments (Macoma, Astarte, Balanus) coll. 6 to 20 ft below summit of gravel knoll (alt ca. 25 ft) beside road to North Point, ca. 1 mi N of Tignish Shore, Prince Edward Island (46° 58′ 30″ N Lat, 63° 59′ 45″ W Long). Half shells of Astarte from depth 20 ft. Deposit probably is glacio-marine. Coll. 1962 by V. K. Prest.* Comment (V.K.P.): the shell-bearing material presumably originated during glacial retreat from NW Prince Edward Island, when the seashore was 80 ft above present sealevel (Prest, 1962). Date agrees with GSC-101: 12,410 ± 170 (GSC-II) for shells 10 mi SW ascribed to a shore at alt 50 ft. Outer 10% of shells discarded. Sample mixed with dead gas for counting. Date based on one 3-day count.

GSC-119. Glennevis, Ontario 10,740 ± 170 8790 B.C.

Marine shells (Macoma balthica) from road cut 1 mi N of Glennevis, Ontario (45° 17.6′ N Lat, 74° 29.8′ W Long), from sand overlapping marine clay on edge of till hill. Sand appears to be a shore or near-shore deposit; thus shells are inferred to relate to a stand of the Champlain Sea at or slightly above the site (alt 258 ft). Coll. 1961 by J. J. L. Tremblay. Comment: although slightly older than expected, date agrees approx. with other dates for shells from Ottawa-Montreal region. Outer and inner fractions of sample were dated separately, after removal of outermost 10% of shells:

outer fraction (11-70% leach) 10,460 ± 160
inner fraction (71-100% leach) 10,740 ± 170

Each date is based on a single count. The inner fraction was mixed with dead gas for counting.

GSC-131. Big Swamp, Picton, Ontario 8460 ± 160 6510 B.C.

Peat coll. with Hiller peat sampler from base of bog overlying lacustrine...
sediments at alt ca. 300 ft in a depression in limestone bedrock, 4.5 mi NW of Picton, Ontario (44° 03’ N Lat, 77° 25’ W Long). Depth below surface, 265 to 275 cm. Coll. 1962 by J. Terasmae. Comment (J.T.): pollen sequence from this locality correlates with that from nearby Rossmore bog at alt 245 ft, and extends below dated level approx. to level of GSC-157 (9480 ± 170, this list) in Rossmore bog. Sample pretreatment did not include usual NaOH-leach.

**GSC-156. Roblin Lake, Ontario**

Gyttja from Roblin Lake ca. 7 mi S of Belleville, Ontario (44° 07’ N Lat, 77° 23’ W Long); coll. in 2-in. Shelby tube from base of dark brown fine-detritus gyttja 45 ft below lake bed and 76 ft below water level (alt 361 ft). Sampled layer is underlain in sequence by inorganic sediments, glacial deposits, and limestone. Coll. 1963 by J. Terasmae and E. Mirynech. Comment (J.T.): date marks beginning of rapid deposition of organic sediment, probably resulting from climatic change at beginning of Hypsithermal time. Palynological record in the core extends deeper than dated level. Correlation of this pollen record with those from Rossmore bog (GSC-157, this list) and Victoria Road bog (GSC-132, this list) indicates that recession of the lake in Ontario basin (transition Lake Iroquois to Lake Ontario) below level of Roblin Lake took place considerably earlier than this date, probably prior to 9500 yr ago. Date based on one 3-day count. NaOH-leach omitted from pretreatment of sample.

**GSC-157. Rossmore Bog, Ontario**

Gyttja coll. with piston sampler at 320 to 330 cm depth in bog ca. 3 mi S of Belleville, Ontario (44° 07’ N Lat, 77° 25’ W Long). Sample from base of gyttja overlying inorganic lacustrine and glacial deposits. Surface of bog is at alt of Lake Ontario (ca. 245 ft). Coll. 1962 by J. Terasmae. Comment (J.T.): date is minimum for establishment of Lake Ontario at or near its present level, following abandonment of the Iroquois level and short-lived intermediate levels. NaOH-leach was omitted from pretreatment of sample.

**GSC-132. Victoria Road Bog, Kirkfield, Ontario**

Gyttja 565 cm below bog surface at alt ca. 825 ft, 3.6 mi NE of Kirkfield, Ontario (44° 37’ N Lat, 78° 57’ W Long). Coll. with piston sampler from lowest organic layer in bog and lake deposits overlying alluvial sand in an abandoned channel. Coll. 1962 by J. Terasmae. Comment (J.T.): date gives minimum age for abandonment of the Kirkfield outlet between the Huron and Ontario Lake basins. Date based on one 3-day count. Sample pretreatment did not include usual NaOH-leach.

**GSC-130. Copetown bog, Ontario**

Peat and gyttja coll. with Hiller peat sampler at 720 to 730 cm depth, ca. 0.5 mi S of Copetown, Ontario (43° 13’ 45” N Lat, 80° 03’ 15” W Long). Sample from base of organic deposit overlying inorganic lacustrine sediment at alt ca. 800 ft in a depression in drift. Coll. 1961 by J. M. Stewart, McMaster Univ.; subm. by J. Terasmae. Comment (J.T.): pollen record from this bog extends below GSC-130 and has been correlated with sequences from Galt and
Hamilton with basal C\textsuperscript{14} dates of 11,950 ± 350 (I(GSC)-29) and 10,150 ± 450 (I(GSC)-11), respectively (see Isotopes I). C\textsuperscript{14} dates from the three sites support the pollen correlation. NaOH-leach was omitted from pretreatment of sample.

**GSC-92. Churchill, Manitoba**

Marine pelecypod shells (*Hiatella arctica* and *Mya truncata*) from surface of emerged beach, alt ca. 465 ft, probably a few ft to tens of ft below marine limit, 55 mi SW of Churchill, Manitoba (58° 11' N Lat, 95° 03' W Long). Coll. 1960 by J. D. Aitken for B. G. Craig. Comment (B.G.C.): sample gives minimum date for retreat of Laurentide ice from area and for entry of Tyrrell Sea (Lee, 1960) into SW Hudson Bay.

**B. Western Canada**

**GSC-141. Waldron Ranch, Alberta**

Small pieces of charcoal scattered through silty clayey alluvium of Oldman River in gully at Waldron Ranch, ca. 16 mi N of Lundbreck, Alberta (SE\textsubscript{1}/4, Sec. 7, tp. 10, rge. 1, W 5th Mer.: 49° 48’ N Lat, 114° 07’ W Long). Alluvium overlies varved silt and clay which overlies Laurentide till. Sample from 2 to 12 ft below ground level and below a 1/2-in. bed of volcanic ash probably equivalent to ash overlying GSC-161. Coll. 1960 by A. M. Stalker. Comment: sample pretreatment did not include usual NaOH-leach. Date based on a single long count. Sample mixed with dead gas for counting.

**GSC-161. Blood Indian Reserve, Alberta**

Organic matter from N bank St. Mary River in Blood Indian Reserve ca. 10 mi S of Lethbridge, Alberta (NW\textsubscript{1}/4, Sec. 4, tp. 7, rge. 22, W 4th Mer.: 49° 32’ 30” N Lat, 112° 56’ 30” W Long), 2.5 to 3.5 ft below top of 4-ft soil profile forming base of 14 ft of alluvial and eolian deposits overlying varved clay and silt, in turn overlying youngest Laurentide till in vicinity. A 1-in. bed of volcanic ash above sampled soil probably is equivalent to ash layer overlying GSC-141. Coll. 1962 by A. M. Stalker. Comment: date based on single count. NaOH-leach omitted from sample pretreatment.

**GSC-169. Downie Creek, British Columbia**

Spruce wood (id. by R. J. Mott) from alt 6900 ft at head of Downie Creek ca. 25 mi N of Revelstoke, British Columbia (51° 18’ N Lat, 118° 01’ W Long). Sample from one of three logs 1 ft in diam and up to 6 ft long partly embedded in outwash 1000 ft beyond glacier snout and 900 ft above tree line. Coll. 1962 by J. O. Wheeler. Comment: the wood is probably from a tree that grew within the area covered by the glacier at its 19th-century maximum and at least 900 ft above the present tree line when the climate was more favorable than today.

**GSC-168. Fort Langley, British Columbia**

Shells (*Macoma calcarea*) from marine clay 25 ft below land surface and
40 ft above sealevel, in excavation for Trans-Canada Highway SE of Fort Langley, Langley Municipality, British Columbia (49° 10' N Lat, 122° 35' W Long). Coll. 1963 by J. E. Armstrong. Comment (J.E.A.): shells accumulated during post-Vashon marine submergence, and prior to or contemporaneous with Sumas ice advance a few mi E.

GSC-124. Coquitlam, British Columbia

Peaty silt from Maryhill gravel pit, Coquitlam Municipality, Lower Fraser Valley, British Columbia (49° 14' N Lat, 122° 35' W Long), from silty bed near base of ca. 50-ft section of nonglacial sandy alluvium overlain by 100 ft (+) of Vashon drift and underlain by till and clay. Coll. 1962 by J. E. Armstrong. Comment (J.E.A.): this is first dated occurrence of Quadra sediments in Fraser Lowland E of Vancouver metropolitan area. Date based on one 3-day count.

Icarus Point series, Vancouver Island, British Columbia

Peat from two levels on wooded sea cliff at Icarus Point, NW of Nanaimo, Vancouver Island, British Columbia (49° 14.5' N Lat, 124° 00.5' W Long). Exposed section includes 3 tills separated by 2 series of stratified sediments containing peat.

GSC-98. Icarus Point, upper peat

Peat about 60 ft above beach, from 5-ft section of silt and fine sand with wood fragments and peat partings overlain and underlain by till. The sampled strata comprise the basal part of the upper series of intertill sediments. Coll. 1958 by J. G. Fyles. NaOH-leach omitted from sample pretreatment.

GSC-155. Icarus Point, lower peat

Peat about 28 ft above beach, from prominent 6 to 10 in. peat bed within 10 ft of silt underlain by 15 ft of sand and 10 ft of marine clay. These strata comprise the lower series of intertill sediments and lie beneath the till sheet beneath GSC-98. Coll. 1962 by E. C. Halstead. General Comment: the upper intertill series was assumed equivalent to Quadra sediments (typical dates 25,000 to 30,000 yr). The infinite date of GSC-98 raises the possibility that unit is older than the Quadra (see GSC-81, 94, 99, GSC-II).

Crofton series, Vancouver, British Columbia

Peat and wood from interglacial or interstadial strata exposed in excavations at British Columbia Forest Products' pulp mill .75 mi N of Crofton, Vancouver Island, British Columbia (48° 52' 30'' N Lat, 123° 38' 40'' W Long). Coll. by E. C. Halstead.

GSC-163. Crofton peat

Peat from 4 to 6 in. bed of peaty silt and wood at alt 100 ft on 40 ft face 'behind' the pulp mill. Peat bed lies within 15 ft of silt and clay underlain by sand and overlain by 10 ft of silty sand; this succession is overlain and truncated by the surface (Vashon) till. Coll. 1963. Comment (E.C.H.): peat-bear-
ing beds are similar to the Quadra sediments but the infinite date suggests they are older. Date based on a single count.

**GSC-153. Crofton wood**  
>36,500

Wood fragments from fresh exposure on partly overgrown sea cliff adjacent to railway below pulp mill, associated with layers of sparse fine plant material within silt and fine sand at alt 15 ft. These materials appear to constitute a channel fill truncating laminated silt and clay and younger than the strata enclosing GSC-163. Coll. 1962.

**C. Northern Canada, General**

**GSC-88. Hunker Creek (silt), Yukon**  
30,800 ± 1600  
-1400  
28,850 B.C.

Fine plant detritus from frozen silt beneath a 20-ft bed of woody, silty peat in right bank of Hunker Creek at mouth of Last Chance Creek, Klondike Dist., Yukon (64° 01’ N Lat, 139° 06’ W Long), 2 ft above creek level and 4 ft below top of silt. Coll. 1961 by J. Terasmae and O. L. Hughes. *Comment:* wood from base of peat at depth 20 ft dates 9520 ± 130 (GSC-73: GSC II). Dates confirm existence of a major stratigraphic break between silt and overlying peat. Silt is tentatively correlated (O.L.H.) with similar material, 4.5 mi upstream along Hunker Creek, beneath a bone-bearing gravel that yielded wood dated >35,000 (I (GSC)-181, Isotopes II). NaOH-leach was omitted from sample pretreatment. Date based on single 4-day count.

**GSC-121. Porcupine River, Yukon**  
10,740 ± 180  
8790 B.C.

Peat 4 ft below ground on upper part of S bank of Porcupine River, Yukon (67° 28’ N Lat, 139° 54’ W Long), from base of marly peat with freshwater shells overlying silty clay which overlies a thick section of silt with minor sand and gravel. Coll. 1962 by O. L. Hughes. *Comment* (O.L.H.): silty clay beneath peat possibly accumulated in a lake when meltwater from Laurentide Ice Sheet discharged into Porcupine Basin through McDougall Pass and/or through headwaters of Eagle River, perhaps as recently as late Wisconsin. NaOH-leach omitted from sample pretreatment.

**GSC-128. ‘Gill’ Lake, Yukon**  
12,550 ± 190  
10,600 B.C.

Silty gyttja from NW side of ‘Gill’ Lake, Yukon (65° 28’ N Lat, 139° 42’ W Long), coll. with SIPRE coring drill at depth 91 to 93 in. near base of permanently frozen bog in a depression in terminal moraine of a former valley glacier. Coll. 1962 by O. L. Hughes. *Comment* (O.L.H.): date is compatible with view that the moraine relates to a glacial advance distinctly older than the latest advance in the Ogilvie Mtn area (Vernon and Hughes, in press). Minimum date for the latter is GSC-50: 7510 ± 100 (GSC-I) for basal peat on a moraine at North Fork Pass, Yukon. Sample pretreatment did not include usual NaOH-leach.

**King Point series, Yukon**

Peat and wood from deposits exposed on rapidly eroding sea cliff E of
King Point, Arctic coast, Yukon (69°04.5' N Lat, 137° 50' W Long). Coll. 1962 by O. L. Hughes.

**GSC-151. King Point, beneath till**

Wood and peaty fragments coll. 2 ft above base of sea cliff 3.5 mi E of E end of King Point spit. Sample from organic silt grading up into stony clay with marine shells (thickness 10 to 18 ft) overlain in succession by till (20 to 30 ft), sand and silt (8 to 15 ft), and surface peat (up to 3 ft). The till, representing last glaciation of site, apparently terminates in vicinity of a moraine, ca. 4 mi W, which is assumed to mark maximum (classical?) Wisconsin stand of Laurentide Ice Sheet.

**GSC-159. King Point, above till**

Peat 18 ft below ground level 0.2 mi W of GSC-151, from 2-in. peat bed in silt 4 ft above till in stratigraphic section similar to that at GSC-151. Sample treated with cold (rather than hot) NaOH.

**GSC-120. Rat River, Northwest Territories**

Wood, in part beaver-chewed, from W side of Rat River, W of Mackenzie River, Northwest Territories (67° 39.5’ N Lat, 135° 28’ W Long); coll. near base of 40-ft section of silt with organic layers, which overlies till over gravel. No till was seen above silt in poorly exposed upper part of section, but evidence from surrounding area suggests that Laurentide ice covered the site and extended several mi W in (classical?) Wisconsin time. Coll. 1962 by O. L. Hughes.

**GSC-147. Rat River, Northwest Territories**

Wood (twigs) 12 ft below ground on back wall of flow slide on N bank of Rat River, W of Mackenzie River, North West Territories (67° 43.5’ N Lat, 135° 50.5’ W Long). Sample from organic silt 0.4 ft thick beneath clay, silt, and peat, and resting on 1 ft of clay over sand. The dated layer may have originated in pond or floodplain antedating modern valley of Rat River. Coll. 1962 by O. L. Hughes. Sample mixed with dead gas for counting.

**MacAlpine Lake series**

Pelecypod shells and peat collected in two localities a few mi apart to determine approximate date of ice recession and age of highest marine beaches. Coll. 1962 by W. Blake, Jr.

**GSC-110. MacAlpine Lake, shells**

Whole shells and fragments of *Hiatella arctica* from surface and down to 1 ft depth in silt, alt ca. 600 ft, 18 mi NW of MacAlpine Lake, Northwest Territories (66° 49’ N Lat, 103° 28’ W Long). Date based on one 3-day count.

**GSC-116. MacAlpine Lake, peat**

Basal peat 10 to 12 in. below surface of tussock, and underlain by sand and gravel, between beaches on an esker, alt ca. 630 ft, 5 mi N of MacAlpine Lake, Northwest Territories (66° 47’ N Lat, 103° 04’ W Long). Chemical pre-
treatment omitted from sample preparation. Sample mixed with dead gas for counting.

**General Comment (W.B., Jr.):** because the shells are within 50 ft of highest marine beaches (ca. 650 ft alt) pelecypods are believed to have lived when the highest beaches were being formed immediately after the glacial retreat. Blake (1963) cites evidence that edge of ice-sheet was still at end moraine along N edge of MacAlpine Lake 8160 yr ago. Peat was dated in unsuccessful attempt to obtain independent check on age of highest beaches.

**GSC-115. Bathurst Inlet**

Whole shells of *Hiatella arctica*, and fragments of *Hiatella*, *Mya* sp., and *Macoma balthica* from surface and down to 1 ft depth in silt between ca. 650 and 670 ft alt, 4 mi W of Bathurst Inlet, Northwest Territories (66° 32' N Lat, 107° 42' W Long). Coll. 1962 by W. Blake, Jr. *Comment (W.B., Jr.):* shells are the highest found in region, and presumably date highest beaches, at 700 to 750 ft.

**GSC-125. Mt. George, Kent Peninsula**

Shells of *Mya truncata* on surface of beaches on top of Mt. George, the highest point (alt ca. 610 ft) on Kent Peninsula, Northwest Territories (68° 39.5' N Lat, 107° 01' W Long). Coll. 1962 by H. H. Bostock for W. Blake, Jr. *Comment (W.B., Jr.):* the dated pelecypods indicate that Kent Peninsula was ice free 9200 yr ago. Higher beaches do not exist on Kent Peninsula, but the marine limit elsewhere along the mainland coast is close to 700 ft. Shells probably date highest beaches. Sample mixed with dead gas for counting.

**Gordon Bay series**

Plant debris and pelecypod shells coll. in deltaic beds of silt and sand in attempt to determine recent rate of land uplift. The nearly flat-lying deltaic beds are exposed at the head of Gordon Bay on E side of Bathurst Inlet, Northwest Territories (66° 49.5' N Lat, 107° 05' W Long). Top surface of delta below surface peat is at alt of 29 ft. Coll. 1962 by W. Blake, Jr.

**GSC-138. Gordon Bay, plant debris**

Leaves and twigs of birch, alder, and willow, and fragments of mosses from 19 ft alt. Date based on one 3-day count.

**GSC-137. Gordon Bay, shells**

Whole shells and fragments of *Mytilus edulis* at 24 ft alt. Date based on one 3-day count.

**General Comment (W.B., Jr.):** the changing fauna and increasing coarseness of sediments upward in section indicate imminent approach of shoreline, and eveness of surface of delta suggests that little erosion has occurred since emergence. Thus *Mytilus* and accompanying fragile *Macoma balthica* in living position are believed to have lived when beds now at 29 ft alt were at or close to sealevel. If so, uppermost sediments were being deposited ca. 2000 yr ago,
and, if constant sealevel is assumed, uplift since then has averaged 1.5 ft per century (Blake, 1963).

**Melville Sound series**

Plant debris, pelecypod shells, and peat coll. in and on top of silty and sandy, gently dipping deltaic beds in unnamed bay on S side of Melville Sound, Northwest Territories (68° 11.5' N Lat, 106° 17' W Long). Uppermost sand beds in delta are at alt 29 ft. Coll. 1962 by W. Blake, Jr.

**GSC-152. Melville Sound, plant debris**

3070 ± 140

1120 B.C.

Twigs, leaves, and moss fragments from bed at ca. 24 ft alt deformed by growth of an ice wedge. Sample pretreatment included cold NaOH-leach. Sample mixed with dead gas for counting.

**GSC-158. Melville Sound, shells**

2510 ± 180

560 B.C.

Whole shells and fragments of the pelecypods *Macoma balthica, Macoma calcarea,* and *Mya truncata* at 26 to 28 ft alt. Sample mixed with dead gas for counting.

**GSC-172. Melville Sound, peat**

400 ± 140

A.D. 1550

Peat at 28 ft on top of ice wedge and at base of peat layer 2 to 3 ft thick that mantles surface of deltaic beds. Date based on single 3-day count.

*General Comment* (W.B., Jr.): dates on the organic debris and shells are similar to those obtained from Gordon Bay; possible reasons for the slight age differences appear elsewhere (Blake, 1963). Perhaps uplift during last 2500 yr has been slightly slower at Melville Sound, about 100 mi N of Gordon Bay. Age of surface peat, which has accumulated since the delta emerged from the sea, gives no information as to time of passage of shoreline. Shell date indicates that the ice wedge started to develop within last 2500 yr, but because the surface peat mantles the ice wedge as well as the deltaic beds, significant growth of the wedge ceased 400 yr ago, or earlier.

**GSC-136. Lang River, Somerset Island**

9180 ± 170

7230 B.C.

Marine pelecypod shells (*Hiatella arctica* and *Mya truncata*) from surface of delta, alt 418 ft, 3 mi W of mouth of unnamed river 6 mi S of Lang River, E side Somerset Island, Northwest Territories (72° 11' 30" N Lat, 94° 05' W Long). Site probably ca. 100 ft below marine limit. Coll. 1962 by B. G. Craig. *Comment:* date is minimum for retreat of Laurentide ice from area (see also Craig, in press, and L571 A, B, Lamont VII).

**GSC-150. Cunningham River, Somerset Island**

9180 ± 170

7230 B.C.

Marine pelecypod shells (*Hiatella arctica*), 7 mi inland from mouth of Cunningham River, Somerset Island, Northwest Territories (73° 59' N Lat, 93° 40' W Long), from eroded surface of marine silt at alt 204 ft, at least 200 ft below marine limit. Shells abundant; many occur paired in living position. Coll. 1962 by B. G. Craig. *Comment:* date is minimum for retreat of ice from N Somerset Island (Craig, in press).
Cape Alexander series, Boothia Peninsula

Plant detritus and marine shells from bank of stream ca. 2 mi inland from small bay E of Cape Alexander, W side of Boothia Peninsula, Northwest Territories (70° 22' N Lat, 96° 19' W Long). The bank, cut below a terrace at alt 72 ft, exposes alternating layers of plant detritus and sand containing marine pelecypod shells. Coll. 1962 by B. G. Craig.

**GSC-144. Cape Alexander, shells**

Shells of *Astarte borealis* coll. 4 ft below ground level. Date based on one 3-day count.

**GSC-145. Cape Alexander, plant detritus**

Twigs, leaves, and other plant fragments from layer immediately above GSC-144. Sample pretreatment included cold NaOH-leach. Sample mixed with dead gas for counting. *General Comment* (B.G.C.): the two samples appeared to represent an estuarine-deltaic environment when seashore stood ca. 75 ft above its present level. In view of other shell dates from the region (particularly Northern Keewatin series, GSC I) and disparity in age of the two samples, it is apparent that shells in this deposit have been redeposited from a higher site. Consequently, the strata may be alluvial rather than deltaic, and the 2120-yr plant material may have been deposited when shoreline was between sample site (alt 72 ft) and present shore.

**GSC-146. Makinson Inlet (S arm), Ellesmere Island**

Marine pelecypod shell fragments from surface of raised beach at head of S arm of Makinson Inlet, Ellesmere Island, Northwest Territories (77° 10' N Lat, 81° 50' W Long), at ca. 240 ft, ca. 100 ft below the marine limit. Coll. 1960 by R. L. Christie. *Comment* (J.G.F.): shells probably originated closely following general deglaciation, at a time when sea penetrated to site from Baffin Bay through lower reaches of Makinson Inlet, a region largely glacier-covered today. Outer and inner fractions of sample were dated separately, after removal of outermost 12% of shells:

- outer fraction (13-70% leach) 7620 ± 210
- inner fraction (71-100% leach) 8200 ± 220

The discrepancy between the two dates is ascribed to contamination of the outer fraction. Each date is based on a single count.

**GSC-140. Makinson Inlet (N arm), Ellesmere Island**

Peat from upper part of valley wall 5 mi E of head of N arm of Makinson Inlet, Ellesmere Island, Northwest Territories (77° 40' N Lat, 81° 40' W Long), from base of 4-ft bed of sandy moss peat exposed in a landslide scar that cuts a meltwater channel. Peat, overlain by boulders in channel bottom and underlain by bouldery gravel on sandstone and shale, probably accumulated on floor of channel. However, the ‘old’ date reinforces alternative possibility that peat and gravel beneath it comprise remnant of high-terrace deposits.
(interglacial or preglacial) across which channel was eroded. Coll. 1961 by J. G. Fyles.

**GSC-118. Augusta Bay, Ellesmere Island**  
6370 ± 100  
4420 b.c.

Marine shells (*Mya truncata, Hiatella arctica*) from silt underlying 15 ft of sand beneath a beach terrace near S shore of Augusta Bay, Bay Fjord, Ellesmere Island, Northwest Territories (78° 51’ N Lat, 81° 48’ W Long). Site, at alt 120 ft, is on seaward face of moraine marking a stand of the terminus of former outlet glacier. An associated ice-contact delta at alt 250 ft is believed to mark the sealevel when the glacier margin stood at the moraine. Coll. 1961 by J. G. Fyles. **Comment:** date is minimum for ice retreat from the moraine, which now lies 10 mi W of the ice cap (see also GSC-170, 175, this list).

**GSC-170. Strathcona Fiord (shells), Ellesmere Island**  
7750 ± 160  
5800 b.c.

Shells of *Mya truncata* a few hundred ft S of Strathcona Fiord opposite mouth of N arm of Fiord, Ellesmere Island, Northwest Territories (78° 42’ N Lat, 82° 51’ W Long). Sample is from a shell-rich zone including paired valves at the top of massive silt beneath 5 ft of beach gravel at alt 245 ft. Site is on a seaward face of a valley-side ice-contact deltaic terrace (alt 335 ft) that probably marks sealevel when the glacier terminus in the fiord stood close to this locality. Coll. 1961 by J. G. Fyles. **Comment:** date is minimum for glacial retreat from this part of the fiord valley some 20 mi W of the present ice cap.

**GSC-175. Strathcona Fiord (peat), Ellesmere Island**  
7680 ± 150  
5730 b.c.

Moss peat from base of sandy peat at depth 9 ft in bottom of a small upland gully, alt 1300 ft, at top of valley wall 1 mi SW of the head of Strathcona Fiord, Ellesmere Island, Northwest Territories (78° 33’ N Lat, 82° 20’ W Long). Peat is underlain by till and covered by 1 to 2 ft of colluvium. Coll. 1961 by J. G. Fyles. **Comment:** date is minimum for time since deglaciation of the upland 10 mi W of present ice cap. Compare with dates for early post-glacial marine shells from nearby valleys (GSC-118 and 170, this list). Sample held at slightly less than normal pressure during one count; mixed with dead gas during other count.

**GSC-129. Borup Fiord, Ellesmere Island**  
3720 ± 140  
1770 b.c.

Willow wood and moss from deformed alluvium beneath glacier snout at head of Oobloyah Bay, Borup Fiord, Ellesmere Island, Northwest Territories (80° 50’ N Lat, 83° 06’ W Long), from lower part of 80-ft section of sand, silt, and gravel, covered by 10 to 30 ft of coarse gravel and underlain by marine clay. These deposits, tilted and faulted, now stand at alt 50 to 150 ft at E side of glacier terminus and are exposed by gully of ice-margin stream. They comprise an up-thrust part of the modern outwash plain graded to present sealevel. Coll. 1961 by J. G. Fyles. **Comment:** glacier has recently encroached on ground that has been ice-free for more than 3700 yr (compare with GSC-105, GSC II, related to a glacier 9 mi E).
Marine pelecypod shells on or in surface deposits at various localities within the Arctic Archipelago have yielded ‘old’ C\(^{14}\) dates. Some of the ‘old’ samples comprise thick fragments and rare thick whole shells collected above the postglacial marine limit, from sites that lack deposits or landforms suggesting marine inundation; these shells probably were glacially transported from lower positions (see GSC-111, 135, below; GSC-51, GSC I). Other ‘old’ shell samples come from sites below or approx. at upper limit of marine submergence and, prior to dating, gave no indication of being other than postglacial (GSC-134, 139, 149, and 154, below). Some may be glacial erratics but some may have come directly from unrecognized remnants of interglacial marine deposits or may have been reworked from such deposits by the postglacial sea or by rivers. Stratigraphically distinct interglacial marine deposits so far are known only on N. Axel Heiberg Island and adjacent parts of Ellesmere Island (see GSC-113, below; GSC-65, GSC II).

**GSC-111. Hare Cape Ridge, Ellesmere Island** \(36,300 \pm 2000\) 34,350 b.c.

Thick, worn fragments and rare whole shells of *Hiatella arctica*, *Mya truncata*, and *Astarte* sp. from upland extending W from the summit of Hare Cape Ridge, Ellesmere Island, Northwest Territories (79° 55' N Lat, 86° 22' W Long); coll. at alt ca. 2050 ft from several acres of ground surface in an area of sandstone and shale rubble and disintegrated outcrop strewn with erratic stones. Emerged beaches and marine sediments have been recognized only below alt 500 ft. The shells at this high locality and at others nearby above 500 ft probably were transported by glacier ice. Outer and inner fractions of sample were dated separately after removal of outermost 10% of the shells:

- outer fraction (11-50% leach) 30,300 ± 1600
- inner fraction (51-100% leach) 36,300 ± 2000

Coll. 1961 by J. G. Fyles. Comment: sample site is at approx. same locality as L-548 (Lamont VII; Sim, 1961) dated as 19,500 ± 1100. GSC-51 (28,700 ± 600) is from a similar site at 630 ft 8 mi SW (see GSC I). The differences in age between GSC-111 and L-548 as well as between the two fractions of GSC-111 are assumed to result from varying degrees of contamination with young C. Thus all the dates are probably minimal.

**GSC-134. Swinnerton Peninsula, Ellesmere Island** \(29,800 \pm 220\) 27,850 b.c.

Shells and fragments of *Hiatella arctica*, *Mya truncata*, and rare *Astarte* from alt 280 to 300 ft on S side of Swinnerton Peninsula, Ellesmere Island, Northwest Territories (77° 20' N Lat, 81° 40' W Long); from sandy ground surface approx. at upper limit of emerged marine beaches and at highest occurrence of shells in any quantity (isolated shell fragments were found up to 350 ft). Coll. 1961 by J. G. Fyles. Comment: shells were expected to be early postglacial (see GSC-146, 8200 ± 220, this list, from a nearby site), but apparently belong to an earlier marine episode, probably prior to last glaciation. It is not known whether shells have been redeposited. Dates were determined
for two preparations:

standard preparation (11-100% leach fraction) 29,430 ± 680
inner preparation (63-100% leach fraction, date based on one 3-day count) 29,800 ± 220

Similarity of the two dates suggests absence of major contamination. Hence, they may indicate the approx. absolute age rather than a minimum (contrast with GSC-111 above).

GSC-113. Rens Fiord, Axel Heiberg Island 36,800 ± 4200 34,850 B.C.

Marine shells (*Astarte* sp.) from alt 350 to 370 ft, 3 mi SE of Rens Fiord, N Axel Heiberg Island, Northwest Territories (81° 03' N Lat, 93° 10' W Long). Shells from ground surface on upper part of bank of small river, and derived from stratified silt, sand, and gravel beneath boulder-strewn, apparently glacial deposits. Site is ca. 200 ft above inferred postglacial marine limit. Coll. 1961 by J. G. Fyles. *Comment*: date agrees with the inference that the deposits are interglacial. The occurrence is similar to GSC-65 (GSC II) coll. 35 mi. E on Ellesmere Island. Sample mixed with dead gas for counting; date probably is minimal.

GSC-139. Rens Plain, Axel Heiberg Island 36,600 ± 3700 34,650 B.C.

Marine shells (*Hiatella arctica*) from bank of stream eroded through sandy plain at alt 140 ft on N Axel Heiberg Island, 5 mi W of Nansen Sound, Northwest Territories (81° 05' N Lat, 92° 25' W Long). Sample from 20 ft of sand covered by wash of pebbles and underlain by silt. Coll. 1961 by J. G. Fyles. *Comment*: site lies below marine limit (ca. 170 to 200 ft) and shells were expected to date from the postglacial submergence ca. 8000 yr ago. However they must belong to an earlier, possibly interglacial marine interval (see GSC-113, above; GSC-65, GSC II). It is not known whether the inclosing sands were deposited during the same interval or whether they are younger materials containing reworked shells. The freshness and abundance of the shells indicate a nearby primary source. Date is probably minimal.

GSC-149. NW Ellesmere Island 37,200 ± 4100 35,350 B.C.

Marine shells (*Hiatella arctica*) from wall of a gully at alt 150 ft, 1 mi inland from Nansen Sound 4 mi S of White Point, Ellesmere Island (81° 10' N Lat, 90° 15' W Long). Marine limit is at ca. 230 ft. Shells are abundant, in silt beneath beach gravel and overlying poorly sorted gravel or till. Coll. 1961 by J. G. Fyles. *Comment*: for GSC-139, above, applies to this sample.

GSC-154. Nelson Griffiths Point, Melville Island 34,050 ± 2650 32,100 B.C.

Marine shell fragments (incl. *Hiatella arctica*) from surface at Nelson Griffiths Point, Melville Island, Northwest Territories (75° 05' N Lat, 106° 00'
W. Dyck and J. G. Fyles

W Long), at alt 198 ft on highest emerged beach recognized in the vicinity. Coll. 1962 by W. E. S. Henoch, Geog. Branch, Dept. of Mines and Tech. Surveys, Ottawa. *Comment*: shells were expected to be early postglacial but evidently belong to an earlier marine episode, probably prior to the last glaciation. It is not known whether shells have been redeposited. Date is probably minimal.

**GSC-123. Fury Beach, Somerset Island**  
31,860 \( \pm \) 2560  
29,910 B.C.

Marine pelecypod shell fragments (*Hiatella* sp.) from ground surface 12 mi NW of Fury Beach, Somerset Island, Northwest Territories (72° 45' N Lat, 92° 25' W Long), in stony marine clay or till at base of end moraine, alt ca. 744 ft, ca. 250 ft above marine limit. Coll. 1962 by B. G. Craig. *Comment* (B.G.C.): shells antedate last glaciation and were deposited here by glacier ice. Date based on one 3-day count and possibly is minimum.

**GSC-135. Port Logan, Boothia Peninsula**  
>23,300

Marine pelecypod shells and fragments (*Yoldia arctica*, *Clinocardium ciliatum*, *Astarte* sp., and *Hiatella arctica*) from cross-bedded sand 16 mi W of Port Logan, E side of Boothia Peninsula, Northwest Territories (71° 20' N Lat, 93° 52' W Long); alt ca. 640 ft, possibly ca. 100 ft above marine limit. Coll. 1962 by B. G. Craig. *Comment* (B.G.C.): sample was small and mixed with dead gas for counting; date is minimum. Shells antedate last glaciation, and may be indigenous or redeposited.

**II. ARCHAEOLOGIC SAMPLES**

**GSC-143. Bennett site, Ontario**  
690 \( \pm \) 130  
A.D. 1260

Charcoal from Bennett site, Ontario, in Lot 14, Concession 1, Nelson Tp., Halton Co. (43° 25' N Lat, 79° 57' W Long), in Pot Concentration 3 under pottery fragments and 4 to 9 in. below the plough zone. Coll. 1962 by J. V. Wright, Nat. Mus. of Canada, Ottawa. *Comment* (J.V.W.): site is assigned to the late Pickering branch of the Ontario Iroquois Tradition and was occupied just prior to the Uren site. C\(^{14}\) date is in excellent agreement with the seriations estimate of 1250 A.D.

**GSC-162. Morrison’s Island, Quebec**  
4700 \( \pm \) 150  
2750 B.C.

Charcoal from Morrison’s Island 6-site, Pontiac Co., Quebec (45° 48.5' N Lat, 77° 02' W Long), ca. 3 mi down Ottawa River from Pembroke, Ontario. Sample from squares T14X and T14Y of Burial 17 at alt 426 ft; maximum depth of burial 28 in. Coll. 1963 by C. C. Kennedy; subm. by J. V. Wright. *Comment* (J.V.W.): date is slightly older than was expected for this site with its Brewerton Focus (Laurentian Archaic) lithic complex and abundance of native copper artifacts.

**GSC-148. McCormick Inlet, Melville Island**  
1150 \( \pm \) 160  
A.D. 800

Charred moss from prehistoric dwelling 6 ft above high tide on shore of
McCormick Inlet, Melville Island, Northwest Territories (75° 49' N Lat, 112° 07' W Long). The moss, mixed with fragments of charred wood and bone, occurred on upper surface of a hearthstone and gave impression of having been placed there as fuel. Coll. 1962 by W. E. S. Henoch, Geog. Branch, Ottawa; subm. by W. E. Taylor, Nat. Mus. of Canada. Comment (W.E.T.): date indicates occupation of site less than 1150 yr ago. Dead moss beneath hearth has date of 1740 ± 190, I-840 (Isotopes IV). The few artifacts recovered represent a Dorset Culture occupation and constitute the northwesternmost occurrence of this culture discovered so far. Sample mixed with dead gas for counting; date based on a single 3-day count.

References

Date lists:

- GSC I  Dyck and Fyles, 1962
- GSC II Dyck and Fyles, 1963
- Isotopes I Walton, Trautman, and Friend, 1961
- Isotopes II Trautman and Walton, 1962
- Isotopes IV Trautman, 1964
- Lamont VII Olson and Broecker, 1961


Vernon, Peter, and Hughes, O. L., in press, Surficial geology of Dawson, Larsen Creek, and Nash Creek map-areas, Yukon Territory: Canada, Geol. Survey, Bull.
SMITHSONIAN INSTITUTION
RADIOCARBON MEASUREMENTS I

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Washington 25, D. C.

INTRODUCTION

The radiocarbon dating laboratory at the Smithsonian Institution, Division of Radiation and Organisms, was established in September 1962. After careful calibration with known samples and refinements in the methane synthesis system, routine analysis of samples was begun in the spring of 1963.

Standard sample pretreatment consists of hand removal of foreign matter such as rootlets, and leaching in hot 2% NaOH followed by hot 5% HCl. Shells are washed in HCl until their weight is reduced by 25%.

Methane, the counting gas, is produced catalytically from CO₂ by a method patterned after that of Fairhall’s (Fairhall et al., 1961). Yields of greater than 95% are obtained consistently. The samples of methane are stored for two weeks after synthesis and counted at least twice for a period of more than 1000 min each.

The counter has a 2.2 l active volume with a 0.5 mil center wire, and is constructed of OFHC copper, teflon and epoxy plastic. Surrounding the counter is 1 in. of mercury, then a methane-filled, multiple anode proportional guard counter (anti-coincidence counter). This unit is immersed in a steel tank filled with 5 tons of mercury, resulting in 6 in. of mercury shielding on the sides and 12 in. on top.

The counter is operated at a pressure of 63 in. Hg at 3900 volts. The background is 5.4 cpm and the ages were calculated using 0.950 of the activity of the NBS oxalic acid (24.3 cpm). The standard deviation indicated represents only the 1σ of the counting statistics.

Interlaboratory Check Samples

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<th>SI No.</th>
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<th>Other C-14 Age on Sample</th>
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<td>11,365 ± 290</td>
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<td>9</td>
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<td>10</td>
<td>160 ± 80</td>
<td>250 ± 55</td>
<td>Arizona IV</td>
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</tbody>
</table>

* Present address: Isotopes, Inc., Westwood, N. J.
† A duplicate analysis made on additional sample material.
SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLE

SI-27. New Providence Island, Bahamas  
1900 ± 80  
A.D. 50

Peat from near sea level, above truncated coral reef and overlain by unconsolidated sand and silt, Lyford Cay Club yacht basin excavation (25° 01’ 30” N Lat, 77° 32’ 05” W Long), Bahamas. Coll. 1960 and subm. by D. F. Squires, Div. of Marine Invertebrates, Smithsonian Inst. Comment: the peat probably had been accumulating throughout much of post-Pleistocene time, as its thickness reaches 16 ft.

II. ARCHAEOLOGIC SAMPLES

A. North America

Winslow site series, Maryland


SI-37.  
635 ± 80  
A.D. 1315

Charcoal from Refuse Pit 12, 48 to 55 in. depth. Associated with sherds from Late Woodland Period. The earlier date of A.D. 837 ± 150 (M-1189, Michigan VIII, p. 243) from a nearby pit was not part of the same series of refuse pits as this sample. Comment (C.E.): reanalysis of the pottery of the earlier pit is now required to justify the differences and see if another occupation is clearly distinguished by the pottery. Date agrees with the Late Woodland occupation of area.

SI-41.  
665 ± 100  
A.D. 1285

Charcoal from House I-31, associated with Mareey Creek series sherds but directly underneath Late Woodland Period materials. Comment (C.E.): date confirms that sample is from the Late Woodland Period.

SI-44. Shepard site, Maryland  
430 ± 70  
A.D. 1520

Charcoal from Burial Pit 1, Square 26D, Shepard Barracks site (39° 05’ 00” N Lat, 77° 27’ 17” W Long), Montgomery County, Site 18-MO-4. Coll. 1962 by R. G. Slattery and W. A. Tidwell; subm. by Clifford Evans. The associated materials are of Late Woodland Period. Comment (C.E.): this site has identical cultural materials to Hughes and Keyser Farm sites, both of which have been interpreted as Late Woodland; hence date corroborates the cultural designation.

Medicine Creek series, Nebraska

Site 25FT17 (40° 23’ N Lat, 100° 14’ W Long), on Medicine Creek, ca. 8.5 mi N of Cambridge, Frontier County, representing Upper Republican
Culture. Coll. 1948 by M. F. Kivett and G. S. Metcalf; subm. by W. R. Wedel, Head Curator of Anthropol., Smithsonian Inst. Wood from a nearby house pit (Feat. 15) has been dated at A.D. 1170 ± 125 (I-585, Isotopes III, p. 73).

SI-32.

830 ± 65  
A.D. 1120

USNM T1371. Post butt in prehistoric square earthlodge, Feat. 30.

SI-34.

1485 ± 65  
A.D. 465

USNM T1660. Unburned wood fragments from square house fill, Feat. 70, 16 to 24 in. depth. Comment (W.R.W.): date seems much too early.

SI-36.

865 ± 65  
A.D. 1085

USNM T1630. Unburned wood fragments from square house, Feat. 66, 14 to 20 in. depth.

SI-40.

710 ± 65  
A.D. 1240

USNM T1766. Well-preserved post butt from square house, Feat. 90, 20 to 37 in. depth.

Medicine Creek Reservoir series, Nebraska

Juniper wood from post butts in sites in Frontier County (40° 8' N Lat, 100° 14' W Long), representing prehistoric farming villages of the Upper Republican Culture. Coll. 1948 by M. F. Kivett and G. S. Metcalf; subm. by W. R. Wedel. Comment: sample from another house ruin (Feat. 30) in Site 25FT70 was dated at A.D. 1450 ± 200 (M-844, Michigan V, p. 41).

SI-47.

790 ± 65  
A.D. 1160

USNM T2705. Juniper wood from butt of NW center post from rectangular house, Feat. 4.

SI-50.

1070 ± 70  
A.D. 880

No. T2632. Entrance post, rectangular house, Site 25FT70.

SI-53.

845 ± 65  
A.D. 1105

No. T2702A. Center post from rectangular house F4, Site 25FT70.

SI-56.

750 ± 65  
A.D. 1200

No. T2523. From rectangular house, Site 25FT39.

Lower Cheyenne River site series, South Dakota

Stanley County (44° 46' N Lat, 100° 43' W Long), Site 39ST1. Samples are unburned juniper wood from post butts in long rectangular houses, probably Thomas Riggs Focus. Coll. and subm. by W. R. Wedel.
Smithsonian Institution Radiocarbon Measurements I

SI-12.

A.D. 920

1030 ± 60


SI-15.

A.D. 1150

800 ± 60

USNM 421991A. In situ in house site, Feat. 24. Coll. 1951. This house is in same village with SI-12 and SI-17, and is considered culturally identical with them.

SI-17.

A.D. 1080

870 ± 60


SI-25. Molstad site, South Dakota

A.D. 1475

475 ± 100

River Basin Surveys Site 39DW234 (45° 27' 30" N Lat, 100° 20' 45" W Long), Dewey County. Post butt from palisade bastion in W sector of fortified area, 1.25 ft depth. Coll. 1962 by J. J. Hoffman; subm. by R. W. Neuman, Missouri Basin Project, 1517 O St., Lincoln, Nebraska. Comment: this date agrees with tree ring date of A.D. 1500.

SI-48. Grover Hand site, South Dakota

A.D. 230

1720 ± 75


Langdeau Village series, South Dakota

Charcoal samples from Site 39LM209 (44° 08’ N Lat, 99° 36’ W Long), representing a previously undescribed complex within the broad Middle Missouri Tradition. Coll. 1962 by R. E. Jensen; subm. by R. W. Neuman.

SI-51.

A.D. 1000

950 ± 65

No. 332 from fill of Feat. 60, a bell-shaped cache pit in floor of Feat. 4, a long rectangular house.

SI-54.

A.D. 1100

850 ± 55

No. 1523 from fill of Feat. 58, a large bell-shaped cache pit in Feat. 11, a long rectangular house.

SI-57.

A.D. 1140

810 ± 70

No. 1036 from surface of floor, Feat. 10, a long rectangular house with wide bench extending across front.
Valdivia Culture series, Ecuador

Guayas Province (1° 56' S Lat, 80° 45' W Long). Earliest Formative Period pottery culture from Ecuador with ceramic forms and decoration showing relationships to Early-Middle Jomon Period materials from Kyushu, Japan. Shell midden refuse from stratigraphic excavations. Coll. 1961 by E. Estrada, B. J. Meggers and Clifford Evans; subm., by Evans, Div. of Archaeol., U. S. Natl. Mus., Smithsonian Inst. Series of dates from the Period A and Period B parts of the Valdivia Culture based on artifact and pottery changes in the sequence.

General comment: see dates from W-630, W-631, W-632 (USGS V, p. 181) and M-1317, M-1318, M-1320, M-1321, M-1322 (Michigan IX) for additional cross-dating in same sequence.

SI-16.

4220 ± 100
2270 B.C.
No. 872-A. Anomalocardia subimbricata from 3.90 to 4.20 m depth in Stratigraphic Cut J, Sec. E. Period A, Valdivia Culture.

SI-18.

4230 ± 100
2280 B.C.
No. 872-B. Anomalocardia subrugosa from 3.90 to 4.20 m depth in Stratigraphic Cut J, Sec. E. Period A, Valdivia Culture. Comment: both samples SI-16 and SI-18 are two different species of shell from same layer of midden refuse and give comparable dates to those obtained from charcoal (cf. SI-22).

SI-20.

2805 ± 105
855 B.C.
No. 870. Fine ash, dust type of charcoal from Stratigraphic Cut J, Sec. E, 3.30 to 3.60 m depth. Period A-B, Valdivia Culture. Submitted to see validity of this type of fine dust-ash sample in midden refuse as compared to shell and large fragments of charcoal. Comment: in view of other Valdivia Culture dates, this date suggests that sample was contaminated with more recent materials.

SI-22.

4450 ± 90
2500 B.C.
No. 847. Charcoal from Stratigraphic Cut J, Sec. D, 3.00 to 3.30 m depth. Period A, Valdivia. Comment: dates in same range as SI-16 and SI-18, shell samples from same cultural period of refuse.

Pepa de Huso series, Ecuador

Manabi Province (1° 3' S Lat, 80° 34' W Long), Site M-55, Pepa de Huso. Charcoal samples in stratigraphic cut representing the Late Chorrera Period as determined by pottery classification. Coll. 1961 by E. Estrada; subm. by Clifford Evans.

General Comment (C.E.): samples SI-35 and SI-43 agree with time sequence on coast of Ecuador.

SI-35.

2525 ± 105
575 B.C.
No. 1023. 2.60 to 2.80 m below surface.


**Smithsonian Institution Radiocarbon Measurements I**

**SI-42.**

No. 1024. 2.80 to 3.00 m below surface. Comment (C.E.): because of the consistence of SI-35 and SI-43 and because of the expected age on the basis of cultural association, this material is considered intrusive into the section. Date is within estimated range (500 to 1000 A.D.) for the Chirije Culture, represented in the upper levels at the site.

**SI-43.**

No. 1025. 3.00 to 3.20 m below surface.

**Esteros series, Ecuador**

Charcoal samples from Site M-7 (57° S Lat, 80° 41’ W Long), Manabi Province, Ecuador. Three samples from Stratigraphic Cut A, associated with pottery of the Bahia Culture. Coll. 1961 by E. Estrada, Clifford Evans, and B. J. Meggers; subm. by Evans. Comment (C.E.): in agreement with estimated range of culture based on pottery sequences.

**SI-49.**

No. 988. 3.20 to 3.40 m.

**SI-52.**

No. 989. 3.40 to 3.60 m.

**SI-55.**

No. 991. 3.80 to 4.00 m.

**SI-33. Rio Solimoes, Territory of Amazonas, Brazil**

Charcoal from Coari site (4° 6’ S Lat, 63° 8’ W Long), Cut 2, 80 cm depth. Coll. 1957 by P. Hilbert of Museu Goeldi; subm. by Clifford Evans. Sample should date the Coari Phase, Incised Rim Horizon Style. Comment: in agreement with the A.D. 763 ± 48 date of this culture (P-370, Univ. of Penna. VI. p. 100), based on sponge spicule temper in pottery.

**C. Arabia**

**Wadi Beihan series, Arabia**

Burned wooden beams from Hajar Bin Humeid (14° 54’ N Lat, 45° 46’ E Long), an ancient town site in S Arabia with 15 m of occupational debris which has been divided into 19 periods. Coll. 1951 by D. W. Dragoo and G. W. Van Beek; subm. by Van Beek, Div. of Archaeol., U. S. Natl. Mus., Smithsonian Inst.

**SI-23.**

H 24. Stratum A, Room A29, 2.48 m depth. Comment (G.W.V.B.): archaeologically, the complex from which this specimen comes can scarcely be earlier than the 1st century A.D. and is probably no older than the 7th century A.D.
SI-19.  
2390 ± 70  
440 b.c.

H 1280. Stratum F, Area 1, 5.77 m depth.

SI-21.  
2200 ± 75  
250 b.c.

H 1083. Stratum G, Area 1, 6.18 to 5.98 m depth. Comment (G.W.V.B.): stratigraphically, this specimen should be older than or at least roughly contemporary with SI-19. It should not be younger.

SI-14.  
2690 ± 100  
740 b.c.

H 2684. Stratum Q, Area 4, 11.08 m depth. Comment: a sample from this beam was dated at 857 ± 160 b.c. (W-437, G. W. Van Beek, 1956).

References

Date lists:
- Arizona III Damon and Long, 1962
- Arizona IV Damon, Long, and Sigalove, 1963
- Isotopes III Trautman, 1963
- Michigan V Crane and Griffin, 1959
- Michigan VIII Crane and Griffin, 1963
- Michigan IX Crane and Griffin, 1964
- Univ. of Pennsylvania VI Stuckenrath, 1963
- USGS V Rubin and Alexander, 1960


Stuckenrath, Robert, Jr., 1963, University of Pennsylvania radiocarbon dates VI: Radiocarbon, v. 5, p. 82-103.


TEXAS A & M UNIVERSITY RADIOCARBON DATES I

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The Radiocarbon Dating Laboratory of Texas A & M University was initiated as a research facility in the Oceanography and Meteorology Department. The facilities are available to graduate study programs and to other research groups associated with the University.

Research was begun in June 1960, towards development of a carbon dating method utilizing liquid scintillation counting. Benzene was chosen as the counting solvent because of its high energy transmitting properties and the high carbon content of benzene which could be totally derived from the sample to be dated. A catalytic method of synthesis of $\text{C}_6\text{H}_6$ at low temperature, as first reported by Shapiro and Weiss (1957), was further developed and modified by Noakes and others (1963) to a procedure suitable for carbon dating. A combined effort of this laboratory and the University of Texas Radiocarbon Dating Laboratory has resulted in a routine procedure for carbon dating, as reported earlier (Texas I).

In the dates reported here the sample preparation and the method of conversion of carbon samples to the counting solvent, benzene, was the same as reported in the earlier papers cited. The problem, reported then, of variation in background count rate between counting vials was eliminated by prior determination of the background for each vial used. With the exception of samples TAM 1 and TAM 2, all dates reported here were calculated according to this procedure.

The modern standard used was wood obtained from a tree felled in Central Texas between 1850 and 1854. The count rate for this standard was 6.42 counts/min/g with a counting efficiency of 50%, as determined by use of a Packard Tri-Card Automatic Liquid Scintillation Spectrometer, Series 314E, operating at a voltage of 850 with a 10 to 50-division window operating in coincidence. The statistics quoted here indicate only the uncertainty involved in counting random events. Ages are calculated on a $\text{C}^{14}$ half-life of 5568 yr, using 1950 as the reference yr.

The check samples TAM 1 and TAM 2 listed in the date list are the same as samples TX-1 and TX-2 reported earlier by the University of Texas (Texas I), since both laboratories were initially developed through a co-operative effort.

Marine water samples from the Gulf of Mexico have been dated relative to our modern wood standard. Sea water dates will be published as $\delta\text{C}^{14}$ values relative to a NBS oxalic acid $\text{C}^{14}$ standard when mass spectrometric $\delta\text{C}^{13}$ values are available for these calculations, as suggested by Broecker and Olson (1959).

ACKNOWLEDGMENTS

Dr. E. Mott Davis, Director of the Radiocarbon Dating Laboratory of the University of Texas, made available the facilities of his laboratory while our
laboratory was being renovated. The technicians of his laboratory, F. Howard Hughes and William B. Wollet, helped in certain phases of the sample preparation of the dates recorded here.

Dr. Brian Logan of the Geological Section of the Department of Oceanography and Meteorology of Texas A & M University contributed many samples and helped in the evaluation of dates.

Dr. Ruble Langston of the Department of Plant Physiology and Pathology at Texas A & M University generously made available his liquid scintillation counter for counting and rechecking the samples.

SAMPLE DESCRIPTIONS

I. CHECK SAMPLES (GEOLOGIC)

TAM-1 (= Tx-1). Grand Forks, North Dakota 10,820 ± 190 8870 B.C.

Wood from sand overlying till of the last ice advance in North Dakota; from 15 mi W of Grand Forks in NW¼ sec. 31, T 152 N, R 52 W (47° 56' N Lat, 97° 22' W Long), Grand Forks County, North Dakota. Coll. 1958 by R. W. Lemke, U. S. Geol. Survey, Denver, Colorado, and H. E. Wright, Jr., Univ. of Minnesota, Minneapolis; subm. to Univ. of Texas Lab. in 1961 as a check sample by Meyer Rubin, U. S. Geol. Survey, Washington, D. C. Comment: measurement was previously reported as Tx-1 (Texas I). Sample has also been dated by U. S. Geol. Survey as W-723, 10,960 ± 300 (USGS V).

TAM-2 (= Tx-2). Sheep Creek, Alaska 5925 ± 275 3975 B.C.

Wood from stump in W wall of placer cut, Sheep Creek, near Fairbanks, in SE¼ sec. 17, T 1 N, R 2 W (64° 55' N Lat, 148° 00' W Long), Fairbanks D-2 Quadrangle, Alaska. From ca. 5 ft below surface of a gravel fan interbedded in silt, representing perhaps the last third of the Quaternary Period. The gravel overlies the Wisconsin-age Goldstream Muck Formation, or is part of the upper part of it, and is perennially frozen. Coll. 1956 by T. L. Péwé, U. S. Geol. Survey, College, Alaska; subm. 1961 to Univ. of Texas Lab. as a check sample by Meyer Rubin. Comment: measurement was previously reported as Tx-2 (Texas I). Sample has also been dated by U. S. Geol. Survey as W-859, 5940 ± 250 (USGS V).

TAM-3. Hutchins Creek, Illinois 4815 ± 250 2865 B.C.

Wood specimen from Hutchins Creek Terrace, in NW¹⁄₄, SW¹⁄₄, sec. 25, T 11 S, R 3 W (37° 32' N Lat, 89° 23' W Long), Union County, Illinois. Log with well-preserved leaves, found in silt 24 ft below terrace surface. Coll. 1957 by S. E. Harris, Jr., Southern Illinois Univ., Carbondale. Comment: sample has been dated by U. S. Geol. Survey as W-823, 4840 ± 300 (USGS V).

II. GEOLOGIC SAMPLES

A. Campeche Bank, Yucatan

These dates were determined in an attempt to establish a chronology of sedimentary events in the late Pleistocene and early Holocene transgression of Campeche Bank, Yucatan. Samples are from cores and surface grabs taken on
various cruises of the Texas A & M research vessel R. V. Hidalgo during 1960 and 1961. The material dated includes calcareous shells and tests, oolites and calcareous pellets from various carbonate lithofacies in the area.

**TAM-4. Cayo Arenas, Campeche Bank**

1500 ± 500 A.D. 450

Coral fragment forming nucleus of a large algal nodule at Station 70, Cayo Arenas reef, Campeche Bank (22° 08' 27" N Lat, 91° 22' 27" W Long), depth 47 m. *Comments*: predicted age was about 7000 B.P., synchronous with a lower sea level during the Holocene. The C¹⁴ date may be anomalous, due to the introduction of large amounts of secondary carbonate (aragonite).

**TAM-5. Campeche Bank, Station 715, Sample 1**

17,710 ± 500

15,760 B.C.

Shells from 43 to 71 cm interval below top of core from Station 715, Campeche Bank. Station occupied on cruise 61-H-2 (21° 30' N Lat, 32° 25' W Long), depth 180 m. Sample was taken from a stratum of white clayey pellet calcarenite in the lower section of the core and from immediately below a burrowed zone in the core which marks the upper surface of this stratum. Material dated consisted of planktonic tests and shells, calcareous pellets, and benthic tests. *Comment*: the white clayey pellet calcarenite is widespread on the NW margin of Campeche Bank, occurring in cores from depths below 110 m. It is believed to be of Wisconsin age.

**TAM-6. Campeche Bank, Station 715, Sample 2**

10,220 ± 300

8270 B.C.

Shells from 11 to 26 cm below top of core from Station 715, Campeche Bank. Station occupied on cruise 61-H-3 (21° 30' N Lat, 32° 25' W Long), depth 180 m. Samples was taken from a stratum of planktonic lutite in the upper section of the core and overlying the white clayey pellet calcarenite (Sample 1, Station 715). *Comment*: date closely approaches the postulated age (early Holocene).

**TAM-7. Campeche Bank, Station 342**

13,320 ± 200

11,370 B.C.

Superficial oolites and calcareous pellets from a surface grab sample at Station 342, Campeche Bank. Station was occupied on cruise 61-H-10 (21° 04' N Lat, 92° 28' W Long), depth 99 m. The grab was taken on the top of a mound-like feature on the shelf margin. *Comment*: the oolites were believed to be synchronous with the terrace at 90 to 100 m on Campeche Bank; their expected age was late Wisconsin.

**TAM-8. Campeche Bank, Station 1224**

Modern

Pelecypods from Station 1224, Campeche Bank. Station occupied on cruise 61-H-14 (20° 30' N Lat, 90° 46' W Long), depth 9 m. Shells were from a skeletal calcarenite veneer that overlies sea floor. *Comment*: expected age: modern.

**TAM-9. Campeche Bank, Station 1234, Sample 1**

5200 ± 170

3250 B.C.

Coarse fragments of pelecypod shells from surface grab at Station 1234, Campeche Bank, occupied on cruise 61-H-14 (20° 22' N Lat, 91° 40' W Long),
depth 35 m. Similar to the modern fauna from Station 1224. Comment: expected age: 6000 to 8000 B.P.

**TAM-10. Campeche Bank, Station 1234, Sample 2**

3570 ± 200

1620 B.C.

Fine shell fragments from surface grab at Station 1234, Campeche Bank, occupied on cruise 61-H-14 (20° 22' N Lat, 91° 40' W Long), depth 34 m. Fine silt-size carbonate grains washed out of the matrix of Sample 1/1234. Postulated age 1000 to 3000 yr. Comment: as expected, date was younger than the coarse fraction of the sediment from TAM-9 (above) suggesting that the bimodality of this lithology is due to mixing of two genetically and chronologically unrelated components.

**TAM-11. Campeche Bank, Station 1231**

3925 ± 150

1975 B.C.

Fine silt-sized skeletal grains from a skeletal calcarenite lithology from a surface grab Station 1231, Campeche Bank, occupied on cruise 61-H-14 (20° 22' N Lat, 91° 17' W Long), depth 22 m. Comment: expected age: 1000 to 3000 B.P.

**TAM-12. Campeche Bank, Station 1236**

3470 ± 1000

1520 B.C.

Thin-shelled pelecypod fauna from sandy carbonate mud surface grab, Station 1236, Campeche Bank. Station occupied on cruise 61-H-14 (20° 22' N Lat, 91° 56' W Long), depth 42 m. Comment: C¹⁴ date was obtained to test the postulated modern age of this fauna.

**TAM-13. Campeche Bank, Station 141**

3150 ± 380

1200 B.C.

Fine skeletal grains from fine-grained skeletal calcarenite from a surface grab, Station 141, Campeche Bank. Station occupied on cruise 60-H-2 (21° 40' N Lat, 91° 48' W Long), depth 45 m. Comment: expected age: 1000 to 3000 B.P.

**TAM-33. Campeche Bank, Station 1301, Sample 1**

10,930 ± 170

8980 B.C.

Hard calcareous pellets from a surface grab, Station 1301, Campeche Bank. Station occupied on cruise 62-H-2 (22° 20' 48" N Lat, 91° 28' 42" W Long), depth 115 m. Comment: sample was dated to ascertain the age of an extensive blanket of pelletal and oolitic sediments which overlie the northern margin of the Campeche Bank between the 80 and 160 m isobaths.

**B. Antarctica**

During the 1959-1960 and 1961-1962 Antarctic field seasons, several samples of mummified seal remains were collected from the Victoria Land sector of Antarctica by members of two separate field parties from the University of Kansas, Lawrence, Kansas. Dates are of interest in relation to present and future geological and geochemical studies.

**TAM-14. Victoria Land, Sample McMRS-1**

1385 ± 200

A.D. 565

Flesh of a freshly-killed Weddell Seal (*Leptonychotes weddelii*) taken from the ice near NAF, McMurdo Sound, Victoria Land, Antarctica (77° 51'
Texas A & M University Radiocarbon Dates

S Lat, S Lat, 166° 37" E Long). Coll. Nov. 1961; stored in CCl₄. Subm. Dec. 1961 by E. E. Angino, Dept. of Geology, Univ. of Kansas. **Comment:** CCl₄ was eliminated from sample by vacuum drying. Sample used as modern reference standard to calculate date of mummified seal (MTN-1) relative to modern seal.

**TAM-15. Victoria Land, Sample MTN-1**

1855 ± 160

A.D. 95

Bones, skin and flesh from mummified crab-eater seal (*Lobodon carcinophagus*) from surface of dry moraine at alt 793 ± 25 m on the SW flank of Mount Nussbaum, Taylor Dry Valley, Victoria Land, Antarctica (77° 41' 30" S Lat, 162° 40' E Long). Coll. and stored in CCl₄ Dec. 1959, by E. E. Angino and E. J. Zeller, Dept. of Geology, University of Kansas; subm. Oct. 1961 by E. E. Angino. **Comment:** sample was dried in a vacuum oven to eliminate CCl₄. Calculated date relative to modern seal (sample TAM-14) was 500 yr. Olson and Broecker (Lamont VII) dated fur from carcass of a mummified seal (L-462E) obtained from Bonney Lake at the upper end of Taylor Dry Valley (77° 42' S Lat, 162° 25' E Long) in McMurdo Sound Area. Through use of a contemporary Antarctic seal (L-570, Lamont VIII) as a reference standard, an age of 300 yr was calculated. Relative to an oxalic acid C¹⁴ standard, their modern seal gave an age of 1300 yr.

**References**

Date lists:

- Texas I  Stipp et al., 1962
- USGS V  Rubin and Alexander, 1960
- Lamont VI  Broecker and Olson, 1959
- Lamont VII  Olson and Broecker, 1961
- Lamont VIII  Broecker and Olson, 1961


MONACO RADIOCARBON MEASUREMENTS I

J. THOMMERET and J. L. RAPAIRE
Centre Scientifique de Monaco

Created in 1961, the $^{14}C$ dating laboratory of the Centre Scientifique de Monaco (founded by H. S. H. Prince Rainier III in 1960) made its first dating measurements in 1962.

APPARATUS AND PROCEDURE

Procedures and methods of preparation of samples are similar to those used in the Centre d'Etudes Nucléaires de Saclay. $^{14}C$ is measured in a 1.2 L stainless steel proportional counter filled with purified CO$_2$ to a pressure of 74 cm Hg. The counter is protected by two layers of shielding (bismuth, iron and lead), and by a cylindrical crown of 32 G.M. counters connected in anti-coincidence. Negative voltage ($-6000$ v) is applied to the shell of the proportional counter. Measurements are made in an air-conditioned room 30 days after preparation of samples. Sample counts (of 1000 min) are repeated several times between counting runs on ancient and modern standards.

The background from a filling of pure CO$_2$ prepared from anthracite is 3.64 counts/min. The modern $^{14}C$ standard (1950) is obtained from NBS oxalic-acid standard multiplied by 0.95.

The counting error of samples (standard deviation) is given by $\sqrt{N/t}$ ($N =$ counted number of impulses and $t =$ time of measurement). Counting errors for ancient and modern reference standards are combined with this figure to give the age-error as quoted. Dates are calculated on the Libby half-life value ($T^{1/2} = 5570 \pm 30$ yr) and expressed as years before A.D. 1950. In geochemical measurements, $^{13}C$ assays have not been made.

In order to test the linearity of our counter, we measured artificial samples containing variable known percentages of $^{14}C$ and we found expected values. Some measurements on several samples already checked by other laboratories (Saclay, Scripps) are in agreement with ours; two of these are given in this list.

ACKNOWLEDGMENTS

We are grateful to H. S. H. The Prince of Monaco for supporting our laboratory, to H. E. A. Crovetto, President of the Centre Scientifique de Monaco, to Commandant J. Y. Cousteau, Director of the Musée Océanographique, for laboratory facilities, and to J. Labeyrie and G. Delibrias of the C. E. N. Saclay for technical information.

SAMPLE DESCRIPTIONS

1. GEOLOGIC SAMPLES

A. Viet Nam

Ca Na series, South Viet Nam
Shell samples from marine terraces of Ca Na ($11^\circ 21' \ N \ Lat, 108^\circ 53' \ E$
J. Thommeret and J. L. Rapaire

Long) 32 km S of Phan Rang. Coll. by E. Saurin, Univ. of Saigon, to determine age of the marine regression that is obvious on this coast.

**MC-1. Ca Na, Viet Nam 1** 4500 ± 250
Sea shells and corals coll. 1928 on a marine terrace of 4 m alt at 0.50 m under surface.

**MC-2. Ca Na, Viet Nam 2** 4500 ± 250
Sea shells and corals coll. 1960 at the same place as MC-1. *Comment*: sample coll. to check possibility that exposed shells have exchanged carbon with the atmosphere. No obvious alteration was seen and no H-bomb carbon was detected in the checked sample.

**MC-3. Ca Na, Viet Nam 3** 150 ± 150
Modern shells coll. 1960 on the present shore.

**MC-4. Ca Na, Viet Nam 4** 18,500 ± 250
Sea shells and corals coll. 1960 at 15 m alt.

**Saigon Delta series, Viet Nam**

Two wood samples from a boring in the subsoil of Saigon (10° 46’ N Lat, 106° 43’ E Long). Coll. by E. Saurin, to evaluate the rate of sedimentation and to define the history of the local Quaternary.

**MC-5. Saigon Delta 1** >30,000
Wood coll. at -185 m.

**MC-6. Saigon Delta 2** >30,000
Wood coll. at -183.80 m.
*Comment*: both samples are too old to be very useful.

**II. ARCHAEOLOGIC SAMPLES**

*A. France*

**Grotte de la Madeleine series**

Three samples of charcoal from the Grotte de la Madeleine, Villeneuve les Maguelonne, Hérault (43° 31’ N Lat, 3° 56’ E Long). Coll. 1958 and subm. by L. Barral, Conservator of the Musée d’Anthropologie de Monaco, to confirm the Neolithic Chasseen and Chalcolithic cultures.

**MC-7. Grotte de la Madeleine Layer VII** 5100 ± 250
Neolithic Chasseen culture.

**MC-8. Grotte de la Madeleine Layer X** 5220 ± 230
Neolithic Chasseen culture.

**MC-9. Grotte de la Madeleine I** 2050 ± 200
Furnace in slumped and disturbed material, supposedly under the Chasseen layers.
Grotte du Pertus II series

Two samples of charcoal coll. in the Grotte du Pertus II, Méailles, Basses Alpes (44° 6' N Lat, 6° 39' E Long). Subm. by L. Barral.

MC-10. Grotte du Pertus II Layer H/I 4450 ± 230
Neolithic Chasseen culture.

MC-11. Grotte du Pertus II Layer B6 4080 ± 250
Chalcolithic culture.

MC-12. Marchais Castle, Aisne 620 ± 160
Piece of a human skin from the marshes of the Marchais Castle (49° 25' N Lat, 3° 54' E Long), which belongs to the Prince of Monaco. Subm. by L. Barral. Comment: stratigraphic position of find was not clear; the burial is evidently not as old as had been suspected.

III. CHECK SAMPLES

MC-13. Les Portions, Moselle 1080 ± 120
Fossil wood from a water canalization of a mill. Dated by Saclay as 954 ± 120 (Saclay, unpub.)

MC-14. Jabbaren Tassili, Sahara 5460 ± 300
Charcoal coll. at 20 to 60 cm depth in a center where the principal neolithic deposit was found in 1956 (24° 29' N Lat, 9° 44' E Long). Coll. in 1956 by H. Lhote. Comment: dated by Saclay as SA-66, Jabbaren, 5470 ± 300 (Saclay I).

References

Date list:
Saclay I  Labeyrie and Delibrias, 1963
GAKUSHUIN
NATURAL RADIOCARBON MEASUREMENTS III
KUNIHKO KIGOSHI, DER-HWANG LIN,* and KUNIHKO ENDO
Department of Physics and Chemistry, Gakushuin University
Mejiro Toshimaku, Tokyo, Japan

This date list covers many of the datings done from November 1962 to October 1963. The instruments and technique used for this work are essentially the same as those used for the previous work (Gakushuin II). Age calculations are based on the Libby half life of C\textsuperscript{14}, 5570 ± 30 yr. The errors quoted are the standard deviations obtained from the number of counts only. When observed activities are less than 2\(\sigma\) above background, infinite dates are given with a limit corresponding to the activity of 3\(\sigma\), and when they are greater than the activity of 95\% of NBS oxalic-acid standard minus 2\(\sigma\), modern dates are given with the limit equal to 3\(\sigma\) below the 95\% of NBS standard.

ACKNOWLEDGMENTS

The authors are indebted to M. Oda, S. Saito and other members of the Institute of Nuclear Study, University of Tokyo, for supplying wood specimens taken from Yaku Island. Technical assistance has been provided by Hiromi Kobayashi and Tamako Morinaga. Grateful acknowledgment is made to many donors and collectors of samples for descriptions and comments.

SAMPLE DESCRIPTIONS

1. TREE RING SAMPLES

Yaku-sugi series, Kyushu

Wood of Cryptomeria japonica from Yaku Island, Kyushu (0° 40’ N Lat, 130° 30’ E Long). Coll. 1960 and subm. by Minoru Oda, Univ. of Tokyo. The tabulated \(\delta C^{14}\) are computed as age-corrected C\textsuperscript{14} concentrations, taking 95\% of NBS standard as modern activity, not corrected for isotopic fractionation. Errors quoted do not include the errors on the activity measurements of NBS standard. Comment: tree has 1821 growth rings, and was probably cut in A.D. 1950. Wood samples dated by tree ring counting may have errors less than 50 yr. Thin sliced wood samples were treated for ca. 30 min with hot 5\% NaClO solution.

\[\delta C^{14}, \%\]

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Sample</th>
<th>(\delta C^{14}), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.D. 710 to A.D. 729</td>
<td>Yaku-sugi—29</td>
<td>2 ± 5.9</td>
</tr>
<tr>
<td>A.D. 810 to A.D. 829</td>
<td>Yaku-sugi—34</td>
<td>-8 ± 3.0</td>
</tr>
<tr>
<td>A.D. 1050 to A.D. 1069</td>
<td>Yaku-sugi—46</td>
<td>-7 ± 2.2</td>
</tr>
</tbody>
</table>

* Permanent address: Department of Chemistry, National Taiwan University.
GaK-270:4. Yaku-sugi—50
From A.D. 1130 to A.D. 1149.

GaK-270:5. Yaku-sugi—54
From A.D. 1210 to A.D. 1229.

GaK-270:6. Yaku-sugi—60
From A.D. 1330 to A.D. 1349.

From A.D. 1450 to A.D. 1469.

II. GEOLOGIC SAMPLES

A. Japan

Ariake series, Kyushu

Samples from Ariake area, Nagasaki and Saga Prefectures, Kyushu. Connected with the eruptions of Unzen and Aso Volcano. Coll. 1962 by Ariake Research Group.

GaK-272. Kuriyagawa


GaK-283. Oumisaki

Charcoal from Matsuobashi, Ariakemura, Nagasaki Prefecture (32° 49’ 50” N Lat, 130° 21’ E Long), imbedded in volcanic mudflow from Maidake, Unzen Volcano, ca. 5 m below surface. Coll. and subm. by Tomoyuki Shinbori, S. K. Kenkyu-sho. Comment (T.S.): dates an eruption of Unzen Volcano. Stratigraphically, a younger date than that for the Aso Lava (GaK-274) was expected.

GaK-274. Shimabara 1

Wood from Harajooshi Minami-arimamachi Nagasaki Prefecture (32° 37.5’ N Lat, 130° 15.5’ E Long), ca. 5 m above sealevel, imbedded in Ōe Layer underlain by Aso Lava. Coll. and subm. by Yukio Kuwano, S. K. Kenkyu-sho. Comment: Ōe layer is twofold, consisting of a lower layer of sandy silt containing fossil plants, and an upper one of shell beds. On age of the latter see GaK-319 of this series.

GaK-319. Shimabara 2

Shell of Rapana thomasiiana from same site as GaK-274, ca. 7 m above sealevel, imbedded in Ōe Marine layer. Coll. and subm. by Y. Kuwano.

GaK-282. Yame

Charcoal from Oota, Hirokawacho, Yamegun, Fukuoka Prefecture (33°
13.7° N Lat, 130° 32.5′ E Long), 3.2 m below surface, imbedded in lower layer of Yame pumice flow. Coll. by Y. Gohara and T. Shinbori; subm. by Y. Gohara, S. K. Kenkyu-sho. Comment (Y.G.): lower layer of Yame pumice flow is correlative with the Aso Lava. More accurate dates are needed to show the relationship between them.

**GaK-273. Shimabara 3**

Charcoal from near the site of GaK-274 (32° 37.5′ N Lat, 130° 16′ E Long), imbedded in base of Aso Lava (welded tuff), 1.9 m thick. Coll. and subm. by Y. Gohara. Comment (Y.G.): dates Aso Lava and an eruption of Aso Volcano.

**GaK-284. Imari**

Clay containing small fragments of wood from Imari City, Saga Prefecture (33° 16′ N Lat, 129° 52′ E Long). Coll. and subm. by Közi Suzuki, S. K. Kenkyu-sho. Comment (K.S.): field relations suggest that sample came from one of the Yame pumice flows dated by GaK-282. Date does not positively support the view.

**GaK-329. Tokushima**

Peat from boring at Kotashima, Anan City, Tokushima (33° 53′ 15″ N Lat, 134° 39′ 46″ E Long), 23 m from surface, in silty clay overlain by fine sand and underlain by sandy gravel. Coll. 1962 by Fukada Geol. Inst.; subm. by Kazumi Suyari, Univ. of Tokushima. Comment (K.S.): dates base of alluvial deposit.

**Osaka marine layer series**

Shells from marine sand in Osaka area. Coll. and subm. by Hikotaro Kajiyama, Juso P. O. Comment: series dates a marine layer of ca. 5000 B.P., as does GaK-166, 4840 ± 120 (Gakushuin I).

**GaK-278. Kadoma**

Dosinia angulosa, Macoma tokyensis and Anodontia sternsiana from Mitsushima Kadoma City, Osaka (34° 42′ 41″ N Lat, 135° 35′ 32″ E Long), alt 2.5 m, 7 m below surface. Coll. 1962.

**GaK-279. Ogimachi**

Callista chinensis and Dosinia japonica from site of Yomiuri Building, Ogimachi, Osaka (34° 41′ 53″ N Lat, 135° 30′ 23″ E Long), alt 3.5 m, 10 m below surface. Coll. 1954.

**GaK-293. Toyonaka**

Mya japonica, Meretrix lusoria, Anadara subcrenata and Dosinia japonica from Hattori, Toyonaka City (34° 45′ 28″ N Lat, 135° 28′ 22″ E Long), alt 4.0 m, 3 to 4 m below surface. Late Yayoi pottery was found 1 to 2 m below surface. Coll. 1953.
Sakai City series, Osaka

Wood and peaty clay from Sakai City, taken from the deposits overlain by alluvium and underlain by the Pleistocene Osaka Group, both unconformably. Dates were expected to provide correlation between buried deposits and nearby terrace cut in alluvium. Subm. by Nobuo Ikebe and Junnosuke Takenaka, Osaka City Univ. Comment (N.I.): greater age of the clayey sediments (GaK-320) than of the terrace deposits (GaK-321) agrees with geological evidence.

**GaK-320. Ohama Park**

Wood from boring 1.5 km off the coast of Ohama Park, Sakai City (34° 34' 30" N Lat, 135° 26' E Long), imbedded in sandy gravel, 23 m below sea-level. Base of alluvial deposit at this site is 5 to 10 m below sealvel. Coll. 1962 by N. Ikebe.

**GaK-321. Ebaradera**


**GaK-322. Toyota**

Wood fragments from Toyota, Sakai City (34° 29' 11" N Lat, 135° 30' 30" E Long), imbedded in clayey sand underlain unconformably by the terrace alluvium at alt 55 m. Coll. 1963 by J. Takenaka.

**GaK-175. Lake Biwa, Shiga Prefecture**

Wood from the lacustrine terrace (T-3) of Takashima-gun, Shiga Prefecture (35° 19' N Lat, 135° 58' E Long), alt 135 m, in W part of Lake Biwa basin. Sample was imbedded in sand layer overlain by subrounded gravels. Coll. 1959 and subm. by S. Horie, Kyoto Univ.

**GaK-312. Yokoyama, Nagano**

Charred wood from Yokoyama, Kawanishimura, Nagano (36° 22' N Lat, 138° 10' E Long), imbedded in peat in Shiota Layer. Coll. and subm. by Namio Iijima, Shinshu Univ. Comment: in addition to the peat, Shiota layer contains several fossils of *Elephas namadicus naumanni*, horse and *Megaceros*. See GaK-161, 15,750 ± 390 (Gakushuin I) for date of related Totchu deposit; and Lake Nojiri series, this date list.

**Lake Nojiri series, Nagano**

Wood samples from W side of Lake Nojiri, Tachigahana, Nagano (36° 50' N Lat, 138° 14' 56" E Long), imbedded in lacustrine sediments. Samples associated with *Megaceros* and *Elephas namadicus naumanni*, and upper layer contained a Paleolithic culture. Coll. 1962; subm. by Lake Nojiri Research Group, Univ. of Nagano.

**GaK-267. Nojiri 1**

40 cm below surface.
Gakushuin Natural Radiocarbon Measurements III 201

GaK-268. Nojiri 2
21,600 ± 900
19,650 B.C.
61 cm below surface.

GaK-269. Nojiri 3
31,000 ± 2500
29,050 B.C.
97 cm below surface.

Takata series
Drift wood from Koizumi, Naoetsu City (37° 8' N Lat, 138° 15' E Long), alt 8.3 m, imbedded in alluvial deposit of Takata plain. Coll. 1962; subm. by Takata Plain Research Group, Takata High School. Comment: dates end of marine and beginning of terrestrial deposition.

GaK-280. Koizumi -250 cm
2300 ± 150
850 B.C.

GaK-281. Koizumi -256 cm
2240 ± 150
290 B.C.

GaK-311. Komoro, Nagano
10,650 ± 250
8700 B.C.

GaK-318. Rengeji, Gotemba 2
16,500 ± 400
14,550 B.C.

GaK-275. Toyano, Fukushima
21,000 ± 850
19,050 B.C.

GaK-176. Ichinome-gata, Akita
9070 ± 400
7120 B.C.
Wood from lacustrine terrace of a closed lake named Ichinome-gata, Akita (39° 57' N Lat, 139° 44' E Long), alt 88 m, imbedded in silt several meters above lake level. Coll. 1955; subm. by S. Horie. Comment (S.H.): dates lacustrine terrace formed during a rainier time of higher lake level.
GaK-177. Lake Inawashiro, Fukushima

Wood from sand and sandy clay layer of lacustrine terrace of Lake Inawashiro, Fukushima (37° 28' N Lat, 140° 6' E Long), alt 514 m, ca. 30 cm above bank of river that has trenched the lacustrine terrace, and 4 m below terrace surface. Coll. 1961; subm. by S. Horie. Comment (S.H.): date indicates that former high lake level was sometime during the late Pleistocene.

GaK-178. Lake Tazawa, Akita

Wood from silt layer of lacustrine terrace of extinct closed Lake Tazawa, situated in a caldera, Akita (39° 43' N Lat, 140° 40' E Long), alt 250 m. Coll. 1951; subm. by S. Horie. Comment (S.H.): date is minimum for age of the caldera and of the high lake level.

GaK-314. Hanayama, Miyagi

Drift wood, perhaps Cryptomeria japonica, from Zasu, Hanayama-mura, Miyagi Prefecture (38° 47' 30" N Lat, 140° 50' 47" E Long), imbedded in lacustrine sediments, 1.5 m below surface. Coll. 1962; subm. by Keiji Oide, Tohoku Univ. Comment (K.O.): sediments contain pisolite and volcanic ash which are common in several lacustrine layers found along the line from Naruko via Zasu and Nakayama-daira to Mukai-machi Basin, Yamagata Prefecture. Sediments in one of these lacustrine layers at Onikobe were described by Shimada (1955).

GaK-344. Rishiri Island

Charcoal from N coast of Rishiri I., Fujino Sagidomari, Rishiri-gun, Hokkaido (45° 15.2' N Lat, 141° 12.5' E Long), alt 10 m, from just below basalt lava flow that is underlain by a Miocene marine layer. Coll. 1962 by Kazunori Matsui; subm. by Konosuke Sawamura, Geol. Survey of Japan. Comment: dates the basalt lava flow. On the petrology of the lava, see Y. Katsui (1953).

B. Antarctica

East Ongul Island series

Molluscan shells and foraminifera from East Ongul I. (69° 1' S Lat, 39° 34' E Long). Coll. and subm. 1962 by Japanese Antarctic Research Exped. Comment: topographic evidence indicates that part of Ongul I. was submerged beneath the sea and then uplifted ca. 20 m after the shrinkage of the ice sheet. Dates show the retreat of ice from Ongul I. took place at least 23,000 B.P., although dates are not well ordered in relation to alt. The reduction of age by admixture of recent shells is possible. Other measurements in this series are GaK-200 and 201 (Gakushuin I). Sampling, topography and species of associated foraminifera are described by Meguro et al. (1963).

GaK-285. Kitamihama 1

Molluscan shell fragments from Kitamihama, N-facing beach of East Ongul I., alt 7 to 8 m.
GaK-289.  Kitamihama 2  
\[31,200 \pm 2500\]  
\[-1900\]  
\[29,250\ B.C.\]

Foraminifera mixed with a few echinoid spines from the site of GaK-285. Alt 7 to 8 m.

GaK-286.  Kitamihama 3  
\[34,000 \pm 3000\]  
\[-2000\]  
\[32,050\ B.C.\]

Molluscan shell fragments from Kitamihama, alt 12 m.

GaK-287.  Kainohama 1  
\[22,800 \pm 1000\]  
\[20,850\ B.C.\]

Molluscan shell fragments from Kainohama, alt 9 to 10 m.

GaK-288.  Kainohama 2  
\[29,500 \pm 2400\]  
\[-1800\]  
\[27,550\ B.C.\]

Molluscan shell fragments from Kainohama, alt 3 to 4 m.

C. Madagascar

GaK-277.  Baie des Galions  
\[2250 \pm 420\]  
\[300\ B.C.\]

Shell from a wave-cut notch at Baie des Galions, S of Madagascar (25° 30' S Lat, 46° 30' E Long). Notch is 1 to 1.4 m above the similar notch corresponding to present sealevel. Coll. 1957 and subm. by R. Battistini, Univ. de Madagascar. Comment (R.B.): dates the period in which sealevel was 1 to 1.4 m higher than present level. Similar notches are frequent on S and W coasts of Madagascar (Battistini, 1958).

III. ARCHAEOLOGIC SAMPLES

A. North America

Platte County series

Charcoal samples from burial mound and remains of house of the Steed-Kisker focus of the Middle Mississippi Culture, Platte County, Missouri. Coll. and subm. by M. Shippee, Univ. of Missouri.

GaK-266.  Platte County 1  
A.D. 1290  
\[660 \pm 80\]

Charcoal from burial mound (C), (39° 42' N Lat, 94° 40' W Long), 30 to 36 in. from the surface. Coll. 1958.

GaK-330.  Platte County 2  
A.D. 1260  
\[690 \pm 90\]

Charcoal from a large post lying on floor of a house (39° 15' N Lat, 94° 40' W Long). Coll. 1962.

GaK-295.  Clay County  
A.D. 1200  
\[750 \pm 120\]

Charcoal from a small storage pit in floor of House 2 at site 14CY30, Clay County, Kansas (30° 14' 10" N Lat, 96° 58' 45" W Long). Site is an earthlodge site belonging to the Smoky Hill Aspect of the Central Plains Phase. Coll. 1961 and subm. by T. A. Witty, Kansas State Hist. Soc. Comment
(T.A.W.): date agrees very closely with date from House 1, a.d. 1176 ± 150 (M-113, Michigan 1).

**GaK-296.  Two Dog site, Kansas**

Charcoal from the Two Dog site, 14M0301, Morris County, Kansas (38° 14' 13" N Lat, 96° 31' 50" W Long), a village site belonging to the Middle Woodland Pattern. Sample was taken from occupation level at the site, associated with conical based pot. Coll. 1962 and subm. by T. A. Witty. *Comment* (T.A.W.): while date appears late for this artifacts inventory, it might show that Middle Woodland peoples were still occupying the Flint Hills area in this period. More work is needed on this problem. See T. A. Witty (1962a).

**GaK-297.  William Young site, Kansas**

Charcoal from William Young site, 14M0304, an Archaic campsite to be assigned to the Mumkers Creek Focus, Morris County, Kansas (38° 44' 50" N Lat, 96° 31' 28" W Long). Sample was taken from center of occupation zone, associated with lanceolate-shaped points, large chipped stone blades and fired clay effigy heads. Coll. 1963 by W. Frantz, Kansas State Hist. Soc.; subm. by T. A. Witty. *Comment* (T.A.W.): the dating and artifacts identify a hitherto unrecognized Archaic complex (Witty, 1962a).

**GaK-298.  Slough Creek site, Kansas**

Portion of a burned lodge post taken from House 1 in Slough Creek site, 14M0308, Morris County, Kansas (38° 42' 50" N Lat, 96° 32' 20" W Long). Associated stone artifacts are Middle Woodland specimens but pottery and house features share traits with the later Central Plains Phase. Coll. 1962 by W. Frantz; subm. by T. A. Witty. *Comment* (T.A.W.): date is too late for the traits (Witty, 1962a). Another sample should be processed.

**GaK-306.  Morris mound, Kansas**

Charcoal from center of Morris mound 14M0314, Morris County, Kansas (38° 42' 50" N Lat, 96° 32' 7" W Long). Sample was part of central burial complex, associated with Snyder-like blades. Coll. 1962 and subm. by T. A. Witty. *Comment*: see T. A. Witty (1962 a,b).

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**B. Japan**

**Naniwa-gu series, Osaka**

Wood from remains of royal palace Naniwa-gu, probably constructed in the Shomu period (ca. a.d. 700), Hoensakamachi Higashiku, Osaka (34° 40' N Lat, 135° 31' E Long). Coll. and subm. by Tokutaro Yamane, Osaka City Univ. *Comment*: see report by T. Yamane et al. (1956) and GaK-114 (Gakushuin I).

**GaK-294.  Naniwa-gu 1**

Base of wooden pole still erect in ground. *Comment* (T.Y.): date seems too young.
GaK-324. Naniwa-gu 2  
A.D. 420

Wooden plate of Cryptomeria japonica taken from 3.6 m from surface. Sample has more than 100 tree rings. Coll. 1954. Comment (T.Y.): probably implies a maximum age of the construction of Naniwa Takatsu-gu.

GaK-292. Morinomiya, Osaka  
A.D. 150

Shells of Corbicula sandai from remains of shelter at Morinomiya, Higashi-ku, Osaka (34° 40' 39"  N Lat, 135° 31' 55"  E Long), alt 7.0 m. Coll. 1960 and subm. by H. Kajiyama.

GaK-301. Kaide, Kyoto  
A.D. 20 B.C.

Charred wood from midden exposed by construction of Tokaido Railway, Minami-hichihanda Kaide, Otokuni-gun, Kyoto (35° 0' N Lat, 135° 45' E Long), 1 m below surface. Associated with Middle Yayoi pottery. Coll. 1962 and subm. by Shuichi Nakayama, Education Comm. Kyoto.

Fukumachi series, Fukui

Wood samples from remains of artificial waterway for rice-field, Fukumachi, Fukui City (36° 3' N Lat, 136° 11' E Long), alt 4 m. Sediments in this waterway contain Late Yayoi pottery. Coll. 1962 by Seiji Onishi, Fukui Univ.; subm. by S. Miura. Comment (S.O.): dates the construction of waterway and Late Yayoi Period on the Japan Sea coast.

GaK-315. Fukumachi 1  
A.D. 100

Pile driven into sandy sediments of waterway. Top of the pile was at the boundary of sand and clay, 2 m below present surface.

GaK-316. Fukumachi 2  
A.D. 380

Pile driven into sandy sediments. Top is 30 cm above boundary of sand and clay, 1.7 m below present surface.

GaK-317. Fukumachi 3  
A.D. 490

Drift wood taken from sandy sediments in the waterway, 2 m below present surface.

GaK-309. Togimachi, Ishikawa  
A.D. 1050

Charcoal from peaty humic layer in sand dune, Sakami Togimachi, Ishikawa Prefecture (27° 8' N Lat, 136° 42' E Long) associated with Middle Jomon pottery and stone ware. Coll. 1962 and subm. by Norio Fuji, Kanazawa Univ. Comment: date seems too young, but association of charcoal and pottery may be secondary result of dune movement.

GaK-310. Sakanomiya, Kanazawa  
A.D. 260

Shells from shell mound, Sakanomiya Tsukikage, Ishikawa Prefecture (36° 38' N Lat, 136° 43' E Long), associated with Yayoi pottery. Coll. 1959 by Y. Yoshioka; subm. by N. Fuji.
GaK-334. Noola Rockshelter

Charcoal from hearth at depth of 121 in. in a horizon containing a flaked pebble chopper, Noola Rockshelter via Rylstone, New South Wales (33° 0' S Lat, 149° 57' E Long). Coll. 1963; subm. by N. B. Tindale, South Australian Mus. Comment: charcoal was very finely dispersed in deposit of kaolin and quartz sand derived from weathering of shelter; it was separated by elutriation and treated with acid. Upper portion of this excavated section, to a depth of 96 in., was reported by N. B. Tindale (1961).

GaK-335. Lake Menindee

Charcoal from hearth in Area II, top of Layer B, Lake Menindee, New South Wales (32° 18' S Lat, 142° 20' E Long). Coll. 1962; subm. by N. B. Tindale. Comment: fine charcoal powder was separated from sand by elutriation and treated with acid. (N.T.) The hearth lies stratigraphically above a stone implement found in Layer B. The bones of extinct Australian mammals are abundant in Bed B. See Tindale (1955).

GaK-336. Cape Northumberland

Charcoal from lowest occupation horizon at edge of cliff at depth of 4 ft, Cape Northumberland, South Australia (38° 1' S Lat, 140° 57' E Long). Coll. 1961; subm. by N. B. Tindale. Comment (N.T.): dates the earliest local occupation by a people who used the relatively unstained blue-black flint implements of the Murundian Culture. See Tindale (1957).

GaK-337. Shellharbour

Charcoal from the basal 1 in. of the occupation horizon, Shellharbour, New South Wales (34° 37' S Lat, 150° 37' E Long); mixed with wind-blown sand and shells. Coll. 1962; subm. by N. B. Tindale. Comment (N.T.): a late occupation site with pebble end-chopping tools and food shell debris on the present sea shore. Site rests on dunes which were formed over earth and rock considered to have been planed off by seas of the 10-ft (Later Peronian) terrace period.

D. Madagascar

GaK-276. Talaky

Charcoal from 1 mi E of Talaky Ambany, Tsihombe, Madagascar (28° 28' S Lat, 48° 21' E Long), in a fireplace located in Sq. C4 and C5 of 2nd site in B zone, 20 cm below surface. Associated with pottery, iron hooks and other artifacts. Coll. and subm. 1962 by P. Vérin, Univ. de Madagascar. Comment (P.V.): date indicates that iron was known in the beginning of the second millenium in the area, when Aptoptornis maximus was abundant. For a detailed description see Battistini et al. (1963).
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MIAMI NATURAL RADIOCARBON MEASUREMENTS III*
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INTRODUCTION
The list of dates grouped below is a continuation of work reported in our earlier lists. In one case (Core A 254-BR-C), an extensive sequence of dates is reported which, for completeness, includes some data presented in an earlier report (Miami II, 1963).

We continue to use a 1.0-L CO₂ proportional counter operating a 3 atm pressure (see Stockholm V for details). Except for the early incorporation of a counter for tritium analyses within our present shielding house and switching over to transistorized electronics, we do not anticipate changes in our set-up.

Wherever possible we have entered the δC^{13} corrected date as well as the δC^{13} value determined from that sample. An apparent 400-yr sea-surface carbonate age is subtracted from the calculated age of marine carbonate materials, but not for organic material (Miami I and Miami II).

ACKNOWLEDGMENTS
Operation of the laboratory and collection of some samples is made possible by supporting grants (NSF G-22033, NSF-G P-887) from the National Science Foundation. The Office of Naval Research has provided additional support [NONR 4008(02)] for oceanographic collecting and processing of geological materials.

We are pleased to acknowledge the excellent assistance of Britt-Marie Hellström in routine machine operation and chemical preparations. Our thanks are expressed to Walter B. Charm for laboratory assistance and sample collection. Dr. C. Emiliani and his staff of the Institute of Marine Science Mass-Spectrographic Laboratory have kindly contributed their time in making C^{13} analyses.

SAMPLE DESCRIPTIONS
1. GEOLOGIC SAMPLES FROM DEEP-SEA CORES

Tongue of the Ocean, Bahamas, B.W.I.

Core MG 62-17 series
Large diam (11.4 cm) piston core from E wall of the Cul de Sac (23° 31' N Lat, 76° 35' W Long, water depth 631 m). Collected for a study of slope accumulation and radium diffusion rates. A previous core from the vicinity of this basin slope had indicated a relatively high sediment accumulation rate (see Miami I, Core MG 61-1 series) and suggested the possibility of evaluating the uniformity of the local sedimentation mechanism and the radium diffusion rates in calcilutite. A large-diam (11.5 cm) piston corer was used so that close-spaced sections of the core could yield sufficient C for testing the uniformity of sedimentation conditions. Reliable carbonate radium-diffusion rates could be

* Contribution No. 528 from the Marine Laboratory, Institute of Marine Science, University of Miami.
established only if it could be proved that the sediment accumulated uniformly with time and then only if the rates were so slow as to show significant differences in radium content above the lowest detection capabilities of radium analyses. One of us (G.A.R.) examined the core after its recovery by the Marine Lab. staff and judged the core to be undisturbed and suitable for this study; it exhibited no obvious lithologic variations and appeared to be homogeneous calcilutite.

**ML-123.** MG 62-17, 0-2 cm

Bulk CaCO$_3$; $\delta^{13}C = +0.74$, $\Delta = -82 \pm 6$.

**ML-124.** MG 62-17, 149-151 cm

A.D. 1485

Bulk CaCO$_3$; $\delta^{13}C = +2.21$.

**ML-125.** MG 62-17, 266-268 cm

A.D. 1410

Bulk CaCO$_3$; $\delta^{13}C = +1.55$.

*General Comment* (G.A.R.): this series demonstrates the difficulty of obtaining a core with a uniform deposition rate, for, although the lithology appears uniform, the assumption of uniformity cannot be made safely for this area even for short time intervals. The core’s usefulness for radium diffusion studies must be rejected on the basis of non-uniform deposition, but even without that difficulty the core could not be used because the rate of accumulation is too high. According to B. Szabo (personal communication) the difference in radium content between top and bottom of the core is at the limit of detectable difference.

*Caribbean Sea*

The two Caribbean core series included here have undergone extensive O$_{18}$/O$_{16}$ analyses from which detailed paleotemperature curves have been constructed. The Core A 254-BR-C series has had several sections dated previously by the Pa$^{231}$/Th$^{230}$ method (Rosholt et al., 1961, 1962) as well as by C$^{14}$ (Miami II). The previous date list (Miami II) established the importance of C$^{14}$ dating in (1) establishing verification and correspondence of the Pa$^{231}$/Th$^{230}$ method, (2) providing closely-spaced series for dating rapid inflections of the paleotemperature curve, (3) giving sufficient detail in dating for discrimination among changing accumulation rates related to climatic events, and (4) demonstrating that the coarse (>62 $\mu$m) and fine (<62 $\mu$m) fractions of cores may have differing sedimentation histories. The model we have commonly assumed for pelagic deposits requires that pelagic Foraminifera often undergo co-deposition with older, bottom-transported fines. The following series shows that such a generalized model should be used with caution, as reversals probably caused by turbidity-current deposition or burrowing benthic fauna, may be common.

**Core A 254-BR-C series**

Piston core from Beata Ridge area, Caribbean Sea (15° 57' N Lat, 72° 53.5' W Long, depth 2968 m). *Globigerina-ooze* core exhibiting well-defined stratigraphy. Sections selected for dating were based on stratigraphy and near-
ness to core segments used for $^{234}\text{Pa}/^{230}\text{Th}$ dating as a check of reliability of the method. Dates are arranged in order of increasing age. Unless otherwise stated, an average $\delta^{13}\text{C}$ value of $-1.21$ has been used in making the fractionation correction. Coll. by J. Zeigler and W. Athearn; subm. by G. A. Rusnak.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Depth</th>
<th>$\delta^{13}\text{C}$ Value</th>
<th>Date B.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML-94</td>
<td>A 254-BR-C, 0-4 cm</td>
<td>8860 ± 130</td>
<td>6910 B.C.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bulk CaCO$_3$; $\delta^{13}\text{C} = -0.93.$</td>
<td></td>
<td></td>
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<tr>
<td>ML-137</td>
<td>A 254-BR-C, 7-13 cm</td>
<td>7720 ± 115</td>
<td>5770 B.C.</td>
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</tr>
<tr>
<td></td>
<td>Bulk CaCO$_3$; $\delta^{13}\text{C} = -1.06.$</td>
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<td></td>
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</tr>
<tr>
<td>ML-72</td>
<td>A 254-BR-C, 20-28 cm</td>
<td>12,480 ± 200</td>
<td>10,530 B.C.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coarse CaCO$_3$ fraction $&gt;62 \mu$.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>ML-73</td>
<td>A 254-BR-C, 20-28 cm</td>
<td>12,770 ± 150</td>
<td>10,820 B.C.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine CaCO$_3$ fraction $&lt;62 \mu$.</td>
<td></td>
<td></td>
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<tr>
<td>ML-95</td>
<td>A 254-BR-C, 38-42 cm</td>
<td>15,220 ± 220</td>
<td>13,270 B.C.</td>
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<tr>
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<td>Bulk CaCO$_3$; $\delta^{13}\text{C} = -1.55.$</td>
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</tr>
<tr>
<td>ML-100</td>
<td>A 254-BR-C, 54-60 cm</td>
<td>18,785 ± 510</td>
<td>16,835 B.C.</td>
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<tr>
<td></td>
<td>Coarse CaCO$_3$ fraction $&gt;62 \mu$.</td>
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<tr>
<td>ML-101</td>
<td>A 254-BR-C, 54-60 cm</td>
<td>19,100 ± 300</td>
<td>17,150 B.C.</td>
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<tr>
<td></td>
<td>Fine CaCO$_3$ fraction $&lt;62 \mu$.</td>
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<tr>
<td>ML-96</td>
<td>A 254-BR-C, 68-72 cm</td>
<td>21,910 ± 430</td>
<td>19,960 B.C.</td>
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<tr>
<td></td>
<td>Bulk CaCO$_3$; $\delta^{13}\text{C} = -1.91.$</td>
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<tr>
<td>ML-102</td>
<td>A 254-BR-C, 74-80 cm</td>
<td>24,350 ± 510</td>
<td>22,400 B.C.</td>
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<tr>
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<td>Coarse CaCO$_3$ fraction $&gt;62 \mu$.</td>
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</tr>
<tr>
<td>ML-103</td>
<td>A 254-BR-C, 74-80 cm</td>
<td>22,870 ± 350</td>
<td>20,920 B.C.</td>
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<tr>
<td></td>
<td>Fine CaCO$_3$ fraction $&lt;62 \mu$.</td>
<td></td>
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<tr>
<td>ML-97</td>
<td>A 254-BR-C, 98-102 cm</td>
<td>27,440 ± 950</td>
<td>25,490 B.C.</td>
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</tr>
<tr>
<td></td>
<td>Bulk CaCO$_3$; $\delta^{13}\text{C} = -3.00.$</td>
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<tr>
<td>ML-139</td>
<td>A 254-BR-C, 117-124.5 cm</td>
<td>$&gt;32,000$</td>
<td></td>
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<tr>
<td></td>
<td>Coarse CaCO$_3$ fraction $&gt;62 \mu$; $\delta^{13}\text{C} = -0.79.$</td>
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<td></td>
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<tr>
<td>ML-138</td>
<td>A 254-BR-C, 117-124.5 cm</td>
<td>30,200 +1300</td>
<td>28,250 B.C.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine CaCO$_3$ fraction $&lt;62 \mu$; $\delta^{13}\text{C} = -0.22.$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML-141</td>
<td>A 254-BR-C, 147-153 cm</td>
<td>$&gt;45,000$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coarse CaCO$_3$ fraction $&gt;62 \mu$.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ML-140. A 254-BR-C, 147-153 cm

Fine CaCO₃ fraction <62 µ; δ¹³C = -0.22. Comment (G.A.R.): this age considered invalid by stratigraphy.

Core CP-28 series

Piston core from Albatross Bank area SE of Jamaica (16° 47.7’ N Lat, 74° 26.4’ W Long, water depth 3036 m). Another Globigerina-ooze core showing well-defined stratigraphic sequence in upper 840 cm, but possible disturbances below in 840 to 1400 cm section. Core sections selected for dating on basis of temperature-curve and coarse-fraction-curve inflections. Dates arranged in order of increasing age to give possible ages of minor temperature maxima. Coll. by Marine Lab. staff; subm. by G. A. Rusnak. Unless otherwise stated, an average δ¹³C = + 0.40 (based on the three values reported for the CP-28 series) has been used for the fractionation correction.

ML-161. CP-28, 4.5-9.5 cm

Coarse CaCO₃ fraction >62 µ.

ML-162. CP-28, 4.5-9.5 cm

Fine CaCO₃ fraction <62 µ.

ML-163. CP-28, 45-50 cm

Coarse CaCO₃ fraction >62 µ.

ML-164. CP-28, 45-50 cm

Fine CaCO₃ fraction <62 µ; δ¹³C = + 0.09

ML-165. CP-28, 85-90 cm

Coarse CaCO₃ fraction >62 µ; δ¹³C = - 0.56.

ML-166. CP-28, 85-90 cm

Fine CaCO₃ fraction <62 µ; δ¹³C = + 1.77.

General Comment (G.A.R.): both piston cores exhibit age differences between their coarse and fine fractions within a sampled segment of the core. The data show no definite pattern of coarse fraction younger than fine fraction, or vice versa, within a single core. Thus one must consider composite models to explain the sedimentation data. Similarly, one cannot assume that the top of a core has approximate zero age for calculations of accumulation rates. Although dates from the tops of cores may sometimes be misleading (compare ML-94 with ML-137) because of possible mechanical disturbance in accumulation or coring, they provide additional control in evaluating sedimentary processes. Dating of separate size fractions provides not only insight into possible sedimentation mechanisms but also possible checks on the validity of a group of dates within a series. ML-140 and ML-141 are an example of widely divergent ages from a set of two size fractions. ML-140 has somehow become contami-
nated, and therefore indicates an erroneous age which cannot be accepted in view of the stratigraphy evident in the rest of the core. A Pa\(^{231}/\text{Th}\(^{230}\) age for this same core (A 254-BR-C), at a depth of 161-170 cm, is 60,000 ± 7000 yr b.p. and fits the C\(^{14}\) progression in stratigraphy (Rosholt et al., 1962). Detailed discussion of rates of accumulation and models will appear elsewhere.

II. GEOLOGIC SAMPLES FROM NEARSHORE AND COASTAL DEPOSITS

A. Chesapeake Bay

ML-153. Sample BSC-A1 Chesapeake Bay Entrance 9900 ± 105 b.c.

Log fragment (designated BSC-A1) uncovered by Norfolk Dredging Co. from borrow pit (37\(^°\) 04.2' N Lat, 76\(^°\) 03.2' W Long) at Baltimore Ship Channel near Chesapeake Bay Entrance, from depth of 85 ft below MLW, 40 ft below bay bottom, in Recent sediments overlying tertiary contact. May date submergence during eustatic rise of sealevel. Coll. 1962 and subm. by B. W. Nelson, Univ. of South Carolina, Columbia. Comment (G.A.R.): sample was treated and dated twice as two separate fragments of the same log. The first fragment, treated only once for removal of carbonates and humic acids (Olson and Broecker, 1958), gave 9700 ± 105 yr b.p. with a measured δC\(^{13}\) value of ~24.69. The second fragment, processed twice yielded the date recorded for ML-153 with a δC\(^{13}\) value of ~24.05. The older age is considered more reliable because more “young” humic acid was removed. The difference in ages is not great but might be significant. Age agrees with dates previously obtained from the same area and the same apparent stratigraphic horizon (see ML-91 in Miami II). The significance of this date and others from this area is discussed by Harrison et al. (in press).

B. Georgia


Shell material from sediment core taken with Sewell Portable corer near center of Cabretta Island (31\(^°\) 25' 57” N Lat, 81\(^°\) 14' 27” W Long) in low dunes. Hole cored and drilled to depth 47 ft. Shell material, from 16 ft below MLW, may help date sediments of Silver Bluff age. Coll. and subm. by J. H. Hoyt, Univ. of Georgia Marine Inst., Sapelo Island. Sample consists mainly of Mulinia sp.; id. by R. Work, Univ. of Miami. Comment: although ca. 30% of the material was digested with acid leaching, contamination by younger C is possible. Composite assortment of shells and shell fragments are especially vulnerable. The final date reported above preferably should be considered as a minimum age of a sample which is certainly >40,000 yr b.p. δC\(^{13}\) = + 4.46.

ML-158. Wilmington Island, Georgia, sample Wil-1 42,700 ± 5100 -3100 b.c.

Shell material from borrow pit S of Canal St., Wilmington Island, Georgia (32° 01' 58” N Lat, 80° 58' 20” W Long), consisting of Mulinia lateralis, Tagelus sp., Anadera sp., Donax sp., Pholas sp., Dosina sp., Nassarius sp.,
Busycicon sp., Terebra sp., and Mellita sp. (id. by R. Work) from fine sand and mud, approx. at mean sealevel, in association with Silver Bluff shoreline on Wilmington Island. Coll. and subm. by J. H. Hoyt, Sapelo Island, Georgia, on possibility that it may date Silver Bluff sediments. Comment: although a finite date has been reported for this sample, as for the previous one ML-157, the age should be considered minimum for a sample which is certainly >40,000 yr B.P. δC₁³ = + 0.40.

C. Gulf of Mexico

Campeche Bank series, Gulf of Mexico

Samples in this group were coll. by Dept. of Meteorology and Oceanography, Texas Agricultural and Mechanical College, and subm. by Dr. E. Rona, Oak Ridge Inst. of Nuclear Studies, to test various dating techniques.

ML-135. Core sample C-1 (56), 20-30 cm A.D. 1740

Bulk calcilutite; δC₁³ = +0.11. Depth 550 m (21° 06' N Lat, 92° 48' W Long). Comment (E.R.): sediment in core appears to have been reworked by burrowing organisms.

ML-136. Core sample C-27 (53), 20-30 cm 810 B.C.

Bulk calcilutite; δC₁³ = -0.38. Depth 550 m (20° 37' N Lat, 92° 48' W Long). Comment (E.R.): sediment in core appears to have been reworked by burrowing organisms.

ML-185. Surface Grab sample 72 8630 B.C.

Calcarenite; δC₁³ = +0.75. Depth of 37 m (22° 00' N Lat, 89° 30' W Long). Comment (E.R.): sand sample was treated with 30% H₂O₂ to remove organic C and then lightly leached with 5% HCl as pretreatment.

D. Chuckchi Sea, Alaska

Core 268-98 series

Piston core from Chuckchi Sea (67° 30' N Lat, 165° 52' W Long) water depth 40 m; length 744 cm; dark gray marine or brackish-water sediment throughout. Sample from core base dated 14,200 ± 600 yr B.P. (12,250 B.C.) by Isotopes, Inc. (I-843, unpub.). Only organic material of core suitable for dating. Pretreatment consisted of HCl digest of carbonates present. Coll. and subm. by J. Creager, Dept. of Oceanography, Univ. of Washington, Seattle.

ML-160. Core 268-98, 19-38 cm 2010 B.P.

Organic fraction; δC₁³ = -20.95.

ML-159. Core 268-98, 344-359 cm 11,750 B.C.


General Comment (G.A.R.): this series permits estimate of rate of sediment accumulation in this remarkable area of near-estuarine to estuarine conditions. If derived ages can be considered valid, then data show a remarkable decrease of sediment accumulation during past 10,000-12,000 yr.
ML-168. **Grab Sample MG 63-34B**

915 ± 60

Partially indurated oolitic sand capping loose sand (23° 23.2' N Lat, 76° 30' W Long), from 20 ft water depth. Coll. and subm. by G. A. Rusnak. δC₁³ = +7.77.

*General Comment* (G.A.R.): although it had been suspected that partially indurated cap over on the oolite dunes might be old, date indicates that cap is relatively recent. Cementation of the dune surface must be accomplished either by direct precipitation of carbonate out of the overlying water mass or by cementing activities of organisms, such as the algae, or a combination of both.

ML-167. **Grab Sample MG 63-34A**

<200

*Strombus gigas* shell, thickly encrusted with cemented oolites and algae, from hard encrusted surface of submerged oolite dunes (23° 23.2' N Lat, 76° 30' W Long), at 20 ft depth. Coll. and subm. by G. A. Rusnak. *Comment*: date is good evidence that active cementation of bank surface is occurring in this area. δC₁³ = +6.40. Δ = −67 ± 5.

ML-132. **Grab Sample MG 62-37**

<200

Fragment of *Strombus gigas* from wave-cut nip in reef-rock “pocket” on shoreline at S end of N Bimini (25° 43' 15" N Lat, 79° 18' 30" W Long), completely surrounded by reef growth, but free-moving within the hole. Coll. by R. F. Johnson; subm. by G. A. Rusnak. *Comment*: sample carefully cleaned to remove contamination, as shell gave promise of defining sealevel rise. After outer shell layers were sawed away, interior was subjected to HCl leach and X-ray diffraction analysis, which indicated only aragonite; hence sample was judged uncontaminated. Its surprisingly late date contrasts with its discolored appearance and position within the reef “pocket.” δC₁³ = +6.92. Δ = −139 ± 4.

*References*

Date lists:

- Miami I: Ostlund, Bowman, and Rusnak, 1962
- Miami II: Rusnak, Bowman, and Ostlund, 1963
- Stockholm V: Ostlund and Engstrand, 1963


Harrison, W., Malloy, R. J., Rusnak, G. A., and Terasmae, J., in press, Possible Late Pleistocene Uplift, Chesapeake Bay Entrance: Jour. Geology.


COPENHAGEN RADIOCARBON DATES VI
HENRIK TAUBER
Carbon-14 Dating Laboratory, Department of Natural Sciences
National Museum, Copenhagen

The following list comprises a selected number of measurements made up to November 1963. Age calculations are based on a contemporary value equal to 95% of the activity of the NBS oxalic-acid standard, and on a half life for C\textsuperscript{14} of 5570 ± 30 yr.

Results are expressed in years before 1950 and in the B.C.-A.D. scales. Errors quoted include the standard deviations of the count rates for the unknown sample, the contemporary value, and the background. Calculated errors smaller than 100 yr have been increased by rounding to that figure as a minimum. Sample descriptions have been prepared in collaboration with collectors and submitters.

SAMPLE DESCRIPTIONS

I. GEOLOGIC AND POLLEN-DATED SAMPLES

A. Denmark

Draved Mose series, the elm fall

Samples from an open profile, 30 m long, in the central part of the bog Draved mose (55° 1' N Lat, 8° 57' E Long), Logumkloster, Jutland. The profile exposes peat from Boreal to present, overlies sand. A standard pollen diagram is being prepared. Samples include the much debated elm fall, which occurs in European pollen diagrams at the Atlantic/Sub-boreal transition, and is marked here by two charred layers. The lower layer occurs where the elm curve begins to fall, the upper one where the fall ends. Coll. 1959 by Alfred Andersen; subm. by Johs. Iversen, Geol. Survey of Denmark. Comment: dates, the first direct determinations of the elm fall in Denmark, fit well with other dates for the elm fall in NW Europe (Godwin, 1960).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-737. Draved Mose, D.G.U. 156</td>
<td>5080 ± 110 3130 B.C.</td>
</tr>
<tr>
<td></td>
<td>Sphagnum peat in and below lower charred layer, 29 to 30 cm above the sand. Antedates elm fall.</td>
</tr>
<tr>
<td>K-738. Draved Mose, D.G.U. 157</td>
<td>4980 ± 100 3030 B.C.</td>
</tr>
<tr>
<td></td>
<td>Sphagnum peat above the lower charred layer, 30 to 31 cm above the sand. Beginning of elm fall. Average of two determinations:</td>
</tr>
<tr>
<td>K-738 A</td>
<td>4940 ± 110</td>
</tr>
<tr>
<td>K-738 B</td>
<td>5010 ± 110</td>
</tr>
<tr>
<td>K-739. Draved Mose, D.G.U. 158</td>
<td>4960 ± 110 3010 B.C.</td>
</tr>
<tr>
<td></td>
<td>Sphagnum peat above upper charred layer, 33 to 34 cm above the sand. At end of elm fall.</td>
</tr>
</tbody>
</table>
K-741. Draved Mose, D.G.U. 159

Sphagnum peat 2 cm above upper charred layer, 35 to 36 cm above the sand. Postdates elm fall.

K-101. Ruds Vedby (remeasured)

Wood from a thin, dark layer representing pollen-zone border II/III, Allerød-Younger Dryas. Isolated from peaty lake mud in a profile at Ruds Vedby (55° 32' N Lat, 11° 22' E Long), Zealand (Iversen, 1953; Krog, 1954). Coll. 1951 by H. Krog; subm. by Johs. Iversen. Comment: sample was dated as black C to 11,090 ± 240 (Copenhagen III). This time it was run in series with K-770 (this date list) as a control of that determination.

B. U.S.A.

K-770. Menasha, Two Creeks oscillation

Section of well-preserved wood (Picea sp.) from a forest bed in till 37 mi W of the Two Creeks type locality, at Menasha (44° 13' N Lat, 88° 19' W Long), Wisconsin. Believed to correlate with Two Creeks oscillation. Coll. by R. F. Black; subm. by W. S. Broecker, Lamont Geol. Observatory. Comment: sample first treated for humic acid removal. As a check, sample was run in series with K-101 (above). Part of sample dated at Lamont as L-607 B (Broecker and Farrand, 1963). Date agrees well with results at Lamont: L-607 B (Cellulose) 11,760 ± 100 and L-607 B (Lignin) 11,820 ± 100. Copenhagen result is the average of two measurements:

K-770 A 11,710 ± 150
K-770 B 11,890 ± 150

C. Finland

Kuusamo series, Late-glacial

Pollen-dated gyttja from tarn at Kuusamo (66° 10' N Lat, 29° 0' E Long), North Finland, representing characteristic pollen horizons during oldest phases of vegetational development following last glaciation at the locality (Vasari, 1962 and 1963). Coll. 1959 by Y Vasari, Inst. of Geol. and Paleontol., Helsinki; subm. by Johs. Iversen. Comment: dates are older than supposed; contamination with redeposited material is suspected by collector.

K-721. Kuusamo 2.x.59

Fine silty gyttja from depth 475 to 485 cm below surface. Are the 10 lowermost cms of gyttja overlying silt of supposed Late-glacial origin. Sample, non-calcareous, contained only ca. 2.5% organic matter. Supposed to mark Younger Dryas/Pre-boreal transition. Date is the average of two determinations:

K-721 A 11,850 ± 140
K-721 B 11,720 ± 140
K-771. Kuusamo 3.x.59

Coarse gyttja from depth 420 to 430 cm. From an intermediate period with almost equal frequencies of pine and birch pollen and with high NAP-values. Supposed to be late Pre-boreal or early Boreal.

K-722. Rovaniemi 33

Decayed Bryales-peat from organogenic layer between two tills at Rovaniemi (66° 70' N Lat, 26° 12' E Long), N. Finland. Stratigraphy suggests interglacial or interstadial deposit. Pollen frequencies: Alnus 1%, Betula 85%, Picea 1%, Pinus 13%, ratio of NAP to AP = 1:1. Coll. 1961 by V. Okko, Univ. of Helsinki; subm. by Sigurd Hansen. Comment: date confirms an interglacial or interstadial age.

D. Czechoslovakia

K-766. Zispachy Z 4, Late-glacial


II. ARCHAEOLOGIC SAMPLES

A. Denmark

Christiansholms Mose series

Lignin fractions of slightly charred, uncarved pieces of wood from Christiansholms Mose (Ordrup Mose) (55° 45' N Lat, 12° 34' E Long), Copenhagen. Found in 1876 together with carved wooden objects (vessels, axe handles, and a spoon), and with bone implements. Supposed to represent a late Ertebølle phase (Troels-Smith, 1960). Subm. by J. Troels-Smith, Natl. Mus., Copenhagen. Comment: samples had been treated with preservatives (probably Al-sulphate and glycerol) prior to dating. Cellulose and lignin fractions were isolated as described in K-599 (Copenhagen V). Only the lignin fraction yielded material enough for a dating; thus it could not be checked whether the purification was complete. Dates agree well with each other but are somewhat older than expected.

K-729. Christiansholms Mose, 271, 275

Lignin fraction of two larger wood pieces (Ulmus sp.).

K-750. Christiansholms Mose, 269, 279

Lignin fraction of two wood pieces (Quercus sp.).

Tustrup series, Early Passage Grave Period

Samples from a cult building erected together with two dolmens and a passage grave on a megalithic cemetery at Tustrup (56° 29' N Lat, 10° 31' E
Long), Jutland. The three graves lie on the circumference of a semicircle with a radius of 46 to 48 m, and the cult building lies in the center of the semicircle. A votive deposit of 30 pottery vessels of a Middle Neolithic age was found locked in the building (Kjærum, 1955). Coll. 1954 and subm. by P. Kjærum, Prehistorical Mus., Aarhus, Denmark. Comment: compare K-717 (this date list).

K-718. Tstrup, d

4390 ± 120
2440 B.C.

Charred wood (Quercus sp.) from a wall plank in the cult building.

K-727. Tstrup, e

4440 ± 120
2490 B.C.

Bark (Quercus sp.) from a charred wall plank in the cult building.

K-717. Ferslev, Early Passage Grave Period

4430 ± 120
2480 B.C.

Charcoal (Tilia sp.) from a charred plank in the wall of a cult building found in connection with a number of Passage Graves at Ferslev (56° 57' N Lat, 9° 54' E Long), Jutland. In the building 35 pottery vessels of Middle Neolithic types were found. The cult building is supposed to be almost contemporaneous with the Tstrup house mentioned above (Marseen, 1961). Coll. 1959 and subm. by O. Marseen, Aalborg Hist. Mus., Aalborg, Denmark. Comment: compare K-717 and K-727 (this date list).

K-800. Lundgaardshede, yoke

2280 ± 100
330 B.C.

Wood (Acer sp.) from a draught-yoke for oxen found by peat cutting in a lowering in a bog Bredmose at Lundgaardshede (56° 31' N Lat, 9° 10' E Long), Jutland. Found together with other (not preserved) wooden objects. It is unknown when use of ox-yokes began in Denmark, and no safely datable yokes have previously been found. Coll. 1947; subm. 1961 by Skive Mus., Denmark. Comment: yoke had been treated with linseed oil prior to dating. Sample was therefore split in two halves and cellulose and lignin were isolated as described in K-599 (Copenhagen V). Their fractions were dated separately with the following results:

K-800 A. Lignin-fraction

2320 ± 100

K-800 B. Cellulose-fraction

2230 ± 100

Borremose series, Iron Age

Samples related to an Iron Age settlement on an islet in the bog Borremose (56° 47' N Lat, 9° 34' E Long), Jutland. In Celtic Iron Age a fortification was erected on the islet but soon after abandoned. After an intermediate period with no settlement a village with several houses was built, and a paved road connecting the dry land and the islet was constructed. These periods are clearly reflected in pollen diagrams from the locality. Coll. 1951 and 1955 by Alfred Andersen; subm. by Johs Iversen. Comment: dates agree well with the archaeological interpretation.
Bayonet-shaped piece of wood (Quercus sp.), worked on, from a cult place belonging to the beginning of the fortification period.

Piece of wood (Salix sp.) with marks from cutting, found on the same cult place from the beginning of the fortification period. Date is the average of two determinations:
K-789 A 1950 ± 100
K-789 B 1990 ± 100

K-752. Borremose, D.G.U. 31 a 1990 ± 100 40 B.C.
Sphagnum peat with Comarum from just below a thin sand layer which represents the intermediate period. Taken from a pit close to the islet.

K-828. Borremose, D.G.U. 29 a 2080 ± 140 130 B.C.
Sphagnum peat with Comarum just below the same thin sand layer, but taken at a greater distance from the islet (profile II).

K-730. Borremose, D.G.U. 74 1840 ± 100 A.D. 110
Sphagnum peat with Comarum taken just below a layer of Sphagnum-Vaginatum peat. This contact can be followed over a long distance in the bog. According to pollen analyses it seems to coincide with the closing of the village period.

K-785. Borremose, D.G.U. 73 1790 ± 100 A.D. 160
Sphagnum-Vaginatum peat just above the above mentioned contact.

Drengsted series, prehistoric iron furnaces
Samples from prehistoric iron furnaces at Drengsted (55° 5' N Lat, 8° 40' E Long), South-Jutland. Only the slag pits of these furnaces were left. Are up to 90 cm deep and 105 cm in diam. Plug of straw had been placed in each slag pit. During iron smelting, slag fused into single large lump which reproduces shape of a portion of the pit. Straw contained a score of seeds, predominantly of barley (Voss, 1963). Coll. 1961 and 1963 and subm. by O. Voss, Natl. Mus., Copenhagen. Comment: compare K-822 below.

K-784. Drengsted, EL 11 1740 ± 100 A.D. 210
Charred straw from pit EL 11.

K-824. Drengsted, 3 1740 ± 100 A.D. 210
Charred straw from pit No. 3.
K-825. Drengsted, 101  
A.D. 280

Charred straw from pit No. 101. Date is the average of two determinations:
K-825 A 1690 ± 100
K-825 B 1650 ± 100

K-822. Ellum, prehistoric iron furnace  
A.D. 300

Charred straw from slag pit found at Ellum (55° 3’ N Lat, 8° 55’ E Long), South-Jutland. Slag pit belongs to prehistoric iron furnace similar to those mentioned in Drengsted series above. Coll. 1934 by Th. Thomsen; subm. by O. Voss. Comment: date agree well with dates from Drengsted series (this date list).

K-757. Broskov, Iron Age road  
A.D. 260

Branches (Salix sp.) from Iron Age road at Broskov (55° 8’ N Lat, 12° 0’ E Long), Zealand. Thin layer of branches had been placed below stone layers in construction of road. Two spear heads of indistinct type found in a sand layer above road, but no other directly datable objects were disclosed (Kunwald, 1962). Coll. 1961 and subm. by G. Kunwald, Natl. Mus., Copenhagen.

K-748. Kanhave canal  
A.D. 800

Wood (Quercus sp.) from a plank used in construction of Kanhave canal (55° 54’ N Lat, 10° 37’ E Long), Samsø, Denmark. At point where Samsø is ca. 1 km broad, an old canal, up to 1.5 m deep, and connecting Stavns Fjord to the E with the sea W of Samsø, was found. To protect sides of canal against waves, a wharf with three planks above each other was built. Sample taken from one of these planks. Supposed to be from Viking or early medieval time. Coll. 1961 and subm. by H. Stiesdal, Natl. Mus., Copenhagen. Comment: date suggests that the canal was built in Viking time.

Borup Ris series, early medieval village

Samples from a village founded in early medieval times after extensive clearings of the forests at Gunderslev (55° 19’ N Lat, 11° 37’ E Long), Sorø, Denmark. For unknown reasons the village was abandoned after ca. 200 yr. The old fields, which can be traced in the forests today, show that large areas were cultivated. Coll. 1957-1962 by J. L. Østergaard and A. Steensberg; subm. by A. Steensberg, Univ. of Copenhagen. Comment: dates confirm the early medieval age and suggest a short period of settlement.

K-579. Tyste Mose 1  
A.D. 1020

Charcoal (Fagus sylvatica) found in the bog Tyste Mose, situated within area belonging to medieval village Borup Ris. Sample taken in a characteristic charcoal horizon in the bog. On the basis of pollen analyses this layer believed to be contemporaneous with the foundation of the village; thus the continuous pollen curve for cornflower begins immediately above this layer.
K-580. Tyste Mose 1a

Bark (*Fagus sylvatica*) from the same charcoal layer as mentioned in K-579.

K-581. Tyste Mose 2

Charcoal (*Alnus* sp.) from lower charcoal layer in same profile in the bog Tyste Mose. Layer probably originates from a clearing phase prior to the founding of Borup Ris. The pollen spectra immediately above layer indicate a Sub-Atlantic age. Below the layer pollen destroyed and analysis not possible.

K-760. Borup Ris, farm 1

Bark (*Alnus* sp.) found in layer of twigs 10 to 20 cm thick at bottom of well belonging to farm in village Borup Ris. Layer resting on a bluish gyttja and covered by mould. Farm was demolished before village abandoned, as shown by row of stones (a field division) placed over site of farm.

K-801. Borup Ris, Sandbækken 1

Wood (*Quercus* sp.) from pile-planking weir of a water mill supposed to be contemporary with village Borup Ris. Wooden weir erected in a brook within area of village. Brook previously called Sandbækken and now named Pilebækken.

K-805. Borup Ris, Sandbækken 2

Wood (*Quercus* sp.) from a post in same water mill as mentioned in K-801. Post driven into bottom of brook in connection with the construction of the weir.

B. Greenland

Sermermiut series, Main Area B

Samples from a Paleo-Eskimo site at Sermermiut (69° 12′ N Lat, 51° 11′ W Long), Jacobshavn district, West Greenland, from Sec. I, Main Area B. The section contained two separate culture deposits, a lower one (layers 2 to 3) with implements of Sarqaq type, and an upper one (layers 10 to 11) with implements of Dorset type (Mathiassen, 1958). These deposits have previously been dated (Copenhagen IV). The present series comprises a more complete sequence including the intermediate layers (7 to 9) and the overlying layer (12). A detailed pollen diagram is being prepared from this section. Coll. 1955 and subm. by J. Troels-Smith. *Comment*: dates agree well with the previous dates.

K-806. Sermermiut B, 17

Humus sand from Layer 2, 103 to 92 cm below the surface. The layer contained implements of Sarqaq type.
K-807. Sermermiut B, 18

Highly humified peat from Layer 3, 92 to 87 cm below the surface. The layer contained implements of Sarqaq type.

K-808. Sermermiut B, 20

Slightly humified peat from Layer 7, 77 to 73 cm below the surface. Intermediate between the Sarqaq and the Dorset deposits.

K-809. Sermermiut B, 21

Slightly humified peat with twigs from Layer 8, 73 to 65 cm below the surface. Intermediate between the Sarqaq and the Dorset deposits.

K-811. Sermermiut B, 22

Light-brown peat moss from Layer 9, 65 to 51 cm below the surface. Intermediate between the Sarqaq and the Dorset deposits.

K-812. Sermermiut B, 23

Blackish-brown swamp peat from Layer 10, 47 to 37 cm below the surface. Intermediate between the Sarqaq and the Dorset deposits. Implements of Dorset type were found in the uppermost part of Layer 10.

K-813. Sermermiut B, 26

Pale-brown peat moss from Layer 12, 14 to 9 cm below the surface. Above the layers containing Dorset deposits.

Jørgen Brønlund Fjord series

Charcoal from driftwood from terraces (Deltaterrasserne) at Jørgen Brønlund Fjord (82° 10' N Lat, 31° 14' W Long), Pearyland. A series of raised beaches is found at levels of 21 m, 17.5 m, 14 m, 10 to 12 m, and 4 to 5 m above sealevel. Each terrace contains driftwood from the time when the terrace was at sealevel. The samples are from the 21 m and the 14 m terraces; a sample from the 10 to 12 m terrace had previously been dated (K-150, Copenhagen III). Paleo-Eskimo camp sites of Independence I Culture have been found on the terraces (Knuth, 1954, 1956). It is likely that each group of Eskimos lived on the terrace that was lowest in its time and picked up the wood for its fireplaces on the terrace where it lived. Coll. 1960 and subm. by Eigil Knut, Natl. Mus., Copenhagen. Comment: compare K-753 and K-756 (this date list) and other dates for Independence I Culture in Copenhagen III and IV.

K-754. Jørgen Brønlund Fjord, 21 m terrace

Charcoal (Picea sp.) from hearth in ruin No. 13 on the 21 m terrace. This is highest terrace at locality and the implements seem to represent an early phase of Independence I Culture.

K-755. Jørgen Brønlund Fjord, 14 m terrace

Charcoal (Picea sp.) from hearth in ruin No. 12 on the 14 m terrace. The flint implements on the campsite belong to Independence I Culture.
K-753. Danmark Fjord

_Driftwood (Larix sp.) from an old raised beach, 11.5 m above sealevel at Ranum Elv, Kap Viborg (80° 54' N Lat, 23° 45' W Long), Danmark Fjord, North Greenland. A campsite with implements from Independence I Culture was found 1.8 m above the terrace. Coll. 1960 and subm. by Eigil Knuth. Comment: compare K-754, K-755, and K-756 (this date list)._  

3680 ± 120 1730 B.C.

K-756. Wyckoff Land

_Charcoal from driftwood (Larix sp.) from a fireplace in a campsite on a 15 m terrace on Wyckoff Land (82° 50' N Lat, 24° 0' W Long), Pearyland. Camp site represents an early Independence I Culture. Coll. 1960 and subm. by Eigil Knuth. Comment: compare K-753, K-754, and K-755 (this date list)._  

3850 ± 120 1900 B.C.

C. Alaska

**Point Hope series, Near Ipiutak**

_Samples of driftwood from a Paleo-Eskimo campsite at Jabbertown (68° 19' N Lat, 166° 42' W Long), Point Hope, Alaska. The campsite was on the rear beach under a thick layer of turf. It contained flint implements of Near Ipiutak types (Larsen and Rainey, 1948; Larsen, 1961). Supposed to originate from 500 to 1 b.c. Coll. 1961 and subm. by Helge Larsen, Natl. Mus., Copenhagen. Comment: dates agree well with estimated ages for Near Ipiutak._

K-725. Jabbertown, Fireplace 1  
2070 ± 100 120 b.c.

Charcoal from driftwood (Picea sp.) from Hearth Area I, Fireplace 1.

K-724. Jabbertown, Fireplace 2  
1970 ± 100 20 b.c.

Charcoal from driftwood (Picea sp.) from Hearth Area I, Fireplace 2.

D. Italy

**Chia series, Punic-Roman settlement**

_Samples of charcoal from graves found below a temple building in the Punic-Roman settlement Bithia (38° 54' N Lat, 8° 58' E Long), Chia, Sardinia. The graves were found in a sand layer containing remains from a prehistoric culture. The graves are older than the temple and the question is whether they belong to the Punic-Roman settlement or to the prehistoric culture layer. Coll. 1953 by G. Kunwald and E. Thorvildsen; subm. by E. Thorvildsen, Natl. Mus., Copenhagen. Comment: dates refer the graves to the Punic-Roman settlement._

K-558. Chia, 519  
2140 ± 120 190 b.c.

_Charcoal found between the bones in grave No. 2._

K-559. Chia, 536  
2290 ± 120 340 b.c.

_Charcoal from grave No. 1._
E. Norway

Gyrinos series, Mesolithic

Samples from stone age dwelling places in the Norwegian highland at Lake Gyrinosvatn (60° 45' N Lat, 8° 12' E Long), Buskerud. The culture layers contained fireplaces and stone implements of a Fosna-like type, but no remains of houses or camps. The places represent a pure hunter’s culture and therefore belong either to the Mesolithic or to groups of hunters who have survived into the Neolithic (Martens and Hagen, 1961). Comment: dates confirm the Mesolithic age.

K-710. Gyrinos III 7860 ± 120 5910 B.C.

Charcoal (Pinus sylvestris L) from an open dwelling place, Gyrinos III, situated at shore of Lake Gyrinosvatn, 1100 m above sealevel. The thin culture layer was covered by peat.

K-711. Gyrinos IV 5700 ± 120 3750 B.C.

Charcoal (Pinus sylvestris L) from a dwelling place, Gyrinos IV, 150 m N of Gyrinos III.

K-712. Digernes I, Mesolithic 7410 ± 130 5460 B.C.

Charcoal (Pinus sylvestris L) from a stone age dwelling place, Digernes I, in the Norwegian highland at Lake Ustevatn (60° 30' N Lat, 8° E Long), Buskerud. The open dwelling place was 950 m above sealevel. Culture remains were of same character as those at places mentioned in K-710 and K-711. Coll. 1959 by I. Martens; subm. by A. Hagen.

K-715. Bordalshelleren 1920 ± 120 A.D. 30

Charcoal (Pinus sylvestris L) from a dwelling place, Bordalshelleren, in the Norwegian highland at Lake Bordalsvatn (59° 30' N Lat, 7° E Long), Telemark, 850 m above sealevel. The culture layer which contained stone implements was up to 45 cm thick and covered by 25 cm of turf. Represents either very late Stone Age or early Metal Age (Martens and Hagen, 1961). Coll. 1959 by I. Martens; subm. by A. Hagen.

F. Switzerland

Weier series, Early Neolithic

Samples from construction timber from a lake dwelling in Weier (47° 45' N Lat, 8° 42' E Long), Thayngen, Ct. Schaffhausen. The lake dwelling belongs to the Michelsberg Culture. Three settling phases have been recognized in the lake dwelling (Guyan, 1955, Troels-Smith, 1955). Coll. 1956 and subm. by J. Troels-Smith. Comment: K-539 is from an older construction than K-540, but the difference is not detectable by C14. Dates agree well with measurements on the same material made in Bern (Bern I).

K-539. Weier, Wh 158a 4750 ± 100 2800 B.C.

Wood (Alnus sp.) from a stick lying horizontally in the lower part of the culture layer.
K-540. Weier, Wh 149a

K-540 A. 4890 ± 120
K-540 B. 4940 ± 120

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Copenhagen V Tauber, 1962


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TATA INSTITUTE RADIOCARBON DATE LIST II

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The C¹⁴ dates presented here have been obtained by counting acetylene, synthesised from the sample, in an Oeschger-Houtermans’ gas proportional counter. The chemical and counting procedures have been described in some detail (Kusumgar et al., 1963a).

Dates are based on the C¹⁴ half-life value of 5568 yr. For conversion of B.P. dates to A.D./B.C. scale, A.D. 1950 has been taken as the reference yr. Ninety-five % activity of NBS oxalic acid has been adopted as the value for the pre-1900 age-corrected wood.

All samples were treated with dilute HCl. Whenever NaOH pretreatment was possible, it has been mentioned in the date list. In the case of bones, only the inorganic fraction has been dated.

GENERAL COMMENT ON DATES

The C¹⁴ dates for Kalibangan presented here and those for other Harappan and allied sites (Broecker et al., 1956; Kusumgar et al., 1963b; Stuckenrath, 1963) now establish a compact date bracket of ca. 2300 to 1750 B.C. The total time spread of Harappa Culture is much smaller than the millenium-long span postulated on the basis of archaeological evidence (Gadd, 1932). For a detailed discussion of the evaluation of Harappan chronology on the basis of C¹⁴ dates, reference is made to Agrawal (1964). The few C¹⁴ dates available for the Painted Grey Ware (upper levels) agree with Wheeler’s chronology, ca. 300 to 500 B.C. (Wheeler, 1959). More measurements from different sites would be necessary to determine precisely the time spread of this ware. However, it seems certain that P. G. Ware people did not come in contact with the Harappans; in fact C¹⁴ dates suggest a gap of ca. 1000 yr between the two.

Several dates of bone samples from Alamgirpur, Mohanur, and Nagarjunakonda presented here are in complete disagreement with the archaeological estimates. These samples were not specifically collected for C¹⁴ dating. Furthermore, possibility of misidentification of levels due to later disturbances at the site is not ruled out. Thus the disagreement is probably not entirely due to the fact that the samples dated are bones. It may be mentioned here that TF-112, also a bone sample, gives a date in excellent agreement with that of charcoal from the same layer.

ACKNOWLEDGMENTS

Our thanks are due to Mr. A. Ghosh, Dr. H. D. Sankalia, Mr. B. B. Lal, and Mr. B. K. Thapar for helpful discussions.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

TF-70. Adichannalur, India, burials 775 ± 95 A.D. 1175

Wood sample from Adichannalur (8° 50’ N Lat, 76° 40’ E Long), Tin-
nevely District, Madras, believed to be associated with urn burials. The site was excavated during 1899 to 1905. The sample had been stored after soaking in wax. Subm. by Satyamurti. Wood pieces were boiled in hot water to remove wax. NaOH pretreatment was also given. Comment: date obtained is in wide divergence with the archaeological estimates, if the sample is correctly identified.

TF-51. Alamgirpur, India

A composite of three bone samples believed to have been derived from the Painted Grey Ware deposit of the site, Alamgirpur (30° 45' N Lat, 75° 50' E Long), District Meerut, U.P. Subm. by A. Ghosh. Comment: date obtained is at considerable variance with the archaeological estimate. Because such a large contamination is unlikely and because from the sections the samples appear to belong to disturbed strata, the possibility of a wrong identification of the levels cannot be ruled out.

TF-173. Dwarka, India, Medieval Culture

Charcoal from Dwarka (22° 15' N Lat, 69° E Long), District Jamnagar, Gujarat, from Trench A, Locus 3.40 × 1.50 m, depth 1.45 to 1.50 m, Layer 3, Field No. 119. The site was excavated by Dr. H. D. Sankalia, Deccan College, Poona-6, who subm. the sample. Visible rootlets were hand-picked. Comment: it will help date the medieval period of the site.

Hastinapur series, Uttar Pradesh

Hastinapur (29° 9' N Lat, 78° 3' E Long) is located on the left bank of Ganga River in Meerut District. The site was excavated by B. B. Lal, Director, School of Archaeol., in 1950-52 and 1962. The samples presented in this paper belong to Periods II and III, characterized by the occurrence of Painted Grey Ware and Northern Black Polished Ware, respectively, in the site. The excavator has suggested an association of Aryans with the P. G. Ware industry of Period II. Samples subm. by A. Ghosh.

The eight dates presented here have an internal consistency borne out by the stratigraphic sequence of the site. The C¹⁴ measurements suggest the spread of Period III between ca. 400 and ca. 100 B.C. (on the basis of t₁/₂ = 5730 yr). There also does not appear to be much of a gap between the end of Period II and the beginning of Period III. It is highly desirable to obtain more C¹⁴ measurements for these crucial periods in Indian archaeology in order to define the chronologies of N.B.P. and P.G. Wares.

TF-80, 82. Period III

A composite of two samples of charcoal (mixed with soil) from Trench HST-1/1962 (northern extension), Locus G-H, Layer 23, Field Nos. HST/62/C/1 & 4, depth 3.9 m below surface. Visible rootlets were hand-picked. Comment: samples derived from identical depths and layers. They are believed to be associated with the end of Period III, which marks the culmination of N.B.P. Ware.
TF-81. **Period III**  
2015 ± 95  
65 B.C.

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XC-XCIV, Layer 18, depth 5.1 m below surface. Field No. HST/62/C/2. Visible rootlets were hand-picked. NaOH pretreatment was also given. CO$_2$ was evolved by wet combustion method. *Comment*: sample derives from the uppermost layer of Period III, marking the end of N.B.P. Ware. Compare with TF-80, 82, 1940 ± 110.

TF-88. **Period III**  
2225 ± 110  
275 B.C.

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 25, Field No. HST/62/C/15, depth 6.45 m below surface. Visible rootlets were hand-picked. *Comment*: sample is from the lowest layer of Period III which marks the beginning of N.B.P. Ware.

TF-83. **Period II**  
2220 ± 110  
270 B.C.

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 26, and Pit Y sealed by Layer 25, Field No. HST/62/C/6, depth 6.75 m below surface. Visible rootlets were handpicked. *Comment*: sample derives from the uppermost layer of Period II marking the end of P.G. Ware.

TF-112. **Period II**  
2260 ± 95  
310 B.C.

Bone sample (coated with earth) from Trench HST-1/1962, Locus XC’-XCVII’, Layer 26 and Pit Y sealed by Layer 25, Field No. HST/62/C/7. *Comment*: sample derives from the latest layer of Period II and will date the flooding of the site which led to its desertion by P.G. Ware-using people.

TF-90. **Period II**  
2270 ± 110  
320 B.C.

Charcoal (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 26, Field No. HST/62/C/17, depth 6.6 m below surface. *Comment*: sample is from the same layer as TF-83.

TF-85. **Period II**  
2385 ± 125  
435 B.C.

Charcoal (mixed with earth) from Trench HST-1/1962, Locus XC-XCIV, Layer 28 and Pit Z which is sealed by Layer 27, Field No. HST/62/C/10, depth 7.25 m to 7.45 m below surface. Visible rootlets were hand-picked. *Comment*: sample belongs to the late levels of Period II.

TF-91. **Period II**  
2450 ± 120  
500 B.C.

Charcoal sample (mixed with earth) from Trench HST-1/1962, Locus XCIV-XCVII, Layer 27, depth 6.9 m below surface, Field No. HST/62/C/18. Visible rootlets were hand-picked. *Comment*: sample derives from late levels of Period II.
TF-109. Hathinia Hill-Baira, India, ash pit 30 ± 90 A.D. 1920

Charcoal (mixed with earth) from the Megalithic site of Hathinia Hill-Baira, Varanasi District of U.P. Sample derives from Trench KKR-A1, Locus III-IV, Pit A sealed by Layer 1, depth 1.09 m below surface, Field No. HAH/H 63/KKR-2. Visible rootlets were handpicked. NaOH pretreatment was also given. Comment: as Pit A was disturbed by a late pit, the excavators were doubtful about its association with the megalithic habitation, but since this was the only sample which was adequate for C14 measurement, it was taken up for dating. Site excavated by the Inst. of Archaeol. of Allahabad Univ. under the supervision of its Director, G. R. Sharma, who subm. the samples.

Kalibangan series, Rajasthan

The twin mounds of Kalibangan (29° 25' N Lat, 74° 05' E Long), District Sri Ganganagar, are located on the banks of Ghaggar (now dried). The site, discovered by Sir Aurel Stein, was identified as belonging to Harappa Culture by A. Ghosh. Excavations have been conducted under the joint supervision of B. B. Lal and B. K. Thapar since 1960 to 1961 (Lal, 1962). The site has yielded relics of Kalibangan Culture which preceded the Harappans. The Kalibangan Culture has some affinities with the Kot Diji pre-Harappan and pre-defence Cultures of Harappa itself. Samples subm. by A. Ghosh.

TF-150. Harappa Culture 3740 ± 100 1790 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus ZE1, Qdt. 4, Layer 6, depth 1.35 m below surface, Field No. KLB-2, ZE1/C/1962-63-16. NaOH pretreatment was given. Comment: sample belongs to the latest levels of Harappa Culture at the site.

TF-139. Harappa Culture 3775 ± 100 1825 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus XA8, Qdt. 2, Layer 6, depth 0.95 m below surface, Field No. KLB 2, XA8/C/1962-63-2. NaOH pretreatment was given. Comment: sample derives from the middle levels of Harappa Culture at the site.

TF-151. Harappa Culture 3800 ± 100 1850 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus E1, Qdt. 1, Layer 17, depth 3.10 m below surface, Field No. KLB-2, E1/C/1962-63-17. Comment: sample belongs to the middle levels of Harappa Culture at the site.

TF-147. Harappa Culture 3865 ± 100 1915 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus E1, Qdt. 1, Layer 23, depth 5.00 m below surface, Field No. KLB-2, E1/C/1962-63-13. NaOH pretreatment was given. Comment: sample from the lower middle levels of Harappa Culture at the site.

TF-145. Harappa Culture 3895 ± 100 1945 B.C.

Charcoal (mixed with earth) from Trench KLB-2, Locus XA8, Qdt. 3,
Layer 14, depth 2.25 m below surface, Field No. KLB-2, XA8/C/1962-63-10. NaOH pretreatment was given. *Comment:* sample derives from the lower middle levels of Harappa Culture at the site.

**Kausambi series, Uttar Pradesh**

Kausambi (25° 20' N Lat, 81° 23' E Long), modern Kosam, is situated on the northern bank of Yamuna. According to the Puranas, the capital of the Pandavas was shifted from Hastinapur to Kausambi at the time of Nichaksu, fifth in descent from Parikshita, the grandson of Arjuna. The measured samples cover Periods III and IV of the site (Sharma, 1960). Site excavated every year during past decade by Allahabad Univ. under direction of G. R. Sharma who subm. these samples.

**TF-98. Period IV**

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<th>A.D. 480</th>
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<td>1470 ± 90</td>
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Charcoal (mixed with earth) from Trench KSB-G/R-E6, Locus XXXIII-XXXIV, Pit sealed by Layer 2, depth 1.25 m below surface, Field No. KSB/63/GR-101. Visible rootlets were hand-picked. *Comment:* sample is derived from the debris of Huna invasion.

**TF-93. Period IV**

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</tbody>
</table>

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 3-5, Layer 4, Field No. KSB/63/AP-1, depth 1.25 m below surface from Asokan Pillar area. Visible rootlets were hand-picked.

**TF-97. Period IV**

<table>
<thead>
<tr>
<th>A.D. 310</th>
</tr>
</thead>
<tbody>
<tr>
<td>1640 ± 105</td>
</tr>
</tbody>
</table>

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 2-5, Layer 6, Field No. KSB/63/AP-5, depth 1.65 to 1.7 m below surface from Asokan Pillar area. Visible rootlets were hand-picked.

**TF-94. Period IV**

<table>
<thead>
<tr>
<th>A.D. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1945 ± 90</td>
</tr>
</tbody>
</table>

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 4-5, Road VI, depth 1.33 m below surface, Field No. KSB/63/AP-2. Visible rootlets were hand-picked.

**TF-95. Period IV**

<table>
<thead>
<tr>
<th>A.D. 110</th>
</tr>
</thead>
<tbody>
<tr>
<td>1840 ± 115</td>
</tr>
</tbody>
</table>

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 4-6, Road V, depth 1.44 m below surface, Field No. KSB/63/AP-3. Visible rootlets were hand-picked.

**TF-96. Period IV**

<table>
<thead>
<tr>
<th>55 B.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005 ± 95</td>
</tr>
</tbody>
</table>

Charcoal (mixed with earth) from Trench KSB-I-III-RD, Locus 4-6, Road IV, depth 2.03 m below surface, Field No. KSB/63/AP-4. Visible rootlets were hand-picked.

**TF-100. Period III**

<table>
<thead>
<tr>
<th>210 B.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2160 ± 95</td>
</tr>
</tbody>
</table>

Charcoal (mixed with earth) from Trench KSB-G/R-YZ2, Locus 1-2, Pit A sealed by Layer 18A, BK, depth 2.15 m below surface, Field No. KSB/63/
GR-103. Visible rootlets were hand-picked. Comment: sample derives from the last phase of N.B.P. Ware from Ghositarama area.

TF-62. Kudan, Nepal, early medieval temple

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>TF-62a</td>
<td>1020 ± 100</td>
</tr>
<tr>
<td>TF-62b</td>
<td>850 ± 95</td>
</tr>
</tbody>
</table>

**A.D. 1015**

Charred wood (mixed with earth) from Kudan (27° 32' N Lat, 83° 2' E Long), Layer 3, depth 1.55 m, Field No. Kudan D6, from a temple door frame. Visible rootlets were hand-picked. NaOH pretreatment was given. Subm. by A. Ghosh.

TF-77. Mohanur, India, burials

**A.D. 1620**

Bone sample from Mohanur (10° 30' N Lat, 79° 05' E Long), Salem District. Sample is believed to have derived from the accidental discovery of the “vestigeal urn burials” on the banks of Kaveri River. Subm. by Satyamurti, State Mus., Madras.

TF-75. Mohenjodaro, W. Pakistan, Harappa Culture

**1650 B.C.**

Clean charred grain from Mohenjodaro (27° 19' N Lat, 68° 8' E Long), Sind. Locus: Chamber 60, Block-2, from the pavement of a 'late date', depth 1.27 m below datum, Field No. L855, as recorded in Marshall’s report. Since A.D. 1925 the sample has been kept sealed in a glass bottle in the Safdarjang-Collection, New Delhi. Subm. by A. Ghosh. Comment: this is the first C14 date for the late Harappan levels of Mohenjodaro.

**Nagarjunakonda series, Andhra Pradesh**

The extensive site of Nagarjunakonda (16° 31' N Lat, 79° 14' E Long) is situated in Guntur District. Excavations were conducted by Dr. Subramanyham of the Survey during 1954 to 1961 (Ghosh, 1954-61). The samples described below are believed to have all derived from the Neolithic cemetery (ca. 2000 B.C.). Samples subm. by A. Ghosh. Comment: the C14 dates obtained are in complete disagreement with the archaeological estimates. As there was no sealing deposit over these graves, later disturbances and possibilities of misidentification cannot be ruled out.

TF-73. Burials

**A.D. 455**

Soft and spongy human bones from the Neolithic cemetery. Grave No. 4, Skeleton No. 6, depth 40 cm below surface.

TF-72. Burials

**A.D. 425**

Soft and spongy human bones from the Neolithic cemetery. Grave No. 6, Skeleton No. 8, depth 52 cm below surface.

TF-30. Burials

**A.D. 415**

Animal bones laden with ash from a Neolithic pit No. 44, Site 46, Sec. NV, Div. 362, Trench A3, depth 1.2 m to 1.5 m below surface.
TF-63b. Burials

Soft and spongy human bones from the Neolithic cemetery, Grave No. 5, Skeleton No. 7, depth 35 cm below surface.

TF-74. Burials

Soft and spongy human bones from Neolithic cemetery. Grave No. 8, Skeleton No. 10, depth 50 cm below surface.

TF-61. Rajar Dhibi, India, Period V

Charcoal sample (mixed with soil) from Rajar Dhibi (23° 34’ N Lat, 87° 39’ E Long) from District Burdwan, W. B., Trench No. RDB IV, Locus: 0-II, depth 1 m, Layer 2C. Subm. by P. Dasgupta. Visible rootlets were hand-picked. NaOH pretreatment was given. Comment: this is the first time that the latest period of this culture has been dated. No definite datable archaeological evidence seems to be available at present to determine the chronology of these cultures of West Bengal.

References

Date lists:
- Lamont III, Broecker, Kulp and Tucek, 1956
- Pennsylvania VI, Stuckenrath, 1963
- Tata Institute I, Kusumgar, Lal and Sarna, 1963

Stuckenrath, R. Jr., 1963, University of Pennsylvania radiocarbon dates VI: Radiocarbon, v. 5, p. 82-103.
SACLAY NATURAL RADIOCARBON MEASUREMENTS I

G. DELIBRIAS, M. T. GUILLIER, and J. LABEYRIE

Service d'Electronique Physique, Centre d'Etudes Nucléaires de Saclay
B. P. no. 2, Gif-sur-Yvette (S. et O.), France

The following list shows the age measurements carried out at Saclay by the Service d'Electronique Physique, using the C\textsuperscript{14} method.

The apparatus employed was completed and calibrated in 1956 and the first tests were performed during the same year. The counting unit is a 1.2 L stainless steel proportional counter and the filling gas is pure CO\textsubscript{2} at 74 cm Hg pressure. The shield consists of 20 cm of lead, 10 cm of iron, a coincidence ring and 2 cm of bismuth. The background is 4.86 ± 0.05 counts/min. (Error is ± \sigma, the duration of each counting being 24 hours.) Final purification is performed by adsorption of CO\textsubscript{2} on alumina at low temperature, followed by desorption at room temperature; this has proved particularly effective and gives a very good filling gas. Technique was described in detail previously by the authors (Perquis, Delibrias, and David, 1956; Delibrias and Perquis, 1958).

As a modern carbon standard we first used wood taken from the 1930 to 1945 rings of a large Douglas fir; this standard gave a net count of 6.02 counts/min. This activity, taking into account a 2\% Suess-effect for this wood, was found to be 95\% of the activity of the NBS oxalic-acid standard, measured in the same counter.

The NBS standard has been adopted by this laboratory since January 1961, and values given here are calculated from this new standard.

Measurements listed are dates obtained from 1956 through 1962. No reports are given here from other types of measurements carried out at Saclay, such as: (1) C\textsuperscript{14} content of wild plants growing in the vicinity of nuclear reactors; (2) measurement of C\textsuperscript{14} in blood proteins of workers of the radioactive-tracers industry; (3) Spallation cross-sections for C\textsuperscript{14} production in oxygen and iron by high energy protons; (4) C\textsuperscript{14} content of meteorites.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Leucate pool series, Aude, France

Dried marine plants (Posidoniae) imbedded in clayey sand, 5 m to 30 m above sealevel, on NE bank of Leucate pool (43° 10' N Lat, 3° 00' E Long). These deposits are supposedly ancient (Quaternary) lagoon formations. Coll. 1956 and subm. by A. Rivière, Faculté des Sciences, Orsay, Seine-et-Oise, France.

Sa-31. Leucate, 5 m level

\[
643 \pm 120
\]

A.D. 1307

Sa-32. Leucate, 10 m level

\[
480 \pm 120
\]

A.D. 1470
Sa-33. Leucate, 17 m level

Sa-34. Leucate, 30 to 32 m level

Comment: these very recent ages show an important transport of materials from the lagoon, probably due to strong winds.

La Brière swamp series, Loire-Maritime, France

Peat and wood (mainly chestnut, beech, oak) at various levels above green marine clay in central part of swamp of La Grande Brière. Upper surface of the clay, flat and horizontal over more than 100 km², is ca. 1.8 m above present low tide level, and ca. 2 m under present ground surface. Between the green clay and the modern surface is peat, yellow near bottom and black near surface, with a layer of bark and wood, 15 cm thick, in the middle. At present, and probably since about 2000 B.P., La Brière is a reed swamp, dry during summer and flooded with fresh water during winter. Stumps are found rooted in upper part of the green clay, and prostrate trunks are found in the peat; now hard and black, they are used locally for building (Vince, 1958). Coll. 1955 and subm. by A. Vince, St. Malo-de-Guersac, L-M, France.

Sa-35. Swamp of l’Isle

4040 ± 400
2090 B.C.

Tree at 1.7 m depth below surface, channel of the swamp of l’Isle (47° 24’ N Lat, 2° 14’ W Long).

Sa-39. Rozé I, buried wood

4630 ± 300
2680 B.C.

Wood rooted in upper part of green marine clay, 1.7 m below surface, in the swamp Rozé (47° 23’ N Lat, 2° 12’ W Long).

Sa-40. Rozé II, emerging tree

3880 ± 300
1930 B.C.

Piece of oak emerging 1 m above Rozé swamp, but rooted in lower yellow peat at same locality as Sa-39.

Sa-41. Rozé III, lower peat

4480 ± 300
2530 B.C.

Sample from lower part of yellow peat layer, in contact with marine clay, 1.7 below surface, same locality as Sa-39.

Sa-42. Rozé IV, bark

4100 ± 300
2150 B.C.

Layer of bark remains, between yellow and dark peat, 0.9 m below surface, same locality as Sa-39.

Sa-43. Rozé V, upper peat

2770 ± 300
820 B.C.

Black peat, 50 cm below surface, same locality as Sa-39.

Sa-46. Fedrun, tree root

4260 ± 300
2310 B.C.

Root from upright stump, 1.5 m below surface (47° 25’ N Lat, 2° 15’ W Long).

General Comment: Flandrian transgression has probably deposited the marine green clay, filling the great granitic basin of La Brière. During a period of regression, about 4600 B.P., a forest was living on this clayey ground. From
that time till the present the small barriers of organic sand were probably formed at the upper limit of tides by combined action of the sea and of the river Loire. These natural dams prevented the seaward flow of fresh water, forming swamps with peat production. Formation of the yellow peat, between 4600 and 4100 B.P. occurred at the same time as marine transgression observed in SE England from 4850 to 4150 B.P. and attributed to a downward movement of the E of England (Q-129 to Q-474, 1961, Cambridge III). The level 0.9 m below present surface, with bark and wood remains dated 4100 B.P., is a forest soil probably formed on dried peat during a short regression or pause in the transgression, during which backing-up of fresh water ceased.

**Sa-190. St. Jacques Bay, Morbihan, stem 2350 ± 150**

Oak stem, rooted in peat on shore of coast of Bretagne, 2 km E of St. Jacques (47° 35' N Lat, 2° 45' E Long). Coll. 1962 and subm. by G. Delibrias and J. Labeyrie. **Comment:** the peat is now 4.0 m under the highest sealevel, indicating a subsidence of this region by at least 2.50 m in 2350 yr. Subsidence had been suspected from the fact that several Megalithic monuments of the Morbihan coast are now below sealevel.

**Seine Estuary series**

After the melting of the ice of Wurm II, the Seine valley was gradually filled with alluvial deposits graded to a rising sealevel. The rise was interrupted by episodes of stillstand during which peat bogs were formed in former lagoons and cut off meanders. Measurements carried out on core samples of peat, buried in the alluvium, have fixed the dates of the various episodes of rise. (Jouis, 1961, p. 91-104), Coll. 1956, 1957, and subm. by E. Jouis, Inst. Natl. de la Recherche Agronomique, Rouen (Seine-et-Maritime).

**Sa-60. Anneville-sur-Seine 1800 ± 160**

Peat from the subsoil of the communal meadow land of Anneville-sur-Seine (49° 20' N Lat, 0° 30' W Long), ca. 2.50 m above present mean sealevel. Peat is covered by only ca. 50 cm of clayey calcareous alluvium. Coll. 1956. **Comment:** peat level is probably covered by the deposit of the general transgression which occurred in the 3rd century A.D.

**Sa-68. Mesnil-de-Lillebonne boring, Layer k 1740 ± 150**

Peat from core taken in swamp of Mesnil-de-Lillebonne (49° 30' N Lat, 0° 32' E Long), depth 8.20 to 8.40 m, Layer k. Coll. 1957.

**Sa-69. Mesnil-de-Lillebonne boring, Layer o 7630 ± 350**

Lignified peat, depth 9.90 m to 10.05 m, Layer o, in same boring as Sa-68.

**Sa-70. Mesnil-de-Lillebonne boring, Layer q 7380 ± 350**

Peat, depth 11.10 m to 11.50 m, Layer q, in same boring as Sa-68.

**Sa-71. Mesnil-de-Lillebonne boring, Layer s 7100 ± 350**

Peat, depth 11.85 m to 12.23 m, Layer s, in same boring as Sa-68.
Comment for Sa-68 to Sa-71: depths are given in meters below present mean sealevel. Present ground level is at +4.40 m; boring encountered limestone at –17.20 m. No organic matter was found below Layer s; overlying alluvium is limy sand and clay, except in pebble zone at –8.80 m to –9.25 m and in organic layers q, o, and k and four other thin peat layers (Jouis, 1961). Low rate of filling appears between –9.90 m and –8.40 m, and rapid one above –8.20 m.

II. MARINE GEOLOGIC SAMPLES

A. Coastal Samples

Villefranche-sur-Mer series, Alpes-Maritimes, France


Sa-101. Villefranche-sur-Mer I, 470-475 cm 2020 ± 160 70 B.C.

Organic carbon from layer of leaves of Posidoniae debris, depth interval 470 to 475 cm below top of sediment from piston core taken at N end of bay, in small basin of black mud (43° 42’ 10” N Lat, 7° 18’ 59” E Long), water depth 16 m. Comment: indicates very fast rate of sedimentation in N part of bay.

Sa-106. Villefranche-sur-Mer II, 580-600 cm 3040 ± 200 1090 B.C.

Total organic carbon; depth interval 580 to 600 cm below top of sediment from piston core taken in S part of bay (43° 41’ 27” N Lat, 7° 18’ 50” E Long), water depth 100 m.

Sa-104. Villefranche-sur-Mer III, surface 5400 ± 300 3450 B.C.

Total organic carbon in surface mud, dredged at 60 m depth in entrance to bay (43° 41’ 20” N Lat, 7° 19’ E Long).

Sa-108. Villefranche-sur-Mer IV A.D. 1220

Leaves of Posidoniae, from plants living on the sea floor in the roadstead (43° 41’ 40” N Lat, 7° 18’ 38” E Long), water depth 20 m. Comment: at least in roadstead, the Posidoniae evidently take their carbon from mixture of surface water and “older” deep water; the apparent age of Sa-108 reflects marked depletion (δ14C = –8‰). Salinity and temperature measurements previously made agree with this hypothesis, but the C14 content of the water itself has not been measured.

B. Mediterranean open-sea cores

All data presented here are from deep-sea cores coll. from western basin of Mediterranean sea, at distances from the French coast greater than 100 mi. Depth is constant (2600 ± 100 m) over 100,000 km²; mineralogical and hydrological studies suggest that large amounts of detrital carbonate may have been carried over the whole N part of the basin from the coast of Corsica and
Provence. Material used for dating consisted of bulk CaCO₃. When samples contained enough coarse fraction (>63 µ) for separate measurements, C¹⁴ ages from the coarse fraction and from the fine one (<63 µ) were determined. Presence of many sand and silt layers suggests that sedimentation is not regular and that a given horizon may contain reworked carbonate from continental erosion; hence measured C¹⁴ ages may be older than true ages. Coll. Aug. 1962 from R/V Calypso and subm. by J. Bourcart and J. Ros, Centre des Faibles Radioactivités, C.N.R.S. Gif-sur-Yvette, Seine-et-Oise, France.

**Core no. C-14 series**

Piston core, taken at depth of 2673 m (41° 24’ N Lat, 7° 05’ E Long), presents two well defined “turbidite” sand layers at 24 to 30 cm and 53 to 59 cm and two ill-defined turbidite layers at 6 to 15 cm and 277 to 285 cm. Dated sections appear largely undisturbed from a lithological point of view.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date (B.C.)</th>
<th>Depth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sa-163</td>
<td>4200 ± 250</td>
<td>30-50</td>
</tr>
<tr>
<td>Bulk CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa-164</td>
<td>5400 ± 300</td>
<td>63-83</td>
</tr>
<tr>
<td>Bulk CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa-165</td>
<td>15,200 ± 500</td>
<td>94-110</td>
</tr>
<tr>
<td>Bulk CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa-166</td>
<td>13,600 ± 450</td>
<td>110-128</td>
</tr>
<tr>
<td>Coarse CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa-167</td>
<td>12,800 ± 450</td>
<td>140-150</td>
</tr>
<tr>
<td>Bulk CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa-168</td>
<td>&gt;30,000</td>
<td>160-170</td>
</tr>
<tr>
<td>Bulk CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa-169</td>
<td>&gt;30,000</td>
<td>180-200</td>
</tr>
<tr>
<td>Coarse CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa-170</td>
<td>&gt;30,000</td>
<td>396-416</td>
</tr>
<tr>
<td>Bulk CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**General Comment:** locally formed foraminifera are mixed with continental carbonate in variable proportions. Nevertheless, mean sedimentation rate is very fast: 120 cm per 10,000 yr at least, during the postglacial period.

**Core no. C-13 series**

Piston core taken at depth of 2618 m (41° 58’ N Lat, 7° 5’ E Long) on top of small submarine hill, ca. 50 m high. Core is relatively homogeneous except for thin layers of silt at 44 cm and 135 cm.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date (B.C.)</th>
<th>Depth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sa-171</td>
<td>6600 ± 300</td>
<td>3-13</td>
</tr>
<tr>
<td>Bulk CaCO₃ fraction.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sa-172. C-13, 43-51 cm  
23,000 ± 1500  
21,050 b.c.

Bulk CaCO₃ fraction.

Sa-173. C-13, 51-59 cm  
28,500 ± 2500  
26,550 b.c.

Bulk CaCO₃ fraction.

Sa-174. C-13, 107-113 cm  
15,500 ± 500  
13,550 b.c.

Bulk CaCO₃ fraction.

Sa-175. C-13, 136-143 cm  
18,300 ± 800  
16,350 b.c.

Bulk CaCO₃ fraction.

General Comment: the upper few cm of this core appear to have been lost during coring. Ages found for sections 43 to 51 cm and 51 to 59 cm are too old because they contain much reworked carbonate, which probably indicates that after the end of the last glacial period a very important erosion period occurred in SE France.

Core no. C-20 series

Samples from a large diam (20 cm) gravity core coll. at depth of 2580 m (41° 52' N Lat, 6° 52' E Long). Core contains a well-defined “turbidite” quartz sand layer at 16 to 21 cm and a significant but unusual accumulation of pteropod shells at 5 to 9 cm.

Sa-176. C-20, 5-10 cm  
3660 ± 200  
1710 B.C.

Fine CaCO₃ fraction.

Coarse CaCO₃ fraction.

Sa-177. C-20, 60-70 cm  
11,700 ± 400  
9750 B.C.

Fine CaCO₃ fraction.

Coarse CaCO₃ fraction.

General Comment: the section 5 to 10 cm has significantly older age for fine fraction than for coarse one (pteropods), indicating high proportion of recently reworked carbonate. In section 60 to 70 cm the two fractions have the same age, indicating section consists only of locally produced carbonate, and giving a mean sedimentation rate of 65 ± 5 cm in 11,750 ± 400 yr; this is about 100 times the mean sedimentation rate in the deep basins of the Indian, Pacific and Atlantic oceans.

III. GEOLOGIC SAMPLES; VOLCANISM

A. France

Sa-90. Puy de la Vache, Puy-de-Dôme  
7650 ± 350  
5700 B.C.

Carbonized oak wood from soil under the St. Saturnin basalt flow from the Puy de la Vache prehistoric volcano (45° 39' 28" N Lat, 3° 5' 32" E Long).
A vertical section in this region shows overlying sand of granitic origin and from bottom to top: (1) ca. 50 cm of black sand containing small fragments of carbonized vegetable matter, and, in its upper 15 cm, carbonized branches; (2) white volcanic ash, 1 cm thick; (3) compact coarse black volcanic ash, 25 cm thick; (4) solid basalt, ca. 10 m thick.

Each fragment of wood is surrounded by a halo of carbonized organic matter that impregnates the sand, indicating that fragments come from roots and branches of a forest “cooked” in situ. Probably the higher branches were completely burned by the black ashfall, because no organic matter remains in upper part of ash layer (Pelletier and others, p. 2221-2222, 1959). Coll. 1944 by A. Rudel; subm. by H. Pelletier.

**Sa-94. Puy Pariou, Puy-de-Dôme**

Fossilized pine wood found under the Nohanent outflow of lava from Puy Pariou volcano (45° 48' N Lat, 3° 03' E Long). Coll. and subm. by H. Pelletier. Comment: this and the St. Saturnin flow (Sa-90, this date list) are believed to be results of the last volcanic eruptions in France.

**B. Martinique**

The following samples were taken under the principal conglomerate deposits around the big volcano of Mont Pelée in order to date the last major explosive eruptions.

**Sa-30. Montagne Pelée**

Peat and wood fragments, immediately beneath a volcanic conglomerate 8 m thick, topped by a bed of volcanic ash and pumice several meters thick (14° 47' 53" N Lat, 61° 08' 06" W Long). Coll. 1955 and subm. by H. Grunevald, Observatoire de la Martinique, Fonds-Saint-Denis, Martinique. Comment: this conglomerate, indicated as “α Ph” on the 1958 geologic map, appears in ravines all around Mont Pelée Volcano; it is supposed to be the debris of the volcanic explosion which created the great caldera at the top of Mont Pelée.

**Sa-81. A'ou a Bouillon**

Burnt wood, under a conglomerate from Pelean cloud, 5 m thick, topped by 2 m of pumice and ash (14° 48' 28" N Lat, 61° 07' 39" W Long). Coll. 1955 and subm. by H. Grunevald. Comment: dated to determine if the Pelean cloud was ejected by the volcano at the same time as volcanic explosion from which comes the conglomerate (Sa-30).

**Sa-83. Propreté région**

Wood, in peat layer, under 3 m of pumice and volcanic ash partially transformed into clay (14° 45' 08" N Lat, 61° 07' 10" W Long). Coll. 1955 and subm. by H. Grunevald. Comment: this pumice eruption of Mont Pelée volcano has diverted the ancient upper Mahault river to the Capot river, and reduced the forest to thin layers of peat containing wood fragments.
**Sa-82.** Demare

**19,500 ± 1000**

**17,550 B.C.**

Burnt wood, under 5 m of volcanic conglomerate (14° 49' 54" N Lat, 61° 06' 20" W Long). Coll. 1955 and subm. by H. Grunevald. **Comment:** dates ejecta of one of the first vulcanian type explosions of Mont Pelée Volcano.

**Sa-80.** Baie Baraban

**>25,000**

Wood, partially silicified, under a volcanic conglomerate injected with small quartz veins, on shore of Caravelle Peninsula (14° 46' 32" N Lat, 60° 53' 13" W Long). Coll. 1955 and subm. by H. Grunevald. **Comment:** notwithstanding its similarity to the conglomerate of Mont Pelée (Sa-30, Sa-81 and Sa-82) that of Baie Baraban was evidently much older; it is mapped as post-Eocene (Grunewald, 1961).

**C. New Zealand**

**Sa-91.** Ngauruhoe, New Zealand

**1210 ± 120**

**A.D. 740**

Charcoal, under layer of white lapilli and ash, 20 cm thick, slope of Ngauruhoe volcano (39° 5' S Lat, 175° 40' E Long). Coll. 1959 and subm. by H. Tazieff, Centre Européen de Volcanologie, Bruxelles. **Comment:** geologic dating of this ash-fall was unclear.

**IV. ARCHAEOLOGIC SAMPLES**

**A. Egypt**

**Sa-12.** Luxor, Egypt

**2220 ± 150**

**270 B.C.**

Cedar wood from sarcophagus found during excavation in a “Mastaba,” S of Luxor (25° 41’ N Lat, 32° 21’ E Long); dated historically at 300 ± 30 B.C.

**Louvre Coptic Cloths series**

Coptic cloths, belonging to the Collection of the Musée du Louvre and subm. by Father du Bourguet, 1958, Musée du Louvre, Paris.

**Sa-10.** Cloth no. 21

**575 ± 120**

**A.D. 1375**

Presumed date, 10th century A.D.

**Sa-11.** Cloth no. 23

**1235 ± 120**

**A.D. 715**

Presumed date, 11th century A.D.

**Sa-51.** Cloth no. 36

**450 ± 120**

**A.D. 1500**

Presumed date, 12th century A.D.

**Sa-52.** Cloth no. 45

**620 ± 120**

**A.D. 1330**

Presumed date, 10th century A.D. at the earliest, more probably 12th century.

**General Comment:** the disagreement between the results and the presumed ages has not been explained (P. du Bourguet, 1957, p. 57-59; 1958, p. 52-63).
a) Neolithic group

The following results testify to the existence of a Mediterranean-type vegetation between ca. 6000 B.P. and 4000 B.P. in mountainous regions of Central Sahara (Tassili, Hoggar, Adrar Bous). They also date a remarkable culture based on domestic cattle. Numerous beautiful wall drawings and paintings of this culture have recently been discovered in caves and shelters in sandstone cliffs of this region. They indicate ethnic and cultural connections both with Egypt and the Niger valley (H. Lhote, 1958).

Sa-55. Taessa, Hoggar

Fossilised guano of daman or “cony” (Procavia rufipes) from a rock shelter at Taessa, alt 2000 m (23° N Lat, 5° 40’ W Long). Palynological study showed abundance and variety of pollen indicating a flora of marked Mediterranean character (Pons and Quezel, 1957). Coll. and subm. by P. Quezel, Faculté des Sciences d’Alger.

Sa-59. Hassi Meniet, Hoggar

Organic soil, part of a culture layer, coll. at 45 cm depth in rock shelter of the Hassi Meniet Neolithic station, alt 900 m (25° N Lat, 4° 18’ W Long); abundant traces of an industry of fishermen with bone harpoons, ascribed to the later Saharan Neolithic period, occurred in the same deposit (Delibrias, Hugot, and Quezel, 1957); palynologic study of sample showed a xerophile Mediterranean flora (Pons and Quezel, 1957). Coll. 1957 by H. Hugot; subm. by P. Quezel.

Sa-62. Sefar, Tassili n’Ajjer

Organic material from ash layer, at surface of deposit containing bovine bone fragments and Neolithic industry, in rock shelter of Sefar Neolithic station (25° 2’ N Lat, 9° 5’ E Long), at the foot of rock paintings of bovines. Coll. 1956 by H. Lhote; subm. by P. Quezel.

Sa-65. Jabbaren I, Tassili n’Ajjer

Charcoal, found in a layer, depth ca. 50 cm, in the “Orycterop cave” at Jabbaren (24° 29’ N Lat, 9° 44’ E Long). Coll. 1956 and subm. by H. Lhote, Musée de l’Homme, Paris.

Sa-66. Jabbaren II, Tassili n’Ajjer

Charcoal coll. at 20 to 60 cm depth in a shelter where the main Neolithic deposit was found in 1956 (24° 29’ N Lat, 9° 44’ E Long). Coll. 1956 and subm. by H. Lhote. Comment: Jabbaren is a small flat sandstone hill in the Tassili mountains, with many shelters at the foot of the cliffs. In a square area 600 by 600 m more than 5000 paintings were found in 1956. On the shelter floors were many bovine bones with a Neolithic industry of flints and pottery (Lhote, 1958).
Sa-100. Adrar Bous III, Ténéré  

Charcoal from hearth in Neolithic deposit at Adrar Bous III (20° 20’ N Lat, 9° 8’ E Long). Coll. 1960 and subm. by H. Hugot, Musée du Bardo, Univ. d’Alger. Comment: Adrar Bous III is a very important Neolithic station (10,000 m²) of “Tenereen” culture, discovered in 1960 on the bank of a fossil lagoon. Many bones of bovines, hippopotamus, and catfish, shells of lake oysters (Aetheria), and an industry of beautiful polished axes of green jasper, arrows and tools of quartz, flint and haematite, crushing stones and pottery, show that the culture was based on fishing, hunting and agriculture. Like the similar Es-Shaheinab industry, dated at 5100 ± 450 and 5450 ± 380 (Arkell, 1953), it is supposed to be a western extension of the predynastic Egyptian civilization (Tixier, 1962, p. 333-348; Delibrias and Hugot, 1962, p. 71-72). Palynologic study of the diatomite floor of the dry lagoon has shown a mediterranean fauna (Phillyrea, Quercus ilex, Pistacia lentiscas, Alnus glutinosa, Cupressus, Juniperus, Pinus, Tilia, etc.; Quezel and Martinez, 1962, p. 313-332). Coll. 1960 and subm. by H. J. Hugot.

b) Preislamic group

Sa-76. Kouga, Mali

Charcoal found in a vertical pit of the “banco” layer at top of W tumulus of Kouga, on NW shore of Lake Fati (16° 17’ N Lat, 3° 45’ W Long). Coll. 1954 by R. Mauny; subm. by Th. Monod, Inst. Français d’Afrique Noire, Dakar. Comment: medieval site (Mauny, 1961). The banco is a clay layer,
1 to 2 m thick, converted to a ceramic by heat from wood burned in the many small pits (2 m depth, 1 m diam) dug in this layer.

Sa-77. Koumbi Saleh, Mauritania  
A.D. 1210

Sa-61. Iaye, Mali  
A.D. 1470
Fragment of cailcedra wood from statuette representing an Andujo (God of the Rain), found during excavation of the cave of the village Iaye, in Bandiagara cliffs (14° 25’ N Lat, 4° 10’ W Long). Coll. 1956 and subm. by F. Di Dio, 65, rue du Mt Cenis, Paris. Comment: statuette from Tellem civilization, supposed to have been carved between 10th and 13th centuries A.D.

D. Morocco

Taforalt cave series, Morocco
Charcoal from Epipaleolithic layers in a large necropolis, overlying a Mousterian industry and fauna, Taforalt cave (34° 49’ N Lat, 2° 24’ E Long), Morocco. Cultural levels, numbered I to X from top downward, are imbedded in ash, accompanied by plant and animal fossils implying a colder climate than today’s. Industry chiefly microlithic, with some bone tools; scarcity of geometric shapes on implements. Coll. 1953 to 1955 and subm. by J. Roche, 16, avenue du Bel Air, Paris.

Sa-13. Taforalt, Level II
Wood charcoal, Level II, Sec. A.B.-21,22, advanced Epipaleolithic.
10,800 ± 400  
8850 B.C.

Sa-14. Taforalt, Level VI
Wood charcoal, Level VI, Sec. A.-29,31, middle Epipaleolithic.
12,070 ± 400  
10,120 B.C.

Sa-15. Taforalt, Level VIII
Wood charcoal, in contact with yellow earth, Level VIII, Sec. K.M.-21,23, oldest Epipaleolithic.
10,500 ± 400  
8550 B.C.

Comment: mixed sample between Level II and Level VI was dated 11,900 ± 240 (L-399 E, Lamont V). Anomalously young age of the deepest sample (Sa-15) has not been explained.

E. South America

Sa-47. Ponsomby, Patagonia  
4450 B.C.
Wood and roots from peat deposit, bog No. 54, 150 m from the present bank, at Ponsomby, on shore of Skyring sea, strait of Magellan (52° 10’ S Lat, 71° 28’ W Long). Coll. 1953 and subm. by J. Emperaire and A. Laming,
G. Delibrias, M. T. Guiller, and J. Labeyrie

C.N.R.S., Paris. Comment: formation of the peat bog corresponds to a lacustrine phase immediately following recession of glaciers. The bog was contemporaneous with the oldest of the four archaeological levels known at the site of Ponsomby. This level contains an industry similar to the “Pampa” industry, and remains of the extinct American horse (J. and A. Emperaire, 1959).

**Sa-48. Ilha dos Ratos, Parana, Brazil**

1540 ± 150 A.D. 410

Palm nuts in “Sambaqui”, Trench IV, Sec. K, Ilha dos Ratos, Guaratuba Bay (25° 52’ S Lat, 46° 34’ W Long), accompanied by human burials shells, and implements of polished stone and whale bone. Coll. 1956 and subm. by J. Emperaire and A. Laming. Sambaquis are artificial shell heaps on the flat alluvial S coast of Brazil. Some of them are very large (ca. 10,000 m² in area, 20 m high) (Emperaire and Laming, 1956, p. 5-163).

**Sa-75. Cajarmaquilla, near Lima, Peru**

340 ± 120 A.D. 1610

Fragments of cloth found in ruins of Cajarmaquilla, near Lima (11° 56’ S Lat, 76° 51’ W Long). Coll. 1958 and subm. by R. Daudel, C.N.R.S., Paris. Comment: ruins, with thick clay walls, were supposedly dated between A.D. 500 and A.D. 1000 (oral communication, R. Daudel).

**Sa-49. Fell cave, Ultima Esperanza, Chile**

10,200 ± 400 A.D. 8250 B.C.

Dry manure of Mylodon, Sec. II, Layer C, oldest level of the Fell (or Mylodon) cave (51° 35’ S Lat, 72° 00’ W Long). Coll. 1953 and subm. by J. Emperaire and A. Laming, C.N.R.S., Paris. Comment: another sample (C-484) of the same layer was dated 10,832 ± 400, by the Chicago lab. (Libby, 1952). Bones of the American horse were also found in the dated level. The cave, situated in the dry pampas region, contains several archaeological levels, characterized by different shapes of arrow points (Emperaire and Laming, 1954, p. 173-206).

**Sa-109. San-Pedro de Atacama, Chile**

1650 ± 150 A.D. 300

Wood from grave of the “Atacamian” (pre-Inca) civilization, near San-Pedro de Atacama (23° S Lat, 68° W Long). Coll. 1959 by Father Le Paige and subm. by H. Tazieff, Centre Européen de Volcanologie, Brussels, Belgium. Comment: burial sites of this culture were recently discovered in the flat and saline sandy ground of the desert of Atacama. They contain flexed mummies, directly buried in dry sand of the desert, at depth of ca. 2 m, and pottery with gold and enamel jewels.

F. Portugal

**Sa-16. Moita do Sebastião, Muge, Portugal**

7350 ± 350 5400 B.C.

Charcoal from bottom of shell heap, under shell layers, Sec. M. L. 14-16. Sample is from the oldest level of the Mesolithic deposit of Moita do Sebastião, Muge (39° 06’ N Lat, 9° 00’ W Long). Coll. 1954 and subm. by J. Roche, 16 Av. du Bel Air, Paris 12°. Comment: the “concheiro” (shell heap) de Moita is about 15 m above the level of the Tagus river. Fauna (shells) suggests tem-
temperatures and salinity higher than today's in the waters of Tagus and Muge rivers. The stone industry is microlithic, with trapezoidal forms predominating. Rough quartzite tools, bone implements, traces of habitation and tombs are also present here, described by Roche (1960).

**G. Cambodia**

**Angkor-Vat series, Cambodia**

Wood fragments coll. in the Angkor monuments (13° 26' N Lat, 103° 50' E Long), a temple complex representing the perfection of Kmer art. It is the mausoleum of King Souvavarman II. **Coll. 1955 and subm. by L. Malleret, Ecole Française d’Extême Orient, Saigon.**

**Sa-2. Bayon**

Fragment of wood (*Terminalia tomentosa*) from Central tower, W inner room, Bayon. **Comment:** supposed date (written communication, L. Malleret), late 12th or early 13th century A.D. **1160 ± 150 A.D. 790**

**Sa-3. Porte de la Victoire**

Fragment of wood (*Terminalia tomentosa*) from high beam on E side, Porte de la Victoire. Supposed date, late 12th or early 13th century A.D. **1270 ± 150 A.D. 680**

**Sa-4. North Kleang**

Fragment of wood (*Terminalia tomentosa*) from beam lining S inner door, main W entrance, North Kleang. Supposed date, late 10th or early 11th century A.D. **880 ± 150 A.D. 1070**

**Sa-5. Baphuon**

Fragment of wood (*Terminalia tomentosa*) lining beam, N door, first floor, Gepura 2 East, Baphuon. Supposed date, A.D. 1060. **920 ± 150 A.D. 1030**

**Sa-6. Angkor-Vat**

Fragment of wood (*Sphorea obtusa*) from ceiling in the Angkor-Vat Temple. Supposed date, 12th century A.D. **400 ± 150 A.D. 1550**

**Museums series**

Samples from wooden statues and objects, from collections of Phnom-Penh and Saigon Museums. Subm. 1956 by L. Malleret. Numbers are reference to museum catalogue.

**Sa-20. Thap-Muoi, (3445)**

Statue of the Great Buddha at Thap-Muoi. Supposed date, 5th century A.D. **1620 ± 150 A.D. 330**

**Sa-21. Phong-My, (2809)**

Statue of Buddha found at Phong-My. Supposed date, 7th century A.D. **1490 ± 150 A.D. 460**

**Sa-22. Da-Noi I, (R-126)**

Statue of Buddha found at Da-Noi. Supposed date, 5th century A.D. **1360 ± 150 A.D. 590**
Sa-23. Duc-Hoa I, (4840) 1490 ± 150 A.D. 460
Statue of Buddha found at Duc-Hoa. Supposed date, 6th century A.D.

Sa-24. Duc-Hoa II, (4841) 1350 ± 150 A.D. 600
Statue of Buddha found at Duc-Hoa. Supposed date, 6th century A.D.

Sa-25. Da-Noi II, (R-126) 1375 ± 150 A.D. 575
Arm of statue of Buddha found at Da-Noi. Supposed date 5th century A.D.

General Comment: results agree with stylistically determined dates of wood fragments from statues; agreement is less satisfactory for wood samples from beams in various monuments at Angkor-Vat, and this may mean some reconstruction (Sa-6) or some re-use (Sa-2, Sa-3) of ancient material.

II. France

Sa-9. Paris, Quai Bourbon 450 ± 120 A.D. 1500

Sa-57. Vailly-sur-Aisne, Neolithic 5470 ± 300 3520 B.C.
Ox and boar bones in hearth in foundations of a Neolithic hut, Vailly-sur-Aisne (49° 24’ N Lat, 3° 31’ E Long). Foundations were immediately below arable soil covering sandy alluvium of the Aisne and not far from a terrace, 4.5 m above river level. Coll. 1957 and subm. by H. Joulié, Vailly-sur-Aisne. Comment: with the dates established by other laboratories for Brittany (Cuñic, Guissény, Finistère 5100 ± 60 [GrN-1966, Groningen IV] and Brasparts 5170 ± 60 [GrN-1983, Groningen IV]), for central France (Roucadour, Themines, Lot, from 4280 ± 125 to 5940 ± 150, [Coursaget, Giot, and Lerun, 1960]) we have now a “long” chronology for the Neolithic in France instead of a “short” one as was favored until recently.

Sa-53. Vailly-sur-Aisne, mammoth 11,550 ± 450 9600 B.C.
Mammoth tooth from a gravel pit in region of Vailly-sur-Aisne (49° 24’ N Lat, 3° 31’ E Long). Coll. 1956 by M. Bianciotto; subm. by H. Joulié. Comment: date seems reasonable for one of the last mammoths supposed to have disappeared at the end of the Magdalenian period. In the same gravel pit were found two other teeth and two mammoth tusks.

Sa-56. Fontaines Salées (Yonne) 2970 ± 170 1020 B.C.
Oak wood fragments from Fontaines Salées near Vezelay (47° 30’ N Lat, 3° 45’ W Long). From trunk of oak hollowed by fire and used as lining for a well-shaft to collect mineral water that rises through the ancient and recent alluvial deposits of the Cure River. Coll. and subm. by B. Lacroix, Mus. of Saint-Père-sous-Vezelay (Yonne). Comment: several burial urns found nearby
belong to the well-known urn-field culture (Hallstatt B); the installation dated here is contemporary with this civilization. It is the oldest known installation of the type. Later, this thermal station was occupied and used by the Romans (Lacroix, 1960).

**Sa-67. La Plagne, Macot (Savoie)**

Wood from mines of La Plagne (45° 30' N Lat, 6° 41' E Long). Coll. 1958 and subm. by H. Lewind, Mines de la Plagne, Aime, Savoie. **Comment:** wood from beams buried in old embankments in the mine; dated to know whether the old mine workings recently found were Roman or much more recent. The latest workings (during 19th century) yielded nothing interesting, but the Romans were supposed to have found a particularly rich vein of silver.

**Sa-69. Boutigny-sur-Essonne**

Charcoal from hearth in perfectly sealed cave in Essonne Valley, Boutigny (48° 26' N Lat, 2° 23' E Long). Subm. by J. Baudet, Inst. de Paléontologie Humaine, Paris. **Comment:** a problematic site supposed to be early Mesolithic (J. Baudet, private communication).

**Sa-89. Paris, Boul. St. Germain**

Fragment of oak wood, 6 m depth in street excavations, Boulevard Saint-Germain, Paris (48° 52' N Lat, 2° 23' E Long). Coll. and subm. by Centre Technique Forestier Tropical, Paris.

**Sa-95. Kercado (Morbihan)**

Charcoal from the chamber in barrow of granitic gravel, Kercado (47° 35' N Lat, 3° 05' E Long). In the vault, the chamber was filled with earth to depth of 1 m, in which were found human bones, partially burned, with charcoal and calcium sulphate. Sample No. 635, Mus. of Carnac; subm. by Y. Rollando, Archeol. Mus., Chateau-Gaillard, Vannes (Morbihan). **Comment:** significance of gypsum is unknown; age found here is estimated to be about 1000 yr too old, according to style of barrow (P. R. Giot, private communication).

**Sa-96. Mont-Saint-Michel (Morbihan)**

Charcoal from Mont-Saint-Michel barrow, at Carnac (47° 35' N Lat, 3° 05' E Long). Barrow is surrounded by granitic gravel. In the main vault were found vegetable matter, ashes, charcoal, burnt bones. Sample No. 823, Mus. of Carnac, subm. by Y. Rollando. **Comment:** same as for Sa-95.

**Sa-102. Lascaux Cave**

Wood charcoal from cave of Lascaux, near Montignac, Dordogne (45° 04' N Lat, 1° 10' E Long), taken in archaeological layer of the “puits de l'homme.” Coll. 1960 by A. Glory, Centre Nat. de la Recherche Sci., Paris; subm. by J. Labeyrie. **Comment:** charcoal sample from entrance of same cave, coll. by H. Breuil, was dated at 15,516 ± 900 (C-406; Libby, 1952). Another sample taken by A. Glory in 1958 in another part of the cave dated 17,190 ± 140 (GrN-1632, Groningen IV, p. 168). The Lascaux cave contains the most beauti-
ful and most famous paintings of bulls, cows, rhinoceros, stags, bison, etc. of the Aurignacian period.

**Mortar series**

The following dates are standardizing measurements on samples of known historic age, showing that it is possible to date non-biological samples, such as old mortars. Mortar is made by mixing water and sand with freshly calcined calcium oxide; during the following months, the mixture takes CO$_2$ from the ambient atmosphere, as would a growing plant. Proportion of CaCO$_3$ so formed is about 10% of total weight. The material must be tested by microscopic examination; samples containing calcareous debris, such as foraminiferan tests, are rejected (Delibrias and Labeyrie, 1963).

**Sa-190. Madeleine Castle, Seine et Oise**  
660 ± 120  
**A.D. 1290**  
Mortar between sandstone blocks of N wall of the Castle; siliceous sand. Historic age: 600 ± 50 yr.

**Sa-191. Roman aqueduct of Barbegal, Bouches du Rhône**  
1620 ± 150  
**A.D. 330**  
Mortar from pillars, siliceous sand. Historic age: 1600 ± 60 yr.

**Sa-192. Roman Terrazzo, Vannes**  
1650 ± 150  
**A.D. 300**  
Mortar between tegulae (tiles) of a terrazzo pavement; granitic sand. Found covered by ca. 1 m of humus, near S coast of Brittany. Historic age: 1650 ± 200 yr.

**Sa-193. Wall of Gif, Seine-et-Oise**  
<100  
NW wall of park of Gif Castle, siliceous sand (44° 42' N Lat, 2° 7' E Long). Historic age: 100 ± 30 yr.

**General Comment:** agreement between ages deduced from C-14 content of mortars and their historical ages. This shows (1) that formation of CaCO$_3$ takes place quickly in a mortar and (2) that there is no exchange with atmospheric CO$_2$ after the initial formation of CaCO$_3$.

**V. Atmospheric Radiocarbon: Bomb Effect**

Measurements have been made since 1958 in order to know the atmospheric concentration of artificial C$^{14}$ due to nuclear weapons tests. Collecting sites were chosen so as to be free from contamination by fuels. Organic samples were leaves, mainly oak collected in November; measured activity represents atmospheric C$^{14}$ activity during growth. Sampled trees grew in S part of the Massif Central, France (44° 11' N Lat, 1° 37' E Long). Inorganic samples were obtained by pulling atmospheric air (for about 10 days for each sample) through solutions of Ba (OH)$_2$, at the station of Val-Joyeux, Seine-et-Oise (48° 49' N Lat, 2° 1' E Long). No mass-spectrometric measurements of the C$^{13}$/C$^{12}$
Saclay Natural Radiocarbon Measurements

Ratio were performed; values quoted are averages of Broecker’s and Östlund’s measurements (Lamont VI and VIII; Stockholm V).

1) Organic series

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<td>F-59 Nov. 1959</td>
<td>+190±20</td>
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<td>Sa-181</td>
<td>F-61 Nov. 1961</td>
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2) Inorganic series

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HANNOVER RADIOCARBON MEASUREMENTS III

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The following list covers the measurements in our institute from January 1962 to March 1963. Sample preparation and conversion into acetylene are described by Wendt, Schneekloth and Budde (1962).

An Oeschger counter with an effective volume of 1.5 L came into operation in 1962. It is shielded by 4 cm of iron and 10 cm of lead. The background amounts to 2.24 cpm, the standard C¹⁴ counting-rate 17.05 cpm. In routine measurements, the impure acetylene, after a four-week storing period, is put into the counters. Examination of purity of the gas is carried out by means of an external Cs¹³⁷ source. In case the gas shows bad plateau characteristics, it is converted by a new process into ethane, using H₂ and a palladium catalyst. Thereby, the plateau characteristics improve considerably. The 50%-voltage then is 200 v lower, the slope of the plateau only amounts to 0.2 %/100 v (with external source), and the plateau length increases from 600 v to 1200 v. The additional work amounts to \( \frac{1}{2} \) hour.

After the midpoint of the plateau is chosen by use of the external source, measurements are made at two different voltages, 100 v above and below the midpoint. The slope of the plateau for all pulses counted, including coincidences, is estimated in this way and is taken into account in calculating errors. Replicate measurements are compared by calculating \( \chi^2 \), and are not averaged unless the probability of a real difference is less than 0.99; a confidence limit of 0.95 is required for combination of replicates of background and of reference standard counts. Infinite ages are stated on a criterion of \( + \ 2\sigma \) above background.

Age determinations of spring water were carried out on assumptions discussed by Münnich (1957). The recent activity was assumed to be 70% of the C¹⁴ activity of recent wood. Results from water samples are dependent on unknown changes in the C¹⁴ activity of modern reservoirs. The stated limits of error do not include the deviations caused thereby, which may amount to at least \( \pm \ 1000 \) yr. Values of \( \delta C^{13} \), though measured, were not used as corrective factors.

Abbreviations in the following text are N.L.f.B. for Niedersächsisches Landesamt für Bodenforschung, Hannover (Germany); B.f.B. for Bundesanstalt für Bodenforschung, Hannover, (Germany); and D.G.M. for Deutsche Geologische Mission.

ACKNOWLEDGMENTS

The authors thank Rose-Marie Westphal for her excellent work in chemical preparation and measurement of samples. The C¹²/C¹³ measurements were carried out by Wolfgang Stahl with an Atlas CH4-mass spectrometer.
SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Germany

Hv-173. Hesepertwist, Niedersachsen 8400 ± 340

Charcoal from surface digging near Hesepertwist, depth 250 cm (52° 36' 55" N Lat, 7° 07' 27" E Long), on podsolic soil, overlain by raised bog 250 cm thick. Coll. 1960 and subm. by Christian Ullrich, N.L.f.B. *Comment:* beginning of bog growth obtained by pollen analysis was in Zone IX (3000 to 1000 B.C.) according to Overbeck and others (1957). Pollen analysis by Heinrich Schneekloth, N.L.f.B.

Wanna series, Niedersachsen

Peat samples from coastal bog in marshy area near Wanna. Typical profiles of bog display, as result of postglacial sealevel changes, repeated oscillation between growth of highmoor peat and sedimentation below water table. Intercalated nonpeaty sediments include marine clay up to 5 m thick, age of which is bracketed by dates of over- and underlying peat. Episodes of growth and non-growth in bogs situated further inland are connected to the oscillations of sealevel. Samples are from 11 profiles. Two of them (Wanna 436 and Wanna 437) were investigated palynologically by H. Schneekloth (1963a'), and geology is described by Schneekloth (1963b). Altitudes in following descriptions are related to sealevel (NN = Normal Null). Coll. and subm. 1962 by H. Schneekloth.

Hv-281. Wanna, Profile 423, 180 to 190 cm 3490 ± 80

Valley-bog peat overlying marine clay 250 cm thick, 1.3 m below NN (53° 46' 40" N Lat, 8° 43' 30" E Long).

Hv-282. Wanna, Profile 436, 110 to 120 cm 1540 ± 90

Slightly decomposed Sphagnum peat directly above a recurrence horizon (SWK = Schwarz-/Weisstorfkontakt), 1.3 m above NN (53° 45' 45" N Lat, 8° 43' 01" E Long).

Hv-283. Wanna, Profile 436, 240 to 250 cm 2590 ± 90

Valley-bog peat directly overlying marine clay 80 cm thick in same boring as Hv-282, alt about NN.

Hv-196. Wanna, Profile 436, 390 to 400 cm 4340 ± 230

Valley-bog peat, 40 cm above base of bog, in same boring as Hv-282, 1.6 m below NN.

Hv-284. Wanna, Profile 453, 145 to 155 cm 4230 ± 80

Valley-bog peat directly overlying marine clay 350 cm thick, 0.2 m above NN (53° 46' 00" N Lat, 8° 45' 18" E Long).
**Hv-285.** Wanna, Profile 456, 115 to 120 cm

Valley-bog peat layer 30 cm thick is intercalated within raised-bog peat ca. 250 cm thick. Sample was strongly decomposed Sphagnum peat directly above valley-bog peat layer, 0.4 m above NN (53° 45' 40'' N Lat, 8° 44' 38'' E Long).

**Hv-286.** Wanna, Profile 458, 180 to 190 cm

From valley-bog peat layer 25 cm thick, intercalated within raised-bog peat ca. 250 cm thick, 0.1 m above NN (53° 45' 43'' N Lat, 8° 45' 18'' E Long).

**Hv-287.** Wanna, Profile 458, 330 to 350 cm

Valley-bog peat directly overlying marine clay 170 cm thick, 1.45 m below NN. From same boring as Hv-286.

**Hv-288.** Wanna, Profile 460, 160 to 170 cm

Birch-wood peat directly overlying clay layer 10 cm thick, overlain and underlain by raised-bog peat, 0.5 m above NN (53° 45' 15'' N Lat, 8° 45' 18'' E Long). Comment: clay at this alt is unlikely to be marine, and has probably been washed in from adjoining boulder-clay slopes. Date also shows the section to be anomalous; comparison with other Wanna samples cannot yet be made.

**Hv-289.** Wanna, Profile 474, 150 to 160 cm

From same profile as Hv-288; valley-bog peat overlying upper marine clay layer, 1.5 m below NN.

**Hv-289.** Wanna, Profile 474, 75 to 85 cm

Stratigraphic sequence in profile 474 (53° 45' 07'' N Lat, 8° 48' 04'' E Long): down to 85 cm, valley-bog peat; 85 to 110 cm, transition-bog peat; 110 to 160 cm, valley-bog peat (lower part slightly clayey); 160 to 175 cm, marine clay; 175 to 210 cm, raised-bog peat; 210 to 215 cm, valley-bog peat; 215 to 275 cm, marine clay; 275 to 360 cm, transition-bog peat with thin layers of clay; Pleistocene sand below. Sample was valley-bog peat from directly above uppermost transition-peat layer, 0.7 m below NN.

**Hv-290.** Wanna, Profile 474, 250 to 260 cm

From same profile as Hv-291; valley-bog peat overlying upper marine clay layer, 1.2 m below NN.

**Hv-291.** Wanna, Profile 477, 135 to 145 cm

Stratigraphic sequence in profile 477 (53° 44' 50'' N Lat, 8° 48' 20'' E Long): down to 120 cm, slightly decomposed Sphagnum peat; 120 to 150 cm, valley-bog peat; 150 to 180 cm, transition-bog peat; 180 to 250 cm, raised-bog peat; 250 to 265 cm, valley-bog peat; 265 to 270 cm, marine clay; 270 to 340 cm, raised-bog peat; 340 to 380 cm, transition-bog peat; Pleistocene sand below. Sample was from upper layer of valley-bog peat, alt ca. NN.

**Hv-292.** Wanna, Profile 477, 250 to 260 cm

From same profile as Hv-291; valley-bog peat overlying layer of marine clay, 1.2 m below NN.
Hv-340. Wanna, Profile 428, 50 to 60 cm 1920 ± 70 A.D. 30
Valley-bog peat directly overlying marine clay, 0.8 m above NN (53° 36' 30'' N Lat, 9° 24' 59'' E Long). Comment: same age as Hv-283 was expected.

Hv-341. Wanna, Profile 451, 100 to 110 cm 3670 ± 80
Valley-bog peat, directly overlying marine clay 400 cm thick, 0.9 m above NN (53° 46'' 12'' N Lat, 8° 44' 56'' E Long).

Hv-342. Wanna, Profile 452, 220 to 230 cm 3965 ± 90
Valley-bog peat, overlying marine clay 50 cm thick, 0.3 m below NN (53° 45' 55'' N Lat, 8° 44' 50'' E Long).

General Comment: dates prove that sedimentation of marine clay in area had mainly ended ca. 2200 B.C.; younger deposits occur only rarely. Probably because of later subsidence or compaction, contemporaneous peat directly overlying marine clay is found, somewhat unexpectedly, to lie at various altitudes (from ca. 1.5 below to 1.0 m above NN). In the raised bog of investigation area periods of rising sealevel effected a developmental change from oligotrophic to eutrophic conditions by forming valley-bog peat layers within raised-bog peat. On the whole, palynological dates in Profiles Wanna 436 and 477 agree with C¹⁴ dates.

Hv-197. Falkenberger Moor, Niedersachsen 2140 ± 190 190 B.C.
Slightly decomposed Sphagnum peat from depth of 90 to 100 cm, from a boring in Falkenberger Moor (53° 43' 01'' N Lat, 8° 46' 11'' E Long), directly above recurrence surface overlying strongly decomposed Sphagnum peat. Coll. 1962 and subm. by H. Schneekloth. Comment: profile has been pollenanalytically dated by H. Schneekloth. Sample dates the recurrence horizon and characteristic features of pollen diagram. Results of both dating methods show correlation.

Gifhorn series, Niedersachsen
Sphagnum peat samples from Grosse Moor, near Gifhorn. Coll. and subm. 1963 by H. Schneekloth. Age determinations of recurrence horizon from different profiles, within region of same bog, were made both by C¹⁴ and by pollen analysis. Stratigraphy of raised bog of ca. 60 km² shows strongly decomposed Sphagnum peat overlain by slightly decomposed Sphagnum peat. Contact between these two peat layers (SWK, see Hv-282) is seen nearly everywhere in the bog. Within the strongly decomposed peat is an extensive layer of less decomposed Sphagnum peat (Brauntorf), described by Potonie (1912) already. Developmental history of Grosse Moor near Gifhorn has been treated by Overbeck (1952). Samples are from six profiles, pollenaanalytically dated by H. Schneekloth (preliminary report, 1963c; a full account in “Geologisches Jahrbuch” is in preparation).

Hv-404. Gifhorn, Profile 1, 70 to 75 cm 1850 ± 60 A.D. 100
Sphagna-Acutifolia peat, moderately decomposed, directly above SWK (52° 33' 39'' N Lat, 10° 38' 31'' E Long).
Hv-405. Gifhorn, Profile 1, 110 to 115 cm \[2820 \pm 60\] 870 b.c.
Sphagna-Cymbifolia peat, slightly decomposed, from uppermost layer of Brauntorf, from same boring as Hv-404.

Hv-418. Gifhorn, Profile 1, 125 to 130 cm \[2910 \pm 80\] 960 b.c.
Sphagna-Cymbifolia peat, slightly decomposed, from middle of Brauntorf layer, from same boring as Hv-404.

Hv-415. Gifhorn, Profile 1, 150 to 155 cm \[3605 \pm 60\] 1655 b.c.
Sphagnum peat, strongly decomposed, directly beneath Brauntorf, from same boring as Hv-404.

Hv-462. Gifhorn, Profile 2, 45 to 50 cm \[2345 \pm 110\] 395 b.c.
Sphagna-Acutifolia peat, slightly decomposed, directly above SWK (52° 34' 40" N Lat, 10° 39' 35" E Long).

Hv-407. Gifhorn, Profile 2, 95 to 100 cm \[3500 \pm 100\] 1550 b.c.
Sphagnum peat, moderately decomposed, from uppermost layer of Brauntorf, from same boring as Hv-462.

Hv-416. Gifhorn, Profile 2, 120 to 125 cm \[5240 \pm 120\] 3290 b.c.
Sphagnum peat, moderately decomposed, from lowermost layer of Brauntorf, from same boring as Hv-462.

Hv-408. Gifhorn, Profile 3, 25 to 30 cm \[2000 \pm 70\] 50 b.c.
Sphagna-Cymbifolia peat, slightly decomposed, directly above SWK.

Hv-417. Gifhorn, Profile 3, 105 to 110 cm \[4330 \pm 110\] 2380 b.c.
Sphagna-Acutifolia peat, moderately decomposed, from lowermost layer of Brauntorf, from same boring as Hv-408.

Hv-463. Gifhorn, Profile 4, 75 to 80 cm \[1510 \pm 110\] a.d. 440
Sphagna-Acutifolia peat, slightly decomposed, directly above SWK (52° 32' 46" N Lat, 10° 35' 25" E Long).

Hv-410. Gifhorn, Profile 4, 105 to 110 cm \[3350 \pm 80\] 1400 b.c.
Sphagnum peat, moderately decomposed, from uppermost layer of Brauntorf, from same boring as Hv-463.

Hv-411. Gifhorn, Profile 5, 65 to 70 cm \[1400 \pm 75\] a.d. 550
Sphagna-Acutifolia peat, slightly decomposed, directly above SWK (52° 32' 27" N Lat, 10° 38' 56" E Long).

Hv-412. Gifhorn, Profile 5, 100 to 105 cm \[2690 \pm 80\] 740 b.c.
Sphagna-Acutifolia peat, moderately decomposed, from uppermost layer of Brauntorf, from same boring as Hv-411.
Hv-465.  Gifhorn, Profile 5, 155 to 160 cm  2940 ± 170
990 B.C.
Sphagna-Cuspidata peat, moderately to strongly decomposed, from lower-most layer of Brauntor, from same boring as Hv-411.

Hv-413.  Gifhorn, Profile 6, 85 to 90 cm  1560 ± 80
A.D. 390
Sphagna-Cuspidata peat, moderately decomposed, directly above SWK (62° 31’ 35” N Lat, 10° 37’ 33” E Long).

Hv-414.  Gifhorn, Profile 6, 110 to 115 cm  2225 ± 80
275 B.C.
Sphagnum peat, moderately decomposed, from same boring as Hv-413, uppermost layer of Brauntor. Comment: Brauntor not clear in this profile; low age indicates that it was incorrectly identified, and sample should be rejected.

General Comment: considering these dates and Heidelberg dates from the same bog (Overbeck et al., 1957; samples H-72/88, H-71/85, H 119/105), it is clear that a single recurrence surface can have distinctly different ages, probably because local hydrographic conditions differed. In Grosse Moor near Gifhorn, the differences are regionally grouped. The maximum age difference between profiles is ca. 1000 yr for the SWK and ca. 500 yr for the contact between Brauntor and overlying black peat. The C14 age differences for the SWK are confirmed by pollen analysis, but the contact between Brauntor and the younger dark peat appears younger by pollen analysis than by C14. The pollen dating is less reliable here, as the pollen percentages are atypical and difficult to interpret.

Hv-158.  Wremer Specken, Niedersachsen  3640 ± 125
1690 B.C.
Clayey valley-bog peat from depth of 80 cm (53° 39’ 21” N Lat, 8° 32’ 58” E Long). Sample is underlain and overlain by brackish water sediments from influencing area of ancient estuary of Weser river. Coll. 1960 and subm. by H. A. Schneeberg. Comment: the aim was to delimit age of this brackish marsh and of younger marine cover. Age is as expected according to stratigraphy.

Weserauelaehm series, Niedersachsen
Wood and humic loam from borings in Weser river area. Coll. 1961 and subm. by Gerd Lüttig, N.L.f.B. Dates serve the stratigraphical division of high-flood loam in district of the Weser.

Hv-127.  Landesbergen, 2 m  370 ± 110
A.D. 1580
Wood bedded on gravel, overlain by high-flood loam (52° 36’ 22” N Lat, 9° 09’ 26” E Long). Comment: result corresponds to geological observation and findings of human settlements.

Hv-157.  Leeseringen, 3 m  435 ± 200
A.D. 1515
Drifted trunk on gravel, overlain by youngest high-flood loam (52° 36’ 22” N Lat, 9° 08’ 42” E Long).
Hv-195. Oppermann, 4 m

Wood imbedded in gravel, overlain by high-flood loam 2 m thick (52° 15' 16" N Lat, 9° 49' 55" E Long). Comment: according to remains of vertebrates, sample is too young.

Hv-198. Gleidingen, 4 m

Wood sample bedded like Hv-195 (52° 16' 77" N Lat, 9° 49' 23" E Long). Comment: according to probable age of vertebrates, age of sample expected to be 4500 yr B.C. or younger.

Hv-199. Ruthe, 2.5 m

Driftwood sample bedded like Hv-195 (52° 15' 01" N Lat, 9° 49' 11" E Long). Comment: dates (see also Hv-102) permit correlation with Schulenburger complex.

Hv-201. Gleidingen, 6 m

Wood, underlain by gravel and overlain by high-flood loam (52° 16' 30" N Lat, 9° 49' 26" E Long).

Hv-203. Ruthe, 0.8 m

Fossil, humic loam imbedded in loess (52° 15' 10" N Lat, 9° 48' 57" E Long). Comment: date aids subdivision of loess in Lower Saxony. See also Lüttig (1960).

Hv-202. Grabstede, Niedersachsen

Wood from 180 cm depth, from digging near clay pit of Grabstede (53° 22' 27" N Lat, 8° 00' 18" E Long), from Lauenburger Ton. Coll. 1961 and subm. by Arnim Graupner, N.L.f.B. Comment: dates recent wood on upper part of Lauenburger Ton.

Salzderhelden series, Niedersachsen

Wood from borings near Salzderhelden. The profile shows layers of fine sandy silt, 3.50 to 4.50 m thick, resting on coarse sand and gravel, in which pieces of wood were found. Coll. 1961 and subm. by Otto Sickenberg, N.L.f.B. Samples dated to get age of high-flood loam that fills Leine River valley.

Hv-376. Salzderhelden, 3.5 m

Wood from a coarse sand layer (51° 45' 00" N Lat, 9° 57' 37" E Long).

Hv-377. Salzderhelden, 4.0 m

Wood from same coarse sand layer as Hv-376 (51° 44' 42" N Lat, 9° 57' 33" E Long).

Hv-296. Drüber, 5.5 m

Wood from coarse sand layer (51° 45' 48" N Lat, 9° 06' 08" E Long). Comment: result agrees with expectations about age of younger high-flood loam in upper Leine River district.
Hv-82. **Nesselröden, Niedersachsen**  
850 ± 100 A.D. 1100
Charcoal from a boring, interbedded between Younger Loess 1 and Younger Loess 2, from depth of 3 m (51° 35’ 40” N Lat, 10° 14’ 55” E Long). Coll. 1959 and subm. by G. Lütting. **Comment:** date permits the stratigraphic subdivision of Leine River loess near Duderstadt.

Hv-204. **Helsdorf, Niedersachsen**  
930 ± 50 A.D. 1020
Charcoal from depth 70 to 105 cm, from digging near Helsdorf (52° 35’ 58” N Lat, 9° 35’ 28” E Long), imbedded in high-flood loam 2 m thick. Coll. 1961 and subm. by Kurt Genieser, N.L.f.B. **Comment:** dates high-flood loam of Leine River; which probably started ca. 4000 B.C. and is still going on (Beschoren, 1936). See also Hv-82.

**Wurthfleth series, Niedersachsen**
Peat from borings in marshy area near mouth of Weser River. Peat layer 1 m thick is interbedded between marine sediments. Coll. 1960 and subm. by J. H. Benzler, N.L.f.B. Samples date sealevel changes of North Sea.

Hv-163. **Wurthfleth, 1.1 to 1.2 m**  
2580 ± 200 630 B.C.
Clayey valley-bog peat from uppermost part of peat layer (53° 51’ 50” N Lat, 8° 32’ 50” E Long).

Hv-164. **Wurthfleth, 2.2 to 2.3 m**  
4090 ± 220 2140 B.C.
Clayey valley peat from lowermost part of peat layer (53° 52’ 10” N Lat, 8° 32’ 20” E Long). **Comment:** date confirms assumption of peat growth during whole Sub-Boreal period (Benzler, 1963).

Hv-300. **Isle of Wangerooge, North Sea**  
1450 ± 80 A.D. 500
Shell from depth 0.2 to 0.5 m, from digging at NW beach of Wangerooge (53° 47’ 48” N Lat, 7° 51’ 06” E Long), from layer of marine clay, 1 m thick, in which numerous Scrobicularia shells are imbedded in life-like position. Layer occurs throughout the whole island. Coll. 1962 and subm. by Heinz Sindowski, N.L.f.B. **Comment:** geological situation supports age of less than 2000 yr.

**Bartshausen series, Niedersachsen**
Peat from boring of Bartshausener marshy area (53° 22’ 51” N Lat, 7° 06’ 00” E Long). Profile shows four alternating sequences of silty clay and valley-bog peat down to 6.25 m depth. Samples date flooding phases of North Sea. Coll. 1961 and subm. by H. Voigt, N.L.f.B.

Hv-245. **Bartshausen, 2.1 to 2.2 m**  
3250 ± 75 1300 B.C.
Peat from upper part of second valley-bog peat layer.

Hv-246. **Bartshausen, 3.7 to 3.8 m**  
3660 ± 60 1710 B.C.
Peat from base of second peat layer.
Hv-247. Bartshausen, 4.2 to 4.3 m
Peat from upper part of third peat layer.

Hv-248. Bartshausen, 4.65 to 4.75 m
Peat from base of third peat layer. Comment: date confirms peat growth during whole Sub-Boreal as expected (see also Hv-163 and Hv-164).

Hv-381. Urberach, Hessen
Charcoal from a depth 50 to 80 cm, from profile near Urberach (49° 58’ 35” N Lat, 8° 46’ 12” E Long), from base of charcoal-bearing layer of minor thickness, imbedded in eolian sand. Coll. 1962 and subm. by Ernst Schönhals, N.L.f.B. Comment: date proves blown-sand deposits in this region formed during historical times.

Hv-393. Hopsten, Nordrhein-Westfalen
Wood from 80 cm depth, from digging near Hopsten (52° 19’ 38” N Lat, 7° 33’ 10” E Long), imbedded in colluvial, eolian sand of low-terrace of Ems River. Coll. 1963 and subm. by F. J. Braun, Geol. Landesamt Nordrhein-Westfalen, Krefeld. Comment: sample was assumed to originate either from the Alleröd (8000 to 10,000 B.P.) or the Bölling (12,000 to 14,000 B.P.).

Hv-331. Mühlenheim, Nordrhein-Westfalen
Wood from depth 6 to 7 m, from digging near Oberhausen, imbedded in sand and gravel. Coll. 1962 and subm. by F. J. Braun. Comment: sample expected to be post-Atlantic and to belong to low terrace of Ems River.

Hv-174. Dortmund-Wickede, Nordrhein-Westfalen
Humic acid from depth of 105 to 130 cm, from a humus soil (2.7% organic matter) (51° 32’ 18” N Lat, 7° 37’ 22” E Long). Profile shows a fossil gley in loess, covered by reworked loess 105 cm thick. Coll. 1960 and subm. by H. O. Dahm, Geol. Landesamt Nordrhein-Westfalen, Krefeld. Comment: loess sedimentation may correlate with a land-clearing phase although pollen analysis by G. von der Brelie indicated Pre-Boreal period (7000 to 8000 B.C.).

Hv-274. Karlsruhe, Baden-Württemberg
Wood from a boring, 12 m depth, at Karlsruhe oil harbor (49° 03’ 34” N Lat, 8° 19’ 20” E Long), imbedded in river gravel. Coll. 1961 and subm. by Kurt Bartz, Geol. Landesamt Baden-Württemberg, Freiburg. Comment: gravels down to 12 m belong to Holocene valley fill.

Hv-275. Würmersheim, Baden-Württemberg
Wood from 11.50 to 13.70 m depth, from a boring near Würmersheim (48° 54’ 11” N Lat, 8° 13’ 46” E Long), imbedded in gravel and sand. Coll. 1961 and subm. by K. Bartz. Comment: gravel is Pleistocene but otherwise undated.
Hagsfeld series, Baden-Württemberg


Hv-277. Karlsruhe, Baden-Württemberg 250 ± 70

A.D. 1700

Wood from 8 to 12 m depth, from a boring near Karlsruhe oil harbor (49° 04’ 26” N Lat, 8° 20’ 22” E Long), imbedded in Rhine River gravel. Comment: Rhine valley in this area was filled during historic time.

Hv-279. Hagsfeld, 100 to 200 cm 2230 ± 70

280 B.C.

Wood, overlain by clayey loam (49° 01’ 23” N Lat, 8° 27’ 45” E Long).

Hv-276. Hagsfeld, 205 to 220 cm 2460 ± 100

510 B.C.

Peat sample overlain by clayey loam (49° 00’ 55” N Lat, 8° 27’ 44” E Long). Comment: geology indicates canyon fill is Holocene.

B. Foreign Samples

Hv-156. Kerman, Iran >25,000

Peaty marl from a well digging, depth 9.8 to 10.4 m, near Kerman (30° 15’ N Lat, 56° 58’ E Long), overlain by partly humous marly lake deposits, 2.05 m thick, and by limy loess-like silt, 7.75 m thick. Coll. 1960 by Reinhold Huckriede; subm. by Helmut Venzlaff, N.L.f.B. Comment: date is compatible with a latest-Pluvial age (according to Huckriede, 1961).

Hv-191. Qunduz, N Afghanistan >32,000

Piece of root, depth 47.5 to 50 m, from a boring near Qunduz (36° 45’ N Lat, 68° 52’ E Long). Overlain by loess, 20 m thick, and sand, 27.5 m thick, in bed of Taluquan River. Coll. 1961 by K. Rudolph; subm. by D. Wirtz, D.G.M., Afghanistan, Kabul. Comment: the 25-m terrace may have been formed in a pluvial-glacial phase during younger Pleistocene.

Ilobasco series, El Salvador


Hv-265. Ilobasco-Veta, 4 to 5 m depth >43,000

Lignite overlain by tuffs and underlain by clay (13° 51’ 22” N Lat, 88° 51’ 50” W Long).

Hv-266. Ilobasco-Veta, 4 to 5 m depth >32,000

Lignite overlain by tuffs and underlain by clay.

Hv-267. Ilobasco-Veta South, 2 m >43,000

Bituminous lignite underlain by clay and overlain by tuffs. Comment: according to Meyer-Abich (1960), basin fill is Pleistocene. Results do not contradict geologic observations (Grebe, 1954).
Boquerón series, El Salvador

Hv-264. Los Choros, 1 to 3 m
Charcoal imbedded in pumice tuff from a young barranco (13° 41’ 36” N Lat, 89° 19’ 16” W Long).

Hv-330a. Escalon, 5 m
Charcoal imbedded in pumice tuff (13° 41’ 25” N Lat, 89° 14’ 55” W Long).

Hv-330b. Escalon, 5 m
Charcoal from same place as Hv-330a. Comment: young pumiceous deposits as well as several prehistoric finds caused Weyl (1955) to assume age of 1000 to 1800 B.P. The difference between Hv-330a and Hv-330b remains unclear.

II. ARCHAEOLOGIC SAMPLES

A. Germany

Hv-153. Hohe Schanze, Niedersachsen
Charcoal from excavation of a pile, 60 to 80 cm depth, near Alfeld (51° 56’ 25” N Lat, 9° 57’ 52” E Long), underlain by flammenmergel and overlain by forest humus. Coll. 1960 and subm. by Wilhelm Barner, Local Mus., Alfeld/Line. Comment: pile could be from the La Tène period or could be built for a Frankish fortification between 800 and 1000 A.D.

Hv-154. Hohe Schanze, Niedersachsen
Carbonized wood from gate construction from a 1-m excavation, near Alfeld (51° 56’ 35” N Lat, 9° 58’ 03” E Long), imbedded in flammenmergel. Coll. 1960 and subm. by W. Barner. Comment: according to their shape, the earth walls on the “Hohe Schanze” were built during the La Tène period (400 to 300 B.C.). Fragments of pottery found there confirm this.

Hv-328. Stolzenau, Niedersachsen
Wood from canoe, 4 to 5 m depth, from an outcrop near Stolzenau (52° 30’ N Lat, 9° 05’ E Long), overlain by high-flood loam 4 m thick. Coll. 1962 by Wilhelm Lohmeyer; subm. by Heinrich Wortmann, Geol. Landesamt Nordrhein-Westfalen, Krefeld. Comment: age of canoe, according to its position in the profile and manner of construction, estimated to be 1000 B.P.

Hv-192. Hameln, Niedersachsen
Wood from a pile foundation from excavation at 1.90 to 2.50 m depth, near Hameln (52° 06’ 21” N Lat, 9° 21’ 35” E Long), overlain by waste material from buildings, underlain by mud. Coll. 1961 and subm. by G. Frhr. v. Ulmenstein, Local Mus., Hameln. Comment: according to construction of build-
ings, the old market settlement’s foundation at Hameln was expected to be of 11th century or even before.

**Hv-170. Wingst, Niedersachsen**  
2800 ± 200  
850 B.C.

Charcoal from 0.75 m depth, from a digging in Wingst (53° 43’ 13” N Lat, 9° 04’ 52” E Long), overlain by rubble and sand. Coll. 1960 and subm. by Günter Möller, Wingst. Comment: charcoal found at a fireplace covered with fragments of pottery. Age determination of the ornamented fragments indicates Stage IV or V (Montelius). According to C¹⁴ dating, fireplace belongs to Stage V (2900 to 2700 B.P.).

**Hv-280. Weeze, Nordrhein-Westfalen**  
1300 ± 50  
A.D. 650

Thick board from 4 to 6 m depth, from a dredging lake, near Weeze (51° 36’ 45” N Lat, 6° 15’ 25” E Long), from old well imbedded in gravels below water level. Coll. 1962 and subm. by F. J. Braun. Comment: well could not be dated archaeologically. Roman period or early Middle Ages was assumed.

**Hv-324. Moers, Nordrhein-Westfalen**  
2970 ± 80  
1020 B.C.

Charcoal from 0.3 to 0.8 m depth, from a settlement pit at the Daubenspeckhof near Moers (51° 27’ 37” N Lat, 6° 36’ 30” E Long), underlain by coarse gravels. Coll. 1962 and subm. by Hermann Hinz, Rheinisches Landesmuseum Xanten. Comment: according to potsherds, age of 500 B.C. (early La Tène period) or 1000 to 500 B.C. (Hallstatt period) assumed.

**Kostedt series, Nordrhein-Westfalen**

Charcoal from 3.5 to 4 m depth, from digging near Minden (52° 13’ 57” N Lat, 8° 50’ 27” E Long), underlain by sandy gravels and overlain by highflood loam. Coll. 1961 and subm. by H. Wortmann.

**Hv-244. Kostedt, 3.5 to 4.0 m depth**  
185 ± 100  
A.D. 1765

Pointed post rammed in Holocene terrace sand.

**Hv-392. Kostedt, 3.5 to 4.0 m depth**  
340 ± 100  
A.D. 1610

Pointed post, ca. 5 m from Hv-244, rammed in Holocene terrace sand. General Comment: considering conditions of layering and working of the posts, age of 1900 to 1700 B.P. expected. Dating of Hv-392 became necessary as result of Hv-244 date.

**Hv-207. Weisser Koog, Nordfriesland**  
750 ± 100  
A.D. 1200

Timber remnant from depth of 70 cm, from floodgate at old dike, in Weisser Koog (54° 42’ 58” N Lat, 8° 51’ 39” E Long), imbedded in marine clay. Coll. 1961 and subm. by Werner Prange, Geol. Landesamt Schleswig-Holstein, Kiel. Comment: according to archival studies, dike built in 16th century.

**Federseemoor series, Baden-Württemberg**

Wood and charcoal from digging of the Federseemoor-region. Coll. 1962
and subm. by K.-H. Göttlich, lecturer on bog science, Sigmaringen. Important settlements in this region were dated.

**Hv-354. Riedschachen, 50 cm depth**  
5160 ± 110 3210 B.C.

Timber from cottage underlain by Carex-peat, overlain by a loam floor (48° 02' 20'' N Lat, 9° 40' 00'' E Long).

**Hv-353. Riedschachen, 90 cm depth**  
5130 ± 100 3180 B.C.

2 m WNW from sample Hv-354, same situation as Hv-354.

**Hv-352. Taubenried, 60 cm depth**  
5110 ± 110 3160 B.C.

Timber underlain by Phragmites-Carex-peat and overlain by coarse detrite gyttja (48° 02' 20'' N Lat, 9° 38' 27'' E Long).

**Hv-355. Dullenried, 70 cm depth**  
4600 ± 100 2650 B.C.

Timber underlain by muddy loam and overlain by loam (48° 03' 07'' N Lat, 9° 37' 02'' E Long).

*General Comment:* contemporaneity of settlements of Taubenried and Riedschachen is proved by pollen analysis (Gottlich, 1963; Groschopf, 1957). However, settlement of Dullenried was assumed to differ in age (Bertsch, 1933; Rheinerth, 1936; Gronbach, 1961). See also Gottlich (1962).

**Hv-305. Glems, Baden-Württemberg**  
1450 ± 80 A.D. 500

Charcoal from 0.10 to 0.60 cm depth from layer of iron slag (some decimeters thick) near Glems (48° 30' 31'' N Lat, 9° 17' 19'' E Long). Coll. 1962 and subm. by Friedrich Weidenbach, Geol. Landesamt Baden-Württemberg, Stuttgart. *Comment:* sample from an old type of iron-ore smelting works rarely found in this region. According to Dept. for Conservation of Hist. Buildings in Stuttgart, iron-ore was smelted in this manner from Celtic times till the Middle Ages. Date is reasonable.

**B. Foreign Samples**

**Hv-356. Olympia, Greece**  
3920 ± 90 1970 B.C.

Conchylia 0 to 2 m depth, from excavation near Olympia (37° 37' N Lat, 21° 35' E Long), imbedded in sandy flood marl. Coll. 1962 and subm. by Julius Büdel, Geogr. Inst. der Univ. Würzburg. *Comment:* sample from 3 m above Adrian pavement of ancient holy area of Olympia. Town was buried by river sediments during early Antiquity. Date between A.D. 600 and 1500 (Büdel, 1963).

**Char-I-Mar series, Afghanistan**

Hv-425. Char-I-Mar, 650 cm depth
Charcoal imbedded in cave gravels.

Hv-426. Char-I-Mar, 100 cm depth
Same layering as Hv-425.

Hv-427. Char-I-Mar, 230 cm
Same layering as Hv-425.

Hv-428. Char-I-Mar, 400 cm
Same layering as Hv-425.

Hv-429. Char-I-Mar, 350 cm
Same layering as Hv-425.

General Comment: age of 12,000 to 17,000 B.P. was expected for sample Hv-425, and age of 1850 to 1950 B.P. for sample Hv-426; approx. 2000 yr for Hv-427, and approx. 7000 yr B.P. for Hv-428 as well as for Hv-429. For the excavations, see Coon (1957) and Dupree (1959).

Quala Shaharak series, Central Afghanistan

Hv-187. Quala Shaharak, 50 to 150 cm
Charcoal imbedded in ancient fortification walls.

Hv-188. Quala Shaharak, 150 to 200 cm
Same layering as Hv-187.

Hv-205. Pol-E-Zak, 200 to 250 cm
Same layering as Hv-187.

Hv-206. Pol-E-Zak, 250 to 350 cm
Same layering as Hv-187.

General Comment: C¹⁴ dating places deposit in early Islamic period. This is reasonable historically.

Hv-190. Cakhansur, SW Afghanistan
Peat-like sheep dung from 3 m depth, in trench at bottom of mound-like elevation, remnant of lower terrace of Seistan Lake area (31° 15' N Lat, 62° 03' E Long). Coll. 1960 and subm. by D. Wirtz, D.G.M., Afghanistan. Comment: on the lower terrace many ruined settlements and buildings destroyed by the Mongols; its formation is supposed older than first millenium B.C.
Hv-167. Cabecudas, Brazil

Charcoal from 2 to 3 m depth, from prehistoric shell heap (sambaqui), near Cabecudas (48° 50’ N Lat, 28° 20’ S Long), imbedded in sandy shell layers. Coll. 1960 and subm. by Hannfried Putzer, B.f.B., Hannover. Comment: sample dates pre-Columbian shellheap culture as well as young Quaternary sea-level changes and tectonical movements along S Brazilian coast (Guerra, 1950; Putzer, 1957).

Lima series, Peru

Woven material from excavated mummy graves. Coll. 1962 by W. D. Loeper; subm. by Immo Wendt, B.f.B., Hannover. Samples date Inca culture.

Hv-350. Chancaay

Woven material from open mummy grave (10° 18’ S Lat, 75° 26’ W Long).

Hv-351. Pachacamac

Woven material from open mummy grave (10° 28’ S Lat, 75° 20’ W Long). Comment: according to character of weaving, age of 1400 to 500 yr B.P. expected for the two samples.

Hv-362. Kaminaljuyu, Guatemala

Charcoal from 4.5 m depth, from archaeological excavation of a Maya earth-pyramid, near Kaminaljuyu (14° 35’ N Lat, 91° 26’ W Long). Coll. 1961 and subm. by H. Putzer. Comment: sample is from the base of old temple pyramid, previously dated as pre-Classic (300 B.C. to A.D. 300). According to Museo Arqueológico de Guatemala, date of building should be 2000 B.C.

III. WATER SAMPLES

Ringelheim series, Niedersachsen

Fixed and free carbonic acid precipitated by Ba(OH)₂ from water of karstic spring near Ringelheim. Coll. 1962 and subm. by Heinrich Fauth, B.f.B., Hannover.

Hv-387. Altwallmoden, water-supply 72.9 ± 0.6% modern plant

Sample from water conduit net (52° 00’ 24” N Lat, 10° 15’ 46” E Long). δC¹³ = −12.2‰; “apparent age recent.”

Hv-388. Baddeckenstedt, water-supply 72.5 ± 0.6% modern plant

Sample from water conduit net (52° 05’ 17” N Lat, 10° 13’ 37” E Long). δC¹³ = −13.4‰; “apparent age recent.” Comment: both water works are supplied by a pure karstic spring.

Hildesheim series, Niedersachsen

Fixed and free carbonic acid from water of karstic spring near Hildesheim. Coll. 1962 and subm. by H. Fauth.
Hv-360. Ortschlump, water work  61.1 ± 0.6% modern
Sample from water conduit (52° 09’ 11” N Lat, 9° 56’ 29” E Long).
δC¹³ = −11.1‰; “apparent age 1100 yr.”

Hv-361. Husum, water work  58.8 ± 0.5% modern
Sample from water conduit net (52° 07’ 31” N Lat, 10° 05’ 50” E Long).
δC¹³ = −10.4‰; “apparent age 1400 yr.” Comment: as is usual in karstic
springs, outflow depends on the amount of precipitation. Therefore, a recent
water was assumed. However, the chloride concentration has been found
independent of the quantity of outflow, implying admixture of fossil ground-
water from saline Malm facies with recent karst water.

Niedersachsen series, Norddeutschland

Fixed and free carbonic acid from water samples, precipitated by
Ba(OH)₂ from some deep and some shallow groundwaters in N Germany. Coll.
and subm. by H. Fauth.

Hv-257. Winningstedt, 32 to 33 m  55.7 ± 0.9% modern
depth
Water from a boring (52° 03’ 00” N Lat, 10° 47’ 24” E Long). δC¹³ =
−11.8‰; “apparent age 1820.”

Hv-260. Isenbüttel, 40 m  44.4 ± 1.6% modern
Water from an artesian well (52° 25’ 42” N Lat, 10° 31’ 31” E Long).
δC¹³ = −14.4‰; “apparent age 3650 yr.”

Hv-383. Rheiderland, 25 to 45 m  47.8 ± 2.4% modern
Sample from 2nd aquifer below surface (53° 09’ 39” N Lat, 7° 27’ 27”
E Long). δC¹³ = −17.4‰; “apparent age 3100 yr.”

Hv-261. Tarmitz, 50 m  46.5 ± 0.7% modern
Sample from artesian well (52° 58’ 50” N Lat, 11° 10’ 54” E Long).
δC¹³ = −11.8‰; “apparent age 3270 yr.”

Hv-258. Twülpstedt, 62 to 70 m  37.6 ± 0.4% modern
Sample from water work (52° 23’ 12” N Lat, 10° 53’ 25” E Long).
δC¹³ = −11.8‰; “apparent age 5000 yr.”

Hv-385. Westhauanderfeen, 80 m  69.8 ± 0.6% modern
Water from a well (63° 08’ 39” N Lat, 7° 32’ 27” E Long). δC¹³ =
+8.5‰; “apparent age recent.”

Hv-262. Artlenburg, 120 m  36.1 ± 0.7% modern
Water from artesian well (53° 20’ 52” N Lat, 10° 27’ 15” E Long).
δC¹³ = −12.2‰; “apparent age 5300 yr.”

Hv-339. Leerheide, 81 to 134 m  43.2 ± 0.5% modern
Water from well in fine silty sands (53° 35’ 57” N Lat, 8° 37’ 15” E
Long). δC¹³ = −9.4‰; “apparent age 4400 yr.”
Hv-338. Buxtehude, 140 to 147 m 28.0 ± 0.5% modern
Water from well in early Pleistocene sand (53° 28’ 13” N Lat, 9° 41’ 42” E Long). δC\textsubscript{13} = -10.3%; "apparent age 7400 yr."

Hv-390. Haverlahwiese, 375 m 35.6 ± 0.5% modern
Sample from well in red sandstone (52° 05’ 51” N Lat, 10° 20’ 01” E Long). δC\textsubscript{13} = -11.2%; “apparent age 5400 yr."

Hv-391. Ohlendorf, 834 m 24.8 ± 1.3% modern
Water from of 7th hanging level of Ohlendorf mine (52° 03’ 30” N Lat, 10° 27’ 33” E Long). δC\textsubscript{13} = -5.4%; “apparent age 8300 yr."

Comment: samples are from mainly undisturbed sources in different aquifers of the Quaternary and young Tertiary in NW Germany. Regarding the presence of relatively high sealevel a considerable movement of the groundwater cannot be expected. Thus waters are assumed to be older with increasing depth. Results confirm that water of N German aquifers is not “connate” (Martini and others, 1963).

A later mixing of the water with old CO\textsubscript{2}, originating from decomposition of organic matter or other causes, can be excluded by the geologic situation. The expected correlation between water hardness and C\textsubscript{13} content, which would have rendered possible a correction of water age by δC\textsubscript{13}, has not been found. Since the results appear geologically reasonable without such correction, and since the geochemical basis of the correction is not clear in this context, we have preferred to state the apparent C\textsubscript{14} ages without adjustment (except for the assumption that “recent” = 70% of the C\textsubscript{14} content of the standard).

References

Date list:

Hannover I Wendt, Schneckloth and Budde, 1962


Mehus A. Geyh and Heinrich Schneekloth

INTRODUCTION

The following list presents dates obtained on a fraction of the total number of measurements made during the years 1962 and 1963 and measurements made previously for which sample data has been recently received. The results which do not appear are withheld pending additional information, or at the request of clients.

Procedures employed in sample pretreatment, preparation of CO₂ and method of counting and age calculation remain unchanged. Except for minor alterations, all information and comments are those of the persons submitting samples.

ACKNOWLEDGMENTS

It is recognized that data obtained at Isotopes, Inc. remain the sole property of our clients. Nevertheless we encourage our clients to submit these descriptions for publication and we wish to acknowledge the cooperation of all personnel mentioned in this list. In addition, we are indebted to Jerry M. Bonicos of Isotopes, Inc. for technical assistance in the laboratory.

I. GEOLOGIC SAMPLES

A. Canada

Baffin Island series, Canada


I-405. Ikpik Bay, 241 ft

Shells from E shore of Ikpik Bay (69° 18′ N Lat, 75° 37′ W Long), 15 mi N of Baird Peninsula, Baffin Island. From sandy bank with vertical range of less than 10 ft at alt 241 ft. Alt is ca. 90 ft below that of local postglacial marine limit.

6060 ± 250
4110 B.C.

I-406. Ikpik Bay, 291 ft

Shells from E shore of Ikpik Bay (69° 10′ N Lat, 76° 28′ W Long), 8 mi NE of Baird Peninsula. From silt at alt 291 ft. Alt is ca. 40 ft below that of local postglacial marine limit.

6725 ± 250
4775 B.C.

I-485. Steensby Inlet, 28 ft

Shells from E coast of Steensby Inlet (70° 9′ N Lat, 71° 35′ W Long), 8 mi S of Rowley River estuary, Baffin Island. From center of mud circle 28 ft above high tide.

4000 ± 180
3050 B.C.
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Location</th>
<th>Date ± Error</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-487</td>
<td>Steensby Inlet, 70 ft</td>
<td>4700 ± 210 b.c.</td>
<td><strong>Shells from E coast of Steensby Inlet (70° 9' N Lat, 71° 35' W Long), from silty sand on marine terrace at alt 70 ft.</strong></td>
</tr>
<tr>
<td>I-486</td>
<td>Steensby Inlet, 180 ft</td>
<td>5750 ± 250 b.c.</td>
<td><strong>Shells from E coast of Steensby Inlet (70° 9' N Lat, 71° 35' W Long), from center of mud circle 180 ft above high tide limit. General Comment (J.D.I.): I-405, I-406, and I-485 to I-487 (this list) are the first dates from late-glacial and postglacial marine beaches and associated features available for NE Foxe Basin. I-486 represents the highest occurrence of marine mollusks in this area where the marine limit is 315 ft above present high tide. This series indicates the rate of uplift of NE Foxe Basin during the late-glacial and postglacial isostatic recovery. Outwash terraces, associated with end moraines in the hinterland, are graded to base levels below the marine limit, and precise levelling should permit correlation of late-glacial marine and land-ice phases (Ives and Andrews, 1963).</strong></td>
</tr>
<tr>
<td>I-842</td>
<td>Wakeham Point, Canada</td>
<td>625 ± 100 A.D. 1325</td>
<td><strong>Partially buried drift wood from smooth beach of bay N of Wakeham Point (74° 50' N Lat, 110° 25' W Long), Melville Island, N.W.T. Canada. Beach well protected from ice and storm-wave action by two peninsulas on which emerged beaches are well-developed and in places disrupted by ice-pushed ridges. Coll. 1962 by W. E. S. Henoch; subm. 1963 by J. D. Ives. Comment (W.E.S.H.): height of 1.6 m represents the maximum possible movement of the land relative to sealevel that could have occurred since deposition of the driftwood. Despite allowance for the actual time of drifting, age and position of the wood corroborate I-840 and I-148 from the Dorset Culture site in McCormick Inlet, indicating that positive movement of the land has been slight through the past 1000 yr or more (Henoch, 1964, in press).</strong></td>
</tr>
<tr>
<td>I-840</td>
<td>McCormick Inlet, Melville Island, Canada</td>
<td>1740 ± 190 A.D. 210</td>
<td><strong>Moss peat from S shore of McCormick Inlet, Melville Island N.W.T., Canada (112° 7' W Lat, 75° 49' N Long), 1.8 m above high tide, from under flagstones in center of a Dorset Culture dwelling. Coll. 1962 and subm. 1963 by W. E. S. Henoch, Geog. Branch, Dept. Mines and Tech. Surveys. Comment (W.E.S.H.): as it is unlikely that a dwelling would be built much closer to high water than 1.8 m, it is assumed that age of the moss affords a good estimate of the positive movement of the land relative to sealevel since moss was buried. Artifacts among the dwellings were indent. as Dorset by W. E. Taylor, Nat. Mus. of Canada. Burned moss, found in the fireplace, was dated I(GSC)-148 as 1150 ± 150 yr old. Sample date I-840, Geol. Survey date I(GSC)-148 and the archeological evidence are consistent and suggest that positive movement of the land, for the last 1½ millennia has been appreciably less than 1.8 m (Henoch, 1964, in press).</strong></td>
</tr>
</tbody>
</table>
I-841. **Ross Point, Melville Island, Canada**

Marine shells coll. on surface of terrace covered with sandy silt, Melville Island, N.W.T., Canada (107° 11' W Lat, 74° 55' N Long), 22 m above high tide. Coll. 1962 and subm. 1963 by W. E. S. Henoch. *Comments* (W.E.S.H.): shells may not have been *in situ* when coll.; thus they cannot be related to a specific sealevel. Age and position implies only that about 7600 yr ago the sealevel stood more than 22 m higher than today (Henoch, 1964, in press).

**9075 ± 275**

**7125 B.C.**

Tingmisut Lake, Melville Island, Canada

Marine shells, *Hiattella Arctica* Linné 71.5 m above high tide, Melville Island, N.W.T., Canada (107° 42' W Lat, 75° 55' N Long), from surface of a broad terrace. Coll. and subm. 1962 by W. E. S. Henoch. *Comment* (W.E.S.H.): shells represent highest recorded evidence of marine submergence on Melville Island. Age of 9075 ± 275 yr is probably minimum. Date is later than that related to southerly withdrawal of northern margin of last inland ice sheet on Victoria Island and does not coincide with general pattern of deglaciation. C14 dates indicate that classical Wisconsin ice margin must have withdrawn from S shore of Viscount Melville Sound prior to 12,400 ± 320. Providing that higher and older mollusks are not found, it can be assumed that island was at least partially submerged beneath an ice cap covering several Queen Elizabeth Islands for some 3000 yr after opening of S shore of Viscount Melville Sound (Henoch, 1964, in press).

**B. Africa**

**Wadi Halfa Area series, Sudan**

Carbonate gastropod shells in Wadi Halfa Township, Sudan.

I-534. **Wadi Halfa I**

Carbonate gastropod shell, *Cleopatra bulimoides*, at foot of Jebel Halfa (21° 55' 40'' N Lat, 30° 20' 25'' E Long), 100 m E of Nile, 2 mi above “Nile oyster bed” (I-531) in surficial silty gravel; alt 134 m above mean sealevel, and 12 m above Nile high water level today. *Comment* (R.W.F.): gastropods are small (10-15 mm long) and numerous. Prepared for dating by cutting off tips of spires for complete cleaning. As empty gastropod shells normally float and mark floods, they date the last big oscillation of Nile (to 12 m above present). Date and level correspond closely with dates measured on oysters M-795 (9450 ± 400) and M-794 (9175 ± 400) from El Hani near Abka (Michigan V), 23 km S of Wadi Halfa; representing a “high Nile” about 11 m above present (Fairbridge, 1962).

I-531. **Wadi Halfa Area 2**

Pelecypod shell, (*Etheria elliptica* (21° 55' 50'' N Lat, 31° 20' 30'' E Long), 1000 mi SE of Nile, at foot of Jebel Halfa, found 9 to 10 m above Nile flood level and, thus, 132 m above mean sealevel, in a gray silty gravel, the
shells in part adhering, in growth position, directly to the Nubian Sandstone. Coll. 1961 and subm. 1962 by R. W. Fairbridge. Comment (R.W.F.): site represents bed of former Nile, where the Etheria (Nile oyster) was covered by water all year round. The silty gravels are younger than the Sebilian and occupy a secondary valley filling when Nile flood level must have been 15 to 18 m above its present level (Fairbridge, 1962).

I-533. Wadi Halfa Area 3  
14,950 ± 300  
13,000 B.C.

Pelecypod shell, Unio wilcocksi (22° 03’ 40” N Lat, 31° 23’ 07” E Long), 300 m E of village of Nag Ikhtiariya, in Dubeira E district (15 km N of Wadi Halfa), 20 m above Nile flood level, and thus 141 m above msl, in Sebilian silt, Associated with Corbicula, Viviparus and artifacts and mammal bone fragments. Coll. 1961 and subm. 1962 by R. W. Fairbridge. Comment (R.W.F.): site is about the middle of the older Sebilian silts (darker and more consolidated than younger parts). Associated cultural material is latest Paleolithic, confirmed by the C14 date. This strong siltation phase (of unweathered calcareous and feldspathic silts) indicates large-scale desiccation in the headwaters of the Nile at Late-Glacial stage of the Wurm. Unio individuals are only about 5 to 8 cm long, less than half the size of their modern equivalents (Fairbridge, 1962).

I-441. Omega Creek series, Alaska  
11,750 ± 250  
9800 B.C.

Wood twigs from placer-mine excavation of Montana Mining Co. in Omega Creek, Eureka Mining District, Tanana A-1 Quadrangle (65° 10’ 7” N Lat, 150° 20’ 3” W Long), Alaska. Imbedded in weathered silty peat having lenses of fine gravel underlain by 3 ft of weathered pebble gravel and overlain by peat, silt and gravel 20 ft thick. Coll. 1956 and subm. 1961 by D. M. Hopkins. Comment (D.M.H.): sample helps establish age and rate of sedimentation of late Pleistocene fill in Eureka mining district. W-896, 4100 ± 200 was coll. 8 ft higher in this sequence (USGS VI, 1961).

Barrow Ridge series, Alaska

Peat from ridge at alt 28 ft between Voth Creek and Village Slough, Barrow (71° 17’ 50” N Lat, 156° 42’ 25” W Long), Alaska. Coll. 1962 by J. Brown, Cold Regions Research and Engineering Lab., Hanover, New Hampshire, and J. B. O’Sullivan, Iowa State Univ., Ames, Iowa.

I-699. Barrow Ridge, 2 ft depth  
1775 ± 120  
A.D. 175

Frozen peat inclusion at depth 2 ft in silty frozen mineral soil of meadow tundra soil profile. Lower boundary in contact with massive ice wedge.

I-700. Barrow Ridge, 5 ft depth  
9550 ± 240  
7600 B.C.

Frozen peat inclusion at depth 5 ft adjacent to thin ice wedge. Represents lower boundary of peat inclusions in auger hole.

I-701. Barrow Ridge, 10 ft depth  
10,525 ± 280  
8575 B.C.

Frozen peat inclusion at depth 10 ft from auger hole 3 ft N of I-700.
General Comment (J.B.): dates in series do not exceed C\textsuperscript{14} dates for similar buried peat within area and at similar elevations. Shallowest sample (I-699) is associated with relatively recent peat accumulations and ice-wedge growth. Oldest sample (I-701) may have been buried by sedimentation or emplacement by thawing of ice-wedge from surface downward to present level, during a period of thicker active layer (Coulter, Hussey and O'Sullivan, 1960; Douglass and Tedrow, 1960; Péwé and Church, 1962).

C. Eastern United States

I-421. Hackensack River Valley, Rockland County, 4000 ± 200 N. Y. No. 2 2050 B.C.
Peat (41° 05' 20'' N Lat, 73° 57' 08'' W Long), about .04 mi W of Rte 303 and 0.21 m S of Rte 59 in Hackensack River Valley, near W Nyack, Rockland County, N. Y. Core sample of peat layer 19 to 20 ft below land surface, overlying lacustrine silt and clay. Coll. and subm. 1958 by N. M. Perlmutter, Ground Water Branch, U. S. Geol. Survey. Comment (N.M.P.): peat overlies deposits of Glacial Lake Hackensack (Perlmutter, 1959).

I-422. Hackensack River Valley, Rockland County, 5625 ± 175 N. Y. No. 1 3675 B.C.
Peat (41° 05' 20'' N Lat, 73° 57' 08'' W Long) about .05 m W of Rte 303 and 0.21 m S of Rte 59 in Hackensack River Valley, near W Nyack, Rockland Co., N. Y. Core sample of peat layer 24 to 25 ft below surface, overlying lacustrine silt and clay. Coll. and subm. N. M. Perlmutter. Comment (N.M.P.): peat lies on deposits of Glacial Lake Hackensack (Perlmutter, 1959).

II. ARCHAEOLOGIC SAMPLES

A. Alaska

Naknek Drainage series, Alaska

Except as indicated in individual sample notations, all samples were coll. by D. E. Dumond during excavation in 1960 and 1961 by the Univ. of Oregon on 1\frac{1}{2} mi long Brooks River in Katmai Nat. Monument, and on the adjacent Naknek River of SW Alaska. All samples were subm. by L. S. Cressman in 1961. All comments by D. E. Dumond.

Archaeologic materials recovered have been divided into eight sequential cultural phases on both typologic and geologic grounds (Dumond, 1962, 1963). At Brooks River, chronological control of excavated material was assisted by the presence of five recognized superimposed deposits of volcanic ash. Of these, the uppermost (Volcanic Ash 1) is of known date, proceeding from the eruption of Mt. Katmai in 1912. All samples dated were from strata covered by this volcanic ash deposit, the only one recognized on the Naknek River. The relationship of cultural phases and volcanic ash deposits is schematically illustrated below. Charred wood associated with all phases except that designated Pavik, which falls entirely within the period of Russian and American contact, was subm. for age determinations.
Brooks River Volcanic Ash Deposits, Ash 1 (A.D. 1921)
Brooks River Bluffs Phase

Brooks River Phase

Naknek River Phases

Bluffs

Camp

Ash 2

Falls

Smelt Creek

Weir

Hilltop

Gravels

Ash 4

Ash 5

Brooks River Bluffs Phase

Sample materials were from two sites located approx. 400 m apart on S bank of Brooks River, Alaska (58° 35’ N Lat, 155° 44’ W Long), from strata below Volcanic Ash 1 and above Volcanic Ash 2. Associated with rubbed slate implements and gravel-tempered pottery generally similar to late prehistoric Eskimo remains from elsewhere in Alaska.

I.209. Brooks River Bluffs Phase, BR3-1 230 ± 80 A.D. 1720

Charred wood from a hearth located stratigraphically ca. midway in Bluffs Phase deposits at Site BR3-1. Coll. 1960. Comment: stratigraphically above Y-932, with age of 450 ± 60 (Yale VII), directly overlying deposit of Volcanic Ash 2 at BR3-1.

Brooks River Camp Phase

Sample materials were from Site BR1-2, located on N bank of Brooks River, Alaska (58° 35’ N Lat, 155° 44’ W Long), from strata below Volcanic Ash 2 and above Volcanic Ash 3. Associated with an artifact assemblage including both chipped and ground stone implements, as well as thick, gravel-tempered pottery, some of which bears paddle-impressed decoration in concentric circles, similar in both paste and decoration to pottery of the Birnirk Phase and others of N Alaska, from as early as ca. A.D. 800 (Penn IV). The two samples should bracket the Camp phase material.

I.524. Brooks River Camp Phase, BR1-2, 300 ± 75 A.D. 1650

Charred wood from campfire remnant at extreme top of Camp Phase deposits at Site BR1-2, directly beneath an unbroken deposit of Volcanic Ash 2. Coll. 1961. Comment: sample appears younger than expected, in view of Brooks River Bluffs Phase determinations obtained on material from above Volcanic Ash 2.
Isotopes, Inc. Radiocarbon Measurements IV

I-525. Brooks River Camp Phase, BR1-2, 680 ± 90 A.D. 1270

Brooks River Falls Phase
Sample materials are from three hearths in Falls Phase deposits at Site BR5-1, on S bank of Brooks River, Alaska (58° 35' N Lat, 155° 44' W Long). Associated with an artifact assemblage including thick, barrel-shaped pottery with hair and vegetal temper, some of which is impressed on the exterior with a large diamond pattern, and implements of rubbed slate and flaked chalcedony and igneous rock, including series of small projectile points, some of which display pronounced barbs. These implements were previously separated into two phases (Dumond, 1962), but recent field work indicates they should be combined into a single cultural phase.

I-519. Brooks River Falls Phase, BR5-1, 1200 ± 170 A.D. 750
Hearth C
Charred wood from hearth at base of Falls Phase deposits at Site BR5-1, and located between ash deposits 3 and 4. Coll. 1961.

I-520. Brooks River Falls Phase, BR5-1, 975 ± 120 A.D. 975
Hearth A
Charred wood from hearth stratigraphically above Hearths B and C at BR5-1, and located above Volcanic Ash 3 but below Volcanic Ash 2, Coll. 1961.

I-522. Brooks River Falls Phase, BR5-1, 1175 ± 125 A.D. 775
Hearth B
Charred wood from hearth near base of Falls Phase deposits at Site BR5-1, and located between deposits of Volcanic Ash 3 and 4. Coll. 1961.

Brooks River Weir Phase
Sample materials were from campsites from which were recovered implements predominantly of flaked dense igneous rock (notably a distinctive series of side blades), together with pecked and ground stone vessels, and hair-tempered pottery bearing external impressions both of twined basketry and of a diamond-shape, paddle-impressed pattern. Implements of this phase have been separated on typologic grounds from those of the succeeding Brooks River Falls Phase, although recent research has demonstrated that this phase is ancestral to the Falls Phase. In view of C^14 ages applicable to the Falls Phase and to the preceding Smelt Creek Phase (see below), an age spread of 1650 to 1450 for this phase seems acceptable, and is permissible if ages are considered with two standard deviations. Samples were from between Ash Deposits 3 and 4.

I-210. Brooks River Weir Phase, BR7-1 1850 ± 100 A.D. 100
Charred wood from fireplace in a single-occupation campsite, BR7-1, on E shore of Brooks Lake ca. 120 mi from head of Brooks River, Alaska (58° 35' N Lat, 155° 44' W Long). Coll. 1960.
I-526. Brooks River Weir Phase, BR8-2  
1230 ± 150  
A.D. 720

Charred wood from fireplace remains at Site BR8-2 on N bank of Brooks River, Alaska (58° 35' N Lat, 155° 44' W Long), approx. 1200 m from Site BR7-1. Coll. 1961.

Smelt Creek Phase

Archaeologic materials assigned to this phase include a large quantity of check-stamped pottery as well as predominantly flaked stone implements, all generally similar to materials of Norton Culture of Norton Bay, which has age of 2213 ± 110 (Penn IV). Site SC1 is outside area of Brooks River volcanic ash deposits, so that the Brooks River geologic (i.e., volcanic ash) evidence does not pertain. The only characteristic Smelt Creek Phase ceramics at Brooks River are in Site BR9-1.

I-507. Smelt Creek Phase, SC1, Upper  
150 ± 75  
A.D. 1800

Scattered, charred wood from top of Smelt Creek deposit at Site SC1, located at the confluence of Smelt Creek and Naknek River, Alaska (58° 42' N Lat, 156° 42' W Long). Coll. 1961 by W. A. Davis. Comment: sample originally expected to provide a terminal date for Smelt Creek Phase, but was found to have overlain also some materials reminiscent of the Brooks River Camp and later phases, which were intrusive into the Smelt Creek deposit. Accordingly, its recent age is in complete accord with the archaeologic evidence.

I-508. Smelt Creek Phase, SC1, Lower  
1900 ± 150  
A.D. 50

Charred wood from Hearth at top of lowest 1/3 of Smelt Creek Phase deposit at Site SC1, located at the confluence of Smelt Creek and Naknek River, Alaska (58° 42' N Lat, 156° 42' W Long). Coll. 1961 by W. A. Davis.

I-527. Smelt Creek Phase, BR9-1  
850 ± 120  
A.D. 1100

Charred wood from fireplace in Site BR9-1, N bank of Brooks River, Alaska (58° 35' N Lat, 155° 44' W Long). Coll. 1961. Comment: at Site BR9-1 Smelt Creek Phase pottery post-dated the deposit of Volcanic Ash 4, but its relationship to Volcanic Ash 3 was obscure because site had been intruded upon in later aboriginal times and Volcanic Ash 3 dug through. Seems likely that this age should pertain to that intrusion, and not to Smelt Creek Phase occupation.

Brooks River Hilltop Phase

Materials of this phase consist of small basalt adzes with rubbed bits, as well as small flaked bifacies of both chalcedony and igneous rocks, reminiscent in form of those of the Arctic Small Tool tradition (Irving, 1962), and have been recovered from three adjacent sites on S bank of Brooks River, in strata between Volcanic Ash 4 and Volcanic Ash 5.

I-517. Brooks River Hilltop Phase, BR5-1  
3125 ± 200  
1175 B.C.

Charred wood from an isolated hearth, Site BR5-1, on S bank of Brooks River.
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**Brooks River Gravels Phase**

Materials of this phase include small scrapers and small bifacially flaked end or sideblades of chalcedony, all reminiscent of implements of the Arctic Small Tool tradition from elsewhere in Alaska (Irving, 1962). Of these, the Denbigh Flint Complex, of Norton Bay, has been found to underlie materials dated at 4040 ± 280 (Penn IV). Gravels Phase implements from Site BR5-1, including sample reported below, appeared between deposits of Volcanic Ash 4 and Volcanic Ash 5. Age of another component of Gravels Phase, underlying Volcanic Ash 5 at nearby BR3-1 site, has been measured at 3972 ± 440 (Yale VII). A sample of peat adjacent to a deposit of Volcanic Ash 5 from a bog along Brooks River is dated at 3860 ± 90 (Yale VII). Age for Gravels Phase materials at Site BR5-1 is consequently somewhat less than expected, and reported age seems closer than desirable to that for the succeeding Brooks River Hilltop Phase. This is further discussed elsewhere (Dumond, 1963).

**I-518. Brooks River Gravels Phase, BR5-1**

| 3250 ± 200 |
| 1300 B.C. |


**Miscellaneous Determinations, Naknek Drainage and Vicinity**

**I-521. Brooks River unassigned assemblage**

| 1225 ± 130 |
| A.D. 725 |

Charred wood from remains of campfire, Site BR5-1, S bank of Brooks River, Alaska (58° 35' N Lat, 155° 44' W Long), apparently between Volcanic Ash 3 and Volcanic Ash 4, and believed at time of excavation to be associated with a few implements of flaked stone, and with fragments of pottery bearing linear-stamped exterior decoration, apparently similar both in decoration and paste to ceramics from farther N assigned to Norton Culture, Coll. 1961. **Comment:** age much less than expected. In view of closeness of age to that of samples assigned to Brooks River Falls Phase, it is possible that charcoal from which this determination was made was also of Falls Phase deposition, and that inferred association with linear-stamped potsherds was erroneous. No similar pottery has been recovered elsewhere in Naknek drainage.

**I-505. Kukak Bay, Katmai National Monument**

| 775 ± 95 |
| A.D. 1175 |

Charred wood, Kukak Bay site, Shelikof Strait coast of Katmai National Monument, Alaska (58° 19' N Lat, 154° 10' W Long), believed to date earliest level in which pottery was recovered. Coll. 1953 by W. A. Davis (Davis, 1960). **Comment:** sample associated with materials markedly similar to those of Brooks River Camp Phase. Provides a date for occurrence of pottery in Pacific Eskimo area, and as expected is in agreement with I-525.
I-678. Heins Creek site, Wisconsin  

1230 ± 150  
A.D. 720

Burned food adhering to interior of sherds from Heins Creek site (45° 1’ N Lat, 87° 9’ W Long), on coast of Lake Michigan, 41/4 mi S of Baileys Harbor, Door County, Wisconsin. Obtained by scraping interior surfaces of sherds found in buried humus zone ca. 1 to 2 ft thick ca. 41/2 ft beneath aeolian sand and 10 ft above level of Lake Michigan. Coll. 1961 and subm. 1962 by R. J. Mason and C. I. Mason, Lawrence College, Appleton, Wisconsin. Comment (R.J.M.): sample from pottery types Heins Creek Cordmarked, Heins Creek Corded Stamped, and Heins Creek Cordwrapped-stick Impressed. Date is considered reliable for early late Woodland Heins Creek Complex and is compatible with C14 dates on typologically comparable assemblages in Illinois, Iowa, and New York.

I-744. Sherman Park mounds, South Dakota  

1575 ± 180  
A.D. 375


I-167. Hell Gap site, Kimble Locations, Wyoming  

10,850 ± 550  
8900 B.C.


I-221. Sister’s Hill Site, Miami  

9650 ± 250  
7700 B.C.

Charcoal from Sister’s Hill Site (44° 16’ N Lat, 106° 46’ W Long), 6 mi SW of Buffalo, Johnson County, from vertical stratigraphic interval not exceeding 3 in. Composite of 3 layers representing intermittent occupation over an unknown period of time. Coll. 1960 by E. Galloway, G. Agogino, V. Haynes; subm. 1961 by V. Haynes and G. Agogino. Comment (G.A.): sample washed and screened in lab. Material smaller than 30 mesh discarded. Remaining rootlets removed by hand. Sample dates average time during which site was occupied by Agate and Hell Gap peoples. Cultural levels on weathering profile believed to correlate with Two Creeks interstadial. Date suggests a compound Paleosol separating the Ucross and Kaycee formations.
I-245. **Hell Gap Site (Frederick Location), Wyoming**

Charcoal from Scotts Bluff occupation level of Hell Gap Site, Frederick Location (42° 24' 30" N Lat, 104° 38' 15" W Long) 12 mi N of Guernsey, Goshen County, Wyoming. Coll. 1960 by V. Haynes and G. Agogino; subm. 1961 by V. Haynes and G. Agogino. Comment (G.A.): sample washed and screened in lab. Material smaller than 30 mesh discarded. Remaining rootlets removed by hand. Sample dates time at which Scotts Bluff and other peoples occupied the site during a period of loess accumulation. A brief halt in loess deposition, either contemporary with or just after occupation, is indicated. Date supports a geologic age estimate of terminal Valders time.

**References**

Date lists:
- Michigan V: Crane and Griffin, 1960
- Penn IV: Ralph and Ackerman, 1961
- USGS VI: Rubin and Berthold, 1961
- Yale VII: Stuiver and Deevey, 1962


——— 1963, Two early phases from the Naknek drainage: Arctic Anthropol., v. 1, no. 2, p. 93-104.


Ralph, E. K., and Ackerman, R. E., 1961, Univ. of Pennsylvania radiocarbon dates IV: Radiocarbon, v. 3, p. 4-14.


TRONDHEIM
NATURAL RADIOCARBON MEASUREMENTS IV

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INTRODUCTION

This date list covers mainly the datings done in 1962 and 1963 and is therefore a continuation of our last date list (Trondheim III).

Counter design—The major number of the samples were measured in a counter with a background of 3.50 counts/min and a recent standard net count of 14.20 counts/min. Some of the samples were measured in the small counter described earlier (Nydal, 1962). This counter has, however, been used mainly in experiments during the past few years.

Pretreatment and purification—In pretreatment of samples and purification of CO₂, we have mainly followed our previous procedure (Trondheim III).

Calculation—All dates are calculated in both B.P. and A.D., B.C. scale. In the B.P. scale all dates are calculated from the year 1950, taken as “present”. The C¹⁴ half-life used is 5568 yr; its standard deviation ± 30 yr is not included in the standard deviation (1σ) of the dating results. The NBS recent standard is 95% of the C¹⁴ activity in the oxalic acid, and has been applied since 1960.

Most of the samples are measured for isotopic fractionation, and a correction in the age is applied for deviations more than 1‰ from the observed mean value in a large number of measurements. The limit of error in the fractionation analysis is ca. ± 1‰, and there are possibilities for a maximum error of 30 yr in the age of the samples.

ACKNOWLEDGMENTS

Sample descriptions have been prepared in collaboration with collectors and submitters of the samples. C¹³/C¹² ratios are measured by R. Ryhage, Karolinska Institutet, Stockholm. Most of the samples were selected by a committee consisting of Olaf Holtedahl, Department of Geology, University of Oslo, Knut Faegri, Botanic Museum, University of Bergen, and Sverre Marstrander, Videnskapselskapets Oldsaksamling, Trondheim. Special thanks are due to Dr. S. Westin, head of the Physics Department, to Mr. Fred Harald Skogseth for valuable assistance in laboratory work, and to Norges Almenvitenskapelige Forskningsråd for financial support.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES, NORWAY

A. Driftwood, Northern Norway

T-351. Kvalnesberget II, Nordland 3070 ± 100

1120 B.C.

Driftwood (Pinus, id. by E. Mork) from Kvalnes, Dverberg, Nordland
Reidar Nydal, Knut Lövseth, Karl E. Skullerud, and Marianne Holm

(69° 09’ N Lat, 16° 02’ E Long), Norway. From sand below peat layer 1 m thick, alt 4.7 m. Coll. 1961 and subm. 1962 by M. Marthinussen, Univ. of Oslo (collector and submitter of 1st nine samples).

St-926. Dverberg Church I, Nordland 2780 ± 65 830 B.C.

Driftwood log (Larix, id. by E. Mork) from 4.0 m above sealevel at Dverberg Church, Andøy, Nordland (69° 07’ N Lat, 15° 57’ E Long), Norway. Underlain by beach sand and covered by ca. 1 m of peat. Comment: dated at Radioactive Dating Lab., Stockholm.

T-385. Saura II, Nordland 2710 ± 90 760 B.C.

Driftwood log (Larix, id. by E. Mork) from surface of sand beneath peat layer 1 m thick, alt 3.7 m in Saura, Andøy, Nordland (69° 07’ N Lat, 16° 03’ E Long), Norway.

T-350. Saura I, Nordland 2200 ± 100 250 B.C.

Driftwood log (Larix, id. by E. Mork) from former seafloor surface beneath peat layer 0.5 to 1.0 m thick, alt 2.7 m, Saura, Dverberg, Andøy, Nordland (69° 08’ N Lat, 15° 59’ E Long), Norway. Comment (M.M.): driftwood logs are found fairly close to Ramså, where investigations on shoreline displacements have recently been carried out (Marthinussen, 1962, inter al., Pl. 2). Datings were made in order to get approx. information of comparatively late movements of shoreline in area. Ages seem to agree, and they also add to the picture of the shore movements. Dates T-350 and T-351 have been marked out in op. cit., Pl. 2.

B. Marine transgression, Northern Norway

Ramsåprofile I series, Nordland

Peat samples from deposits of Ramsåprofile I, Ramså, Andøy, Nordland (69° 10’ N Lat, 16° 05’ E Long), Norway.

T-271 B. Ramså I, ca. 8.55 m below surface of deposit 10,950 ± 130 9000 B.C.

Sample, at alt 0.75 m, from same peat layer as T-271 (Trondheim III, p. 165; Marthinussen, 1962, p. 42-43 and 48-49). Comment (M.M.): T-271 B was dated to verify dating result of T-271, and results are in fairly good agreement (see also T-382, Ramsåprofile Ia this paper). Dates indicate possibility of shore-level lower than present one at Ramså in early Younger Dryas time (cp. op. cit.).

T-381. Ramså I, ca. 8.45 m below surface of 9890 ± 240
in same subsection of profile (Trondheim III, p. 165). An underlying sub-
section that includes peat of T-271 and T-271 B at the top, is different from
T-381 and T-294 in that it lacks gyttja and is gravelly. Dates T-271, T-271 B,
T-381 and T-294 indicate that transition layer between sub-divisions may also
separate deposits of quite different (early Younger Dryas and Preboreal ?) ages.

T-380. Ramså I, ca. 8.70 m below surface of deposit 9660 ± 210

    7710 b.c.

Scattered straws, probably remnants of vascular plants, from a slope on
gravel (see Trondheim III, p. 165), at alt ca. 0.6 m (below peat layer of
T-271 and T-271 B). Material may be primary and actually overlain at first
by gravel and then by peat of T-271 (T-271 B), or it may be secondary, e.g.
representing younger root filaments penetrating the gravel. Comment (M.M.):
if stratigraphy is interpreted correctly, the date of T-380 is not in harmony
with that of T-271 and T-271 B. The possibility of a secondary deposit (by
river) may also be considered.

Ramsåprofile Ia series, Nordland

Sections of this profile and Ramsåprofile I are situated at bank of the
rivulet Gårdselva ca. 15 m apart, and circumstances are virtually identical.

T-382. Ramså Ia, ca. 0.9 m above sealevel 10,940 ± 240

    8990 b.c.

Peat from uppermost part of subsection which (in spite of slight height
difference) is assumed to be identical with that of Ramsåprofile I, ranging
downwards from 0.8 m above sealevel (Trondheim III, p. 165). Samples above
as well as below this have also been coll. Comment (M.M.): more dates are
needed for closer interpretation of profile. Subsection and date (T-382) of
profile correspond fairly well with stratigraphic unit and dates (T-271 and
T-271 B) of Ramsåprofile I.

T-353. Ramså Ia, ca. 3.25 m above sealevel 3470 ± 100

    1520 b.c.

Shells of Cyprina islandica from gravel layer in a sand body formerly
thought to represent a part of Ramsåprofile Ia section. Presumption evidently
not correct, since incision cut in sand-gravel masses was not sufficiently deep
(horizontally) to reach deposited layers of profile. Comment (M.M.): the date
shows that the shell-bearing gravel and the inclosing sand are younger than
Ramsåprofile Ia (and I). An emergence and possibly also a subsequent slight
erection, were evidently valid during the date of the two deposits. Dat
Trondheim Natural Radiocarbon Measurements IV

T-272. Ramså IIIa, ca. 3.90 m below surface of deposit

Gyttja (peat) and plant remnants from layer 3 cm thick, underlain by fragments of rocks in Ramså, Andøy, Nordland (69° 10' N Lat, 16° 05' E Long), Norway. Coll. 1958 by S. Manum; subm. 1960 by M. Marthinussen. Comment (M.M.): stratigraphy here as in Ramså profile II seems to reveal one transgression. Age of T-272 was expected to be greater than one which corresponds with transgression time concerned. This has been verified by age of T-272 and by age of T-296 (6100 ± 150 yr B.P.) from Ramså profile II (Trondheim III). When sample (T-272) was submitted for dating, no profiles but Ramså profile I, apart from present one, were known, and no dates of samples from Ramså had been finished.

C. Sandstrand shells and whale bones, Northern Norway

Samples from Sandstrand, Skånland, Troms (68° 40' N Lat, 16° 45' E Long), Norway; in clay, underlain by blue clay at base of slope in clay pit near the lake Sandvatnet. Uppermost parts of clay body reach alt of ca. 80 m. Coll. and subm. 1962 by M. Marthinussen.

T-378 B. Sandstrand, whale bones (protein fraction)

Alt 72.8 to 73.3 m.

T-379. Sandstrand, Mya truncata

Alt 73.5 m.

Comment (M.M.): previous datings (Marthinussen, 1962, p. 46-47 and Trondheim III, p. 167) have shown that shore-level in Sandstrand area at times during the Allerød and probably also during Older Dryas reached at least alt 74 to 75 m. Clay formation, however, indicates somewhat higher shore-line, ca. 80 m. The two dates, which coincide as expected, were done to establish the approx. age of clay as well as of contemporaneous maximum sealevel. Result points to Allerød. Underlying blue clay may be of greater age; see T-269 (Marthinussen 1962, p. 46 and Trondheim III, p. 167).

D. Postglacial marine deposits, Southern Norway

T-390. Bjugnholmen, Sör-Trøndelag

Shells of Saxicava arctica from Bjugnholmen, Örlandet, Sör-Trøndelag (63° 45' N Lat, 09° 34' E Long), Norway, from lowest 10 cm of deposit at NW side of islet, at shore. Coll. 1937 and subm. 1962 by Isak Undås, Bergen. Comment (I.U.): deposit contains fossils from all late-glacial and postglacial times since deglaciation, and 40 samples were taken, at 10-cm intervals. Dated sample is No. 1 at base of sequence. Date is minimum for deglaciation, probably antedating Örland-moraine or late in Ra-period (Undås, 1963, p. 39).

T-228 A. Florida, Bergen

Shells of Pecten islandicus and Mya truncata from the site of Univ. of
Bergen, Florida, Bergen (60° 25' N Lat, 05° 20' E Long), Norway; found in till. Coll. 1946 by Miss A. Monsen; subm. 1960 by Hans Holtedahl, Univ. of Bergen. Comment (H.H.): shells are Allerød and till is supposedly of Younger Dryas age.

**T-302. Instevik, Sogn**

Shells, *Mya truncata*, *Saxicava arctica*, *Pecten islandicus*, from Instevik, Kyrkjebø, Sogn og Fjordane (61° 7' N Lat, 6° 0' E Long), Norway. Found next to glaciomarine sand and gravel, alt ca. 20 m, at mouth of small side valley of Sogne Fiord. Coll. 1950 and subm. 1961 by A. Carlsson, Solna, Sweden. Comment (A.C.): from the main fiord no terminal moraines or ice-front deltas are known; in tributary valleys two moraines occur. In an equally distant shoreline diagram the heights of glacial delta surfaces meet a nearly straight line with inclination of 0.90 m/km. Marine limit level from the Tapes period can be followed on a line, the inclination being 0.26 m/km. The line first mentioned would then correspond closely to the h-line in the epirogenetic system of shore lines constructed by V. Tanner (1930). Thus, of the systems in which the present author classifies the frontal formations in the Sogne Fiord district, the oldest ought to be simultaneous with the Ra-moraines in the Oslo Fiord. This is verified by the C14 date (Carlsson, 1950, 1960).

**T-370. Tveitavatn, Hordaland**

Diatom mud from bog bordering the lake Tveitavatn on Stord, Hordaland (59° 46' N Lat, 05° 29' E Long), Norway. Coll. by Hiller borer from 3.30 to 3.40 m below surface of bog formed at SW edge of lake, just behind *Cladium mariscus* community. Except for sampled layer the series (5.7 m) consists of coarse detritus gel-mud. Coll. and subm. 1962 by Ulf Hafsten, Univ. of Bergen. Comment (U.H.): small amounts, less than 6%, of *Cladium* pollen can be traced down to 5 m depth, to middle of Zone V or Boreal period, but at sampled layer the amount increases to more than 20% and in the next 0.5 m reaches its postglacial maximum. Rational limit for lime curve lies 0.1 m below sampled layer and start of cultivation pollen curve takes place immediately above this layer. Sampled layer coincides with highest postglacial values for mixed oak-forest (QM).

**E. Botanic samples, Southern Norway**

**T-114. Galdhöpiggen, Opland**

Large specimens of lichen *Umbilicaria rigida* (DR) Frey from summit of Galdhöpiggen, alt 2468 m, Jotunheimen, Oppland (61° 38' N Lat, 08° 18' E Long), Norway. Coll. and subm. 1959 by E. Dahl, Norges Landbrukshøgskole, Vollebekk; dated 1959. Comment (E.D.): lichens are supposed to grow very slowly in the Arctic. The main part of the lichen weight is due to cell-wall substances; if these are metabolically inactive, as in higher plants, a minimum date might be obtained. Young age obtained suggests that lichen either is younger than supposed, or that cell-wall substances are in metabolically active state.
T-362. Kópsvatn, South Iceland

Shells of *Saxicava arctica* from glaciomarine silt from E bank of the river Hvítá at Kópsvatn, alt 62 m, district Hrunamannahreppur (64° 10' N Lat, 20° 20' W Long), South Iceland. Shells (with *Balanus* sp.) are from base of part of glaciomarine silt overlain by alluvium and loess. Coll. 1941 by Gudmundur Kjartansson; subm. 1962 by Thorleifur Einarsson, Univ. Research Inst., Reykjavik. See comment for T-362 (Kjartansson, 1939).

T-362. Brúará, South Iceland

Shell fragments of *Zirphaea crispa*, *Mytilus edulis*, *Saxicava arctica* var. *rugosa* and *Balanus* sp. from Brúará Bridge, near Spóastadir, South Iceland (64° 08' N Lat, 20° 34' W Long), Iceland, found in situ in glaciomarine silt, alt 55 m, outside of lateglacial Búdi-stage end-moraine belt. Comment (Th.E.): age of highest shorelines (alt 110 to 120 m) has been estimated as Postglacial, i.e. Holocene. Pollen analyses have shown that shore lines were found during Icelandic pollen zone A (Betula-free zone), with upper limit of ca. 9000 B.P. Earlier C¹⁴ dates (W-482, USGS IV, 1958 and W-913, USGS VI, 1961) from peat bed below postglacial Thórsárløva at Tjórsá Bridge gave ages 8065 ± 400 and 8170 ± 300 yr B.P. respectively, which are in agreement with T-362. Age of shell material from Kópsvatn (T-343, 7970 ± 180 yr B.P.), 10 km NE of Brúará Bridge farther inland, seems low.

T-363. Seltjörn, Reykjavik, Iceland

Carex peat from submerged peat in Seltjörn-bay by Reykjavik (64° 09' N Lat, 22° 01' W Long), SW Iceland, from beneath basaltic tephra layer K (3 cm thick) 70 cm below top of submerged peat layer in inlet of bay Seltjörn on outermost part of peninsula Seltjarnarnes near Reykjavik, alt 0 m. The mean difference between high water and low water level in area is ca. 4 m. Coll. and subm. 1962 by Th. Einarsson. Comment (Th.E.): from base of peat deposit come two C¹⁴ dates (9030 ± 280 yr B.P., Y-249, Yale II, 1955, and 8780 ± 150 yr B.P., H-404/370, Einarsson, 1961, p. 41). These studies indicate that high sealevel at Seltjörn was at least 4.5 m lower around 9000 B.P. than today. Tephrochronological studies in S and SW Iceland indicate that tephra layer K was produced by an eruption of the volcano Katla in the glacier Mýrdalsjökull, Middle S Iceland, and that tephra layer K is older than rhyolitic tephra layer H₄ (4030 ± 120 yr B.P., K-140, Tauber, 1961, p. 390), which is older than rhyolitic tephra layer H₃ from Hekla (2720 ± 130 yr B.P., Y-85, Yale II, 1955, and 2820 ± 70 yr B.P., St-813, Stockholm V, 1963). Pollen analyses show that tephra layer K is contemporaneous with a Betula minimum which seems to have occurred in late Atlantic or early Subboreal time, ca. 5500 to 4500 B.P. The C¹⁴ age (T-363) therefore seems low, possibly because of contamination by roots or other sources of younger C¹⁴, but it is also possible that tephra layer K has been misinterpreted (Thórarinsson and others, 1956; Einarsson, 1961).
T-394. Thorisstadir (ruin), East Iceland 770 ± 90 A.D. 1180

Carex peat from Thorisstadir, Hrafnkelsdalur, Jökuldalshreppur, S of the river Jökulsá á Dal (65° 00’ N Lat, 15° 35’ W Long), E Iceland. Coll. at 1 m depth from soil profile at lower contact of thin rhyolitic volcanic tephra layer, alt 370 m. Coll. by S. Thórarinsson; subm. 1962 by Th. Einarsson. Comment (Th.E.): the tephra layer correlated with tephra layer H1, found in bog and soil profiles in S and N Iceland, marks first eruption of Hekla at beginning of 12th century A.D. (after Icelandic Annal in 1104 A.D.). In soil profile from Thorisstadir have also been found sheep bones a few cm below this layer. Settlement (landnám) of Iceland took place in yr A.D. 870 to 930. The C14 date falls close to estimated age.

F. Niger series, Africa

Lacustrine sediments in areas of East Niger now deserts, have been correlated with long humid period early in the Quaternary; an immense Lake Chad covered large part of Niger, from Ténéré desert in SE towards present Lake Chad. Sediments are between ancient dunes of sand and more recent colian sands. Six C14 dates from these sediments, all coll. 1954-62 and subm. by H. Faure, Faculté des Sci. de l’Univ. de Dakar, fall between 9240 ± 130 and 6900 ± 150 yr B.P. End of lacustrine period was probably ca. 700 yr B.P. Beginning of period is fixed. The dates indicate that humid periods in the Sahara do not necessarily correspond to European Ice Ages (Faure and others, 1963).

T-279. Kandel Bouzou (No. 3013) 6900 ± 150 4950 B.C.

Carbonized organic fragments (moss and water plants) from Kandel Bouzou, East Niger (15° 24’ N Lat, 10° 59’ E Long), Africa, found in black sandy mud, alt 385 m, probably a former bog beneath sand with Neolithic pottery. Comment (H.F.): date may indicate the end of a great humid period; it agrees with that of inorganic carbonates (T-361 and T-341).

T-280. Bouloum Gana (No. 3072) 9150 ± 200 7200 B.C.

Diatomite from Bouloum Gana, East Niger (15° 01’ N Lat, 10° 37’ E Long), Africa, from a well, alt 390 m, from sequence of lacustrine sediments.

Agadem series

Diatomites from Agadem (16° 50’ N Lat, 13° 20’ E Long), East Niger, Africa, in lacustrine deposit of clay or mud, locally mixed with limestone containing numerous silicified stems of Phragmites.

T-338 A. Agadem (No. 986) 8580 ± 110 6630 B.C.

Pure diatomite from the principal layer.

T-338 B. Agadem (No. 1020) 9240 ± 130 7290 B.C.

Impure diatomite imbedded in mud from a lower position.
subm. 1959 by Anders Hagen, Univ. Oldsaksamling, Oslo. Comment (Martens and Hagen, 1961): majority of findings are flint artifacts, but some slate is also present. Refinement of tools dates settlement to Middle Neolithic time.

**T-217. Bordalshelleren, Telemark** 2100 ± 100

Charcoal from 35 cm below surface in habitation layer limited above and below by two arrowheads from youngest part of Stone Age, in rock shelter near Bordalsvatn, Vinje, Telemark (59° 50' N Lat, 07° 23' E Long), Norway. Coll. 1959 by E. Christensen; subm. 1959 by A. Hagen. Comment (Martens and Hagen, 1961): archaeological date based on refinement of tools would be early Metal Age, but contamination of younger layers is possible (T-259, Trondheim III, 1962, p. 175).

**T-260. Nordre Fjarefit, Telemark** 6250 ± 150

Charcoal from open settlement Nordre Fjarefit, alt 970 m, at Songa, Vinje, Telemark (59° 55' N Lat, 07° 28' E Long), Norway. Habitation layer is mixture of soil and coal below turf. Sample was gathered over area of ca. 1 m². Coll. 1959 by J. Bleken-Nilssen; subm. 1959 by A. Hagen. Comment (Martens and Hagen, 1961): according to fragments from grinding of flint axes, site dates within Neolithic Period.

**Gyrinosvatn series, Buskerud**

Charcoal from areas of 1 to 2 m² in open Stone Age settlement sites at Gyrinosvatn, A1, Buskerud (60° 50' N Lat, 08° 02' E Long), Norway, alt ca. 1100 m. Habitation deposits are thin layers consisting of mixture of earth, sand, and charcoal not more than 10 cm below turf. Coll. 1959 by T. S. Eikhorn; subm. 1959 by A. Hagen. Comment (Martens and Hagen, 1961): findings indicate settlement of pure hunter culture dated archaeologically well within Mesolithic time. Culture has some connection to Fosna Culture found on shores of N Møre, Norway.

**T-215. Gyrinos III** 8150 ± 200

**T-256. Blånut** 6850 ± 150

**T-257. Skyrvenut** 6550 ± 200

**B. Easter Island**

**Orongo series**


**T-193. Orongo site, Complex A** 530 ± 70 A.D. 1420
T-194. Orongo site, Complex B

470 ± 70
A.D. 1480

References

Date lists:
- Stockholm V: Ostlund and Engstrand, 1963
- Trondheim III: Nydal, 1962
- USGS IV: Rubin and Alexander, 1958
- USGS VI: Rubin and Berthold, 1961
- Yale II: Preston, Person and Deevey, 1955


Kjartansson, Gudmundur, 1939, Stadier i isens tilbagerykning fra det sydvestislandske lavland: Meddelelser fra dansk geol. forening, v. 9, no. 4, p. 447.


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UPPSALA
NATURAL RADIOCARBON MEASUREMENTS IV

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The following list covers most of the samples measured at the Uppsala C¹⁴ laboratory since the last list (Uppsala III) except for all the samples utilized for determining the increase of the C¹⁴/C¹² ratio due to explosion of nuclear devices and the few samples measured with a new proportional counter.

The technique used is the same as previously described by Olsson (1958) and the pretreatment is that which has been used earlier (wood, charcoal, peat, gyttja and other organic sediments are boiled with HCl, 1 to 2%, washed with distilled water, kept in NaOH, 1 to 2%, at +80°C over night, washed with distilled water and finally acidified to pH about 3 before being dried) except for Foraminifera tests, see below.

The reference sample is 95% of the activity of the NBS oxalic-acid standard. Any corrections for apparent water ages are thus not included here, but will be discussed in later papers dealing with the marine samples. Corrections for deviations from the normal C¹³/C¹² ratio (−25.0‰ in the PDB scale) are applied for the unknown samples. Our oxalic acid was measured by Craig (1961) and has a C¹³/C¹² ratio of −18.97‰ and corresponds to the accepted standardized value, −19‰, which should be used for age determinations (Editorial Statement in Radiocarbon, v. 3). Two new combustions of oxalic acid have not shown any significant difference in their C¹³ content relative to the oxalic acid 1 sample measured by Craig.

The value 5570 yr has been used for the half-life of C¹⁴. Results are expressed in years before 1950 (b.p.). Errors include the standard deviations (σ) of the counted particles as well as the error in the δC¹³ values. When the activity is very low, so that 2σ corresponds to a possibility of infinite age, 2σ has been used instead of σ.

Several samples had to be diluted with CO₂ from an old source to bring them to the normal working pressure of 3 atm.

ACKNOWLEDGMENTS

Descriptions of the samples are based on information provided by those responsible for collecting and submitting them. Before the final manuscript was ready, most contributors were kind enough to read the draft and suggest improvements. Sincere thanks are due to them. Special thanks are also due Dr. R. Ryhage and his co-workers for making the C¹³/C¹² determinations; Prof. K. Siegbahn, who has made it possible to do this work at the institute; and Statens Naturvetenskapliga Forskningsråd, which has given the laboratory financial support. The authors are indebted to Fil. kand. P. Källberg for his assistance in programming the IBM 1620 for calculating ages and Fil. mag. Anders Ingemarsson for taking part in the dating during the autumn 1962, and to Miss

* On leave from the Middle East Technical University, Ankara, Turkey.
Birgitta Wallin and Miss Maud Söderman who began taking part in the work in February and April 1963 respectively.

One of us (S.K.) would like to acknowledge a fellowship from the Swedish Agency for International Assistance through the International Seminar for Research and Education in Physics.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Mediterranean Area

Western Mediterranean Sea series

Foraminifera tests from deep-sea cores, Coll. 1948 by Swedish Albatross Expedition (Pettersson); subm. by K. Gösta Eriksson, Kvartärgeologiska Inst., Uppsala Univ., Uppsala, Sweden. All present and previous samples of sediment core No. 210 are described by Eriksson (1964) and samples from the other two sediment cores Nos. 209 and 211 will be described later by Eriksson. The Foraminifera analyses were made by Todd (1958). Comment: samples did not contain enough coarse fraction (>74 m) for separate measurements as suggested by Rubin and Suess (1955) and Ericson and others (1956). An investigation has been initiated in order to determine the most suitable choice of fractions for C14 dating; so far, 2 samples have been investigated after the material was separated into three fractions (>44 m, 4-44 m, and <4 m). Results show that finer fractions may give erroneous results. Another important con-

TABLE 1

Contamination of “infinitely” old material with recent material due to different dispersing media

<table>
<thead>
<tr>
<th>Laboratory No.</th>
<th>Dispersing medium*</th>
<th>Apparent age± years</th>
<th>δC13‰</th>
<th>Net counting rate (contamination) counts/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-287</td>
<td>Dist. H2O</td>
<td>33,800 ± 2400 - 1900</td>
<td>-7.5</td>
<td>0.14 ± 0.03</td>
</tr>
<tr>
<td>U-288</td>
<td>NH4OH 0.1%</td>
<td>32,000 ± 1600 - 1400</td>
<td>-8.2</td>
<td>0.18 ± 0.03</td>
</tr>
<tr>
<td>U-289</td>
<td>Dist. H2O</td>
<td>37,400 ± 3600 - 2500</td>
<td>-7.5</td>
<td>0.09 ± 0.03</td>
</tr>
<tr>
<td>U-290</td>
<td>Boiled dist. H2O</td>
<td>&gt;40,000</td>
<td>-7.7</td>
<td>0.02 ± 0.03</td>
</tr>
<tr>
<td>U-291</td>
<td>NH4OH 0.1%</td>
<td>36,500 ± 3100 - 2300</td>
<td>-7.3</td>
<td>0.10 ± 0.03</td>
</tr>
<tr>
<td>U-292</td>
<td>Dil. HCl (pH = 4.0)</td>
<td>&gt;40,000</td>
<td>-7.5</td>
<td>0.05 ± 0.03</td>
</tr>
</tbody>
</table>

* 1 L medium + 0.5 L wash liquid of same composition.

a) Following filtration this sample was treated with 5 ml of dil. HCl (pH = 4.0) and dried in the oven at 105°C.

b) The apparent ages are the results, within the limits of error, corresponding to the net counting rates, due to contamination. The errors given are the statistical errors. The accepted value of 5570 yr is used for the half-life of C14. The δC13 values give the C13 enrichment relative to the Chicago PDB standard (Craig, 1961). 95% of the net counting rate of the NBS oxalic acid gives 9.31 counts/min in the proportional counter.
consideration is preparation of core material. It has been shown that it is important to use water that is free from CO₂ (Table 1). The investigations are treated in detail by Eriksson and Olsson (1963) and Olsson and Eriksson (1964).

**U-293.** Core 20903, 145 to 155 cm, > 44 µ 14,200 ± 480 12,250 B.C.

Core 20903 (38° 31' N Lat, 03° 50' E Long), depth 145 to 155 cm, depth in sea 2596 m. Level corresponds to marked increase of Globigerina inflata and second increase of Globigerinoides rubra. Comment: fraction >44µ was used; dist. H₂O was dispersing medium. Diluted. δC¹³ = −3.2‰.

**U-294.** Core 20903, 145 to 155 cm, 4-44µ 26,600 ± 830 24,650 B.C.

The same sample as U-293 but fraction 4-44µ was used. δC¹³ = −1.2‰.

**U-295.** Core 20903, 145 to 155 cm, <4µ 17,300 ± 300 15,350 B.C.

The same sample as U-293, but fraction <4µ was used. δC¹³ = 0.0‰.

**U-296.** Core 21107, 428 to 440 cm, >44µ 16,700 ± 1200 14,750 B.C.

Core 21107 (35° 55' N Lat, 02° 20' W Long), depth 428 to 440 cm, depth in sea 1325 m. Dominance of Globigerina pachyderma and Globigerina eggeri and absence of warm-tolerant species. Comment: fraction >44µ was used; boiled dist. H₂O was dispersing medium. Diluted. δC¹³ = +0.1‰.

**U-297.** Core 21107, 428 to 440 cm, 4-44µ 22,300 ± 750 20,350 B.C.

The same as U-296 but fraction 4-44µ was used. Diluted. δC¹³ = −2.3‰.

**U-298.** Core 21107, 428 to 440 cm, <4µ 21,200 ± 430 19,250 B.C.

The same as U-296 but fraction <4µ was used. δC¹³ = 0.0‰.

**U-251.** Core 21007, 390 to 398 cm, >44µ 13,180 ± 300 11,230 B.C.

Core 21007 (37° 26' N Lat, 01° 05' E Long), depth 390 to 398 cm, depth in sea 2782 m. Level is in transition zone between cool-tolerant and warm-tolerant Foraminifera species. Comment: fraction >44µ was used; tap water was dispersing medium. Diluted. δC¹³ = −9.7‰.

**U-252.** Core 21009, 527 to 537 cm, >44µ 17,250 ± 370 15,300 B.C.

Core 21009 (37° 26' N Lat, 01° 05' E Long), depth 527 to 537 cm, depth in sea 2782 m. Dominance of cool-tolerant Foraminifera species. Comment: fraction >44µ was used; dist. H₂O was dispersing medium. Diluted. δC¹³ = −2.8‰.
U-253. Core 21011, 663 to 675 cm, >44µ  22,000 +1000  
20,050 B.C.  
Core 21011 (37° 26' N Lat, 01° 05' E Long), depth 663 to 675 cm, depth in sea 2782 m. Dominance of cool-tolerant Foraminifera species. Highest abundance of *Globigerina pachyderma* in core No. 210. Comment: fraction >44µ was used; dist. H₂O was dispersing medium. Diluted. δC¹³ = −7.1‰.

U-254. Core 21014, 850 to 865 cm, >44µ  30,100 +1200  
28,150 B.C.  
Core 21014 (37° 26' N Lat, 01° 05' E Long), depth 850 to 865 cm, depth in sea 2782 m. Level corresponds to increase of *Globigerina pachyderma*. Comment: fraction >44µ was used; dist. H₂O was dispersing medium. Diluted. δC¹³ = −4.3‰.

U-255. Core 21001, 23 to 29 cm, >44µ  5880 ± 100  
3930 B.C.  
Core 21001 (37° 26' N Lat, 01° 05' E Long), depth 23 to 29 cm, depth in sea 2782 m. Comment: fraction >44µ was used; dist. H₂O was dispersing medium. Diluted. δC¹³ = −2.3‰.

U-300. Core 21105, 262 to 272 cm, >44µ  10,290 ± 290  
8340 B.C.  
Core 21105 (35° 55' N Lat, 02° 20' W Long), depth 262 to 272 cm, depth in sea 1325 m. Dominance, although a decrease, of *Globigerina pachyderma* and *Globigerina eggeri* and increase of *Globigerinoides rubra* and *Globigerina inflata*. Comment: fraction >44µ was used; dist. H₂O was dispersing medium. Diluted. δC¹³ = −2.0‰.

Correction to sample U-142 in Uppsala II:  

U-142. Core 21104, 223 to 227.5 cm  10,800 ± 400  
Core 21104 (35° 55' N Lat, 02° 20' W Long), depth 223 to 227.5 cm, depth in the sea 1325 m. Level corresponds to increase of *Globigerinoides rubra* and decrease of *Globorotalia scitula*. Comment: fraction >4µ was used. δC¹³ = +20.0‰. Comment: U-142 given as previously published, with typographic errors corrected, and with reference to same standards as in Uppsala II. With oxalic acid and PDB as standards age is 10,930 ± 400 B.P. and δC¹³ is −4‰.

B. Africa

U-266. Abidjan CI 60/1 c  950 ± 70  
A.D. 1000  
Salt water lagoon mollusc shells, accumulated by wave action, from Adiopodioume, Abidjan (5° 10' N Lat, 3° 50' W Long), Ivory Coast. Sample from a 50 cm thick layer of shells, 48 m alt. Coll. 1960 and subm. by J. Tricart. Centre de Géog. Appliquée et Inst. de Géog., Univ. de Strasbourg, Strasbourg, France. Comment: inner 17% was used. δC¹³ not measured but assumed to be −5.2‰.
U-265. Abidjan CI 60/1 b

Shell layer surrounding the part used for sample U-266. Comment: layer corresponds to 34% of the shells. $\delta^{13}C = -5.8\%$.

990 ± 70
A.D. 960

U-264. Abidjan CI 60/1 a

Shell layer surrounding the part used for sample U-265. Comment: layer corresponds to 42% of the shells. 7% was removed by washing. $\delta^{13}C = -4.6\%$.

970 ± 110
A.D. 980

C. Asia

Sogho-nor series

Shells coll. by N. Hörner at the lake Sogho-nor (42° N Lat, 101° E Long) and at Camp H82 (40° 34' N Lat, 90° 10' E Long) near the lake Lop-nor, Turkestan. Shells are probably freshwater but of unknown species. Finite ages may be too great, owing to recycling of carbonates, but age of two old samples is probably minimum if there has been atmospheric contamination. Measure-

Fig. 1. Map showing the lake Sogho-nor and its beaches.
ments were undertaken in an effort to contribute some new information to an exceptionally interesting problem, described by Hörner and Chen (1935) and discussed anew by Norin (in preparation). The map (Fig. 1) shows Sogho-nor and its beaches.

**U-281. Sogho-nor 040233 AB**

33,700 +1400
-1200
31,750 B.C.

Shells on surface of uppermost terrace, 15½ m above level of lake on collection day, Locality 4 on the map N of Camp H308. Coll. Febr. 4, 1933 by Hörner; subm. by Erik Norin, Mineralogisk-geologiska Inst., Uppsala Univ., Uppsala, Sweden. Comment: inner 86% was used. δC¹³ = -5.1‰.

**U-280. Sogho-nor 270530 shell**

34,200 +1400
-1200
32,250 B.C.

Shells in ancient gravelly beach 8 m above level of lake on collection day, and in silt accumulated behind the ridge, Locality 1 on the map. Shells probably derived from adjoining terrace sediments. Coll. May 27, 1930 by Hörner; subm. by Norin. Comment: inner 57% was used. δC¹³ = -4.8‰.

**U-286. Lop-nor b 230731**

3100 ± 110
1150 B.C.

Shells from “yardang sediments” (erosional remains of ancient Tarim delta) at Camp H 82 E of ruined town of Lou-lan, Lop-nor. Coll. 1931 by Hörner. Comment: inner 25% was used. Diluted. δC¹³ = -7.6‰.

**U-285. Lop-nor a**

3020 ± 90
1070 B.C.

Shell layer surrounding the part used for U-286. Comment: layer corresponds to 45% of the shells. 30% was removed by washing. δC¹³ = -7.9‰.

**U-283. Avdat I, Israel**

A.D. 1890

Pieces of wood from stone wall at Avdat (30° 45’ N Lat, 34° 45’ E Long), Israel. Wood was supposed to be either recent roots or to belong to construction of wall, which is ca. 2000 yr old. δC¹³ = -11.6‰.

**D. Spitsbergen**

**Vestspitsbergen series**

Peat and shells measured as a continuation of Vestspitsbergen series (Uppsala II and III; Feyling-Hanssen and Olsson, 1959-1960) and also to date pollen-analyzed peat. All altitudes are above mean seal level.

**U-206. Skansbukta 15 M h**

3410 ± 230
1460 B.C.

Humus exaracted by hot NaOH from peat used for sample U-185, Skansbukta 15 M p (78° 31.5’ N Lat, 16° 03’ E Long), Billefjorden, Spitsbergen, dated at 4800 ± 120 B.P. (Uppsala III). Diluted. δC¹³ = -25.4‰.

**U-203. Anservika 334 b**

4500 ± 90
2550 B.C.

*Astarte borealis* from Anservika (78° 28’ N Lat, 16° 23’ E Long) Billefjorden, Spitsbergen, 9.7 m alt (Feyling-Hanssen and Jørstad, 1950, p. 33
and Feyling-Hanssen, 1955, p. 58-65). Coll. 1950 and subm. by Rolf Feyling-Hanssen, Paleontologisk Mus., Oslo, Norway. Comment: inner 53% was used. $\delta^{13}C = +0.1\%$.

**U-204. Anservika 334 a**

$^{14}C$ of 1950 and subm. by Rolf Feyling-Hanssen, Paleontologisk Mus., Oslo, Norway. Comment: inner 53% was used. $\delta^{13}C = +0.1\%$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-204</td>
<td>$4160 \pm 170$</td>
<td>$2210$ B.C.</td>
</tr>
</tbody>
</table>

Shell layer surrounding the part used for U-203. Comment: layer corresponds to 16% of the shells; 31% was removed by washing. Diluted. $\delta^{13}C$ assumed $0\%$.

**U-279. Anservika 334 c**

$^{14}C$ of 1950 and subm. by R. W. Feyling-Hanssen. Comment: inner 25% was used. Sample was also dated in 1961, in fractions corresponding to those of U-203 and U-204 (this date list) but the fractions gave too large a difference in age at that time, and two new samples were selected, fractionated, and dated. The age difference may indicate a strong contamination. 700 years corresponds to 10% contamination with pre-bomb material. $\delta^{13}C = +0.9\%$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-279</td>
<td>$5210 \pm 90$</td>
<td>$3260$ B.C.</td>
</tr>
</tbody>
</table>

Astarte borealis from Anservika (78° 28’ N Lat, 16° 23’ E Long), Billefjorden, Spitsbergen, 9.7 m alt (Feyling-Hanssen and Jørstad, 1950, p. 33 and Feyling-Hanssen, 1955, p. 58-65). Coll. 1950 and subm. by R. W. Feyling-Hanssen. Comment: inner 25% was used. Sample was also dated in 1961, in fractions corresponding to those of U-203 and U-204 (this date list) but the fractions gave too large a difference in age at that time, and two new samples were selected, fractionated, and dated. The age difference may indicate a strong contamination. 700 years corresponds to 10% contamination with pre-bomb material. $\delta^{13}C = +0.9\%$.

**U-278. Anservika 334 b**

$^{14}C$ of 1950 and subm. by R. W. Feyling-Hanssen. Comment: inner 31% was used. $\delta^{13}C = +2.0\%$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-278</td>
<td>$5250 \pm 90$</td>
<td>$3300$ B.C.</td>
</tr>
</tbody>
</table>

Shell layer surrounding the part used for U-279. Comment: layer corresponds to 30% of the shells. $\delta^{13}C = +1.2\%$.

**U-277. Anservika 334 a**

$^{14}C$ of 1950 and subm. by R. W. Feyling-Hanssen. Comment: inner 25% was used. Sample was also dated in 1961, in fractions corresponding to those of U-203 and U-204 (this date list) but the fractions gave too large a difference in age at that time, and two new samples were selected, fractionated, and dated. The age difference may indicate a strong contamination. 700 years corresponds to 10% contamination with pre-bomb material. $\delta^{13}C = +0.9\%$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-277</td>
<td>$5110 \pm 140$</td>
<td>$3160$ B.C.</td>
</tr>
</tbody>
</table>

Shell layer surrounding the part used for U-278. Comment: layer corresponds to 33% of the shells; 12% was removed by washing. $\delta^{13}C = +1.9\%$.

**U-424. Teltfjellbekken 357 c**

Astarte borealis, Arctica (= Cyprina) islandica, Saxicava arctica, Macoma calcarea, Littorina littorea from S of Teltfjellbekken (78° 38’ N Lat, 16° 44’ E Long), Brucebyen, Billefjorden, Spitsbergen, 23.0 m alt. Locality described by Feyling-Hanssen (1955, p. 82-86). Coll. 1950 and subm. by R. W. Feyling-Hanssen. Comment: inner 31% was used. $\delta^{13}C = +0.9\%$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-424</td>
<td>$9340 \pm 140$</td>
<td>$7390$ B.C.</td>
</tr>
</tbody>
</table>

Shell layer surrounding the part used for U-423. Comment: layer corresponds to 15% of the shells. Diluted. $\delta^{13}C$ assumed $+2.0\%$.

**U-423. Teltfjellbekken 357 b**

$^{14}C$ of 1950 and subm. by R. W. Feyling-Hanssen. Comment: inner 31% was used. $\delta^{13}C = +2.0\%$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-423</td>
<td>$9490 \pm 270$</td>
<td>$7540$ B.C.</td>
</tr>
</tbody>
</table>

Shell layer surrounding the part used for U-424. Comment: layer corresponds to 15% of the shells. Diluted. $\delta^{13}C$ assumed $+2.0\%$.

**U-422. Teltfjellbekken 357 a**

$^{14}C$ of 1950 and subm. by R. W. Feyling-Hanssen. Comment: inner 31% was used. $\delta^{13}C = +2.0\%$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-422</td>
<td>$9140 \pm 190$</td>
<td>$7190$ B.C.</td>
</tr>
</tbody>
</table>

Shell layer surrounding the part used for U-423. Comment: layer corresponds to 18% of the shells. 36% was removed by washing. $\delta^{13}C = +2.3\%$.

**U-261. Hornsund 1**

A.D. 560

Brown basal peat in bog, surface alt 12 m, 55 to 60 cm depth, among moraine boulders, Hornsund (77° 00’ N Lat, 15° 28’ E Long), Spitsbergen. Bog is described by Šrodoń (1960) and the dates are discussed by Blake,
Ingrid U. Olsson and Serap Kilicci

Srodon, and Olsson (in preparation). Coll. 1957 by A. Srodon, Inst. Botaniki, Polska Akad. Nauk, Kraków; subm. by Weston Blake Jr., Geol. Survey of Canada, Ottawa 4, Ontario. Comment: another sample from nearly the same depth in the same bog gave two different ages, both younger, when fractionated (U-202, U-275, this date list). $\delta^{13}C = -23.8\%$.

**U-262. Hornsund 2, p**

A.D. 1330

Light-brown peat from same bog as U-261, 54 to 55 cm depth, Hornsund. Coll. 1957 by A. Srodon; subm. by W. Blake Jr. Comment: humus fraction (U-275, this date list) was dated at 260 ± 110 B.P. $\delta^{13}C = -24.9\%$.

**U-275. Hornsund 2, h**

A.D. 1690

Humus extracted from the peat used for sample U-262, Hornsund. Diluted. $\delta^{13}C = -27.4\%$.

**U-210. Russekeila I, 55, p**

2830 B.C.

Peat from same bog as U-212, Russekeila (78° 05' N Lat, 13° 47' E Long), Isfjord, Spitsbergen, 9.5 m above high tide level on a raised beach sloping from 12.5 to 7.5 m alt. 55 cm below surface, showing no frost cracks. Bog is pollen-analyzed by E. Norling. Coll. 1960 and subm. by E. Norling, Kvartärgeologiska Inst., Uppsala Univ., Uppsala. $\delta^{13}C = -28.3\%$.

**U-211. Russekeila I, 55, h**

3530 B.C.

Humus extracted from the peat used for U-210, Russekeila, Isfjord, Spitsbergen. $\delta^{13}C = -26.0\%$.

**U-212. Russekeila II, 55, p**

A.D. 860

1090 ± 80

Amblystegium peat from ca. 15 cm depth in same peat bog as U-210, Russekeila. Coll. 1960 and subm. by E. Norling. $\delta^{13}C = -29.6\%$.

**U-205. Talavera O, h**

A.D. 1080

3030 ± 290

1080 B.C.

Humus extracted with hot NaOH from the peat used for sample. U-186, Talavera O, p (78° 15' N Lat, 20° 50' E Long), Barentsøya, Spitsbergen, dated at 6000 ± 400 B.P. (Uppsala III). Diluted. $\delta^{13}C = -22.0\%$.

**Nordaustlandet series**

Shells, peat, and humus collected to confirm previously obtained results on land uplift (e.g. Olsson and Blake, 1961-1962), to get a measure of accumulation rate of sediments, and to date pollen-analyzed peat.

**U-227. Trippvatnet H/1**

A.D. 1830

4880 ± 120

2930 B.C.

Limnic peat and algal mud from 59 to 68 cm above bottom of pollen-analyzed sediment core, Trippvatnet (80° 01' N Lat, 18° 47' E Long), Nordaustlandet, Spitsbergen. 5.2 m alt. Below sediment core was clay with pieces of schist. Described by Häggblom (1963). Coll. 1958 and subm. by Anders Häggblom, Geog. Inst., Stockholms Univ., Stockholm, Sweden. Comment: a sample from the same sediment and corresponding level was dated at
5290 ± 400, U-93, corrected to oxalic acid (published as 5160 ± 400, Uppsala II). Diluted. \( \delta^{13}C = -26.3\% \).

**U-228. Krystallvatnet H/28-58**

4940 ± 100

2990 B.C.

Limnic peat (Fontinalis type) from 98.5 to 104.5 cm above bottom of pollen-analyzed sediment core with total length of 130 cm, Krystallvatnet (79° 58' N Lat, 18° 40' E Long), Nordaustlandet, Spitsbergen, 62 m alt. Below bottom of core was firm clay. Described by Häggblom (1963). Coll. 1958 and subm. by A. Häggblom. **Comment:** a sample from same sediment, but coll. 10 cm above bottom of core, was dated at 10,030 ± 550, U-92, corrected to oxalic acid (published as 9900 ± 550, Uppsala II). \( \delta^{13}C = -27.3\% \).

**U-263. Lady Franklinfjorden 48**

13,470 +530

11,520 B.C.

Shells and calcareous algae (*Lithothamnion*, *Balanus*, and probably *Hiatella* and *Mya*) from 2 collecting points in till at Lady Franklinfjorden (80° 12' N Lat, 18° 42' E Long), Nordaustlandet, Spitsbergen, 1.5 to 2 m alt. Shells are part of matrix of till, and thus give a limiting date for the time of glacier advance. Beach gravel overlies the till, and in one place peat dated at 3960 ± 100 b.p., U-276, occurs between the till and the beach gravel. Coll. 1958 by R. Bergrström and W. Blake, Jr., and subm. by W. Blake, Jr. Pollen-analyzed by E. Norling (in preparation). **Comment:** only ca. 8 g was subm., too little to allow thorough pretreatment, and condition of shells was very poor, so result should be regarded as minimum age. Outer 22% was removed by washing. Diluted. \( \delta^{13}C = -2.6\% \).

**U-276. Lady Franklinfjorden 49**

3960 ± 100

2010 B.C.

Plant remains mixed with till (?) or mud above main till at Lady Franklinfjorden (80° 12' N Lat, 18° 42' E Long), Nordaustlandet, Spitsbergen, 2 m alt. Shells in underlying till dated at >13,000 b.p., U-263. Coll. 1958 and subm. by W. Blake, Jr. \( \delta^{13}C = -23.1\% \).

**General Comments:** the results obtained from Spitsbergen confirm previous results in showing that land uplift for the last 8000 yr has been very slow.

As shown earlier, great care must be taken in pretreatment of samples. It is not sufficient to wash shells so that e.g. 10 to 20% of the shells are removed; samples must be carefully selected from bulk material and treated individually.

Large age discrepancies between peat and humus fractions of sediments in frozen ground (Olson and Broecker, 1958) have also been observed in 4 samples presented here. The reasons are still obscure, but one may be that cryoturbation causes vertical movement of soil and stones. Water-borne humus may be carried to various depths in such an environment. Wind-borne material may also easily contaminate the samples.

**E. Åland**

**Åland series**

Gyttja from Åland, Finland, pollen-analyzed to date immigration of spruce (*Picea*) and cultivation of rye (*Secale*) on the main island. Coll., subm.,

**U-231. Söderängsmossen 175 to 180**

1740 ± 120

A.D. 210

Gyttja from the bog Söderängsmossen (60° 18' N Lat, 20° 7' E Long), Saltvik parish, Åland, Finland. Sample from the marked increase of **Picea**, at beginning of Pollen Zone IX (Jessen), 175 to 180 cm below the reference level. Coll. 1961. \( \delta^{13}C = -26.0\%\).

**U-232. Söderängsmossen 172.5 to 175 and 180 to 182.5**

2050 ± 120

100 b.c.

Gyttja above and below sample U-231, from 172.5 to 175 cm and 180 to 182.5 cm level, measured to check the unexpectedly low date of U-231. \( \delta^{13}C = -34.5\%\).

**U-233. Dalkarbyträsk 575 to 580**

2530 ± 90

580 b.c.

Gyttja from Dalkarbyträsk (60° 09' N Lat, 19° 57' E Long), Jomala parish, Åland, Finland. Sample from the marked increase of **Picea**, at beginning of Pollen Zone IX (Jessen), 575 to 580 cm below (frozen) lake surface. Coll. 1962. \( \delta^{13}C = -28.2\%\).

**U-234. Dalkarbyträsk 540 to 546**

1610 ± 90

A.D. 340

Gyttja from Dalkarbyträsk (60° 09' N Lat, 19° 57' E Long), Jomala parish, Åland, Finland. Sample from a level indicating beginning of cultivation of rye, Pollen Zone IX (Jessen), 540 to 546 cm below (frozen) lake surface. Coll. 1962. \( \delta^{13}C = -29.1\%\).

**U-235. Kvarnboträsk 174 to 180**

2080 ± 90

130 b.c.

Gyttja from Kvarnboträsk (60° 17' N Lat, 20° 04' E Long), Saltvik parish, Åland, Finland, from the marked increase of **Picea**, at beginning of Pollen Zone IX (Jessen), 174 to 180 cm below sediment surface. Coll. 1962. \( \delta^{13}C = -30.7\%\).

**F. Sweden**

**U-445. Submarine peat, Laholm bay**

10,060 ± 140

8110 B.C.

Dark brown submarine peat, well humified and containing macrofossils of **Betula, Equisetum, Phragmites** and **Carex**, from bay outside Laholm (56° 31' N Lat, 12° 48' E Long), Halland, Sweden; water depth ca. 16 m. Pollen analysis (Magnus Fries) implies that peat is derived from a fen and belongs to Pollen Zone IV (Jessen). Peat appeared to be in situ when dredged, with no overlying sediment; judging from its altitude, locality should have been above
sealevel at time of date. Recent molluscs were removed before dating. Described by Wärm (1964). Coll. 1963 on the Sunbeam expedition by Mats Wärm and subm. by Mgnus Fries, both Växthiologiska Inst., Uppsala Univ., Uppsala, Sweden. $\delta^{13}C = -28.0\%o$.

**U-428. Levide**

Wood from trunk of *Pinus silvestris* from Hallbåter, Levide (57° 16' N Lat, 18° 15' E Long), Gotland, Sweden, ca. 1500 m S of Ancylus ridge below layer of sand and gravel about 1.9 m deep. Forest was destroyed by a transgression of the Baltic. Coll. 1961 and subm. by Bengt Pettersson, Växthiologiska Inst., Uppsala Univ., Uppsala, Sweden. $\delta^{13}C = -25.1\%o$.

**U-429. Bunn, Bunge**

Charcoal of *Pinus silvestris* from Bunn, Bunge (57° 52' N Lat, 19° E Long), Gotland, Sweden, found with potsherds and mixed with sand. Supposedly from a dwelling-place buried by sand, ca. 2 m thick. Coll. 1957 and subm. by B. Pettersson. $\delta^{13}C = -24.2\%o$.

**U-427. Nyköping boat**

A.D. 855

Pine wood, part of boat, in excavation for basement of Nyköping Town Hall (58° 45' N Lat, 17° 1' E Long), Södermanland, Sweden. Boat imbedded in *Phragmites* peat member of lake deposit, pollen-dated as lower Zone IX, underlain by mud and Baltic sediments. Diatom analysis by Maj-Britt Florin, pollen analysis by Thorolf Candolin; described by Florin and Olsson (1964). Coll. 1959 and subm. by Sten Florin, Kvartärgeologiska Inst., Uppsala Univ., Uppsala, Sweden. $\delta^{13}C = -25.7\%o$.

**Land Uplift series, Eastern Central Sweden**

Sediments from eastern Central Sweden, coll. from ancient lakes developed by isolation from the sea, to determine time and rate of land uplift in this part of Sweden. Described by Maj-Britt Florin (1944) and Sten Florin (1944, 1947, and 1948).

**U-218. Grässjön II**

6370 B.C.

Clay-gyttja from the lake Grässjön (59° 10' N Lat, 14° 31' E Long), Nysund parish, Närke, Sweden; drainage threshold at 121.1 m alt. Sediment from level 200 to 207 cm below surface. Diatom and pollen analysis performed by Maj-Britt Florin (1944) and subsequent analysis performed by G. Piehl-Linnman and T. Candolin. Analyses imply that this sediment was deposited shortly after lake had been isolated from sea in early time of Zone IV (Jessen) before increase of *Corylus*. Coll. 1959 and subm. by Sten Florin. Diluted. $\delta^{13}C = -19.2\%o$.

**U-269. Grässjön I**

5820 B.C.

Gyttja from the lake Grässjön (59° 10' N Lat, 14° 31' E Long), Nysund parish, Närke, Sweden, drainage threshold at 121.1 m alt, from level 190 to 198 cm below surface and taken above sample U-218. Diatom and pollen
analysis performed by Maj-Britt Florin and others (see U-218). Coll. 1959 and subm. by Sten Florin. Comment: this sample more organogenic than sample U-218. Diluted. $\delta^{13}C = -24.4\%$

**Late Pleistocene vegetational series, Eastern Central Sweden**


**U-217. Långa Getsjön III**

Detrital gyttja with fine sand from 415 to 419 cm below surface, Långa Getsjön (58° 42' N Lat, 16° 16' E Long), alt 120 m (MSL). Coll. 1962. Pollen analysis implies Pre-Boreal time, Pollen Zone IV (Jessen). Diluted. $\delta^{13}C = -31.7\%$

**U-426. Långa Getsjön II**

Clay-gyttja from 440 to 445 cm below surface, Långa Getsjön (58° 42' N Lat, 16° 16' E Long). Coll. 1963. Pollen analysis implies Pollen Zone IV (Jessen). Sedimented in fresh water according to diatom analysis. $\delta^{13}C = -21.8\%$

**U-425. Långa Getsjön I**

Clay with one sandy layer from 455 to 465 cm below surface, Långa Getsjön (58° 42' N Lat, 16° 16' E Long). Coll. 1963. Pollen analysis implies late Pollen Zone III or early Pre-Boreal Pollen Zone IV (Jessen). Sedimented in fresh water according to diatom analysis. Comment: this sample and varved glacial clay samples from Lugnvik (U-213, U-214, and U-260, this date list), show that too high ages may be obtained if the clay contains allochtonous material. Diluted. $\delta^{13}C = -26.6\%$

**U-420. Stuggölen I**

Clay and clay-gyttja from 430 to 435 cm below surface, Stuggölen (58° 42.5' N Lat, 16° 22' E Long), alt 95 m. Coll. 1963. According to pollen analysis sample is correlated with Pollen Zone IV (Jessen), and diatoms show influence of the Yoldia Sea. $\delta^{13}C = -17.5\%$

**U-421. Stuggölen II**

Detrital gyttja from 425 to 430 cm below surface, Stuggölen (58° 42.5' N Lat, 16° 22' E Long), immediately overlying U-420. According to pollen and diatom analysis sample is correlated with Pollen Zone IV (Jessen) and sedimentation occurred in fresh water. $\delta^{13}C = -17.9\%$

**U-219. Dragby sedge bog 16**

Sedge dy and gyttja from Dragby (59° 59' N Lat, 17° 35' E Long),
Skuttunge parish, Uppland, Sweden. Bog is in a kettle, drainage level at 28.5 m alt. Sample from upper part of Pollen Zone VIII near boundary of Pollen Zone IX (Jessen), below the increase of *Picea*. Pollen analysis by T. Candolin. Sample near isolation contact according to diatom analysis by M.-B. Florin. Described by M.-B. and S. Florin (1960) and S. Florin (1963). Samples of archaeologic interest from Dragby are given in Uppsala II and III, Stockholm IV and V, and this paper. Coll. 1962 and subm. by S. Florin. $\delta^{13}C = -25.0\%o$.

**Varved glacial clay series, Lugnvik**

Organic material deposited in glacial varves +29 to +82, Borell-Offerberg's (1955) time-scale, at Lugnvik (62° 55' N Lat, 17° 55' E Long). Concentration of organic material was almost as high as 1%. Although organic material could be expected to be mainly allochthonous and thus probably old, pollen analysis (Hörnsten) proved that part of it is contemporaneous with the sediment. Samples were determined partly to give information about origin of deposited material and partly to prove that selection of samples is important. Only authigenic material in sediments may be used for dating. Dates given here by the varve chronology are not exact since there is some uncertainty concerning the extrapolation to present time. Samples are described by Hörnsten and Olsson (1964). Coll. 1962 and subm. by Åke Hörnsten, Kvartärgeologiska Inst., Uppsala Univ., Uppsala. Comment: due to the low carbon content and the high ages a small contamination with modern material may change the result for U-213 and U-214 considerably so that the dates given should be regarded as lower limits. The insoluble (in hot NaOH) fractions are thus supposed to be older than 30,000 yr and 34,000 yr, respectively. A similar sample from Södermanland (U-425) has also been dated.

**U-260. Lugnvik varves, +29 to +55**

Varved clay dated by varved clay chronology at 6894 to 6868 yr B.C. Clay content about 43% ($<2\mu$). $\delta^{13}C = -28.6\%o$.

**U-213. Lugnvik varves, +56 to +82 (a)**

30,000 $+2500$

28,000 B.C.

Varved clay dated by varved clay chronology at 6867 to 6841 yr B.C. Clay content about 38% ($<2\mu$). $\delta^{13}C = -29.4\%o$.

**U-215. Lugnvik varves, +56 to +82 (ah)**

9000 $+1400$

7000 B.C.

Humus extracted with hot NaOH from clay used for U-213. Diluted.

**U-214. Lugnvik varves, +56 to +82 (b)**

34,000 $+2200$

32,000 B.C.

Varved clay from same bulk material as U-213. Coll. 1962.
II. ARCHAEOLOGIC SAMPLES

A. Iran

**U-274. Takht-i-Suleiman**

Muck from Takht-i-Suleiman (36° 37' N Lat, 47° 14' E Long), Azerbaijan, Iran, found in pit with artifacts about 1500 yr old. Coll. 1962 and subm. by Carl Nylander and Lars Gezelius, Inst. för Klassisk Fornkunskap och Antikens Historia, Uppsala Univ., Uppsala, Sweden. \( \delta^{13}C = -19.9\%o \).

**U-267. San Giovenale 62-183 b**

Charcoal from San Giovenale (42° N Lat, 12° E Long), province of Viterbo, Italy, found in fill with sherds dating from 600 to 300 B.C. Coll. 1962 and subm. by C. Nylander. \( \delta^{13}C = -22.9\%o \).

**U-268. San Giovenale 62-159 d**

Charcoal from San Giovenale (42° N Lat, 12° E Long), di Viterbo, Italy, found in fill with sherds dating from 600 to 300 B.C. Coll. 1962 and subm. by C. Nylander. \( \delta^{13}C = -24.7\%o \).

B. Italy

**U-240. Raheennamadra 1 a**

Wood from wooden post supposed to have supported roof of souterrain house. \( \delta^{13}C = -28.5\%o \).

C. Ireland

**Raheennamadra series, Ireland**

Wood and charcoal from a so-called ring-fort from Raheennamadra (52° 3' N Lat, 8° 3' W Long) near church of Knocklong in the Golden Vale, Co. Limerick, Ireland. The late Seán Ó Riordáin suggested collaboration with Swedish archaeologists and his intention was fulfilled in 1960-61 by Michael O'Kelly of Cork and Mårten Stenberger of Uppsala. The ring-fort has total diam of 45 m including surrounding bank with an associated outer fosse. Diam of raised platform within the bank (the site) is 20 m and close to the bank at SW is souterrain house, 8.5 x 2.5 m, of 2 rooms with stone walls, 2 m high. In center of the site are faint traces of something believed to be a hut of wattle-work. Site is described in a preliminary report by Stenberger (1962). Sample coll. 1961 and subm. by Mårten Stenberger, Inst. för Nordisk och Jämförande Fornkunskap, Uppsala Univ., Uppsala, Sweden.

**U-241. Raheennamadra 1 b**

Wood from wooden post supposed to have supported roof of souterrain house. \( \delta^{13}C = -29.5\%o \).
Uppsala Natural Radiocarbon Measurements IV

U-243. Raheennamadra 2 b  
\[ \text{A.D. 690} \quad 1260 \pm 120 \]  
Same piece of wood as U-242 but new pretreatment and combustion.  
\[ \delta^{13}C = -24.9\%o. \]

U-244. Raheennamadra 3 a  
\[ \text{A.D. 620} \quad 1330 \pm 110 \]  
Charcoal from log on hearth built of clay outside and above top of E gable-wall of souterrain.  
\[ \delta^{13}C = -23.6\%o. \]

U-245. Raheennamadra 3 b  
\[ \text{A.D. 650} \quad 1300 \pm 120 \]  
Same charcoal sample as U-244 but new pretreatment and combustion.  
\[ \delta^{13}C = -24.6\%o. \]

U-246. Raheennamadra 4 a  
\[ \text{A.D. 750} \quad 1200 \pm 110 \]  
Charcoal from hearth in E end of souterrain.  
\[ \delta^{13}C = -24.0\%o. \]

U-247. Raheennamadra 4 b  
\[ \text{A.D. 590} \quad 1360 \pm 100 \]  
Same charcoal sample as U-246 but new pretreatment and combustion.  
\[ \delta^{13}C = -26.7\%o. \]

U-248. Raheennamadra 5  
\[ \text{A.D. 110} \quad 1840 \pm 110 \]  
Charcoal from a dark layer, assumed to be a hearth, in a trial trench within what was supposed to be a hut, 114 cm below arbitrary datum.  
\[ \delta^{13}C = -26.7\%o. \]

D. Sweden

Dragby series

Resin and charcoal from Dragby (59° 59’ N Lat, 17° 35’ E Long), Skut-  
tunge parish, Uppland, Sweden. Results of the excavations and geological inves-  
tigations are given by Stenberger (1960, 1961), M.-B. and S. Florin (1960),  
Olsson (1960), Gräsland (1961), Jaanusson and Silvén (1962), Rydh (1962),  
Danell and Sjögren (1962), Florin (1963), and Gejvall (1963). Coll. by  
students and subm. by M. Stenberger. Other samples have been dated  
previously (Uppsala II and III; Stockholm IV and V).

U-201. Dragby 335 B  
\[ \text{2070 \pm 100} \quad 120 \text{ B.C.} \]  
Resin from Grave 335 B. Coll. 1960.  
\[ \delta^{13}C = -29.1\%o. \]

U-403. Dragby 325  
\[ \text{2060 \pm 80} \quad 110 \text{ B.C.} \]  
Resin from Grave 325, attributed to Early Iron Age. Coll. 1963.  
\[ \delta^{13}C = -26.5\%o. \]

U-400. Dragby 359 V  
\[ \text{2340 \pm 170} \quad 390 \text{ B.C.} \]  
Charcoal from Grave 359 V, attributed to Early Iron Age.  
\text{Comment:} \quad \text{diluted. } \delta^{13}C = -29.4\%o. \]
U-404. Dragby UO X, G3

2830 ± 80
380 B.C.

Charcoal from Pit No. 3 above layer of brittle burnt stones, 10 to 15 cm thick, on bottom of pit, one of several pits near Grave field, probably used for cooking. Sampled level consists of black clayey soil and black soil with gravel, both containing charcoal. Coll. 1963 by Per Kåks. \( \delta^{13}C = -23.0\% \).

III. CROSS-CHECK SAMPLES

U-239. Lago di Nemi

2120 ± 80
170 B.C.

Wood from Roman ships at Lake Nemi (41° 43' N Lat, 01° 34' E Long), Italy. Ships are attributed to Emperor Caligula (A.D. 37 to 41). Subm. by C. Cortesi and F. Bella, C²¹⁴ Laboratory, Ist. di Geochim. dell Università Roma, Italy. Comment: for this determination the same gas was used as for U-68 (Uppsala I), published as 1980 ± 70 and \( \delta^{13}C = +0.1\% \). These data, when recalculated to oxalic acid and PDB standards, give 2100 B.P. and -24.1\%, i.e. are indistinguishable from measurements made after 5 years’ storage. For reference to other determinations see U-68 (Uppsala I, p. 100). \( \delta^{13}C = -23.1\% \).

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BERLIN RADIOCARBON MEASUREMENTS I

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The C\textsuperscript{14} Laboratory of the German Academy of Sciences of Berlin (DAW) began to obtain dates in 1961. The focus of research is in archaeology. Samples, coll. in close collaboration with the DAW’s Institut für Vor- und Frühgeschichte, are mainly from the Neolithic of central and southeastern Europe, and contribute to the continuing discussion (Milojčić, 1961; Müller-Beck, 1961) of the chronology of this period.

Our counter is operated in the proportional region, with acetylene as counting gas. Instead of adding SrC\textsubscript{2} to 1 to 2 L of water, as recommended by Suess (1954), we generate C\textsubscript{2}H\textsubscript{2} by dropwise addition of ca. 10 ml of water to the carbide. In this way, a tested supply of a few liters of water serves for several hundred acetylene preparations, reducing the danger of contamination by tritium. The counting chamber, constructed by Kohl after the design of Houtermans and Oeschger (1958), has a sensitive volume of 1.8 L and is filled to a pressure of 700 Torr. It is protected from environmental radiation by 5 cm of mercury and a steel shield 20 to 35 cm thick, and from neutrons by 20 cm of a paraffin-boric acid mixture; the shielding weighs ca. 20 T.

The background is normally 2 counts/min and the modern counting rate 14.5 counts/min. Modern standards are treerings of A.D. 1825 ± 3 from pine (Pinus silvestris) grown near Dresden and of A.D. 1820-1830 from a beech grown north of Copenhagen, kindly provided by Henrik Tauber. Deviations from 0.95 times the NBS oxalic-acid standard, in use since 1963, are negligible, so that no corrections are needed for dates obtained earlier. Following the recommendation of the Cambridge Conference, 1962, all dates are calculated from the 5568-yr half life of C\textsuperscript{14}.

Samples are usually counted for two 48-hr periods, 10 to 20 days apart, giving 10,000-25,000 counts according to age. Standard errors assigned include those of the sample count, the background and modern counts, and the half life.

In preparing samples, all substances are washed first in distilled water and rootlets and other gross contaminants are removed as far as possible. All are then soaked for 24 hr in 5\% HCl to remove contaminating carbonates, and, when contamination by humus is likely, samples are soaked for 24-48 hr in 5\% NaOH.

The majority of samples used for dating were wood or wood-charcoal, a few being grain, seeds, peat, or gytta. Special attention was given to an extensive series of ceramic materials (Kohl, 1961). The strongly organic-tempered pottery of the early Neolithic, especially of the Linienbandkeramik and Körös Cultures, has proved to be datable, as the plant fragments mixed with the clay were only partly oxidized at the low firing temperatures (300 to 400°C) employed. The carbon content is 0.5 to 2\%, so that 1 to 2 kg of pottery is needed for a date. CO\textsubscript{2} is released when the pottery, after standard chemical treatment followed by thorough drying, is sealed in a quartz combustion tube and heated
to 600-900°C in a stream of O₂. Although carbon incorporated in potsherds should be contemporary with the manufacture, the C¹⁴ dates of such samples seem generally to be somewhat younger than those of other organic materials of equivalent age; more paired comparisons are needed to resolve this problem.

Measurements in the following list were made in 1961 and 1962. Dates are expressed as before A.D. 1950. Where the archaeologic data are unpublished, we have quoted descriptions and cultural assignments kindly provided by the excavators or their sponsoring institutions. Botanical determinations are by K.-D. Jäger, of Berlin. Our particular thanks are due to the Forschungsgemeinschaft der Naturwissenschaftlichen Institute der DAW zu Berlin, which has supported our laboratory and its operations for several years.

SAMPLE DESCRIPTIONS

A. Germany

Bln-47. Dedeleben

Wood (Quercus sp.) from Pile No. 1 of a trackway in the Grossen Bruch, NW of Dedeleben (52° 02' N Lat, 10° 53' E Long), Kr. Halberstadt. The trunk, ca. 2 m long and 15 cm thick, was sharpened at upper end and driven into the clayey subsoil of the bog. Archaeologic associations not determined; surface finds at S exit of trackway range from Neolithic to medieval. Coll. 1960 by O. Krüger, Dedeleben; subm. by H. Behrens, Landesmus. f. Vorgeschichte, Halle (Matthias, 1963).

Bln-73. Dresden-Nickern

Seeds (Pisum sativum L.) from a Bandkeramik dwelling site, Dresden-Nickern (51° N Lat, 13° 47' E Long). Peas, in quantity, covered horizontal floor of storage-pit, coordinates 173 E, 8.5 S, cut 75 cm in loess loam, overlain by humus soil, 40 to 50 cm thick. Associated with sherds of younger Linienbandkeramik Culture, comparable with those from Grave 1 at the same site (Baumann, 1960). Excavated 1961 and subm. by W. Baumann, Landesmus. f. Vorgeschichte, Dresden.

Bln-73a. Dresden-Nickern

average: 3995 B.C.

Bln-77. Dresden-Nickern

Coarse, undecorated potsherds from same Bandkeramik site as Bln-73, Point 4, coordinates 4.70 E, 8.50 S. From pit dug to 1.05 m depth below surface, streaked with loam in lower part. Sherds are distinct in organic temper and surface texture from younger Linienbandkeramik sherds prevalent elsewhere on the site; diagnostic vessel forms and decoration are lacking, but assignment to oldest or older Linienbandkeramik Culture is probable. Excavated and subm. by W. Baumann (Baumann, 1960).

Ehrenstein series


**Bln-54. Ehrenstein 885**  
5140 ± 80  
3190 B.C.

Soil-rotted log (*Alnus* sp.), Sample 885, from lower baulk layer (Zwischenwand) of House 5, Construction B, 1.5 m below surface, assigned to younger part of Period I, Michelsberger and Schussenrieder occupations. **Comment**: 2 wood samples from the same site, excavated 1952 by O. Paret, were dated at Heidelberg: H-125/107, 5200 ± 140; H-61/148, 5140 ± 130 (Groschopf, 1961).

**Bln-70. Ehrenstein 928**  
5240 ± 100  
3290 B.C.

Oak wood (*Quercus robur* L.) from House 6, Construction A, assigned to older part of Period I.

**Bln-71. Ehrenstein**  
5200 ± 100  
3250 B.C.

Oak wood (*Quercus robur* L.) from House 5, Construction B (same stratigraphy and archaeology as Bln-54).

**Bln-51. Eitzum**  
6310 ± 200  
4360 B.C.

Sherds from Bandkeramik occupation at Eitzum (52° 09' N Lat, 10° 48' E Long), Kr. Wolfenbüttel; found at 0.45 cm depth in residual block, Point 9 easterly, T 0.0. The thick-walled, strongly organic-tempered and weakly fired sherds belong to the oldest Linienbandkeramik phase present on the site, Excavated 1958 and subm. by F. Niquet, Landesmus., Braunschweig (Niquet, 1963; Quitta, 1960). **Comment**: wood-charcoal, likewise from the oldest Linienbandkeramik complex, from Point 5 at the Eitzum site, was dated 1961 by the Heidelberg laboratory: H-1487/985, 6480 ± 210 (H. Schwabedissen, private communication).

**Bln-56. Friedberg**  
6120 ± 100  
4170 B.C.

Sherds, recovered from several pits in a Bandkeramik occupation site nr. Friedberg (50° 20' N Lat, 8° 45' E Long), Kr. Friedberg. Thick-walled, chaff- or coarse-sand-tempered, rarely decorated material is assigned to a developed phase of the oldest Linienbandkeramik Culture. Coll. 1954 and subm. by F. R. Herrmann, Wetterau-Mus., Friedberg (Herrmann, 1957; Quitta, 1960).

**Halle-Dölauer Heide series**


**Bln-53. Halle-Dölauer Heide, Pile 26**  
4630 ± 100  
2680 B.C.

Carbonized wood (*Quercus* sp.) from Pile 26, part of a palisade; palisade trench, 20-25 cm wide and cut to 50-60 cm depth in adjacent gravel, contains carbonized pile fragments over ca. 10 m distance. Assigned to the Salzmünder phase of the central German Funnel-Beaker Culture. Excavated 1955. **Comment**: wood-charcoal from the same palisade trench was dated 1959 by the
Heidelberg laboratory: H-209/579, 4970 ± 90 (H. Schwabedissen, private communication).

**Bln-64. Halle-Dölauer Heide, Pile 17**

4780 ± 100

2830 B.C.

Carbonized oak wood from Pile 17, part of same palisade as Bln-53. Excavated 1955.

**Bln-65. Halle-Dölauer Heide, Grave 4**

3940 ± 100

1990 B.C.

Rotten wood from floor of Grave 4, Burial Mound 6, a tub-shaped grave, 88 by 34 cm, excavated to 40-50 cm depth in adjacent soil, walled with wood and covered by 2 sandstone blocks. Grave contained a badly decomposed child’s skeleton without furnishings. As burial was secondary, assignment to Cord Ceramic Culture is probable. Excavated 1954. Comment: two wood samples from an older (stone-chambered) Cord Ceramic grave in the same mound were dated 1956 and 1960 by the Heidelberg laboratory: H-253/208, 4520 ± 110; H-572/919, 4110 ± 75 (H. Schwabedissen, private communication).

**Bln-35. Hiddensee**

A.D. 1590

Carbonized wood (*Quercus* sp.) from shipwreck, under 2 m of water, ca. 300 m W of N tip of island Hiddensee (54° 35' N Lat, 13° 05' E Long). Coll. 1960 and subm. by K. Ebbinghaus, Mus. Kloster auf Hiddensee.

**Bln-85. Irlbach**

5345 ± 100

3395 B.C.

Sherds encountered in various quarry workings at the baronial gravel quarry of Irlbach (48° 51' N Lat, 12° 46' E Long), Kr. Straubing. Assigned to an early phase of Linienbandkeramik Culture by their wide-line decoration, thick handles, flat bases, and strongly organic temper. Coll. 1953 and subm. by J. Keim, Straubing (Quitta, 1960).

**Bln-78. Kratzeburg**

2765 ± 100

815 B.C.


**Bln-39. Magdeburg-Salbke**

3200 ± 100

1250 B.C.

Wooden stick (*Fraxinus excelsior* L.), 34.5 cm long, 5.4 by 2.7 cm in flattened cross-section, sharpened, probably artificially, at both ends, dredged at Find-place III/IV in Magdeburg-Salbke gravel quarry (52° 05' N Lat, 11° 40' E Long). Inclosing gravel is alluvium, in former bed of Elbe River. No archaeologic association, but finds made nearby, in addition to prehistoric and early medieval objects, include numerous bronze objects of Periods II to V, probably votive offerings. Coll. 1961 and subm. by H. Lies, Kulturhist. Mus., Magdeburg (Lies, 1963).
Bln-93. Mockern  

Wood-charcoal (*Quercus petraea* L., *Corylus avellana* L.) from Crema
tion-burial 14 in the early Iron Age urnfield in the Teufelsbruch, Mockern
(50° 57' N Lat, 12° 26' E Long), Kr. Altenburg. Found mainly on floor of
rectangular grave pit, 80 cm deep, overlain by grass-overgrown humus
soil, 20 cm thick; sherds of 3 pots lay near the urn. Assigned to early Iron Age
(Hallstatt D). Excavated 1953 and subm. by H. Höckner, Mus. Altenburg
(Höckner, 1962).

Oberdorla series

Wood-charcoal from a Germanic shrine at Rieth, nr. Oberdorla (51° 10'
N Lat, 10° 25' E Long), Kr. Mühlhausen. Excavated 1960 and subm. by G.
Behm-Blancke, Mus. f. Ur- u. Frühgesch. Thüringens, Weimar (Behm-Blancke,
1960).

Bln-59. Oberdorla 2.29 m  

Beech charcoal from hearth, Area 14c/60, surrounded by stone circle,
2.29 m depth, Early La Tène time.

Bln-67. Oberdorla 2.23 m  

Wood charcoal from Hearth 2, 2.23 m depth, Early La Tène time.

Bln-33. Oberdorla 3.0 m  

Beech charcoal from B horizon, ca. 3.0 m depth, Early Roman Empire
time.

Bln-97. Perleberg  

Wood-charcoal (*Quercus petraea* L.) from one of several hearths, some
containing fieldstone, exposed in sandpit, 40 cm depth below surface, directly
overlain by organic soil, Golm, nr. Perleberg (53° 05' N Lat, 11° 32' E Long).
Archaeologically datable finds lacking. Coll. 1962 and subm. by A. Hoppe,
Heimatmus., Perleberg.

Bln-46. Rüben  

Wood-charcoal (*Quercus* sp.) from a Roman Empire site at Rüben (51°
13' N Lat, 12° 25' E Long), Kr. Borna. Taken from hollow, dug in surround-
ing gravel, of a closed, dome-shaped structure, supposedly a baker's oven;
dated as Early Roman Empire time by 2 wheel-decorated sherds. Excavated
1956 by G. Mildenberger and H. Hanitzsch; subm. by Inst. f. Vor- u.
Frühgesch., Karl Marx Univ., Leipzig.

Bln-92. Westeregeln  

Seeds (*Pisum sativum* L.) from a Bandkeramik storage-pit, Westeregeln
(51° 58' N Lat, 11° 24' E Long), Kr. Stassfurt. Horizontal floor of rhombic
pit, 2.65 by 1.8 m in area and 1.15 m deep, contained 2 querns and 4 separate
heaps of carbonized seeds, 3 of peas and one of grain. Archaeologically dated by nearby sherds, including some with lines and long impressions that immediately overlay the peas, to an older or middle phase of Linienbandkeramik Culture. Excavated 1947 and subm. by H. Lies (Rothmaler and Natho, 1957). *Comment:* sample from the same storage pit was dated by the Groningen laboratory: GrN-223, 6200 ± 200.

**Bln-42. Westeregen**

Same sample of peas as Bln-92, which had been well protected under glass. Bln-42 lay in an open cardboard container.

**Bln-66. Zwenkau-Harth**

Wood-charcoal (*Quercus* sp.) from posthole of a Stichbandkeramik house, Zwenkau-Harth (51° 14’ N Lat, 12° 21’ E Long), Kr. Leipzig. From 0.85 m depth in posthole, sunk in sand to receive a main roof support, ca. 35 cm thick, later burned, in Quadrant C 1; posthole, easily distinguishable in excavation by its dark color and carbonized fragments, was overlain by loam, 50 cm thick, with a layer of humus, derived from a known medieval forest, at the surface. Design of house, 36.5 m long, dates the posthole to a developed phase of older Stichbandkeramik Culture. Excavated 1953 and subm. by H. Quitta (Quitta, 1958). *Comment:* charcoal from the same posthole was dated 1958 by the Heidelberg laboratory: H-224/223, 6000 ± 115 (H. Schwabedis-sen, private communication); and dated 1959 by the Copenhagen laboratory: K-555, 5840 ± 120 (Tauber, 1960).

**B. Austria**

**Bln-58. Mold**

Thick-walled, undecorated sherds (Mus. Horn, Inv. No. 732) of the Bandkeramik site in the field “Am Hochrain” at Mold (48° 39’ N Lat, 15° 43’ E Long), Bez. Horn; from firepit sunk to ca. 30 cm depth in loess loam, accompanied by several fingernail-impressed and applied-knob vessel fragments, ash, and wood-charcoal. Assigned by Pittioni (1954) to an early phase of the Austrian Bandkeramik. As characteristically early styles are lacking, except for the decoration by impression, which is known to occur later also, and as sherds with musical noteheads are present, we consider the complex to be younger, about in the middle stage of Linienbandkeramik Culture. Excavated 1938 by J. Höbarth; subm. by F. Berg, Höbarth-Mus., Horn/NE (see Fundberichte aus Österreich, v. 3, 1948).

**Bln-83. Pulkau**

Sherds from the Bandkeramik site of Ziegelei Apfelthaler, Pulkau (48° 42’ N Lat, 15° 52’ E Long), Bez. Hollabrunn; details of collection unknown. Sherds can be placed only approximately among the Linienbandkeramik phases by the occurrence of musical-notehead decoration (Pittioni, 1954). Coll. in the ’30s by J. Höbarth; subm. by F. Berg, Höbarth-Mus., Horn.
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Bln-63. Sauerbrunn  

Grain (*Secale cereale* L., *Triticum aestivum* L.) from prehistoric (Lengyel?) site at Sauerbrunn (47° 43' N Lat, 16° 28' E Long), Bez. Mattersburg. From storage pit, 1.70 m deep, widening downward. Archaeologic assignment unknown, as pottery was absent. Excavated 1958 and subm. by A. Ohrenberger, Burgenländisches Mus., Eisenstadt.

Bln-55. Winden am See  

Sherds from a Bandkeramik site in the field “Kräftenäcker,” N of Winden a.S. (47° 57’ N Lat, 16° 50’ E Long), Bez. Neusiedl a.S. From Pit 2 in Parcel 467/1, disturbed earlier by power shovel. Most of the thick-walled, organic-tempered pottery can be assigned to an early stage of Linienbandkeramik Culture, but some sherds of a better-fired ware, decorated with scratches and musical-notehead impressions, imply a more developed stage. Excavated 1948 by H. Mitscha-Marheim; subm. by A. Ohrenberger, Eisenstadt (see Fundberichte aus Österreich, v. 5, 1946-50).

Bln-107. Winden am See  

Entirely undecorated, organic-tempered sherds from various pits, disturbed by trench-plough, same site as Bln-55. Coll. 1947-50 and subm. by A. Ohrenberger.

C. Romania

Bln-29. Baia-Hamangia  

Wood (*Quercus sp.*) from Grave 1 in Burial-mound 1 at Baia-Hamangia (44° 47’ N Lat, 28° 03’ E Long), r. Istria, reg. Constanța. From rectangular grave pit in center of mound, which is ca. 1.5 m high. Floor of grave and skeleton, in flexed position, covered with a thin layer of red ochre; a clay vessel and a marble ornament accompanied the burial. Assigned to the Ochre-grave Culture, distributed from the N Pontic steppe to the Dobrudscha. Excavated 1952 and subm. by D. Berciu, Archaeol. Inst., Romanian Acad. Sci., Bucharest (see Studii și cercetări..., 1953). Comment: wood from the same grave was dated 1959 by the Groningen laboratory: GrN-1995, 4530 ± 65 (Vogel and Waterbolk, 1963).

Cernavoda series


Bln-61. Cernavoda  

Wood-charcoal from Trench S I/s 1.

Bln-62. Cernavoda  

Wood-charcoal (*Quercus petraea* L.) from Trench S I/s 2.
Berlin Radiocarbon Measurements I

D. Czechoslovakia

Bln-102. Mohelnice  6285 ± 100
Bln-102a. Mohelnice  6405 ± 100

**average:** 4395 B.C.

Grain (*Triticum dicoccum*) from the Bandkeramik site of Mohelnice (49° 47' N Lat, 16° 55' E Long), Kr. Zabřeh. From trench, sunk 60 cm into loess loam, Quadr. 0114, Obj. 054, Fundnr. 17, on E side of House 12. On evidence of old style of associated house, and of lack of musical-notehead decoration on pottery, assigned to an early stage of Moravian Linienbandkeramik Culture. Excavated 1961 and subm. by R. Tichý, Archaeol. Inst., ČSAV, Brno (Tichý, 1962). **Comment:** Bln-102 was measured without chemical pretreatment; Bln-102a received the usual acid and alkali soaking.

Bln-74. Nový Bydžov  5225 ± 100

Organic- and sand-tempered sherds from a Bandkeramik site in the Chudonice section of Nový Bydžov (50° 14' N Lat, 15° 30' E Long), Kr. Hradec Králové. Sherds from the same site were figured by Stocký, 1929; material belongs to one of the relatively early Linienbandkeramik phases. Excavated 1960 by A. Rybová; subm. by B. Soudský, Archaeol. Inst., ČSAV, Prague.

Bln-118. Tvarožná Lhota  665 ± 100

Wood-charcoal (*Quercus* sp.) from a Hallstatt grave-field at Tvarožná Lhota (48° 57' N Lat, 17° 28' E Long), Kr. Hodonín. Taken from a fireplace (funeral pyre?), but with no demonstrable connection to a Hallstatt grave; no sherds were in association. Coll. 1962 and subm. by V. Dohnal, Oblastní Mus. Jihovýchodní Moravy, Gottwaldov.

Bln-57. Žopy  6430 ± 100

Sherds from Bandkeramik site of Žopy (49° 20' N Lat, 17° 35' E Long), Kr. Kroměříž. Dwelling pit, ca. 5 m long and sunk to 1 m depth in yellow loess loam, exposed hearth on floor; most of the pottery was in upper half of trench, overlain by humus soil, 40 cm thick. Thick walls, organic temper, vessel forms, and decoration are all characteristic of the oldest Linienbandkeramik phase. Excavated 1954 by J. Pavelčík; subm. by V. Dohnal, Mus. Gottwaldov (Tichý, 1960).

E. Hungary

Bln-75. Gyálarét  7090 ± 100

Sherds from a site of Körös Culture at Gyálarét (46° 13' N Lat, 20° 05' E Long), Bez. Szeged. From pit, 1 to 1.5 m depth below surface. Assigned to eastern Hungarian Körös Culture on basis of uniformly organic temper and typical vessel forms and decoration. Excavated 1960 and subm. by O. Trogmayer, Móra Ferenc Múz., Szeged.  6450 ± 100

Bln-115. Hódmezővásárhely-Kotacpart  4500 B.C.

Sherds from a site of Körös Culture at Kotacpart-Vata-Tanya nr. Hódmezővásárhely (46° 25' N Lat, 20° 19' E Long), Kom. Csongrád. From
old excavations, kept without detailed data in the Szeged Museum, assigned to Körös Culture. Excavated 1931-32 by J. Banner; subm. by O. Trogmayer (Banner, 1933-34).

**Bln-86. Katalszeg**

Sherds from a site of Körös Culture at Katalszeg (46° 40' N Lat, 21° 06' E Long), Bez. Békéscsaba, Kom. Békés; from trench, 1 to 1.2 m depth below surface. Excavated 1960 and subm. by J. Korek, Hungarian Nat. Mus., Budapest.

**Bln-119. Korlát**

Sherds from pit, ca. 1 m depth, site of Bükker Culture at Arkatul nr. Korlát (48° 22' N Lat, 21° 15' E Long), Bez. Abanyszántó, Kom. Borsod. Assigned to an early phase of Bükker Culture; with the fine Bükker ceramics were numerous thick-walled, organic-tempered sherds with the decoration and vessel-forms of the eastern Hungarian Alföld phase of Linienbandkeramik Culture. Excavated 1960 by J. Korek and L. Vértes; subm. by J. Korek.

**Bln-123. Tarnabod**

Sherds from pit, 0.80 to 1.00 m depth in loess soil, overlain by humus soil, 40 cm thick, at Bandkeramik site of Templomföld, NW of Tarnabod (47° 41' N Lat, 20° 13' E Long), Bez. Heves, Kom. Heves. Assigned to Alföld phase of Linienbandkeramik Culture. Excavated 1960 and subm. by N. Kalicz, Archaeol. Inst., Hungarian Acad. Sci., Budapest.

**Bln-87. Zalavár**

Sherds from a Bandkeramik site at Zalavár (46° 40' N Lat, 17° 10' E Long), Bez. Keszthely, Kom. Veszprém. The thick-walled, organic-tempered sherds came from various excavations in salvage operations by the Hungarian National Museum. Assignable to an early phase of Linienbandkeramik Culture; occurrence of a few Zseliz sherds may indicate a longer duration for this ware in western Hungary. Excavated 1954-55 by B. Balint; subm. by J. Korek (Quitta, 1960).

**F. Sudan**

**Bln-116. Musawwarat es Sufra**

Wood-charcoal from a wall construction confining a former large reservoir in the Meroitic temple-precinct of Musawwarat es Sufra (16° 28' N Lat, 33° 24' E Long), Distr. Shendi, Rep. Sudan. Sample from 1.80 m below surface in section cut in earthwork, heaped together with large blocks and sandy gravel to surround the Great Hafir; earthwork is assigned to a late period of the Meroitic Empire. Excavated 1960 and subm. by G. Viete, Bergakademie Freiberg, member of the Sudan Expedition of the Inst. f. Ägyptol., Humboldt Univ., Berlin (Hintze, 1962).

**REFERENCES**

Date lists:
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- Groningen IV

Tauber, 1960
Vogel and Waterbolk, 1963
Berlin Radiocarbon Measurements I


Studii si cercetari de istorie veche 1953, v. 4, 126 p., fig. 15.
UCLA RADIOCARBON DATES III

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The measurements reported in this list have been made in the Isotope Laboratory of the Institute of Geophysics during 1963 and are a continuation of the work reported previously (UCLA I and UCLA II). The same counting procedure—CO₂ proportional counting at 1 atm pressure in a 7.5 L counter with three energy channels—continues in use. No barometric effect on the background has been observed, presumably because of the combination of fairly constant barometric pressure in this area and the location of the equipment on the ground floor of a five storey building. Dates continue to be calculated on the basis of a C¹⁴ half life of 5568 yr according to the decision of the 1962 Cambridge Conference (Godwin, 1962). The modern standard has been taken as 95% of NBS oxalic acid for all organic samples, while for carbonate material such as shells and tufa, dates have been computed on the basis of estimates of the corresponding contemporary C¹⁴ activity (Broecker and Walton, 1959) as indicated in the description accompanying the results.

ACKNOWLEDGMENTS

We are indebted to the National Science Foundation for Grant G-14287 for financial support for this work, and also acknowledge the excellent assistance of Ervin Taylor and Carleton Hoel with laboratory work.

SAMPLE DESCRIPTIONS

A. Tule Springs, Nevada

Tule Springs, Clark County, Nevada (36° 19' N Lat, 155° 09' W Long) lies approx. 12 mi NW of Las Vegas, at an alt of 2307 ft. The first investigations in this locality were in 1933 by the Am. Mus. of Nat. History. Subsequently, this general area has been excavated by three expeditions from the Southwest Museum, Los Angeles, California (Harrington and Simpson, 1961). Radiocarbon dates from the site of >23,000 yr (C-914, Chicago V) and >28,000 yr (L-533B, Lamont VII) on materials supposedly associated with evidence of human occupation provided the stimulus for a systematic excavation. From October 1962 to February 1963 the Nevada State Mus., assisted by a National Science Foundation grant, made an extensive excavation of the site. The major financial support and planning assistance were provided by H. C. Smith and the Isotope Foundation of Los Angeles. Because of the interdisciplinary nature of the project, an Advisory Committee provided assistance at all stages. These people were H. C. Smith, J. D. Clark, E. W. Haury, R. F. Heizer, A. D. Krieger, W. F. Libby, C. Longwell and H. M. Worthington. Close collaboration between field work and the dating laboratory was maintained by R. E. Taylor of this laboratory who spent part of each week on the site. Dates presented were all obtained during this excavation and all samples were submitted by Richard Shutler, Jr., Nevada State Mus., who directed the excavations. More detailed reports on the geology and archaeology are in preparation.

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The following list has been divided into three sections: two relate to archaeological and geological material from two separate areas, Tule Springs Site and Corn Creek Site, while the third consists of samples from springs that help in the interpretation of the geological history.

1. Tule Springs Site

The main Tule Springs site area, about 2500 ft by 700 ft, lies along the edge of the Vegas Wash. Erosion of the wash channel had exposed fossil material and therefore the main excavation was centered in this area. Most of the dates reported in this section are for samples from the main site area, the other samples being from sites about 2 to 3 mi along the wash channel from the main site.

Heavy earth moving machinery was used to dig several trenches, some 30 ft deep and several thousand ft in length, across the site. The cross-sections displayed by these trenches were of immense value in unraveling the geological sequence in the site area.

The geological history of this site is a complex one, with repeated deposition of alluvium, formation of lakes and cutting of stream channels. Spring activity has also occurred at various periods and is related to faulting.

For convenience, dates in this section are grouped according to five main time periods. These are spring-pond phase, lacustrine phase, early post-playa phase, middle post-playa phase and proto historic alluvial phase.

Some tufa samples, deposited by springs, have been dated in this series in an attempt to set approximate ages when no organic carbon samples were available. For these tufa samples 2500 yr (corresponds to 73% of contemporary C\textsuperscript{14} activity) were subtracted from the age computed on the basis of 0.95 NBS oxalic acid and the error was increased to ±1000 yr to allow for the uncertainty in C\textsuperscript{14} activity at zero age.

**Tule Springs series, spring-pond phase**

One of the features that was very apparent in the cross sections was the so-called "green pond" unit. These green sediments, related to ancient springs, can be seen throughout most of the area of excavations. All of the following dates are from spring-laid sediments, containing a vertebrate assemblage but no evidence of human habitation.

**UCLA-501. Tule Springs**

\[ 26,000 \pm 900 \text{ yr} \]

\[ 24,050 \text{ B.C.} \]

Plant remains in pale "green pond" stratum, associated with animal bones, some of which were exposed as a result of erosion. Sample from upper portion of bone assemblage, which was by far the largest found on the site. Southwest Museum Area 1, Site A, from which portions of samples C-914 and L-533B taken. Coll. 1962 by R. E. Taylor.

**UCLA-517. Tule Springs**

\[ >40,000 \text{ yr} \]

Black plant remains from middle of bone assemblage (see UCLA-501) which was 4 to 5 ft thick. Coll. 1962 by J. Mawby, N. Noble and B. Orlins.
UCLA-502. Tule Springs  >32,000
Plant remains from contact zone, ca. 8 in. thick, between loose silt with rolled caliche gravel and hard jointed siltstone. In “green pond” sediments, 16 in. below surface. Approx. 20 ft NW of and 3.5 ft above UCLA-501 in absolute elevation. Coll. 1962 by R. E. Taylor.

UCLA-511. Tule Springs  >32,000
Plant remains in pale greenish white siltstone of early pond phase, 14 to 20 in. below surface. Bone fragments, a horse tooth and a bone (?) found in close proximity. Approx. 20 ft E of and 1.3 ft above UCLA-501 in absolute elevation. Coll. 1962 by P. Williams and R. E. Taylor.

UCLA-528. Tule Springs  >40,000
Black plant remains from an apparent spring feeder at top of “green pond” unit in base of gray clay, 4 to 5 ft below surface. Should provide minimum age of pond phase. Approx. 50 ft S of and 2 ft above UCLA-501 in absolute elevation. Coll. 1963 by P. Williams.

UCLA-506. Tule Springs  >37,000
Carbonaceous material in pale greenish white silt unit, limonite stained, associated with bone fragments. Expected to be “green pond” age. 2.3 ft below surface. Approx. 300 ft E of and 4.3 ft above UCLA-501 in absolute elevation. Coll. 1962 by W. Stein.

UCLA-523. Tule Springs  >30,000

UCLA-547. Tule Springs  >30,000
Snail shells from a secondary channel fill in “green pond” unit. Same stratum as UCLA-523. Southwest Museum Area 2, Site D. Coll. 1962 by R. J. Fitzwater.

UCLA-524. Tule Springs  >31,000
Comment (C.V.H.): the “green pond” unit is clearly older than 40,000 yr and UCLA-501 may be in error. Two independent measurements were run in the laboratory with excellent agreement, so it appears that the spring may have been active again 26,000 yr ago or the sample itself may be a mixture of younger material with the older.

Tule Springs series, lacustrine phase
Overlying the “green pond” unit is a tan alluvium and a gray lacustrine mudstone with strong calichification. Neither unit contained evidence of human occupation and only the lacustrine unit contained suitable C14 samples.

UCLA-513. Tule Springs  >35,000
Charcoal in contact zone at base of upper gray-white snail-bearing lacus-
trine mudstone associated with bone fragments (some mammoth) and two mammoth teeth, ca. 1000 ft W of UCLA-501. Coll. 1962 by C. V. Haynes and R. E. Taylor.

**UCLA-520. Tule Springs**

Fine grained carbon from dark gray zone in block of caliche cap associated with burned wrist bones of camel. Should provide a minimum age on lower part of lacustrine unit. Upper part has been eroded at this locality. Approx. 800 ft W of UCLA-501. Coll. 1962 by C. V. Haynes.

**UCLA-536. Tule Springs**

Snail shells from erosion remnant in lacustrine unit overlying “green pond” sediments. Coll. 1962 by C. V. Haynes. Comments (C.V.H.): UCLA-513 may be redeposited from the “green pond” unit and hence too old. UCLA-520 and 536 indicate that the maximum level of the ancient lake is contemporary with the last major North American continental glaciation (late Wisconsin).

**Tule Springs series, early post-playa phase**

The lacustrine phase, represented by the playa unit, was followed by an alluvial phase occupying stream channels cut into earlier units and containing a vertebrate fauna and widely dispersed artifacts indicating man’s presence. Ancient carbonate-depositing springs are associated with the channel and obviously supplied water to the stream.

**UCLA-503. Tule Springs**

Tufa from possible outcrop of spring in “green pond” sediments. The uncorrected carbonate date is 15,920 ± 220. Coll. 1962 by C. V. Haynes.

**UCLA-507. Tule Springs**


**UCLA-637. Tule Springs**


**UCLA-509. Tule Springs**

Charcoal, McCown camel site, from dark gray silt in broken and rolled caliche, associated with stone awl. McCown camel site is 1.5 mi W of “350 ft W Cut.” Coll. 1962 by R. J. Fitzwater.

**UCLA-514. Tule Springs**

Charcoal lumps, McCown camel site, in rolled caliche gravel in channel fill, associated with small bone tool and camel bone. 2 ft E and 1 in. higher than UCLA-509. Date should agree with UCLA-509. Coll. 1962 by M. Levine.
UCLA-512. **Tule Springs**

Charcoal, Fenly Hunter Cut, mixed with gray silty clay on caliche gravel lens within ancient channel fill, 12 ft below surface, associated with small bone tool and fragments of camel bone. Coll. 1962 by B. Twitchel, K. Dove, B. Orlins and C. V. Haynes.

**UCLA-604. Tule Springs**


**UCLA-518. Tule Springs**

Plant remains, Site 6, in lower fill of channel which was cut after formation of caliche cap. Associated with camel bones. Coll. 1962 by R. E. Taylor and N. Noble.

**UCLA-521. Tule Springs**

Charcoal lumps from Trench 9, Site 5, 13 in. below surface, in upper portion of channel fill in gray silty sand resting on caliche gravel. Associated with mammoth, antelope, and camel. Site 5 is 1 mi E of “350 ft W Cut.” Coll. 1962 by D. Tuohy and crew.

**UCLA-522. Tule Springs**

Charcoal lumps from Trench 9, Site 5, 21 in. below surface, in lower portion of channel fill in gray silty sand resting on caliche gravel. Associated with mammoth, antelope, and camel. Possible associations with burned digging stick. Coll. 1962 by D. Tuohy.

**UCLA-543. Tule Springs**

Snail shells, Site 5, in channel fill, 26 to 30 in. below surface. Associated with fauna of large vertebrates. Coll. 1963 by D. Tuohy, B. Twitchel and P. Brozanovich. *Comment*: age computed on basis of 0.95 NBS oxalic acid, and therefore probably too great.

**UCLA-546. Tule Springs**

Tufa in caliche gravel of channel fill, Site 5, 39 in. below surface. The uncorrected carbonate date is 16,900 ± 300. Same general area as UCLA-521, 522 and 543. Coll. 1963 by D. Tuohy, B. Twitchel and P. Brozanovich.

**UCLA-552. Tule Springs**

Fine-grained carbonized material in silt in relatively young channel cut in spring-laid sand, W side of Las Vegas wash, 400 ft NW of grid area. Coll. 1963 by C. V. Haynes.

*Comment* (C.V.H.): dates indicate rather brief period for deposition of the early post-playa unit between 13,500 and 12,000 yr ago. Man first appeared on the scene during this period. The tufa dates (UCLA-503 and 546) confirm the
association of springs with the channel sediments and UCLA-503 clearly indicates that some springs active more than 40,000 yr ago were again active 13,000 to 14,000 yr ago.

**Tule Springs series, middle post-playa phase**

The early post-playa sediments are overlain by buff-colored silts representing the middle post-playa alluvial phase, during which time large quantities of floodplain alluvium covered the area.

**UCLA-505. Tule Springs**


10,000 ± 200

8050 B.C.

**UCLA-508. Tule Springs**


11,200 ± 300

9250 B.C.

**UCLA-636. Tule Springs**


11,500 ± 500

9550 B.C.

**UCLA-519. Tule Springs**


7480 ± 120

5530 B.C.

**UCLA-510. Tule Springs**

Finely powdered charcoal and silt, Fenly Hunter Cut, in upper part of laminated buff silt unit, 2 ft below surface. Apparently result of prairie fire. The large error is due to small amount of sample. Coll. 1962 by B. Twitchel, P. Brozanovich, C. V. Haynes.

Comment (C.V.H.): these dates are internally consistent and support the geological estimate of their age.

**UCLA-515. Tule Springs**

Charcoal lumps in and around burned lens in late alluvial silt and sand filling of arroyo (36° 17’ 15” N Lat, 115° 9’ 55” W Long). Coll. 1962 by C. V. Haynes.

360 ± 120

A.D. 1590

**Tule Springs series, protohistoric alluvial phase**

The middle post-playa phase was followed by extensive erosion and channeling for which there are no C¹⁴ dates. The last period of alluviation in the area is represented by the protohistoric alluvium which contains numerous hearths and charcoal lenses and is now being eroded.
UCLA-516.  Tule Springs  
A.D. 1225

UCLA-635.  Tule Springs  
A.D. 1380

UCLA-639.  Tule Springs  
Partially burned wood from upper 6 in. of alluvium fill in arroyo (36° 16' 28" N Lat, 115° 10' 48" W Long). Same arroyo as UCLA-635, so should date end of last phase of alluviation in arroyos near site. Coll. 1963 by C. V. Haynes and P. Mehringer.  
A.D. 1620

UCLA-640.  Tule Springs  
Mesquite wood from stump on late prehistoric alluvial fill (see UCLA-635) (36° 16' 28" N Lat, 115° 10' 48" W Long). Mesquite is growing near the site today. Coll. 1963 by C. V. Haynes and P. Mehringer.  
Comment (C.V.H.): the dates confirm geological and archaeological estimates and complete the young end of the sedimentary record.  
A.D. 1750

2. Corn Creek Site  
About 15 mi NW of Tule Springs lithic artifacts were found in ancient sand dunes at Corn Creek (36° 27' N Lat, 115° 23' W Long) and further investigation disclosed numerous hearths. Charcoal from seven hearths was collected to establish the time period of occupation of this site. Coll. Jan. 1963 by C. V. Haynes and B. Orlins.

Corn Creek series, hearths

UCLA-525.  Corn Creek, Hearth 3  
Charcoal from Hearth 3, 6 in. below surface, 2 ft above caliche cap.  
4440 ± 100 2490 B.C.

UCLA-526.  Corn Creek, Hearth 1  
Charcoal from Hearth 1, 6 in. above caliche cap, 20 ft from UCLA-525.  
5200 ± 100 3250 B.C.

UCLA-531.  Corn Creek, Hearth 6  
Charcoal from Hearth 6.  
4580 ± 100 2630 B.C.

UCLA-532.  Corn Creek, Hearth 7  
Charcoal from Hearth 7.  
4610 ± 100 2660 B.C.

UCLA-533.  Corn Creek, Hearth 8  
Charcoal from Hearth 8.  
4900 ± 100 2950 B.C.
UCLA-534. Corn Creek, Hearth 9
Charcoal from Hearth 9.

UCLA-535. Corn Creek, Hearth 10
Charcoal from Hearth 10.
*Comment* (C.V.H.): a single period of intermittent occupation of about 1000 yr is indicated.

3. Spring Activity Areas

Evidence of past spring activity at the main Tule Springs site is abundant although no springs exist at present. Springs with active discharge are, however, scattered around the surrounding areas along with many mounds formed from past spring activity. Samples of occupational evidence and of organic material from springs in surrounding areas were accordingly taken to investigate times of emergence and life of various springs in the general area of Tule Springs.

**Tule Springs series, active and inactive springs**

UCLA-540. Gilcrease, Spring 7

UCLA-527. Gilcrease, Spring 7

UCLA-537. Gilcrease, Spring 4
Black organic soil from the interior of spring mound (36° 17’ 30” N Lat, 115° 15’ 30” W Long) which became inactive ca. 40 yr ago. Should date emergence of spring. Coll. 1963 by C. V. Haynes.

UCLA-529. Gilcrease, Spring 4-A
Fine-grained organic matter in mound of ancient spring (36° 17’ 30” N Lat, 115° 15’ 30” W Long). Several strongly weathered artifacts were found on the surface of the mound. Coll. 1963 by C. V. Haynes.

UCLA-539. Gilcrease, Spring 4-A
Wood fragments from lens located on contact between green clay and overlying gray clay silt below organic soil dated by UCLA-529 (9200 ± 250). Coll. 1963 by C. V. Haynes and R. E. Taylor.

UCLA-530. Corn Creek
Fine-grained organic matter from center of mound of ancient spring, 6
mi NW of Corn Creek game range headquarters (36° 29' N Lat, 115° 27' W Long). Weathered artifacts found on surface. Coll. 1963 by C. V. Haynes.

**UCLA-538. Corn Creek, Spring 4**

Black organic soil from top of mound surrounding modern spring in Corn Creek area, 13 mi NW of Tule Springs site (36° 26' 30" N Lat, 115° 21' W Long). Should date emergence of springs in this area which was presumably related to faulting. Coll. 1963 by C. V. Haynes.

**UCLA-541. Corn Creek, Spring 3**

Organic mat from under gray silt of ancient spring, Corn Creek (36° 27' 4" N Lat, 115° 21' 8" W Long). Should date emergence of springs in this area which was presumably related to faulting. Coll. 1963 by C. V. Haynes.

**UCLA-542. Corn Creek, Spring 8**


**UCLA-544. Tule Springs**


**UCLA-549. Tule Springs**


**UCLA-550. Tule Springs**


**UCLA-551. Tule Springs**


**UCLA-638. Tule Springs**

Charcoal from mound of now-inactive spring near base of scarp 3.8 mi SW of Tule Springs site (36° 15' 49" N Lat, 115° 12' 14" W Long). Mound covered with a deposit, up to 2 ft thick, consisting of charcoal, silt, burnt caliche fragments, pottery and flint. Date should indicate time of occupation when spring was presumably flowing. Coll. 1963 by C. V. Haynes and R. Shutler, Jr.
UCLA-641. Tule Springs

12,500 ± 1000
10,550 B.C.

Tufa outcrop near scarp, 3.4 mi SE of Tule Springs site (36° 16' 42" N Lat, 115° 9' 14" W Long). The uncorrected carbonate date is 15,000 ± 300. Coll. 1963 by C. V. Haynes and R. Shutler, Jr.

UCLA-642. Tule Springs

9300 ± 1000
7350 B.C.

Tufa outcrop near scarp, 3.5 mi SE of Tule Springs site (36° 17' 22" N Lat, 115° 8' 16" W Long). Tufa believed deposited by springs and should provide minimum date on faulting in area. The uncorrected carbonate date is 11,800 ± 250. Coll. 1963 by C. V. Haynes and R. Shutler, Jr.

Comment (C.V.H.): the dates clearly indicate that some of the springs have been active at various times in the past. In the final geological analysis it is expected that these dates will permit the understanding of a time-space sequence of faulting in the area. They will also help demonstrate the movement of prehistoric man in response to the appearance or disappearance of springs.

B. Western United States

Yosemite series, California

Burned wood from site Mrp-105, alt 6000 ft, 1.2 mi SE Crane Flat Ranger Station, Yosemite National Park, California (37° 46' N Lat, 119° 46' W Long). The region in which this site is located has been an area of cultural contact between the people inhabiting the Central Valley of California and the Great Basin to the East. These samples should thus provide absolute dates for the Sierran archaeological sequence and also an indication of time required for transmission of cultural traits over a given distance and hence on the migrations of aboriginal peoples. Coll. by R. J. Fitzwater; subm. by C. W. Meighan, Anthropol. Dept., Univ. of California, Los Angeles.

UCLA-276. Yosemite Park

950 ± 70
A.D. 1000

Charcoal from Pit 22C, 18 to 24 in. depth. Associated with an artifact assemblage containing Desert Side-notched projectile points believed to have their origin in the Southwest about A.D. 900.

UCLA-277. Yosemite Park

1580 ± 80
A.D. 370

Charcoal from Pit 22C, 36 to 42 in. depth. Should date transition period which contains Elko Eared, Elko Contracting Stem and Elko Corner-notched projectile points which have been dated at a site in the Great Basin at 2950 ± 200 yr (LJ-203, La Jolla II).

UCLA-278. Yosemite Park

2040 ± 100
90 B.C.

Charcoal from Pit 22C, 48 to 54 in. depth, deepest portion of site. Contains Pinto projectile points identical to those from Danger Cave dated as 8960 ± 340 (C-640, Chicago III).
Comment (C.W.M.): UCLA-276 is in good agreement with the archaeological evidence from other sites. UCLA-277 and 278 appear too young—either the artifacts in association persisted over a very long time span, or there is a contamination or stratigraphic problem yielding erroneous dates, or the dating evidence from other sites is in error.

Southfork Shelter series, Nevada

Southfork Shelter is a refuse-filled rockshelter near mouth of South Fork of Humboldt River, Elko County, Nevada (40° 44' 8" N Lat, 115° 51' 40" W Long). In the excavations, a sequence of projectile point types was recovered, the upper part of the series overlapping with that from Wagon Jack Shelter, Churchill County, Nevada (Heizer and Bennyhoff, 1961). Samples selected to date earliest occupation of site. Subm. by R. F. Heizer, Univ. of California, Berkeley.

UCLA-295. Southfork Shelter, Nevada 4360 ± 300 2410 B.C.

Charcoal, probably sagebrush, 120 in. below surface, from refuse midden in Pit 1.

UCLA-296. Southfork Shelter, Nevada 4310 ± 400 2360 B.C.

Charcoal from depth of 94 to 100 in. in Pit 2 in midden deposit. Comment: date is consistent with that of LJ-203 (3320 ± 100, LJ II) from depth of 72 in. in Pit 2.

UCLA-298. Leonard Rockshelter, Nevada 13,000 ± 1000 11,050 B.C.

Shells of small gastropods (Amnicola sp.) in sandy beach deposit forming base of the post-lacustrine deposits of Leonard Rockshelter, Nevada (40° 2' 5" N Lat, 118° 29' W Long). A number of C-14 dates from the site have been secured (see Heizer, 1951 for list), the oldest of which (C-599, 11,199 ± 570, Chicago II) is for bat guano lying directly on the sand and gravel beach deposit formed by the stand of Lake Lahontan just before its final lowering. Alt of top of this “beach” is 4175 ft. Comment (R.F.H.): age of UCLA-298 is consistent with other evidence of the final high stand of Lake Lahontan. Subm. by R. F. Heizer.

UCLA-297. Fernandez Site, California 2180 ± 250 230 B.C.

Charcoal from depth of 76 in. in Pit A9 in shellmound (38° 0' 2" N Lat, 122° 12' 31" W Long), 4.5 mi from the shore of San Francisco Bay. Comment (R.F.H.) : age of sample is consistent with cultural evidence (Davis, 1960) and other C-14 dates for the San Francisco Bay region (Heizer, 1958). Subm. by R. F. Heizer.

Goleta Valley series, California

Shell samples from an early “milling stone” camp site, 4Sba l42, Glen Annie Canyon, Goleta Valley, California (34° 25' 40" N Lat, 119° 52' 40" W Long). Dating of this site should establish the age of the Oak Grove horizon which occurs throughout the Santa Barbara coastal area. All ages have been
expressed with respect to shells collected in 1880 on California coast. Coll. and subm. by R. C. Owen, Anthropol. Dept., Univ. of California, Santa Barbara.

**UCLA-605. Goleta Valley**

6880 ± 120 4930 B.C.

Shells (*Saxidomus nuttallii*), Pit 3, 12 to 18 in. depth, from matrix of a burial typical of this site.

**UCLA-606. Goleta Valley**

6980 ± 120 5030 B.C.

Shells, various species, Pit 4, 12 to 18 in. depth. Associated with a burial not typical of other burials on this site.

**UCLA-607. Goleta Valley**

7270 ± 120 5320 B.C.

Shells (*Saxidomus nuttallii*), Pit 4, 12 to 18 in. depth. Heaped over a burial complex.

**UCLA-608. Goleta Valley**

6380 ± 120 4430 B.C.

Shells, various species, Pit 18, 24 to 30 in. depth. From section of site in which burials did not occur.

Comment (R.C.O.): these dates support the contention, developed in the site report (UCLA Archaeological Survey Annual Report, in preparation) that 4SBa 142 was a temporary camp site utilized for at least 1000 yr. The burials were placed on the soil surface when the midden was in the early stages of being formed. A terminal date for habitation of the site has not been established.

**UCLA-647. Bodega Bay, California**

>40,000

Wood from test boring at Bodega Bay, California (38° 17' N Lat, 122° 58' W Long), proposed test site of atomic power station, 77 ft below surface and 18 ft above mean seallevel. Approx. 125 ft of alluvial soils overlay the granite diorite bedrock. Occasional shear zones are present in the granite, but no indication of displacement in overlying material has been found. Date should thus give a minimum period of time since last displacement of the granite. Coll. and subm. by F. F. Mautz, Pacific Gas and Electric Co., San Francisco.

**UCLA-259. San Ramon, California**

4450 ± 400 2500 B.C.

Charcoal from soil matrix of burial, Site CCO-308, San Ramon Valley, Alamo, California (37° 45' N Lat, 122° 11' W Long). Site has three clear occupational levels. Sample from base of lowest level at depth of 16.5 ft below surface. Coll. 1962 by Dave Frederickson; subm. by G. C. Kennedy, Inst. of Geophysics, Univ. of California, Los Angeles.

**UCLA-271. Salisbury Canyon, California**

120 ± 80 A.D. 1830

Fragments of large storage basket from dry cave in Salisbury Canyon (119° 40' N Lat, 34° 5' W Long) ca. 6 mi N of New Cuyama. Part of large collection of perishable Canalino-type materials recovered in the late 1920's from three dry caves. In addition, there were artifacts of wood, shell, bone, tule
and feathers; nearby caves were decorated with pictographs. Some of the material was Spanish contact. Coll. and subm. by Campbell Grant, Santa Barbara Mus. of Nat. History, Santa Barbara, California.

**UCLA-289. Descanso, California**

Wood from burl root crown of living Red Shank (*Adenostoma sparsifolium*), 10 mi SE of Descanso, California (32° 10' 00" N Lat, 116° 5' 10" W Long). This chaparral shrub is considered a relic species, being restricted to four regions in Southern California. Burls are suspected of living for considerable periods as they are not destroyed by brush fires. Sample therefore taken from center of one of largest burls. Coll. by T. L. Hanes; subm. by Harold Mooney, Dept. of Botany, Univ. of California, Los Angeles.

**Carpinteria series, California**

Large trunks of trees and small limbs exposed in the Carpinteria formation by a bulldozed roadway E of the town of Carpinteria (34° 23' 30" N Lat, 119° 31' 00" W Long). As the wood was impregnated with tar, center portions of samples were shredded and washed with benzene. Coll. Feb. 1962 by G. J. Fergusson and P. C. Orr; subm. by P. C. Orr, Santa Barbara Mus. Nat. History, California.

**UCLA-180. Carpinteria formation**

Wood from depth of 7 ft in formation which is overlaid by 3 ft of alluvium.

**UCLA-181. Carpinteria formation**

Wood from depth of 4 ft in formation.

*Comment (P.C.O.)*: Cheney and Mason (1934) recognized a difference in the floras of the Carpinteria and Santa Cruz Formations, but were unable to determine whether this was due to time or geographic differences. C¹⁴ dates for the Santa Cruz Formation on Santa Cruz Island, UCLA-144, 14,200 ± 250 (UCLA II) and Santa Rosa Island, L-244, 15,820 ± 280 (Lamont IV), show that the two Formations are of different age.

**UCLA-275. Topanga Canyon, California**

Shell (*Mytilus californianus*) from midden at Parker Mesa (LAn-215) Topanga Canyon, Los Angeles County, California (34° 2' N Lat, 118° 35' W Long). Site (King, 1962) is on a sea terrace and sample was collected from bottom level, 18 to 24 in. of a midden-analysis pit. Associated with numerous artifacts. Should date the beginning of occupation of the site. *Comment (C.W.M.)*: the artifact assemblage and terrace location of the site show this site to be a part of the Early Milling Stone Horizon of Southern California, which has yielded numerous C¹⁴ dates in the 5000 to 7000 yr range from Santa Barbara S to San Diego. The date given is possible but appears too young for the cultural context. Coll. by C. D. King; subm. by C. W. Meighan.

**Frenchman Flat series, Nevada**

Plant remains from abandoned middens of packrat in shallow caves in
limestone in the creosote-bush and Coleogyre zones surrounding Frenchman Flat, Nevada. Deposits vary in thickness up to maximum of 2 ft and contain juniper (*Juniperus osteosperma*) twigs and seeds throughout. Organic residue after HCl treatment was used for dating. The past occurrence of juniper in this area implies a rainfall of 10 to 15 in. per yr, compared to less than 5 in. at present. Other samples belonging to this series are UCLA-107, UCLA-I; and UCLA-150 and 151, UCLA II. For a more detailed report on implications of this series, see Wells and Jorgensen (1964). Coll. and subm. by P. V. Wells, Univ. of Kansas, Lawrence, Kansas.

**UCLA-555. Ranger Mountains**

17,450 ± 300
15,500 B.C.

Site 1, alt 3600 ft (36° 47’ N Lat, 115° 53’ W Long). Lower part of deposit.

**UCLA-556. Ranger Mountains**

16,800 ± 300
14,850 B.C.

Site 2, alt 3700 ft. Lower part of deposit.

**UCLA-557. Mercury Ridge**

>40,000

Site 1, E end of Mercury Ridge, alt 4600 ft (36° 43’ N Lat, 115° 52’ W Long). Upper part of deposit which was ca. 2 ft thick.

**UCLA-558. Mercury Ridge**

>38,000

Same cave as UCLA-557. Lower part of deposit.

**UCLA-559. Mercury Ridge**

9000 ± 250
7050 B.C.

Site 2, E end of Mercury Ridge, alt 4600 ft. Lower part of deposit which was ca. 1 ft thick.

**UCLA-560. Narrow Canyon**

7800 ± 150
5850 B.C.

Site 1, alt 4200 ft (36° 42’ N Lat, 115° 53’ W Long). Lower part of deposit which was ca. 1 ft thick.

**UCLA-561. Narrow Canyon**

12,700 ± 200
10,750 B.C.

Site 2, alt 4100 ft. Lower part of deposit.

**UCLA-644. Aysees Peak**

9320 ± 300
7370 B.C.

Deposit with abundant twigs, Aysees Peak (36° 53’ N Lat, 115° 49’ W Long).

**Birch Creek Valley series, Idaho**

Charcoal from two rockshelters, 10-CL-100 and Jackknife Cave, situated well above the flood plain of Birch Creek Valley of eastern Idaho (44° 05’ N Lat, 112° 55’ W Long). Site 10-CL-100 is filled with fan deposits, sloping out of the Beaverhead Mountains and past the front of the shelter. Jackknife Cave is a very dry shelter across the valley from 10-CL-100. Perishable material such as matting and basketry has thus been preserved along with many large side-notched points. Coll. 1962 and subm. by E. H. Swanson, Jr., Idaho State Univ. Mus., Pocatello.
C. Mexico

Cuicuilco Quarry series, Mexico City, Mexico

Charcoal samples from the sub-Pedregal mound area (Cuicuilco-B) in Peña Pobre Quarry 0.3 mi W of the pyramid at Cuicuilco just S of Mexico City (19° 18' N Lat, 99° 11' W Long). A summary of the 1957 excavations at Cuicuilco-B directed by R. F. Heizer with pertinent bibliography appears in Heizer and Bennyhoff (1958). Additional dates appear in Yale IV (Y-437) and UCLA-II (UCLA-205-212, 228). Of the dates reported here, UCLA-602, 603 were coll. by R. F. Heizer, R. F. Millon and R. J. Squier in 1957, UCLA-597 was coll. by J. A. Bennyhoff in 1961, and the remainder were coll. by P. and R. Krotser in 1962. Subm. by R. F. Heizer, Univ. of California, Berkeley and J. A. Bennyhoff, Univ. of Rochester, New York.

UCLA-594. Cuicuilco B-9

Charcoal from Mound 1, Trench 10, Pit 1, depth 4.36 to 4.51 m below Datum A1. Scattered through Middle Zacatenco midden used as fill for Tico-man I structure. Date satisfactory for Middle Zacatenco phase.

UCLA-595. Cuicuilco B-10

Charcoal from Mound 1, Trench 10, Pit 2, depth 4.51 to 4.66 m below Datum A1. Scattered through Middle Zacatenco midden used as fill for Tico-man I structure. Date satisfactory for Middle Zacatenco phase.
UCLA-596. Cuicuilco B-11

Charcoal from Mound 1, Trench 10, Pit 1, depth 4.66 to 4.81 m below Datum A1. Scattered through Middle Zacatenco midden used as fill for Ticoman I structure. Date satisfactory for Middle Zacatenco phase.

UCLA-597. Cuicuilco B-12

Charcoal in combined sample from Mound 1, Trench 9, Pit 2, depth 5.06 to 5.24 m and Test Pit 2, depth 4.36 to 5.01 m below Datum A1. Scattered through same layer of Middle Zacatenco midden used as fill for Ticoman I structure. Date satisfactory for Middle Zacatenco phase, and sample probably contained some charcoal of the Early Preclassic Tlalpan phase, occasional sherds of which did occur in the Middle Zacatenco midden.

UCLA-598. Cuicuilco B-13

Charcoal from Mound 1, Trench 10, Pit 1, depth 5.11 to 6.16 m below Datum 1. Scattered through mixture of earth and Tlalpan phase midden used as fill for Middle Zacatenco structure. Date satisfactory for Tlalpan phase.

UCLA-599. Cuicuilco B-14

Charcoal from Mound 1, Test Pit 8, depth 6.5 to 6.7 m below Datum A2 between floors 3 and 4 of Structure I. Scattered through fill of gravepit through basal layer into subsoil. No sherds associated, but layer elsewhere yielded remains of Tlalpan phase. Date satisfactory for Tlalpan phase.

UCLA-600. Cuicuilco B-15

Charcoal from Mound 1, Test Pit 6, depth 6.23 to 6.55 m below Datum A1. Scattered through basal layer which elsewhere yielded remains of Tlalpan phase. Date satisfactory for Tlalpan phase.

UCLA-601. Cuicuilco B-16

Charcoal in combined sample from Mound 1, Trench 10, Pit 1, depth 6.31 to 6.46 m and Test Pit 8W, depth 6.5 to 6.7 m below Datum A1. Scattered through basal layer which elsewhere yielded remains of Tlalpan phase. Date satisfactory for Tlalpan phase.

UCLA-602. Cuicuilco B-17

Charcoal from Mound 2, Trench 5, depth 2.41 m below Datum A2 between floors 3 and 4 of Structure I. Same sample as UCLA-208 (2100 ± 75, UCLA II). The average date of 195 B.C. would fall at the beginning of the Cuicuilco/Tezoyuca phases (see comment below).

UCLA-603. Cuicuilco B-18

Charcoal from Mound 2, Trench 5, depth 2.68 m below Datum A2 between floors 2 and 3 of Structure I. Re-run of same sample as UCLA-209 (2300 ± 70, UCLA II). The average date of 315 B.C. would fall in the Ticoman II phase (see comment below).
General Comment (R.F.H. and J.A.B.): UCLA-594 to 596 provide consistent dates for the Middle Zacatenco occupation at Cuicuilco. This occupation appears to be very late Middle Preclassic so a terminal date for the Middle Preclassic period of 500 B.C. (rather than 400 B.C. as suggested in UCLA II) would be supported by these new dates. Also in agreement is the Middle Zacatenco date of 2450 ± 250 (M-662, Michigan III) and the Tlatilco date of 2525 (M-660, Michigan III). Such a dating would provide more time for the seven Late Preclassic phases now recognized, and the following C14-based chronology can be suggested: Ticoman I, 500 to 400 B.C.; Ticoman II, 400 to 300 B.C.; Ticoman III, 300 to 200 B.C.; Cuicuilco/Tezoyuca (H4 figurine horizon), 200 to 100 B.C.; Chimalhuacan, 100 B.C. to A.D. 1; Tzacualli, A.D. 1 to 100.

UCLA-598 to 601 provide consistent dates for the Tlalpan phase of the Early Preclassic period. The Tlalpan phase is a new ceramic complex typologically older than Early El Arbolillo. Since the latter is often dated as beginning around 1500 to 1700 B.C., an extension of the “Beginning” of the known Early Preclassic period in the Valley of Mexico back to 2000 B.C. would not be unreasonable. UCLA-210 (3980 ± 60, UCLA II) and UCLA-212 (4050 ± 75, UCLA II) also fall within the range of 1870 to 2160 B.C. It should be emphasized that, of these six samples, only UCLA-598 was associated directly with Tlalpan sherds and that all six samples (including those of the basal layer) probably represent sterile-earth-and-midden-fill deposits laid down in Middle Zacatenco times. It is therefore possible that the great age of the Tlalpan phase dates is due to some mixture with preceramic charcoal, such as represented by UCLA-211 (6715 ± 90, UCLA II). However, if such had occurred, a greater range of variation in the six dates would be expected.

UCLA-602, 603 (as well as UCLA-206, 208, 209 of UCLA II) were submitted to date the successive floors of Structure I in Mound 2. The fill of this structure was composed of Middle Zacatenco midden and various factors suggested construction during the Ticoman I phase. However, the dates obtained imply rebuiting over an extended time period. The two repeated runs (UCLA-602, 208 and UCLA-603, 209) are in excellent agreement so the discrepancy does not appear to be due to the sampling.

Melchor Ocampo series, Mexico


**UCLA-269. Melchor Ocampo**

510 ± 65

A.D. 1440

Charcoal from Mound A, Pit 1, 120 to 140 cm depth.

**UCLA-270. Melchor Ocampo**

390 ± 65

A.D. 1560

Charcoal from probable hearth, Mound B, Pit 1, 100 to 120 cm depth. Comment (H.B.N.): Site is slightly younger than archaeological evidence in-
dicates. If dates were corrected for the higher atmospheric C¹⁴ activity for this period that tree ring studies indicate, agreement would be excellent.

D. South America

**UCLA-664. Chilca, Peru**

5370 ± 120

3420 B.C.

Cane from remains of semi-subterranean house at Chilca, 50 mi S of Lima on S coast of Peru (13°S Lat, 77° W Long), Pit 105XVI.C. House, belonging to a very early Peruvian culture, was in excellent state of preservation permitting detailed analysis of its construction. Associated with a complex of interlocking refuse mounds covering area of ca. 5 acres. Shell and ash form bulk of midden which has maximum depth of ca. 2 m. *Comment* (C.W.M.): site will be reported by F. Enger who has obtained several other C¹⁴ dates in same time range for this site. Coll. 1963 by C. Donnan; subm. by C. W. Meighan.

**Peat series, South Georgia Island**

Acid moncot and moss peats collected by members of British Antarctic Survey from walls of freshly dug pits in bogs of W Cumberland Bay area, South Georgia Island (54° S Lat, 37° W Long). Samples obtained during I.G.Y. Program, for microfossil and volcanic ash analyses and climate studies. Pollen fairly abundant. Samples (small) subm. by Lucy Cranwell, Tucson, Arizona.

**UCLA-658A. Jason Islet**

4300 ± 800

2350 B.C.

*Poa flabellata* peat ca. 10 ft below wholly organic layer well above rock rubble at 12 ft. Coll. 1961 by the late Jeremy Smith. *Comment*: age comparable with peat so far dated for Albatross Plain, Gough Island (Hafsten, 1960).

**UCLA-658B. W of Grytviken, Profile 21**

6500 ± 500

4550 B.C.


**UCLA-658C. W of Grytviken, Profile 19**

2500 ± 800

550 B.C.

Bottom sample from depth of 55 to 60 in. Coll. 1961 by S. W. Greene. *Comment*: apparently (if the dating from this very small sample can be relied on) peat-formers with more rapid growth have built up this younger profile.

E. Africa

**UCLA-229. Twin Rivers, Northern Rhodesia**

22,800 ± 1000

20,850 B.C.

Travertine from breccia-filled fissure, Twin Rivers, Northern Rhodesia (15° 31’ S Lat, 28° 11’ E Long). Fissures, 5 to 6 ft in depth, occur on top of Twin Rivers Kopje and contain remains of Middle Stone Age industry and fauna. Travertine believed to have been formed as result of seepage of water
down slopes of fissures during cooler and wetter climate of main part of last Pluvial. Travertine sample ca. 1 in. in thickness with thin brown layer through center. Bottom and top halves of sample therefore dated. Age of top layer was 23,700 ± 1000 yr and of bottom layer 21,900 ± 1000 yr; thus it appears that C¹⁴ exchange subsequent to deposition has not been significant. Ages have been computed on basis of 73% of 0.95 NBS oxalic acid. Coll. 1956 and subm. by J. D. Clark, Anthropol. Dept., Univ. of California, Berkeley.

**UCLA-629. Tshangula Cave, Southern Rhodesia** 12,200 ± 250 10,250 B.C.

Charcoal from bottom of Wilton layer, Tshangula Cave, Southern Rhodesia (20° 25’ S Lat, 28° 35’ E Long), overlying consolidated ash containing the Early Wilton Culture of the Later Stone Age. Comment (J.D.C.): result is older than expected in view of (unpublished) Gulbenkian Laboratory date of 9400 ± 100 for the same culture at Pomongwe Cave. Could be consistent, however, if sample came from the consolidated white ash floor and was covered by the ash of the later occupation. Coll. by C. K. Cooke; subm. by J. D. Clark.

**F. Pacific Ocean**

**Palawan Island series, Philippines**

Charcoal from Tabon Cave and Duyong Cave, Quezon municipality, W coast of Palawan Island, Philippines (9° 20’ N Lat, 117° 45’ E Long). The first collections in the Philippines by Beyer and others (Beyer, 1947) of crude stone tools similar to types found in Indonesia and neighboring countries in Asia, and the discovery of fossils of extinct Pleistocene mammals, strongly suggested that man is of great antiquity in the Philippines. However, knowledge concerning early man in the Islands has been built almost entirely upon artifacts recovered on the surface of ground, as sites where controlled archaeological investigations are possible are extremely rare. Thus the discovery in 1962 of 40 caves, on the W coast of Palawan Island, which contained fossil human and animal bones in association with an industry of flake tools of chert, prompted extensive excavations in 1962-63. Tabon Cave provided an extremely attractive site for habitation because of its size, the main chamber being 18 m by 40 m. Also, the great size of the mouth of the cave provided a large, well-lighted and airy chamber. Tabon Cave has not been completely excavated; a much deeper and older flake-tool industry has recently been uncovered but no organic materials have been found with it. On the other hand, Duyong Cave is a small cave and has been completely excavated.

**UCLA-285. Tabon Cave, 50 cm depth** >21,000


**UCLA-284. Tabon Cave, 56 cm depth** 9250 ± 250 7300 B.C.

Charcoal from same layer as UCLA-285, 56 m depth, Mus. No. 9060. Coll. 1962 and subm. by R. B. Fox.
UCLA-283. Tabon Cave, 141 to 151 cm depth >22,000
Charcoal from flake-tool industry layer No. 2, Tabon Cave, 141 to 151 cm depth, Mus. No. 2170. Coll. 1962 and subm. by R. B. Fox.

UCLA-288. Tabon Cave, 147 cm depth >22,000
Charcoal from flake-tool industry layer No. 3, Tabon Cave, 147 cm depth, Mus. No. 4001. Coll. 1962 and subm. by R. B. Fox.

UCLA-287. Duyong Cave, 48 cm depth 4630 ± 250 2680 B.c.
Charcoal, 48 cm depth, Duyong Cave, Mus. No. 284. Associated with Neolithic burial which is overlain by Chalcolithic Jar burial. Sample could be intrusive from upper burial. Coll. 1962 and subm. by R. B. Fox and A. Evangelista.

UCLA-286. Duyong Cave, 62 to 68 cm depth 7000 ± 250 5050 B.C.
Charcoal from a flake-tool industry layer, 62 to 68 cm depth, Duyong Cave, Mus. No. 533 and 611. Associated with a midden layer of shells below a late Neolithic burial. Coll. 1962 and subm. by R. B. Fox and A. Evangelista.

Comment: sample size was in general very small; hence it is hoped that further excavations will yield larger samples so that actual ages could be assigned to UCLA-283, 285, 288. Of the many possible causes of the stratigraphic discrepancy between UCLA-284 and 285, the most likely is the egg-laying activities of the tabon or megapode bird which have mixed up artifacts that vary considerably in age. Three “infinite” dates, however, clearly establish considerable antiquity of flake-tool industry. This age is supported by the complete absence of shells from these layers, presumably because during a glacial period the shore line would have been 20 to 30 km from Tabon Cave, too remote for shellfish to be regularly utilized (Fox, 1963).

UCLA-279. Mitaka City, Japan 4570 ± 150 2620 B.C.
Charcoal from under pile of large pebbles, in community site, Mitaka City, Tokyo, Japan (35° 41’ 16” N Lat, 139° 31’ 36” E Long). Sample in humus layer, 75 cm depth, associated with Atamadai and Katsusaka types of pottery of early half of Middle Jomon period. Expected age 4800 yr. Coll. 1962 by J. E. Kidder, Jr; subm. by G. C. Kennedy.

G. England

Medieval English Carpentry series, England
The three most important timbers of a timber-frame building are the post, the tiebeam and the top-plate. Differences in the actual order of assembly of these three timbers and of the joints used have been investigated (Hewett, 1961) for they should correlate with historical evidence as to age of structure. Coll. and subm. by C. A. Hewett, Coggeshall, Essex, England.

UCLA-646. Barley-barn, Cressing Temple 940 ± 70 A.D. 1010
Oak from principal post, SW corner of Barley-barn, Cressing Temple, Witham, Essex (51° 50’ N Lat, 0° 36’ E Long). This Barley-barn believed
built by Knights Templar, on land granted them by Queen Maud in A.D. 1150. The joints used in construction are of a type that is extremely rare in England and was obsolete in France by A.D. 1225.

**UCLA-272. Barley-barn, Cressing Temple**  
A.D. 1710

Oak from post-plate, E side of Barley-barn, Cressing Temple. Comment: re-examination of the building has shown that UCLA-272 was cut from an inserted timber and dates the second major reconstruction of the barn.

**UCLA-273. Navestock Church, Essex**  
A.D. 1180

Wood from “notched-lap-joint,” Navestock Church, Essex (51° 40’ N Lat, 0° 13’ E Long). This type of joint was obsolete in France by A.D. 1260.

**UCLA-274. Belchamp St. Paul’s, Essex**  
A.D. 1410

Oak from tiebeam of barn at the Hall, Belchamp St. Paul’s, North Essex (52° 4’ N Lat, 0° 38’ E Long). This tiebeam believed to be one cited in a lease of A.D. 1120.

**UCLA-645. Belchamp St. Paul’s, Essex**  
A.D. 1350

Wood from one of the posts on which tiebeam (UCLA-274) rests. Comment: together with UCLA-274, confirms that transverse frame is of uniform date and younger than expected.

**References**

Date lists:

- Chicago II Libby, 1951
- Chicago III Libby, 1952
- Chicago V Libby, 1954
- La Jolla II Hubbs, Bien and Suess, 1962
- Lamont IV Broecker and Kulp, 1957
- Lamont VII Olson and Broecker, 1961
- Michigan III Crane and Griffin, 1958
- UCLA I Fergusson and Libby, 1962
- UCLA II Fergusson and Libby, 1963
- Yale IV Deevey, Gralenski and Hoffren, 1959


——— 1954, Chicago radiocarbon dates V: Science, v. 120, p. 739.


OHIO WESLEYAN UNIVERSITY
NATURAL RADIOCARBON MEASUREMENTS I

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Delaware, Ohio

INTRODUCTION

Installation of a Sharp CDL-14 Carbon-Dating Laboratory was completed at Ohio Wesleyan University in June, 1962. The unit includes a sample conversion system constructed by Radiochemistry, Incorporated for the conversion of carbonaceous samples to the counting gas, methane. Counting equipment consists of a modified Sharp Low Beta system with a 6kv power supply and dual printout registers which automatically blank the counting circuits for 0.1 min for each 100-min printout. The detector has a sensitive volume of 0.5 L and is housed in a shield consisting of 8 in. of lead, 1 in. of steel, and 1 in. of mercury. Anticoincidence is provided by a cylindrical 2-L detector containing 16 anodes and filled with petroleum-generated methane to a pressure of 96 cm Hg.

Operating pressures for the sample counter range from 76 cm to 304 cm, depending upon sample size. The background at 76 cm is 1.56 cpm and at 304 cm is 1.86 cpm. Because of significant variations in count rates obtained from sample preparations of oxalic acid (presumably due to fractionation effects), prepared by wet combustion methods, we have recently switched to 1850 wood. Age-corrected counts on the 1850 wood are statistically indistinguishable from 0.95 times the mean of our oxalic acid count rates. Contemporary standard (1850 wood) count rates show a linear relationship within the range of operating pressures, with a count rate of 4.13 cpm at 76 cm and 11.89 cpm at 304 cm.

Samples are counted for at least 1000 min during each of three separate counter fillings. Ages are calculated from comparison with 5000-min background and contemporary standard counts. Background and contemporary standard activities are monitored at weekly intervals to insure stability of the counting system.

All samples are pre-treated with 2% NaOH and 10% HCl. Peat and gyttja samples are pulled down by suction and washed over glass fiber discs and then dried at 105°C before combustion. All methane samples are stored for one month to permit decay of radon.

Ages are quoted with a 1σ counting error, which includes the statistical variation of the sample count as well as that for background and the contemporary standard. The half-life value is 5568 yr, and the reference year is 1950. Check samples, described in more detail in the body of the date list, are given in Table 1.

The limit of sensitivity for the 0.5 L detector, based on a counting time of 3000 min and using the 4σ criterion, is 28,750 yr at 1 atm and 38,750 yr at 4 atm.
Table 1

Interlaboratory check sample dates

<table>
<thead>
<tr>
<th>OWU Sample No.</th>
<th>Sample material</th>
<th>OWU Age</th>
<th>Check Lab Sample No.</th>
<th>Check Age</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>wood</td>
<td>11,352 ± 211</td>
<td>0-766</td>
<td>11,650 ± 250</td>
<td>Kaye, 1962</td>
</tr>
<tr>
<td>8</td>
<td>wood</td>
<td>19,906 ± 691</td>
<td>W-598, Y-1248</td>
<td>20,100 ± 800</td>
<td>USGS V, 1960</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20,230 ± 200</td>
<td>Stuiver (pers. commun.)</td>
</tr>
<tr>
<td>42</td>
<td>wood</td>
<td>18,899 ± 270</td>
<td>OWU-8</td>
<td>Re-run of OWU-8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5300 ± 120</td>
<td>Lamont V, 1959</td>
</tr>
<tr>
<td>16</td>
<td>wood</td>
<td>5394 ± 152</td>
<td>Y-882</td>
<td>5590 ± 140</td>
<td>Yale VII, 1962</td>
</tr>
<tr>
<td>17</td>
<td>wood</td>
<td>7040 ± 291</td>
<td>Y-843</td>
<td>6810 ± 170</td>
<td>Yale VI, 1961</td>
</tr>
<tr>
<td>19</td>
<td>peat</td>
<td>1904 ± 84</td>
<td>H-72/88</td>
<td>2050 ± 110</td>
<td>Overbeck, 1957</td>
</tr>
<tr>
<td>52</td>
<td>wood</td>
<td>17,880 ± 224</td>
<td>W-91</td>
<td>18,050 ± 400</td>
<td>USGS I, 1954</td>
</tr>
<tr>
<td>71</td>
<td>peat</td>
<td>23,382 ± 400</td>
<td>L-221-B</td>
<td>23,450 ± 300</td>
<td>Lamont V, 1959</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(cellulose) 25,050 ± 300</td>
<td>Lamont V, 1959</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(lignin)</td>
<td></td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

The support of the National Science Foundation (G21290) for the installation and operation of the equipment is gratefully acknowledged. Thanks are also due to M. Stuiver, W. J. Wayne, W. S. Broecker, and J. L. Forsyth for submitting previously dated samples as checks on the operation of our system. We are indebted to Dr. George W. Burns and Miss Barbara Bruce of Ohio Wesleyan University for identification of the wood samples described in this date list. Finally, the senior author wishes to thank Professor H. Godwin and Dr. Erik Willis of the Cambridge University Radiocarbon Dating Laboratory and Dr. H. Tauber of the Copenhagen Laboratory for many helpful and stimulating suggestions while he was visiting their laboratories under a John S. Guggenheim Fellowship.

SAMPLE DESCRIPTIONS

OWU-6. Squibnocket Cliff, Massachusetts

Pine wood (id. by B. Bruce) from a forest bed in a limnic section exposed in a wave-cut cliff on the island of Martha’s Vineyard, Massachusetts (41° 18’ N Lat, 70° 46’ W Long). Coll. 1960 by C. A. Kaye, U. S. Geol. Survey, and J. G. Ogden, III, Ohio Wesleyan Univ.; subm. by Ogden. Comment: beaver-gnawed twigs, as well as needles and cones of pine and spruce have been reported by Kaye (1962) from this and several similar sites in SE New England. A similar sample from this deposit was dated by Humble (0-766) at 11,650 ± 250 (Kaye, 1962). A piece of the same log as OWU-6 was subm. to the Smithsonian Institution (this date list) as an interlaboratory check sample. Their determination (SI-3) is 10,900 ± 144. The pollen stratigraphy of this site was discussed by Ogden (1963) in reference to earlier C14 dates reported from the site by the Yale and USGS laboratories (Yale V; USGS V). Samples from a similar deposit found at Point Judith, Rhode Island on the 1962 Friends of the Pleistocene Field Conference were subm. and run as OWU-22 (this date list).

OWU-8. Johnson County, Indiana

Spruce wood (id. by B. Bruce) from the cutbank of a stream in the SW ¼ NW ¼ Sec 30, T11N, R4E (Fruitdale, Indiana 71/2 min quadrangle), about 6 mi E of Morgantown, 3½ mi S of Trafalgar, and about ¾ mi N of the Wisconsin glacial boundary. The cutbank of the stream exposed a veneer (approx. 1 m thick) of alluvium overlying unweathered calcareous till of Wisconsin age (approx. 80 cm), which in turn overlay brown, noncalcareous silt and sand of a buried floodplain sediment (approx. 1 m thick) that rested upon till with the lithic characteristics of the Illinoian till of this area. The sequence is continuous along the creek bank for a few hundred yards. Wood fragments were abundant in the buried alluvial silt and sand. Sample came from 30 cm beneath contact with the overlying Wisconsin till. A similar sequence exposed at Trafalgar a few mi to the N yielded the following dates from closely similar positions: W-598, 20,100 ± 800 and W-597, 20,300 ± 800 (USGS V, 1960). Coll. and subm. by W. J. Wayne, Indiana Geol. Survey. Comment (JGO):
pieces of this wood were subm. to the Smithsonian Institution and to Yale University as interlaboratory check samples. The Smithsonian date (SI-4) of 16,513 yr seems quite young, and therefore a second sample was prepared here. See OWU-42, this date list. The determination by the Yale Geochronometric laboratory (Y-1248) gave 20,230 ± 200 yr, which is in good agreement with OWU-8.

OWU-10. Cochrane, Ontario 6756 ± 111

Wood peat from a bog exposed on the S side of Highway 11 near Cochrane (49° 3' N Lat, 81° 6' W Long), Ontario, about 1.65 mi E of bridge over Frederick House River. Sample coll. from 1 in. above contact with glacio-lacustrine sediments as an interlaboratory check sample near site of W-136 (6380 ± 350, USGS II), and L-433C (5300 ± 120, Lamont V). Coll. 1961 by J. Terasmae and J. G. Ogden, III; subm. by Ogden. Comment (JT): pollen work done since W-136 and L-433C seems to support OWU determination. The pollen studies are supported by other dates from the region. This date is a minimum age for the drainage of Lake Barlow-Ojibway.

OWU-14. Martha’s Vineyard, Massachusetts 8075 ± 103

White pine cone (id. by G. W. Burns) from 3 ft below surface in a small bog exposed during construction of an access road near town of Gay Head on the island of Martha’s Vineyard, Massachusetts (41° 18' N Lat, 70° 46' W Long). Coll. 1960 by Mrs. W. Howland, Chilmark, Mass.; subm. by J. G. Ogden, III. Comment: associated pollen spectra indicated B pollen zone age (7000 to 9000 yr). Sample run to test possibility that white pine grew on Martha’s Vineyard in historic time.

OWU-16. Mesters Vig, Greenland 5394 ± 152

Spruce driftwood (id. by B. Bruce) recovered from till-like deposit (72° N Lat, 24° W Long) at Blyryggen, alt 4 ± 0.5 m. Coll. 1960 by A. L. Washburn; subm. by M. Stuiver, Yale Univ. Comment (JGO): sample subm. as an interlaboratory check sample. Dated by Yale as Y-882, 5590 ± 140 (Yale VII).

OWU-17. Stiles Brickyard, Connecticut 7040 ± 291


OWU-19. Gifhorn, Germany 1904 ± 84 A.D. 46

Peat from 2 cm above SWK (Grenzhorizont) at Grosses Moore 1 mi N of Gifhorn, Germany. Coll. 1962 by J. G. Ogden, III, and subm. as an interlaboratory check sample. The relevant dates for this profile are: H 72/88, 0 to 2 cm above SWK, 2050 ± 110; and H 71/85, 0 to 2 cm below SWK, 2100 ± 100 (Overbeck et al., 1957). Comment (JGO): although OWU sample age...
seems to be approx. 150 yr too young, the original exposure was unavailable, and our sample was taken from a peat face approx. 400 yd W of the original sample locality. In view of the variability of sample dates from recurrence horizons, there is no reason to believe the difference between our date and the Heidelberg date (H72/88) to be significant.

**OWU-21. Delaware, Ohio, Modern Grass**

\[ \delta C^{14} + 20\% \]

Modern grass clippings coll. on University Campus (40° 18' N Lat, 83° 4' W Long) to determine C\(^{14}\) enrichment due to atomic bomb testing. Coll. May 1962 and subm. by J. G. Ogden, III. Comment: sample is in agreement with values found by Godwin and Willis (Cambridge V) for contemporary samples.

**OWU-22. Point Judith, Rhode Island**

10,906 ± 112
8956 B.C.

Beaver-gnawed pine wood (id. by G. W. Burns) coll. near high tide level, Point Judith beach (41° 20' N Lat, 71° 32' W Long), on Friends of Pleistocene Field Conference, May 1962. Macrofossils and pollen spectra closely resemble similar sections described by Kaye (1962), and in particular the Squibnocket forest bed (OWU-6, 11,352 ± 211, this date list) described by Ogden (1963).

**Blaney Pond series, Naushon Island, Massachusetts**

Finely divided woody peat coll. by Livingstone piston corer in Blaney Pond, Naushon Island, Massachusetts (41° 18' N Lat, 70° 45' W Long). Samples coll. to determine the length of time of the B pollen zone for this deposit. Pollen studies and additional C\(^{14}\) dates from this core will be used to calibrate the late-glacial and postglacial pollen sequences of the offshore islands of SE New England (Ogden, 1963). Coll. 1962 and subm. by J. G. Ogden, III.

**OWU-27. BP 1.11-1**

8108 ± 105
6158 B.C.

Upper part of B pollen zone just below rise in oak pollen curve. Sample from 9.90 to 10.02 m.

**OWU-28. BP 1.11-2**

9482 ± 319
7532 B.C.

Lower part of B pollen zone just above spruce decline. Sample from 10.44 to 10.54 m.

**Gray’s Lake series, Gray’s Lake, Illinois**

Clay gyttja from a sediment core coll. with a 1.5 in. Livingstone piston sampler in Gray’s Lake, Lake County, Illinois (42° 20' N Lat, 88° 3' W Long). Pollen stratigraphy is being studied by P. B. Sears, Yale Univ. Coll. 1961 by P. B. Sears and J. G. Ogden, III; subm. by P. B. Sears.

**OWU-33. GL-1: 313**

4003 ± 97
2053 B.C.

Stiff clay gyttja from 8.70 to 8.82 m.
OWU-34.  GL-1: 314  
6539 ± 97  
4589 B.C.
Marly clay gyttja from 9.92 to 10.08 m.

OWU-42.  Johnson County, Indiana  
18,899 ± 270  
16,949 B.C.
Re-run of OWU-8 (this date list) following Smithsonian Institution date of 16,513 (SI-4).  Comment: although OWU-42 is younger than the original determination of OWU-8 (19,906 ± 691) we attribute this to a small leak in our methane reactor which has since been rectified. The difference between the two OWU determinations is not significant.

OWU-51.  Mound City, Ohio  
1772 ± 53  
A.D. 178
Charcoal from Mound 10 Feature 12A Mound City Group National Monument (39° 22' 35" N Lat, 83° 0' 10" W Long). Sample from charred layer beneath sub-floor cremation which included one cord-marked pottery sherd with a copper headdress and copper adze resting on top of the layer. Coll. 1963 and subm. by R. S. Baby, Ohio State Mus., Ohio State Univ.  Comment (RSB): date fits with Hopewellian artifacts characteristic of site.

OWU-52.  Bier's Run, Ross County, Ohio  
17,880 ± 224  
15,930 B.C.
Spruce log (id. by B. Bruce) projecting from till bank along Bier's Run in Ross County, South Union Township, 5.5 mi NW of Chillicothe, Ohio. Overlain by 2 ft of fine sand and 3 ft of till. Coll. 1963 and subm. by J. L. Forsyth, Ohio Geol. Survey.  Comment: sample run as interlaboratory check sample. Previous sample from this locality, W-91, gave 18,050 ± 400 (USGS I).

OWU-53.  Black Lake, Logan County, Ohio  
10,558 ± 365  
8608 B.C.
Clay gyttja from sediment core BL-2 coll. with a Livingstone piston sampler in Black Lake (40° 16' N Lat, 83° 54' 5" W Long). Sample depth from 7.00 to 7.10 m.  Comment: sample, like the Silver Lake, Ohio series (this date list) is part of a general research program into the sedimentation rates, pollen and C14 stratigraphy of lakes in Ohio by Ogden. Although additional dates and the pollen stratigraphy of this deposit will be published subsequently, this date is included because it dates the replacement of spruce by oak in this part of Ohio. See also Silver Lake series, OWU-39, this date list.

OWU-59.  Homolka Hut T, Kladno County, Czechoslovakia  
3424 ± 185  
1474 B.C.
Charcoal from 1.5 m deep in the deposits of Hut T, a late unit at the site of Homolka, village Stehlečeveny, Kladno County, 11 mi WNW of Prague, Czechoslovakia. This is a fortified hilltop village site of the Řívnač culture, Eneolithic period, with sparse Early Bronze Age (Uněticce) material apparently overlying the Eneolithic deposits at this point. The foundation of the pit was cut into the slope of the hill and contained Eneolithic material only. The overlying stratum contained a mixture of Řívnač and Early Bronze Age wares and the traces of a Bronze Age house. Sample comes from the Eneolithic deposit.

**OWU-60. Slanska Hora, Czechoslovakia**

2946 ± 185

996 B.C.

Charcoal from site of Slanska Hora at Slany, 18 mi NW of Prague, Czechoslovakia. Like OWU-59, this comes from a fortified hilltop Eneolithic settlement of the Řívač culture (Pit 4). Coll. 1960 by V. Moucha; subm. by R. W. Ehrich. Comment (RWE): since these dates are considerably younger than the presumed archaeological date (which has an established relation to C¹⁴ dates of earlier and later periods in neighboring territory), the samples must either be contaminated or stem from a context later than the Eneolithic (Řívač) age claimed for it.

**McGraw series, Chillicothe, Ohio**

Charcoal from a Hopewell village site located 1 mi S of Chillicothe, Ohio (39° 18' N lat, 82° 59' W Long). Site includes fruits and nuts of hickory, walnut, acorn, hackberry, and wild plum, in addition to two races of corn. Coll. and subm. by O. H. Prufer, Case Inst. of Tech., Cleveland, Ohio. Comment (OHP): samples are from a Hopewell midden, which is culturally homogeneous (as is the entire site). The midden was overlain by an average of two ft of flood deposit composed of two distinct layers. Ceramic affiliations indicate a late classic Hopewell occupation. The dates are acceptable.

**OWU-61. McGraw Unit C-1**

1469 ± 65

A.D. 481

**OWU-62. McGraw Unit D-2**

1515 ± 166

A.D. 435

**Silver Lake series, Logan County, Ohio**

Gyttja from sediment cores SL-1, SL-2 and surface sample core SL-3, taken with a 1.5 in. Livingstone piston corer in 11.6 m of water in the W basin of Silver Lake (40° 21' N Lat, 83° 48' W Long), 7 mi W of Bellefontaine, Ohio. Samples were measured as part of a research program into sedimentation rates in hard- and soft-water lakes. Pollen stratigraphy and carbonate analyses of the lake sediments are reported in Ogden (in press). Depths are corrected for slight compaction during extrusion. Coll. by J. G. Ogden, III.

**OWU-72. SL-3:1 Surface 0-10 cm, Marl**

829 ± 62

Marl, CO₂ generated by hydrolysis with HCl.

**OWU-72A. SL-3:1 Surface 0-10 cm, Organic**

1353 ± 66

Same as OWU-72, but organic fraction.

**OWU-30. SL-2: 257-1 Surface 0-10 cm, organic**

1186 ± 161

Organic fraction at surface of core SL-2.

Comment: because this lake is located in a region of limestone-rich till, it was expected that sample ages would be “too old” by an amount proportional to the amount of Paleozoic carbonate in the lake system. Further studies are in progress by means of which both C¹⁴ dating and pollen stratigraphy will be
used to cross-calibrate sediment cores from this and other lakes in Ohio, from both hard- and soft-water areas. As a consequence of the surface sample ages listed above, the remaining dates in this list are presented with a correction of 1200 yr as an initial estimate of “old” carbon dilution.

**OWU-38.** SL-2: 257-4 60-70 cm, organic 106 ± 100 A.D. 1844

Sample from sharp rise in *Ambrosia* curve, marking introduction of European agriculture.

**OWU-47.** SL-2: 260-4 130-140 cm, organic 418 ± 101 A.D. 1532

Sample from 2d *Fagus* pollen maximum.

**OWU-77.** SL-2: 261-4 210-220 cm, organic 1090 ± 423 A.D. 860

Sample from base of 2d *Fagus* pollen maximum.

**OWU-57.** SL-2: 264-2 400-410 cm, organic 3833 ± 217 1883 B.C.

Sample from top of 1st *Fagus* pollen maximum.

**OWU-58.** SL-2: 265-4 500-510 cm, organic 4095 ± 232 2145 B.C.

Sample from base of 1st *Fagus* pollen maximum.

**OWU-39.** SL-2: 254-1 605-615 cm, organic 9588 ± 210 7638 B.C.

Sample from spruce-oak transition in Silver Lake. Final disappearance of *Picea* pollen, and sharp rise in *Quercus*, *Carya*, and *Ulmus* pollen.

**OWU-71.** Dashwood Cliff, Vancouver Island, British Columbia 23,382 ± 400 21,432 B.C.

Peat from the base of the Quadra sediments exposed at Dashwood (49° 22' N Lat, 124° 31' W Long) near Qualicum Beach on Vancouver Island, British Columbia. Coll. 1953 by J. G. Fyles and subm. by W. S. Broecker as an interlaboratory check sample. Age determination by the Lamont Geological Observatory gave the following ages on chemical fractions; L-221B: peat cellulose, 23,450 ± 300 and L-221B: peat lignin, 25,050 ± 300 yr (Lamont V). *Comment* (JGO): because of the small sample size, the whole sample was burned after pretreatment with NaOH and HCl. The OWU date is in excellent agreement with the Lamont determination.

**References**

Date lists:

- Cambridge IV Godwin and Willis, 1961
- Lamont V Olson and Broecker, 1959
- USGS I Suess, 1954
- USGS II Rubin and Suess, 1955
- USGS V Rubin and Alexander, 1960
- Yale V Stuiver, Deevey and Gralenski, 1960
- Yale VI Stuiver and Deevey, 1961
- Yale VII Stuiver and Deevey, 1962
- Yale VIII Stuiver, Deevey, and Rouse, 1963

Jumping text...
GRONINGEN RADIOCARBON DATES V

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INTRODUCTION

This date list mainly contains results obtained for archaeological samples which were measured in the Groningen laboratory in the course of the years and which have not hitherto been published in a similar form. As such it is an extension of the previous date list (Groningen IV) and reference is made to this publication for information on the method of presentation, the corrections applied, etc. Samples which are primarily of geological significance will be presented separately in next year's list.

All samples were pretreated with hot dilute hydrochloric acid to remove carbonates and mobile organic material. In cases where, in addition, a humic acid extraction was performed with hot dilute sodium hydroxide it is explicitly mentioned in the text.

It should be pointed out that the C\textsuperscript{13}/C\textsuperscript{12} ratios of the samples have not been measured and that consequently the dates have not been adjusted to correct for variations in the C\textsuperscript{14}/C\textsuperscript{12} ratio due to isotope fractionation. With few exceptions the variations in the initial C\textsuperscript{14} content of plant material does not exceed ± 1% so that the error introduced is less than 80 yr. If users of the dates prefer to incorporate this additional uncertainty in the statistical error it can be done by using the formula

\[ \tilde{\sigma} = \sqrt{\sigma^2 + 40^2} \]

where \( \sigma \) is the statistical uncertainty attached to the date in the list.

Sample descriptions and comments have been compiled on the basis of written communications by the submitters. Usually only one recent reference to literature is given.

SAMPLE DESCRIPTIONS

1. OLD WORLD ARCHAEOLOGY

A. Paleolithic

GrN-2640. Al Ghab, Syria >53,000

Peaty clay with charcoal underlying fluviatile clays with gravel and a Late Levalloisian flint industry at Al Ghab (39.70° N Lat, 40.35° E Long), near Karkour, Syria (Van Liere, 1960-1961), depth 5 m. African fauna elements are lacking in the fluviatile clays, which therefore must be later than beginning of Würm period. Peat would correspond to first Würm interstadial. Coll. 1959 and subm. by W. J. van Liere, P. O. Box 256, Damascus, Syria. Comment: the infinite date is quite satisfactory for this early Würm oscillation.

GrN-2556. Ras el-Kelb, Lebanon >52,000

Charred bone from a Levalloiso-Mousterian culture layer (breccia) in cave of Ras el-Kelb (33° 58' N Lat, 35° 34' E Long), near Beirut, Lebanon

* Physics Laboratory, Westersingel 34, Groningen, and Biological-Archaeological Institute, Poststraat 6, Groningen.
(Garrod, 1956), depth 4.65 to 6.00 m. Age is expected to be about the same as that of Et Tabun C (GrN-2729: 40,900 ± 1000 in Groningen IV). Coll. 1939 by D. A. E. Garrod and G. Henri-Martin; subm. by D. A. E. Garrod, Villebois-Lavalette, Charente, France. Comment: no explanation for the difference between the Et Tabun and Ras el-Kelb dates.

Gorham’s Cave series, Gibraltar

In 1957 two charcoal samples were dated from Gorham’s Cave, Gibraltar (36° 08’ N Lat, 5° 18’ W Long) (Waechter, 1951; Zeuner, 1953). Because of the importance of this site two new samples were collected and measured in 1958 to obtain more precise dates. Coll. by K. P. Oakley and Mrs. C. Tipp; subm. by K. P. Oakley, British Mus. (Nat. History), London.

GrN-1363. Gorham’s Cave D 27,860 ± 300 25,910 B.C.
GrN-1455. Gorham’s Cave D (new sample) 28,700 ± 200 26,750 B.C.
Charcoal from Layer D containing Upper Paleolithic (Aurignacian) industry. Comment: occupation occurred during last of three low sealevel periods presumably belonging to last glaciation.

GrN-1556. Gorham’s Cave G 49,200 ± 3200 47,250 B.C.
GrN-1473. Gorham’s Cave G (new sample) 47,700 ± 1500 45,750 B.C.
GrN-1678. Gorham’s Cave G “humus” fraction >47,000
Charcoal from Layer G, uppermost Mousterian layer, with large amount of flakes and implements. Comment: sedimentation took place during second of low sealevel phases: GrN-1678 is the humus fraction of GrN-1473.

General Comment: GrN-1363 was only pretreated with acid; the humus was removed from the other three samples by treatment with acid and alkali.

GrN-2488. Devil’s Tower No. 3, Gibraltar >30,000
Small sample from Devil’s Tower shelter approx. 1 km N of Gorham’s Cave (see above) at Gibraltar (36° 08’ N Lat, 5° 18’ W Long). Coll. by Prof. Garrod; subm. 1961 by K. P. Oakley. Comment: associated industry is Upper Mousterian and closely resembles that of Layer G in Gorham’s Cave (GrN-1473). Because sample was small it was only pretreated with acid. Even then quantity of gas was insufficient for more precise measurement.

Kalambo Falls series, Northern Rhodesia

Kalambo Falls (08° 35’ S Lat, 31° 15’ E Long) are at SE end of Lake Tanganyika on territorial boundary between Northern Rhodesia and Tanganyika. In a small basin above falls are three main series of sediments forming three terrace features at ca. 20 m, 10 m, and ca. 5 m above the river. These contain a nearly continuous cultural sequence from end of Earlier Stone Age (Late Acheulian) up to present day. Excavations carried out since 1953 by J. D. Clark of Rhodes-Livingstone Mus., now of Dept. of Anthropol., Univ. of California, Berkeley, have exposed a series of well-stratified living floors,
stream, lake and swamp sediments, and erosion surfaces with a wealth of associated cultural remains (Clark, 1954, 1962). Oldest surfaces and floors contain wooden as well as stone artifacts and evidence of fire-using. E. M. van Zinderen Bakker was able to detect in the pollen climatic variations which represent a pre-Gamblian wet period (Late Kanjeran ?), the Gamblian, and the Holocene. C\textsuperscript{14} dates indicate that time span involved is from early Würm onwards. Results obtained from these samples confirm and extend range of dates obtained by Broecker and Kulp (Lamont V). Samples coll. during 1959 excavations and subm. by J. D. Clark in 1959, except where otherwise stated.

\textbf{GrN-3189. Kalambo Falls 1/59R} \hspace{1cm} 370 \pm 50 A.D. 1580

Charcoals at 60 to 90 cm depth in Iron Age clay from Site B2 representing closing stages of Kalambo Culture (Channelled Ware pottery). Expected age not later than A.D. 1400. \textit{Comment}: due to known variation in C\textsuperscript{14} content of atmosphere during this time, age of ca. A.D. 1350 also possible.

\textbf{GrN-3580. Kalambo Falls 4/59R} \hspace{1cm} 930 \pm 40 A.D. 1020

Charcoals at 2.1 m depth in Iron Age clay at Site B2 associated with Channelled Ware pottery. Expected age A.D. 1000. \textit{Comment}: date compares well with L 395B: 1080 \pm 180 from Site A1 (Lamont V).

\textbf{GrN-3196. Kalambo Falls 11/59R} \hspace{1cm} 40,600 \pm 1300 \hspace{1cm} 38,650 b.c.

Charcoal flecks and small fragments in gray sand 15 cm below main (Middle Stone Age) stone line in Trench A4 representing later stages of typical Sangoan Culture (First Intermediate Period). Clay bank covering GrN-3226 had been cut out here by erosion. Pollen evidence indicates climate was cooler and wetter than in immediately following stages. \textit{Comment}: sample was carefully pretreated with acid and alkali.

\textbf{GrN-3226. Kalambo Falls 16/59R} \hspace{1cm} 46,100 \hspace{1cm} 44,150 b.c.

Small sample of charcoal below clay bank in fine white sand in Trench A4 stratigraphically of same age as previous sample (GrN-3196). \textit{Comment}: too little C was present for a full sample and no more exact age could be measured. The two dates are, however, not inconsistent. Fully pretreated for humic-acid removal.

\textbf{GrN-3228. Kalambo Falls 5/59R} \hspace{1cm} 37,900 \hspace{1cm} 35,950 b.c.

Small sample of wood in coarse sand 1.5 m under main (Middle Stone Age) stone line and over gravel stringer containing Sangoan waste. Since Sangoan sediments are characterized by much cutting and filling and culture is conservative, it is difficult to correlate the succession on the different sites. \textit{Comment}: pretreated for humic acid extraction. Sample dates lower levels of Sangoan at Site B. This and following samples GrN-3237 and GrN-3608 should probably be older than previous two, but as all lie within statistical error no
definite conclusion can be drawn as to length of time-lapse. One other finite date for Sangoan Culture at Kalambo has been reported by Lamont: L-399C: 43,000 ± 3000 (Lamont V), in good agreement with above figures.

**GrN-3237. Kalambo Falls 8/59R**  
42,000 ± 2000  
40,050 b.c.

Wood fragments in sterile lower coarse sand 2.3 m under main (Middle Stone Age) erosion surface at Site B2. Sangoan artifacts (middle to lower stages ?) occur sporadically in gravel stringers at this depth. *Comment*: fully pretreated for humic acid removal.

**GrN-3608. Kalambo Falls 18/59R**  
>32,600

Small sample of charcoals 4 m below clay bank in Trench A4 from dark grey clay containing Sangoan artifacts. *Comment*: too little C remained after pretreatment to give full sample.

**GrN-3211. Kalambo Falls 26/59R**  
>49,000

Wood immediately over lower clay layers and from lowest Sangoan level in Trench A4. *Comment*: fully pretreated for humic acid removal. Date appears old for Sangoan and it is possible that wood might have been derived from clays on which it was lying and which in 1963 excavations at Site A were associated with a transitional Acheulian-Sangoan industry.

**GrN-1396. Kalambo Falls /57**  
>52,000

**GrN-2644. Kalambo Falls /57, enriched**  
57,600 ± 750  
55,650 b.c.

Log of well-preserved wood from Floor 6 at Site A1, 6.7 m below surface, associated with late Acheulian industry (handaxes, cleavers and flake tools) which preceded Sangoan at this site. Subm. in 1957. *Comment*: both samples were fully pretreated with acid and alkali to remove humic acids. C\textsuperscript{14} in GrN-2644 was enriched by a factor of 8.7 before measurement (Haring and others, 1958). C\textsuperscript{14} concentration was 0.07% of that of modern C. The uncertainty in the enrichment factor is included in the standard error given. Date would place culture in early stages of last Glacial Period. As no major stratigraphical break could be observed between these Acheulian floors and overlying Sangoan and Middle Stone Age series Clark came to same conclusion “that these deposits must belong to a single climatic cycle” (Clark, 1954). Earlier (Acheulian) part of cycle has been referred to as early Gamblian (Clark, 1962) or as late Kanjeran (Cole, 1963) since this pluvial stage and culture have been considered co-terminous.

**GrN-2438. Radošiná, Czechoslovakia**  
38,400 +2800  
36,450 b.c.  
-2100

Charcoal from fireplace in cave “Čertova pec,” at Radošiná (48° 33’ N Lat, 17° 35’ E Long), district Topolčany, Slovakia (Bárta, 1959) depth 1.90 to 2.00 m. Location close to the entrance. Culture layer would belong to Szeletian; geological age would be optimum of Würm I-II interstadial. Coll. by J. Bárta; subm. by H. T. Waterbolk. *Comment*: sample was too small to be given more than an acid pretreatment and age may therefore be too young.
GrN-2181. Nietoperzowa, Poland

Well-preserved charcoal from cave of Nietoperzowa at Jerzmanowice (50° 10' N Lat, 19° 54' E Long), near Cracow, Poland. Culture layer, originally described by L. Kozlowski (1924) as belonging to Solutrean, is now considered pre-Solutrean (Szeleta-group). Geological age would be final Würm II. Sample was taken in innermost part of cave. Sterile layer of 0.70 m separates Paleolithic culture layer from Neolithic layer. Coll., 1958 and subm. by W. Chmielewski, Archaeol. Mus., Lódz. Comment: date is indeed much older than that of Solutrean sample from Laugerie Haute (GrN-1888: 20,890 ± 300, in Groningen IV, p. 167). No significant difference from date of Radosina GrN-2938: 38,400, above, also belonging to Szeleta-group of paleolithic cultures.

GrN-2376. Grotte du Renne XII

In Groningen IV (p. 166) two dates were given for Layers VII and VIII from cave Grotte du Renne (47° 35' 54" N Lat, 3° 58' 30" E Long), Arcy-sur-Cure, Yonne, France. Results were GrN-1717: 30,800 ± 250 and GrN-1742: 33,860 ± 250 respectively. A further sample, of charred bones from Layer XII, labelled "post-mousterien," has now been dated. Coll. and subm. by A. Leroi-Gourhan, Musée de l’Homme, Paris, France. Comment: date has to be considered as a terminus post quem, since material was treated as charcoal and alkali soluble fraction (humus fraction) measured.

GrN-2470. Nemšová, Czechoslovakia

Charcoal from culture layer in loess deposit at depth of 4.50 to 4.60 m at Nemšová (48° 58' N Lat, 18° 7' E Long), district Trenčín, Slovakia (Bárta, 1961). Layer probably belongs to Gravettian. Geological age would be the W II/W III interstadial. Coll. by J. Bárta; subm. by H. T. Waterbolk. Comment: date is considerably older than those for Gravettian of Nitra-Čermáň and Ságvár (see below), but as far as geological correlation is concerned, compares well with fossil soil horizon dates at Stillfried, Austria as GrN-2533: 28,340 ± 200 and is correlated with “Paudorf” warm phase (Fink, 1962).

GrN-2449. Nitra-Čermáň, Czechoslovakia

Charcoal from fireplace in Gravettian culture layer in loess deposit at depth of 3.00 m at Nitra-Čermáň (48° 17' N Lat, 18° 4' E Long), district Nitra, Slovakia (Bárta, 1960). Geological age would be base of Würm III. Coll. by J. Bárta; subm. by H. T. Waterbolk. Comment: see Ságvár below.

Ságvár series, Hungary

Two charcoal samples from loess site of Ságvár (Gábori and Gábori, 1958) (46° 50' N Lat, 17° 45' E Long), S of Balaton Lake (Plattensee), Hungary. There are two culture layers, an upper at depth of 1.2 to 1.5 m, and a lower at depth of 3.3 to 3.6 m below surface, which is 222 m above sealevel. Both belong to the Gravettian. Coll. (1957 or 1958) and subm. by M. Gábori, Budapest Történeti Muz., Budapest.
GrN-1959. Upper culture layer 17,760 ± 150
          15,810 B.C.

GrN-1783. Lower culture layer 18,900 ± 100
          16,950 B.C.

*General Comment:* both samples contained some rootlets, but these were sorted out and remaining charcoal was treated with concentrated acid and dil. alkali so that dates are considered reliable. They are, however, somewhat younger than GrN-2449 for the Gravettian at Nitra-Čermáň above. See also Arka below.

GrN-4038. Arka, Hungary 17,050 ± 350
          15,100 B.C.

Charcoal (?) from fireplace in loess site of Arka-Herzsarét (ca. 48° 30' N Lat, ca. 21° 30’ E Long), district Borsod-Abauj-Zemplén, N Hungary (Vértes, 1962), depth 2 m. Culture layer belongs to Eastern Gravettian. Coll. and subm. by L. Vértes, Budapest. *Comment:* practically all organic matter in sample dissolved in alkali and this fraction was measured. True age may thus be higher. Nevertheless, result compares well with dates for Ságvár, above.

Angles sur l’Anglin series, France

In order to check the sample GrN-1913 (Groningen IV, p. 169), yielding a date of 14,160 ± 80 for a Magdalenian III culture layer in the rock shelter Roc aux Sorciers at Angles sur l’Anglin (46° 42’ N Lat, 0° 53’ E Long), Vienne, France, two more samples were dated from upper Magdalenian culture layers. Coll. and subm. by S. de Saint-Mathurin, 24 Rue Barbet de Jouy, Paris, France and D. A. E. Garrod.

GrN-2912. Angles sur l’Anglin B4 10,840 ± 120
          8890 B.C.

From Layer B4, possibly belonging to the Magdalenian V.

GrN-2916. Angles sur l’Anglin B2 + B3 11,265 ± 130
          9315 B.C.

From Layers B2 and B3 belonging to the Magdalenian VI.

*General Comment:* relative age of samples is unexpected. Difference, however, is not significant. Furthermore identification of Layer B4 as Magdalenian V was not considered certain by excavators. Taken together, dates show expected difference with regard to Magdalenian III date. Both samples were probably only treated with acid and may be too young.

GrN-828. Witów, Poland 10,820 ± 160
          8870 B.C.

Charcoal layer in late-glacial dune, comparable to Usselo-layer (see Groningen II, p. 3), at Witów (52° 20' N Lat, 19° 8' E Long), district Łęczyca, Poland. Layer also contains flint artifacts, forming a hitherto unknown assemblage. Overlying sand dune contains middle Swiderian industry, considered contemporary to Ahrensburgian of N Germany. Coll. by J. Dylik, Łódź; subm. by G. C. Maarleveld, Stichting voor Bodemkartering, Wageningen, Netherlands. *Comment:* it is satisfactory that the Polish layer is of about the same age as Usselo-layer in Netherlands (Groningen II, p. 3). Compare also Witów dates in Copenhagen V, p. 28.
Groningen Radiocarbon Dates

B. Neolithic and Later

GrN-2660. Tell Halaf, Syria

Charcoal from hearth in trench in Tell Halaf (36° 48’ N Lat, 40° 0’ E Long), NE Syria. Hearth contains Halafian painted pottery, but it is situated near transition from “Altmonochrom” ware, and could thus represent an early stage in Halafian development. Coll. and subm. by R. Braidwood, Oriental Inst., Chicago.

GrN-2435. Kečovo, Czechoslovakia

Charcoal from settlement of Bükk culture in cave of Domica at Kečovo (48° 28’ 40” N Lat, 20° 28’ 30” E Long), district Rožňava, Slovakia (Bárta, 1957). Coll. by J. Bárta, Archaeol. Inst. of the Slovakian Acad. of Sci. at Nitra, Czechoslovakia; subm. by H. T. Waterbolk. Comment: date agrees with dates for Bandkeramik (e.g., Elsloo in Groningen IV, p. 176), later stages of which are considered contemporary with Bükk culture.

GrN-2805. Dar es Soltane, Morocco

Shells from cave deposit (Kitchen midden) at Dar es Soltane (ca. 34° N Lat, 7° W Long), near Rabat, Morocco, depth 1.50 m below upper shell bed. Expected age 5000 yr. Coll. 1960 and subm. by G. C. Maarleveld. Comment: date is according to expectation.

Gumelnita series, Rumania

Two samples from oldest archeological level of site of Gumelnita (ca. 44° 5’ N Lat, 26° 20’ E Long), Rumania. It belongs to A2 stage of Gumelnita culture. Coll. 1960 by V. Dumitrescu; subm. by E. Condurachi, Archeol. Inst. of the Acad. of the People’s Republic of Rumania, Bucharest, Rumania.

GrN-3028. Gumelnita 1

Charred grain.

GrN-3025. Gumelnita 2

Charcoal.

General Comment: slight difference in age between the two samples is explained by the nature of the material. Dates agree with that of another site of Gumelnita culture (Vârăsti, GrN-1987: 5360 ± 70; Groningen IV, p. 185). According to traditional archaeological views these dates should be more than 1000 yr later.

Wildeshausen series, Germany

Two more samples from Wildeshausen (52° 53’ 30” N Lat, 8° 29’ 20” E Long) (see Groningen IV, p. 187), Kreis Oldenburg, Germany, have been measured. Coll. by J. Pätzold; subm. by H. T. Waterbolk.

GrN-4058. Wildeshausen, Katenbäker Heide

Charcoal from primary grave of barrow on Katenbäker Heide, excavated in 1952 (Pätzold, 1954). Grave contained two beakers (“Zickzackbecher”), a
battle axe, two axes and two flint blades. Comment: date agrees with dates from some Dutch graves with beakers of the same type, e.g., Eext (GrN-939: 3885 ± 65) and Witrijt (GrN-381: 3965 ± 150) (Groningen II).

**GrN-4066. Wildeshausen, Katenbäker Berg** 3130 ± 40 1180 B.C.

Charcoal from fireplace at base of Barrow 2 on Katenbäker Berg. Fireplace is 2 m from an inhumation grave containing a wrist-protector and four arrow-heads. Grave and fireplace are thought to be contemporary. Comment: date does not agree with expectation; fireplace is apparently younger than grave.

**City Farm series, Great Britain**

Two samples from Bronze Age site at City Farm (51° 47' N Lat, 1° 26' W Long), Eynsham, Oxford. Coll. 1957 and subm. by H. J. Case.

**GrN-1686. City Farm Ia** 3440 ± 60 1490 B.C.

Charcoal from pyre of cremation burial in ring-ditch cemetery with urns which indicate close connection between Britain and Netherlands during Bronze Age.

**GrN-1685. City Farm II** 3460 ± 65 1510 B.C.

Charcoal from palisade-enclosure adjoining ring-ditch urnfield. Probably somewhat older.

*General Comment:* no significant difference between the dates. They agree with such dates as GrN-1828: 3420 ± 45 from Dutch barrow Toterfout which produced a Hilversum urn of British affinity (Groningen IV, p. 188).

**GrN-1684. Poole I, Great Britain** 3210 ± 50 1260 B.C.

Charcoal from Barrow I, Poole (50° 43' N Lat, 1° 59' W Long), Dorset. Barrow was surrounded by timber circle of the widely-spaced type (Case, 1952). Coll. 1949 and subm. by H. J. Case, Ashmolean Mus., Oxford. *Comment:* date agrees with dates from similar Bronze Age monuments in Netherlands, e.g., from Toterfout-Halve Mijl (Groningen IV, p. 188-9).

**GrN-1691. Volders, Austria** 2860 ± 50 910 B.C.

Charcoal from cremation place in urnfield of Volders (47° 20' N Lat, 29° 12' E Long), 13 km E of Innsbruck, Tirol, Austria. Urnfield belongs to “ältere Urnenfelderzeit” and reaches into Hallstatt B₂ period. Cremation place is near youngest part of cemetery, with expected age on archaeological grounds of ca. 800 B.C. Coll. and subm. by A. Kasseroler, Wattens, Tirol, Austria. *Comment:* date agrees with archaeological estimate.

**GrN-4067. Einen, Germany** 2660 ± 60 710 B.C.

Charcoal from pyre remains at base of barrow at Einen (52° 47' N Lat, 8° 27' E Long), Gemeinde Goldenstedt, Kreis Vechta, Oldenburg. Barrow has been enlarged twice. Urns, interred after barrow got its final height, belong to Jastorf B stage. Coll. 1958 by J. Pätzold; subm. by H. T. Waterbolk. *Comment:*
sample dates an early stage of cemeteries of Pestrup type. Date is confirmed by date of Jastorf B urns at Pestrup, GrN-3542: 2440 ± 70 (Groningen IV, p. 187).

**GrN-2447.** **Mellrichstadt, Germany**

2550 ± 65
600 B.C.

Charcoal found associated with bowl of Late Hallstatt period in settlement site of Mellrichstadt (50° 26’ N Lat, 10° 19’ E Long). Coll. and subm. by J. Wabra, Bad Kissingen, Germany. *Comment:* as expected, date agrees with that from Vogelsburg/Volkach, below.

**GrN-2868.** **Pettange, Luxemburg, alkali soluble fraction**

2575 ± 65
625 B.C.

**GrN-2886.** **Pettange, Luxemburg, insoluble fraction**

2640 ± 50
690 B.C.

Mushroom (genus *Fomes* of *Polyporaceae*) found in alluvial sands at depth of 5 m at Pettange, near Mersch (49° 46’ N Lat, 6° 7’ E Long), Luxemburg. Age on basis of pollen analysis: end of Atlantic. Coll. and subm. by M. Heuertz, Mus. of Nat. History, Luxemburg. *Comment:* a mushroom has the radioactivity of the organic material on which it lives. If this is humus, age obtained will generally be too high. Most *Polyporaceae*, however, are epiphytes of living trees; date will therefore probably be correct.

**Vogelsburg/Volkach series, Germany**

Two samples from the hillfort of Vogelsburg/Volkach (49° 52’ N Lat, 10° 13’ E Long), Kreis Gerolzhofen, Germany. Settlement contains remains from *Urnenfelder* culture and from Hallstatt and La Tène periods. In Hallstatt D stage mud-bricks occur of same type as those on the well-known Heuneburg (6th century B.C. on basis of Greek imports). Coll. by Chr. Peschek, Landesamt für Denkmalpflege, Würzburg, Germany; subm. by J. Wabra, Bad Kissingen, Germany.

**GrN-2367.** **Vogelsburg/Volkach I**

2410 ± 90
460 B.C.

Charcoal from Early La Tène-bowl.

**GrN-2363.** **Vogelsburg/Volkach II**

2540 ± 60
590 B.C.

Charcoal from Hallstatt D-bowl.

*General Comment:* dates are in excellent agreement with archeological dating of end of Hallstatt period.

**GrN-2148.** **Dürnberg 1, Austria**

2180 ± 40
230 B.C.

**GrN-2184.** **Dürnberg 2, Austria**

2210 ± 65
260 B.C.

Two different samples from flakes of coniferous wood, used as lamps in prehistoric salt mines at Dürnberg near Hallein (47° 40’ N Lat, 13° 4’ E Long), Austria. Expected age was 900 to 500 B.C. Coll. 1960 and subm. by F. Morton, The Museum, Hallstatt. *Comment:* age appears to be somewhat younger than expected. Prehistoric mining, however, continued for many centuries.
Denekamp series, Netherlands

Four more samples from “es” field Klokkenberg at Denekamp (52° 22' 30" N Lat, 2° 7' 30" E Long) (see Groningen IV, p. 194). Coll. 1961 and 1962 and subm. by T. van der Hammen, Univ. of Leiden, Netherlands.

GrN-2865. Denekamp—Klok 5

Charcoal from fireplace on old surface. Expected age between those of samples Klok 3 and 2b (1795 ± 50, GrN-2812 and 4405 ± 55, GrN-2814).

GrN-4090. Denekamp—Klok 7a

Charcoal from humic layer with Iron Age potsherds in valley sediments below “es” Layers II and III. Depth of sample 2.10 m. Expected age: 2000 to 3500 yr.

GrN-4091. Denekamp—Klok 8

Wood from valley sediments below “es” Layers II and III. Depth of sample 2.60 m. Expected age 3000 to 5000 yr.

GrN-4092. Denekamp—Klok 9

Charcoal from sunken fireplace below primary “es” layer. Depth ca. 1.50 m. Fire-place has been correlated with Neolithic flints and potsherds.

General Comment: dates fit in general picture obtained from previous measurements. Apparently there was much prehistoric charcoal on the site before the “es” formation started.

GrN-3140. Sprakeler Dose, Germany

Wood from trackway (Bohlenweg) in raised bog Sprakeler Dose (52° 42' N Lat, 7° 16' E Long), between Sprakel and Tinnen, N of town of Meppen, Germany (Hayen, 1957). Expected age between 200 B.C. and A.D. 200. Coll. and subm. by H. Hayen, Oldenburg. Comment: date is according to expectation.

GrN-2121. Utrecht, Netherlands

Wood from early vessel found at Utrecht (52° 5' N Lat, 5° 8' E Long), Netherlands. Possibility existed that boat might date from Roman period. Coll. and subm. by J. Cayens-de Groot, Centraal Mus., Utrecht, Netherlands. Comment: boat appears to date from Carolingian period.

GrN-2086. Cefalu, Italy

Chips of wood from old building E of Cefalu, Sicily, Italy (38° 4' N Lat, 14° 2' E Long). Expected age 3000 to 800 yr. Subm. by E. Medi, Euratom, Bruxelles.

Niah series, Sarawak

Two samples measured to establish date horizon of late Neolithic at Great Cave of Niah (3° 48' N Lat, 113° 47' E Long), Sarawak. Paleolithic levels
from cave have been dated before (Groningen III). Coll. and subm. by T. Harrison, Sarawak Mus., Kuching, Sarawak.

**GrN-1905. Niah W2**

\[ 2700 \pm 70 \]

750 B.C.

Charcoal in immediate subsurface layer of main frequentation deposit at Trench W/2 in cave mouth.

**GrN-1907. Niah coffin**

\[ 2695 \pm 65 \]

745 B.C.

Wood from coffin made of hollowed tree trunk in an “extended burial,” regarded as latest Stone-Age type. *Comment*: pretreated with acid and alkali.

*General Comment*: whole main deposit in cave is pre-Christian and late burials correspond to top levels of frequentation farther out in cave mouth.

**GrN-2341. Graniteside, Southern Rhodesia**

A.D. 1270

Wood charcoal from inside of pots found in Iron Age cemetery at Graniteside, 4 km S of Salisbury (17° 50' S Lat, 31° 5' E Long), Southern Rhodesia. Several shaft graves with skeletal remains were excavated here in 1958 to 1959 by Queen Victoria Mus., Salisbury. Burials were rich in pottery of more primitive type than that of modern Bantu. Beads, iron objects (bangles), and some small stone artifacts (Wilton) were recovered. Trevor-Jones believes skeletons to be of early type, comparable to those from Mapungubwe on Limpopo River. Subm. 1959 by Mrs. E. Goodall. *Comment*: same age was obtained in Yale on another sample from the site, Y-722: 670 ± 100 (Yale V).

**GrN-2222. Hong Kong, China**

A.D. 1715

Wood coll. at depth of 1.5 m from a cutting at base of a mantle-rock (regolith), derived mainly from soil creep, at Ma Koh Tsui (22° 20' N Lat, 113° 55' E Long), Hong Kong. Site is archaeologically dated at ca. 2000 yr old. Traditionally, area has been burnt-over by Chinese farmers, and recent down-washing of 

\[ C \]

from charred vegetation is sometimes present. Coll. and subm. by S. G. Davis, Univ. of Hong Kong. *Comment*: dated material is obviously recent.

**H. New World Archaeology**

**A. Oceania**

**Hawaii series**

From four archaeological sites on Hawaiian islands several samples were dated in order to check validity of local chronology, based on fishhook types (Emory, 1959), and to obtain further absolute dates for settlement history of these islands. Coll. and subm. by K. P. Emory, Bernice P. Bishop Mus., Honolulu, Hawaii.

**GrN-2225. Hawaii H 1**

A.D. 290

1660 ± 60

Charcoal from sand dune Site H 1 at South Point (18° 54' 30" N Lat, 155° 41' W Long), Kau district, Island of Hawaii. Depth of sample 52½ to 61½ in. Expected age A.D. 750 to A.D. 950 on basis of a $C^{14}$ date of Site H 8,
with which Site H 1 is correlated through fishhook types. Coll. 1953. Comment: date is unexpectedly high.

**GrN-2062. Hawaii H 1 - E 5**

- **460 ± 40**
- **A.D. 1490**

Charcoal from same site. Coll. 1953 in the middle of a rich cultural layer, Square E 5. Depth 41 in.

**GrN-2237. Hawaii H 1 - H 3**

- **490 ± 60**
- **A.D. 1460**


**GrN-2061. Hawaii H 2**

- Recent

Charcoal from skelter-cave Site H 2 at South Point (18° 55' 20” N Lat, 155° 40' 40” W Long), Kau district, Island of Hawaii. Square S 9. Depth 33 to 38 in. Coll. 1955. Expected age ca. A.D. 1500, through archaeological correlation with Site H 8. Comment: from same square, but below present sample (depth 48 in.) a charcoal sample was dated at Michigan (M-478: 200 ± 200, Michigan II). Date was considered too recent, since historical events connected with site can be dated at ca. 1780 and first occupation should be earlier.

**GrN-2149. Hawaii H 8 - G 7**

- **350 ± 40**
- **A.D. 1600**

**GrN-2901. Hawaii H 8 - F 5**

- **350 ± 60**
- **A.D. 1600**

Charcoal from Squares G 7 and F 5 in cave shelter H 8, South Point (18° 57' N Lat, 155° 42' W Long), Kau district, Island of Hawaii. Depth 34 in. and 17 to 21 in., respectively. Coll. 1958. Comment: two other samples of cave dated at Michigan: M-666: 1000 ± 200, at depth of 25 to 27 in., and M-863B: 730 ± 200, at 17 to 21 in. (Michigan IV). Our second sample was intended to check discrepancy with Michigan dates. Culturally, our dates seem too young.

**GrN-2835. Hawaii H 8 (canoe)**

- **180 ± 40**
- **A.D. 1770**

Part of wooden canoe found (1956) on surface at H 8. Dated as a further check for contamination in cave.

**GrN-2293. Hawaii K 3**

- **580 ± 50**
- **A.D. 1370**


*General Comment:* no explanation can yet be given for differences between dates obtained for same site, nor for differences between C\textsubscript{14} dates and archaeological estimations.

**Society Islands series, French Oceania**

Two samples from Society Islands, French Oceania. Coll. in 1960 and subm. by K. P. Emory.
GrN-2902. **Matira Point**

Charcoal from cultural deposit at Matira Point (16° 32’ 50” S Lat, 151° 44’ 20” W Long), Borabora. Depth 71 cm. Expected age 300 to 1000 B.P.

**GrN-2960. Ana Paia Shelter**

Charcoal from cultural deposit in rock shelter Ana Paia (17° 35’ S Lat, 149° 50’ W Long), Maatea district, Moorea. Depth 90 to 105 cm. Expected age 300 to 1000 B.P.

*General Comment*: dates fall within expected range.

**B. America**

**Little Colorado River Valley series, Arizona, U.S.A.**


**GrN-1614. Laguna Salada site**

Charcoal from pre-pottery open camp site on beach of a now dry lake (34° 20’ N Lat, 109° 40’ W Long) excavated in 1958. Surface sites represent earliest occupation in area and have produced quantities of stone tools, bifacially worked scrapers, flake knives, and characteristic projectile points, the last with affinities to the Desert Culture. No building activity found (Martin and Rinaldo, 1960a).

**GrN-2801. Tumbleweed Canyon site**

Charcoal from beam in one of three shallow circular pithouses in late pre-pottery settlement at Tumbleweed Canyon (34° 20’ N Lat, 109° 25’ W Long) excavated in 1960. Artifacts similar to earlier sites (above) except for occurrence of a pestle and (preferably notched) projectile points. Pollen analysis revealed corn pollen (Martin and others, 1962).

**GrN-1689. Vernon Site 30, House A**

A.D. 750

**GrN-1613. Vernon Site 30, House B**

A.D. 860

**GrN-1690. Vernon Site 30, House B**

A.D. 770

Three samples of charcoal from pithouse village near Vernon (34° 12’ N Lat, 109° 42’ W Long). Site contained pottery belonging to Group III type in classification of Longacre (Martin and others, 1962). Culture shows strong Mogollon affinities from NW.
GrN-2414. Chilcott site 1 780 ± 80 A.D. 1170
Charcoal from trench in Room 3, S wall of pithouse at Chilcott Site 1 (34° 23' N Lat, 109° 42' W Long). Rooms of pithouse are roughly rectangular with masonry walls. Predominant painted pottery is of Snowflake Black-on-White type (Group IV). Stone artifacts and painted pottery are closely allied with those of Mogollon in Pine Lawn Valley, New Mexico (Martin and others, 1962).

GrN-3006. Hooper Ranch, Great Kiva (III) 730 ± 60 A.D. 1220
GrN-4039. Hooper Ranch, Room 5A 570 ± 65 A.D. 1380
GrN-4040. Hooper Ranch, Room 2B 865 ± 80 A.D. 1085
Two charcoal samples from floor and one wood sample from center post (GrN-4040) of rooms in Hooper Ranch Pueblo (34° 10' N Lat, 109° 18' W Long) near Springville. This plaza type pueblo had two habitation layers, each containing ca. 60 rooms and 3 rectangular kivas, similar to contemporary Hopi and Zuni ones. Most abundant type of decorated pottery was Tularosa Black-on-White. Comment: on typological evidence Martin considers Hooper Ranch Pueblo to be about a century later than Mineral Creek Pueblo; dates confirm. Sample from Room 2B (GrN-4040) is from lower habitation layer; that from Room 5A from upper.

GrN-4111. Carter Ranch, Room 15, floor 1 990 ± 60 A.D. 960
GrN-4112. Carter Ranch, Room 15, floor 2 830 ± 70 A.D. 1120
GrN-4113. Carter Ranch, Room 10 840 ± 70 A.D. 1110
Wood (GrN-4111) and charcoal (GrN-4112) from roof beams of two successive occupation layers of Room 15 and charcoal from floor of Room 10 of Carter Ranch site (34° 31' N Lat, 109° 56' W Long) near Snowflake. Comment: no information about archaeological finds or relation to other sites available to authors.

GrN-4007. Rim Valley Pueblo 880 ± 50 A.D. 1070
Charcoal from roof beam of Room J of small Rim Valley Pueblo village (34° 10' N Lat, 109° 18' W Long) near Springerville, consisting of ca. 25 rooms, one possibly a kiva. Pottery mainly of Reserve Black-on-White, Snowflake Black-on-White, and Tularosa Black-on-White types.

GrN-2417. Mineral Creek, Great Kiva 1220 ± 55 A.D. 730
GrN-4008. Mineral Creek, Room 2 1000 ± 50 A.D. 950
Two charcoal samples from Mineral Creek Pueblo (34° 15' N Lat, 109° 39' W Long) near Vernon, consisting of several adjoining rectangular rooms and separate large round kiva. Snowflake Black-on-White was most popular
Groningen Radiocarbon Dates V

painted pottery. Comment: Martin considers A.D. 730 (GrN-2417) too early; believes site was not occupied much before ca. A.D. 1000.

**GrN-1997. Table Rock Pueblo** 615 ± 55
A.D. 1335
Wood from Table Rock Pueblo (34° 30' N Lat, 109° 20' W Long), St. Johns, coll. 1958. This pueblo, consisting of ca. 60 rooms (some of two stories) and two kivas, is youngest in series and dates from shortly before area was abandoned by pueblo-builders. Pottery is similar to that of upper occupation layer of Hooper Ranch Pueblo (Martin and Rinaldo, 1960b). Comment: date (A.D. 1331) from tree ring analysis made by T. Smiley, Tree Ring Lab., Univ. of Arizona, Tucson, agrees with C14 date.

**Batehaton series, Mexico**

Three charcoal samples from cremation urns in caves at Batehaton (16° 20' N Lat, 90° 50' W Long), Rio Jatate, Chiapas, Mexico (central Maya region). Since Mayas did not burn their dead, age of cremations should be either early Olmeca (2000 to 500 B.C.) or Toltec (from 1000 A.D.). Alt 1000 m. Coll. and subm. by W. Cordan, Escuela Seler, Las Casas (Chiapas), Mexico.

**GrN-1637. Batehaton Cave 10** 330 ± 60
A.D. 1620

**GrN-1638. Batehaton Cave 7** 280 ± 55
A.D. 1670

**GrN-790. Batehaton Cave 7** 410 ± 70
A.D. 1540

General Comment: dates prove a very recent age of urn burials.

**Chiapa de Corzo series, Mexico**

Series of samples from Chiapa de Corzo (16° 42' N Lat, 93° 01' W Long), near Tuxtla Gutierrez, state of Chiapas, Mexico. Subm. by T. S. Ferguson, New World Archaeol. Found., Orinda, California.

**GrN-1056. Chiapa de Corzo 1** 2370 ± 60

Charred wood from Pit 24, Level 2, an ancient refuse dump containing restorable ceramic vessels, ashes, and river snail shells, located 1.2 m below base of Mound 1 substructures. Ceramics pertain to Early Pre-Classic. Coll. 1956 by G. W. Lowe.

**GrN-1512. Chiapa de Corzo 3** 3010 ± 50

Two charcoal samples from Pit 38, Level 2, resting on sterile sand at base of cultural deposit representing a mixture of earliest and second earliest phases of Early Pre-Classic. Coll. 1956 by G. W. Lowe. Comment: another portion of this specimen was dated at Lamont as 2630 ± 150 B.P. (L-427).

**GrN-774. Chiapa de Corzo 5** 3010 ± 150

Charcoal from Pit 50 in deposit of burnt earth, ashes and charcoal at 3.50 m level (anciently filled-in wash). Associated pottery is of earliest cultural period identified in central Chiapas. Coll. 1956 by B. Warren.
GrN-1524. Chiapa de Corzo 6

Bits of charcoal from earthen matrix underlying Burial 15, located beneath Mound 1 substructure and placed by its ceramic offering at beginning of Mesoamerican Late Pre-Classic (Chicanel). Coll. 1956 by G. W. Lowe.

GrN-1525. Chiapa de Corzo 7

Portion of a burnt pole extending from SE corner of Pit 32B back underneath outer stone walls of Mound 1. Depth 1.10 m directly below SW corner of Wall C in Mound 1. Charcoal and Early Pre-Classic sherds associated with a refuse-laden black soil layer underlying outer Mound 1 constructions. Coll. 1956 by B. Warren. Comment: sample from same soil level as GrN-1056, above.

GrN-1589. Chiapa de Corzo 8


Santa Rosa series, Mexico

Two samples from Santa Rosa site (16° 04' N Lat, 92° 28' W Long), state of Chiapas, Mexico. Subm. by G. W. Lowe, New World Archeol. Found., Orinda, California.

GrN-1916. Santa Rosa, F10

Portion of carbonized post in situ in buried floor at 4.10 m depth in Mound B. Associated pottery in mound fill suggests Late Pre-Classic or Proto-Classic period. Coll. 1958 by A. Delgado.

GrN-1932. Santa Rosa, F11

Charcoal from ashy layer covering floor of buried platform structure in Mound F. Pottery from fill suggests Late Pre-Classic period. Coll. 1958 by D. Brockington. General Comment: samples may have been interchanged during chemical pre-treatment in lab., but as there is no significant difference in ages this seems relatively unimportant. Both figures compare well with GrN-1589 which dates Proto-Classic at Chiapa de Corzo (see above).

GrN-2301. Laguna Zope, Mexico

Charcoal from Laguna Zope (16° 25' N Lat, 95° 62' W Long), E of Juchitan, state of Oaxaca, Mexico, at depth of 5 m in soil beneath mound. Belongs to Pre-Classic or Formative period. Coll. 1958 by A. Delgado; subm. by T. S. Ferguson.

GrN-1906. Kaminaljuyu, Guatemala

Charcoal from Kaminaljuyu on outskirts of Guatemala City (14° 37' N Lat, 90° 32' W Long), Guatemala. From earliest level of mound structure F'. Coll. 1958 by G. Espinosa for Guatemala Inst. of Anthropol. and History; subm. by T. S. Ferguson.
GrN-2200. Venado Beach, Panama

Charcoal from contents of a burial urn at Venado Beach (8° 55' N Lat, 79° 35' W Long), Canal Zone, Panama. Site occupied during first stages of Cochlé-style Polychrome pottery, and of metal casting. Yale date from charred material in another burial urn (Y-125, 1750 b.p.) believed too early in view of Peruvian traits in Panama and C¹⁴ dates from Peru.

GrN-846. Onverdacht, Suriname

Charcoal coll. at depth of 50 to 60 cm, together with potsherds and stone objects in former Indian settlement at Onverdacht (5° 37' N Lat, 55° 10' W Long), Suriname. Typologically, pottery resembles that found along Koriobo River in NW British Guiana (Meggers and Evans, 1955); estimated age A.D. 1500. Submitter's number: B-2218. Coll. 1958 and subm. by D. C. Geijskes, Mus. of Suriname, Paramaribo, Suriname. Comment: date is older than expected and needs further confirmation.

GrN-1899. Commetewane River, Suriname

Charcoal, associated with potsherds and stone implements, found 1956 in former Indian settlement near Commetewane River (5° 47' N Lat, 54° 55' W Long), Suriname (Geijskes, 1961). Pottery is slightly more advanced than that from Onverdacht above. Submitter's number C-2358. Coll. and subm. by D. C. Geijskes. Comment: large age-difference between GrN-846 above and GrN-1899 was unexpected. Sample was thoroughly pretreated with acid and alkali.

Hertenrits series, Suriname

Three samples from artificial clay mound ("terp"), the Hertenrits (5° 54' N Lat, 56° 40' W Long), N of Wageningen, district Nickerie, Suriname. Mound was supposedly built in pre-Columbian time. Its height is more than 3 m. Samples would represent a relative chronological sequence. Coll. 1957 and subm. by D. C. Geijskes.

GrN-1898. Hertenrits 0397

Peaty material with charcoal or charred plant remains at depth of 0.60 m. Associated with potsherds.

GrN-1897. Hertenrits 0638

Pieces of wood, associated with potsherds, coll. in third trench, at depth of 2.50 m.

GrN-845. Hertenrits 0689

Peat from seventh trench at depth of 3.20 m. Above and below the peat layer was gray clay with potsherds and pieces of wood. General Comment: no significant difference in age between the three samples.
GrN-2174. Coeroeni-Island, Suriname 785 ± 50 A.D. 1165
Charcoal and charred palm seeds from former Indian settlement on Coeroeni Island (3° 22.4' N Lat, 57° 17.0' W Long), Upper Corantine, Suriname. Depth 0.30 to 0.40 m. Expected age A.D. 1500. Coll. 1959 and subm. by D. C. Geijskes. Comment: date older than inferred from quality of pottery and from fact that site is still overgrown by bamboo.

GrN-2173. Blaugron, Suriname 520 ± 50 A.D. 1430
Charred palm seeds from former Indian settlement at Blaugron (5° 50.6' N Lat, 55° 8.2' W Long), near Paramaribo, Suriname. Depth 0.40 to 0.50 m. Expected age A.D. 1000. Coll. 1960 and subm. by D. C. Geijskes.

GrN-2321. Morico Creek, Suriname 455 ± 65 A.D. 1495
Charcoal from former Indian settlement at Morico Creek (5° 45' 30" N Lat, 54° 45' 40" W Long), district Commewijne, Suriname. Depth 0.30 to 0.60 m. Coll. 1961 and subm. by D. C. Geijskes. Expected age A.D. 1000. Comment: although the above two dates are younger than expected, they seem acceptable.

Tafi del Valle series, Argentine

GrN-2948. Tafi del Valle 1 1950 ± 60 A.D. 1
Charred bones from depth of 1.20 m.

GrN-2946. Tafi del Valle 2 1950 ± 60 A.D. 1
Charred bones from depth 0.70 to 1.70 m.

GrN-3031. Tafi del Valle 4 1930 ± 60 A.D. 20
Charred bones from depth 2.00 m.

GrN-2967. Tafi del Valle 5 1920 ± 65 A.D. 30
Charcoal and charred bones from base of mound (depth 2.80 m). General Comment: Yale measurement for a charcoal sample from depth of 2.20 m is 2296 ± 70 (Y-888).

III. VARIOUS SAMPLES

Sugar Loaf series, Netherlands Antilles
Two coral samples from Sugar Loaf (17° 28' N Lat, 62° 58' W Long), St. Eustatius, Netherlands Antilles. Geological age, on basis of paleontological evidence, is either late-Pliocene or, more probably, late-Pleistocene or sub-

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<tr>
<th>Date</th>
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<tr>
<td>GrN-2651</td>
<td>Sugar Loaf 31</td>
<td>22,400 ± 100 20,450 B.C.</td>
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<tr>
<td>GrN-2655</td>
<td>Sugar Loaf 55</td>
<td>&gt;46,500</td>
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<td>GrN-2656</td>
<td>White Wall, Netherlands Antilles</td>
<td>32,960 ± 300 31,010 B.C.</td>
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<td>GrN-2653</td>
<td>Brimstone Hill, Lesser Antilles</td>
<td>44,720 ± 1150 42,770 B.C.</td>
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<td>GrN-3049</td>
<td>Ekeren 1 (wood remains)</td>
<td>12,330 ± 120 10,380 B.C.</td>
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<tr>
<td>GrN-3052</td>
<td>Ekeren 2</td>
<td>12,340 ± 120 10,390 B.C.</td>
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<tr>
<td>GrN-2458</td>
<td>Ekeren 3</td>
<td>12,460 ± 140 10,510 B.C.</td>
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General Comment: dates agree with supposed Bølling age of the peat.

Marudi series, Brunei

These samples from extensive peat deposit covering ca. 700 square mi at Marudi (ca. 4° 40' N Lat, 114° 05' E Long), in lower Baram River valley, Fourth Division. Preliminary pollen analyses show that peat has formed on mangrove and has been gradually built up by a succession of forest types. At 13 m pollen of Nipa, Rhizophora and Sumeratia, at 8.5 m Gonystylus pollen, and from 5 m Shorea and Pandanus pollen were found. Dates were expected to give information on rate of change of forest types in the area, on growth of
Baram delta and on recent changes of sealevel in area. Coll. and subm. by G. E. Wilford, Geol. Survey Dept., Brunei.

**GrN-1960. Marudi 5488**

Depth 5 m.

**GrN-1962. Marudi 5489**

Depth 10 m.

**GrN-1963. Marudi 5490**

Depth 12 m.

**Piltdown series**

After the demonstration of the Piltdown forgery through the fluorine method by K. P. Oakley in 1950 it was considered worthwhile to obtain C\(^{14}\) dates from the jawbone and the cranium, which the forger had placed together. Jawbone should be that of a modern orangutan, but age of skull was still uncertain. According to fluorine test it should have been lying in the soil for several centuries. Coll. and subm. by K. P. Oakley, British Mus. (Nat. History), London.

**GrN-2204. Piltdown—jawbone**

500 ± 100

A.D. 1450

**GrN-2203. Piltdown—skull**

620 ± 100

A.D. 1330

*General Comment:* the geologically recent age of the jawbone is confirmed by the C\(^{14}\) date. Ethnological evidence suggests it may be a few centuries old: Dyaks are known to preserve orangutan skulls as fetishes or trophies for many centuries. For further details and comments see de Vries and Oakley (1959).


**References**

Date lists:

- Copenhagen V Tauber, 1962
- Groningen II de Vries, Barendsen, and Waterbolk, 1958
- Groningen III de Vries and Waterbolk, 1958
- Groningen IV Vogel and Waterbolk, 1963
- Lamont V Olson and Broecker, 1959
- Michigan II Crane and Griffin, 1958
- Michigan IV Crane and Griffin, 1959
- Michigan V Crane and Griffin, 1960
- Yale V Suiver, Deevey, and Gralenski, 1960


Tauber, Henrik. 1962, Copenhagen radiocarbon dates IV: Radiocarbon, v. 4, p. 27-34.


LABORATORIES

* Inactive Laboratories.
1 From January 1, 1961 the Gro numbers have been replaced by GrN numbers. “New” dates are referred to the NBS oxalic-acid standard.
2 Dates from this laboratory have usually been given a code designation that represents the name of the sponsoring institution, e.g. I (AGS) for American Geographical Society (Heusser, RADIOCARBON SUPPLEMENT, v. 1).
3 Some dates from this laboratory were published with the code designation S (Pringle and others, 1957, Science, v. 125, p. 69-70).
4 See SM.
5 Some dates from this laboratory have been published with the code designation RC (Flint and Gale, 1958, AM. JOUR. SCI., v. 256, p. 698-714). The code designation MP published in volume 1 of the RADIOCARBON SUPPLEMENT (1959, p. 216) has been changed to SM in conformity with the wishes of the laboratory, and is explained by the change of the company’s name from Magnolia Petroleum Company to Socony Mobil Oil Company, Inc.
6 Formerly Texas-Bio-Nuclear.

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<tr>
<td>MC</td>
<td>CENTRE SCIENTIFIQUE DE MONACO</td>
<td>Mr. J. Thommeret or Mr. J. L. Rapaire</td>
<td>Avenue Saint Martin, Monaco</td>
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<td>ML</td>
<td>MIAMI</td>
<td>Dr. H. G. Östlund or Dr. Gene A. Rusnak</td>
<td>University of Miami, Miami, Florida 33149</td>
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<td>Mo</td>
<td>VERNADSKI INSTITUTE OF GEOCHEMISTRY</td>
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<td>Moscow, USSR</td>
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<tr>
<td></td>
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<td>Address: Academician A. P. Vinogradow</td>
<td>Vorobeyskoye shosse, d.47-A</td>
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<td>MP*</td>
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<td>N</td>
<td>RIKEN (TOKYO)</td>
<td>Dr. F. Yamasaki</td>
<td>Bunkyo-ku, Tokyo, Japan</td>
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<tr>
<td>NPL</td>
<td>NATIONAL PHYSICAL LABORATORY</td>
<td>Mr. W. J. Callow</td>
<td>Teddington, Middlesex, England</td>
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<td>Dr. J. E. Blanchard</td>
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<td>Prof. J. H. Green</td>
<td>University of New South Wales, Kensington, New South Wales, Australia</td>
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<td>NZ</td>
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<td>Mr. T. A. Rafter</td>
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</tr>
<tr>
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<td>HUMBLE</td>
<td>Dr. H. R. Brannon</td>
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<tr>
<td>OWU</td>
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</table>
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    Radiocarbon Dating Laboratory
    Kaman Instruments
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    Austin 56, Texas
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<td>Tata Institute of Fundamental Research</td>
<td>Dr. D. Lal</td>
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<tr>
<td>Tx</td>
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<td>Dr. M. A. Tamers</td>
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<td>UW</td>
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<td>Dr. Minze Stuiver</td>
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