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, 1963.

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\(^{14}\). In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, all dates published in this volume (Volume 5) are based on the Libby value, \(5570 \pm 30\) 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, \(5730 \pm 40\) 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 A.D. 1950 is now accepted as the standard year of reference for dates B.P., no ambiguity results from the usual mode of reporting. Many users of dates find it inconvenient, however, and in deference to their wishes we begin, in this volume, the practice of reporting dates in both systems. Although many geologists and geochemists will consider such a date as “23,500 B.C.” to be silly, we have asked the laboratories to follow the new practice for all finite dates, very old as well as recent, and to make exception only for infinite dates. Probably most persons would regard “older than 47,000 B.C.” as silly.

Comprehensive index. Plans are still incomplete for publication, probably as a supplement to Radiocarbon, of a comprehensive index to all published C\(^{14}\) measurements, arranged by laboratory and by sample number, with corrections made necessary for any reason. Meanwhile, we call attention to the useful index prepared by Arthur A. Jelinek (Current Anthropology, v. 3, p. 451-477, 1962), in which dates of archaeologic interest are arranged geographically and chronologically.
Radiocarbon

1963

UCLA RADIOCARBON DATES II

G. J. FERGUSSON and W. F. LIBBY

Institute of Geophysics, University of California, Los Angeles 24, California

The measurements reported in this list have been made in the Isotope Laboratory at the Institute of Geophysics, UCLA during 1962. Dates have been calculated on the C\textsuperscript{14} half life of 5568 years and using 95\% NBS oxalic acid as modern standard, in agreement with the decision of the Fifth Radiocarbon Dating Conference (Godwin, 1962).

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. United States

UCLA-131. Ash Cave, Washington

7940 ± 150

5990 B.C.

Charcoal and charred midden material from hearth at Ash Cave (45WW61) in the lower Snake River canyon, Walla Walla County, Washington (46° 33' N Lat, 118° 33' W Long). Hearth was located at surface of a deep midden deposit (Stratum 3) mantled by a layer of Mt. Mazama ash (Stratum 2). Enclosed in the midden deposit were remains typical of the Old Cordilleran culture in the Pacific Northwest (Butler, 1961). Coll. 1958 by B. R. Butler; subm. by E. H. Swanson Jr., Idaho State College Mus. Comment (B.R.B.): Mt. Mazama ash separates Old Cordilleran culture components from the subsequent Cold Springs horizon at various sites in the Columbia Plateau; the Ash Cave date provides a \textit{terminus ante quem} date for this geologic horizon marker and for the Cold Springs horizon in the Columbia Plateau.

Birch Creek Valley series, Idaho

Charcoal from two large rockshelters, Veratic and Bison caves, near Blue Dome in the Birch Creek Valley of eastern Idaho (44° 05' N Lat, 112° 55' W Long). Both caves were continuously occupied from late Anathermal to early historic times. Veratic Cave is located at the base of an alluvial fan, and Bison Cave is located near the top of the same fan. The physical stratigraphy at Veratic Cave is complex, but the deposits at Bison Cave can be grouped into
five major units: (1) Birch Creek sediments, the earliest; (2) Fan Gravel I, a thick deposit with Mt. Mazama ash enclosed near its surface; (3) Yellow Sandy Loam I, a long sequence of sandy loam sediments; (4) Fan Gravel II, which resembles Fan Gravel I; (5) Yellow Sandy Loam II, which resembles Yellow Sandy Loam I. It is believed that Fan Gravel I represents the onset of the Altithermal, and that Yellow Sandy Loam I continued to near the end of the Altithermal. Fan Gravel II may mark the end of the Altithermal, with the Yellow Sandy Loam II series representing Medithermal deposits. The Birch Creek deposit, which is also at the base of Veratic Cave sequence, is probably late Anathermal in time. Occupation at Bison Cave begins at the surface of the Birch Creek deposit and continues to the surface of Yellow Sandy Loam II. Fan Gravel II artifact inventory is meager, while Yellow Sandy Loam II contains a rich inventory of cultural remains. Occupation at Veratic Cave has also been continuous from the surface of the Birch Creek deposits to the present surface. However, unlike Bison Cave, the earliest occupation is represented by a very rich accumulation of cultural materials, while the later has a meager cultural inventory. Hence correlation of the culture sequences is largely dependent on C\(^{14}\) dates. Coll, and subm. by E. H. Swanson Jr.

**UCLA-220. Bison Cave**

Feature 12, earth oven intrusive from Level 12, penetrates Levels 13, 14 and 15.

**UCLA-219. Bison Cave**

Feature 9, earth oven intrusive from Level 16, bedded on Level 16a.

**UCLA-130. Bison Cave**

Feature 14, earth oven intrusive from surface of Level 16b, bedded on Level 17. *Comment* (E.H.S.): the earth ovens were located one above the other in a close sequence at the bottom half of Yellow Sandy Loam II. Dates are in proper sequence and indicate that repeated construction of earth ovens has not upset the stratigraphy; they also support our previous interpretation of the Medithermal age of Yellow Sandy Loam II.

**UCLA-217. Veratic Cave**

Feature I, hearth intrusive into Level 21 from base of Level 19 or surface of Level 20.

**UCLA-160. Veratic Cave**

Charcoal from Level 22.

**UCLA-218. Veratic Cave**

Feature 8, earth oven associated with Level 26.

**UCLA-162. Veratic Cave**

Feature 5, hearth associated with Level 29.
UCLA-161. Veratic Cave

Charcoal from Level 29.

**General Comment (E.H.S.):** the C¹⁴ dates from Veratic Cave are in stratigraphic order and check the evaluation of the finely stratified sediments at the site. The overlap in the C¹⁴ dates from the two sites will permit establishment of a composite continuous cultural sequence. The two series of C¹⁴ dates confirm in broad outline previous estimates of the geologic age of the deposits at the site and show that the bulk of the alluvial fan deposits are Altithermal in age. They will also be useful for evaluation of the deposits and the attendant depositional processes. Side notched points occur below the two earliest dated horizons at Veratic Cave and continue in an unbroken sequence into the historic deposits at both sites. This cultural continuum, of considerable significance in northwestern prehistory, could not have been so clearly established without C¹⁴ dates.

**Lorenzen series, Modoc County, California**

Charcoal samples from Pit M-11, Lorenzen Site, Modoc County, California. Site is a deep, stratified deposit which includes at its lowest levels Cascade point artifacts. Coll. and subm. by M. A. Baumhoff, Univ. of California, Davis, California.

<table>
<thead>
<tr>
<th>Date Code</th>
<th>Site Details</th>
<th>Date 1</th>
<th>Date 2</th>
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</thead>
<tbody>
<tr>
<td>UCLA-126</td>
<td>Lorenzen Site, 18 in. depth</td>
<td>390 ± 70</td>
<td>A.D. 1560</td>
</tr>
<tr>
<td>UCLA-125</td>
<td>Lorenzen Site, 48 in. depth</td>
<td>1470 ± 60</td>
<td>A.D. 480</td>
</tr>
<tr>
<td>UCLA-127</td>
<td>Lorenzen Site, 75 in. depth</td>
<td>3300 ± 100</td>
<td>1350 B.C.</td>
</tr>
</tbody>
</table>

**General Comment (M.A.B.):** the date sequence is within the expected range. The deepest sample (UCLA-127) appears to be near the beginning of the Achumawi-Atsugewi occupation, for which our current work on glottochronology indicates an age of 3100-3500 yr.

**Canada Verde series, Santa Rosa Island, California**

Three separate cultures are recognized on Santa Rosa Island, the earliest being the Dunedweller, followed by Highland and finally the Canalino. Some of the stratified sites contain remains of more than one culture. The site at Canada Verde, on the north central coast (34° 01’ 31” N Lat, 120° 08’ 05” W Long), is ca. 35 ft above sea level, covers 1200 yds in length and is ca. 30 ft deep. The site contains four cemeteries in which several hundred skeletons have been found. A great number of artifacts have been found with the burials, including a number of points of Gypsum Cave type. Coll. by P. C. Orr and B. White; subm. by P. C. Orr, Santa Barbara Mus. of Nat. History, Santa Barbara, California.

<table>
<thead>
<tr>
<th>Date Code</th>
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<th>Date 1</th>
<th>Date 2</th>
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<tbody>
<tr>
<td>UCLA-137</td>
<td></td>
<td>3250 ± 140</td>
<td>1300 B.C.</td>
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</tbody>
</table>

Charcoal from hearth, 50 ft W of stake of Blackbottom Cemetery A. Depth 12 in. beneath an eroded midden.
G. J. Fergusson and W. F. Libby

UCLA-179.  
3020 ± 100  
1070 B.C.
Shell necklace (Cyprea) from burial No. 94 in Blackbottom Cemetery.

UCLA-138.  
3420 ± 100  
1470 B.C.
Shell (Mytilus californianus) from eroded midden above UCLA-137.

UCLA-139.  
3240 ± 120  
1290 B.C.
Shell (Haliotis rufescens) from same eroded midden as UCLA-138.

UCLA-140.  
4260 ± 90  
2310 B.C.
Charcoal from Cemetery X, with burial at depth of 83 in. Sample in clean sand, below two strata of black midden, each separated by windblown sand.

Comment (P.C.O.): UCLA-137, 138, 139 and 140 occupy the upper strata of a Dunedweller site and were originally regarded as late Dunedweller. However, the above dates signify a transitional period between late Highland and early Canalino cultures (Orr, 1960a).

Canalino Culture series, Santa Rosa Island, California

The prehistoric Canalino Culture was the last Indian culture on Santa Rosa Island, 35 mi off Santa Barbara, California. The following samples are from Cemetery A at Skull Gulch on the northwestern coast of the island (34° 00' 15” N Lat, 120° 11’ 40” W Long). The site is large, occupying both sides of the gulch and comprising 73 house sites and three known cemeteries. Some of the cemeteries have been exposed by the erosion of the gulch, and the others discovered by trenching (Orr, 1956, 1960a). One previous date on this cemetery, UCLA-134, 330 ± 50 (UCLA I), was inconsistent with the stratigraphy of the site, and the following samples were run to check the age of Cemetery A which was expected to be 2500 to 3000 yr. Subm. by P. C. Orr.

UCLA-135.  
1820 ± 90  
A.D. 130
Shell (Mytilus californianus) from midden over Cemetery A.

UCLA-178.  
900 ± 100  
A.D. 1050
Shell beads (Olivella biplacata) screened from about the burials in Trench 4B, Level 2 of Cemetery A. Comment (P.C.O.): it seems unlikely that this small cemetery was in use for 900 yr; therefore it appears that one or perhaps both of these dates are in error.

UCLA-142.  Tecolote Point, Santa Rosa Island, California  
4000 ± 120  
2050 B.C.
Shell (Mytilus californianus) from depth of 3 ft in midden overlying Cemetery A (34° 00’ 25” N Lat, 120° 10’ 55” W Long). Cemetery A represents the Red Head phase of the Dune Dweller culture dated as 7070 ± 300 (L-290-D, Lamont IV). Coll. by P. C. Orr and B. White; subm. by P. C. Orr. Comment (P.C.O.): it appears as though occupation of this site and other
coastal areas was interrupted for up to 3000 yr during the period when the Highland culture was the dominant one on the island. (UCLA-105, UCLA I). The abandonment of coastal areas is probably also related to climate since it coincides with the “little pluvial” 4-6000 yr ago when rainfall was greater than at present.

**UCLA-144. Santa Cruz Island, California**

14,200 ± 250

Wood from large log of Douglas Fir buried in cut bank of creek in Santa Cruz Island Formation (34° 0’ 12” N Lat, 119° 52’ 30” W Long). Coll. by Clifton Smith; subm. by P. C. Orr. Comment (P.C.O.): age compares well with L-244, 15,820 ± 280 (Lamont IV) and confirms that the Santa Rosa Island Formation (Orr, 1960b) and the Santa Cruz Island Formation (Chaney and Mason, 1934) are of late Wisconsin and essentially equivalent.

**San Nicolas Island series, California**

San Nicolas Island (33° 15’ N Lat, 119° 30’ W Long), is one of a group of eight islands lying off the coast of Southern California. The island is ca. 8 mi long and 4 mi wide. More than 50 occupation sites are known—more complete details are given by Reinman and Townsend (1960) and Meighan and Eberhart (1953).

**UCLA-147. San Nicolas Island, Site 40**

3980 ± 100

2030 B.C.

Shell beads (Olivella) from two graves at Site SNI-40 on the northwestern side of the island. The burial area is on the inland slope of the dune and the burials were all found in sterile sand, with the midden seemingly skirting the edge of the area. Coll. by F. Reinman and S. Townsend; subm. by C. W. Meighan, Anthropol. Dept., UCLA.

**UCLA-165. San Nicolas Island, Site 16**

3300 ± 100

1350 B.C.

Shells (Haliotis) associated with burial at Site SNI-16 on the northwestern side of the island. The burial area was on the leeward side of the dune and shells and top of skull were only a few inches below surface of the sand. Coll. by F. Reinman and S. Townsend; subm. by C. W. Meighan.

**UCLA-164. San Nicolas Island, Site 18**

300 ± 60

A.D. 1650

Roughed-out blanks (Haliotis) for manufacture of shell fish-hooks from Site SNI-18 on extreme northwestern end of the island. It is a very high dune site which overlooks the beach to the N and to the W. Largest remaining site on the island. Coll. by F. Reinman and S. Townsend; subm. by C. W. Meighan.

**UCLA-195. San Nicolas Island, Site 51**

2550 ± 80

600 B.C.

Shell (Mytilus californianus) from Site SNI-51. From stratum at depth of 6 ft which contained some woven sea grass, cordage and a stone scraping tool. Deepest known occurrence of woven sea grass. Evidence of human habitation extends down to 7.5 ft. Subm. by C. Rozaire, Southwest Mus., Los Angeles.
UCLA-196.  **San Nicolas Island, Site 51**  

Shell (Mytilus californianus and Haliotis cracherodii) from Site SNI-51 at depth of 7 to 7.5 ft. Bottom layers of deposit. Subm. by C. Rozaire.

UCLA-197.  **San Nicolas Island, Site 51**  

Charcoal from a cremation, Site SNI 51. Subm. by C. Rozaire.

**General Comment:** San Nicolas Island has been inhabited by maritime people for at least 4000 yr. The inhabitants must have had reasonably adequate boats, not only to make the channel crossing but for fishing and sea mammal hunting, as there is evidence from midden refuse that the economy was based on seafaring activities. This is therefore a good area to learn more about the transition from land-oriented to sea-oriented cultures.

**Lake LeConte series, California**

Samples bearing on paleohydrography and paleoecology of Lake LeConte. Subm. by C. L. Hubbs, Scripps Inst. of Oceanography, La Jolla, California.

UCLA-189.  **Lake LeConte**  

Clam shells (Rangia) representing an old brackish-water stage of the lake (33° 22' 12" N Lat, 115° 47' 55" W Long).

UCLA-190.  **Lake LeConte**  

Clam shells (Tagelus) representing a fairly recent marine stage of the lake (33° 22' 12" N Lat, 115° 47' 55" W Long).

UCLA-191.  **Lake LeConte**  

Clam shells (Chione) from the very surface of the exposed lake bottom, where many of these clams occur in paired valves, indicating in situ deposit under marine conditions. Alt 160 ft below mean seal level (33° 23' 32" N Lat, 115° 42' 00" W Long).

UCLA-192.  **Lake LeConte**  

Charcoal from hearths containing freshwater-fish bones. Alt 160 ft below mean seal level (33° 23' 21" N Lat, 115° 42' 12" W Long).

UCLA-200.  **Painted Cave, Baja California**  

Wooden peg from rock crevice in large rock shelter in central Baja California (27° 38' N Lat, 112° 58' W Long). The shelter contains over 135 large painted full sized figures of humans and animals done in red, black and white. The paintings are pre-Spanish. The peg is presumed to be associated with the wall paintings. Coll. and subm. by C. W. Meighan, Anthropol. Dept., UCLA.  

**Comment** (C.W.M.): associated cultural remains belong to the Comondú culture. It is believed that the paintings are associated with the same culture.
UCLA-249.  **Chumash Painted Cave, Santa Barbara, California**

Sample of the paint from about two square feet of solidly painted surface in the Chumash Pictograph Shelter at Hurricane Deck near Santa Barbara, California. It consisted of disintegrated sandstone with some small amount of charcoal which was only 1/20 of the normal amount needed. Coll. by Campbell Grant, Santa Barbara Mus. of Nat. History, Santa Barbara, California. **Comment:** within the large error it appears to be young, certainly not over 2000 yr old. Date similar to Painted Cave from Baja California (UCLA-200), although the Chumash paintings are part of the Canalino culture.

UCLA-124.  **Falcon Hill, Nevada**

Coiled basketry fragment from Shrub-ox shelter at Falcon Hill near N shore of Pyramid Lake, Nevada (40° 19' N Lat, 119° 21' W Long). This site has the first find of the Shrub-ox (Euceratherium) in Nevada, although it is well known from late-Pleistocene fauna of certain caves in northern California. The basketry came from the second lowest level of the site at Area 2, depth 36 to 42 in. Coll. and subm. by Richard Shutler, Jr., Nevada State Mus., Nevada. **Comment:** date places sample in late Lovelock Culture.

**Frenchman Flat series, Nevada**

Plant remains from abandoned nests of packrat in the creosote-bush zone surrounding Frenchman Flat, Nevada. Subm. by P. V. Wells, New Mexico Highlands Univ., Las Vegas, New Mexico.

**UCLA-150. Ranger Mountain**

Twig (Juniperus osteosperma) alt 3500 ft on Ranger Mountain (36° 47' N Lat, 115° 53' W Long).

**UCLA-151. Spotted Range**

Twig (Juniperus osteosperma) alt 5000 ft on Spotted Range (36° 39' N Lat, 115° 56' W Long). **Comment:** should be compared with previous dating from Ranger Mountain, UCLA-107, 10,000 ± 160 (UCLA I). Presence of juniper at 3500 ft implies rainfall of 10 to 15 in. per yr, compared to less than 5 in. at present.

**Grants series, New Mexico**

Samples from aboriginal hearths in the vicinity of Grants, New Mexico. These pre-ceramic sites are exposed by modern arroyos dissecting alluvium and eolian sand. While only non-diagnostic artifacts were found in association with the hearths it is believed that their ages span the time of occupation of the San Jose valley by makers of San Jose and Lobo projectile points as described by Bryan and Toulouse (1943). Coll. and subm. by G. A. Agogino, Baylor Univ., Waco, Texas, and C. V. Haynes, Univ. of Arizona, Tucson.

**UCLA-221. Grants Arroyo Site 36**

Charcoal from hearth in alluvium. Hearth exposed in arroyo wall ca. 3 ft below surface, 2 ft above erosional disconformity on red eolian sand and as-
associated with numerous flint and pitchstone flakes (35° 11' 28" N Lat, 108° 52' 29" W Long).

**UCLA-222. Grants Arroyo Site 5**  
2530 ± 200  
580 b.c.

Charcoal from large hearth in the alluvium exposed in arroyo wall ca. 6 ft below surface and 1 ft above erosional disconformity on red eolian sand. Two sandstone slab milling stones occurred inverted on the hearth (35° 11' 30" N Lat, 108° 52' 31" W Long).

**UCLA-223. Grants Arroyo Site 7**  
4075 ± 100  
2125 b.c.

Charcoal from large hearth near base of alluvium exposed in modern arroyo wall ca. 11 ft below surface and 1 ft above erosional disconformity on red eolian sand. Tip of a projectile point and numerous flint flakes found in direct association with hearth (37° 7' 8" N Lat, 107° 47' 22" W Long).

**UCLA-224. Grants Arroyo Site 9 U**  
7110 ± 270  
5160 b.c.

Charcoal from upper of two charcoal lenses in red eolian sand exposed in arroyo wall and occurring 3 ft below surface. No associated artifacts (35° 7' 10" N Lat, 107° 47' 38" W Long).

**UCLA-225. Grants Arroyo Site 9 L**  
7200 ± 150  
5250 b.c.

Charcoal from charcoal lens 5 ft below UCLA-224.

**UCLA-226. Grants Arroyo Site 12**  
2200 ± 200  
250 b.c.

Charcoal from hearths in alluvium exposed near head of modern arroyo 0.75 mi N of Grants 1 site of Bryan and Toulouse (1943). Numerous flint flakes found in association (35° 11' 30" N Lat, 107° 47' 55" W Long).

**Ohio-Adena, Hopewell series, Ohio**

Samples from Adena and Hopewell sites in Ross County and Hocking County, Ohio. Coll. and subm. by F. J. Soday, Skelly Oil Co., Tulsa, Oklahoma.

**UCLA-241. Thurman DeLong Mound, Adelphi**  
1900 ± 100  
A.D. 50

Charcoal from Adena mound, 4 mi SW of Adelphi, Ross County, Ohio (39° 25' N Lat, 82° 48' W Long). Ohio State Mus. Site Ro83; FJS Site 610. This mound contained an unusual rock layer which covered 1200 sq ft and contained 7970 fire cracked rocks weighing 782 lbs. Underneath it was a puddled clay layer 6 in. thick covering 100 sq ft. With the exception of the adjacent John Luckhart mound, this rock layer is a unique feature in Adena mounds. The cultural inventory also was unusual, and included two bone needles. Sample was obtained in a fired area near a deposit of cremated human bones in the center of the mound, below the rock and puddled clay layers, and ca. 10 ft from the top of the mound.

**UCLA-242A. Earl DeLong Mound, Laurelville**  
1825 ± 70  
A.D. 125
UCLA Radiocarbon Dates II

**UCLA-242B.** Earl DeLong Mound, Laurelville A.D. 12

Charcoal from Adena mound, Laurelville, Hocking County, Ohio (39° 28' N Lat, 82° 44' W Long). FJS Site 612. This Adena mound contained a number of burials and an extensive deposit of cremated human bones. One of the well-preserved skeletons had a stone earpool at the left side of the skull and a projectile point at the right side of the skull. The earpool was similar to the elaborate copper, stone, and wood earpools so characteristic of the Hopewell culture. Sample from depth of 5 ft, adjacent to the cremation area and the burial with the earpool. UCLA-242A and 242B are duplicate collections.

**UCLA-243.** James Starr Mound No. 1, Frankfort 90 B.C.

Charcoal from Adena mound, Frankfort, Ross County, Ohio (39° 24' N Lat, 83° 11' W Long). FJS Site 671. It contained two cremation deposits, a tightly flexed burial with a spearpoint within the rib cage, and other burials. It was constructed from an extremely hard clay (practically unburned brick) which is unusual for this area. Sample from Fireplace 1 at the base of the mound, 52 in. below the surface.

**UCLA-244A.** Russell Brown No. 1, Chillicothe A.D. 200

**UCLA-244B.** Russell Brown No. 1, Chillicothe 140 B.C.

Charcoal from Hopewell mound, Chillicothe, Ross County, Ohio (39° 20' N Lat, 82° 58' W Long). FJS Site 613. This site was presumably associated with the Harness Works, a classic Hopewell center on the Scioto River E of Chillicothe. The first survey was by Squier and Davis in 1850, at which time it comprised a large mound, a large circular enclosure (1750 ft in diam), a square enclosure, and 11 smaller mounds. Mound No. 1 was one of the small mounds. It contained the remains of a well-defined circular habitation structure, 30 ft in diam, and a cremation area filling the house structure. Numerous artifacts were present. The structure may have served as a cremation area for the main Harness mound. UCLA-244A was from Fireplace 210, depth 16 in., and UCLA-244B was from the cremation layer near a large classic Hopewell pottery vessel fragment, depth 24 in.

**UCLA-245.** Russell Brown No. 2, Chillicothe 790 B.C.

Charcoal from Hopewell mound, Chillicothe, Ross County, Ohio (39° 20' N Lat, 82° 58' W Long). FJS Site 615. Although adjacent to Russell Brown No. 1, the structure of this mound was very different. In a rectangular habitation structure some cremation had been practiced, but less than that in Mound 1. The main feature was a large deposit of fire fractured square based knives made both from Flint Ridge flint and from nodular flint. Several large flint cores and an abundance of flake knives also were found. Sample was from a fireplace at the base of the mound, 22 in. depth.

**UCLA-264A.** Russell Brown No. 3, Chillicothe A.D. 615

1938 ± 75

1750 ± 80

2040 ± 100

2090 ± 70

2720 ± 90

1335 ± 70
UCLA-246B.  Russell Brown No. 3, Chillicothe 958 ± 65 A.D. 992

Charcoal from Hopewell mound, Chillicothe, Ross County, Ohio (39° 20' N Lat, 82° 58' W Long). FJS Site 663. This mound also differed in structure and contents from adjacent mounds 1 and 2. It contained only a minor cremation area, and showed no evidences of any habitation. A rectangular copper breastplate with associated textile material was found, but its main characteristic was numerous deposits of fire-cracked rocks devoid of artifacts, but containing some charcoal. These rock pits may have served for the ceremonial deposition of debris from the cremation areas. UCLA-246A and 246B are duplicate collections from a fire pit located at the base of the mound near the center, 24 in. depth.

*General Comment* (F.J.S.): the three Adena mounds are remarkably similar in age—1825 to 2040 yr (UCLA-241, 242, and 243)—which is consistent with their artifact inventory and their expected position in Adena cultural history. The Hopewell mounds cover a larger time span and may indicate that the Harness Works was occupied, perhaps intermittently, by Hopewell people over a period of some 1700 yr (1000 to 2700 B.P.—UCLA-244, 245, and 246). This conclusion is strengthened by the fact that the three mounds were quite dissimilar in structure and artifact inventory, although typically Hopewell in type.

UCLA-216.  Follins Pond, Massachusetts 250 ± 120 A.D. 1700

Wood from post in gully near edge of Follins Pond, Massachusetts (41° 37' N Lat, 70° 19' W Long). Sample related to the possible discovery and attempted colonization of America by the Norsemen, for this was considered as possibly the wintering over base of Leif Eriksson during the three years he and his party spent in “Vinland.” Sample from one of the props used for a ship which was beached to avoid damage from winter ice. Nine such props were located, spread evenly over a 58 ft distance which would correspond with the size of the Viking ships and the fact that they had straight keels. Expected age of sample, 1000 yr. Coll. 1952 by M. Robbins of Mass. Arch. Soc.; subm. by O. G. Landsverk, 641 Sonora Ave., Glendale, California. *Comment*: sample is too young to be related to Leif Eriksson voyages. Confirms “modern” date by Yale Lab., Y-268 (Yale III), which was kindly brought to our attention by E. S. Deevey.

B. Mexico

UCLA-145.  Barra de Navidad, Jalisco, Mexico 760 ± 70 A.D. 1190

Charcoal from depth of 6 m in shell mound at Barra de Navidad, Jalisco, Mexico (19° 50' N Lat, 104° 43' W Long). Site yields pottery, mostly very plain. Coll. by S. Long; subm. by C. W. Meighan. *Comment* (C.W.M.): age younger than expected, for on cultural grounds expected age would be older than A.D. 600. Cross-dating on pottery indicates this level to be contemporaneous to the Morett Site, which yields older dates (see samples UCLA-187, 188—this date list).
UCLA-148. Playa del Tesoro, Colima, Mexico   1430 ± 100
A.D. 520

Charcoal from midden at Playa del Tesoro, Colima, Mexico (19° 17’ N Lat, 104° 20’ W Long). Depth 1.4 to 1.6 m in Pit 1, associated with pottery and clay figurines. Coll. by R. J. Fitzwater; subm. by C. W. Meighan. Comment (C.W.M.): expected age on cultural association was prior to A.D. 600. Good agreement with Morett Site date of 1500 ± 80 (UCLA-187, this date list) which applies to same kinds of cultural remains.

Morett series, Colima, Mexico

Morett Site (19° N Lat, 105° W Long), is situated on the S side of the Rio de Cihuatlan or Marabasco, which constitutes the boundary between the states of Jalisco and Colima. Extensive midden deposits, over 3 m in depth at some points, are present. A definite stratigraphic sequence is evident in ceramic types, and the major occupation of the site appears to correlate with Isabel Kelly’s Tuxacuesco phase from neighboring Jalisco. Coll. by R. J. Crabtree; subm. by H. B. Nicholson, Anthropol. Dept., UCLA.

UCLA-187. Morett Site, depth 1.10 m   1500 ± 80
A.D. 450

Charcoal from probable hearth at depth of 1.10 m in Pit 3.

UCLA-188. Morett Site, depth 2.30 m   2100 ± 90
150 B.C.

Charcoal, scattered pieces from depth of 2.20 to 2.40 m in Pit 7. General Comment (H.B.N.): UCLA-187 should date the final ceramic phase at the site, UCLA-188 the later portion of the earliest phase. The latter date provides the first clear-cut chronological evidence of a late Preclassic or Early Classic occupation of the Mexican W coast by representatives of the advanced Mesoamerican type of culture.

Cuicuilco Pyramid series, Mexico City, Mexico

Charcoal samples from near the pyramid at Cuicuilco just S of Mexico City (19° 18’ N Lat, 99° 11’ W Long), and the associated subpedregal mound area (Cuicuilco B) in Peña Pobre quarry 0.3 mi W. The Cuicuilco site was examined earlier by Cummings (1933) and Kroeber (1925), and by Heizer and Bennyhoff (1958) in 1957. The dates reported here are based on charcoal collected 1957-1962, and it was hoped that they would clarify some of the stratigraphic and chronological problems of the site. The C¹⁴ dates (UCLA-205 to 212 and 228, this date list) present new problems of archaeological interpretation which cannot be adequately explained in the comments attached to each date. Reference is made in the comments on the individual sample dates to the presently accepted archaeological chronology which places the Early Preclassic at 1500-800 B.C. (Tlalpan at Cuicuilco, Early El Arbolillo and Early Zacatenco phases), Middle Preclassic at 800-400 B.C. (Tlatilco and Middle Zacatenco phases), and Late Preclassic at 400 B.C.-A.D. 100 (Ticoman I-III, Tezoyuca, Chimalhuacan and Tzacualli phases). Coll. 1957-62 by R. F. Heizer, J. A. Bennyhoff, and R. Millon; subm. by R. F. Heizer, Univ. of California, Berkeley.
UCLA-228. Cuicuilco A-2

From immediately beneath the thin ash layer on which the pedregal rests, and beneath which is the archaeological deposit. Sample is a root carbonized by action of the lava. Samples from below this layer have given a range of dates: C-200, 2422 ± 250, (Chicago I); M-663, 2040 ± 200; M-664, 1430 ± 200, (Michigan III).  

UCLA-205. Cuicuilco B-1

From Mound 2 at SE corner of Structure II, 1.37 m below Datum A2 in mixed fill of Structure III. Latest ceramics pertain to the Chimalhuacan phase, but date falls within the later Tzaccualli phase.

UCLA-206. Cuicuilco B-2

From Mound 2, Trench 5, depth 2.3 m below Datum A2 on Floor 4 of Structure I. This floor appears, from the date, to have been built in Chimalhuacan phase.

UCLA-207. Cuicuilco B-3

From Mound 4, Trench 1, 2.75 m below Datum A4, above clay basin in hearting of structure. Charcoal in basin was associated with Ticoman I ceramics and figurines, but this date is too early for the usually accepted age of beginning Ticoman I at 400 B.C. Since sample was separated by 10 cm from the older Tlalpan layer below, some mixture may have occurred to give this sample greater age.

UCLA-208. Cuicuilco B-4

From Mound 2, Trench 5, 2.41 m below Datum A2 between Floors 3 and 4 of Structure I. Date suggests Floor 3 was built in Ticoman III phase; ceramics from fill are Middle Zacatenco.

UCLA-209. Cuicuilco B-5

From Mound 2, Trench 5, at 2.68 m below Datum A2 between Floors 2 and 3 of Structure I. Date suggests Floor 2 was built in Ticoman I phase; ceramics from fill are Middle Zacatenco.

UCLA-210. Cuicuilco B-6

From Mound 1, Trench 4, at 4.0 m below Datum A1. Charcoal collected in sterile structure fill layers apparently laid down in Middle Zacatenco times. It is highly unlikely that this phase can date (as sample would suggest) from 1000 yr earlier than other archaeological evidence indicates. The charcoal may come from Tlalpan phase refuse laid down as structure fill in Zacatenco times. Probably reason for early date is due to the use of older refuse which may be either Tlalpan phase or pre-ceramic (if absence of pottery is taken as a guide). There exist early C\textsuperscript{14} dates for Early Zacatenco (1358 B.C.) and Early Tlatilco (1455 B.C.) which are regarded by some archaeologists as too early. If, how-
ever, these are correct, the UCLA-210 and 212 dates may be correct if they refer to the earliest phase at Cuicuilco (i.e. Tlalpan). Only further excavation, more dates, and archaeological analysis can settle this question.

**UCLA-211. Cuicuilco B-7**

6715 ± 90
4765 b.c.

From Mound 1, near Trench 9, at 5.39 m below Datum A1. Date of this sample is too old for it to refer to the ceramic period. Sample came from charcoal-bearing fill lacking pottery (i.e. from pre-ceramic times?) but which seems to have been laid down in Middle Zacatenco phase.

**UCLA-212. Cuicuilco B-8**

4050 ± 75
2100 b.c.

From Mound 1, Trench 1, at 5.86 m below Datum A1. Fill layer which produced charcoal for this date may have been laid down either in Tlalpan or Middle Zacatenco times. The date, while early, may give correct age of the Tlalpan phase which is Early Preclassic. Unfortunately the one undoubted charcoal sample of Tlalpan phase, which was secured from the bottom of Cummings' “shaft” just S of the round pyramid in the Cuicuilco A zone, was lost in the UCLA laboratory and the reliability of UCLA-212 and age of Tlalpan phase must await collection of additional charcoal.

*General Comment* (R.F.H.): UCLA-228 is presumed to date the eruption of Xitli volcano whose lava covered the already abandoned site of Cuicuilco, but seems too young by 200 to 300 yr. Samples C-200 (2422 ± 250, Chicago I) and M-663 (2040 ± 200, Michigan III) came from the Cuicuilco archaeological deposits and therefore predate the eruption by some undetermined amount of time. Sample Y-437 (1925 ± 60, Yale IV) probably does not date eruption, since it seems to refer to the prepedregal archaeological deposit containing Ticoman pottery. Sample M-664 (1430 ± 200, Michigan III) is also a pre-eruption archaeological date, but seems too young in any event for the Ticoman phase at Cuicuilco. Mound 1 (a terraced platform structure) is older than the other mounds (which also contain structures) in the Cuicuilco B site area. This conclusion, arrived at on the basis of ceramics, is borne out even if the oldest dates (UCLA-210, 211, 212) are ignored, because they refer to structure fills derived from pre-ceramic refuse deposits which were transported to the site from their original location.

C. Central and South America

**Tikal series, Guatemala**

Wood samples from Mayan temples at Tikal (17° 13.3' N Lat, 89° 38.5' W Long), Petén, Guatemala, to check on correlations of the Mayan and Christian calendars. Samples were from lintel and vault beams and, where possible, precautions were taken to avoid “post-sample growth” errors. Subm. by Linton Satterthwaite, University Mus., Philadelphia.

**UCLA-159A. Tikal, Temple IV**

1258 ± 40
A.D. 692

General Comment: The C\textsuperscript{14} dates on Temple IV support the Goodman-Thompson correlation while those on Structure 10 fall between the Goodman-Thompson and Spinden correlations. These results can be compared with the Tikal series dated by the Univ. of Pennsylvania (Satterthwaite and Ralph, 1960). For comparison of these samples the half life error has not been included in errors quoted below.

Average of UCLA-159A and 159B which are duplicate samples of P-243 and P-248 = A.D. 712 ± 30
Average of 10 samples dated by Univ. of Pennsylvania, P-235 to P-249 = A.D. 746 ± 16
Difference = 34 ± 34 yr

Average of UCLA-158 series = A.D. 625 ± 25
Univ. of Pennsylvania P-293 = A.D. 606 ± 45
Difference = 19 ± 50 yr

The agreement between the two laboratories is good, especially considering that the Pennsylvania ages were computed using pre-1900 Oak wood as the modern standard and the UCLA ages were computed on basis of 0.95 NBS oxalic acid. The agreement is also additional support for the validity of 0.95 NBS oxalic acid as a C\textsuperscript{14} standard for the contemporary activity of the biosphere.

If the samples measured are representative of the contemporary biosphere of that period, it would appear that Structure 10 is ca. 100 yr older than Temple IV.

However, variations of up to ± 2% between C\textsuperscript{14} ages and calendar ages of tree rings have been reported by many workers. The reason for the discrepancy is not clear. This problem thus introduces some uncertainty when really precise C\textsuperscript{14} dating, corresponding to variations of less than 1% in C\textsuperscript{14} activity...
is attempted. Finding the cause of this scatter in tree-ring data would appear to be the next most vital step in improving the precision of C\textsuperscript{14} dating for samples less than a few thousand years old.

The possibility that C\textsuperscript{14} dates for the Mayan period could be in error due to a slow change in the C\textsuperscript{14} activity of the contemporary biosphere has been minimized by the series of six known age woods of the period A.D. 560 to 900 recently measured by Ralph (1961). The average calendar age of these six samples was A.D. 719 while the average C\textsuperscript{14} age obtained was A.D. 729 ± 29.

**Gatun Lake series, Panama**

Sediments from various depths in the sedimentary complex filling the Gatun Basin which is the lowest physiographic area in the Isthmus of Panama. It seems probable that the basin was slowly filling as a result of rising worldwide sealevel during the melting of the Pleistocene ice sheets. Coll. by Panama Canal Co.; subm. by E. S. Barghoorn, Harvard Univ., Cambridge, Massachusetts.

**UCLA-183. Gatun Lake Sediments**

Wood fragments from Panama Canal Co. core SL-52, depth 43 ft below mean sealevel (9° 11’ + 365' N Lat, 79° 53’ + 911’ W Long).

**UCLA-184. Gatun Lake Sediments**

Wood fragments from Panama Canal Co. core SL-48, depth 66 ft below mean sealevel (9° 11’ + 1331’ N Lat, 79° 55’ + 4501’ W Long).

**UCLA-185. Gatun Lake Sediments**

Mineral peat from Panama Canal Co. core SL-103, depth 109 ft below mean sealevel (9° 16’ + 4945’ N Lat, 79° 52’ + 2963’ W Long).

**UCLA-186. Gatun Lake Sediments**

Wood fragments from Panama Canal Co. core SL-103, depth 158 ft below mean sealevel (9° 16’ + 5945’ N Lat, 79° 52’ + 2963’ W Long).

**General Comment (E.S.B.):** dates fit well with predicted postglacial sealevel rise; and as there is no reason to assume, on geologic grounds, that the Isthmus of Panama has been submerging, it appear that the filling of the basin has been under sealevel rise control. Rate of rise of sealevel represented in the Panama dates also fits well with comparable data from the Gulf coast of the United States and from the Atlantic coast of the New England area.

**Hacha series, Acari Valley, Peru**

The Hacha Site in the Acari Valley, Peru (15° 28’ 42” S Lat, 74° 37’ 36” W Long), is adjacent to an old river channel, now dry, in the desert behind the Hacienda Cerro Colorado on the E side of the river. At this site a very distinctive style of pottery occurs which is considered to be the earliest pottery yet found in southern Peru.
G. J. Fergusson and W. F. Libby

UCLA-153. Hacha Style Pottery

Wood charcoal from shell refuse containing Hacha style sherds. Coll. by G. S. Vescelius, Hernán Amat, and Dorothy Menzel; subm. by J. H. Rowe, Univ. of California, Berkeley.

UCLA-154. Hacha Style Architecture

Carbonized seeds, embedded in top of clay floor under sand fill containing scattered marine shells and Hacha style sherds. Associated with ashes and discoloration of the clay indicating that a fire had been built on the floor. Coll. and subm. by J. H. Rowe. Comment (J.H.R.): both dates acceptable; samples are from different parts of the site and need not be exactly the same age.

Ancon series, Peru

Samples from excavations of campsites near Ancon, Peru. Coll. by E. P. Lanning; subm. by J. H. Rowe, Univ. of California, Berkeley.

UCLA-201. Bay of Ancon

Charcoal (Tillandsia) from site (PV 45-29B) on Pampa de Piedras Gordas near the Bay of Ancon, 32 km N of Lima (11° 48' S Lat, 77° 8' W Long). Comes from a deposit of shallow ash-stained sand containing numerous land snail shells from extinct lomas vegetation, small numbers of sea shells, and burnt Tillandsia stems and leaves. Though not from a normal refuse deposit, sample should date the Piedras Gordas Complex, thought to be the earliest of six lithic industries found around the Bay of Ancon. The lithic industry consists of core tools, large flakes, and a few scrapers and grinding tools.

UCLA-202. Ancon-Chillon

Charcoal from site (PV 45-84) on the Ancon-Chillon watershed 29 km N of Lima (11° 50' 30" S Lat, 77° 7' W Long), separated from the Pampa de Piedras Gordas by a group of low hills. Sample was Tillandsia charcoal from the lower half of a fireplace containing burnt stones, sea shells, and the charcoal. It should date the Luz Complex, thought to be the second of the lithic industries at Ancon, characterized by stemmed projectile points and thick bifacial blades of Paiján type.

UCLA-203. Loma Ancon

Charcoal from site (PV 45-31) on the slope of Loma Ancon overlooking the Pampa del Canario near Ancon (11° 38' S Lat, 77° 8' 30" W Long). Sample was Tillandsia charcoal from the lower part of an ancient fireplace containing burnt stones, sea shells, and the charcoal. The artifacts from this site belong to the Canario Complex, identified by its flat bi-pointed projectile points similar to one from Santa Isabel Ixtapan in Mexico. General Comment (J.H.R.): all three dates are too recent to fit other South American C¹⁴ dates; UCLA-201 and 202 are too close together.
Luembe River series, Angola

Samples taken from sections exposed by mining operations in the buried channel of the Luembe River, Angola, at the Mufo Mine and from creek bed level or below at the Calunda 3 and Furi I mine; related to culture sequences of this region. Coll. 1960 and subm. by J. D. Clark, Anthropol. Dept., Univ. of California, Berkeley.

UCLA-170. Furi I Mine

1800 ± 80
A.D. 150

Wood from lower stream gravel post-Pleistocene. Late Tshitolian Culture. Tools and potsherds indicating resorting in Iron Age times.

UCLA-171. Calunda 3 Mine

4700 ± 100
2750 B.C.

Wood from lower stream gravel, post-Pleistocene. Late Tshitolian Culture.

UCLA-167. Mufo Mine

6830 ± 120
4880 B.C.

Wood from Upper Sand Bed in Flats Terrace at depth 5 ft. Early post-Pleistocene. Tshitolian Culture. Represents the aggradation of the post-Pleistocene Makalian Wet Phase.

UCLA-172. Calunda 3 Mine

12,970 ± 250
11,020 B.C.

Charcoal from lower part of Redistributed Sands IV over lower stream gravel. Early post-Pleistocene. Lower Tshitolian Culture.

UCLA-168. Mufo Mine

38,000 ± 2500
36,050 B.C.

Peat from sand layer in Lower Flats Gravel of Flats Terrace at depth of 10 ft. Early Upper Pleistocene. Lower Lupemban Culture.

UCLA-169. Mufo Mine

>34,000

Wood from sand layer near base of Lower Flats Gravel of Flats Terrace at depth of 15 ft. Early Upper Pleistocene. Lower Lupemban Culture.

General Comment (J.D.C.): the Upper Pleistocene age of the gravels filling the buried channel of the Flats Terrace of the Luembe River is confirmed by UCLA-168 and UCLA-169, which also date the Lower Lupemban Culture to the closing stage of the early Gamblian Pluvial. This is consistent with the age of the Late Acheulian and Sangoan Cultures at the Kalambo Falls from which the Lupemban evolved. The date of UCLA-172 is somewhat older than anticipated although it is consistent with what is believed to be the same surface at Mufo dated as 11,189 ± 490, (C-580, Chicago II). It indicates that a microblade element was present in the cultures of the Congo Basin by terminal Pleistocene times. UCLA-167 confirms the estimated age of this bed and of the Makalian Wet Phase. UCLA-171 and UCLA-170 date the formation of the lower gravels of the stream courses and indicate that these were sometimes resorted in Early Iron Age times.
Kalomo series, Northern Rhodesia

Samples from excavations at Isamu Pate Mound, an early Iron Age occupation mound, Kalomo, Northern Rhodesia. Coll. 1960 by B. M. Fagan; subm. by J. D. Clark.

**UCLA-175. Kalomo, depth 15 in.** 710 ± 50 A.D. 1240
Charcoal from posthole. Strip 1, Square A2.

**UCLA-176. Kalomo, depth 40 in.** 890 ± 70 A.D. 1060
Charcoal from burnt log from a hearth. Strip 1, Square B1.

**UCLA-177. Kalomo, depth 73 in.** 960 ± 70 A.D. 990
Charcoal from remains of a hearth. Strip 1, Square A5.

*General Comment* (J.D.C.): Isamu Pate is the type-site for the Kalomo Culture which was practiced by the Early Iron Age inhabitants of the plateau country between the Zambezi and Kafue Rivers. The midden refuse indicates a mixed farming economy with emphasis on hunting in the earlier stages. These dates successfully confirm the estimated duration of this culture which is in part derived from the Situmpa Culture (= Channelled Ware pottery) dating in the range A.D. 0-200 and in part intrusive.

Lochinvar series, Northern Rhodesia

Lochinvar hot spring mound is a Late Stone Age site on the edge of the Kafue river basin 27 mi NW of Monze, Northern Rhodesia. Cultural deposits within the mound cover a depth of over 8 ft and include a Wilton stone industry, shell beads, charcoal, animal bone, nuts and seeds of edible vegetation, at least one wooden implement and the remains of five of the human occupants. There were no post-Later-Stone-Age materials whatsoever. Coll. 1960 by C. Gabel; subm. by J. D. Clark.

**UCLA-174. Lochinvar, depth 5 ft** 4700 ± 100 2750 B.C.
Wood from depth of 5 ft, associated with human skeleton.

**UCLA-173. Lochinvar, depth 8 ft** 4300 ± 100 2350 B.C.
Charcoal from depth of 8 ft, in association with fossil fauna, Later Stone Age implements, and a wooden digging stick. *Comment:* dates are not in stratigraphic order. Further samples will need to be run to see if this is due to contamination or intrusive material.

E. Pacific Ocean

**UCLA-193. Isle of Pines, New Caledonia** >35,000
Shell (Tridacna) from 11 ft above mean sealevel, Kuto Pt., Isle of Pines, New Caledonia (22° 40' S Lat, 167° 27' E Long). Shell was broken out of the flat surface of an elevated coral reef—this surface extends for ca. 0.5 mi. Coll. by F. P. Shepard; subm. by C. L. Hubbs.
UCLA-194. Tuoho, New Caledonia  
4900 ± 200  
2950 B.C.

Shell (Tridacna) from Tuoho, New Caledonia (20° 45' S Lat, 165° 15' E Long). Shell broken from reef at high tide level, which is 3 ft above low tide level. Indicates a fall of sealevel compared to the reef of at least 3 ft over the last 5000 yr. Coll. by F. P. Shepard; subm. by C. L. Hubbs.

UCLA-146. Atta-Baru, Okinawa  
3370 ± 80  
1420 B.C.

Charcoal from Atta-Baru shell mound, Okinawa (26° 30' N Lat, 128° E Long), Pit H, depth 36 to 42 in. Coll. by H. Takamiya; subm. by C. W. Meighan. Comment (C.W.M.): no other C¹⁴ dates are known for the Ryukyu Islands. Stylistic cross-ties with Japanese finds indicated age to be in B.C. period.

F. England

UCLA-113. Underground Temple, Thanet, England  
280 ± 100  
A.D. 1670

Piece of shell mosaic from E wall of underground shrine located in Thanet, England (51° 23' N Lat, 1° 20' E Long). The temple contains ca. 100 panels of shell mosaic. Its design consists of a Shrine with an altar in the S, the upper part of which forms a 5-rayed Sun. This leads out into a winding passage 30 ft long, a Dome with three Alcoves, and a Rotunda with two 4-ft passage ways surrounding and a passage leading up to the surface in the N. Extensive renovations and replacement of shell mosaic have taken place in the past, chief of which were the removal of the domed and arched roof of the Shrine after the discovery in 1835. Subm. by Conan Shaw, Angmering Village, Sussex.

Cruck-Framed House series, England

The cruck-framed house or barn is one in which the principal trusses supporting the roof consist of pairs of heavy timbers which have a curvature or elbow such that each pair meets at the roof ridge. Variant forms are base crucks in which the feet rest on a stone plinth near ground level and upper crucks which rest just below the wall-plate level. The cruck as a form of timber-frame construction has survived in a few houses and barns of medieval date in several counties of England and Wales (Smith, 1960); by the 14th century, crucks were becoming obsolete except for barns and humble dwellings. There is little historical evidence regarding the antiquity of English crucks, the earliest that can be dated with any certainty being 1382. As this type of framework was brought to England from Northern Europe in pre-Norman times and possibly by the Angles as early as the 6th century, survivals from early medieval times are possible.

Samples from base crucks have been collected from two counties, Derbyshire and Berkshire: the former has a dense distribution of crucks and is on one of the lines of Anglian penetration into England; the latter includes numerous agricultural villages in which various dwellings have persisted from medieval times.
Derbyshire County series

**UCLA-232. Whittington Farm, Chesterfield**

Oak, heartwood, from one of the 5 oak crucks, in the house known as “Whittington Farm, Whittington Moor,” which was dismantled in 1961. Location (53° 15’ N Lat, 1° 25’ W Long), 2 mi N of Chesterfield, and 200 yds W of a place on the River Rother where several ancient bridle paths converged.

**UCLA-233. Cartledge Hall, Holmesfield**

Oak sap-wood from cruck barn at Cartledge Hall, Holmesfield.

Berkshire County series
Coll. 1962 and subm. by M. C. and J. M. Fletcher.

**UCLA-235. Church Lane, Harwell**

Oak, taken inside the house, at 3 ft from the base of end cruck (Fletcher, 1962) at Le Carillon, Church Lane, Harwell (51° 36’ N Lat, 1° 17’ W Long), 100 yds W of Church.

**UCLA-236. Jennings Lane, Harwell**

Oak, heartwood, from internal cruck at 8 ft from base in School House, Jennings Lane, Harwell. The crucks in this house are large and have mortice and tenon joints indicating post A.D. 1200 date.

**UCLA-238. Harwell Church, Harwell**

Wood from part of oak tie-beam removed in 1962 from roof of N Transept of Harwell Church due to attack by deathwatch beetle. Style of timbered roof construction in this transept is typical of local 14th and early 15th century work.

**UCLA-237. Tractor Shed, Long Wittenham**

Oak, probably heartwood, from part of ancient cruck (Portman, 1956) embedded internally in modern brick part of Church Farm, Long Wittenham (51° 38’ N Lat, 1° 12’ W Long).
UCLA Radiocarbon Dates II

UCLA-266. Tractor Shed, Long Wittenham

410 ± 60 a.d. 1540

Oak, mainly sapwood, from crucks in cottage (now converted to tractor shed), adjacent to Church Farm, Long Wittenham. Outer surface of sample planed to remove paint. UCLA-265 is from an internal cruck, while UCLA-237 and 266 are duplicate collections from inside of cruck at NE corner of building.

G. Egypt

Buhlen series, Egypt


UCLA-247. Buhlen, Block 16

4060 ± 60 a.d. 2110 b.c.

Wood charcoal from Building Block 16 (Trench). Estimated age pre-Fourth Dynasty (before 2600 b.c. or 4550 b.p.). Comment: sample is younger than UCLA-248 which is definitely Fourth to Fifth Dynasty.

UCLA-248. Buhlen, Block 1

4420 ± 80 a.d. 2470 b.c.

Wood charcoal from Building Block 1. Sample found with sealings bearing the names of the Kings of the Fourth and Fifth Dynasties (ca. 2600-2350 b.c.). Comment: checks well with expected age of 4300 to 4550 b.p. Age based on new C14 half life of 5730 yr would be 4560 ± 80.

References

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MIAMI NATURAL RADIOCARBON MEASUREMENTS II*
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INTRODUCTION
The C\textsuperscript{14} dates given below are a continuation of the work presented in our first list (Miami I) using the same apparatus and techniques described previously. In addition to the dating of marine carbonate materials, however, we have extended our methods to the dating of wood and peat samples. All dated peat and wood samples have been given a standard pretreatment by successive washings with dilute HCl and 2\% NaOH solution for removal of carbonates and humic acids (Olson and Broecker, 1958). Where sufficient alkali-soluble “humic acid” was recoverable for analysis, this fraction was dated separately and is included with the date obtained from either the wood or peat.

The reported ages were obtained by using a 1.0-L CO\textsubscript{2} proportional counter operating at 3 atm pressure. Samples were measured at least twice for a 1000-minute counting period each and a minimum of 14 days between counting periods. In cases where dilution was necessary because of small sample size, those samples were counted three times. Ages are \delta\textsuperscript{13}C corrected and have been calculated in the usual way by comparison with the 95\% activity of the NBS standard, using a half life of 5568 \pm 30 yr, referred to A.D. 1950. From the calculated age of marine carbonate material we have subtracted 400 yr as an apparent sea-surface carbonate age (Miami I). No such correction is made for organic material. The uncertainty in the given ages includes the experimental standard deviation in the count rate of the modern standard, the unknown and the background, and the standard deviation of the half life of C\textsuperscript{14}.

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Karen A. Brandt handled the routine of machine operation and has made all sample preparations. To Per Nilsson, our glass blower, we wish to express our thanks for maintaining our glasswork and for other technical assistance. Walter B. Charm and B. M. Hellstrom provided additional assistance in laboratory work and sample collection. We are grateful to Dr. C. Emiliani and his staff for making the C\textsuperscript{13} analyses reported from this laboratory.

SAMPLE DESCRIPTIONS
1. GEOLOGIC SAMPLES FROM DEEP-SEA CORES

_Tongue of the Ocean, Bahamas, B. W. I._

Dating of core samples from the Tongue of the Ocean represents a continuation of the program outlined in our previous list (Miami I). Two new cores (MG 61-8, and MO 62-29) have been added here to the former list. The

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ages reported for the other cores in this group extend the series of dates on
cores described previously. These data provide information related to (1)
rates of sediment accumulation, (2) periodicity of turbidite deposition, (3)
estimates of carbonate supply rate from the Bahama Banks to the Tongue of
the Ocean basin, and (4) insight into the anomalous behavior of Ra^{226} dis-
tribution in the sediments. Unless stated otherwise, all samples in this series
were collected by Marine Laboratory staff and were submitted by G. A. Rusnak.

It had been demonstrated earlier (Miami I) that dates of turbidite layers
in the cores are unreliable as indicators of emplacement age for that layer. The
coarse-grained carbonate deposited out of a turbidity current can be
nearly twice as old as the immediately underlying fine-grained pelagic carbonate.
Turbidite layers represent materials which have been reworked from older de-
posits formed on the unstable slopes of this steep-sided basin. It is clear from
the MG 60-18 series that the fine fraction of the turbidite layers also is re-
worked material which must have been entrained in the turbidity current. Age
of turbidite layer and time of its emplacement thus can be evaluated only by
dating the pelagic carbonate layer underlying the turbidite. An average \( \delta^{13}C \)
value of +3.25\% (based on 18 calcilutite samples) was used for all Tongue
of the Ocean samples where no value is stated separately.

**Core MG 57-18 series**
Gravity core collected from the center of the Cul de Sac (23° 40' N Lat,
76° 52' W Long, water depth 1253 m). This core had been supposed to be
largely uninfluenced by turbidity-current deposition as indicated by its lithol-
ogic uniformity. Analyses for Ra^{226} by B. Szabo, however, showed some variation
which raised suspicions about the uniformity of the core. The single date
(ML-13) of this core from our previous list is included here to complete the
series. Core is composed entirely of calcilutite.

**ML-52.** MG 57-18, 0-3 cm

Bulk CaCO_3.
300 ± 70
A.D. 1650

**ML-53.** MG 57-18, 10-15 cm

Bulk CaCO_3; \( \delta^{13}C = +3.61. \)
2105 ± 65
155 B.C.

**ML-54.** MG 57-18, 30-35 cm

Bulk CaCO_3; \( \delta^{13}C = +3.27. \)
2515 ± 65
565 B.C.

**ML-13.** MG 57-18, 44.5-49 cm

Bulk CaCO_3.
4000 ± 100
2050 B.C.

**General Comment (G.A.R.)**: this series demonstrates that although the core
lithology appears uniform, the assumption of uniform deposition rate cannot
be made for this area even for short time intervals. The core section between
the dated units at 30-35 cm and 10-15 cm shows an accumulation rate approxi-
mately six to seven times higher than either of the sections above or below. As
this section does not exhibit obvious disturbances or turbidite features, the high
rate may be accounted for by sudden slumping of contemporaneous calcilutite,
from some higher level in the basin.
Core MG 57-11 series

Gravity core collected from N end of basin axis (24° 59' N Lat, 77° 44' W Long, water depth 2489 m). Core appeared to be a fairly homogeneous calcilutite except for an ill-defined turbidite zone at depth ca. 12-21 cm. An earlier (Miami I) date from near the bottom of this core (ML-12) was supposed to provide an estimate of the accumulation rate unaffected by the complication of turbidity-current deposition. The date is included in this completed series.

ML-55. MG 57-11, 0-3 cm 845 ± 60 A.D. 1105
Bulk CaCO₃; δ¹³C = +2.78.

ML-56. MG 57-11, 14-21 cm 2370 ± 65 420 B.C.
Bulk CaCO₃; δ¹³C = +2.91.

ML-57. MG 57-11, 21-25 cm 2315 ± 65 365 B.C.
Just below ill-defined turbidite. Bulk CaCO₃; δ¹³C = +4.53.

ML-58. MG 57-11, 30-35 cm 2500 ± 65 550 B.C.
Bulk CaCO₃; δ¹³C = +2.67.

ML-12. MG 57-11, 60-65 cm 3700 ± 90 1750 B.C.

General Comment (G.A.R.): like the previous core, this series shows an exceptionally high accumulation rate for a time ca. 2500 yr ago when compared to other sections of the core. The ill-defined turbidite layer ML-55 shows an older age than its underlying unit ML-56 and thus demonstrates its reworked nature.

Core MG 58-6 series

Gravity core collected from axial center of basin (23° 58' N Lat, 77° 18' W Long, water depth 1369 m). A single date from this core was recorded in the earlier list, but additional dates were made to obtain more information concerning the Ra²²⁶ distribution analysed by B. Szabo. The earlier date (ML-14) is included to complete this series.

ML-60. MG 58-6, 0-4 cm 1515 ± 60 A.D. 435
Bulk CaCO₃; δ¹³C = +2.56.

ML-61. MG 58-6, 9-13 cm 1810 ± 65 A.D. 140
Bulk CaCO₃; δ¹³C = +2.63.

ML-62. MG 58-6, 19-23 cm 3650 ± 70 1700 B.C.
Just below ill-defined turbidite. Bulk CaCO₃; δ¹³C = +3.08.

ML-63. MG 58-6, 35-40 cm 4335 ± 75 2385 B.C.
Bulk CaCO₃; δ¹³C = +2.67.
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ML-14. MG 58-6, 55-60.5 cm  
6615 ± 130  
Bulk CaCO₃.

General comment (G.A.R.): top 4 cm contains an ill-defined turbidite layer with reworked sediment and therefore date is too old.

Core MG 60-18 series

Gravity core collected from E side of basin (24° 10' N Lat, 77° 17' W Long, water depth 1380 m). This core exhibits extensive layers of turbidite sands and had been dated earlier to determine frequency of turbidity flows. The following ages have been determined on the coarse (>62µ) and fine (<62µ) fractions of single turbidite units to further test the hypothesis that the coarse fraction is older than the fine. Test results were as expected.

ML-66. MG 60-18, 0-1.5 cm  
1210 ± 140  
A.D. 740

Coarse fraction CaCO₃; >62 µ.

ML-67. MG 60-18, 0-1.5 cm  
1180 ± 90  
A.D. 770

Fine fraction CaCO₃; <62 µ.

ML-68. MG 60-18, 86-89 cm  
7700 ± 115  
5750 B.C.

Coarse fraction CaCO₃ >62 µ.

ML-69. MG 60-18, 86-89 cm  
6950 ± 105  
5000 B.C.

Fine fraction CaCO₃ <62 µ; δ¹³C = +3.29.

General comment: neither the coarse nor fine fraction may be expected to give reliable ages for stratigraphic horizons containing turbidity current deposits.

ML-75. Core MG 60-14, 13-18 cm  
7890 ± 100  
5940 B.C.

Piston core taken along axis of basin due E of the S tip of Andros Island (23° 49' N Lat, 77° 14' W Long, water depth 1345 m). Nearly undisturbed except for turbidite layer in upper 10 cm. Our earlier list (Miami I) gave dates from section 0-5 cm (ML-17), 75-80 cm (ML-19), and 145-150.3 cm (ML-20). The 8275 ± 120 (ML-17) age for the 0-5 cm section was too old because it contained reworked materials. The 13-18 cm section dated here indicated pelagic sedimentation, uncomplicated by reworking, and therefore is considered reliable.

ML-80. Core MO 62-29, 129-134 cm  
4425 ± 70  
2475 B.C.

Gravity core collected from the Cul de Sac (23° 33' N Lat, 76° 57' W Long, water depth 1300 m). Core contains turbidite sand layers at 37-45 cm and 74-77 cm, but dated section appears undisturbed and should make possible a reliable estimate of bulk accumulation rate. Coll. by F. Busby. Bulk CaCO₃; δ¹³C = +2.70.

ML-81. Core MG 61-8, 138-143 cm  
6160 ± 80  
4210 B.C.

Gravity core collected from SW side of the Cul de Sac (23° 32' N Lat,
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77° 08' W Long, water depth 1180 m. Core contains sand layers at 65-66 cm, 71-74 cm, 89-99 cm, and 106-108 cm. Dated section appears undisturbed and should give basis for a reliable estimate of bulk accumulation rate. Bulk CaCO₃; δC¹³ = +3.75.

Caribbean Sea

The two Caribbean core series included here have had extensive O¹⁸/O¹⁶ analyses from which detailed paleotemperature curves have been constructed. In addition, sections of significant climatic changes have been dated by Pa²³¹/Th²³⁰ method (Rosholt et al, 1961, 1962). Hence, dating of various core sections was important to (1) establish a check on the Pa²³¹/Th²³⁰ method, (2) provide a closely-spaced series for dating early inflections in the paleotemperature curve, and (3) give sufficient dating detail for discrimination among changing accumulation rates related to the climatic events. In addition, a number of core sections have C¹⁴ dates determined from the separate coarse (>62µ) and fine (<62µ) fractions to evaluate possible contamination by reworked materials. This factor was of great importance in checking the Pa²³¹/Th²³⁰ dating because the method depends on the clay component for dating.

Core A 240-ML series

Piston core collected from the central Caribbean (15° 26' N Lat, 68° 30' W Long, water depth 4180 m). Undisturbed Globigerina-ooze core with a well-defined stratigraphic sequence in the oxygen-isotope curve. Core sections for dating were selected on basis of temperature curve inflections and duplicate sections of zones used for Pa²³¹/Th²³⁰ dating. Dates arranged in order of increasing age and depth. Coll. by J. Zeigler and W. Ahearn, Woods Hole Oceanographic Inst.; subm. by G. A. Rusnak.

ML-112. A240-ML, 0-6 cm
Coarse CaCO₃ fraction 62µ. δC¹³ = +1.53.

ML-113. A240-ML, 0-6 cm
Fine CaCO₃ fraction <62µ. Avg. δC¹³ value of +1.51 used.

ML-70. A240-ML, 11-15 cm
Coarse CaCO₃ fraction >62µ. Avg. δC¹³ value of +1.51 used.

ML-71. A240-ML, 11-15 cm
Fine CaCO₃ fraction <62µ. δC¹³ value of +1.51 used.

ML-106. A240-ML, 36-43 cm
Coarse CaCO₃ fraction >62µ. δC¹³ = +1.71.

ML-107. A240-ML, 36-43 cm
Fine CaCO₃ fraction <62µ. δC¹³ = +1.10.

ML-108. A240-ML, 44-50 cm
Coarse CaCO₃ fraction >62µ. δC¹³ = +1.50.
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ML-109. A240-ML, 44-50 cm  
Fine CaCO$_3$ fraction <62µ. $\delta^{13}C = +1.76.$

ML-110. A240-ML, 57-63 cm  
Coarse CaCO$_3$ fraction >62µ. $\delta^{13}C = +1.47.$

ML-111. A240-ML, 57-63 cm  
Fine CaCO$_3$ fraction <62µ. Avg. $\delta^{13}C$ value of +1.51 used.

General Comment (G.A.R.): the sedimentation model we have assumed for pelagic deposits requires that pelagic Foraminifera may often undergo co-deposition with older, bottom-transported fines. Thus C$^{14}$ analyses of bulk carbonate or Pa$^{231}$/Th$^{230}$ analyses of the fine clay could give ages older than the age of the Foraminiferal component upon which the stratigraphic record is based. The significantly older age of the coarse fraction in each section of this core indicates a reversal of the model we have selected for co-deposition of older and younger materials. Additional work is being done to arrive at a satisfactory model. The C$^{14}$ date of the 11-15 cm section agrees with the Pa$^{231}$/Th$^{230}$ date of 11,000 ± 3,000 yr B.P. (Rosholt et al., 1961, p. 176) obtained from the 11-20 cm section of this core. Excellent agreement between the two methods is especially evident in the fact that sedimentation rates between the top of the core and the two dated sections compared are virtually identical when the fine carbonate date is used. Thus the fine-carbonate fraction has here a similar sedimentation behavior to the non-carbonate clay fraction with which the Pa$^{231}$ and the Th$^{230}$ are associated. We might therefore assume, with reasonable assurance, that the Pa$^{231}$/Th$^{230}$ age determinations on this core are reliable at all points dated.

Core A 254-BR-C series

Piston core collected from the Beata Ridge area of the Caribbean (15° 57' N Lat, 72° 53.5' W Long, water depth 2968 m). Another Globigerina ooze core exhibiting a well-defined stratigraphic sequence. Sections to be dated were selected on the basis of stratigraphic information and as a check on the Pa$^{231}$/Th$^{230}$ dating of this core. Dates are arranged in order of increasing age and depth. Unless stated otherwise, we have used an avg. $\delta^{13}C$ value of +1.51. Coll. by J. Zeigler and W. Athearn; subm. by G. A. Rusnak.

ML-94. A 254-BR-C, 0-4 cm  
Bulk CaCO$_3$; $\delta^{13}C = -0.93$. Comment (G.A.R.): top of core appears to have been lost during the coring operation.

ML-72. A 254-BR-C, 20-28 cm  
Coarse CaCO$_3$ fraction >62µ.

ML-73. A 254-BR-C, 20-28 cm  
Fine CaCO$_3$ fraction <62µ; $\delta^{13}C = +0.28.$
ML-95. **A 254-BR-C, 38-42 cm**  
Bulk CaCO$_3$, $\delta^{13}C = -1.55$.

ML-100. **A 254-BR-C, 54-60 cm**  
Coarse CaCO$_3$ fraction $>62\mu$.

ML-101. **A 254-BR-C, 54-60 cm**  
Fine CaCO$_3$ fraction $<62\mu$.

ML-96. **A 254-BR-C, 68-72 cm**  
Bulk CaCO$_3$, $\delta^{13}C = -1.91$.

ML-102. **A 254-BR-C, 74-80 cm**  
Coarse CaCO$_3$ fraction $>62\mu$.

ML-103. **A 254-BR-C, 74-80 cm**  
Fine CaCO$_3$ fraction $<62\mu$.

ML-97. **A 254-BR-C, 98-102 cm**  
Bulk CaCO$_3$, $\delta^{13}C = -3.00$.

**General Comment (G.A.R.):** The discussion of the Core A 240-ML series applies to this series except that the upper few cm of this core must have been lost during piston coring. There is no disagreement in the ages obtained by the two dating methods for comparable horizons of this core, although the Pa$^{231}$/Th$^{230}$ date of 19,000 ± 4000 at 31-40 cm (Rosholt et al., 1962) appears to be ca. 4000 yr older than the C$^{14}$ date of 15,245 ± 220 (ML-95) at the 38-42 cm level. As there appears to be a small difference of C$^{14}$ dates between the coarse and fine-carbonate fraction, it may be assumed that the Pa$^{231}$/Th$^{230}$ age dates the core section within the experimental uncertainty of the method.

II. GEOLOGIC SAMPLES FROM COASTAL DEPOSITS

**Florida**

ML-87. **East Naples, buried peat**  
Black crumbly peaty sand (sample EN-1) bed 12 ft below surface in dredge pit (26° 12' 40" N Lat, 81° 47' 46" W Long), behind coastal dune tract at East Naples, Florida. **Comment (G.A.R.):** the peaty sand lies ca. 3 ft above sealevel (mean low water) and is thickly covered by rather clean sand. Age of peat agrees with similar beds from E central Florida as reported by Parker et al. (1955, p. 109) and indicates a common sealevel control of peat accumulation. More importantly, the date records the invasion of the peat by coastal sands in this area. Peat accumulation and cover of coastal dune sand indicates sealevel rose to present level by this time. Coll. 1962 by A. L. Glass, Univ. of Miami. Bulk organic; $\delta^{13}C = -18.41$. 

3075 ± 65
1125 B.C.
Thimble Shoals Channel series, Chesapeake Bay Highway Crossing

Engineer's borings taken in connection with the Chesapeake Bay Highway Crossing near Thimble Shoals, Virginia (36° 59' N Lat, 76° 06' W Long). Peat and wood samples from a buried peat body trending SSW-NNE at 80-98 ft below mean low water, underlain by subaerial erosion surface and overlain by marine sand and silt. Coll. 1962 and subm. by W. Harrison, Virginia Inst. Marine Sci., Gloucester Point, Virginia. Samples date flooding of the area by rising sealevel.

ML-89. Boring B-3, 85 ft below sealevel 11,180 ± 150
9230 B.C.
Brown to black peat (sample SM 5 DB & 6D) containing fine sand and wood. Bulk organic; δC\text{13} = -23.81.

ML-90. Boring M-28, 82 ft below sealevel 9930 ± 130
7980 B.C.
Black to brown peat (sample SM 11-D). Bulk organic; δC\text{13} = -22.84.

ML-91. Boring M-28, 89 ft below sealevel 14,870 ± 200
12,920 B.C.
Black to brown peat (sample SM 13-D). Bulk organic; δC\text{13} = -24.30.

ML-92. Boring SD-1, 87 ft below sealevel <200
Wood log (sample SM SD-1) fragment suggestive of old bog; δC\text{13} = -23.45. Comment (G.A.R.): log sample (ML-92) is obviously a contaminant caused by boring operation and not representative of buried horizon. Significance of other dates in this series is discussed by Harrison and Rusnak (1962).

Hog Island Beach series

Wood, peat and marine shell samples from wave-cut exposure near S end of Hog Island, Virginia (37° 24' 18" N Lat, 75° 41' 48" W Long). Material of sample HIX consists of crumbly black to brown peat occurring as a layer 0.6 to 1.0 ft thick, 2 ft above high tide level. Peat layer is underlain by shell bed 0.5 ft thick (sample HIY) which overlies sand. A single thick-shelled *Mercenaria campechiensis* from HIY was used for dating after ca. 10% of outer surface was removed by HCl digestion. Sample HIZ consists of large fragment of *Pinus* stump whose base lies within or below the sand bed beneath layers HIX and HIY. Coll. 1962 and subm. by W. Harrison. Dates arranged from uppermost layer down.

ML-121. Layer HIX 760 ± 80
A.D. 1190
Humic-acid-free organic fraction; δC\text{13} = -16.50. Comment: alkali-soluble humic-acid fraction gave an age of 590 ± 80 yr, δC\text{13} = +2.11.

ML-117. Layer HIY 1495 ± 75
A.D. 455
*M. campechiensis* CaCO\text{3}; δC\text{13} = +2.28.
ML-118.  Layer HIZ  <200

Pinus wood; δC\(^{13}\) = -22.45. Comment (G.A.R.): stump is stratigraphically much younger than enclosing sediment and probably represents slump-covered drift wood. Other dates suggest post depositional uplift (Harrison and Rusnak, 1962).

ML-119.  Paramore Island, sample PIA  <200

Wood fragments in peat layer from low-tide, wave-cut nip at contact between organic silt and overlying coarse sand on N shore of Paramore Island, Virginia (37° 34' 42" N Lat, 75° 34' 18" W Long). Humic acid free Juniperus fragment; δC\(^{13}\) = -23.50. Coll. 1962 by M. Castagna and W. Harrison; subm. by W. Harrison. Comment (W.H.): this peat is at the same altitude as fresh water peat with tree stumps S of Virginia Beach, Virginia. Young age of this sample undoubtedly represents cut and fill action near inlet between barrier islands. Yale has dated a sample Y-924, of white pine from the Virginia Beach peat at 725 ± 70. (Yale VIII).

Wachapreague, sample WAB

Surface of a peat layer collected from 8 ft below mean low water at Wachapreague dock of Virginia Institute of Marine Science, Wachapreague, Virginia (37° 36' 42" N Lat, 75° 41' 18" W Long). Peat is overlain by 8 ft of organic silt, containing abundant grass stems grading up into sand and silt. Coll. 1962 and subm. by W. Harrison. Comment (W.H.): top of the peat marks a widespread change in rate of sedimentation in the marshes. Pollen analysis is in progress on this and related sections.

ML-120.  Residual, after humic acid removal  <200

δC\(^{13}\) = -17.55.

ML-120.  Humic acid  <200

δC\(^{13}\) = -16.01. Comment (G.A.R.): young age indicates that material from this site unreliable and very likely represents fill or contaminant from dock construction.

Georgia

ML-114.  Pumpkin Hammock, sample VJ-1  480 ± 60 A.D. 1470

Shell sample from exposure along Duplin River at Pumpkin Hammock, Georgia (31° 27' 05" N Lat, 81° 17' 14" W Long). Shell consists entirely of Crassostrea and occurs 3 to 7 ft above mean low water at contact of Silver Bluff marsh and overlying Recent marsh. May date Silver Bluff marsh or Recent marsh formation. Coll. and subm. by J. H. Hoyt, Univ. Georgia, Marine Inst., Sapelo Island, Georgia. Comment: sample leached with 6 N HCl to remove incrusting material.


Core sample from beach backshore at S end of Sapelo Island, Georgia (31° 22' 58" N Lat, 81° 16' 17" W Long). Shell material recovered from 17
to 20 ft below mean low water, may provide rate of prograding beach advance. Sample is mainly *Mulinia* sp. with some *Anadara* and *Crassostrea* and fragments; *id.* by R. Work, Univ. Miami. Coll. 1961 and subm. by J. H. Hoyt. *Comment:* ca. 30-50% of sample is discolored and suggests possible contamination which may not have been removed by acid leach of outer surface. $\delta^{13}C = -1.49$.

**ML-116. Sapelo Island, sample 4-28**

Core sample from beach backshore on Sapelo Island, Georgia (31° 23' 27" N Lat, 81° 15' 54" W Long). Shell consisting mainly of *Mulinia* sp. with a few fragments of *Anadara, Mercenaria, Crassostrea,* and *Trachycardium* (*id.* by R. Work) recovered from 18 ft below mean low water. Coll. 1961 and subm. by J. H. Hoyt. *Comment:* ca. 20% of sample is discolored and suggests possible contamination which may not have been removed by acid leaching of outer surface. $\delta^{13}C = -1.54$.

### III. MISCELLANEOUS SAMPLES OF GEOLOGIC INTEREST

**Florida**

**ML-77. Harney Pond I**

*Chione cancellata* shells collected from newly dredged canal at Harney Pond near Lake Okeechobee, Florida (27° 00' N Lat, 81° 05' W Long). Fresh appearing *Chione* bed occurs 4 ft below surface, but believed to be of Early Pleistocene Fort Thompson age and therefore beyond C$^{14}$ age. *Comment:* ca. 30% of sample leached away to remove surface contamination. Sample is dead.

**Bahama Bank**

Two sets of samples dated in this group: a stalactite from a submerged cave on Grand Bahama Island; and, a set of surface sands from the shallow banks surrounding the Tongue of the Ocean. Stalactite overgrown with marine carbonate of incurring organisms is supposed to give time of cave submergence by rising sealevel. Shallow-bank surface sands give minimum age for sands swept down into the Tongue of the Ocean.

**Grand Bahama Island Stalactite series**

Stalactite sample (GB-1) 5" x 3" from submerged cave at S end Grand Bahama Island, B. W. I. (26° 30' 12" N Lat, 78° 40' 48" W Long, water depth 6 to 9 m). Coll. 1962 by J. Greenberg; subm. by G. A. Rusnak.

**ML-78. Outer organic CaCO$_3$ overgrowth**

$22,570 \pm 340$

$20,620$ B.C.

$\delta^{13}C = +0.72$.

**ML-79. Stalactite center**

$34,970 \pm 1400$

$33,020$ B.C.

$\delta^{13}C = +0.32$.

*General Comment* (G.A.R.): outer heavy crust of marine organic carbonate
removed from stalactite by grinding after preliminary acid leach for removal of superficial incrustations. Dates determined on clean crust and stalactite separates demonstrate large difference, but contamination cannot be ruled out.

Bahamas Bank Surface Sand series

Grab samples of shallow carbonate sands from surface of bank margin surrounding the Tongue of the Ocean.

**ML-83.** Grab sample MG61-38

1480 ± 60

A.D. 470

Sample of skeletal beach sand collected from SW shore-line of Green Cay, Bahamas, B. W. I. (24° 02' N Lat, 77° 11' W Long). $\delta^{13}C = +6.27$.

**ML-84.** Grab sample MG61-34

955 ± 50

A.D. 995

Shelly sand collected by diving on shallow banks S of New Providence Island, B. W. I. (24° 43' N Lat, 77° 23' W Long, water depth 10 m). $\delta^{13}C = +4.16$.

**ML-85.** Grab sample MG61-41

645 ± 50

A.D. 1305

Shelly oolitic sand collected by diving on shallow bank SE of Cul de Sac in Tongue of the Ocean, Bahamas, B. W. I. (23° 25' N Lat, 76° 31' W Long, water depth 8 m). $\delta^{13}C = +4.37$.

**ML-86.** Grab sample MG61-45

2025 ± 55

75 B.C.

Shelly sand collected by diving at Queens Channel on S side of Tongue of the Ocean, Bahamas, B. W. I. (23° 24' N Lat, 77° 03' W Long, water depth 12 m). $\delta^{13}C = +4.75$.

**General comment** (G.A.R.): sample dates provide minimum ages for sand materials swept from bank surface into Tongue of the Ocean basin.

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date list:

Miami I  Õstlund, Bowman, and Rusnak, 1962

Yale VIII  Stuiver, Deevey, and Rouse, 1963


The dating equipment at the National Physical Laboratory was completed by the summer of 1960. A series of calibration and intercomparison measurements was undertaken however, using the NBS oxalic acid reference standard, a modern wood standard (1850 oak tree) and other material before starting routine measurements toward the end of 1961. All results have been obtained using a 4.5 L copper proportional counter filled with CO₂ at a constant density corresponding to standard conditions of 22°C and an absolute pressure of 150 cm Hg. The counter is shielded by 8 in. of steel, 6 in. of paraffin wax containing boric oxide, 23 Geiger counters arranged as two independent groups and finally by 1 in. of mercury.

The net count corresponding to 0.95 times the activity of the NBS oxalic acid is 55.6 counts/min and is statistically indistinguishable from that obtained using the 1850 oak. The background is 9.6 counts/min with a residual barometric pressure effect of ca. 0.22 counts/min/cm Hg for which a correction is applied to all measurements. All results are based on the NBS oxalic acid reference standard, are corrected for isotopic fractionation from measurements with a Metropolitan Vickers M.S. 3 mass spectrometer and reported with A.D. 1950 as the reference year. The quoted uncertainty (± 1σ) is calculated from the variances observed for the standard, unknown and background count rates, together with that of the correction applied for fractionation. A standard error of 80 yr is also included for the de Vries effect, but no error is included for the half life which has arbitrarily been taken as 5568 yr. The apparatus automatically corrects for the dead time imposed during the cancellation of meson pulses and prints answers every 50 min of live time to provide the information necessary for the statistical analysis. Each measurement period is of 16 to 18 hr duration and results are reported for at least three such periods spaced at intervals of about a week and involving independent fillings of the counter. To allow any radon to decay, samples are not measured until three weeks have elapsed after final purification. The limit of sensitivity, based on a total counting time of 48 hr and a 4σ criterion, is between 40,000 and 45,000 yr.

Samples are pretreated with hydrochloric acid and sodium hydroxide, excepting shell which has 30% by weight removed by acid leaching only. For each measurement, gas purity is monitored using an external cobalt-60 source and the charge sensitivity of the special NPL non-overloading amplifier checked using a standard test pulse. Plateaux normally exceed 500 v in length, centered on the operating point of 6000 v, and have a slope of 0.5%/100 v. From time to time the efficiency of the Geiger counters is checked using a coincidence, anti-coincidence technique.

The description of each sample is based on information provided at the time of application 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.

BRITISH ISLES

Penmaenmawr series, Caernarvonshire

Carbonized wood from stone circles on moorland known as Cefn Coch, S of Penmaenmawr. Coll. 1959 and subm. by W. E. Griffiths.

NPL-10. Stone circle 278, Penmaenmawr, A 3355 ± 155
1405 B.C.

Sample A from old surface beneath stony bank of NE quadrant of circle (53° 15' 08'' N Lat, 03° 55' 01'' W Long), N Wales. Comment (W.E.G.): associated with scraps of pottery perhaps representing camp-site of builders of circle.

NPL-11. Stone circle 278, Penmaenmawr, B 3470 ± 145
1520 B.C.

Sample B from old surface against main upright in SW quadrant of circle (53° 15' 08'' N Lat, 03° 55' 01'' W Long), N Wales. Comment (W.E.G.): dates erection or at least use of circle.

NPL-12. Monument 280, Penmaenmawr, C 3080 ± 145
1130 B.C.

Sample C from contents of fire pit dug into old surface of circle (53° 15' 11'' N Lat, 03° 54' 57'' W Long), N Wales. Comment (W.E.G.): dates a time during use of monument.

Badentarbet Lodge series, Ross-shire

Wood of Pinus Sylvestris from peat bog, ca. 50 ft above sealevel, close to gate of Badentarbet Lodge, Achniltibuie, N of Ullapool (58° 02' N Lat, 05° 21' W Long), Scotland. Coll. 1959 by T. G. Longstaff; subm. by H. H. Lamb, Meteorological Office, Air Ministry.

General comment (H.H.L.): samples come from well-grown trees, believed to be part of the most recent forest growth, at an exposed part of coast where trees will now not grow (Manley, 1945; Lamb, 1959). The problem is whether this occurred during the main postglacial Climatic Optimum, 4000 to 2000 B.C. or the less favorable secondary optimum ca. A.D. 1000.

NPL-13. Badentarbet Lodge, A 4420 ± 102
2470 B.C.

Part of log 17 ft long, 7 in. diam at lower end, which had more than 90 growth rings, 2 to 3 ft below present surface of peat. Considered by finder to show signs of fire.

NPL-14. Badentarbet Lodge, B 4220 ± 105
2270 B.C.

Tree roots resting on bare glacial drift and stones, exposed by removal of peat during last 100 yr. The peat bed had been only 3 to 4 ft thick and there was no sign of true humus.
NPL-17. Swarkestone, Derbyshire 3345 ± 160 1395 b.c.

Charcoal, (oak and hawthorn), part of charred logs from base of secondary cremation pit inserted in top of primary barrow (52° 51' 35'' N Lat, 01° 27' 28'' W Long), Derbyshire. Coll. 1956 by E. Greenfield; subm. by L. Biek, Ministry of Public Bldg. and Works. Comment (L.B.): dates the secondary, overhanging-rim urn burial.


Charcoal fragments (oak) on pre-barrow surface (51° 51' 06'' N Lat, 00° 14' 51'' W Long), Hertfordshire. Coll. 1956 by E. Greenfield; subm. by L. Biek. Comment (L.B.): dates primary burial, below which surface was pottery of Middle Bronze Age and Neolithic features.


Charcoal and animal bone from settlement site (50° 47' 07'' N Lat, 02° 30' 39'' W Long), Dorset. Coll. 1958 by Miss V. Russell; subm. by L. Biek. Comment (L.B.): dates Deverel-Rimbury culture in Dorset, of which this is the first settlement site to be located.

NPL-21. Gwithian, Cornwall 3070 ± 103 1120 b.c.

Charcoal (Sample 3) of cremation fires from four contemporary pits, small hollows in a sandy layer, on Site X (1960), Layer 5, Gwithian (50° 14' N Lat, 05° 22' W Long), Cornwall. Coll. 1961 by J. V. Megaw and A. C. Thomas; subm. by A. C. Thomas, Univ. of Edinburgh. Comment: sample required extensive separation from modern rootlets. (A.C.T.): pits also contained part of cremated human skeletons and shell fragments and were immediately sealed by the first plow-soil. This layer seems to provide an exceptionally detailed example of Deverel-Rimbury culture, now regarded as starting in full ca. 1200 b.c.

Minworth series, Warwickshire

Samples from temporary excavation in First Terrace of River Tame, Minworth (52° 31' 20'' N Lat, 01° 45' 20'' W Long), Warwickshire. Coll. 1961 by P. J. Osborne; subm. by M. R. Kelly, Univ. of Birmingham.

NPL-26. Minworth I 3290 ± 95 1340 b.c.

Roots traversing terrace sands, ca. 7 ft down, overlain by clay through which they do not appear to penetrate.

NPL-27c. Minworth IIb 10,530 ± 156 8580 b.c.

Detritus peat, ca. 8 ft down, overlies gravel and underlies sand of Minworth I, with a root-free layer between the two. Comment (M.R.K.): first known occurrence of peat from this terrace yielding a large fauna and flora resembling those of Severn Main and Avon No. 2, which have C¹⁴ dates of 42,000 and 39,000 yr respectively. Sample possibly contaminated with sewage.
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**NPL-39. Shustoke A. 2, Warwickshire**

Plant detritus washed from organic sand layer 2 ft 2 in. thick beneath 6 ft 8 in. of clay silts and sands at Shustoke Reservoirs (52° 31' 12" N Lat, 01° 39' 18" W Long), Warwickshire. Coll. 1960 by M. R. Kelly; subm. by F. W. Shotton, Univ. of Birmingham. **Comment** (F.W.S.): this provides a date for the beginning of alluviation in the Midlands, which on pollen analytical evidence appears to be ca. 5000 B.P.

**NORTH AFRICA**

**Haua Fteah series, Libya**

Wood charcoal from hearths in well-stratified deposits in the Haua Fteah cave, near Cyrene (33° 31' N Lat, 22° 00' E Long), Cyrenaica, Libya (McBurney et al., 1953; McBurney, 1961, 1962). Coll. 1955 and subm. by C. B. McBurney, Univ. of Cambridge.

**NPL-40. Haua Fteah, 3**

Sample HFT 1955/3 from Layer VI at depth of 5 to 6 ft.  
**NPL-41. Haua Fteah, 4**

Sample HFT 1955/4 from Layer VI.  
**NPL-42. Haua Fteah, 9**

Sample HFT 1955/9 from Layer VIII at depth of 6 to 7 ft. **Comment**: cf. W-98 (USGS I).

**NPL-43. Haua Fteah, 17**

Sample HFT 1955/17 from Layer XV and XIV.  
**NPL-44. Haua Fteah, 83**

Sample HFT 1955/83 from Layer XIV ca. 11 ft below surface. **Comment**: cf. W-97 (USGS I).

**General comment** (C.B.M.) : dates increase the precision of age/depth relationship at this site, forming part of the dating evidence for a nearly complete succession of Late Pleistocene and Early Postglacial mammalian fauna of Cyrenaica. NPL-40 and NPL-41 fix the age of the Later Neolithic phase in this territory and demonstrate that this phase was the product of the Ancient Libyan people known from ancient Egyptian historical records. NPL-42 establishes the date of the earliest Neolithic and the first appearance in the area of domestic animals. NPL-43 and NPL-44 confirm the position of another cultural interface, namely, the first appearance on the S Mediterranean shoreline of European type Upper Paleolithic.

**AUSTRALIA**

**The Tombs series, Queensland**

Wood charcoal lumps from rock shelter at ‘The Tombs’, Mt. Moffatt Sta.
(25° 06' S Lat, 147° 51' E Long), Central Queensland. Coll. 1960 and subm. by D. J. Mulvaney, Univ. of Melbourne.

NPL-30. The Tombs, 1

Sample 1 from 2 ft below surface. Comment (D.J.M.): associated with geometric microlith artifacts.

NPL-31. The Tombs, 2

Sample 2 from 3 ft 6 in. below floor surface. Comment (D.J.M.): associated with microliths and other undated Australian prehistoric artifact types.

Kenniff Cave series, Queensland

Wood-charcoal lumps from Kenniff Cave, Mt. Moffatt Sta. (24° 51' S Lat, 148° 01' E Long), Central Queensland. Coll. 1960 and subm. by D. J. Mulvaney.

NPL-32. Kenniff Cave, 1

Sample 1 from depth of 2 ft in evenly stratified cave floor.

NPL-33. Kenniff Cave, 2

Sample 2 from depth of 6 ft 3 in. from surface of cave floor. Comment (D.J.M.): This site has since been re-excavated and from a depth of 5 ft to the bottom of the deposit were found numerous implements whose only parallels are with Tasmanian types, not mainland. This sample is the first stratigraphic evidence that man was in Australia during the Pleistocene and moreover is underlain by over 3 ft of human occupation layers.

References

Date list:

USGS I Suess, 1954
INTRODUCTION

The accompanying date list includes age determinations completed during the period December 1, 1961 to November 1, 1962. All measurements were made with the 2 L counter described in our first date list (GSC I). Sample preparation, counting procedures, and calculation of dates were as described in GSC I except as outlined below:

a. Base and acid treatments were carried out with 1N HCl and 2% NaOH instead of 2N HCl and 4% NaOH, because the less-concentrated solutions were still strong enough to accomplish the desired purification.

b. The Mg(ClO₄)₂ drying columns were removed from the purification train in order to test their effect, if any, on the purity of the gas. Since there was no detectable change in the purity of the gas these columns were left out of the purification line.

c. Ages were calculated using 0.950 of the activity of the N.B.S. oxalic-acid standard as the reference activity and A.D. 1950 as the zero reference year, in line with the recommendations of the editors of Radiocarbon.

In general finite ages were calculated only if the sample activity was greater than four standard deviations. Using the 4σ criterion, zero activity in the present system corresponds to an age of >39,000 yr. Thus samples in this date list with ages designated “greater than,” yet appreciably below this figure, contained measurable activities which were less than 4σ.

No corrections for barometric-pressure fluctuations have been applied to the measured activities. The observed barometric-pressure fluctuations of ±1.5 cm, and the barometric-pressure effect of -1.2%/cm Hg would, in the worst possible case, change the calculated age of samples with counting rates near 4σ (i.e. ages of ca. 40,000 yr) by ca. 4%, and by less than 1% for samples with ages of 30,000 yr and younger. Since the ages of all samples with a finite age above 30,000 yr are arbitrarily quoted with a 2σ error, the barometric-pressure effect is well covered.

A 10-pen Esterline-Angus Operation-Event recorder is being used to record continuously the counting rates of the various channels. Signals from specific decatron outputs are fed into univibrator-type circuits which then actuate a relay-driven pen mechanism. The recording consists of blips made by the pens on a chart that moves at constant known speed. Each blip represents $10^n$ counts where $n = 1,2,3, \ldots$ etc., corresponding to the 1st, 2nd, 3rd \ldots etc. decatron output which is selected as desired, depending on the counting rate of the particular channel. Thus large counting-rate fluctuations due to electrical and/or atmospheric disturbances can be detected at a glance.

* 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 background of the 2 L counter operating at 2 atm has remained constant at 1.4 counts/min for 10 months.

A 5 L copper counter and an all-metal filling line, designed to operate at up to 5 atm, have been constructed. Preliminary tests indicate that background and modern wood counts are 3.0 counts/min and 33 counts/min, respectively, at 1 atm CO₂, and that background increases at ca. 1 count/min/atm.

SAMPLE DESCRIPTIONS

I. GEOLOGICAL SAMPLES

A. Eastern Canada

GSC-56. Grand Falls, New Brunswick

Gyttja from borehole in Town of Grand Falls (47° 02.4' N Lat, 67° 44.5' W Long), from shelly-tube sample 16 ft to 18 ft below surface (alt 462 ft). The gyttja is underlain successively by Lake Madawaska clay, till of the Grand Falls drift, and gravel. These deposits fill an old buried channel passing through Grand Falls. Coll. 1961 by H. A. Lee.* Comment: date is minimum for the Grand Falls drift (other dates: GSC-18, 9820 ± 130, GSC-1; I(GSC)-2, 10,220 ± 350, Isotopes I), and is older than previous dates for Lake Madawaska clay (W-353, 8250 ± 200, USGS IV; L-190B, 8200 ± 300, Lamont II) which crop out N of Grand Falls in the St. John River Valley. In the pollen diagram from this core, prepared by J. Terasmae, the dated sample falls in a zone characterized by a spruce maximum and is assumed to correlate with Deevey's Zone A in Aroostook County, Maine (Deevey, 1951) which Ogden (1959) has correlated with Zone B to the S in Massachusetts and Connecticut. Sample pretreatment did not include the usual NaOH-leach. Sample diluted with dead gas for counting.

GSC-33. Milford Station, Nova Scotia

Wood from gypsum quarry at Dutch Settlement 2 mi SSE of Milford Station (45° 00.5' N Lat, 63° 25.5' W Long). Wood from basal part of till 40 ft thick overlying gypsum (see Prest in Stockwell, 1957, p. 447). O. L. Hughes (oral communication) relates this till to the lower of two till sheets nearby, both of which are inferred to represent a single Wisconsin glaciation (Hughes, 1957). Coll. 1954 by I. M. Stevenson. Comment: wood from the same site has been dated as >18,000 yr by the Nova Scotia Research Foundation using the solid-carbon method (written communication J. E. Blanchard to V. K. Prest.


Marine shells (Mya pseudoarenaria) from sea cliff on W coast of Prince Edward Island 1 mi S of Miminegash (46° 52' N Lat, 64° 14' W Long). Shells collected ca. 30 ft above sealevel from bottom 2 ft of a 5-ft bed of clean gray sand with a few red-clay laminae near the base, overlying red clayey till. The

* All persons referred to as collectors or submittors of samples or cited as sources of data are with the Geological Survey of Canada unless otherwise specified.
sand is overlain by 5 ft of poorly sorted gravel. It is believed that the sand accumulated when the shore was ca. 50 ft above its present position and that the poorly sorted gravels were winnowed out of till by waves when the shoreline had dropped below alt 45 ft. The shells relate to a period of major terracing of the W coast following deglaciation of the island, whereas the highest marine features, at alt ca. 80 ft, originated when the island was still partly ice covered. Coll. 1962 by V. K. Prest. Comment (V.K.P.): the date provides evidence that ca. 12,500 yr ago the W coast of Prince Edward Island stood ca. 50 ft lower relative to the sea than at present. Ice retreat from the NW part of the island and initial encroachment of the sea took place somewhat earlier, possibly ca. 13,500 yr ago.

**Newfoundland North coast series**

**GSC-55. Baie Verte River**  
11,520 ± 180  
9570 B.C.

Marine pelecypod shells (mainly *Macoma calcarea*, *Mya truncata*, and *Hiatella arctica*) from bank of Baie Verte River, Newfoundland, 3.7 mi above river mouth (49° 54.5' N Lat, 56° 17' W Long). Shells from dark-colored silty clay extending 4 ft above river and covered by 10 ft of sand and gravel probably of recent stream origin. The shell-bearing silty clay is 160 ft above sealevel and ca. 60 ft higher than any shells previously reported along this coast. Limit of marine submergence in the vicinity is ca. 200 ft above present sealevel; hence the shells should be little younger than the earliest highest marine features. Coll. 1961 by E. P. Henderson. Date based on one weekend count only.

**GSC-75. Middle Arm, Green Bay**  
11,950 ± 170  
10,000 B.C.

Shells of *Hiatella arctica* and *Mya truncata* from alt 35 to 42 ft in wall of a gully adjacent to N shore of Middle Arm, Green Bay, Newfoundland (49° 42' N Lat, 56° 06' W Long), ca. 20 mi SE of GSC-55. The large thick shells are from bouldery, till-like material that probably is glacio-marine. Hence the shells are believed to relate to the initial influx of the sea during glacial retreat. Coll. 1961 by E. P. Henderson.

**GSC-87. Southwest Arm, Green Bay**  
11,880 ± 190  
9930 B.C.

Marine pelecypod-, gastropod-, and barnacle shells and shell fragments from bank of Paddy’s Brook, 1 mi upstream from head of Southwest Arm, Green Bay, Newfoundland (49° 35' N Lat, 56° 12' W Long). Shells from silty clay at stream level 6 ft below top of bank and 40 ft above sealevel. The clay forms the bottomset beds of a marine delta. The top of the delta at alt 180 ft probably represents the limit of marine submergence in the vicinity, as the delta was largely constructed of outwash from the melting ice. The shells should date the early part of the interval of marine submergence when glacial ice was withdrawing from the area. Coll. 1961 by E. P. Henderson.

*General comment*: these three dates seem to indicate that the ice withdrew from the N coast of Newfoundland ca. 12,000 yr ago. The dates are considerably older than other dates so far published for Newfoundland (oldest previous
date, for bog-bottom peat from Avalon Peninsula, is I(GSC) -4, 8420 ± 300, Isotopes I).

GSC-89. Anticosti Island, Quebec

12,940 ± 180
10,990 B.C.

Marine shells (Hiatella arctica and Mya truncata; identified by F. J. E. Wagner) from cut bank at NE corner of airfield, 4 mi E of Port Menier, western Anticosti Island (49° 50' 20'' N Lat, 64° 16' 10'' W Long). Shells from stratified fine gravel and sand with lenses of clay at alt 180 ft (Locality 3, Bolton and Lee, 1960). Marine limit at 250 ft. Coll. 1958 by T. E. Bolton. Comment: date applies to an early (but probably not the earliest) stage of post-glacial marine overlap of the island, and is older than dates of comparable materials from Newfoundland to the E (GSC-55, 75, 87, this list) and from the lower part of the St. Lawrence Valley to the W (GSC-61, 63, and 70, this list).

Rivière-du-Loup series, Quebec

The following dates relate to glacial retreat and marine submergences in the lower St. Lawrence basin, involving the following events (Lee, 1962; Lee, in press).

1. Deglaciation of the Notre Dame Mountains S of the St. Lawrence near Rivière-du-Loup and encroachment of the sea as far up the St. Lawrence Valley as Trois-Pistoles. GSC-102 relates to these penecontemporaneous events.

2. Later reconstitution of the ice margin in the St. Lawrence basin W of Trois-Pistoles to form the moraine at St. Antonin. GSC-102 and GSC-61 bracket this event.

3. Retreat of ice from the region and progressive uplift of land relative to sea. GSC-102, 63, and 70 relate to uplift "outside" (E of) the moraine at St. Antonin; GSC-61, 69, 68, and 112 relate to uplift behind (W of) the moraine.

GSC-102. Trois-Pistoles

12,720 ± 170
10,770 B.C.

Shells of Yoldia arctica from 23 to 27 ft below ground surface in a highway cut made in 1960, 2 mi E of Trois-Pistoles, Quebec (48° 07.7' N Lat, 69° 07.9' W Long). Shells from clay overlain by and regionally interbedded with delta sand. The dated material is part of a marine-deltaic-outwash deposit formed when wastage of the ice sheet permitted the sea to penetrate into this part of the St. Lawrence basin (Lee, in press). The delta surface, at alt ca. 550 ft, is believed to mark the local marine limit. Coll. 1962 by H. A. Lee. Comment: sample treatment did not include the usual preliminary leaching of the outer 10% of the shells with HCl. Sample diluted with dead gas for counting.

GSC-63. St. Epiphane

11,410 ± 150
9460 B.C.

Marine pelecypod shells (chiefly Macoma calcarea, Mya truncata and Hiatella arctica) from 10 to 15 ft below surface in a road cut 2.8 mi N of St. Epiphane, Quebec, near N bank of Rivière Fourche (47° 56.3' N Lat, 69° 19.2' W Long). Shells collected at alt 310 ft from lens of gray clay at base of "High Terrace sands" overlying "stony red clay" (Lee, 1962). Date is be-
The believed maximum for the “High Terrace sands” in the vicinity and to represent a marine level at alt 310 ft or slightly higher. Coll. 1961 by H. A. Lee.

**GSC-70. L'Isle-Verte, 260 ft**

Marine-pelecypod shells (chiefly *Macoma calcarea*, *Mya truncata*, and *Hiatella arctica* from ca. 25 ft of marine clay (top at alt 260 ft) in road cut 3.8 mi S of L'Isle-Verte, Quebec (47° 57.7' N Lat, 69° 19.4' W Long). The shells probably represent the *Macoma calcarea* community (*written communication, F. J. E. Wagner*). Assuming a depth range of 0 to 60 ft for this community, sample represents a marine level at alt between 260 and 320 ft. Coll. 1961 by H. A. Lee. Comment: this date and the dates of the two higher samples listed above (GSC-102, GSC-63) comprise a series that decreases in age with decreasing altitude and provides a rough chronology of emergence in the area “outside” the moraine at St. Antonin.

**GSC-61. Rivière-du-Loup**

Shells of *Hiatella arctica* from gravel pit 0.6 mi SE of railway station, Rivière-du-Loup, Quebec (47° 49.2' N Lat, 69° 30.8' W Long). Shells from clay lens within stratified gravels, ca. 7 ft below top of section. Sample believed to be related to a shoreline at or slightly above the top of the section (alt 330 ft). Coll. 1961 by H. A. Lee. Comment: this date and the dates for the three lower samples listed below provide a rough chronology of emergence in the area formerly covered by the glacial lobe bordered by the moraine at St. Antonin. As would be expected, GSC-61 is younger than GSC-63 and 70, which appear to relate to about the same marine level “outside” the moraine at St. Antonin. The date for GSC-61 quoted above was determined using our standard procedure for extracting CO₂ from shells. The following additional dates were determined for the outer and inner parts of a second preparation of the sample, after removal of the outer 10% of the shells.

- outer fraction (10 to 50% leach) 10,360 ± 240
- inner fraction (50 to 100% leach) 10,540 ± 210

**GSC-69. L’Isle-Verte, 180 ft**

Marine-pelecypod shells (chiefly *Hiatella arctica*) from gullied surface of marine clay at alt 180 ft, 2.5 mi SSW of L’Isle-Verte, Quebec (47° 58.1' N Lat, 69° 19.9' W Long). Shells were picked from an assemblage representing the *Astarte* zone of the *Macoma calcarea* community (*written communication, F. J. E. Wagner*). Assuming a depth range of 0 to 60 ft for this community, the sample represents a marine level between alt 180 and 240 ft. Date based on one weekend count only. Coll. 1961 by H. A. Lee.

**GSC-68. Cacouna**

Marine-pelecypod shells (chiefly *Macoma calcarea*) from stream-eroded surface, in marine clay at alt 53 ft, ca. 3.5 mi NE of Cacouna, Quebec (45° 57.3' N Lat, 69° 27.4' W Long). Shells represent the *Macoma calcarea* com-
munity, possibly the *Astarte* zone (*written communication, F. J. E. Wagner*). Assuming a depth range of 0 to 60 ft for this community, the sample should represent a local sealevel between alt 53 and 115 ft. However, in view of the geology of the locality, the shells may have been reworked from a higher site. Coll. 1961 by H. A. Lee.

**GSC-112. Rivière-des-Vases bog**

Peat collected with a piston sampler at 250 cm depth at bottom of a bog ca. 12 mi NE of Rivière-du-Loup, Quebec (47° 58' N Lat, 69° 25.5' W Long). Sample from base of peat overlying sand and gravel at alt ca. 50 ft in an abandoned river channel. Date is minimum for emergence of the site, and hence, for regression of the shore below the 50-ft level. Coll. 1962 by Jaan Terasmae.

**GSC-90. Pembroke, Ontario**

Marine-pelecypod shells from stratified fine sand and silty clay at alt 450 ft, 15 ft below surface, in a gravel pit ca. 4 mi SE of Pembroke, Ontario (45° 47' N Lat, 77° 03' W Long). The shell-bearing deposit occurs as a lens occupying a depression in the top surface of glacio-fluvial gravel and sand, and is overlain in turn by laminated alluvial silty sand and Ottawa River gravel. Coll. 1957 by Jaan Terasmae. *Comment*: date is assumed to record maximum NW extent of the Champlain Sea up the Ottawa River Valley. It supports the earliest date suggested by Terasmae and Hughes (1960a) for the opening of the North Bay outlet. Sample diluted with dead gas for counting.

**GSC-77. Thedford, Ontario**

Wood from cut bank, E side of Decker Creek 1.3 mi N of Thedford, Ontario (43° 11' N Lat, 81° 51' W Long). Sample from base of 3-ft layer of alluvial sand overlying shale bedrock and overlain, in succession, by 2 ft of clayey silt with mollusc shells and 3 ft of silty clay with plant remains. The sand inclosing the wood contains pollen suggesting a warm climate. The deposits probably accumulated at or adjacent to the margin of Lake Huron during the Nipissing phase (top of wood-bearing layer 1 ft below average Nipissing level). Coll. 1960 by Aleksis Dreimanis, Univ. of Western Ontario, London. *Comment*: C¹⁴ age is somewhat younger than expected and may indicate that the deposits accumulated during the later part of the Nipissing phase.

**Little Pic River series, Ontario**

Wood and shells from gully 150 yd S of E end of bridge over Little Pic River on Trans-Canada Highway around N shore of Lake Superior (48° 47' N Lat, 86° 37' W Long). The gully exposes 13 ft of clean sand with abundant *Sphaerium sulcatum* (Lamarck) overlying at least 25 ft of thin bedded clayey silt with disseminated plant materials and two layers that include wood and charred wood. The sloping surface above the gully edge includes another 5 ft of clean sand and, where unmodified by construction work, 1 to 5 ft of wind-blown sand. Ground alt at E end of bridge 715 ft by altimeter (110 ft above
Lake Superior) although Farrand (1960) records alt of same terrace as 692 ft. The plant-bearing clayey silt is regarded as an estuarine deposit of the ancestral Little Pic River, built into a lake in the Superior basin, at least 90 ft and possibly 110 ft or more above present lake level. The Sphaerium-bearing sands are clearly shoreline deposits of a lake 110 ft above present lake level. Coll. 1961 by V. K. Prest.

**GSC-82. Little Pic River, upper wood**  
5920 ± 120  
3970 B.C.

Wood from upper organic-debris layer in well-stratified clayey silt 80 ft above Lake Superior and 8 ft below base of shell-bearing sand.

**GSC-103. Little Pic River, lower wood**  
5960 ± 110  
4010 B.C.

Wood from lower organic-debris layer in well-stratified clayey silt 68 ft above Lake Superior and 20 ft below base of shell-bearing sand.

**GSC-91. Little Pic River, shells**  
7060 ± 120  
5110 B.C.

Shells (Sphaerium sulcatum) from central part of 13- to 18-ft mantle of clean sand overlying organic clayey silt, and with surface alt 110 ft above Lake Superior.

**General Comment (V.K.P.):** study, by J. Terasmae, of woody layers has revealed a pollen assemblage comparable to that of other parts of N Ontario for the period 7000 to 5000 yr B.P. The two wood dates (GSC-82 and 103) are in accord with this interpretation but are older than would be expected if the Little Pic River flats represent the Nipissing-Algoma stage as concluded by Farrand (1960). The discrepancy between the shell and wood dates is regarded as due to recycling of older carbonate during the life of the molluscs.

**GSC-83. Attawapiskat River, Ontario (sub-till)**  
>35,800

Wood from W bank of Attawapiskat River, Ontario (52° 36’ N Lat, 86° 02’ W Long). At the sample site, till 16 ft thick is underlain successively by horizontally stratified sand and gravel 7-ft thick and by clay with sand and silt laminae dipping 20° SE. The sparse wood fragments were collected from clay 5 ft below the erosional surface at the base of the sand-gravel unit. Nearby, clay unit is horizontal. Coll. 1961 by H. H. Bostock for V. K. Prest. **Comment:** deposits are assumed to represent the same unit as the better-known sub-till plant-bearing beds along the Albany and Missinaibi Rivers 150 and 250 mi SE. Plant materials from the Missinaibi beds have been assigned various “infinite” C14 dates (oldest GrN 1435, >53,000), and the deposits are considered to have accumulated during a post-Sangamon interstadial interval (Terasmae and Hughes, 1960b).

**B. Western Canada, general**

**GSC-74. Piper Ave., Burnaby, British Columbia**  
12,230 ± 200  
10,280 B.C.

Shells of Chlamys selected from mixed shells in stony marine clay from spoil of a sewer excavation paralleling the Great Northern Railway on the N,
a few hundred feet W of Piper Ave., Burnaby, British Columbia (49° 15' N Lat, 122° 56' W Long). The clay is at least 7 ft thick, beneath a 14-ft section of nonmarine sand, peaty sand, peat, and lenses of gravel. Alt of top of clay 39 ft; level of dated shells within the clay is not known. Coll. 1961 by W. H. Mathews, G. E. Rouse, and L. V. Hills; subm. by W. H. Mathews, Univ. of British Columbia, Vancouver. Comment: it had been hoped that these shells, coupled with the date of overlying peat would date the emergence of the site. However, in view of other dates from the vicinity, and particularly that of shells from alt 440 ft on nearby Burnaby Mountain (L-391C, 11,900 ± 300, written communication J. E. Armstrong), this sample relates to an early phase of marine submergence when the site was still depressed well below sealevel. Date based on one weekend count only.

GSC-64. North Delta, British Columbia 12,460 ± 170 10,510 B.C.

Shells of Serpula and of various marine pelecypods from Linton gravel pit, North Delta, Lower Fraser Valley, British Columbia (49° 08' N Lat, 122° 55' W Long). Shells from stony, silty sand overlain by till-like material, glacio-marine stony, clayey silt, and beach gravel. The shell-bearing layer rests on the eroded surface of thick horizontal sand similar to the sub-till Quadra sediments. Coll. 1961 by J. E. Armstrong. Comment: the shell-bearing material is interpreted as being glacio-marine, accumulated during wastage of the last (Vashon?) ice sheet. The date is compatible with this interpretation and compares favorably with I(GSC)-248, 12,800 ± 175, Isotopes II. Date based on one weekend count only.

GSC-80. Nanaimo, Vancouver Island 12,420 ± 150 10,470 B.C.

Marine shells and shell fragments (chiefly Mya, Serripes, and Mytilus) from an excavation at Dept. of Natl. Defense property, Nanaimo, British Columbia (49° 09' 00'' N Lat, 123° 58' 10'' W Long). Shells from silty, stony clay, max 10 ft thick, underlain by till and overlain by beach gravel. Site is 354 ft above sealevel and ca. 100 ft below the marine limit. Coll. 1961 by E. C. Halstead. Comment: the dated material accumulated during the early part of the interval of postglacial marine submergence when the shore was still less than 100 ft below its earliest highest level. The C¹⁴ age is a few hundred years younger than expected from other dates from the region, particularly L-391D, wood, 12,150 ± 250, and L-391E, Marine shells, 12,350 ± 250 (Lamont V) from a delta 20 mi NW and only 170 ft above sealevel.


Fresh water shells (Margaretifera margaretifera var. falcata, Anodonta nuttalliana: id. by F. J. E. Wagner) from borrow pit at the base of the S wall of Thompson River Valley ca. 5 mi W of Kamloops, British Columbia (50° 41' 20'' N Lat, 120° 26' 30'' W Long). Shells are from clayey silty sand, 35 ft thick, overlain by recent alluvium and underlain by silty clay. Deposits similar to the clayey silty sand and silty clay are exposed beneath till at various places. The shell-bearing deposit accumulated in a lake occupying the Kamloops Lake
basin during an interstadial or interglacial interval prior to the last (classical Wisconsin) glaciation. Coll. 1961 by R. J. Fulton. Comment: date agrees with the geologic interpretation (above) based on field evidence. It also supports the tentative inference that the deposits are equivalent to the Quadra sediments in the Strait of Georgia region (see dates below).

C. Interstadial deposits, Georgia Depression, SW British Columbia

The following dates, from the lowlands bordering the Strait of Georgia, British Columbia, apply to various nonglacial, sub-till deposits, including the widespread interstadial Quadra sediments. Dating was undertaken to help distinguish the Quadra and its equivalents from older (and perhaps younger) sub-till nonglacial deposits. Plant materials known to belong to the Quadra so far have yielded only finite dates ranging from 24,000 to 36,000 yr (L-221A, L-221B, L-424B, L-424C, L-424E, Lamont V; L-455B, L-502, Lamont VII; GSC-53, 95, 108, 109, this list). Marine shells from the basal part of the Quadra, however, have yielded infinite dates (L-475A, L-475B, Lamont VII). Plant materials that probably belong in the basal part of the Quadra at two localities have likewise yielded infinite dates (GSC-81, 94, this list).

**GSC-60. East Delta, Lower Fraser Valley**

Wood from Kiewet gravel pit, East Delta, Lower Fraser Valley, British Columbia (49° 07' N Lat, 122° 54' W Long). Sample from 25-ft section of horizontally stratified silty sand and sand resting unconformably on gravel and overlain by 3 to 5 ft of stony laminated silt, 5 to 10 ft of till, and 5 ft of beach gravel. Coll. 1961 by J. E. Armstrong. Comment: see GSC-62.

**GSC-62. Knight Road, Lower Fraser Valley**

Wood from Knight Road gravel pit, South Westminster, Lower Fraser Valley, British Columbia (49° 10' N Lat, 122° 55' W Long). Sample from a 1- to 5-ft layer of clayey silty sand beneath a few feet of till and beach gravel. The wood-bearing material rests on stratified silt containing channel-like bodies of gravel. Comment: this sample and GSC-60 are from two of the many small exposures of sub-till stratified deposits along the margin of the Surrey Upland. Such deposits are widely distributed beneath the upland, but little is known of their stratigraphy and none are known to be equivalent to the Quadra sediments. In view of the C¹⁴ dates, the sampled materials may possibly be older than the Quadra sediments.

**GSC-108. Spanish Banks, Point Grey**

Wood from Quadra sand 50 ft above sealevel in sea cliff at Spanish Banks, Point Grey (Vancouver Metropolitan area), British Columbia (49° 17' N Lat, 123° 13' W Long). Sample site ca. 300 ft from L-502 (24,400 ± 900, Lamont VII) and at about the same stratigraphic level, Coll. 1962 by J. E. Armstrong. Comment: this additional sample from the type section of the Quadra was dated to provide confirmation of the age of the unit, because of uncertainties arising from the infinite date of GSC-81 (this list).
GSC-109.  Wreck Beach, Point Grey  

25,100 ± 600  
23,150 B.C.

Peat from stratified silt and sand 25 ft above sealevel on sea cliff at Wreck Beach, Point Grey (Vancouver Metropolitan area), British Columbia (49° 16' N Lat, 123° 15' W Long). Site ca. 2 mi S of GSC-108. Coll. 1962 by J. E. Armstrong. Comment: date supports assignment to the Quadra sediments. Date based on a single count.

GSC-81.  Highbury Tunnel, Vancouver  

>36,800

Peat from bore-hole 30-0-9, Highbury St. Sewage Tunnel, Vancouver (City), British Columbia (49° 15' N Lat, 123° 11' W Long). Sample from depth between 144 and 147 ft (91 ft above sealevel) at base of sub-till sands believed to belong in the Quadra sediments. Coll. 1962 by J. E. Armstrong. Comment: sample was expected to yield a typical Quadra age of ca. 25,000 to 30,000 yr. The infinite date may possibly be compatible with the inference that the sample belongs at the base of the Quadra (see introduction to this group of dates and L-475A, L-475B, Lamont VII). NaOH-leach was omitted from pre-treatment of the sample.

GSC-93.  Lynn Canyon, North Vancouver  

33,200 ± 2300  
1800  
31,250 B.C.

Wood from peat bed 2 ft thick near base of Canyon wall, Lynn Creek, North Vancouver, British Columbia (49° 21' N Lat, 123° 02' W Long). The peat is underlain by till and lies at the base of more than 150 ft of sand and gravel believed to be equivalent to and younger than the Quadra sediments. Coll. 1960 by J. E. Armstrong. Comment: the C¹⁴ age supports the inference that the sand and gravel unit is in part equivalent to the Quadra sediments. It also suggests correlation with the upper of two sand-gravel units (with basal peat) lying between three till sheets, exposed in a nearby highway cut (see I(GSC)-214, 32,200 ± 3300, Isotopes II).

GSC-36.  Tupper School, Vancouver  

>38,100

Wood from a peat bed exposed in an excavation at the Sir Charles Tupper School, 23rd and St. George St., Vancouver (City), British Columbia (49° 15' N Lat, 123° 06' W Long). Sample from one of several peaty beds within clays and sands ca. 10 ft thick separated from underlying Tertiary sandstone by ca. 1 ft of till and overlain by 5 to 10 ft of Surrey (Vashon) till and Newton glacio-marine deposits. Coll. 1958 by J. E. Armstrong. Comment: relation of this sub-till deposit to others in the region remains unknown, but in view of the C¹⁴ date it may be older than the Quadra sediments.

GSC-58.  Upper Campbell, Vancouver Island  

25,000 ± 400  
23,050 B.C.

Wood (base of tree 2 in. diam.) ca. 3 ft above the base of a 15-ft cut bank on SE side of logging road immediately above Buttle Lake Road, E side of Upper Campbell Lake, Vancouver Island, British Columbia, 1000 ft NE of Berry Creek and alt ca. 780 ft (49° 56' 50'' N Lat, 125° 35' 50'' W Long). Sample from a layer of sticks in the bottom few inches of a 7-ft section of in-
distinctly laminated silt, clay, and fine sand containing peaty partings. Beneath the wood layer is 3-to-6 in. of peaty silt resting on and penetrating downward into angular gravel which directly overlies bedrock at one end of the exposure. This sequence of deposits forms an isolated pocket, covered by slope debris, at the bottom of the steep wall of the U-shaped valley. The deposits appear to belong at the base of several hundred feet of horizontal sands and silts capped by till in the re-entrant in the valley wall occupied by Berry Creek. These and other isolated bodies of similar materials in the valley and on the lowland to the NE are believed to be remnants of formerly extensive fluvial and lacustrine deposits that have survived glaciation. The C\textsuperscript{14} date supports correlation with the Quadra sediments. Coll. 1958 by J. G. Fyles.

**GSC-96. Buttle Lake, Vancouver Island**  
25,190 ± 470  
23,240 B.C.

Wood from a small tree (Abies) exposed in a road cut, E bank of Campbell River at upstream end of U-bend in river 1 mi N of Buttle Lake dam, Vancouver Island, British Columbia (49° 51' 05" N Lat, 125° 37' 20" W Long); collected from 1.5 ft of laminated silt with organic layers, overlain by ca. 20 ft of till and gravel. The plant-bearing material is separated from the steep bedrock wall of the U-shaped valley by a few inches of angular gravel resembling sliderock. The deposit is believed to be a remnant of the same stratigraphic unit as GSC-58 (see above) collected ca. 7 mi N in the same valley. Date supports correlation with the Quadra sediments. Coll. 1958 by J. G. Fyles.

**Willemar Bluff series, Vancouver Island**

Wood from two levels within the sand unit of the Quadra sediments on the sea cliff at Willemar Bluff 1.5 mi E of Comox, Vancouver Island, British Columbia (49° 40' 10" N Lat, 124° 53' 50" W Long). Coll. 1957 by J. G. Fyles.

**GSC-53. Willemar Bluff, upper wood**  
26,100 ± 400  
24,150 B.C.

Water-worn fragments of wood from driftwood lens in sand 118 ft above high-tide level.

**GSC-95. Willemar Bluff, lower wood**  
28,800 ± 740  
26,850 B.C.

Flattened wood up to 0.5 in. diameter from 3-in. bed of silty peat 70 ft above high tide.  
*General comment:* these two dates are in correct stratigraphic sequence in relation to each other and also in relation to L-424B, L-424C, and L-424E (30,200 ± 1300, 29,300 ± 1400, 30,000 ± 1200, respectively; Lamont V) for wood from the thin silt-gravel unit of the Quadra sediments beneath the sand unit on Denman Island 5 mi to the SE (Fyles, 1960). Despite overlap of the age range of the three Lamont dates with that of GSC-95, the correct stratigraphic arrangement of the dates is taken as evidence supporting the validity of the finite C\textsuperscript{14} ages assigned to plant materials from the sand unit and the silt-gravel unit of the Quadra (see discussion of Quadra beds series,
Lamont V). The sequence of dates also points up the disparity between these finite dates and the infinite date assigned to shells from the immediately underlying marine stony clay (L-475A, Lamont VII; see also GSC-94, this list).

**GSC-78. Wilfred Creek, Vancouver Island**  \(>37,600\)

Dense peat from a fresh landslide scar on the wooded NW wall of Wilfred Creek valley, 1.3 mi upstream from the E and N Railway, near Fanny Bay, Vancouver Island, British Columbia (49° 28' 25" N Lat, 124° 50' 00" W Long). The peat layer, 0.5 in. thick, lies within 20 ft of laminated silt, sand, and pebble gravel containing oxidized plant remains. These materials are underlain by thick bouldery gravel and overlain by 150 ft of pebble gravel and sand capped by a few feet of till. These sub-till deposits, which underlie an area 5 mi long and up to 2 mi wide, differ somewhat in lithology from the Quadra sediments. From geologic evidence, they may be either a facies variant of the Quadra or an entirely different unit; on the basis of this date they may be older than the Quadra. Coll. 1956 by J. G. Fyles.

**GSC-99. Chef Creek, Vancouver Island**  \(>37,900\)

Wood from cut bank, S side of Island Highway 0.25 mi E of Chef Creek, near Deep Bay, Vancouver Island, British Columbia (49° 27' N Lat, 124° 45' W Long). Sample from an inter-till section 10 ft thick in which fine sand and silt containing wood and mats of plant detritus grade laterally into medium to coarse sand and into shell-bearing marine clay beneath the sand. These deposits are inferred to form the base of the Quadra sediments at this locality (Fyles, 1963, p. 26, 27) and have yielded abundant pollen suggesting forest comparable to that growing today in the wetter parts of Vancouver Island (Fyles, 1963, p. 28). Coll. 1951 by J. G. Fyles. **Comment:** this date raises the same problem regarding the age range of the Quadra interval as other samples such as GSC-81 and GSC-94 (this list). In spite of the infinite date, the collector still tentatively assigns the deposits to the Quadra sediments, but admits the possibility that they are distinct from and older than the Quadra.

**GSC-84. Cordova Bay, Vancouver Island**  \(22,600 \pm 300\)  
\(20,650\) B.C.

Plant fibers concentrated from organic silt 40 ft above the beach on a sea cliff, SE part of Cordova Bay, near Victoria, Vancouver Island, British Columbia (48° 29' 40" N Lat, 123° 19' 10" W Long). The sampled bed lies within a 50-ft section of organic silt and fine sand overlain by 80 ft of sand and underlain by thin gravel and marine stony silt. These nonglacial strata lie beneath the surface (Vashon) till and belong to a widespread interstadial unit similar in lithology and occurrence to the Quadra sediments. At the E end of Cordova Bay, till beneath these deposits is underlain by a second succession of rather similar nonglacial deposits overlying a still older till. Coll. 1958 by J. G. Fyles. **Comment:** date suggests correlation of the widespread upper interstadial unit on SW Vancouver Island with the Quadra sediments. This is the youngest date so far assigned to sub-till deposits in the region. **See** also comments concerning GSC-94, below.
GSC-59. Sidney Island

Wood from the base of a wave-cut cliff on the E side of Sidney Island, Haro Strait, British Columbia (48° 38′ 40″ N Lat, 123° 19′ 40″ W Long), a few tens of feet S of base of spit at N end of island. The small flattened pieces of wood were collected from a 1-ft bed of peaty silt in a shallow pit at the in-shore margin of the beach. The peaty bed is underlain by fine sand and overlain by 10 ft of sand capped by till. The same sub-till deposits are exposed in many places (thickness up to 80 ft) along the E shore of the island for 2 mi S of the sample site. Coll. 1958 by J. G. Fyles. Comment: the sub-till deposits to which this date applies are characteristic of the widespread sandy upper interstacial deposits of the SW Vancouver Island region. The date supports correlation of this unit with the Quadra sediments (see GSC-84).

GSC-94. Cowichan Head, Vancouver Island

Wood collected 35 ft above the beach on a sea cliff at Cowichan Head, Saanich Peninsula, Vancouver Island, British Columbia (48° 34′ N Lat, 123° 22′ W Long). Sample from a pocket of driftwood within 7 ft of pebbly fine silty sand containing marine shells. This material grades upward into sands and sandy gravels 80 ft thick capped by till, and is underlain by ca. 10 ft of stony marine silt and clay. This sequence of strata beneath till is believed to be equivalent to the upper inter-till unit at Cordova Bay ca. 5 mi to the S (see GSC-84, above). Coll. 1958 by J. G. Fyles. Comment: wood from stony marine clay at Cowichan Head at a slightly lower level than this sample has been dated as >42,000 (L-514C, Lamont VII). Shells from the stony marine clay have yielded an age of 35,000 ± 1600 (L-514D, Lamont VII) but the author of the Lamont date list suggests that the shells are contaminated. If the sands above the wood- and shell-bearing deposits belong to the same stratigraphic unit as GSC-84 and 59, as maintained by the collector, then the wood- and shell-bearing deposits are much older than the overlying sands. This age difference is analogous to that between comparable units of the Quadra sediments (see L-475A, L-475B, Lamont VII and various entries in this list above).

D. Northern Canada

Hunker Creek series, Yukon

Wood from frozen silty peat in a fresh cut-bank exposure in right bank of Hunker Creek, at the mouth of Last Chance Creek, Klondike Dist., Yukon (64° 01′ N Lat, 139° 06′ W Long). Samples were collected from a 20-ft bed of woody, silty peat underlain by 6 ft of silt containing plant detritus down to the creek. Sand and gravel seams occur in the base of the peat unit. Coll. 1961 by Jaan Terasmae and O. L. Hughes.

GSC-57. Hunker Creek

Wood from woody silty peat unit at depth 16 ft. Pollen is poorly preserved; vegetation was similar to the present Boreal forest.
**GSC-73. Hunker Creek**

<table>
<thead>
<tr>
<th>Age</th>
<th>B.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9520 ± 130</td>
<td></td>
</tr>
<tr>
<td>7570</td>
<td></td>
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</tbody>
</table>

Wood from base of woody silty peat unit at a depth of 20 ft.

*General comment (O.L.H.):* the change from uniform silt (lower part of this section) to woody silty peat containing sand and gravel seams (upper part of this section) represents a significant change in sedimentation. The age of GSC-73, immediately above this break, is almost identical with the 9510 ± 220 yr age (I(GSC)-196, Isotopes II) obtained for organic silt underlain by silty gravel with mammal bones, and capped by woody peat, from Fant and Norbeck placer pit 4.5 mi upstream on Hunker Creek. Silt in the lowermost 6 ft of the present section is tentatively correlated with silt that lies beneath the bone-bearing gravel at Fant and Norbeck placer pit, and that has yielded wood dated at >35,000, (I(GSC)-181, Isotopes II).

**GSC-66. Hay Ranch Bog, Yukon**

<table>
<thead>
<tr>
<th>Age</th>
<th>A.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>280 ± 120</td>
<td>1670</td>
</tr>
</tbody>
</table>

Peat, 12 in. below surface, in an extensive muskeg along Klondike River ca. 15 mi E of Dawson, Yukon (64° 03' N Lat, 139° 00' W Long). Exposure in a highway borrow pit shows alluvial gravel at base, overlain by thin sand layer (2 to 5 in.) and 6 to 8 in. of decomposed woody peat and 12 in. of fresh *Sphagnum* peat. Coll. 1961 by Jaan Terasmae. *Comment:* the sudden change in the peat sequence is accompanied by an increase of black spruce, pine, and ericaceous pollen and *Sphagnum* spores possibly reflecting climatic change. Sample was treated with cold (rather than hot) NaOH and HCl.

**Hart Lake marl series, Yukon**

**GSC-67. Carbonate fraction**

<table>
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<tbody>
<tr>
<td>12,900 ± 150</td>
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</tr>
<tr>
<td>10,950</td>
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</tbody>
</table>

**GSC-67-2. Organic residue**

<table>
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<tbody>
<tr>
<td>12,120 ± 140</td>
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<tr>
<td>10,170</td>
<td></td>
</tr>
</tbody>
</table>

Marl from ca. 6 ft below original surface, exposed on the face of a frost-heaved block in an area of palsa mounds, NW end of Hart Lake, Yukon (64° 37' N Lat, 135° 10' W Long). The marl is overlain by 2 to 12 in. of peat. Hart Lake, in which the marl was deposited, is impounded by a moraine ridge at its NW end. The age is minimum for retreat of a valley glacier from the moraine. Coll. 1961, by Peter Vernon; subm. by O. L. Hughes. *Comment (O.L.H.):* the age is compatible with approximate correlation of the moraine with late Wisconsin moraines of the region, but does not rule out correlation with considerably older moraines of the same region. Carbonate rocks are abundant in the area; the greater apparent age of the inorganic fraction may be attributed to hard water effect.

**GSC-97. Peel River, Yukon**

<table>
<thead>
<tr>
<th>Age</th>
<th>B.C.</th>
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<tbody>
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<td>8780 ± 160</td>
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<tr>
<td>6830</td>
<td></td>
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</tbody>
</table>

Wood from 6.5 ft below surface in the backwall of a flow slide, S bank of Peel River 3.5 mi downstream from mouth of Wind River, Bonnet Plume Basin, Yukon (65° 52’ N Lat, 135° 08’ W Long). Peel River at this point is entrenched through 230 ft of Pleistocene and 135 ft of Tertiary sediments. The
Pleistocene stratigraphy, typical of that exposed along lower Wind and Bonnet Plume Rivers, and Peel River between the mouths of the former, consists from the bottom up of gravel, glacio-lacustrine clay, till, and glacio-lacustrine clay, capped by woody silt and peat. Coll. 1962 by O. L. Hughes. Comment: the age of the sample, from near the base of woody silt and peat at the top of the section, is minimum for drainage of a glacial lake which discharged northward via Eagle River during retreat of a lobe of Laurentide ice which earlier had pushed westward at least to 136° 20' W Long. Drainage may have occurred considerably before burial of the wood. Date based on one weekend count only.

GSC-54. Mackenzie River Delta

Wood from depth 125.5 ft in bore-hole MD2, Natl. Res. Council permafrost borings 5 mi SW of Inuvik, Dist. of Mackenzie, Northwest Territories (68° 18' N Lat, 133° 50' W Long), on the delta plain of Mackenzie River. The borings encountered (top to bottom) 100 ft of thinly stratified sandy silt with layers of woody plant material throughout, 80 ft of sand with plant layers (dated sample), spaced at irregular intervals throughout, and 60 ft of dense clay with no visible organic remains and with stones in the lowermost few feet. Microorganisms from various woody layers represent fresh water rather than marine conditions. Coll. 1961 by G. H. Johnston, Div. of Building Res., Natl. Res. Council, Ottawa, Canada. Comment: evidently the plant-bearing esturaine-deltaic sand and silt began to accumulate several thousand years after retreat of the last (classical Wisconsin?) Laurentide Ice Sheet from the site, which is close to ice-sheet limit. NaOH-leach was omitted from pretreatment of the sample.

GSC-34. Nicholson Peninsula

Wood collected 20 ft below top of 120-ft sea cliff at N end of Nicholson Peninsula, Dist. of Mackenzie, Northwest Territories (69° 56' N Lat, 128° 55' W Long). Sample from deformed sand containing numerous flattened logs up to 5 in. in diam. Shells of Yoldia arctica (id. by F. J. E. Wagner), are present in underlying clay, and fragments of mammoth (?) tusk apparently washed out of the cliff are present on the beach. The wood-bearing strata are believed to have been deformed by glacial ice thrust (Mackay, 1956) and therefore to be older than the last glacial invasion of the region. Coll. 1960 by J. Ross Mackay, Univ. of British Columbia; subm. by the Geog. Br., Dept. of Mines and Tech. Surveys, Ottawa, Canada.

GSC-32. Arrowsmith River (560 ft) Peat

Woody plant material at alt 560 ft on W side of Arrowsmith River 25 mi from Pelly Bay (68° 05' N Lat, 90° 09' W Long). Sample from bottom of section of several feet of peat lying on marine silt. Coll. 1960 by M. Tremblay for B. G. Craig. Comment (B.G.C.): this sample and shell sample GSC-47 (8700 ± 120, GSC I) were dated to bracket time of emergence of the site. However, date of this sample suggests emergence long before accumulation of the peat. Sample treated with cold (rather than hot) NaOH and HCl.
GSC-65. White Point, Ellesmere Island 38,600 ± 2600 36,650 b.c.

Marine pelecypod (mostly *Hiatella arctica*) shells and fragments collected 2 mi inland from Nansen Sound 5 mi S of White Point, Ellesmere Island, Northwest Territories (81° 07' N Lat, 90° 07' W Long). Shells from slumped bank of modern stream, alt ca. 400 ft, ca. 150 ft above the highest clearly defined marine features. The shells occur in stratified gravel, sand, and silt containing thin organic layers. On the basis of poor exposures, the shell-bearing material is inferred to underlie till. Coll. 1961 by J. G. Fyles. *Comment*: date is based on three counts. As the shells were collected from the ground surface where they could readily be contaminated with the minute amount of modern carbon required to give them the measured activity, the date should probably be regarded as minimum.

GSC-105. Oobloyah Bay, Ellesmere Island 4190 ± 130 2240 b.c.

Peat collected a few hundred feet from the ice cliff at the W side of a piedmont glacier tongue blocking the head of a valley 10 mi E of the head of Oobloyah Bay, Ellesmere Island, Northwest Territories (80° 54' N Lat, 82° 17' W Long). Sample from the bottom of a stream bank cut into peat that has accumulated on the valley floor upstream from a cross-valley moraine 1/3 mi W of the present ice cliff. The sample was collected ca. 6 ft below ground but the true stratigraphic depth is probably less than this figure. The base of the peat was not exposed at the sample site but elsewhere the peat rests on gravel at depths of 1 to 3 ft. Coll. 1961 by J. G. Fyles. *Comment*: date is minimum for the moraine. Moreover, the piedmont-glacier lobe is now as extensive as, and probably more extensive than at any time during the last 4000 yr. Sample mixed with dead gas for counting. Date based on one count.

II. ARCHAEOLOGICAL SAMPLES

GSC-85. Pic River Site, Ontario 1000 ± 80 A.D. 950

Charcoal from Pic River site, W bank of mouth of Pic River, N shore of Lake Superior, Ontario (48° 36' N Lat, 86° 17' W Long). Sample from Stratum 3, Sq OEIN2, depth 9 in. It relates to a pure component of the Black-duck Focus which played a major role in the Late Woodland culture history of N Minnesota, NW Ontario, and SE Manitoba. Coll. 1960 by J. N. Emerson; subm. by J. V. Wright, Nat. Mus. of Canada, Ottawa.

GSC-86. Malcolm Site, Ontario 3850 ± 90 1900 b.c.

Charcoal from the Malcolm site (Dailey and Wright, 1955) 3 mi W of Cornwall, Ontario, in Lot 23, Concession 1, Cornwall Twp., Stormont Co. (45° 01' N Lat, 74° 49' W Long). Sample from Pit 11, Trench 1, Sector 15, depth 22 to 25 in. below surface. Coll. 1954 by J. V. Wright. *Comment*: charcoal came from one of seven large pits devoid of cultural material. The date indi-
cates pits are much older than the Point Peninsula 4 Focus material mantling the site and suggests they belong to the Archaic period, even though diagnostic Archaic traits were lacking.

References

Date lists:
- GSC I  Dyck and Fyles, 1962
- Isotopes I  Walton, Trautman, and Friend, 1961
- Isotopes II  Trautman and Walton, 1962
- Lamont II  Kulp and others, 1952
- Lamont V  Olson and Broecker, 1959
- Lamont VII  Olson and Broecker, 1961
- USGS IV  Rubin and Alexander, 1958


Dailey, R. C., and Wright, J. V., 1955, The Malcolm Site, a late stage of the Middle Point Peninsula Culture in eastern Ontario: Royal Canadian Inst., Trans. v. 31, pt. 1, p.3-23.


TEXAS BIO-NUCLEAR
RADIOCARBON MEASUREMENTS I

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INTRODUCTION

Introduction—Texas Bio-Nuclear is a proprietary establishment engaged in offering C¹⁴ dating by the liquid-scintillation method as a service to those institutions and individuals who have a need for such a service. The Laboratory began actual dating operations in December 1961. The first few months were devoted to processing check samples in order to establish the reliability of the system. The dates listed below are not inclusive of all our dating, since the dates we furnish our clients are their property and the publishing of this information is their decision.

Sample types and pretreatment—The types of samples submitted to our laboratory vary widely, some are: natural gases, charcoal, wood, terrestrial shells, ivory, textile, limestone, humic soil, and mixtures of soil and charcoal. Sample pretreatment follows the usual method: 1) removal of gross foreign matter by hand, 2) distilled-water rinse, 3) hot 0.1 N NaOH bath for ten minutes, 4) distilled-water rinse, 5) hot 0.1 N HCl bath for ten minutes, 6) a final distilled-water rinse. This routine is varied occasionally for samples of unusual nature. Ultrasonic cleaning has been used with some success on textile and shell samples.

Chemical conversion—The sample is burned to CO₂ and synthesized to benzene in a manner similar to that used at the University of Texas (Stipp, et al., 1962).

The overall efficiency of the chemical conversion of sample carbon to benzene carbon is ca. 50%. Primary scintillator (PBD) and secondary scintillator (POPOP) are dissolved in the sample benzene, which is placed for counting, in a 4 ml cylindrical type vial. The vial used is of frosted glass. Through our investigations we have found the combination of this vial type and the scintillators mentioned above produce improved pulse-height resolutions, thus increasing the counting efficiency for C¹⁴. It is sometimes necessary to add “dead” reagent grade benzene to bring the vial up to volume when the sample benzene is not sufficient.

Sample counting and counting equipment—The counter currently in use is our modified version of the commercially available Packard Tri-Carb Liquid Scintillation Spectrometer. The unit is operated under modified operating conditions. The detector unit of the system is placed in a freezer and operated at a temperature of 4.5° to 5.5°C. The balance of the electronic components are installed in a smaller freezer operating at ca. 60°F. The effects of these modifications, including the use of the special vial, have been: 1) reduced background, 2) greater instrument stability, and 3) increased counting efficiency.
The entire counting system is installed in a document-storage vault whose walls, ceiling, and floor are of 8-in. thick concrete.

The modern standard presently in use is 95% of the activity of the NBS oxalic-acid standard. This produces a gross uncorrected count of 27.34 counts/min. Background for an equal volume of modern sample is 3.2 counts/min. Ages are calculated using the Libby half life of 5568 yr, with A.D. 1950 as the reference year.

Acknowledgements—We acknowledge our appreciation of the technical guidance of Dr. John K. Kirby, former Director of Laboratories at Texas Bio-Nuclear; M. C. Davis, former Research Chemist at Texas Bio-Nuclear; and the C14 dating staff at Texas Bio-Nuclear.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Southwestern United States

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Age (B.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBN-307.1</td>
<td>Rich Lake, Texas</td>
<td>17,756 ± 358</td>
</tr>
<tr>
<td>TBN-307.2</td>
<td>White Lake, Texas</td>
<td>18,612 ± 347</td>
</tr>
</tbody>
</table>

Limestone from an exposed bluff of Tahoka sediments at the NE corner of Rich Lake, Terry County, Texas (33° 17' N Lat, 102° 12' W Long). Coll. 1961 and subm. by F. Wendorf and J. Hester, Mus. of New Mexico, Santa Fe, New Mexico. Comment (J.H.): this sample is the lowest of three freshwater limestones exposed at this site and should date near the beginning of the Pleistocene. This sample may have been contaminated by groundwater. A comparable sample has been dated at 26,500 ± 800 (Lamont VII, L-513B).

II. ARCHAEOLOGIC SAMPLES

A. Northwestern United States

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Age (B.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBN-304-2</td>
<td>Birch Creek, Idaho</td>
<td>6282 ± 229</td>
</tr>
</tbody>
</table>

Charcoal (no. 25537) from Feature 6, Veratic Cave, a well-stratified rockshelter near Blue Dome in the Birch Creek Valley of eastern Idaho (44° 05' N Lat, 112° 55' W Long). Subm. by E. H. Swanson, Idaho State College Mus., Pocatello, Idaho. Comment: this is one of a large series of C14 samples collected during the 1960-61 excavations at various sites in the Birch Creek Valley.
Valley; its stratigraphic position was earlier than UCLA-161 and UCLA-162 (UCLA II), which dated 5870 ± 120, and 5670 ± 120 respectively, but probably not much older. The calculated date agrees closely with the previous estimate.

**Weis Rockshelter series, Idaho**

This is a large, stratified, continuously occupied site at Camas Prairie in N Idaho (45° 55' N Lat, 116° 20' W Long). Enclosed in the deposits is a layer of Mt. Mazama ash, which separates a component of Old Cordilleran culture from a subsequent component of the Cold Springs horizon in the Columbia Plateau (Butler, 1961, 1962). However, redeposited volcanic ash was also found in the deposits enclosing the Old Cordilleran component, and this raised a question as to the antiquity of the earlier deposits and cultural materials which they enclosed. C¹⁴ samples of the same type were selected from the earliest and latest of this early series of deposits as a means of examining the problem further. Coll. and subm. by B. R. Butler, Idaho State College Mus.

**TBN-319. Substratum 5g**

Charcoal and humus from substratum 5g, earliest of the Old Cordilleran components at the site.

**TBN-322. Substratum 5c**

Charcoal and humus from substratum 5c, one of the latest of the Old Cordilleran components.

*General Comment* (B.R.B.): provided the layer of Mazama Ash noted above does not represent redeposition from local sources, the two dates are ca. 2000 yr younger than expected. However, the dates agree closely with respect to the relative stratigraphic positions of the two samples and with an independently calculated rate of accumulation of deposits at the site. This has led to reexamination of the deposits in question, the results of which will be published in Butler, 1962.

**B. Southwestern United States**

**TBN-306-3. Navajo Reservoir, New Mexico**

Wood charcoal (field specimen no. 4195-106-27) occurring in an oven fill of Feature 106; 0 to 1.0 ft above floor; Site LA 4195 (36° 58' N Lat, 107° 26' 33" W Long), San Juan County, New Mexico. Coll. 1961 and subm. by A. E. Dittert, Jr., Mus. of New Mexico. *Comment*: burials and associated pottery in the oven fill are of the Sambrito phase. This oven fill is overlain by Rosa phase materials of the period a.d. 700 to 900. Sample should date the Sambrito phase remains which occur stratigraphically between the Los Angeles Pinos phase (ca. a.d. 1 to 400) and the Rosa phase (a.d. 700 to 900). Date obtained appears to be too early.
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TBN-311. Caddo County, Oklahoma

Mammoth tusk ivory (no. 400-36) in fragmentary condition from a Pleistocene marsh deposit exposed by a permanent stream in the bottom of a 50 ft deep arroyo in Caddo County, Oklahoma (1 mi E of 34° 57' 30" N Lat, 98° 17' 30" W Long). Coll. 1961 and subm. by A. D. Anderson, Mus. of the Great Plains, Lawton, Oklahoma. Comment (A.D.A.): sample was associated with Paleo-Indian projectile points and should date a period of association between extinct Pleistocene fauna and Paleo-Indian in Oklahoma. This date is obviously too recent for mammoth. The sample was in crumbly condition, and was probably contaminated by stream water and exposure to weather.

C. Central America

Barton Ramie series, British Honduras

Samples from the Barton Ramie site (17° 15' N Lat, 89° W Long), in the Belize Valley near the Guatemala border in British Honduras. Coll. 1962 and subm. by G. R. Willey, Peabody Mus., Harvard Univ., Cambridge, Massachusetts.

TBN-310-1. Mound BR-155

Charcoal-earth mixture (no. 1006) from a fire area in Mound BR-155, Cut 1, from the 1.3 to 1.5 m level.

TBN-310-2. Mound BR-123, fire area

Charred maize-earth mixture (no. 1766) from a fire area between Floors D and E (S) in Mound BR-123.

TBN-310-3. Mound BR-123, Oven fill

Charcoal-earth mixture (no. 1676) from oven fill, Section 2 of Mound BR-123.

General Comment (G.R.W.): the archaeological context of TBN-310-1 and TBN-310-3 is the Barton Creek phase of the Late Pre-Classic period in the Maya Lowlands and these samples should date this period. The context of TBN-310-2 is Late Classic period, Spanish Lookout phase and should date this period. The dates appear to ca. 1500 yr too early in each instance. However, it is interesting to note that TBN-310-2, which was placed archaeologically later than the others, is ca. 600 yr later according to these dates.

Chichen Itza series, Yucatan, Mexico

Three wood samples were taken from two buildings at Chichen Itza (20° 41' N Lat, 88° 34' W Long), Yucatan, Mexico. Two samples were taken from "La Iglesia" of the Las Monjas complex, and a supplementary sample was taken from the "Red House" or "Chicchanchob." Coll. 1962 by E. W. Andrews, Middle Amer. Research Inst., Tulane Univ., New Orleans, Louisiana, and David Bolles; subm. by J. S. Bolles, 14 Gold St., San Francisco 11, California.
TBN-313-1. La Iglesia I  
1170 ± 70  
A.D. 780  
Wood, presumably sapote, taken from a beam-stub in a series of five small beams 252 cm above floor level along W wall. The stub of the fourth beam, 99 cm from the S corner of W wall, was removed for this sample.

TBN-313-2. La Iglesia II  
1350 ± 70  
A.D. 600  
Wood, presumably sapote, taken from a beam-stub in a series of beams 380 cm above the floor along W wall. Fragments were removed from the third beam N to comprise this sample.

TBN-313-3. Red House or Chicchanjochob  
1340 ± 60  
A.D. 610  
Wood, presumably kiichi, taken from the southernmost beam of the upper tier of beams in this structure.

General Comment (E.W.A.): samples taken from “La Iglesia” are contemporaneous with the original construction of the building. The sample from the “Red House” lacks the certainty of the “La Iglesia” samples, but the possibility is believed to be very remote that it dates later than the original construction of the “Red House.”

Bilbao series, Escuintla, Guatemala

These samples are from the Bilbao site, Finca Las Ilusiones, Santa Lucia Cotzumalhuapa, Escuintla, Guatemala (14° 20’ N Lat, 91° 0’ W Long). Coll. 1962 by R. Ritzenthaler and L. A. Parsons; subm. by S. F. de Borhegyi, Milwaukee Public Mus., Milwaukee, Wisconsin.

TBN-315-1. Monument 21, platform rubble  
1423 ± 136  
A.D. 527  
Charcoal from 4 to 5 ft below surface, Group B, Mound 2, Monument 21, excavation unit 4. Comment: sample was found among the stone rubble of a platform sloping away from the front of Monument 21 (carved in Santa Lucia Cotzumalhuapa style). The sample was associated with pottery sherds which include assumed Late Pre-Classic and Early Classic types, and should date the construction of the rubble platform, associated pottery types, and possibly carving of the monument.

TBN-315-2. Esperanza Nursery  
503 ± 70  
A.D. 1447  
Charcoal from 3.5 to 5.0 ft below surface, Test Pit no. 2 at Esperanza Nursery locality (0.5 mi N of Acropolis). Comment: sample was associated with a concentrated refuse heap of sherds of supposedly Late Classic context. The sherds include San Juan Plumate, Tiquisate, and tall redware vases of specular hematite. The charcoal fragments were scattered throughout the refuse heap rather than in a single spot. Since the associated pottery includes types assumed to be of a single period, the charcoal should have been deposited within a relatively short span of time, and should date the deposition of the above pottery types.
D. Middle East

TBN-320-2. Rayy, Iran (Persia)  \[985 \pm 50\]  A.D. 965

Silk textile from burial shroud (sample no. RN-6948) taken from a grave in the NW area of a small hill, Nakkareh Khaneh, in the outskirts of Rayy, 6 km SE of Teheran, Iran (35° 45' N Lat, 51° 45' E Long). Coll. 1936 by E. F. Schmidt; subm. by W. J. Young, Mus. of Fine Arts, Boston, Massachusetts. *Comment*: the Rayy excavations provide dates from the 8th century A.D. to A.D. 1220, and sample should date this type of silk and burial. It is possible this grave may have been disturbed, for it was not a sealed deposit.

References

Date list:
- Lamont VII  Olson and Broecker, 1961
- UCLA II  Fergusson and Libby, 1963
- ________ 1962, Contributions to the Archeology of the Columbia Plateau: Occasional Papers of the Idaho State College Mus., no. 9, in press.
ISOTOPES, INC. RADIOCARBON MEASUREMENTS III
MILTON A. TRAUTMAN
Isotopes, Incorporated, Westwood, New Jersey

INTRODUCTION

The following list presents dates obtained on a fraction of the total number of measurements made during the years 1961 and 1962 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 our clients.

Procedures employed in sample pretreatment, preparation of CO2 and method of counting remain unchanged as are our methods of age calculation. In addition to the two counters previously described, (Isotopes, Inc. I, II), a third counter is now in use. The volume of the third counter is slightly over two liters. Background is 9.4 counts/min. and \( A_{\text{ox}} \times 0.95 \) is 26.1 counts/min. Except for minor alterations, the comments on the \( \text{C}^{14} \) ages, information concerning the sample site, etc., are provided by 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. Alaska

Copper River Basin, Alaska series

Samples from Copper River Basin area, Alaska. Samples were collected by members of the staff and subm. in 1961 by W. E. Davies, U. S. Geol. Survey, Washington, D. C.

I-267. Gulkana River, Alaska \( >37,000 \)

Wood from river bluff exposure along E side Gulkana River (63° 23' N Lat, 145° 22' W Long), near mi 135.4, Richardson Highway. Wood present in laminated sand and silt unit overlain by 10 ft of lacustrine diamicton, 12 ft of poorly stratified silt with numerous pebble-sized phenoclasts, and 2 to 3 ft of windblown silt and fine sand at the surface. Sampled unit is underlain by sand and gravel. Coll. 1958 by O. J. Ferrians, Jr. and H. R. Schmoll. Comment (W.E.D.): sample dates the time of transition from a fluvial to a lacustrine environment of deposition during the initial phase of last major glaciation in area.

I-268. Indian River, Alaska \( 1750 \pm 100 \) A.D. 200

Wood from cut-bank 16 ft high on W side Indian Creek, 2 mi W of its confluence with the Copper River (62° 41' N Lat, 144° 26' W Long). Wood
present 6 in. above base of 13 ft of organic silt and sand at surface. Organic silt and sand underlain by 3 ft medium to coarse gravel, Coll. 1956 by O. J. Ferrians, Jr., and H. R. Schmoll. Comment (W.E.D.): dates time when small alluvial fan was actively forming along margin of Indian Creek valley.

I-270. Ahtell Creek, Alaska

1260 ± 100
A.D. 690

Peat and organic silt from small cut along trail on intermediate terrace on N side of Ahtell Creek, ca. 1.5 mi from the Glenn Highway (62° 44' N Lat, 143° 59' W Long), Alaska. Taken from top of 1.5 in. layer of peat, organic silt and fine sand which overlies gravel and is over lain by sand. Coll. 1960 by H. R. Schmoll and R. H. Bennett; subm. 1961 by H. R. Schmoll. Comment (H.R.S.): date marks a time toward close of deposition of materials in this terrace subsequent to which terrace was cut and the low-terrace material deposited.

I-269. Drop Creek, Alaska

7540 ± 150
5690 B.C.

Organic silt from small exposure on NE bank Drop Creek (62° 35' N Lat, 143° 50' W Long), Nabesna C-6 quadrangle, Alaska. Organic silt overlies till, and is overlain by interbedded organic silt and colluvial diamicton. Coll. 1960 by H. R. Schmoll and R. H. Bennett; subm. 1961 by H. R. Schmoll. Comment (H.R.S.): date is minimum for glaciation of area and is consistent with other dates in adjacent areas.

I-364. Mentasta Basin, Alaska

>32,000

Wood from thin layer 6 ft below top of 80-ft road cut at mi 77, Tok Cutoff of Glenn Highway (62° 52' N Lat, 143° 40' W Long), Nabesna D-6 quadrangle, Alaska. Stratigraphic section includes 30 ft of silt and fine sand overlain by 36 ft of sand, all probably of glaciolacustrine origin, Coll. 1961 by H. R. Schmoll and R. H. Bennett; subm. 1961 by H. R. Schmoll. Comment (H.R.S.): sample postdates incursion at Wrangell Mountain glaciers into the Mentasta Basin area, as well as most of subsequent glaciolacustrine deposition with concomitant damming ice in vicinity of Mentasta Lake from Alaska Range. Copper River Basin probably was not filled with glacier ice after this time.

I-271. Klutina River, Alaska

>29,000

Wood from tree limb exposed in middle of till section of 50-ft river-bluff section, N side Klutina River, 0.5 mi W of its mouth at Copper Center (61° 57' 30" N Lat, 145° 19' W Long), Alaska. Till is overlain by 15 ft of terrace gravel and underlain by fluvial sand and gravel, lacustrine silt, and till. Coll. 1955 by D. R. Nichols. Comment (W.E.D.): date is minimum for till (Chetaskina glaciation: Nichols, in preparation) now thought to be middle or early Pleistocene.

I-272. Chitina, Alaska

8480 ± 150
6530 B.C.

Compressed wood (spruce?) from bank of small unnamed tributary to Copper River, 2 mi S of Chitina (61° 29' N Lat, 144° 28' W Long), Alaska.
From oxidized sand overlain by silty peat with numerous woody zones and underlain by fluvial sand and gravel. Entire section was permafrost. Coll. 1956 by D. R. Nichols. Comment (W.E.D.): dates cessation of rapid alluviation following drainage of large proglacial lake after retreat of Mt. Drum glaciers in late Pleistocene time.

I-438. Harbor Point, Alaska

Wood (Alnus) from stump rooted in surface of till 20 ft above mean sea-level, 1000 ft from high-tide shoreline at Harbor Point (58° 36' N Lat, 137° 39' W Long), on S side of entrance to Lituya Bay, Alaska. Sample was formerly buried in surficial peat and soil, removed by the giant wave in Lituya Bay July 9, 1958. Coll. 1958 and subm. 1959 by D. J. Miller. Comment (D.J.M.): the stump was believed immediately to postdate last retreat of ice from the end moraine forming the constricted entrance to Lituya Bay. W-800, 6060 ± 200 (USGS V), is from an ice-sheared stump at base of the surficial till; the two samples, therefore, are interpreted as bracketing the last advance of ice to the mouth of Lituya Bay, and retreat from that stand.

I-646. Ruby Creek, Alaska

Wood from root of buried white spruce from terrace on E side of Delta River along Richardson Highway, in Central Alaska Range, where Ruby Creek crosses highway (63° 38' N Lat, 145° 53' W Long). Taken 16.8 ft below surface in loess, 0.8 ft above gravel underlying terrace. Coll. and subm. 1962 by T. L. Pévé, Univ. of Alaska, College, Alaska. Comment (T.L.P.): date marks beginning of loess deposition on late Pleistocene terrace and is minimum for Late Donnelly glaciation (Pévé, 1953).

I-647. Ruby Creek, Alaska


I-648. Gulkana Glacier, Alaska

Peat from gravel terrace on W side Gulkana Glacier (63° 14' N Lat, 145° 29' W Long), central part of Alaska Range, Alaska. From buried peat layer ca. 7 mm thick, 4 ft from base of gravel terrace, 10 ft below surface. Coll. and subm. 1962 by T. L. Pévé. Comment (T.L.P.): date is minimum for a recent advance or ice position (Sellmann, 1962).

I-206. Anaktuvuk Pass, Alaska

Peat from beneath 10 to 12 in. unfrozen, mineral tundra soil in silty drift of Echooka age, adjacent to NE end of Summit Lake, Anaktuvuk Pass (68° 9' N Lat, 151° 43' W Long), Alaska. Sample was frozen and consisted of a layer
2 to 4 in. thick of fibrous plant remains virtually free of mineral particles. Cottongrass-tussock vegetation was unbroken at sample site, indicating relative stability of the surface and no recent frost action (Douglas and Tedrow, 1960). Coll. 1959 and subm. 1961 by Jerry Brown, Rutgers Univ., New Brunswick, New Jersey. Comment (J.B.): two minimum dates are reported by Porter (1962) from samples in perennially frozen lacustrine silt in an Eskimo cellar (Mackay, 1961) on W side of Summit Lake (6260 ± 160, Y-770, Yale VI, and 7241 ± 95, Y-1082, Yale VIII). Present sample agrees with the proposed chronology and suggests burial of peat, possibly by frost churning during the Hypsithermal interval (Porter, 1962). Sample pretreated with 0.5% NaOH and 1% HCl.

I-207. Okpilak River, Alaska

175 ± 75
A.D. 1775

Partially humified organic matter of A. Horizon, maximum 5 in. thick, from podzol-like soil several hundred yards SW of W Okpilak Lake (69° 25' N Lat, 144° W Long), Alaska. Coll. 1959 and subm. 1961 by Jerry Brown. Comment (J.B.): soil morphology in the surrounding pit suggested frost churning prior to or coincident with formation of the underlying A1 horizon (Brown, 1962). The relatively young age, although average for the horizon, indicates active soil formative process in this arctic region, as compared to the age of an A1 horizon at Point Barrow, Alaska, 3000 ± 130 (L-400A, Lamont V).

B. Eastern United States

I-368. Laurel Creek Cave

900 ± 200
A.D. 1050

Snail shells from sand layer 4 ft below top of cave-earth fill 9 ft thick, capped by flowstone 2 to 3 in. thick, Laurel Creek Cave, Monroe, West Virginia (37° 33' 32" N Lat, 80° 39' 56" W Long). Coll. 1958 and subm. 1961 by W. E. Davies. Comment: dates middle part of cave fill and is minimum for flowstone.

I-610. Sefton Farm

20,000 ± 500
18,050 B.C.

Wood from calcareous, organic-rich silt, at Sefton Farm (39° 35' N Lat, 85° 7' 32" W Long), 12 mi E of Nulltown, Fayette County, Indiana. Silt is underlain and overlain by calcareous till. Coll. and subm. 1962 by A. M. Gooding, Earlham College, Richmond, Indiana. Comment (A.M.G.): wood is from a post-Sangamon interstadial deposit (Gooding, in press).

I-586. Wells Mastodon site, Indiana

12,000 ± 450
10,050 B.C.

Wood from 90 in. level in excavation for the Wells Mastodon, SE 1/4 Sec. 17, T. 30 N., R. 2 E (41° 4' N Lat, 86° 15' W Long), ca. 5 mi W of Rochester, Indiana. Sample is from marl overlain by organic sand and peat, and lies just below level of most of the mastodon remains. Coll. and subm. by A. M. Gooding. Comment (A.M.G.): site is in broad area of valley-train and outwash between the Maxinkukee and Peckenton moraines. Pollen profile for site suggests mixing of marl by the mastodon, but overlying peat appear not to have
been disturbed. A rather rapid change from dominantly coniferous pollen below, to dominantly deciduous pollen above occurs at base of peat. A similar change was dated in a pollen profile near Richmond, Indiana at ca. 11,000 B.P. (Ogden, 1963; Kapp, 1963).

**A. M. Trautman**

I-587. **American Aggregates, Indiana**  >38,000

Wood from railroad cut at American Aggregates gravel quarry (39° 50' 30" N Lat, 84° 49' 30" W Long), at NE edge of Richmond, Indiana. Taken 6 in. below top of calcareous till. Coll. and subm. by A. M. Gooding. *Comment* (A.M.G.): organic silt and till beneath it are believed to be post-Sangamon in age (Gooding, 1963; Kapp, 1963). L-478B, >40,500 (Lamont VII), is from same deposit.

I-611. **Cummins Farm**  >40,000

Wood from creek-bank exposure on Cummins Farm (39° 40’ N Lat, 85° 15’ 30” W Long), Fayette County, Indiana. Sample appeared to be part of stump *in situ* on top of intact paleosol, and was surrounded by calcareous rock flour and overlain by calcareous till. Coll. and subm. 1962 by A. M. Gooding. *Comment* (A.M.G.): paleosol is interpreted to be of Sangamon age (Gooding, in press).

**D. Canada**

I-428. **Gilman Glacier, Canada**  965 ± 75  A.D. 985

Moss from surface of sand, gravel and weathered sliderock near margin of a small ice dome on E side of Gilman Glacier. Elesmere Island (82° 11’ N Lat, 70° 56’ W Long). Sample, from alt 3800 ft is known to have been exposed by recession of ice dome during summer of 1960 (Hattersley-Smith, G. et al., 1961). Coll. and subm. 1961 by G. Hattersley-Smith, Defence Res. Board, Ottawa, Canada. *Comment*: locality is close to altitude limit of present moss growth. Age is consistent with belief that ice cover was no more extensive and climate no more severe 1000 yr ago than now.

I-462. **Drynoch Slide, Canada**  3175 ± 150  1225 B.C.

Wood from failure zone beneath Drynoch Slide, on Transcanada Highway, E bank of Thompson River 4 mi SW of Spences Bridge, British Columbia (50° 17’ N Lat, 121° 18’ W Long). Portion of tree trunk beneath slide and covering vegetation *in situ*. Coll. and subm. 1961 by C. O. Brawner, Dept. of Highways, Victoria, British Columbia, Canada. *Comment*: wood is thought to date commencement of the slide (Drysdale, C. W., 1914).

**E. Greenland**

Hekla Sund series, Greenland


I-365. **Rivieradal, 68 ft**  5025 ± 150  3075 B.C.

Shells (*Hiatella arctica* and *Mya truncata*) imbedded in marine silt under-
lying marine terrace at alt 68 ft on S side of Rivierdal (80° 3' N Lat, 20° 40' W Long). Comment (W.E.D.): compares with I (USGS) -367 and I (USGS) -366 at Saefaxi Elv, 4 mi N.

I-366.  Saefaxi Elv, 130 ft

6900 ± 150
4950 B.C.

Shells (Hiatella arctica and Mya truncata) from upper 4 in. of marine silt underlying terrace at alt 130 ft on N side Saefaxi Elv (80° 6' N Lat, 20° 40' W Long). Terrace flanks morainal ridges. Comment (W.E.D.): age is comparable to I (USGS) -366 which is from N side Saefaxi Elv.

I-367.  Saefaxi Elv, 125 to 145 ft

6800 ± 150
4850 B.C.

Shells (Hiatella arctica and Mya truncata) from upper 4 in. of marine silt underlying terrace at 125 to 145 ft and on S side Saefaxi Elv (80° 6' N Lat, 20° 40' W Long). Comment (W.E.D.): age is comparable to I (USGS) -366 which is from N side Saefaxi Elv.

I-369.  Saefaxi Elv, 23 ft

3375 ± 125
1450 B.C.

Shells (Mya truncata) from upper 6 in. of marine silty clay at alt 23 ft at mouth of Saefaxi Elv (80° 6' N Lat, 20° 40' W Long).

I-370.  Ingolf Fjord

6700 ± 150
4750 B.C.

Shells (Hiatella arctica and Mya truncata) from upper 4 in. of marine terrace at alt 190 ft at head of S arm of Ingolf Fjord (80° 28' N Lat, 20° 45' W Long). Comment (W.E.D.): age compares with I (USGS) -367 and I (USGS) -366 from 30 mi S.

Mesters Vig series, Greenland

Various samples from Mesters Vig outwash plain (72° N Lat, 24° W Long), NE Greenland. Coll. 1961 by Fred Pessl and N. P. Lasca, Univ. of Michigan, Ann Arbor; subm. 1961 by Fred Pessl (Pessl, 1962).

I (UM) -429.  Kong Oscars Fjord

7350 ± 190
5400 B.C.

Baleen from sand and gravel in an emerged beach at alt ca. 50 m deposit, S shore Kong Oscars Fjord, ca. 1 km SE of mouth of Mesters Vig. Comment (F.P.): date agrees with those obtained from shell and wood collected at similar altitudes nearby (Washburn and Stuiver, 1962).

Oske River series

Shell samples from SW side of mouth of Oske River.

I-432.  Oske River 1

6530 ± 200
4580 B.C.

Shells (Hiatella arctica) from emerged delta remnant at alt ca. 40 m. Comment (F.P.): date agrees with dates of other samples collected in vicinity (Washburn and Stuiver, 1962).
I-430.  Oske River 2  
7600 ± 230  
5650 B.C.  

Shells (Mya truncata, Hiatella arctica), in growth position, from emerged delta remnant, alt ca. 53 m. Comment (F.P.): date agrees with baleen (I-429, this list) from similar altitude in same vicinity, and with data published by Washburn and Stuiver (1962).

I-431.  Oske River 3  
5500 ± 175  
3550 B.C.  

Shells (Macoma calcarea, Astarte, pulchella, Clincardium ciliatum) from rim of a breached pingo in stoney clay, punched up through overlying outwash gravels, at alt ca. 13 m. Comment (F.P.): date not relevant to postglacial isostatic adjustment data because of development of the pingo; however it is maximum for deposition of the outwash gravel.

F. Africa

I-556.  Mahoma Lake, Uganda  
14,700 ± 290  
12,750 B.C.  

Gyttja from Mahoma Lake (0° 21' N Lat, 29° 58' E Long), alt 3000 m, the lowest glacial lake in the Ruwenzori Range. Sample from 5.2 to 5.4 m depth in lake sediment at a station in 0.5 m of water. Coll. 1960 and subm. 1962 by D. A. Livingstone, Duke Univ., Durham, North Carolina. Comment (D.A.L.): date is a minimum for and probably close to true age of glacial retreat from the lowest valley moraines. This is first known direct dating of any glacial event in equatorial Africa, and indicates that retreat from the last glacial maximum was synchronous with that in the temperate zone (Livingstone, 1962).

II. ARCHAEOLOGIC SAMPLES

A. Eastern United States

I-424.  O'Neil Farm, New York  
4000 ± 220  
2050 B.C.  

Charcoal from hearth at 31 to 39 in. below surface in Sec. E 20520, Feature 4, on the E. J. O'Neil Farm (43° 04' 48” N Lat, 76° 35' 09” W Long), 2.25 mi NW of Weedsport, Cayuga County, New York. Feature 4 occupies a shallow depression in top of the lowest of three strata, each with different cultural complex. Hearth occurred at top of Late Archaic horizon, in immediate contact with major cultural stratum of site which pertained to Transitional period, Susquehanna Broad point complex. Coll. and subm. 1961 by W. A. Ritchie, N. Y. State Mus. and Sci. Service, Albany, N. Y. Comment (W.A.R.): appears to date terminal Archaic occupation at this site, a late manifestation of the Brewerton focus.

825 ± 100  
A.D. 1125  

Charcoal from storage pit (Feature 89), 35 in. deep, Bates Site (42° 17' 50” N Lat, 75° 47' 42” W Long), 2.25 mi S of Greene, Chenango County, New York. From lower level beneath a shell layer. Site is small village of late Woodland Owasco culture. Coll. 1958 and subm. 1961 by W. A. Ritchie. Comment
(W.A.R.): charcoal from Feature 22, a similar storage pit at this site, has been dated at 660 ± 200 (M-762, Michigan IV). This date (I-425), is closer to the expected age.

**Russell Cave Series, Alabama**

Charcoal from within Russell Cave (34° 58' N Lat, 85° 48' 32" W Long), Doran Cove, Jackson County, Alabama. The cave has been excavated extensively (Miller, 1958). Coll. and subm. by C. F. Miller, Smithsonian Inst., Washington, D. C.

**I-399. Russell Cave, 1 ft**

1200 ± 120
A.D. 750

Charcoal from fire burned area 1 ft beneath present cave floor. Cultural period attributed to Middle Mississippi evolving into Chickamauga Cherokee. *Comment* (C.F.M.): date agrees with terminal Woodland period and emergence of the middle Mississippi period.

**I-396. Russell Cave, 2.0 ft**

8350 ± 180
6400 B.C.

Charcoal from 2.0 ft beneath present floor. Cultural period attributed to Early Archaic from Transitional of Paleo-Indian. *Comment* (C.F.M.): date agrees with series dated at Univ. of Michigan (M-845, 846, 847, Michigan VI).

**I-398. Russell Cave, 6.5 ft**

772 ± 180
A.D. 1178

Charcoal from large hearth at 6.5 ft level. *Comment* (C.F.M.): date agrees with series from various cultural levels (Michigan VI).

**I-397. Russell Cave, 10.0 ft**

8450 ± 180
6500 B.C.

Charcoal from hearth at 10.0 ft level. *Comment* (C.F.M.): date agrees with cultural material of Early Archaic period (Michigan VI).

**I-480. Morris Site, F51, Kentucky**

475 ± 90
A.D. 1475

Charred wood from firepit located in a wall trench house pattern, Feature 51, Structure 10, 2.4 ft deep at Morris Site, K 49 (37° 17' N Lat, 87° 35' W Long), Hopkins County, Kentucky. Site is 1.5 mi SW of junction of Sugar Creek with Clear Creek, a tributary of the Tradewater River, 5 mi SW of Madisonville, Kentucky. Coll. 1941 by G. A. Jackson, Univ. of Kentucky, Lexington; subm. 1962 by D. W. Schwartz and M. A. Rolingson, Univ. of Kentucky. *Comment* (D.W.S., M.A.R.): material associated with sample is Mississippian. Sample dates first of two building periods at site while I-481 (this list) dates the latter building period. The first period is characterized by construction of wall-trench house patterns and a wall-trench stockade pattern.

**I-481. Morris Site, F 16, Kentucky**

270 ± 80
A.D. 1680

Charred wood from deep firepit centrally located in an individual post-house pattern, Feature 16, Structure 3, 3 ft below surface at the Morris Site, HK 49 (37° 17' N Lat, 87° 35' W Long), Hopkins County, Kentucky. Coll. 1941 by G. A. Jackson; subm. 1962 by D. W. Schwartz and M. R. Rolingson.
Comment (D.W.S., M.A.R.): material with sample is Mississippian. Sample dates from latter of two building periods while I-480, (475 ± 90, this list) dates the first period. The later period is characterized by the construction of individual post-house patterns and an individual post-stockade pattern.

I-479. Roach Site, Kentucky

Charred wood from SW corner of a wall trench pit house, from 2.5 ft below surface at the Roach Site (36° 50' N Lat, 88° 8' W Long), Triss County, Kentucky. This site is located .25 mi E of the Tennessee River on the N bank of Ewes Branch, .75 mi upstream from entrance of Jonathan Creek into the Tennessee River. Coll. 1941 by James Greenacre, Univ. of Kentucky, Lexington; subm. 1962 by D. W. Schwartz and M. A. Rolingson. Comment (D.W.S., M.A.R.): material in association with sample is Mississippian. Pottery associated with the house pattern included a Neeley's Ferry Plain globular jar.

I-477. Goheen village, Kentucky

Charred wood from SW corner of pit house, Feature 9 at Goheen village Site (47° 40' N Lat, 88° 8' W Long), Marshall County, Kentucky. Site is on W bank of Tennessee River, 1.5 mi N of entrance to Jonathan Creek into the Tennessee River. Structure originated in Zone A, and extended into Zone B. Sample is from Zone B. Coll. 1941 by Harold Dahms, Univ. of Kentucky, Lexington; subm. 1962 by D. W. Schwartz and M. A. Rolingson. Comment (D.W.S., M.A.R.): material associated with sample is Mississippian.

I-478. Tinsley Hill village, Kentucky

Charred wood from center post of a wall-trench structure at depth of 37 cm at Tinsley Hill village (37° 1' N Lat, 88° 3' W Long), Lyon County, Kentucky. Site is on E bank Cumberland River, 1.8 mi SE of the Kentucky State Prison in Eddyville, and 0.6 mi downstream from mouth of Eddy Creek. Coll. 1960 by L. H. Hanson, Jr., Univ. of Kentucky, Lexington; subm. 1962 by D. W. Schwartz and M. A. Rolingson. Comment (D.W.S., M.A.R.): material associated with sample is Mississippian. The site lies at the foot of the bluff where the Tinsley Hill stone grove cemetery, dated at 570 ± 150 (M-1150, unpublished, is located (Schwartz, 1961).

B. Central United States and Great Plains

Missouri Basin

The following series of samples were submitted during late 1961 and early 1962 by R. W. Neuman, Smithsonian Inst., Lincoln, Nebraska, as part of the Missouri Basin chronology program. This program is part of a broad study of the archaeological history of the people and cultures in the Missouri Basin.

Side Hill Mound series, South Dakota

Samples from Mound 1, Side Hill mound site (44° 2' 10" N Lat, 99° 22' 55" W Long), Buffalo County, South Dakota. Coll. and subm. 1961 by R. W. Neuman.
I-448. Side Hill Mound Site, Feature 1  

Charcoal bone (human) from 1.5 to 20 ft depth in Feature 1. Comment (R.W.N.): dates cremation in Mound 1 and supplies date for Truman Plain Rim pottery (Neuman, 1962).

I-446. Side Hill Mound Site, Feature 2  


Sitting Crow series, South Dakota  

Samples from Sitting Crow Site (44° 1’ 50” N Lat, 99° 22’ 10” W Long), Buffalo County, South Dakota. Coll. 1961 by W. E. Buckles, Smithsonian Inst., Lincoln, Nebraska.

I-560. Sitting Crow Site, Mound 3  

Charred bone from a shallow hearth, Feature 7, Mound 3. Comment (R.W.N.): provides a date for preceramic occupation at site, defined by thin triangular points having slightly convex sides and a concave base. Age is considered minimum (Neuman, 1962).

I-447. Sitting Crow Site, Mound 2  


I-581. Cheyenne Village Site, South Dakota  

Wood from center post in long-rectangular house (F34) at Cheyenne Village Site (44° 46’ N Lat, 100° 43’ W Long), Stanley County, South Dakota. From same house site as M-840 (650 ± 200, Michigan V). Coll. 1955 by W. R. Wedel. Comment (R.W.N.): represents earliest of three components, with Thomas Riggs focus affinities.

I-561. Site 39CH9, South Dakota  

Charcoal from Feature 21 of mound at Site 39 CH9 (43° 3’ 35” N Lat, 98° 32’ 35” W Long), Charles Mix County, South Dakota. Coll. 1948 by P. L. Cooper. Comment (R.W.N.): dates mound at this site.

I-614. Site 39SL24, South Dakota  

Wood from post hole fill in F 27, Site 39SL24 (44° 47’ N Lat, 100° 42’ W Long), Sully County, South Dakota. F27 is a large circular house structure at a single-component site. It is characterized by circular domiciliary structures clustered around a large ceremonial structure. Pottery is Russell ware (McNutt, 1959). Coll. 1959 by C. H. McNutt, Smithsonian Inst.

I-562. Site 39CH4, South Dakota  

Wood from Mound 1, Site 39CH4 (43° 9’ 8” N Lat, 98° 47’ 15” W Long), Charles Mix County, South Dakota. Coll. 1947 by P. L. Cooper of the Smith-

**I-613. Site 39SL41, South Dakota**  
430 ± 95  
_A.D. 1520_  

**Boundary Mound series, North Dakota**  
Samples from the Boundary Mound Site (45° 56' 45" N Lat, 100° 31' 30" W Long), Sioux County, North Dakota. Coll. 1960 and subm. 1962 by R. W. Neuman.

**I-499. Boundary Mound Site, Mound 1**  
1540 ± 160  
_A.D. 410_  
Wood found lying on floor of structure in Mound 1. Mound characterized by a central subfloor tomb, and abundant bison bone remains (Neuman, 1961). *Comment* (R.W.N.): samples dates burial with the mound.

**I-498. Boundary Mound Site, Mound 2**  
1340 ± 150  
_A.D. 610_  

**I-414. Boundary Mound Site, Mound 3**  
2200 ± 125  
_B.C. 250_  

**Effigy Mounds National Monument series, Iowa**  
Charcoal samples from burial mounds in Effigy Mounds Natl. Monument (43° 1' 45" N Lat, 91° 11' 15" W Long), Iowa. Coll. 1961 by the Park Archaeologist. (No name available.)

**I-441. Marching Bear Mound, No. 1**  
1575 ± 100  
_A.D. 375_  
Charcoal from area of scattered charcoal and burned earth in heart region of bear-shaped burial mound, 1 ft 6 in. to 2 ft 10 in. below surface. *Comment* (R.W.N.): sample provides typical date for Marching Bear mound group.

**I-412. Marching Bear Mound, No. 2**  
1325 ± 100  
_A.D. 625_  
Charcoal from area of scattered charcoal and burned earth in heart region of bear-shaped burial mound, 1 to 2 ft deep. *Comment* (R.W.N.): date compares with I-412, 1575 ± 100 (this list), and provides typical age for this group of mounds.

**I-413. Marching Bear Mound, No. 3**  
430 ± 75  
_A.D. 1520_  
Charcoal from 1.5 ft beneath bottom of treasure hunter's hole at one end of a linear mound considered to be part of the Marching Bear group.
I-509. Root Site, Kansas  
975 ± 100  
A.D. 975

Charcoal from Pit 3, in floor of House 1, Root Site (38° 55' 24" N Lat, 98° 29' W Long), Lincoln County, Kansas. Site is Smoky Hill aspect in Hell Creek, a tributary of the Saline River (Wedel, 1959). Coll. 1950 by W. R. Wedel.

Medicine Creek Reservoir series, Nebraska

Samples collected from sites in the Medicine Creek Reservoir area (40° 22' 40" N Lat, 100° 12' 45" W Long), Frontier County, Nebraska.

I-584. Medicine Creek, Site 25 FT 13  
510 ± 100  
A.D. 1440

Charcoal from center post 18 to 30 in. deep in Feature 1. 52% of rim shovels are braced. Site is assigned to Upper Republican aspect (Kivett, 1949). Coll. 1948 by M. F. Kivett, Smithsonian Inst.

I-583. Medicine Creek, Site 25 FT 16  
715 ± 125  
A.D. 1235

Wood from posthole in House 2, Site 25 FT 16. The site has 60% braced rims and is assigned to the Upper Republican Aspect (Kivett, 1949). Coll. 1947 by A. T. Hill, Nebraska State Hist. Soc.

I-585. Medicine Creek, Site 25 FT 17  
780 ± 125  
A.D. 1170

Charcoal from house floor, Feature 15, at depth of 4 to 6 in. Site has 73% braced rims, and is assigned to the Upper Republican Aspect (Kivett, 1949). Coll. 1948 by George Metcalf, Smithsonian Inst.

I-496. Kropp Mound, North Dakota  
950 ± 85  
A.D. 1000

Charcoal from Kropp Mound (47° 3' N Lat, 98° 45' W Long), Stutsman County, North Dakota. Combined specimens from depth of 6.15 to 7.2 ft Square N220 W 150 and 6.55 to 7.15 ft deep in Square N220 W 140. Associated with secondary burials of Feature 13. Tumulus is a large, domed structure with three radiating ridges, two of which have terminal mounds (Wheeler). Coll. 1952 by R. P. Wheeler, Smithsonian Inst., Lincoln, Nebraska.

I-497. Site 32BA1, North Dakota  
1860 ± 150  
A.D. 90

Wood from log covering central tomb of Mound A, site 32BA1 (47° 8' N Lat, 98° 00' W Long), Barns County, North Dakota. Construction of tomb characterized by a subfloor, log covering, and bison bone remains (Hewes, 1949). Coll. 1948 by G. W. Hewes, Univ. of North Dakota.

I-644. Buffalo Creek, Wyoming  
2600 ± 200  
650 B.C.

Charcoal from center section of bone-saturated cultural level 12 in. thick, overlain by 9 ft sterile overburden, at site 30 mi E of Sheridan (44° 46' N Lat, 106° 58' W Long), Wyoming, on Buffalo Creek drainage. Coll. and subm. 1962 by R. C. Bentzen, Wyoming Archaeol. Soc., Inc., Sheridan. Comment (R.C.B.): although artifacts from this site are identical with those recovered
from the Powers-Yonkee site, they have a C\textsuperscript{14} age 1850 ± 325 yr younger than the Powers-Yonkee (I-410, 4450 ± 125, unpub.). This would lengthen considerably the span of McKean culture.

C. Western United States

Columbia River series, Oregon

The following dates are part of the data from a continuing study by the University of the processes of diffusion from the southern interior of the state to the Columbia River (Cressman, 1942, 1956, 1960). The samples were collected by various workers; subm. 1962 by L. S. Cressman. The Round Butte samples are the first firm dates for archaeological material from this part of Oregon.

I-503. John Day Dam Reservoir,
Site 35GM24, Oregon

Charcoal from lowest major occupation level of Hobo Cave, Site 35GM24 (45° 43' N Lat, 120° 33' W Long), on left bank of Columbia River ca. 7 mi E of mouth of John Day River, and ca. 25 m above mean river level in August. Cave fill is separable into three geologic levels based on color and composition. Three side notched points come from below the sample. Coll. 1961 by D. L. Cole. Comment (L.S.C.): date is evidence that sometime before 6150 ± 250 B.P., projectile points characteristic of an early Northern Great Basin type appear on the Columbia (Cressman, 1960).

I-504. John Day Dam Reservoir,
Site 35GM9, Oregon

Charcoal from house (?) planks at John Day Dam Reservoir Site 35GM9, Area 5 (45° 41' 20" N Lat, 120° 29' 42" W Long), on left bank Columbia River at Quinton, Oregon. Site covers large area between cliffs and the river and different parts were occupied at different times (Cressman, 1960). This sample comes from portion near river where the surrounding fill was damp. Earlier occupation exists below sample level. Coll. 1961 by D. L. Cole. Comment (L.S.C.): this sample, with I-504 (this list) give ages for different cultural manifestations in the area. See also Wildcat Canyon site series (M-1119, M-1120, M-1121, M-1122, Michigan VII).

I-500. Round Butte Cave No. 2

Charcoal from top of Level I, in Round Butte Cave No. 2 (44° 35' N Lat, 121° 18' W Long), on right bank of Deschutes River slightly above its confluence with the Metolius River, Oregon. Site is ca. 500 yds upriver from site of I-501. Cave has three cultural levels, though they do not differ greatly, numbered I, II, III with I the earliest. While geologic differentiation occurred in the fill, there was no correlation between the cultural and geologic stratification. Coll. 1962 by D. L. Cole. Comment (L.S.C.): this cave on the right bank of Deschutes River is on side comprising the Columbia Plateau and extending to the Columbia River. It was thus separated from the interior—Columbia River route referred to in I-501 (this list) by rugged canyons ca. 1000 ft deep.
I-501. Round Butte Cave No. 1

Charcoal from fire lens approximately halfway down cultural fill in Round Butte Cave No. 1 (44° 35' N Lat, 121° 18' W Long), on left bank Deschutes River, Oregon, ca. 500 yds downstream from confluence with the Metolius River. Fill is separable into two levels geologically, but there was no correlation between varieties of artifacts and the geologic stratigraphy. Coll. 1961 by John Wells. *Comment* (L.S.C.): site is in a region relatively unknown archaeologically but is close to the route from the Klamath Lakes and adjacent Northern Great Basin to the Columbia River. Sample age provides a chronological referent for the archaeological manifestations in the area.

D. Far East

**Kojohama series, Japan**

Charcoal taken from black humus representing lowest level of cultural deposit in floor of pit house at Kojohama Village (42° 27' N Lat, 141° 14' E Long), Shiraol County Hokkaido, Japan. Both samples are from same level and date one of the earliest known pottery types in Hokkaido (Oba and Chard, in press). Coll. 1961 by Toshio Oba, Hokkaido Univ., Sapporo, Japan; subm. 1962 by C. S. Chard, Univ. of Wisconsin, Madison.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
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<tbody>
<tr>
<td>1-550. Kojohama, undecorated</td>
<td>7680 ± 200 5730 B.C.</td>
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<tr>
<td>1-551. Kojohama, Shell-marked</td>
<td>7700 ± 200 5750 B.C.</td>
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*General Comment* (L.S.C.): in view of marginal position of Hokkaido in relation to the Tokyo area and the consequent expectable time-lag, these dates lend strong support to the validity of the age of 9450 ± 400 (M-769, Michigan V) for the earliest pottery at the Natsushima shell mound near Tokyo. No pottery elsewhere in the world is known to approach such an age.

I-554. Koboro Cave, Japan

A.D. 1575

Charcoal from occupational deposit in Koboro Cave (45° N Lat, 141° E Long), Rebun, Hokkaido, Japan. Sample associated with pottery of Esan type. Coll. 1961 by Toshio Oba; subm. 1962 by C. S. Chard. *Comment* (C.S.C.): it was hoped that the sample would date the Post-Jomon Esan pottery. More recent occupations were also identified in the cave; the sample evidently came from a mixed zone as it is far too recent for Post-Jomon.

I-552. Nakazawa Site, Japan

1875 B.C.

Charcoal from interior of pit house assigned to Middle Jomon ceramic stage at Nakazawa Site, Tomikaza, Morbetsu (44° N Lat, 144° E Long), Hokkaido, Japan. Coll. 1961 by Toshio Oba; subm. 1962 by C. S. Chard. *Comment* C.S.C.): date is somewhat more recent than expected.

I-555. Tsikibetsu Site, Japan

1030 B.C.

Charcoal from interior of pit house at Tsikibetsu site, Haboro-cho, To-
mama (44° 25′ N Lat, 141° 45′ E Long), Hokkaido, Japan. House assigned to Satsumon culture and sample was associated with Satsumon pottery. Coll. 1961 by Toshio Oba; subm. 1962 by C. S. Chard. Comment (C.S.C.): age is close to that expected for Satsumon culture in this area.

I-553. Misato Cave, Japan

6800 ± 225
4850 B.C.

Charcoal from Misato Cave (43° 40′ N Lat, 143° 50′ E Long), Kitami City, Hokkaido, Japan. Taken from occupational deposit and associated with pottery. Coll. 1961 by Toshio Oba; subm. 1962 by C. S. Chard. Comment (C.S.C.): sample dates Early Jomon stage in this area and is close to expected age for this type of pottery.

I-434. Vishnu City, Burma

1950 ± 90
A.D. 1

Charcoal from structural post in Peikthanomyo (Vishnu City) (20° N Lat, 95° 23′ E Long), Kokkogwa Village, Taundwingyi Township, Magwe District, Burma. Site within the old city is debris mound 6 ft above ground level. Sample is from charred wooden post within brick structure. Coll. 1961 by U. Aung Thaw, Archaeol. Society of Burma, Rangoon; subm. 1961 by D. W. Overton, Japan Soc., Inc., New York, New York. Comment (U.A.T.): date is ca. 400 yr earlier than expected in relation with a known site, and ca. 400 yr later than traditional accounts.

E. South America

El Inga series, Ecuador

Soil samples containing powdered charcoal taken from the El Inga site (0° 17′ S Lat, 78° 32′ W Long), in the Andean Highlands near Tumbaco, Ecuador. Samples were to provide date for fluted point complex found at the site and believed to be ca. 8000 to 10,000 yr old on typological grounds and similarities with Fell’s Cave type projectile points (Bell, 1960; Mayer-Oakes and Bell, 1960). Coll. and subm. 1961 by R. E. Bell, Univ. of Oklahoma, Norman.

I-557. El Inga, Level 8

4000 ± 190
2050 B.C.

From stratigraphic block No. 1, Square S 37, Left 1, Level 8, at depth 14 to 16 in. Comment (R.E.B.): date appears to be too young, but comparative materials are lacking.

I-558. El Enga, Level 6

5550 ± 200
2600 B.C.

From Square S 16-Left 2, Level 6 at depth 20 to 22 in. Comment (R.E.B.): date is consistent with I-557 (this list) in terms of stratigraphy, but also appears too young.

I-637. El Hatillo, Panama

415 ± 90
A.D. 1535

Charcoal from deep tomb near the Parita River 6 mi SW of town of Parita, Herrera Province, Panama (8° N Lat, 80° 33′ W Long). The tomb which yielded the sample was unusually rich in content with a large number and variety of associated artifacts. Coll. 1947 and subm. 1962 by M. W.
Stirling, Natl. Geog. Soc., Washington, D. C. Comment (M.W.S.): date confirms archaeologic belief that the El Hatillo culture is later than Coele and slightly precedes the early 16th century Spanish conquest of Panama (Stirling, 1949).

III. MISCELLANEOUS SAMPLES

I-577. Heian figure, Freer Gallery  

Wood (Torreya rucifera?) chiseled from inside hollow Japanese seated figure 38 in. high now in Freer Gallery of Art, Smithsonian Inst., Washington, D. C. Coll. and subm. 1962 by R. J. Gettens, Freer Gallery of Art. Comment (R.J.G.): figure dated stylistically as Heian period, 10 to 11th centuries A.D. C¹⁴ date confirms antiquity of the object.

I-476. Seated Buddha figure, Freer Gallery  

Ivory (elephant?) from Chinese seated Buddha figure 30.8 cm high now in Freer Gallery of Art, Smithsonian Inst., Washington, D. C. Statuette was obtained by C. L. Freer in 1916. Coll. and subm. 1961 by R. J. Gettens. Comment (R.J.G.): figure dated uncertainly on stylistic grounds as Sung Dynasty (A.D. 960 to 1279), but on basis of C¹⁴ date is provisionally late Ming (A.D. 1368-1644) or early Ching (A.D. 1644-1912) dynasty.

I-475. Standing Buddha figure, Freer Gallery  

Ivory (elephant?) from a Chinese Buddha figure 45.5 cm high now in Freer Gallery of Art, Smithsonian Inst., Washington, D. C. Sample chiseled from interior of object. Coll. and subm. 1961 by R. J. Gettens. Comment (R.J.G.): statue dated stylistically and from inscription as Sung Dynasty (A.D. 960 to 1279). Doubts had arisen in respect to this date and authenticity of the object. C¹⁴ date indicates the figure was made from fossil ivory. It is now known that fossil mammoth ivory was abundantly available and widely used for carving over long periods in the Far East. C¹⁴ date is interesting in respect to origin of the ivory, but yields no clue as to age of the statue.

I-417. Bat Cave, New Mexico  

Bat guano from guano and silt fill ca. 1 ft beneath base of flowstone floor of S edge of Bat Cave (32° 10' 40" N Lat, 104° 26' 10" W Long), Carlsbad Caverns, New Mexico. Coll. 1959 by Paul Spangle; subm. 1959 by P. T. Hayes. Comment (P.T.H.): gives maximum age to flowstone floor of Bat Cave and indicates that a large portion of the carbonate decorations in Carlsbad Caverns are quite recent. This date is considerably younger than similar material from beneath flowstone in New Cave, 9 mi SW of Bat Cave (Chicago V).

I-586. Wells Mastodon site, Indiana  

Wood from 90 in. level in excavation for the Wells Mastodon, SE ¼ Sec. 17, T. 30N., R. 2E (41° 4' N, Lat, 86° 15' W Long), ca. 5 mi W of Rochester, Indiana. Sample is from marl overlain by organic sand and peat, and lies just below level of most of mastodon remains. Coll. and subm. by A. M. Gooding. Comment (A.M.G.): site is in broad area of valley-train and outwash between
the Maxinkukee and Packenton moraines. Pollen profile for site suggests mixing of marl by the mastodon, but overlying peat appears not to have been disturbed. A rather rapid change from dominantly coniferous pollen below, to dominantly deciduous pollen above occurs at base of peat. A similar change was dated in a pollen profile near Richmond, Indiana at ca. 11,000 B.P. (Ogden, 1963; Kapp, 1963).

I-587. American Aggregates, Indiana  >38,000

Wood from railroad cut at American Aggregates gravel quarry (39° 50' 30" N Lat, 84° 49' 30" W Long), at NE edge of Richmond, Indiana. Taken 6 in. below top of calcareous till. Coll. and subm. by A. M. Gooding. Comment (A.M.G.): organic silt and till beneath it are believed to be post-Sangamon in age (Gooding, 1963; Kapp, 1963). L-478B, >40,500 (Lamont VII), is from same deposit.

References

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<tr>
<td>Pennsylvania IV</td>
<td>Ralph and Ackerman, 1960</td>
</tr>
<tr>
<td>USGS V</td>
<td>Rubin and Alexander, 1960</td>
</tr>
<tr>
<td>Yale VI</td>
<td>Stuiver and Deevey, 1961</td>
</tr>
<tr>
<td>Yale VII</td>
<td>Stuiver and Deevey, 1962</td>
</tr>
<tr>
<td>Yale VIII</td>
<td>Stuiver and Deevey, 1963</td>
</tr>
</tbody>
</table>


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RADIOCARBON DATING
AT THE UNIVERSITY OF WASHINGTON. II*

A. W. FAIRHALL and W. R. SCHELL

Department of Chemistry, University of Washington, Seattle, Washington

The radiocarbon dating equipment previously used (Dorn, Fairhall, Schell and Takashima, 1962) has been moved to a different location. During the resulting hiatus in our dating program we have constructed a new counter with a few novel features. It is similar in concept to the Houtermans-Oeschger counter (Houtermans and Oeschger, 1958), but two changes have been made in the design: (1) The inner counter, constructed of thin, metallized plastic foil of thickness 4.2 mg/cm², is leak-tight relative to the outer counter. By means of two solenoid valves actuated by a simple differential mercury manometer the outer and inner counters can be filled separately with a pressure differential on the partition of less than 0.5 cm Hg. Thus all of the sample can be introduced into the inner counter while inert gas is fed into the outer counter. As the sample gas is not needed for anti-coincidence filling efficiency increases ca. 30%; (2) The metallic parts are made of commercially available high-purity nickel which is easier to procure than O.F.H.C. copper; nylon is used for the other parts. The outer counter appears to have a very low radioactivity, its $\alpha$ activity being 5 pulses/hr/100 cm².

Methane continues to be used as the counting gas. The new system has now been in operation for four months and is remarkably stable. Counts of NBS oxalic acid (as CH₄) are reproducible within the statistics of counting, which on occasion we have carried to 0.5%. The gross counting rate of the oxalic-acid standard in counts/min, for pressures $P$ above 1 atmosphere, is gross NBS std. = $7.084 \pm 0.004 \times P - 0.30$.

The counter is housed in a meter-long piece of 16-in. gun barrel from a battleship; the steel walls are 8 in. thick. The counter rests inside a mercury shield and the remaining space is packed with boron and paraffin. The background counting rate, also reproducible within statistics, is

$$\text{bkgd} = 0.675 \pm 0.10 + 0.475 \times P$$

The useful pressure range for operation is 15 to 100 in. Hg, the limit of the Bourdon gauge presently in use. The pressure-voltage relationship is

$$\text{operating voltage} = 1900 + 975 \times P$$

One difficulty is worth reporting: when C.P. grade tank methane was used in preliminary tests there was a most discouraging downward drift in the anti-coincidence counting rate. We finally were able to attribute this to radon, which must be maintained by radium, somehow present inside the methane tank.† Radon has been observed in tank methane by others (De Voe, 1961). We now store aliquots of tank gas in separate, clean cylinders before use.

* Supported in part by grants from the National Science Foundation.

† Note added in proof: This difficulty, evidently due to accumulated calcium deposits from lime scrubbers used to purify the gas, has been overcome by specifying that the methane be supplied in new cylinders.
One further modification will be made. The wall of the inner counter is constructed of two layers of aluminum foil bonded to Mylar. Aluminum, notoriously impure, no doubt accounts for some of the observed background. We plan to replace it with high-purity, pinhole-free nickel foil.

Further details may be obtained by writing to the authors.

References
UNIVERSITY OF PENNSYLVANIA
RADIOCARBON DATES VI

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University of Pennsylvania, Philadelphia 4, Pennsylvania

INTRODUCTION

In conformance with the request of the editors, ages in this date list have been calculated with the Libby half life value of 5568 ± 30 yr, although the present best estimate of the half life value is 5730 ± 40 yr (Godwin, 1962). Additional support for the latter value as being closer to the “effective” value for dating has been obtained by the measurements of samples of known age.

Our standard samples for calibration are 110-yr old oak samples. These, when corrected for age, have C14 contents equal to 95% of the NBS oxalic-acid standard. The differing fractionation effects as reported by Craig (1961) in the processing of oxalic acid have negligible bearing on our age calculations since we have continued to use the wood standard. Our measurements of C13/C12 ratios of different lots of CO2 obtained from the NBS oxalic acid demonstrate also that significant and variable fractionation effects occur in the “wet” conversion of oxalic to CO2. The minor variations of our wood samples due to fractionation effects are being determined presently by the measurement of C13/C12 ratios.

All samples have been pretreated with HCl and some, where noted in the date list, have received additional NaOH pretreatment for the removal of possible humic acid contaminants. All samples were counted at least twice.

The B.P. ages are calculated from A.D. 1950, and the errors quoted include the half life error of ± 30 yr. These samples were measured in 1961 and 1962.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Eastern United States

P-426. > 41,000

Ivory tusk from N margin of Spy Pond (42° 24' N Lat, 71° 09' W Long), a glacial kettle, Arlington, Mass. The tusk, identified as that of a probiscidian mammal by N. D. Harris, Mus. of Science, Boston, Mass., was found on the sandy bottom of the pond under 3 ft of water. Coll. 1960 by Arvid Carlson, Arlington, Mass.; subm. by Harris. Comment: sample was taken from a well-preserved central portion of the tusk, and washed only with water (no HCl). The age quoted is the two-sigma limit of detection, based upon three counts of 1000 min each. The apparent age of the tusk was 42,060 ± 4305 yr B.P.

II. ARCHAEOLOGIC SAMPLES

NEAR EAST

A. Syria

Ras Shamra series, Syria

Ras Shamra (35° 37' N Lat, 35° 48' E Long), lies on the E shore of the
Mediterranean Sea, 9 mi N of Latakia (Lattaquia) in N Syria. The site, the ancient Phoenician capital of the region, has yielded materials ranging from Neolithic through the Bronze Age. Subm. by C. F. A. Schaeffer, Collège de France, Paris. Samples P-460, 459, 458, 457, 389 represent stratigraphic series from 14 m (Pre-pottery Neolithic) to 4 m (Ubaid). (Schaeffer, 1961a, 1961b).

P-460. Pre-pottery Neolithic, 13.75 m to 14 m
8364 ± 101
6414 B.C.
Charcoal and earth from pt. 132, 13.75 m to 14 m, on virgin soil in West Baal Temple sounding. Coll. 1956.

P-459. Pre-pottery Neolithic, 13 m
8142 ± 100
6192 B.C.

P-458. Neolithic, 11.15 m
7686 ± 112
5736 B.C.

P-457. Neolithic, 9 m
7184 ± 84
5234 B.C.

P-389. Early Ubaid Period, 4 m
6134 ± 173
4184 B.C.
Charcoal and gravel from pt. 175, 4 m, from burned material at bottom of Ubaid level, overlying Tell Halaf level. Coll. 1954.

P-462. Late Bronze Age 3, Little Palace
3140 ± 151
1190 B.C.
Charcoal and clay from Dromos Tomb I in the Little Palace, Late Bronze Age 3. Coll. 1958. Comment: NaOH pretreatment.

P-384. Late Bronze Age, Royal Palace, No. 1
3079 ± 64
1129 B.C.
Charcoal from burned wooden beam from wall of Royal Palace, Late Bronze Age. Coll. 1954.

P-461. Late Bronze Age, Royal Palace, No. 51
2991 ± 53
1041 B.C.
Charcoal from burned wooden beam from main wall of Royal Palace, Late Bronze Age. Coll. 1951.

B. Jordan

Tell es-Sultan series, Jericho, Jordan

These samples represent a succession of pre-pottery Neolithic levels at Tell es-Sultan, Jericho (31° 53' N Lat, 35° 27' E Long), Jordan. The sites here represented (D, E, and F) were excavated by the British School of Archaeol. at Jerusalem under K. M. Kenyon, Director. The phases indicated are building sequences within the sites, those of Site D have been correlated.
with Site F, while those of E have not. Coll. and subm. by Kenyon (1954 a, b, 1955, 1956 a, b, 1957 a, b, 1959; Zeuner, 1954).

P-379.  Pre-Pottery Neolithic A, Site D  9655 ± 84 7705 B.C.
      Charcoal from phase YY-XX succeeding Stage VI of pre-pottery Neolithic A defenses of Site D-I. Coll. 1958. Comment: half of the sample (P-379) received standard HCl pretreatment, while the other half (P-379A) received additional NaOH pretreatment; difference in ages was not significant, and the average of four counting runs is quoted here. Compare with British Museum date for material from same phase of Site D: BM-106, 10,300 ± 200; and from phase BB-CC, final destruction of pre-pottery Neolithic A defenses: BM-110, 10,180 ± 200 (British Museum IV).

P-380.  First Pre-Pottery Neolithic B, Site D  8610 ± 75 6660 B.C.
      Charcoal and ash from first pre-pottery Neolithic B level, Phase EEii, of Site D-I. Coll. 1956.

P-376.  Mesolithic, Site E  11,166 ± 107 9216 B.C.
      Charcoal and ash and/or gravel from Mesolithic level, Phase YY, of Site E-I, II, V. Coll. 1958. Comment: NaOH pretreatment.

P-377.  First Pre-Pottery Neolithic A, Site E  9582 ± 89 7632 B.C.
      Charcoal and ash and/or gravel from first pre-pottery Neolithic A level, Phase RR, of Site E-I, II, V. Coll. 1958.

P-381.  Early Pre-Pottery Neolithic B, Site E  8658 ± 101 6708 B.C.

P-382.  Mid-Pre-Pottery Neolithic B, Site E  8956 ± 103 7006 B.C.
      Charcoal and ash from mid-pre-pottery Neolithic B level, Phase KKii of Site E-I, II, IV. Coll. 1954. Comment: NaOH pretreatment. Note that, although stratigraphically later than P-381, P-382 yielded a date significantly earlier (298 ± 144 yr = 2.1 sigma). Compare British Museum date for material from same phase of Site E as P-382: BM-115, 9170 ± 200 (British Museum IV).

P-378.  Pre-Pottery Neolithic A, Site F  9775 ± 110 7825 B.C.
      Charcoal from phase SSii succeeding construction on pre-pottery Neolithic A defenses of Site F-I. Coll. 1958. Comment: compare with British Museum date for material from same phase of Site F-I: BM-105, 10,250 ± 200 (British Museum IV).

C.  Iraq

Grai Resh series, Iraq

Grai Resh (36° 25' N Lat, 42° 10' E Long), is a N Uruk site, comparable to Gawra XIA-VIIIIB, on the S slope of the Sinjar Mts. in NW Iraq. The road
from Tell Afar to Balad Sinjar cuts through the mound site, exposing a dark stratum underlying ashy strata.

**P-469. Grai Resh, South Face**  
5169 ± 64  
3219 B.C.

Charcoal and ash from exposed S face of road cut. Sample was taken from ends of 20 cm band of dark material 2.5 m below surface. Comment: exposed 3 cm of surface material was removed before sampling. Quantities of unidentified larvae were removed from the soil at time of sampling.

**P-468. Grai Resh, North Face**  
4939 ± 75  
2989 B.C.

Charcoal and ash from exposed N face of road cut. Sample was taken from midpoint of 20 cm band of dark material, under maximum height of the mound, 3.2 m below surface. Comment: large quantities of fine roots noted in the sample, all visible ones removed before pretreatment.

**Nimrud series, Iraq**

Nimrud (36° 20' N Lat, 43° 10' E Long), also known as Calah, lies S of Mosul on the E bank of the Tigris River in Iraq. The city was founded as the capital of Assyria under Assur-nasir-pal II (reigning from 883 to 859 B.C.), and was neglected after 727 B.C. Nothing is known of Nimrud after the fall of neighboring Ninevah in 612 B.C. Coll. 1952 by H. Helbaek; subm. by F. R. Matson.

**P-464. Southeast Building, Room IV**  
2690 ± 62  
740 B.C.

Charcoal from charred beam in Room IV of the Southeast Building, destroyed by heavy fire. Comment (F.R.M.): NaOH pretreatment. Surface material was scraped from the charred beams of P-463 and P-464 before sampling in an effort to avoid surface contamination, but may have introduced post-sample growth error.

**P-463. Southeast Building, Room II**  
2643 ± 63  
693 B.C.

Charcoal from charred beam in Room II of the Southeast Building, destroyed by heavy fire. Comment: NaOH pretreatment.

**P-530. Nippur, Uruk Protoliterate “b”**  
4672 ± 74  
2722 B.C.


**D. Iran**

**Hasanlu Tepe series, Iran**

Hasanlu (37° N Lat, 45° 28' E Long), is located near the town of Nagadeh in Azerbaijan province of Iran, about halfway between Nagadeh and the S shore of Lake Urmia, just S of the small freshwater lake known as Hasanligut or Shor Gol. Coll. and subm. by R. H. Dyson, Jr., director of the Joint Expedition of the Univ. Mus., Univ. of Pennsylvania, the Metropolitan Mus. of
Robert Stuckenrath, Jr.

Art of New York City, and the Archaeol. Service of Iran. Four cultural phases, all overlying the Painted Orange Ware Phase (Period VII) of carinated bowls and plain grit-tempered pottery, are represented by the samples from the Citadel Mound listed below. The Button Base Phase (Period V) is characterized by small gray-ware cups with loop handles and disc bases, and by disc-based simple painted buff-ware vases; the material is known elsewhere in the late second millennium B.C. The more recent Gray Ware Phase (Period IV), represented by spouted pitchers, was ended by the sacking of the site, an event perhaps fitting historically with a known Urartian campaign in the area at the end of the 9th century B.C. The following Triangle Ware Phase (Period III) is thought to date to the end of the Median period, late 7th century, B.C. The beginning of the uppermost phase represented by these samples is the Post-Triangle Ware Phase (Dyson, 1958, 1959, 1960a, b, 1962; Pennsylvania III).

Button Base Phase (Period V)

P-418. Operation XVI, B

Charred wood from Operation XVI, Stratum 5, Area 1, under wall A, Sample B. Coll. 1959. Comment: half of the sample (P-418A) received standard HCl pretreatment, while the other half (P-418B) received additional NaOH pretreatment; difference in ages was not significant, and the average of four counting runs is quoted here. Estimated date: 1200 to 1000 B.C.

P-419. Operation XVI, A

Charred wood from Operation XVI, Stratum 5, Area 1, under Wall A. Sample A. Coll. 1959. Comment: half of sample (P-419A) received standard HCl pretreatment, while other half (P-419B) received additional NaOH pretreatment; difference in ages was not significant, and the average of five counting runs is quoted here. Estimated date: 1200 to 1000 B.C.

General comment on Button Base-Phase samples: compare with other samples from the Button Base at Hasanlu: P-185, 3000 ± 120, and P-198, 3083 ± 122 (Pennsylvania III). P-198 is from a grave which belongs typologically to the succeeding Gray Ware Phase, but is one of the earlier burials of that phase and may mark a tentative division between the two phases.

Gray Ware Phase (Period IV)

P-421. Operation XLI, Burned Building II

Charred wood from large beam lying on the floor of NW storage room, Burned Building II, Operation XLI, Stratum 3, Area 3. Coll. 1959. Comment: half of sample (P-421A, 2550 ± 62) received standard HCl pretreatment, while the other half (P-421B, 2913 ± 56) received additional NaOH pretreatment; the difference in ages (363 ± 83 yr = 4.4 sigma) was significant, and the age of P-421B is quoted here.

P-423. Operation XLIV, Burned Building I

Charred wood, beam fragments from door in E wall of main room in E
wing of Burned Building I, Operation XLIV, Stratum 3, Area 8. Coll. 1959. *Comment:* half of the sample (P-423A) received standard HCl pretreatment, while the other half (P-423B) received additional NaOH pretreatment; difference in ages was not significant, and the average of four counting runs is quoted here.

**P-425. Operation XXV, Burned Building I**  
2872 ± 62  
922 b.c.

Large lumps of charcoal, fragments of structural timber found in debris of Burned Building I, Operation XXV, Stratum 2, Area 3. Coll. 1958. *Comment:* half of sample (P-425A, 2719 ± 54) received standard HCl pretreatment, while other half (P-425B, 2872 ± 62) received additional NaOH pretreatment; difference in ages (153 ± 82 yr = 1.9 sigma) was significant, and the age of P-425B is quoted here.

**P-323. Operation XXII, Burned Building I**  
2858 ± 45  
908 b.c.

Large lumps of charcoal from burned post in E column of S wall of main columned hall of wall of main columned hall of Burned Building I, Operation XXII, Stratum 3, Area 2. Coll. 1958. *Comment:* half of sample (P-323A) received standard HCl pretreatment, while the other half (P-323B) received additional NaOH pretreatment; the difference in ages was not significant, and the average of six counting runs is quoted here.

**P-440. Operation XL, Burned Building II**  
2864 ± 64  
914 b.c.


**P-322. Operation IX-G, Burned Level Under Tower 4**  
2857 ± 54  
907 b.c.

Charcoal and gravel from Oper. IX-G, Stratum 4, running under Triangle Ware Phase reconstruction of main citadel fortification at NW corner of Tower 4. Coll. 1958. *Comment:* half of sample (P-322A, 2708 ± 58) received standard HCl pretreatment, while the other half (P-322B, 2857 ± 54) received additional NaOH pretreatment; the difference in ages (149 ± 79 yr = 1.9 sigma) was significant, and the age of P-322B is quoted here.

**P-437. Operation XXXVII, Burned Building II**  
2841 ± 63  
891 b.c.

Large pieces of charcoal from the hall of Burned Building II, Operation XXXVII, Stratum 5, Area 5. Coll. 1960. *Comment:* half of sample (P-437A) received standard HCl pretreatment, while the other half (P-437B) received additional NaOH pretreatment; difference in ages was not significant, and the average of two counting runs is quoted here.

**P-424. Operation XXIV, Burned Building I**  
2816 ± 55  
866 b.c.

Charcoal fragments from structural timber found in debris of Burned Building I, Operation XXIV, Stratum 3, Area 1. Coll. 1958. *Comment:* half of
sample (P-424A) received standard HCl pretreatment; while other half (P-424B) received additional NaOH treatment; difference in ages was not significant, and average of three counting runs is quoted here.

**P-439. Operation XXV, Burned Building I, Area 1**


**P-577. Operation R-24, Burned Building III**


**P-250. Operation XXV, Burned Building I, Area 2**

Charred wood from roof beam found in debris of Burned Building I, Operation XXV, Stratum 3, Area 2. Coll. 1958.

**P-576. Operation R-23, Burned Building III**


*General comment on Gray Ware-Phase samples*: of the samples listed above, P-576 and P-577 are representative of the final occupation of this phase—wheat and grapes harvested shortly before the sacking of the site. The other samples listed are from structural timbers representative of the construction of the phase. Therefore, the complete listing of the ages of all these samples does not prove to be statistically consistent, but samples representing the construction of the phase are consistent, as are the samples representative of the final occupation:

<table>
<thead>
<tr>
<th>Construction samples</th>
<th>2865 ± 20</th>
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<tbody>
<tr>
<td>(NaOH pretreatment; P-322, 323, 421, 424, 425, 437, 440)</td>
<td>2865 ± 20</td>
</tr>
<tr>
<td>Final occupation</td>
<td>2730 ± 49</td>
</tr>
<tr>
<td>(NaOH pretreatment; P-576, 577)</td>
<td>2730 ± 49</td>
</tr>
<tr>
<td>Difference</td>
<td>135 ± 53</td>
</tr>
<tr>
<td>(= 2.5σ)</td>
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The difference is clearly significant and would indicate, first, that the samples bracket the Gray Ware Phase and second, that the phase was short-lived. Compare with other samples from the Gray Ware Phase at Hasanlu: P-198, 3083 ± 122; P-186, 2881 ± 119; P-111, 2770 ± 130; and P-187, 2765 ± 117 (Pennsylvania III).

**Triangle Ware Phase (Period III)**

**P-399. Operation XXX-A, Wall D Pavement**

Large lumps of charcoal and fine ash from burned material overlying
pavement associated with Wall D, West Gate area. Coll. 1960. Comment: half of sample (P-399A, 2390 ± 62) received standard HCl pretreatment, while other half (P-399C, 2521 ± 54) received additional NaOH pretreatment; difference in ages was significant (131 ± 82 yr = 1.6 sigma), and age of P-399C is quoted here.

**P-398. Operation XXXIV, Grain Storage Pit**  

2473 ± 54  
523 B.C.

Charred wheat from a grain storage pit dug into the Gray Ware-Phase ruins of Burned Building II, Operation XXXIV, Stratum 5a, Area 2. Coll. 1960. Comment: half of sample (P-398A) received standard HCl pretreatment, while other half (P-398B) received additional NaOH pretreatment; difference in ages was not significant, and the average of three counting runs is quoted here.

**P-420. Operation VII, North Trench**  

2347 ± 54  
397 B.C.

Grain from Operation VII, Stratum 3, North Trench, over pavement of Triangle Ware Phase. Coll. 1959. Comment: half of sample (P-420A) received standard HCl pretreatment, while other half (P-420B) received additional NaOH pretreatment, difference in ages was not significant, and the average of three counting runs is quoted here. Probably late Triangle Ware Phase IIIA.

**Post-Triangle Ware Phase (Period II)**

**P-582. Operation AA-31**  

2294 ± 60  
344 B.C.

Charcoal from a pit in surface upon which Period II structure is built, Operation AA-31, Stratum 2. Coll. 1962. Comment: NaOH pretreatment. Might represent end of late Triangle Ware Phase IIIA.

**Pisdeli Tepe series, Iran**

Pisdeli Tepe (37° N Lat, 45° 29' E Long), is a small mound lying NE of Hasanlu Tepe in the Solduz Valley, along the S shore of Lake Urmia in Azerbaijran province, Iran. This site, excavated by the Univ. Mus., Univ. of Pennsylvania, in 1958 and 1961, has yielded plain straw-tempered pottery, painted pottery, obsidian blades, bone awls, clay spindle whorls, and an animal figurine, all indicative of a NW Iran variant of the Ubaid of N Iraq. Coll. and subm. by T. C. Young, Jr., Univ. Mus., Univ. of Pennsylvania (Dyson and Young, 1960).

**P-505. Operation II, Stratum 10**  

5638 ± 85  
3688 B.C.


**P-504. Operation II, Stratum 5**  

5518 ± 81  
3568 B.C.

Ashy soil from Operation II, Stratum 5, E balk. Comment: NaOH pretreatment.
P-503. Dalma Tepe, Iran

Ashy soil from Operation IV, Stratum 4A, of Dalma Tepe (37° N Lat, 45° 29’ E Long), SW of Hasanlu Tepe in the Solduz Valley, near S shore of Lake Urmia in Azerbaijan province, Iran. The site yielded a ceramic equivalent in date, but typologically distinct from Halaf wares, falling stratigraphically between Hajji Firuz and Pisdeli ware. Stratum is a small lens of ashy soil immediately above Hearth No. 1. Coll. 1961 and subm. by T. C. Young, Jr. (Young, 1962). Comment: NaOH pretreatment.

Hajji Firuz series, Iran


P-455. Stratum D-15

Charcoal mixed with clay and ash from Stratum D-15, the basal stratum of the lower sounding. Coll. 1958. Comment: NaOH pretreatment. Materials associated with this level were tentatively labeled as Neolithic; pottery finds are stratigraphically earlier than Dalma ware in the area.

P-502. Operation V

Fine ash and clay from Operation V, Stratum 4, NW corner in upper part of a 3 m deep cut (which did not reach virgin soil). Coll. 1961. Comment: NaOH pretreatment. Small rootlets noted throughout the stratum, all visible ones removed.

General comment on Hajji Firuz series: these dates support the stratigraphic field evidence that the stratigraphically lower Hajji Firuz-ware levels predate Dalma ware- and Pisdeli-ware levels, as dated by this laboratory: Dalma Tepe, P-503, 5986 ± 87 (this date list); Pisdeli Tepe, P-157, 5460 ± 160 (Pennsylvania III); P-504, 5518 ± 81; and P-505, 5638 ± 85 (this date list).

P-438. Tal-i-Bakun B, Iran

Fine charcoal and dirt from 3 m below surface of newly-cut Japanese trench at Tal-i-Bakun (30° N Lat, 52° 50’ E Long), on the Marv Dasht Plain near Fars, SW of Persepolis, Iran. Associated with handmade straw-tempered pottery of Tal-i-Bakun B type. A prehistoric site, its materials are among the earliest excavated materials of southern Iran. Coll. 1958 and subm. by R. H. Dyson, Jr.

Yarim Tepe series, Iran

Yarim Tepe (37° 15’ N Lat, 55° 11’ E Long), lies on the N bank of the Kara Su River, 9 km S of Gunbad-i-Qabus in NE Iran. The site presents a series of strata estimated to run from Late Iron Age to Early Chalcolithic.
University of Pennsylvania Radiocarbon Dates VI

Coll. 1960 and subm. by D. B. Stronach, British Inst. for Persian Studies, Teheran, Iran.

P-509. Early Chalcolithic 3917 ± 156
1967 B.C.

Charcoal from Trench Y, Level 7A, one of the earliest Chalcolithic levels, just above virgin soil. Comment: estimated date: 4000 B.C.; in light of results for P-508, collector is sure that P-509 must have been contaminated.

P-508. Late Bronze Age 3996 ± 242
2046 B.C.

Charcoal and ash from Trench Z, Level 4, one of the latest Bronze Age levels. Comment: estimated date: 2nd millennium B.C.

P-507. Early Iron Age 2850 ± 59
900 B.C.

Charcoal and ash from Trench D, Level 13, one of the earliest Iron Age levels. Comment: NaOH pretreatment. Estimated date: 1200 to 800 B.C.

P-506. Late Iron Age 1773 ± 62
A.D. 177

Charcoal from Trench A, Pit 1, one of the latest Iron Age levels. Comment: NaOH pretreatment.

P-442. Tepe Siahbid, Iran 5815 ± 83
3865 B.C.

Charcoal and large amounts of clay from Tepe Siahbid (34° 30' N Lat, 47° 15' E Long), 10 km ENE of Kermanshah, Iran. This is a small painted-pottery site comparable in time to Susa b-c or the Early Ubaid of S Iraq. Sample is from Operation I, Level I, 1.05 m deep, a well-marked occupation level containing fragmentary evidence of structures. Coll. 1960 and subm. by F. R. Matson, Pennsylvania State Univ. (Braidwood, Howe and Reed, 1961). Comment: age of this sample was originally estimated at 8000 to 9000 B.P. Organic carbon analysis of the sample, which consisted mostly of clay, indicated 2.77% carbon, while analysis of clay of the same area showed 0.71% carbon.

Tepe Sarab series, Iran

Tepe Sarab (34° 30' N Lat, 47° 15' E Long), lies 7 km ENE of Kermanshah, Iran. A prehistoric site with semi-pit structures, roughly comparable to Jarmo, it represents the earliest village-like occupation of NW Iran. Coll. 1960 and subm. by F. R. Matson (Braidwood, Howe and Reed, 1961).

P-466. South strip, Level 5 7956 ± 98
6006 B.C.

Charcoal from black hearth material found in concave layers interstratified with ash and dirt, from Operation I, S strip, Level 5. *Helix salomonica* shells (local land snail) and unidentified animal bones were found with the sample.
P-465. South strip, Level 4 7605 ± 96 5655 B.C.

Charcoal from black hearth materials found in concave layers interstratified with ash and dirt, from Operation I, Level 4 of S strip. *Helix salomonica* shells (local land snail) and unidentified animal bones were found with the sample.

P-467. Central strip, Level I 7644 ± 89 5694 B.C.

Charcoal from black hearth material found under good floor of Level 1, Operation L, central strip. *Helix salomonica* shells and unidentified animal bones were found with the sample.

E. India

P-481. Kalibangan, India 3879 ± 72 1929 B.C.

Charcoal and dirt from Kalibangan (28° N Lat, 72° 30' E Long), in Bikaner State of Rajasthan, India. The site consists of two mounds whose surface remains indicate that the site is of Harappan context, but excavations reveal Kot Dijian-like materials as well. Sample is from the mound, KLB-2, Layer 3, 1 m deep. Coll. 1961 by B. B. Lal; subm. by W. A. Fairservis, Jr., Am. Mus. Nat. Hist., New York. Comment: NaOH pretreatment.

Chandoli series, India

Chandoli (19° N Lat, 74° E Long), is located 34 mi NNE of Poona, Maharashtra State, India. This is a Chalcolithic site having ceramic links with the sites of Madhya Pradesh and the Deccan of central India. Coll. 1961 and subm. by H. D. Sankalia and S. B. Deo, Deccan College Postgraduate and Research Inst., Poona 6.

P-473. Chandoli No. 216 3184 ± 68 1234 B.C.

Charcoal from Trench 7, Layer 2, 2 ft 9 in. below surface. Comment: NaOH pretreatment.

P-472. Chandoli No. 190 3157 ± 68 1207 B.C.

Charcoal from Trench 8, Layer 2, 2 ft 11 in. below surface. Comment: NaOH pretreatment.

P-474. Chandoli No. 188 3099 ± 185 2149 B.C.

Charcoal from Trench 9, Layer 2, 2 ft 6 in. below surface. Comment: NaOH pretreatment.

Navdatoli series, India

Navdatoli (22° 11' N Lat, 75° 36' E Long), is on the S bank of the Narmada River, opposite Maheshwar, in the Nimar district, Madhya Pradesh, India. Coll. 1959 by Deccan College Postgraduate and Research Inst., and the M. S. Univ. of Baroda, Baroda; subm. by H. D. Sankalia. The site is described by Ghosh (1958), Sankalia, Subbarao, and Deo (1958), and Sankalia (1958).
P-475. Navdatoli 3570
Charcoal from the earliest floor, 6 ft 8 in. below surface, near “S” section. 
Comment: NaOH pretreatment.

P-476. Navdatoli 82
Charcoal from remains of burnt wooden post in red debris at NE corner, Trench I, A-17, Layer 7, 4 ft 2 in. below surface. Comment: NaOH pretreatment.

General comment on Navdatoli series: compare these dates with those obtained for other samples from the site: P-200, 3457 ± 127; P-201. 3492 ± 128; P-202, 3503 ± 128; P-204, 3449 ± 127; and P-205, 3294 ± 125 (Pennsylvania III).

Eran series, India
Eran (24° 5' N Lat, 78° 10' E Long), lies 45 mi WNW of Sagar in Madhya Pradesh, India. The pottery finds associated with these samples are similar to those excavated from the Chalcolithic phase at Navdatoli-Maheshwar in central India. Coll. 1962; subm. by K. D. Bajpai, Director of Eran Excavations, Univ. of Saugar.

P-529. Layer 4
Charcoal and clay from Layer 4, 12 ft 2 in. to 12 ft 4 in. below surface. Comment: NaOH pretreatment.

P-525. Layer 15
Charcoal and clay from Layer 15, 17 ft 2 in. below surface, representing Period II, the second level of occupation succeeding the earliest occupation. Comment: NaOH pretreatment.

P-526. Layer 18-C
Charcoal and clay from Layer 18-C, 19 ft 9 in. to 20 ft 7 in. below surface. Comment: NaOH pretreatment.

P-527. Layer 19
Charcoal and clay from Layer 19, 22 ft 3 in. to 22 ft 7 in. below surface. Comment: NaOH pretreatment.

P-528. Layer 20
Charcoal and clay from Layer 20, 24 ft to 24 ft 8 in. below surface. Comment: NaOH pretreatment. Sample was very damp; mold growing on one portion was removed before pretreatment.

F. West Pakistan

P-524. Kile Gul Mohammad, Baluchistan
Charcoal from Kile Gul Mohammed (30° N Lat, 69° E Long), Quetta-
Robert Stuckenrath, Jr.

Pishin district, former province of Baluchistan, West Pakistan. Sample was taken from floor of room located between walls VII and VIII, in Phase 23, Sec. I, Q-24. Phase 23 is in KGM-I context, a preceramic horizon at this site. Coll. 1950 and subm. by W. A. Fairservis, Jr. (Fairservis, 1956). Comment: NaOH pretreatment.

**P-478. Niai Buthi, Baluchistan**

3740 ± 64
1790 B.C.

Charcoal and dirt from Niai Buthi (26° 10’ N Lat, 66° 15’ E Long), in the Las Bela district, Welpat tahsil, former province of Baluchistan, West Pakistan. The sample, apparently a hearth remnant, was found in association with Kulli pottery on the S portion of W face of the site. Coll. 1960 and subm. by Fairservis. Comment: NaOH pretreatment.

**Damb Sadaat series, Baluchistan**

Damb Sadaat (28° 15’ N Lat, 68° 50’ E Long), is located in the Quetta-Pishin district, former province of Baluchistan, West Pakistan. Coll. 1950 and subm. by Fairservis (Fairservis, 1956).

**P-522. Damb Sadaat II, Phase 7**

4378 ± 196
2428 B.C.

Charcoal and ash from Phase 7, Sec. II, Cut G-T, Q-8, in Damb Sadaat II context. Comment: NaOH pretreatment.

**P-523. Damb Sadaat II, Room A**

4029 ± 74
2079 B.C.

Charcoal from hearth in Room A, Q-8, in Damb Sadaat II context. Comment: NaOH pretreatment.

**EUROPE**

**A. Switzerland**

**P-456. Grave LXII, Schiers, Switzerland**

1583 ± 58 A.D. 367

Wood from Grave LXIV, one of more than 70 found near an early Christian church at Schiers (Grisons) (46° 58’ N Lat, 9° 41’ E Long), Switzerland. The burials were covered by 3 ft of rock debris from mountain slides. Objects found in the graves have indicated an age range of 4th to 6th centuries A.D. Coll. 1960 by Hans Erb, Ratusches Mus.; subm. by H. H. Staub, Physikalisches Inst. der Univ. Zurich (Der Frei Ratier, 1960; Bern II). Comment: compare with other dates from this site: B-165, 1680 ± 100; B-166, 1430 ± 80; and B-168, 1640 ± 100 (Bern II).

**CENTRAL AMERICA**

**A. Mexico**

**P-409. Palenque, Excavation 69**

4175 ± 223
2225 B.C.

Charcoal and dirt from Palenque (17° 31’ N Lat, 91° 59’ W Long), a Maya site in the state of Chiapas, Mexico. Sample is from Excavation 69, Level 17—lower zone, 2.85 m to 4.20 m below surface, the lowest culture-
bearing deposit of the excavation. Coll. 1959 and subm. by R. L. Rands, Univ. of Mississippi, University, Miss. (Rands, 1961, in press; Ruz, 1958). Comment: compare with dates obtained for other samples from this site: 0-396, 1400 ± 100; 0-397, 1450 ± 100; 0-639, 1575 ± 105; and 0-641, 1550 ± 105 (Rands, written communication, 1961). These samples are representative of the Classic period at Palenque, while P-409 is material from the earliest culture-bearing deposit of the excavation.

SOUTH AMERICA

A. Bolivia

Kalasasaya series, Bolivia

Kalasasaya (16° 35' S Lat, 68° 40' W Long), is located near Tiwanaku, Ingavi province, Bolivia. The site was excavated 1957-58 by the Centro de Invest. Arqueologicas en Tiwanaku under direction of C. Ponce S.; subm. by Ponce (Ponce, in press; Pennsylvania III).

P-532. Epoch I
Charcoal and dirt from Pit E-17, 364 cm deep.

P-534. Epoch II
Charcoal and dirt from Pit I-12, 215 to 217 cm deep.

P-531. Epoch III
Charcoal and ash from S part of Pit G-15, Layer 3, consisting of pale reddish-brown clay, 85 to 100 cm deep.

P-533. Epoch IV
Charcoal from Pit F-8, over paved floor of house, 110 to 135 cm deep.

B. Brazil

Sambaqui do Macedo series, Brazil

Sambaqui do Macedo (30° S Lat, 50° W Long), is a shellmound site lying ca. 2.5 km S of the Bay of Paranagua and 520 m NE of Alexandra, in Municipio de Parangua, Parana, Brazil. The base of the mound lies on an ancient beach at least 1.6 m above the present shore line, and excavations in 1960 by the State Univ. of South Dakota and the Univ. of Parana reveal a mound height of 10.26 m at center. The samples are from charcoal remains of fires within the midden layers of the mound. The levels listed below are arbitrary, the oldest expected to date ca. 3000 B.P. If the dates are correlated with Fairbridge’s chart, the raised beach under the mound may have been deposited during the Younger Peron high (ca. 4000 to 3600 B.P.). Coll. by W. R. Hurt, State Univ. of South Dakota, Vermillion, S. D., and Oldemar Blasi, Univ. of Parana, Curitaba, Parana, Brazil; subm. by Hurt (Hurt, 1962; Hurt and Blasi, 1960).
<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Site Description</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-482</td>
<td>Sambaqui do Macedo, 0.75 m to 1.25 m</td>
<td>3306 ± 61 1356 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 0.75 m to 1.25 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
<tr>
<td>P-483</td>
<td>Sambaqui do Macedo, 1.25 m to 2.25 m</td>
<td>3344 ± 61 1394 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 1.25 m to 2.25 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
<tr>
<td>P-485</td>
<td>Sambaqui do Macedo, 2.25 m to 2.75 m</td>
<td>3271 ± 48 1321 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 2.25 m to 2.75 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
<tr>
<td>P-486</td>
<td>Sambaqui do Macedo, 2.75 m to 3.25 m</td>
<td>3373 ± 58 1423 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 2.75 m to 3.25 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
<tr>
<td>P-487</td>
<td>Sambaqui do Macedo, 3.25 m to 4.00 m</td>
<td>3284 ± 61 1334 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 3.25 m to 4.00 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
<tr>
<td>P-488</td>
<td>Sambaqui do Macedo, 4.00 m to 4.75 m</td>
<td>3361 ± 70 1411 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 4.00 m to 4.75 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
<tr>
<td>P-489</td>
<td>Sambaqui do Macedo, 4.75 m to 5.50 m</td>
<td>3424 ± 62 1474 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 4.75 m to 5.50 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
<tr>
<td>P-500</td>
<td>Sambaqui do Macedo, 5.50 m to 6.50 m</td>
<td>3496 ± 56 1546 B.C.</td>
</tr>
<tr>
<td></td>
<td>Fine charcoal and dirt from level 5.50 m to 6.50 m, quadrant A-B, 2-4.</td>
<td></td>
</tr>
</tbody>
</table>

**Lagoa Santa series, Brazil**

The samples listed here are from Rock Shelter No. 6 (19° 40' S Lat, 33° 10' W Long), Cerce Grande, Lagoa Santa region of Minas Gerais, Brazil. The site was excavated in 1956 by the State Univ. of South Dakota, Vermillion, S. D., and the Mus. Nac., Rio de Janeiro. Vertical distribution of the levels is 25 cm below surface for Level 2 to 2 m for Level 7. Subm. by W. R. Hurt (Hurt, 1960, 1962; Walter, no date).

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Levels</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-521</td>
<td>6 and 7</td>
<td>9720 ± 128 7770 B.C.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charcoal from Levels 6 and 7 (Squares TE-Q 1-2 and TE-Q 2-3), representing the earliest levels of human occupation at this site.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Levels</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-519</td>
<td>2 and 3</td>
<td>9028 ± 120 7078 B.C.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charcoal from Levels 2 and 3 (Square TA-Q 1-2).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*General comment on Lagoa Santa series*: materials were expected to produce dates roughly similar to those obtained for Lagoa Funda cave materials, per-
haps 3000 B.P. The above dates, therefore, cannot be considered definitive until further investigation.

**Sambaqui de Gomes series, Brazil**

Sambaqui de Gomes (25° 20’ S Lat, 84° 45’ W Long), is a shellmound site lying off the Bay of Antonina, 1000 m NE of the railroad station of Saquarema, Municipio of Morretes, Parana, Brazil. Samples are from occupational and hearth levels within the shellmound. Coll. 1962 by J. W. Rauth, Mus. de Arqueología, Paranagua, Parana, Brazil; subm. by W. R. Hurt (Hurt, 1962).

**P-540. Sambaqui de Gomes, 25 to 75 cm**

Charcoal, clay and powdered shell from level of recent occupation, 25 to 75 cm.

**P-541. Sambaqui de Gomes, 150 cm**

Charcoal, clay and powdered shell from 150 cm level.

**P-588. Manguerias site, Rio Japurá, Brazil**

Charcoal from the Manguerias village site (1° 50’ S Lat, 69° 10’ W Long), in the Terra Preta (black earth) region of the left side of Rio Japurá, a tributary of the Amazon River, 60 km E of the Colombian-Brazilian border. Sample is a combination of materials from the 60 to 75 cm levels of Cut I (60 m from bank of Rio Japurá) and Cut II (110 m from Rio Japurá) of the Japurá phase. Coll. 1959 and subm. by P. P. Hilbert, Mus. Paraense Emilio Goeldi, Inst. Nac. de Pesquisas da Amazonia, Belem do Para, Brazil.

**C. Peru**

**Peruvian coastal series, Peru**

The samples presented in this series represent ceramically-linked sites of the Ica and Nasca Valleys of the Peruvian coast. Coll. 1958 and subm. by D. T. Wallace, Univ. of Oregon, Eugene, Oregon.

**Ica Valley samples:**

**P-515. Cerro Max Uhle, Nasca 3 phase**

Cotton stock and carbonized cloth from Tomb P of Cerro Max Uhle (14° 05’ S Lat, 75° 39’ W Long), in the Ocucaje Basin of the lower Ica Valley, Peru. The material was found with vessels of Nasca 3 phase, representing the height of “Monumental” or “A” style of Nasca ceramic tradition (Strong, 1957). *Comment: expected to date ca. A.D. 250, less than 150 yr earlier than P-513 below, and approximately the same age as Nasca A materials previously dated: C-460, 1314 ± 250 (Chicago I); and L-268H, 1630 ± 80 (Lamont III).*

**P-512. Callango-Uyujaya, Epigonal phase**

Cotton cloth from the interior of a mummy bundle from an unnamed site (14° 04’ S Lat, 75° 39’ W Long), on the slopes of the lower Ica Valley be-
tween Callango and Uyujaya, Peru. The mummy bundle was one of several found in a cache, and identified by bundle-form and associated textiles and ceramics as Epigonal, the closing phase of the Middle Horizon. This period marks the end of Wari stylistic predominance, and the reformation of essentially local styles (Strong, 1957; Menzel, 1958). Comment: expected to date ca. A.D. 900, later than P-511, below.

Upper Ica Valley samples:
These samples are vegetal remains from habitation refuse excavated at the Cerrillos site on the slopes of the upper Ica Valley above the pueblo of Pampa de la Isla (13° 55′ S Lat, 75° 40′ W Long), Peru (Wallace, 1962).

P-516. Cerrillos, Early Cerrillos phase  
Vegetal remains from Cut 2, Pit C, Level 3, the basal level at this site, containing materials of the Cerrillos phase and underlying the Isla phase. The Cerrillos phase is representative of the earliest known phase of the Paracas style in a period of intensive Chavin stylistic influence from the north. Comment: expected to date ca. 500 B.C.  

P-518. Cerrillos, Early Isla phase  
Vegetal material from Cut 5, Pit B, Level 7a, associated with first major construction phase of Isla phase. Materials at this level represent the beginning of a series of major construction phases marking the second major occupation period of the site, and constitute the Early Isla phase, an early stage in the local development of the Paracas style. Comment: NaOH pretreatment. Material expected to date ca. 300 B.C., perhaps 100 to 300 yr later than P-516, 50 to 100 yr earlier than P-517, and at least 200 yr earlier than Late Paracas materials dated as: W-422, 2080 ± 160 USGS IV); L-268A, 1910 ± 80 (Lamont III); L-335C, 1840 ± 100 and L-335D, 1940 ± 100 (Lamont IV).

P-517. Cerrillos, Late Isla phase  
Vegetal remains from Cut 4, Pit A, Level 1, representing the third major construction phase of the Isla phase. Comment: NaOH pretreatment. Material was expected to date ca. 200 B.C., perhaps 50 to 100 yr later than P-518.

Nasca Valley samples:
These two samples are from the Lopez cemetery lying on the N side of Hacienda Cahuachi (14° 55′ S Lat, 74° 39′ W Long), ca. 15 km down river from the town of Nasca in the Nasca Valley, Peru (Strong, 1957; Menzel, 1958).

P-513. Hacienda Cahuachu, Nasca 4 phase  
Llama or alpaca wool from Tomb 3, associated with Nasca 4 ceramics, indicative of the first full development of the “Monumental” or “A” style of Nasca ceramics. Comment: expected to date ca. A.D. 350, approximately the same age as Nasca A style materials mentioned in P-515 comment, above.
P-511. Hacienda Cahuachi, Nasca 9 1345 ± 118 605 B.C.

Cotton cloth from a mummy bundle found in Tomb 2 with Nasca 9 phase ceramics which mark the end of the Nasca tradition and are coeval with full-scale penetration of the Wari-Pacheco influence from the highlands. Comment: expected to date ca. A.D. 800, in line with materials dated from Huaca del Lora: L-268E, 1100 ± 70; L-268F, 1170 ± 70; and L-268G, 1400 ± 80 (Lamont III); and L-335F, 1200 ± 90 (Lamont IV).

D. Miscellaneous

Potsherd series

The samples listed below are potsherds from the tropical forest areas of Brazil, Ecuador, and Venezuela. The potsherds were tempered with organic matter: powdered charcoal; cariapé, or ash derived from burning the siliceous bark of trees belonging to the genera Bignoniacea, Moquilea, Licania, and Turivia; or cauíxi obtained from burning a fresh-water sponge of the genus Parmula with siliceous spicules. The samples were dated in order to determine whether or not such materials were suitable for C\textsuperscript{14} dating, with the thought that, if so, there would be no question of the association of the dated materials with the potsherds. This laboratory had previously dated two samples (P-160, of charcoal and charred tubers, and P-162, of charred nuts or seeds, Pennsylvania III) from the tropical forests of Venezuela, and it was thought that they might serve as controls for the dating of associated organic-tempered potsherds from the same excavation levels. In addition, a number of other potsherd samples were dated for which we have no true controls other than archaeological estimates. Subm. by Clifford Evans, U. S. Natl. Mus., Washington (Evans and Meggers, in press; Pennsylvania III).

Venezuelan sample group

P-261. Nericagua culture, 1.0 to 1.2 m 1263 ± 54 A.D. 687

Potsherds tempered with cariapé from Sitio Martinez (4° 05' N Lat, 67° 50' W Long), Rio Orinoco, Territory of Amazonas, Venezuela. Samples are from Mound 2, Cut 1, 1.0 to 1.2 m. Coll. 1957 by C. Evans, B. J. Meggers, and J. M. Cruxent (Evans, Meggers, and Cruxent, 1960). Comment: carbon content of the sample was ca. 0.6%. Compare with P-162, 619 ± 103 (Pennsylvania III), composed of charcoal and charred tubers, from same cut and level of Mound 2, associated with these potsherds, and expected to be of approximately the same age. Difference in ages was significant: 644 ± 115 = 5.6 sigma.

P-262. Nericagua culture, 20 cm to 40 cm 1032 ± 54 A.D. 918

Potsherds tempered with cariapé from Sitio Martinez, Cut 4, 20 cm to 40 cm. Comment: carbon content of sample was ca. 1.0%. Compare with P-160, 1189 ± 93 (Pennsylvania III), composed of charred nuts or seeds, from same cut and level, associated with these potsherds, and expected to be of
approximately the same age. Difference in ages was little more than significant, 1.39 sigma.

Brazilian sample group

P-373. Coari site, 0 to 15 cm  
A.D. 1150

Potsherds tempered with cariapé from the Coari site (4° 06' S Lat, 63° 08' W Long), at the mouth of the Coari River, a tributary of the Amazon River, state of Amazonas, Brazil. Sample is from Cut 1, Level 0 to 15 cm. Coll. 1958 by P. P. Hilbert (Meggers and Evans, 1961). Comment: carbon content of the sample was ca. 1.8%. The archaeological excavations show two distinct occupations at this site. On the basis of ceramic affiliations, the second occupation (polychrome horizon of a Napo-like culture) was one stage of a downriver movement from sub-Andean areas toward an area known to have an established culture from A.D. 1200 to 1400. This date agrees with the archaeological estimate for the second occupation—slightly before A.D. 1200.

P-370. Coari site, Level 15 to 30 cm  
A.D. 763

Potsherds tempered with cauixi from Cut 2, Level 15 to 30 cm. Comment: carbon content of this sample was ca. 1.2%. This date roughly matches the archaeological estimate of A.D. 100 to 800 for the first occupation (Incised Rim horizon style) for this site (see P-373 comment), although earlier than expected.

P-372. Itacoatiara site  
A.D. 86

Potsherds tempered with cauixi from Itacoatiara site (3° 06' S Lat, 58° 22' W Long), on the Amazon River, state of Amazonas, Brazil. Coll. 1957 by P. P. Hilbert. Comment: carbon content of the sample was ca. 0.3%. Pottery from this level belongs to the Late Incised and Punctate horizon, estimated to appear after A.D. 1000.

P-406. Manacapuru site  
A.D. 425

Potsherds tempered with cauixi from Manacapuru site (3° 18' S Lat, 60° 37' W Long), on N bank of the Amazon River, upriver from Manaus, state of Amazonas, Brazil. Sample is from Level 0 to 15 cm. Comment: carbon content of sample was ca. 0.6%. This sample falls in the same archaeological context (Incised Rim horizon) as does P-370, above.

Ecuador sample group

These samples were collected at Nueva Armenia (0° 53' S Lat, 75° 28' W Long), on the Rio Napo, Napo-Pastaza province, Ecuador. Coll. 1958 by C. Evans and B. J. Meggers (Meggers and Evans, 1958).

P-269. Nueva Armenia, Cut 1  
A.D. 1179

Potsherds tempered with charcoal fragments from Cut 1, Level 0 to 15 cm. Comment: carbon content of the sample was ca. 1.4%. Ceramic affiliations of this site resemble the earliest ceramic horizon of Marajoara pottery on
Marajo Island downriver from this site. This site is estimated to be one stage of the downriver movement from sub-Andean areas toward Marjo Island which is known to have an established culture from A.D. 1000 to 1200. The date is in agreement with the archaeological estimate for the Napo culture—slightly before A.D. 1200.

**P-347. Nueva Armenia, Broadside B**

Potsherds tempered with charcoal fragments from Broadside Cut B. Comment: carbon content of the sample was ca. 0.8%. This date is in agreement with the archaeological estimate (see P-269 comment).

**General comment on potsherd series:**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Temper</th>
<th>% Carbon</th>
<th>Age in A.D. Years</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-261</td>
<td>cariapé</td>
<td>0.6</td>
<td>687 ± 54</td>
<td>P-162 from same level, A.D. 1339 ± 103</td>
</tr>
<tr>
<td>P-262</td>
<td>cariapé</td>
<td>1.0</td>
<td>918 ± 54</td>
<td>P-160 from same level, A.D. 769 ± 93</td>
</tr>
<tr>
<td>P-373</td>
<td>cariapé</td>
<td>1.8</td>
<td>1150 ± 47</td>
<td>Estimated A.D. 1200; agrees with P-269 and P-347 of related complex.</td>
</tr>
<tr>
<td>P-269</td>
<td>charcoal</td>
<td>1.4</td>
<td>1181 ± 51</td>
<td>Estimated A.D. 1200, agrees with P-373 and P-347, related in complex.</td>
</tr>
<tr>
<td>P-347</td>
<td>charcoal</td>
<td>0.8</td>
<td>1168 ± 53</td>
<td>Estimated A.D. 1200, agrees with P-269 and P-373, related in complex.</td>
</tr>
<tr>
<td>P-372</td>
<td>cauixi</td>
<td>0.3</td>
<td>86 ± 58</td>
<td>Estimated post-A.D. 1000.</td>
</tr>
<tr>
<td>P-370</td>
<td>cauixi</td>
<td>1.2</td>
<td>763 ± 48</td>
<td>Estimated A.D. 100 to 800.</td>
</tr>
<tr>
<td>P-406</td>
<td>cauixi</td>
<td>0.6</td>
<td>425 ± 58</td>
<td>Estimated A.D. 100 to 800.</td>
</tr>
</tbody>
</table>

The *cariapé*-tempered potsherds in this survey seem unreliable when compared with their charcoal counterparts. While P-262 barely agrees with P-160 within the errors quoted, P-261 yielded a date far earlier than its counterpart, P-162. It should be noted that the carbon contents of P-261 and P-262 were 1.0% or less, while that for the single *cariapé*-tempered sample in agreement with its archaeological estimate, P-373, was 1.8%.

The charcoal-tempered samples were generally in agreement with their respective archaeological estimate, with carbon contents of 0.8% or more.

The *cauixi*-tempered samples, with the exception of P-372, were in agreement with their archaeological estimates. The carbon content of P-372 was only 0.3%, while that of the other samples was 0.6% or more. In general,
then, it would seem that where the carbon content of the sample is great enough, 1.0% or more, organic-tempered potsherds may well be suitable for C$^{14}$ dating.

References

Date lists:
- Bern II
- British Museum IV
- Chicago I
- Lamont III
- Lamont IV
- Pennsylvania III
- USGS IV


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BRITISH MUSEUM
NATURAL RADIOCARBON MEASUREMENTS IV
HAROLD BARKER and JOHN MACKEY
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The following list comprises measurements made to the end of September 1961, when the equipment had to be dismantled for removal into new premises at 39 Russell Square, London W.C.1. The technique used is as described previously (Barker and Mackey, 1959) and as in previous lists, the error terms are not based solely on counting statistics but are widened to include contributions of ± 80 yr for possible isotopic fractionation effects and ± 100 yr for the de Vries-effect. NBS oxalic acid is used as the reference standard and ages are calculated on a half life of 5568 yr and expressed as years B.P. (before 1950 A.D.) and also in terms of the Christian calendar.

SAMPLE DESCRIPTIONS
ARCHAEOLOGIC SAMPLES

A. Barbados

BM-128. Greenland Estate 850 ± 150

Shell chisel (shell of Strombus gigas) found in ca. 2 ft of dark colored soil in association with pottery and other artifacts at the Greenland Estate, Barbados (13° 15' N Lat, 59° 34' W Long). Coll. 1960 by C. T. Trechmann; subm. by K. P. Oakley, British Mus. (Natural History). Comment: this is the first C14 date for archaeological material from this island.

B. Crete

Knossos series

BM-124. Knossos 1 8050 ± 180

Charcoal (sample no. 1) from the central court of the Minoan Palace, Knossos, Crete (35° 31' N Lat, 25° 10' E Long). The sample is part of the remains of a stake found in Pit F, Area AC, Level 27, of a sounding below the central court of the palace and is from the lowest level above bedrock (Evans, 1961). Coll. 1960 by J. D. Evans, Inst. of Archaeol., Univ. of London.

BM-126. Knossos 5 7000 ± 180

Charcoal from the same excavation as BM-124, Area A, Level 16A, near the top of the Early Neolithic levels. Coll. 1960 by J. D. Evans. Comment (J.D.E.): dates are considerably earlier than expected. No other C14 dates are available for the Cretan Neolithic or Late Chalcolithic of Anatolia, which it resembles in some way. C14 dates for the Early Chalcolithic of W Anatolia (Hacilar) lie between 5600 B.C. and 5220 B.C. (BM-48, British Museum I; and P-316, Pennsylvania V) and suggest that the Late Chalcolithic should have begun after 5000 B.C. On the other hand, the Knossos Early Neolithic is not identical with W Anatolian Late Chalcolithic. It lacks certain features of this
(white painted pottery, pattern burnish, nose bridge handles) and could represent a similar tradition at an earlier stage. The dates given by the samples are therefore not necessarily unacceptable.

C. Great Britain

BM-129. Arminghall, Norfolk

Oak charcoal from the base of Posthole 7, Henge Monument, Arminghall, Norfolk, England (52° 36' 19" N Lat, 1° 18' 30" E Long). The sample was from the center of an upright oak timber, diameter estimated as 3 ft, which may have been upward of 120 yr old when felled. Coll. 1935 by J. G. D. Clark, Cambridge Univ.; subm. by R. R. Clarke, Director, of Norwich Mus. via G.D.G. Sieveking., Dept. of British and Medieval Antiquities, British Mus. (Clark, 1936). Comment (G.D.G.S.): date seems satisfactory, though possibly slightly early. The chronological position of the culture concerned has not previously been satisfactorily demonstrated.

Barmston Lake series

Two samples of wood from an excavation at Barmston, Yorkshire, England (54° 00' 24" N Lat, 0° 12' 50" W Long). Both samples are parts of wooden stakes from an occupation pit dug into the center of a peat deposit sealed by hill wash and occupying the edge of a former glacial lake. Coll. 1960 by W. J. Varley; subm. by John Bartlett, Director of Hull Mus.

BM-122. Stake from Section A15

BM-123. Stake from Section A30

Comment: ages are as expected on archaeo logical grounds.

BM-113. Ebbsfleet 1

Part of a block of wood from the base of a peat monolith coll. by Donald Walker, Botany School, Cambridge, at the original Ebbsfleet site (Site 1), not more than 10 ft from the original excavations at Northfleet, Kent, England (51° 26' 16" N Lat, 0° 19' 38" E Long). Subm. by G. D. G. Sieveking, Dept. of British and Medieval Antiquities, British Mus. (Burchel and Piggott, 1939; Sieveking, 1960). Comment (G.D.G.S.): Burchel records pottery was recovered below the peat so that it could be slightly earlier than date established by this sample.

BM-133. Fifty Farm, Suffolk

Charcoal found in association with flint work, bone, hearth rubbish and type A long neck beakers at Fifty Farm, Suffolk, England (52° 21' 20" N Lat, 00° 25' 35" E Long). Coll. 1934 by C. S. Leaf; subm. by G. D. G. Sieveking (Leaf, 1935). Comment (G.D.G.S.): settlement site contains Necked Beaker pottery and is apparently closely dated, sealed beneath a later harrow of the same culture. Charcoal sample is from this settlement. Date is satisfactory. It
may be compared with similar dates provided for the Dutch Beaker sites by the Groningen Laboratory (e.g., Gro-381) van der Waals and Glasbergen, 1955.

**Grimes Graves series**

A group of five samples of antler from the Grimes Graves flint mines, near Thetford, England (52° 25' 39" N Lat, 00° 38' 41" E Long). Coll. 1937 and 1938 by A. L. Armstrong; subm. by G. D. G. Sieveking. Earlier measurements (BM-87 and BM-88, British Museum III) had shown good agreement in C¹⁴ ages between charcoal and antler from this site, indicating measurements on further antler samples would probably be worthwhile. Samples form part of infilling of various pits which were excavated for flints, and archaeological evidence indicates each pit was filled within a relatively short time, so that the depth of the find is unimportant.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Pit</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>BM-93.</td>
<td>Pit 10 (B)</td>
<td>3870 ± 150 1920 B.C.</td>
</tr>
<tr>
<td>BM-97.</td>
<td>Pit 12</td>
<td>4290 ± 150 2340 B.C.</td>
</tr>
<tr>
<td>BM-99.</td>
<td>Pit 14</td>
<td>3980 ± 150 2030 B.C.</td>
</tr>
<tr>
<td>BM-103.</td>
<td>Pit 11</td>
<td>3700 ± 150 1750 B.C.</td>
</tr>
<tr>
<td>BM-109.</td>
<td>Pit 8</td>
<td>3290 ± 150 1340 B.C.</td>
</tr>
</tbody>
</table>

**Comment (G.D.G.S.):** BM-93, 97, 99, 103, are internally consistent and show clearly that the flint mines were in use from 2200 to 1800 B.C. or thereabouts. This can be regarded as satisfactory from the point of view of the basic chronology. BM-109 is clearly outside the general dating pattern, though it is possible some flint mines could have been in use in Middle and Late Bronze Age times (see references to Armstrong’s “Black Hole” with pottery probably of Late Bronze Age, referred to by Armstrong [1926] as Halstatt).

**BM-130. Hembury, Dorset**

Charcoal from the bottom of the Neolithic ditch, cutting XA at Hembury, Honiton, Dorset, England (50° 49' 13" N Lat, 3° 15' 38" E Long). Excavated in 1931 by the late Mrs. Dorothy Liddell and now in the reserve collection of the Royal Albert Mus., Exeter (Liddell, 1931). Subm. by Lady Eileen Fox, Exeter Univ. **Comment:** compares well with Windmill Hill (BM-73, British Museum III) and the earliest Western Neolithic in Ireland (D-37, Dublin I).

**D. Jordan**

**Jericho series**

Samples from Tell es Sultan, Jericho, Jordan (31° 53' N Lat, 35° 27' E Long). Excavation sponsored by the British School of Archaeol, in Jerusalem under the directorship of K. M. Kenyon. Coll. and subm. 1960 by Miss Kenyon. Samples from this site were also subm. to the Univ. of Pennsylvania Laboratory (P-376 to P-382, Pennsylvania VI).
BM-105.  
10,250 ± 200  
8300 B.C.

Charcoal, ref. J. P. F. 301/12. FI, phase SSii. The phase succeeding the construction of the pre-pottery Neolithic A defenses (see P-378, 9775 ± 110, Pennsylvania VI).

BM-106.  
10,300 ± 200  
8350 B.C.

Charcoal, ref. J. P. D. 303/19. DI, phase YY-XX. The phase succeeding Stage VI of the pre-pottery Neolithic A defenses (see P-379, 9655 ± 84, Pennsylvania VI).

BM-110.  
10,180 ± 200  
8230 B.C.

Charcoal, ref. J. P. D. 401/28. DI, phase BB-CC. Final destruction of pre-pottery Neolithic A defenses. 9170 ± 200

BM-115.  
7220 B.C.

Charcoal, ref. J. P. E. 206.7g. Ei,II,V, phase KKii. Mid pre-pottery Neolithic B.

E. Malta

BM-100. Ta Hagr at  
4660 ± 150  
2710 B.C.

Charcoal from Level 4. Found sealed beneath a beaten earth floor at the prehistoric temple of Ta Hagr at, Mgarr village, Malta (35° 55' N Lat, 14° 22' E Long). Coll. 1954 and subm. by J. D. Evans (Evans, 1953, 1959). Comment (J.D.E.): compares well with dates for the Chassey culture of France which is probably contemporary, e.g., 4400 ± 500 B.P. (L-188A, Lamont III) for Chassey B level at La Madeleine cave. Also compares well with early Cortaillod of Switzerland.

BM-101. Tarxien  
4485 ± 150  
2535 B.C.

Charcoal from the remains of the cremation cementery, stratified above Neolithic (Period 1E) at prehistoric temple, Tarxien parish, Malta (35° 51' N Lat, 14° 31' E Long). Excavator’s reference Q-4. Coll. 1915 by Sir T. Zammit; subm. by J. D. Evans (Zammit, 1916, 1930). Comment (J.D.E.): the only other directly relevant C¹⁴ date is BM-100. There are three probably quite long archaeological phases between this and BM-101, yet the difference in age is slight. The expected date for this sample was ca. 15th century B.C., as evidenced by the presence of faience beads in the cemetery and Mycenaean pottery of 16th and 15th centuries B.C. in a level with similar pottery. The wood, of course, may have been already ancient when burnt (e.g., part of the fittings of an abandoned temple.

F. Turkey

Hacilar series

Two samples of charcoal from the prehistoric site at Hacilar village, 17 mi W of Burdur, SW Turkey (37° 35' N Lat, 30° 05' E Long). Coll. and subm. 1960 by James Mellaart. Excavation sponsored by the British Inst. of Archaeol. in Ankara.
BM-125.

Charcoal (ref. P. VII) part of the corner post of a room. From the Late Neolithic (Level VII).

BM-127.

This sample came from Area Q, where remains of an A ceramic mound yielded seven superimposed floors numbered from top to bottom Aceramic I-VII. The sample consisted of charcoal fragments from the courtyard floor of Level V and is probably throwout from a hearth (Mellaart, 1961). See also BM-48, British Museum II.

References

Date lists:

| British Museum I | Barker and Mackey, 1959 |
| British Museum II | Barker and Mackey, 1960 |
| British Museum III | Barker and Mackey, 1961 |
| Dublin I | McAulay and Watts, 1961 |
| Lamont III | Broecker, Kulp and Tucek, 1962 |
| Pennsylvania V | Ralph and Stuckenrath, Jr., 1962 |
| Pennsylvania VI | Stuckenrath, Jr., 1963 |


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GAKUSHUIN
NATURAL RADIOCARBON MEASUREMENTS II
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This date list covers many of the datings done from November 1961 to October 1962. Technique described in Gakushuin I (Gakushuin I) is virtually unchanged, using 900-m1 acetylene-filled proportional counter (Counter 1) with multiple-anode anti-coincidence ring counter.

Two samples (GaK-223 and 224) are measured by a counter having an effective volume of 6.8 L (Counter 2) with the same counter arrangement as Counter 1. Samples are also filled as acetylene at pressure 400 to 760 mm Hg. The background counting rate of Counter 2 is $25 \pm 0.0021 \text{P counts/min}$, where $P$ is the pressure of acetylene in mm Hg. The NBS oxalic-acid standard gives $106.7 \pm 0.3 \text{counts/min}$ above background at pressure 760 mm Hg and $0^\circ\text{C}$.

In order to attain accuracy with Counter 2, special care was taken in preparation of counting gas and determination of operating voltage. To avoid contamination by atmospheric CO$_2$ the preparation of acetylene was done in a CO$_2$-free atmosphere. There was contamination by tritium in appreciable amount when we used tap water for the preparation of acetylene. This source of error was eliminated by the use of water distilled from sea water. Details of experimental procedure and characteristics of Counter 2 will be published elsewhere.

Age calculations are based on the Libby half life of C$^{14}$, 5570 $\pm$ 30 yr. As a modern-carbon standard we used 95% of the NBS oxalic acid instead of the wood standard used in Gakushuin I. The change of modern carbon standard involves no numerical change in dates measured in Counter 1.

Dates on shell reported here were calculated with the same standard as for terrestrial samples. Errors on terrestrial samples include only the uncertainty calculated from the standard deviation of the counting rate. Errors on shell datings are those calculated from the standard deviation plus 300 yr. The latter number was introduced to cover the error derived from the fluctuations of C$^{14}$ concentration in the ocean surface or shallow water.

Grateful acknowledgment is made to many donors and collectors of samples for descriptions and comments.

SAMPLE DESCRIPTIONS

1. GEOLOGIC SAMPLES

GaK-211. Furue, Kagoshima

Carbonized humic sandy clay beneath pumice layer 8 m thick, Furue, Kanoya City, Kagoshima ($31^\circ 24'$ N Lat, $130^\circ 49'$ E Long), Coll. 1961; subm. by Yasumasa Gohara, S. K. Kenkyu-sho, Tokyo. Comment (Y.G.): carbonization is supposed to have resulted from the fall of pumice from the volcano Mt.
Aira. The pumice, widely distributed, covers a marine layer supposed to be correlative with the Shimosueyoshi layer. Date indicates the time of formation of Aira Caldera, and does not conflict with known stratigraphic data.

**GaK-231. Kanoya, Kagoshima**

Humic volcanic clay from Kasanohara, Kanoya City, Kagoshima (31° 23’ N Lat, 130° 52’ E Long), overlain by pumice ca. 2.5 m thick. The pumice is allophane and supposed to be from eruption of Mt. Kirishima or Mt. Sakurajima. Coll. 1956; subm. by Shigenori Aomine, Kyushu Univ. Comment (S.A.): hydrated halloysite occurs in and below the layer in which sample was taken.

**GaK-230. Tochigi, Kumamoto**

Humic volcanic clay from Tochigi Asogun, Kumamoto (32° 34’ N Lat, 132° 2’ E Long), overlain by pumice (allophane) ca. 1.5 m thick. Coll. 1956; subm. by S. Aomine. Comment (S.A.): hydrated halloysite occurs in and below the layer in which sample was taken. Date measures time for the change of allophane to hydrated halloysite.

**GaK-213. Kita-ku, Osaka**

Humic sand from Minamimori-machi Kita-ku, Osaka (34° 41’ 40” N Lat, 135° 30’ 50” E Long, alt 4.9 m), imbedded in sand, 3.5 m below surface. Top of Temma gravel is 4 m below surface here. Coll. and subm. 1961 by Hikotaro Kajiyama, Juso Post Office, Osaka. Comment: consistent with GaK-169 (Gakushuin I).

**GaK-206. Teragawa, Nara**

Peat from Tawara-hommachi Nebutoguchi, Nara (34° 33’ N Lat, 135° 30’ 50” E Long, alt 50 m). Peat layer, 50 cm thick, ca. 5 m below surface, contains *Menyanthes polygonum, Iris carex, Actinostemma phragmites*, fresh water diatoms and insects (Kokawa, 1961). *Picea* forms 10% of total pollen (Yamagata, 1958). Coll. 1960; subm. by Shohei Kokawa, Osaka City Univ. Comment: date and altitude agree with GaK-112 (Gakushuin I).

**GaK-225. Daisen, 2**

Wood (*Fagus crenata*) from N side of Mt. Daisen, Nawa-machi Mikuradani Tottori Prefecture (35° 27’ 49” N Lat, 133° 30’ 26” E Long), 5 m below surface. Sample was imbedded in volcanic mudflow with carbonized wood, overlain by volcanic clay 3 m thick. Coll. and subm. 1961 by Tsurunaga Kimachi. Comment: sample dates a major eruption of Mt. Daisen. See GaK-163 (Gakushuin I).

**GaK-240 a. Hiromi-machi, Kiso, 1**

Inner part of a log from Fushimi, Gifu Prefecture (35° 35’ N Lat, 135° 48’ E Long). Sample was imbedded in a volcanic mudflow 3.6 m below surface of Takabe Terrace. Coll. and subm. 1961 by Kunio Kobayashi, Shinshu Univ. Comment (K.K.): tree was probably killed during eruption of Mt. Ontake Volcano.
GaK-204 b.  Hiromi-machi, Kiso, 2

Outer part of a log used for GaK-204 a.

GaK-249.  Kariya, Aichi

Shell (Anadara granosa) from site of new Tokaido Railway bridge at the Aizuma, Kariya, Aichi Prefecture (35° 0’ N Lat, 136° 59’ E Lat), 1.3 m below surface of river-bed. Associated shells include Ostrea gigas, Rapana thomasiana, Meretrix lusoria, Cyclina sinensis and Corbicula japonica. Coll. 1962 by Kazuo Harada; subm. by Masashi Sugiuura, Chiryu High School. Comment: two shell mounds of Jomon period are found 700 m S of this place.

Mt. Fuji series

GaK-203.  Rengeji, Gotemba

Wood from Rengeji, Gotemba (35° 19’ 12” N Lat, 138° 57’ 30” E Long), imbedded in peat 3.5 m below surface. Peat is underlain unconformably by Tachikawa Loam and overlain by volcanic mudflow of Mt. Fuji Volcano. Coll. and subm. 1961 by Kanto Loam Research Group. Comment: dates maximum age of Chankiri mudflow which covers wide area of this district.

GaK-224.  Oyama, Shizuoka


GaK-255.  Hakoarezawa, Mt. Fuji

Charcoal from Hakoarezawa tunnel (1950 m from entrance), S side of Mt. Fuji (35° 19’ N Lat, 138° 40’ E Long, alt 1050 m), imbedded in mudflow of Old Fuji Volcano. Coll. and subm. 1962 by Hiromichi Tsuya, Univ. of Tokyo.

Mt. Amagi series, Shizuoka

GaK-207.  Mitaka

Wood from site of tunnel building, Kamogun, Mitaka, Shizuoka Prefecture (34° 45’ 13.2” N Lat, 139° 0’ 58.1” E Long), imbedded in Inatori volcanic mudflow, 33 m below surface. Coll. 1961; subm. by Yoshio Kasahara, Shimoda Kita High School. Comment: dates an early eruption of Mt. Amagi.

GaK-253.  Nakaizu

Wood from Nakaizu-machi Shinden Shizuoka Prefecture (34° 54’ N Lat, 138° 58’ E Long). Tree trunk 10 m long, buried in pumice. Coll. 1961; subm. by Hisashi Kuno, Univ. of Tokyo. Comment (H.K.): on stratigraphic evidence the pumice probably corresponds to the last eruption of Amagi.
GaK-252. Ito

Wood from SW part of Ito City, Shizuoka Prefecture (34° 58' N Lat, 139° 6' E Long), imbedded in clay incorporated within Hachigakubo scoria. Coll. 1960; subm. by H. Kuno. Comment: dating failed to give maximum age of Omuroyama ejecta and lava which partly cover Hachigakubo scoria.

GaK-246. Uotsu, Toyama

Root of Cryptomeria japonica with 1000 growth rings, from peat, Uotsu, Toyama (36° 49' N Lat, 137° 23' E Long). Many buried trees of Cryptomeria japonica are found near sealevel along the shore line of Toyama Prefecture. Sample associated with late Jomon pottery. Coll. 1961; subm. by Saburo Fukai, Toyama Univ. Comment: date does not conflict with late Jomon period in view of age of tree. As Cryptomeria japonica usually occurs > 100 m above sealevel, depression of land by more than 100 m during the last 2000 yr is implied.

Niigata series

Peat from borings on a line extending inland from a point near coast SW of Niigata City. Profiles show several wind-blown dunes parallel to coastline arranged on this line. Peat occurs between the dunes. Coll. and subm. by Kunio Suyama, Fukada Geol. Inst. Comment: dates are minimum for dune formation.

GaK-236. Okura

Okura, Niigata (37° 48' 0" N Lat, 139° 0' 10.4" E Long, alt 2.8 m), 10.2 to 10.5 m below surface. Coll. 1961.

GaK-235. Ajikata

Ajikata, Niigata (37° 47' 12" N Lat, 139° 0' 38.4" E Long, alt 2.8 m), 14.2 to 14.8 m below surface. Coll. 1961.

GaK-233. Shirane

Shirane City, Niigata (37° 46' 30" N Lat, 139° 1' 17.4" E Long, alt 2.8 m), 6.1 to 6.4 m below surface. Coll. 1960.

GaK-237. Shoze, Niigata, 1

Shoze, Shirane City, Niigata (37° 43' 0" N Lat, 139° 2' 31.4" E Long, alt 4.3 m), 4.15 to 4.32 m below surface. Coll. 1961.

GaK-239. Shoze, Niigata, 2

Same boring as GaK-237, 14.15 to 14.45 m below surface.

Kisarazu series, Tokyo Bay

Peat from borings near Kisarazu City, ca. 1 km off the coast in Tokyo Bay. Depths indicated are measured from mean tide level of Tokyo Bay. Peat is underlain by Pleistocene sand and gravel. Coll. 1960; subm. by Gosaburo Miki, Univ. of Tokyo, Sohei Kaizuka, Tokyo Metropol. Univ. and Hiroshi
Naruse, Chiba Univ. Comment: depth/age relation does not agree with other ages of Tokyo Bay sediments. See GaK-137 to 146 (Gakushuin I) and GaK-181, 182, 184, this date list.

GaK-179. Kisarazu, -5.10 to -5.20 m  >30,000
(35° 22' 26" N Lat, 139° 54' 16" E Long).

GaK-180. Kisarazu, -5.30 to -5.80 m  17,400 ± 900
(35° 20' 55" N Lat, 139° 51' 22" E Long).

Goi series, Tokyo Bay
Peat from borings near Goi-machi ca. 500 m off the coast. Depths indicated are mean tide level of Tokyo Bay. Coll. 1960; subm. by G. Miki, S. Kaizuka and H. Naruse. Comment: relation between age and depth agree with measured dates of Tokyo Bay series, GaK-137 to 146 (Gakushuin I).

GaK-181. Goi, -22.23 to -22.51 m  8930 ± 230
(35° 30' 23" N Lat, 140° 3' 44" E Long). Silt overlain and underlain by marine sand.

GaK-182. Goi, -32.14 to -32.44 m  9450 ± 350
(35° 30' 11" N Lat, 140° 2' 57" E Long). Silt overlain and underlain by marine silt and sand.

GaK-184. Goi, -43.43 to -43.73 m  10,400 ± 400
(35° 30' 36" N Lat, 140° 38' 23" E Long). Silt overlain and underlain by marine sand.

GaK-223. Kasaibashi, Tokyo  9900 ± 600
Shell (Ostrea gigas) from -37 m to -38 m in boring 300 m N of Kasaibashi, Tokyo (35° 40' 0" N Lat, 139° 50' 10" E Long). Date indicates rate of sedimentation and age of dark brown loam underlying the shell horizon. Coll. 1961; subm. by K. Suyama. Comment: rate of sedimentation agrees with Goi series, GaK-181, 182 and 184. Implies minimum age of Tachikawa Loam does not conflict with the maximum age given by GaK-171, 11,330 ± 260, and GaK-172, 11,840 ± 290 (Gakushuin I).

Fukushima series
Wood from alluvium in Fukushima Basin and related alluvial fans. Coll. and subm. by Keiji Suzuki, Fukushima Univ. Dates show simultaneous formation of Kuwaori and Otsuki alluvial fans, and rapid deposition of the sediments.

GaK-208. Toyano  6370 ± 110
Kunihiko Kigoshi and Kunihiko Endo

GaK-209. Kuwaori-machi


GaK-244. Katahira

Standing tree buried by Otsuki fan, Ouse-mura Katahira, Fukushima, W side of Kooriyama Basin (37° 24' 30" N Lat, 140° 18' 10" E Long, alt 270 m).

GaK-245. Tadano


Hachirogata series, Akita

Shell and peat from borings at Hachirogata Akita. The profiles show peat and peaty silt 1 to 4 m thick, underlain by coarse sand and gravel and overlain by marine clay and silt. Dating provides information on the rate of sedimentation and compression of clay by pressure and age. Coll. 1961; subm. by Nobuyoshi Ushijima, Tohoku Univ. Comment: samples and profiles are described by N. Ushijima et al. (1962), and, using the dates, compression of clay and migration of petroleum are discussed by N. Ushijima (1962).

GaK-219. Hachirogata, depth -37.0 m

Shell (Ostrea gigas) from middle of Hachirogata Lagoon (39° 57' N Lat, 140° 1' E Long).

GaK-220. Hachirogata, depth -53.0 m

Peat from NW side of lagoon (40° 2' N Lat, 139° 57' E Long).

Jusanko series, Aomori

Peat from borings 1 to 6 km S of the shore of Jusanko Lagoon. Dates rate of sedimentation and formation of alluvial plain near Jusanko. Coll. 1961; subm. by Y. Ushijima. Profiles are described by Y. Ushijima et al. (1962).

GaK-221. Jusanko, depth -27.1 to -27.4 m

(41° 0' N Lat, 140° 25' E Long).

GaK-222. Jusanko, depth -39.0 m

(41° 3' N Lat, 140° 25' E Long).

Towada series, Aomori

GaK-205. Hodozawa

Carbonized wood from tuff, Hodozawa Itsunohe, Aomori, 30 km E of Lake
Gakushuin Natural Radiocarbon Measurements II

Towada (40° 31' 26" N Lat, 141° 19' 34" E Long). Coll. 1961; subm. by Shoji Oike, Hachinohe High School. Comment: sample tree thought to have been killed by the eruption which formed Towada Caldera, and which could correlate with the ash layer at Urami-machi Aomori dated 13,900 ± 330 (Gakushuin I).

GaK-226. Kosaka, Akita, 1
Wood from Kosaka, Akita, 20 km SW of Lake Towada (40° 19' 50" N Lat, 140° 46' 1" E Long), imbedded in clay overlain by welded tuff. Coll. 1961; subm. by Shouichiro Hayashi, Geol. Survey of Japan.

GaK-227. Kosaka, Akita, 2
Wood from almost the same position as GaK-226. Coll. 1961 by T. Hashimoto; subm. by S. Hayashi.

Mashu Volcano series, Hokkaido
Carbonized wood from mudflow, Mashu Volcano, Hokkaido, correlated with Mashu Caldera. Coll. 1960; subm. by Yoshio Katsui, Hokkaido Univ. Comment: Katsui found Jomon pottery on the pumice flow deposit at Wakin, shore of Lake Kutcharo. See GaK-188, this date list. Stratigraphic studies of volcanic ash and pumice layer are described by Y. Katsui (1961).

GaK-247. Teshikaga-cho
Wood from Teshikaga-cho Kushiro, Hokkaido (43° 29’ N Lat, 144° 28’ E Long), imbedded in volcanic mudflow.

GaK-248. Kiyosato-cho
Wood from Kiyosato-cho Kitami, Hokkaido (43° 45’ N Lat, 144° 31’ E Long), imbedded in same deposit as GaK-247.

II. ARCHAEOLOGIC SAMPLES

A. Iran

Mary-Dasht series, Iran
Soil containing small fragments of charcoal from Mary-Dasht Valley Tall-i-Gap, Iran (29° 55’ N Lat, 53° 0’ E Long). In 1959 the second Tokyo University Iraq-Iran Archaeol. Exped. excavated a big hill of remains at Tall-i-Gap which is a round hillock 5 m in height and ca. 120 m in diameter. Samples for C¹⁴ dating were taken from layers corresponding to cultural epochs I and II at this site. Details of excavation and remains of building and pottery were described by N. Egami and T. Sono (1962). Subm. by Shinichi Izumi, Univ. of Tokyo.

GaK-197. Tall-i-Gap, Iran, 1
Layer 17 in cultural epoch GAT-I. 5870 ± 160 3920 B.C.

GaK-198. Tall-i-Gap, Iran, 2
Layer 6 in cultural epoch GAT-II. 5440 ± 120 2490 B.C.
Kunihiko Kigoshi and Kunihiko Endo

B. Andes

Kalasasaya series, Tiahuanaco

Charcoal from Kalasasaya, Tiahuanaco (17° S Lat, 72° W Long) Bolivia. Coll. by Centro de Inv. Arqueológicas en Tiahuanaco; subm. by Shinichi Izumi. Comment: cultural descriptions published by Ishida et al. (1958). See also Kalasasaya series, Gakushuin I.

GaK-192. Kalasasaya, 4


1990 ± 110

40 B.C.

GaK-193. Kalasasaya, 5


1850 ± 90

A.D. 100

GaK-194. Kalasasaya, 6

Charcoal powder from Layer 6, (Epoch I), Pit K-16. Coll. 1958. Comment: unexpectedly old compared with GaK-52 (Gakushuin I) and cultural epoch.

GaK-195. Kalasasaya, 7


1750 ± 100

A.D. 200

C. Japan

Lake Saroma series, Hokkaido

GaK-186. Tofutsu

Charcoal from Tofutsu, Hokkaido, 2.5 km E of shore of Lake Saroma (44° 20' N Lat, 143° 31' E Long). Sample is from remains of a shelter, 30 cm below surface. Coll. 1957 by Kazuchika Komai, Univ. of Tokyo; subm. by K. Komai and Takaji Sadasue, Univ. of Tokyo. Comment (K.K.): associated Satsumon pottery has an older style than that of pottery found with GaK-187.

1610 ± 110

A.D. 340

GaK-187. Sakaeura

Charcoal from Sakaeura, Hokkaido, 5 km E of shore of Lake Saroma (44° 20' N Lat, 143° 33' E Long). Sample was taken near an oven at floor level of shelter, associated with Satsumon potteries. Coll. 1958 by K. Komai; subm. by K. Komai and T. Sadasue.

1070 ± 80

A.D. 880

GaK-188. Tokoro Shell Mound

GaK-189.  Utoro  1420 ± 170  A.D. 530

GaK-190.  Tokoro Chashi  990 ± 140  A.D. 960
Charcoal from Tokoro Chashi, Hokkaido (44° 19' N Lat, 144° 35' E Long). Sample is from remains of a dwelling with Okhotsk Culture pottery. The dwelling has form of a chashi (fort) indicating that the remains are younger than that of GaK-189. Coll. 1960 by Yoshiro Kurata, Univ. of Tokyo; subm. by K. Komai and T. Sadasue.

GaK-191.  Tobinitai  1310 ± 120  A.D. 640
Charcoal from Tobinitai, Hokkaido (44° 8' N Lat, 144° 43' E Long), associated with Okhotsk pottery. Coll. 1960 by Y. Kurata; subm. by K. Komai and T. Sadasue.

Shirataki series, Hokkaido
Wood and grass from Shirataki-mura Yubetsugun, Hokkaido (43° 53' N Lat, 143° 8' E Long). Sample was from Shirataki layer with Paleolithic culture. Coll. 1961; subm. by Yoshio Kitagawa, Hokkaido Univ. Comment: previously reported date, 15,800 ± 400 (GaK-160, Gakushuin I) was measured on a sample possibly contaminated by alcohol.

GaK-210.  Shirataki, -3.38 m  14,800 ± 350  12,850 B.C.
Soil containing many fragments of wood and grass.

GaK-212.  Shirataki, -3.77 m  15,800 ± 380  13,850 B.C.
Wood from the same layer as GaK-160 (Gakushuin I).

References

Date list:
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NEW ZEALAND
NATURAL RADIOCARBON MEASUREMENTS I-V

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This list comprises dating determinations of the New Zealand Radiocarbon Laboratory.

All dates listed herein were published previously (NZ-1-78 in Fergusson and Rafter, 1953, 1955, 1957; NZ-79-264 in Fergusson and Rafter, 1959; NZ-265 in Grant-Taylor and Rafter, 1962.

NZ-1-4 were counted by the solid-carbon method and NZ-10 onward by gas-counting methods; details of the methods are given in Rafter (1953, 1955a) and Fergusson and Rafter (1953, 1955). Where possible, allowance has been made for biological fractionation effects by use of secondary standards (Rafter, 1953b). The accuracy of the methods is discussed by McCallum (1955).

The ages reported have a correction of 120 yr for industrial carbon in material that lived on land and of 100 yr in material that lived in shallow seas. Material from deep oceanic environments and from Antarctica has been excluded from this list, even though it may have appeared previously (Fergusson and Rafter, 1957, 1959). It has become clear that material in the deep oceans is formed with a C14 content that varies considerably, and “dates” on such material have an initial uncertainty that may exceed 3000 yr. The significance that can be attached to such dates is no more than an upper limit of age.

In the list, grid references are given for most New Zealand localities in terms of the National 1000-yr grids published in NZMS-1 maps. The age in all cases is given in years before A.D. 1950, in terms of the old half life of C14 of 5568 ± 30 yr.

We have adhered as closely as possible to the data in the published New Zealand lists 1 through 3. Some descriptions have been expanded.

In conformity with the decision of the Cambridge conference 1963 dates in terms of the present calendar are included. However a recent reassessment of the half life of C14 suggests the presence of a 5% error from this source. Also work done by various laboratories, de Vries, 1958, Willis et al., 1960 and Jansen, 1962 suggests an additional variation of irregular nature and unknown origin. The magnitude of this variation as determined by three of the four laboratories appears to be similar, although the absolute amount of the variation at a given time may vary. The maximum deviation as determined by tree ring counts is ca. 50% of the C14 age.

SAMPLE DESCRIPTIONS

Taupo series

Dates a violent rhyolitic eruption in NW of Lake Taupo.
T. L. Grant-Taylor and T. A. Rafter

**NZ-1. Taupo, N. Z.**

Charcoal from coarse Taupo pumice, close to the main Taupo-Rotorua Road ca. 0.5 mi S of burnt Forest Products Plantations (38° 36′ S Lat, 176° 09′ E Long), grid ref. N94/624492. Coll. by I. L. Baumgart, N. Z. Soil Bur., Wellington. *Comment:* dates the eruption of pumice blocks that carbonized the wood.

**NZ-2. Taupo, N. Z.**

Charcoal from fossil soil, in quarry face, ca. 1 mi SE of Terrace Hotel on the Napier Taupo Rd. (38° 43′ S Lat, 176° 07′ E Long). Coll. by I. L. Baumgart. *Comment:* date places a younger limit on underlying Waimahia lapilli member.

**NZ-3. Taupo, N. Z.**


**NZ-4. Taupo, N. Z.**


**NZ-5. Rangitawa Stream near Kakiriki**

Wood from Ohakeo alluvium, ca. 1 ft above base of alluvium, which rests unconformably on Castlecliffian sandy mudstone, on S bank of Rangitawa Stream across railway from McLennan’s gate (40° 08′ S Lat, 175° 27′ E Long), N143/953626. Coll. by M. T. Te Punge, N. Z. Geol. Surv., Wellington. *Comment:* sample dates the alluvium, interpreted as younger postglacial valley fill.

**NZ-6. Pollen Island, Waitemata Harbor**

Mangrove-swamp peat from top 4 in. in layer ca. 2 ft thick, overlain by marine silt, 1 ft thick (36° 52′ S Lat, 174° 40′ E Long), N2/185593. Subm. by V. J. Chapman, Auckland Univ. *Comment:* date places a younger limit on age of formation, which would therefore appear to be no younger than the last interglacial age.

**NZ-7. Aramaho, Wanganui, North Island**

Fossil tree trunk, rooted in place, at bottom of Aramaho pumice quarry, remnant of a forest on flats beside Wanganui River that was buried by floods of pumice alluvium (39° 53′ S Lat, 175° 06′ E Long), N138/624917. Coll. by C. A. Fleming, N. Z. Geol. Surv.

**NUZ-8. Aramaho, Wanganui, North Island**

Charcoal fragments, depth 2 to 5 ft below surface in Aramaho pumice
quarry, same locality as NZ-7. Charcoal is believed to have been formed at the time of the pumice eruption and almost immediately brought down to the coast by the Wanganui River. Coll. by C. A. Fleming. Comment: age is similar to NZ-7 and supports the interpretation, but the difference as compared with NZ-1 through NZ-4 (this date list) suggests the possibility of another eruption in the district.

NZ-9.  Wanganui Valley, Westland, South Island  930 ± 150 A.D. 1020

Wood, buried in gravel deposit that was deformed by late movement of the Alpine fault, Wanganui Valley, 1.25 mi upstream from road bridge (43° 10' S Lat, 170° 37' E Long). Coll. by C. A. Fleming.

NZ-10.  Kaingaroa Forest, Rotorua  930 ± 70 A.D. 1020

Wood from 10-in. depth below surface, 3 in. above contact with buried soil developed on Taupo volcanic ash, imbedded in and stratigraphically overlain by Kaharoa ash, 4 ft thick, and then by Tarawera ash, 6 in. thick, exposed in cut on Northern Boundary Rd., Kaingaroa Forest (38° 19' S Lat, 176° 44' E Long), N86/127801. Coll. by I. L. Baumgart. Comment: sample places an older limit on age of Kaharoa eruption and approximately dates the eruption.

NZ-11.  Penrose, Auckland  9270 ± 80 7320 B.C.

Wood from tree trunk underlying basalt flow, in excavation for overhead bridge on the Penrose main-road deviation (36° 54' S Lat, 174° 49' E Long), N42/330540. Subm. by J. Healy, N. Z. Geol. Surv., Rotorua. Comment: dates one of the younger basalts of the Auckland district.

NZ-12.  Napier  20,670 ± 300 18,720 B.C.

Wood, 5 ft below surface, in deeply weathered pumiceous clay, 9 in. above unweathered pumice and ash, exposed in excavation for Napier Hospital nurses' home, Hospital Hill, Napier (39° 29' S Lat, 176° 54' E Long), N134/317397. Coll. by J. A. Berry, George St., Napier. Comment: sample places a younger limit on deposition of pumice ash and an older limit on deposition of the pumiceous clay, which is loess-like.

NZ-13.  Rapahoe, Greymouth, Westland  4720 ± 70 2770 B.C.

Wood from a large tree trunk, 15 ft above sealevel, imbedded in marine gravel terrace at Rapahoe (42° 23' S Lat, 171° 15' E Long), S44/766972. Coll. by R. P. Suggate, N. Z. Geol. Surv., Christchurch. Comment: terrace apparently represents deposition at postglacial sealevel higher than the present one, but tectonic uplift is also probable.

NZ-14.  Featherston, Wairarapa  >37,000

Wood from peat bed, encountered in boring 150 ± 5 ft below sealevel, in an area of postglacial aggradation (41° 13' S Lat, 175° 18' E Long), N161/823303. Coll. by I. Barton, Featherston. Comment: sample places a younger limit on peat bed, which is clearly not postglacial.
NZ-15. **Ohariu Valley, Wellington**  
**840 ± 50**  
**A.D. 1110**  
Wood from layer of driftwood, overlain by carbonaceous blue clay, 2 ft thick, and then by sandy silt, 8 ft thick, making a depositional river terrace that reaches 12 ft above present stream level (41° 14’ S Lat, 174° 44’ E Long), N164/294289. Coll. by J. W. Brodie, N. Z. Oceanog. Inst., Wellington. *Comment:* sequence records local aggradation followed by downcutting; cause of the events is not certainly known.

NZ-16. **Buna Kokodu area, New Guinea**  
**13,870 ± 250**  
**11,920 B.C.**  
Wood from tree trunk imbedded in ash of the earliest phase of volcanic activity in the district (9° 05’ S Lat, 148° 09’ E Long), Mt. Lamington, an active volcano in the district, has ash deposits that are little consolidated, and is regarded as having begun activity within the last 20,000 yr. Coll. by C. S. Christian, CSIRO, Canberra, Australia.

NZ-17. **Titahi Bay, Wellington**  
**>35,000**  
Wood from submerged forest, exposed between tide levels, Titahi Bay (41° 06’ S Lat, 174° 50’ E Long), N160/389441. Bay is backed by a low cliff cut in Pleistocene alluvium; forest bed consists of fossil soil with abundant vegetable remains and stumps in growth position. Flora suggests a climate similar to the present, and hence that the forest is of (last?) interglacial age. Coll. by C. A. Fleming.

NZ-18. **Fielding**  
**>35,000**  
Impure lignified peat, underlying topmost sandstone that covers the (very young) Fielding anticline, exposed in Walter Seiferts coal mine, Ranfurly Ave., Fielding (40° 13’ S Lat, 175° 33’ E Long), N144/052521. Coll. by M. T. Te Punga.

NZ-19. **Palmerston North**  
**>37,000**  
Well-preserved wood, probably totara (*Podocarpus totara*), in gray mudstone ca. 30 ft above river level, 0.5 mi upstream from Fitzherbert Bridge, Palmerston (40° 23’ S Lat, 175° 38’ E Long), N149/123327. Coll. by M. T. Te Punga.

NZ-20. **Rangitikei Valley**  
**>37,000**  
Wood from log with annual rings in Rangitawa Stream (40° 08’ S Lat, 175° 28’ E Long), N143/964624. Sample, imbedded in sediments with upper Castlecliffian fossils, was bored by marine lamellibranchs. Collected from beds 25 ft below the unconformity that marks base of Ohakea alluvium. Coll. by M. T. Te Punga and A. L. Bloom.

NZ-21. **Palliser Bay**  
**>37,000**  
NZ-22. Waikanae River  
Wood from mudstone lens in Otaki sandstone, overlain by terrace gravel of early last glaciation, Waikanae River, 0.25 mi downstream from railway bridge (40° 53' S Lat, 175° 03' E Long), N156/590710. Coll. by M. T. Te Punga.

NZ-23. Palliser Bay  
Wood in “coverhead,” 80 to 90 ft thick, 60 ft above base of “coverhead,” in beach cliff 200 yd E of Lake Ferry Hotel (41° 24' S Lat, 175° 09' E Long), Coll. by R. L. Kite, Victoria Univ., Wellington. Comment: “coverhead” is considered to have been deposited during last interglacial.

NZ-24. Cape Palliser  
Well-preserved wood, 5 ft above base of gravel composing emerged coastal plain that fringes part of E side of Palliser Bay, near Waitarangi wool-shed on road to lighthouse (41° 28' S Lat, 175° 13' E Long), Coll. by R. L. Kite and M. T. Te Punga.

NZ-25. Christchurch  
Muddy peat in alluvial gravel, sand and silt, encountered in well 190 ft below surface which is 45 ft above sealevel, Corner of Blighs Road and Wairaki Rd., Christchurch (43° 30' S Lat, 172° 36' E Long), S84/972594. Coll. by B. W. Collins N. Z. Geol. Surv., Christchurch.

NZ-26. Christchurch  
Wood, 11 ft below surface, in alluvium near base of Port Hills fm, exposed in basement excavation at alt 20 ft above sealevel, Cashmere Hospital, Christchurch (43° 34' S Lat, 172° 37' E Long), S84/989514. Coll. by B. W. Collins.

NZ-27. Christchurch  
Wood, 8 ft below surface, in silty sand, exposed in excavation; 25 ft above sealevel; St Asaph St., Christchurch (43° 32' S Lat, 172° 38' E Long), S84/995555. Coll. by B. W. Collins.

NZ-28. Wairakei  

NZ-29. North Auckland  
Kauri (Agathis australis) wood imbedded in indurated humus and iron pan, One Tree Point, Ruakaka (35° 40' S Lat, 174° 27' E Long), N24/967859. Coll. by N. H. Taylor. Comment: pan horizon is almost certainly part of a podzol that existed when One Tree Point was more extensive than at present. Result is average of two determinations, 35,000 ± 2000 and 34,600 ± 1000.
NZ-30.  Hutt Valley

4470 ± 100
2520 B.C.

NZ-31.  Hutt Valley

4400 ± 100
2450 B.C.

Wood from two matai (Podocarpus spicatus) stumps in growth position at base of Melling Terrace, just N of Old Melling Bridge (41° 12' S Lat, 174° 55' E Long), N160/458324. Stumps were at present-day Hutt River level, which is at MHW, 17 ft below terrace top and 50 yd apart. Seeds, leaves, and pollen in peat at same horizon give some indication of climate warmer than present. Coll. by G. R. Stevens, N. Z. Geol. Surv.

NZ-32.  Victoria, Australia

Modern

Wood from central, most-decomposed part of root of standing Eucalyptus oleosa, ca. 4 ft in diam, 40 ft high, of “bull-mallee” habit, on research farm of Victoria Dept. of Agriculture (35° 10' S Lat, 142° 00' E Long). Tree was suspected to be several thousand years old. Coll. by A. B. Costin, Soil Conserv. Authority, Victoria.

NZ-33.  Mount Gambier, Australia

4830 ± 70
2280 B.C.

Charcoal from A horizon of fossil soil immediately below ash of Mount Gambier volcano, 46 in. below surface (37° 49' S Lat, 140° 46' E Long). Soil profile above sample consists, from top downward, of gray-brown organic loam, 7 in. yellow-brown loam, 15 in. yellow-brown loam (weathered ash), 7 in., and dark, gray-speckled, stratified volcanic ash, 17 in. Subm. by E. D. Gill, Natl. Mus. of Victoria, Melbourne. Comment: sample dates the A horizon, indicates maximum age of volcanism, and gives upper limit of time needed to form the overlying loam.

NZ-34.  Lake Eyre, South Australia

19,200 ± 500
17,250 B.C.

Organic matter (leaves, insects, and microorganisms) found in sulfur deposit at Lake Eyre (28° 58' S Lat, 137° 41' E Long). Carbon content of sulfur sample, 0.3%. Coll. by I. Kaplan, Fisheries Div. CSIRO, Sydney.

NZ-37.  Ngaruawhaia

A.D. 170

1780 ± 60

Charcoal lumps imbedded in thin layer of pumice conglomerate, 16 ft below surface, within gritty quartzose pumiceous sands, in boring on regatta grounds, Ngaruawhaia, near junction of Waipa and Waikato Rivers (37° 40' S Lat, 175° 09' E Long), N56/659624. Coll. by J. C. Schofield, N. Z. Geol. Surv. Comment: date is that of Taupo lapilli member and probably also that of pumice flood in the Waikato River.

NZ-38.  Waikato

A.D. 150

1800 ± 70

Charcoal from white water-sorted pumice layer in quarry, Hinton Gully (37° 49' S Lat, 175° 20' E Long), N65/837449. Coll. by J. C. Schofield.

NZ-39.  Hope River

A.D. 1100

850 ± 50

Wood fragments from stems up to 5 in. diam, S bank Hope River, 0.5 mi
upstream from Lewis Pass highway bridge (42° 36' S Lat, 172° 27' E Long), S53/848703. Coll. by M. Gage, Canterbury Univ., Christchurch. Comment: apparently dates a recent landslide.

NZ-40. Cox Creek  >42,000
    Wood, 130 ft above sealevel, 25 ft below top of marine gravel, in road cut just N of Cox Creek (42° 19' S Lat, 171° 16' E Long), S44/792038. Coll. by R. P. Suggate.

NZ-41. Johnsonville  20,900 ± 300
    Wood, 18,950 B.C.
    Wood from W side of Porirua-Johnsonville motorway cut, 0.25 mi N of Takapu Road (41° 11' S Lat, 174° 48' E Long), N160/364300. Associated seeds, leaves and pollen indicate temperate climate. Coll. by J. W. Brodie, D. R. McQueen, and W. P. Tolley.

NZ-42. Johnsonville  >40,000

NZ-43. Hutt Valley  >42,000
    Wood from peat bed between gravel, which overlies greywacke and underlies solifluction debris, in road cut, Foster Crescent, Belmont (41° 11' S Lat, 174° 55' E Long), N160/470340. Pollen from peat indicates a climate similar to the present one. Coll. by G. R. Stevens.

NZ-44. Hutt Valley  >42,000
    Wood, on Haywards-Pauatahanui Rd., opposite Haywards Substation housing settlement (41° 09' S Lat, 174° 59' E Long), N160/520390. Associated leaves, seeds, and pollen indicate a climate cooler than the present one. Coll. by J. W. Brodie, D. R. McQueen, and W. P. Tolley.

NZ-45. Hauraki Plains  2370 ± 70
    420 B.C.
    Shells from pit in shell deposit, ca. 10 ft above sealevel, Kopuarahi, (37° 14' S Lat, 175° 30' E Long), N49/003140. Coll. by D. Kear and J. C. Schofield.

NZ-46. South Canterbury  1450 ± 70
    A.D. 500
    Podocarpus totara log lying on surface, probably having moved downslope, 3500 ft above sealevel, 0.5 mi NNE Trig B, Block IV, Burke S. D., Canterbury, on E face of Mount Dalgety 0.5 mi S of MacKenzie Pass (45° 44' S Lat, 170° 27' E Long). Sample came from outside of log, which was charred, presumably by tussock fires; growth rate of tree was ca. 2.75 in. in 160 yr. Coll. by J. D. Raeside, N. Z. Soil Bur., DSIR. Comment: present vegetation is snow tussock and fescue tussock, greatly reduced by fire and erosion. No living totara has been observed on this range.
New Zealand Natural Radiocarbon Measurements I-V

NZ-47. Central Otago

Podocarpus totara log lying on surface, 2350 ft above sealevel, 1.5 mi SE Trig P, Block IX, Nevis S. D., Otago, on L bank of Doolan’s Creek (45° 09’ S Lat, 168° 58’ E Long). Present vegetation is chiefly Festuca novae-zealandiae with scattered Danthonia flavescent and matagouri scrub; site is somewhat stony. Coll. by P. Wardle, Univ. of Otago. Comment: no living totara in Nevis catchment.

NZ-48. Eastern Otago

Dacrydium biforome log, 7 ft long, diam 9 in., growth rate 3.25 in. for ca. 240 rings, 2300 ft above sealevel, Maungatua Range, W edge of Taieri Plain (45° 52’ S Lat, 170° 09’ E Long), S163/847728. No living Dacrydium trees in the neighborhood. Coll. by A. R. Mark, Univ. of Otago.

NZ-49. Egmont

Charred wood from stream bank, on branch of Waiwakaiho River, 100 ft upstream from junction with main stream (39° 16’ S Lat, 174° 04’ E Long), N119/668673. Specimen comprised two fragments from dead trunk in growth position and washed clean; it marks a forest layer buried by a young lahar from Mount Egmont. Coll. by J. T. Salmon, Victoria Univ. College, Wellington.

NZ-50. Blenheim


Te Anau series

Organic material from the higher of two shelters used during recent Maori occupation of the high valley of Te Anau (45° 17’ S Lat, 167° 40’ E Long). Coll. by K. Miers, Wild Life Div., N. Z. Dept. of Int. Affairs.

NZ-51. Tussock

Tussock, presumably used as bedding.

NZ-52. Totara

Totara bark, presumably used as containers for preserved birds. Average of two runs, 320 ± 60 and 840 ± 60.

NZ-53. Hina Hina

Charcoal from lowest charcoal stratum, 4 ft below surface, on clean sand and ash with few shells, Hina Hina moa-hunter site, 0.5 mi from Pounawea moa-hunter site, Papatowai (46° 29’ S Lat, 169° 42’ E Long), S184/485966. Coll. by L. Lockerbie, Otago Mus. School Serv., Dunedin. Comment: tree roots extend to sampled level. Although the area receives relatively high rainfall, the sand is usually dry. Sampled stratum lies several feet above high-tide level.
Pounawea series, Otago

Samples from Pounawea moa-hunter site at junction of Catlins and Owaka Rivers, Papatowai (46° 28' S Lat, 169° 42' E Long), S184/486975. Site is in a high-rainfall district, low-lying but well drained. Stratification below present forest (chiefly Podocarpus totara) is: (a) top stratum, chiefly of loose shells with fish, seal, whale, and bird bones; artifacts of bone and stone throughout (b) intermediate stratum of fine gray ash and sand containing charcoal, bones (including moa), moa eggshell, a few seashells, and many artifacts (c) bottom stratum of black, greasy ash and sand containing charcoal and bird, seal, whale, fish, and moa bones; shells not numerous; flake knives and other artifacts present. Significant dietary changes are evident; date of abandonment of site is apparently confirmed by ages of totara trees growing on the deposit. Coll. by L. Lockerbie.

NZ-54. Pounawea, upper shell
Shell from 2 in. below surface in top stratum. 390 ± 60 A.D. 1560

NZ-55. Pounawea, intermediate charcoal
Charcoal from deposit in intermediate stratum. 520 ± 55 A.D. 1430

NZ-56. Pounawea, seal carbonate fraction
Carbonate and organic fractions of seal bones from intermediate stratum. 520 ± 55 A.D. 1430

NZ-56. Pounawea, seal organic fraction
550 ± 55 A.D. 1400

NZ-57. Pounawea, lower shell
Shell from lowest shell deposit. 600 ± 60 A.D. 1350

NZ-58. Pounawea, lower charcoal
Charcoal from bottom of deposit, resting on unconsolidated river silt. 810 ± 60 A.D. 1140

Hawksburn Valley series, central Otago

Samples from moa-hunter site on terrace in narrow part of Hawksburn Valley, 2050 ft above sealevel, Carrick Mountains (45° 13' S Lat, 169° 10' E Long). Steep slopes, fringing cliffs, and swamps provide a natural trap for moas; bones and wood would be expected to remain on surface for a long time, as district has little rainfall (10 to 12 in.), low tussock vegetation, slow soil formation, and extreme winter frosts. Climatic changes are indicated by occurrence of totara logs at alt 3000 ft, which is above present limit of growth. Coll. by L. Lockerbie.

NZ-59. Hawksburn, burnt bone carbonate
Burnt moa bone from oven containing other moa (unburnt) bones, a 410 ± 55 A.D. 1540

NZ-59. Hawksburn, burnt bone organic matter
400 ± 55 A.D. 1550
canid jaw, and stone artifacts, surrounded by dry loess, surface cover tussock and scabweed. NZ-60 (unburnt) was mixed with this sample before processing.

NZ-60. Hawksburn, Euryapteryx bone  
A.D. 1500
Unburnt bone, a femur of Euryapteryx, 6 to 7 in. below surface, in very dry, dusty soil, associated with jasperoid and quartzite artifacts.

NZ-61. Hawksburn, wood  
A.D. 1360
Charred, well-preserved wood from bottom of occupation deposit, 26 in. below surface, on blue clay, associated with artifacts and moa-bone fragments.

NZ-62. Hawksburn, charcoal  
A.D. 1350
Charcoal from upper 6 in. of occupation layer.

Egmont series
Charcoal from a Maori oven, overlain by volcanic ash, 15 in. thick, part of the Burrell ash shower, Egmont (39° 18’ S Lat, 174° 07’ E Long), N119/701617. Samples antedate the ash, and, being firewood, may also antedate the oven. Coll. by H. S. Gibbs, N. Z. Soil Bur., DSIR.

NZ-63. Egmont  
A.D. 1550
Charcoal from large piece in centre of oven.

NZ-64. Egmont  
A.D. 1590
Small pieces of charred wood from various parts of oven.

NZ-65. Te Horo  
>45,000
Wood from lignitic layer, 18 to 24 in. thick, overlying marine sediments with sponge spicules, overlain by sandstone, 10 ft thick, and then by angular solifluxion debris, 30 in. thick, exposed in ancient seacliff, 2 mi 30 chains at 215° from Te Horo Railway Station (40° 50’ S Lat, 175° 06’ E Long), N157/625772. Coll. by M. T. Te Punga.

Lake Merindee series, South Australia
Unionid shells from archaeologic site, Lake Merindee (32° 20’ S Lat, 142° 25’ E Long). Dates are calculated from C¹⁴ content of modern Unio shells from Tartanga lagoon on Murray River, which was 1.70 ± 0.4% above NZ modern wood standard. Coll. by L. F. Marcus, South Australia Mus., Adelaide.

NZ-66. Lake Merindee, Layer B, Area I  
4620 B.C.
6570 ± 100
Shells, collected in situ and broken from matrix, accompanied by extinct genera of Late Pleistocene or recent mammals and by artifacts of Tartangan culture.
NZ-67.  Lake Merindee, Layer B, Area II  
Modern
Shells from Layer B, on surface in an area 15 by 5 yd; some were collected in situ but all were friable and easily separated from matrix. Four Rat Kangaroo mandibles and a maxillary fragment were found in association on surface.

NZ-68.  Lake Merindee, Layer O, Area IV  
Modern
Shells, mainly broken, lying on surface, on Layer O, wind-blown, loose, coarse sand, ca. 9 in. deep. Fauna of Layer O comprised only living species of mammals; associated artifacts were of Mudukian culture. Comment: a few artifacts found on the site suggest the Kartan culture, which is probably Late Pleistocene, at least at its beginning. The Tartangan date quoted above was for a middle horizon of the culture, and agrees closely with NZ-66. The much younger, microlithic Mudukian culture has been shown elsewhere to postdate the Pirrian culture, a mid-point of which was dated at Devon Downs at 4250 ± 180 (32° 20' S Lat, 142° 25' E Long.)

NZ-69.  Cape Martin, South Australia

8800 ± 120
6850 B.C.
Charcoal, separated by washing from a hearth at same horizon as Tartangan artifacts, in Layer B, a red, earthy deposit containing dominantly estuarine shells, overlain by white dune sand on which there is a site of Murundian culture containing reef shells similar to those now living at Cape Martin (37° 29' S Lat, 140° 01' E Long). Coll. by N. B. Tindale, South Australia Mus., Adelaide.

Eromanga series, Queensland
Calcium carbonate deposited from artesian water, stored for several years before measurement. Coll. by H. C. Webster, Univ. of Queensland.

NZ-70.  Eromanga

>48,000
Carbonate from bore pipe, diam 6 in., which originally supplied township of Eromanga (26° 42' S Lat, 143° 48' E Long).

Harper River series

Wood from a probable major slump at junction of E and W Branches of Harper River (43° 11' S Lat, 171° 33' E Long), S66/554555. The area is close to a major fault (Harper Fault), involving late Tertiary beds (Suggate, 1958a). Coll. by R. P. Suggate and D. Wilson, N. Z. Geol. Surv., DSIR.

NZ-72.  Harper River, 50 ft above river level

4620 ± 80
2670 B.C.

NZ-73.  Harper River, 6 ft above river level

4550 ± 80
2600 B.C.

NZ-74.  Johnsonville

>45,000
Wood, part of a temperate flora, at road level, Porirua-Johnsonville motorway, 1st cut on E side, S of Porirua Railway Station, 75 ft above sealevel (41° 09' S Lat, 174° 51' E Long), N160/397395. Coll. by D. R. McQueen.
New Zealand Natural Radiocarbon Measurements I-V

NZ-75. Riccarton 3570 ± 70 1620 B.C.

Wood from peat bed in silt underlying Canterbury Plains surface, Mandeville Road, depth 12 ft, Bore No. 2 (43° 32' S Lat, 172° 36' E Long), S84/979558. Coll. by P. J. Alley, Canterbury Univ. College, Christchurch.

Jerf Ajla series, Syria

Finely divided charcoal, mixed with dirt, from Jerf Ajla, a cave in the Syrian Desert (34° 38' N Lat, 37° 08' E Long). The two samples (A and C) were expected to be of the same age, older than 30,000 yr, and to settle the question of late persistence of Levalloiso-Mousterian culture in the district. Carbon content after treatment with HCl, ca. 25%. Coll. by C. S. Coon, Univ. Mus., Univ. of Pennsylvania, Philadelphia, Penn., U. S. A.

NZ-76. Sample A-8, charcoal 43,000 ± 2000 41,050 B.C.

NZ-77. Sample C-8, charcoal 18,000 ± 200 16,050 B.C.

NZ-78. Sample C-8, carbon dioxide 19,800 ± 300 17,850 B.C.

CO₂ evolved from sample NZ-77 during HCl treatment.

NZ-79. Auckland >43,000

Carbonized wood from well-defined seam, 1 to 3 in. thick, ca. 25 ft below surface, 10 ft below upper level of Waitemata formation, Civic Sq., Auckland (36° 51' S Lat, 174° 46' E Long), N42/283605. Coll. by Ministry of Works, Auckland.

NZ-80. Awahuri >45,000

Wood, depth 233 ft in Dairy Factory Well, Awahuri (40° 18' S Lat, 175° 32' E Long), N149/033427. Coll. by M. T. Te Punga.

NZ-81. Foxton 9900 ± 150 7950 B.C.

Wood, depth 155 ft (150 ft below sealevel) in well near water tower, Foxton (40° 29' S Lat, 175° 17' E Long), N148/796206. Coll. by M. T. Te Punga.

NZ-82. Waiora Valley, Wairakei 2000 ± 100 50 B.C.

Wood from small log in cave at W end of Alum Lake at head of Waiora Valley (38° 37' S Lat, 176° 04' E Long), N94/533460. Dates a volcanic eruption in Waiora Valley. Coll. by C. J. Banwell, Dominion Physical Lab., DSIR.

NZ-84. Christchurch 1550 ± 80 A.D. 400

Wood, depth 11 to 15 ft in boiler foundation excavation, Public Hospital, Christchurch (43° 32' S Lat, 172° 38' E Long), S84/995558. See Suggate, 1958b for details. Coll. by B. W. Collins.
NZ-85. **Terrace-Bowen Street, Wellington**  

NZ-86. **Bowenvale Road, Christchurch**  
Wood, 8 ft below road level, S abutment of Heathcote Bridge, Bowenvale Rd., Christchurch (43° 34' S Lat, 172° 39' E Long), S84/009519. Coll. by B. W. Collins.

NZ-87. **Herbert Street, Wellington**  
Wood, depth 35 ft in drill hole for building foundation, in Upper Pleistocene Whiteman Terrace, Herbert Street, 20 ft from W corner of Dixon St., Wellington (41° 18' S Lat, 174° 47' E Long), N164/336214. Coll. by R. W. Willett and G. J. Lensen, N. Z. Geol. Surv., DSIR.

NZ-88. **Lake Hawea**  

NZ-89. **Silver Peaks, Dunedin**  
Wood (*Podocarpus totara*), 2300 ft above sealevel, on hillside now carrying snow tussock and silver beech, Silver Peaks Dist., Dunedin (45° 44' S Lat, 170° 27' E Long), S164/100880. Dates a period of climate moister than the present one. Coll. by P. Wardle, Univ. of Otago.

NZ-90. **The Gap, Silver Peaks, Dunedin**  
Wood (*Podocarpus totara*), 1850 ft above sealevel, on hillside now carrying snowgrass, The Gap, Silver Peaks-Dist., Dunedin (45° 42' S Lat, 170° 28' E Long), S155/120930. Some silver beech in vicinity, but no other trees; totara dates a period of climate moister than the present one. Coll. by G. T. S. Bayliss, Univ. of Otago.

NZ-91. **Waverley**  
Wood from upright tree trunk, part of a drowned forest, in river bed at mouth of Waitotara River, Waverley (39° 51' S Lat, 174° 41' E Long), N137/239967. Coll. by C. A. Fleming. Comment: date, and stratigraphic situation, suggest subsidence of ca. 10 ft in the last 1000 yr.

NZ-92. **Wanganui**  
Wood from youngest band in lignite bed, in Kaiwhara alluvium, the youngest member of the Rapanui formation, Landguard Bluff, Wanganui (39° 57' S Lat, 175° 01' E Long), N138/553837. Alluvium was deposited during a period of slight climatic amelioration after a period of river entrenchment through the marine Waipuna Delta conglomerate. Coll. by C. A. Fleming.
**Canterbury Plains series**

Wood and peat in alluvium, sampled to date the Otarama surface and the younger Kowhai River Terrace that overlies it, Canterbury Plains. Coll. by M. Gage, B. W. Collins, R. P. Suggate, and R. W. Willett.

**NZ-93. Rubicon River**

6050 ± 110
4100 B.C.

Peat, overlain by Kowhai River Terrace, S bank Rubicon River (43° 19' S Lat, 171° 53' E Long), S74/338832.

**NZ-94. Joyce Stream**

>45,000

Wood and peat, 200 ft below Otarama surface, N bank Joyce Stream (43° 17' S Lat, 171° 57' E Long), S74/394868.

**NZ-95. Joyce Stream, wood**

>42,000

Wood, ca. 200 ft below Otarama surface, N bank Joyce Stream 0.25 mi upstream from ford on disused Otarama Rd. (43° 17' S Lat, 171° 57' W Long), S74/394868.

**NZ-96. Joyce Stream, peat**

>40,000

Peat, same locality and stratigraphic position as NZ-95.

**NZ-97. Rubicon River, wood**

6050 ± 80
4100 B.C.

Wood, 10 ft below surface of main Kowhai River Terrace, overlying Otarama surface, S bank Rubicon River, 0.25 mi downstream from homestead at end of Rubicon Rd. (43° 19' S Lat, 171° 53' E Long), S74/338832.

**NZ-98. Rubicon River, peat**

10,200 ± 120
8250 B.C.

Peat, same locality and stratigraphic position as NZ-97.

**NZ-99. Blighs Road, Christchurch**

>45,000

Peat, depth 150 ft in well, Blighs Rd., Christchurch (43° 30' S Lat, 172° 36' E Long), S84/972504. Sampled to determine position of hypothetical unconformity between postglacial alluvial and marine sediments (Suggate, 1958b). Coll. by R. P. Suggate.

**NZ-100. Lake Waikaremoana**

2200 ± 60
250 B.C.

Wood from standing tree, drowned by rise of lake, exposed by lowering of lake level by ca. 50 ft, N shore of Lake Waikaremoana, 2.5 mi WNW of Lake House (38° 45' S Lat, 177° 07' E Long), N105/532295. Coll. by H. W. Wellman.

**NZ-101. Lake Waikaremoana**

2190 ± 60
240 B.C.

Wood from another tree at same locality as NZ-100.

**Takapu Road series, Johnsonville**

Wood from clay fill in V-shaped gully cut in greywacke, Takapu Rd., Johnsonville (41° 11' S Lat, 174° 50' E Long), N160/385348. Sampled to
show rate and continuity of deposition of fill, in connection with study of
former morphology and drainage in the district. Coll. by J. W. Brodie.

**NZ-102. Takapu Road, uppermost horizon**

Sample R160/1.

**NZ-103. Takapu Road, uppermost horizon**

Duplicate of R160/1, NZ-102.

**NZ-104. Takapu Road, 2.5 ft**

Wood from 2.5 ft below R160/1.

**NZ-105. Takapu Road, 7 ft**

Wood from 7 ft below R160/1.

**NZ-106. Takapu Road, base**

From angular conglomerate at base of fill, 14 ft below R160/1.

**NZ-107. Kahao Creek**

Wood from layer of logs, 3 ft below surface of aggradation terrace at

**NZ-108. Porirua**

Peat from clay layer, overlain by angular fragments, overlying gravel,
another bed of clay with plant remains, another gravel layer, and the wood
dated as NZ-74, on Porirua-Johnsonville Rd., same locality as NZ-74 (>45,000,
this date list). Coll. by J. W. Brodie.

**Karori series**

Organic material, part of a suspected fossil soil, 5 ft below surface, over-

**NZ-109. Karori, washed sample**

24,000 ± 500
22,050 B.C.

**NZ-110. Karori, sorted sample**

27,000 ± 600
25,050 B.C.

Comment: material is probably of interstadial age.

**NZ-111. Wainuiomata, Wellington**

Wood with bark, size 8 x 4 x 3.5 in. at top of peat, overlain by 5 ft of
silt. In W bank Black Creek opposite Kent St., Wainuiomata (41° 15’ S Lat,
174° 44’ E Long), N164/491272. Coll. by M. T. Te Punga. Comment: dates
close of peat formation.
NZ-112. Wainuiomata, Wellington  
11,500 ± 160  
9550 B.C.

Wood from branch in peat 5 ft thick, 4 in. above bedrock, 400 yd W of Fitzherbert Rd. junction, beside Wainuiomata Rd. (41° 16’ S Lat, 174° 56’ E Long). Coll. by M. T. Te Punga. Comment: date is early in period of peat formation and shortly after close of last local episode of “solifluction.”

NZ-113. Hawke Bay  
2030 ± 100  
80 B.C.

Carbonized wood: rolled fragments in flat pebbles of pumice from a depth of 30 fathoms in Hawke Bay (39° 16’ S Lat, 177° 22’ E Long). Coll. by H. M. Pantin, N. Z. Oceanog. Inst. Comment: date and lithology suggest this charcoal and pumice may have been deposited by a Taupo-Pumice flood. That the date is greater than that of NZ-1, 3, 4 etc. could be accounted for by derivation from center of a large tree.

NZ-114. Muriwai Beach, Auckland  
1030 ± 60  
A.D. 920

Shells of *Amphidesma Subtriangulata* from sub-fossil deposit behind fore-dunes, 10 mi N of beach road (36° 39’ S Lat, 174° 19’ E Long). Coll. by R. M. Cassie, N. Z. Oceanog. Inst. Comment: these shells are larger than contemporary shells and possibly belong to an extinct race.

NZ-115. Hawera, Taranaki  
>40,000

Wood in peat layer at depth of 35 ft in a well. Peat overlies Upper Pleistocene lahars. Paora Rd., Hawera (39° 34’ S Lat, 174° 14’ E Long), N129/813299. Coll. by P. G. Bamford. Ohawe Beach, Hawera. Comment: peat was formed during the first interstadial of the last glaciation.

NZ-116. Greymouth  
22,300 ± 350  
20,350 B.C.


**Christchurch series**

Shell and wood at various places and positions near Christchurch taken to date postglacial rise of sealevel.

NZ-117. Kaiapoi, Christchurch  
6800 ± 90  
4850 B.C.

Shell from 15 ft below MSL in Moore’s Gravel Pit, Kaiapoi (43° 22’ S Lat, 172° 40’ E Long), S76/033773. Coll. by B. W. Collins. (Suggate, 1958b).

NZ-118. Lake Ellesmere  
9400 ± 120  
7450 B.C.

Wood at depth 71 ft below MSL in bore, Dept. of Agriculture plot, Lake Ellesmere (43° 44’ S Lat, 172° 31’ E Long), S83/891322. Coll. by R. P. Suggate. (Suggate, 1958b.)
NZ-119. Christchurch City 8000 ± 150
Wood at depth 57.5 ft below MSL in bore, corner Madras and Chester Sts., Christchurch City (43° 32’ S Lat, 172° 39’ E Long). Coll. by R. P. Suggate. (Suggate, 1958b.)

NZ-120. Christchurch City 6200 ± 120

NZ-121. 43,000
NZ-120. shell from 11 ft below MSL
NZ-121. peat from 105 ft below MSL

NZ-122. Christchurch City 3810 ± 70
Wood from 3 ft below MSL in excavation, corner Woodham and Worcester Sts., Christchurch City (43° 32’ S Lat, 172° 41’ E Long), S84/040567. Coll. by Mr. Samson, Drainage Board, Christchurch. (Suggate, 1958b.)

NZ-123. Southland 7020 ± 100

NZ-124. Rapahoe Beach, Westland 6500 ± 100

Mohaka River series
NZ-125. Mohaka River >45,000
Wood from basal 2 ft of gravels laid down during early part of last major aggradation in Mohaka Valley at coast, S side (39° 08’ S Lat, 177° 10’ E Long), N115/577824. Coll. by T. L. Grant-Taylor. Comment: trees probably killed during onset of cold of last glaciation, determination places a younger limit on beginning of last glaciation.

NZ-126. Mohaka River >45,000
Wood from 15 ft thick clayey horizon in Mohaka aggradation terrace. Clay laid down during short interval of partial downcutting following deposition of fill of first terrace of last major fluvial aggradation. Mohaka Valley 1.5 mi from coast in gorge formed by small stream (39° 07’ S Lat, 177° 10’ E Long), N115/569835. Coll. by T. L. Grant-Taylor. Comment: because downcutting probably occurred during the first interstadial of the last glaciation, determination places a younger limit on the age of this interstadial.
NZ-127. Hastings

Shells from shell bed 60 ft below MSL in Bore at N. Z. Aerial Mapping Ltd, Hastings (39° 39'S Lat, 176° 51' E Long), N134/263213. Coll. by T. L. Grant-Taylor. Comment: shells show intertidal estuarine ecology, and probably were deposited on a beach. Although the area was affected by earth movements in 1929, depth probably is accurate to ca. 10 ft, and date is that of a sealevel ca. -60 ft.

NZ-128. Hawera

Wood from peat layer immediately above top lahar at end of Fairfield Rd., Hawera (39° 37' S Lat, 174° 17' E Long), N129/852240. Coll. by G. J. Lensen. Comment: a widespread ancient peat overlies the lahars in this area. This sample was separated from underlying lahars by a thin sand: peat probably from interdune swamp. See NZ-115.

NZ-129. Mt. Maunganui

Shells from shell bed 10 ft above sealevel on SW coast of Mt. Maunganui (37° 38' S Lat, 176° 10' E Long), N58/645655. Coll. by D. Kear, N. Z. Geol. Surv., Auckland.

NZ-130. Weheka, Westland

Modern <100

NZ-131

Wood from gravel of low outwash terrace at depth 6 ft. R bank Bullock Creek, 50 yds above road bridge, ca. 5 mi S of Weheka (Fox Glacier), Westland (43° 35' S Lat, 169° 37' E Long), S78/330490. Coll. by N. E. Odell. Comment: two determinations on separate pieces of wood.

NZ-132. Bruce Bay, South Westland

Wood 3 ft below surface in sandy marine terrace 7 ft above sealevel. At Bruce Bay 1 mi N of township at junction of New and Old Shore Rds. (43° 35' S Lat, 169° 37' E Long), S75/330490. Coll. by N. E. Odell. Comment: dates uplift of terrace.

NZ-133. Parawhakatau, Kaikoura Coast

A.D. 1630

Wood from wallpost taken from House Pit C at Parawhakatau 1 mi N of Claveley, Kaikoura Coast (42° 33' S Lat, 173° 30' E Long). Coll. by R. E. Bell, Univ. of Oklahoma. Comment: legend suggests that the pa was occupied for only 20 yrs.

NZ-134. Papatowai, Otago

A.D. 1185

NZ-135. Duplicate sample

Charcoal from lowest levels of occupation debris of a moa-hunter site at mouth of Tahakopa River, Papatowai, Otago (46° 34' S Lat, 169° 27' E Long). Coll by R. E. Bell.
Takahopa River Mouth series

Samples from two occupation levels, in a trench excavation with bones of *Dinornis maximus* and *Eurapteryx gravis* in an association that implies a later date for their extinction than was previously expected. Tahakopa River Mouth, Otago (46° 34' S Lat, 169° 27' E Long). NZ-136 was from basal deposit; the others are from younger occupation, midway up cliff. Coll. by L. Lockerbie.

**NZ-136. Base of trench**  
A.D. 1320
Charcoal associated with moa and seal bones from base of trench.

**NZ-137. Eurapteryx bone**  
A.D. 1490
*Eurapteryx gravis* bones resting on layer of charcoal, ash and sand with bones and artifacts.

**NZ-138. Dinornis bone**  
A.D. 1490
*Dinornis maximus* bone with seal bones and shell.

**NZ-139. Eurapteryx bone**  
A.D. 1640
*Eurapteryx gravis* bones with moa and seal bones.

**NZ-140. Moa bone**  
A.D. 1560
Species not determined.

False Island series

Various samples from two ovens and associated refuse deposit. Deposit postdates use of moa as food at False Island, Otago (46° 29' S Lat, 169° 45' E Long). Coll. by L. Lockerbie.

**NZ-141. Shell**  
A.D. 1480
*Amphidesma australe* shells.

**NZ-142. Fishbones**  
A.D. 1660

**NZ-143. Charcoal from oven**  
A.D. 1630

**NZ-144. Charcoal not from oven**  
A.D. 1605

**NZ-145. Charcoal from oven**  
A.D. 1735

**NZ-146. Tautuku, Otago**  
A.D. 1670
NZ-147. Cannibal Bay, Otago 450 ± 60 A.D. 1500

*Mytilus* shell, from deposit on sandhill slope, well above sealevel, covered by clean sand at Cannibal Bay, Otago (46° 29' S Lat, 169° 45' E Long). Coll. by L. Lockerbie.

**Warehou Bay, Makara series**


NZ-148. Shells Modern i.e. <160 yr 310 ± 60 yr A.D. 1640

NZ-149. Wood

**Cape Campbell Concretion series**

Shell and matrix of a fossiliferous calcareous concretion dredged from ~420 ft off Cape Campbell, Cook Strait (41° 21' S Lat, 174° 17' E Long). Coll. by J. W. Brodie. Comment: shells include abundant *Chlamys delicatula*, now very rare and small in Cook Strait but common in colder water to the S; they lived in a cold climate (Pantin, 1957).

NZ-150. Shells of *Chlamys delicatula* 19,500 ± 1000 17,550 B.C.

NZ-151. Matrix of concretion 27,500 ± 3000 25,550 B.C.

**Sea Bed, Cook Strait series**

Shells from Cook Strait Narrows (41° 21' S Lat, 174° 17' E Long). Coll. by J. W. Brodie. Comment: shells were worn, bored, and stained, therefore processes giving appearance of age are rapid in Cook Strait.

NZ-152. *Ostrea sinuata* shells <200

NZ-153. *Venericardia* shells <250

NZ-154. *Chlamys* shells A.D. 1370 580 ± 100

NZ-155. Various lamellibranchs outside Cloudy Bay A.D. 1700 250 ± 80

NZ-156. Putaruru A.D. 1700 250 ± 80

Carbon flecks from soil underlying the Tirau ash Putaruru-Rotorua Rd. 3.5 mi NE Putaruru (38° 00' S Lat, 175° 49' E Long), N66/308204. Coll. by C. A. Vucetich and D. Cross, N. Z. Soil Bur., DSIR. Comment: gives an older limit for the Tirau ash.
NZ-157. Taupo

2270 ± 100
320 B.C.

Charred wood 10 to 12 in. above Waimihia lapilli member and 8 to 10 in. below base of Taupo lapilli member, in the fossil soil next below that member. Taupo-Rotorua Rd. 0.25 mi NE of Kaimanawa Rd. (38° 34' S Lat, 176° 14' E Long), N94/695523. Coll. by J. Healy.

NZ-158. Hastings

1760 ± 80
A.D. 190

Charcoal from a 10-ft bed in pumice pit on Pakowai Rd. 0.5 mi SSW of Longlands Rd., Hastings (39° 40' S Lat, 176° 47' E Long), N134/212181. Coll. by T. L. Grant-Taylor. Comment: dates the Taupo Lapilli member (see NZ-1, 3, 4, etc.) center of origin 90 mi W.

NZ-159. Hastings

1750 ± 80
A.D. 200

Wood from shrubs in growth position killed by partial burial in the pumice flood debris and consequent rise of water table. Contained charcoal dated 1760 ± 80 yr, NZ-158. From drain 1 chain E of unformed road between Irongate and Maraekakaho Rds., Hastings (39° 39' S Lat, 176° 47' E Long), N134/206194. Coll. by T. L. Grant-Taylor. Comment: date corresponds so closely with that of NZ-158 that the eruption, charring of trees and formation of a pumice flood must have been nearly contemporaneous.

NZ-160. Fort Galatea

1300 ± 80
A.D. 650


NZ-161. Kinleith

1780 ± 80
A.D. 170

Wood from topmost member of Taupo pumice in L bank of sludge channel Kinleith Timber Mill 0.25 mi from Mill (38° 27' S Lat, 175° 53' E Long), N84/371871. Coll. by J. Healy.

NZ-162. Kinleith

1830 ± 70
A.D. 120

Charcoal (small twigs and branches) from Taupo pumice, believed to be mudflow from sludge channel, Kinleith Timber Mill, R bank, 0.25 mi from Mill (38° 17' S Lat, 173° 53' E Long), N84/371871.

NZ-163. Atiamuri Road

1840 ± 50
A.D. 110

Charcoal and twigs from dark gray pumice sand and rhyolite tuff and lapilli above Taupo pumice from pumice pit W side Taupo-Atiamuri Rd. (38° 28' S Lat, 176° 04' E Long), N85/533645. Coll. by J. Healy.

NZ-164. Atiamuri

1890 ± 70
A.D. 60

Twigs from uppermost bed in Taupo pumice, in pumice pit W side of

NZ-165. Arapuni

1900 ± 70
A.D. 50

Small branches, roots, twigs and leaves overlying old soil at site of forest buried below pumice flood at spillway below Arapuni Dam (38° 04' S Lat, 175° 38' E Long), N75/134136.

NZ-166. Lake Okaro

840 ± 50
A.D. 1110

Wood of Leptospermum scoparium 70 yr old in volcanic breccia at depth 20 ft on S bank, Lake Okaro (38° 18' S Lat, 176° 23' E Long), N85/853841. Coll. by D. Cross.

NZ-167. Lake Tutaeinanga

3110 ± 70
1160 B.C.

Wood of partially decomposed log Dacrydium cupressimum 4 ft below surface and 9 in. above Taupo ash bed, in altered andesitic ash erupted from site of Lake Ngapouri. Sample from pit 2 mi W of Waiotapu Hotel and near Lake Tutaeinanga (38° 20' S Lat, 176° 19' E Long), N85/783802.

NZ-168. Pueto River

1900 ± 60
A.D. 50

Wood in dark brown peaty bed immediately below Hatepe Lapilli bed 36 ft below surface. In road cut on left bank of Pueto River at bridge on Broadlands-Taupo Rd. (38° 37' S Lat, 176° 16' E Long), N94/723463. Coll. by C. G. Vucetich.

NZ-169. Rainbow Mountain, Waiotapu

900 ± 40
A.D. 1050

Wood from outer few rings of trees lying directly on top of soil formed from Taupo pumice showers ca. 1800 yr ago. NZ-1, 3, 4, 158, 159, 161, etc. and covered by 20 ft of hydrothermally altered andesite, W side of eroded gulch entering Lake Nahewa Crater, Rainbow Mt., Waiotapu (38° 19' S Lat, 176° 22' E Long), N85/828834. Coll. by E. F. Lloyd, N. Z. Geol. Surv. Comment: fixes maximum date of andesite.

NZ-170. Tongariro National Park

1800 ± 50
A.D. 150

Charred wood from 4 in. above base of rhyolitic pumiceous ash which is overlain by 10 in. of Ngauruhoe ash and underlain by 50 in. of Tongariro ash and lapilli. Tongariro Natl. Park-Wanganui Highway, 1 mi S of junction of Natl. Park-Taupo Rd. (39° 11' S Lat, 175° 24' E Long), N111/905769. Coll. by D. R. Gregg, N. Z. Geol. Sur. Comment: date is that of Taupo lapilli member.

NZ-171. Whakamaru-Tihoi Road

2650 ± 150
700 B.C.

Branches, roots, and twigs, collected from near top of weathered ash shower. From cut on Whakamaru-Tihoi Rd. (38° 25' S Lat, 175° 48' E Long),
N84/283702. Coll. by D. Cross. Comment: sample appears to date host bed rather than overlying ash.

**NZ-172. Lake Rerewhakaitu**

$1800 \pm 100$

**A.D. 150**

Carbonized root from Taupo ash Bretts Rd., near N shore Lake Rerewhakaitu ($38^\circ 17' S$ Lat, $176^\circ 30' E$ Long), N84/958368. Coll. by C. G. Vucetich and D. Cross.

**NZ-173. Atiamuri**

$1750 \pm 50$

**A.D. 200**

Branches and twigs from basal 6 ft of the coarse pumice member in a sequence of pumice-flood deposits carried down the Waikato River Road cut near Atiamuri State Hydro-electric Sta. ($38^\circ 24' S$ Lat, $176^\circ 01' E$ Long), N85/496736. Coll. by J. Healy and B. N. Thompson.

**NZ-174. Atiamuri**

$1800 \pm 100$

**A.D. 150**

Charcoal from base of pumice member, 6 ft thick, underlying coarse pumice member (NZ-173). Road cut near Atiamuri State Hydro-electric Sta. ($38^\circ 24' S$ Lat, $176^\circ 01' E$ Long), N85/496736. Coll. by J. Healy and B. N. Thompson.

**NZ-175. Wairakei**

$1850 \pm 100$

**A.D. 100**

Small charred branches and twigs from rhyolite block member. Compares age of rhyolite block member with that of lapilli member. NZ-1, 3, 4, etc. Rotorua-Taupo Rd., 4 mi NE of Wairakei ($38^\circ 36' S$ Lat, $176^\circ 09' E$ Long), N94/618489. Coll. by J. Healy.

**NZ-176. Terraces Quarry, Taupo**

$1900 \pm 70$

**A.D. 50**

Charcoal dust and fragments of organic material up to 0.25 in. in size, from top inch of Ash Member 9 (Hatepe lapilli) Rotorua Rd., 4 mi NE Wairakei ($38^\circ 43' S$ Lat, $176^\circ 07' E$ Long), N94/589347. Coll. by J. Healy.

**NZ-177.**

$2500 \pm 200$

**550 B.C.**

Charcoal fragments up to 0.5 in. in size, from top inch of Ash Member 11. From quarry on Napier Highway, 1.25 mi SE of Terraces Hotel, Taupo ($38^\circ 43' S$ Lat, $176^\circ 07' E$ Long), N94/589347. Coll. by J. Healy.

**NZ-178. Wairakei**

$2100 \pm 100$

**150 B.C.**

Partially carbonized dust and bits of organic material up to 0.5 in. diam coated with white sediment, from topmost 0.5 in. of Ash Member 9. (Hatepe lapilli). For locality see below, NZ-179.

**NZ-179.**

$3420 \pm 70$

**1470 B.C.**

Charred twigs and branches 0.25 to 1 in. from top of Ash Member 19 (Waimahia lapilli member). From top of first rise on access road to Bore 203 Wairakei ($38^\circ 38' S$ Lat, $176^\circ 05' E$ Long), N94/560439. Coll. by J. Healy.
NZ-180. Hinemaiai River  
3150 ± 90  
1200 B.C.

Carbonized wood from charred log 2 ft above base of a pumice breccia bed 60 ft thick. R bank Hinemaiai River upstream from Pahikokura Creek, Taupo (38° 53’ S Lat, 176° 04’ E Long), N103/531143. Coll. by J. Healy.

NZ-181. Okahukura Bush  
Modern, i.e. <200

Wood from ash layer beneath flow from Te Mari volcanic vent. 4 chains from face of older Te Mari flow. Mangatetipua Stream in Okahukura Bush (39° 08’ S Lat, 175° 40’ E Long), N112/150900. Coll. D. R. Gregg and E. F. Lloyd.

NZ-182. Kaimanawa Road  
2800 ± 100  
850 B.C.

Charcoal up to 0.25 in. from near center of layer of brown rhyolitic ash 3 to 5 in. thick 2 in. above Waimihia lapilli member. (NZ-179) from Rotorua Taupo Rd. 0.25 mi NE of Kaimanawa Rd. corner (38° 34’ S Lat, 176° 14’ E Long), N94/695523. Coll. J. Healy.

Pohokura Road series

NZ-183. Charcoal 27 to 29 in. below surface  
A.D. 150

NZ-184. Charcoal 36 to 39 in. below surface  
450 B.C.

Pohokura Rd. 9 mi. NW of Tutira, Hawkes Bay (39° 07’ S Lat, 176° 49’ E Long), N114/247843. Coll. by H. S. Gibbs. Comment: samples in distinct beds of separate pumice sands, the lower immediately above the Waimihia lapilli member.

NZ-185. Terraces Quarry Taupo  
8850 ± 1000  
6900 B.C.

Carbon flecks and soil from bed 5 in. thick immediately below the Waimihia lapilli member. Terraces Quarry 1.5 mi SE of Terraces Hotel, Taupo (38° 43’ S Lat, 176° 49’ E Long), N94/589347. Coll. by C. A. Vucetich.

NZ-186. Mangatawai Stream  
2500 ± 200  
550 B.C.

Nothofagus sp. leaves from lower 3 in. of unweathered andesitic ash 20 in. thick. The ash which may have come from Mt. Ngauruhoe, is separated from the overlying Taupo pumice by 13 in. of andesitic ash without leaves. The leaf bearing ash is a marker bed throughout 150 sq mi. Cut on Waiouru-Turangi Highway at bridge over Mangatawai Stream, 1 chain S of bridge on S side of road (39° 09’ S Lat, 175° 46’ E Long). Coll. by D. R. Gregg.

NZ-190. Blanche Bay, New Guinea  
A.D. 760

Charcoal from the lower part of pyroclastic deposits which form the wall of Blanche Bay caldera. Tunnel Hill Rd., Blanche Bay, New Guinea (04° 11’ S Lat, 152° 10’ E Long). Coll. by M. A. Reynolds, Vulcanological Observatory,

NZ-191. **Double Island Point Australia** >45,000

Wood *Podocarpus sp.* in lignite (containing mangrove) at high-water mark. Beach front 4 mi S of Double Island Point, Australia (26° 07’ S Lat, 153° 07’ E Long). Coll. J. E. Coaldrake, CSIRO, Brisbane.

NZ-192. **Double Island Point, Australia** >40,000


NZ-193. 39,000 ± 3000

Charcoal in sandy matrix 250 ft above sealevel. Gives minimum age for Teewah Sands. For locality see NZ-194.

NZ-194. 37,050 B.C. 28,350 B.C.

Organic matter of cemented sand 10 ft below hardpan of a former ground water podzol. Cliffs fronting beach 8 mi S of Double Island Point, Australia (26° 06’ S Lat, 153° 07’ E Long). Coll. by J. E. Coaldrake.

NZ-195. **Eucania, Australia** 6270 ± 120 4320 B.C.

Mangrove peat from flat a few feet above high-water mark. Eucania near Babinda, Australia (17° 16’ S Lat, 145° 56’ E Long). Coll. by R. M. Moore, CSIRO, Canberra.

NZ-196. **Mildura, Australia** 5400 ± 80 3450 B.C.


NZ-197. **Tomago, Australia** >33,000


**Soils from Southeastern Australia**


NZ-198. **K₃ cycle** 29,000 ± 800 27,050 B.C.
NZ-199.  \( K_2 \) cycle  
\[ 3740 \pm 100 \]  
1790 B.C.

NZ-200.  \( K_1 \) cycle  
\[ 390 \pm 60 \]  
A.D. 1560

NZ-201.  \( K_0 \) cycle  
modern \(<120\)

NZ-202.  West Pakistan  
Modern \(<200\)


NZ-203.  West Pakistan  
Modern \(<200\)

Charcoal from occupation mound with plain sherds in upper meter which had been used as a Budist Stupa (26° 44' N Lat, 63° 55' E Long). Coll. by H. Field. Comment: sample is from upper meter.

NZ-204.  New Guinea  
Modern \(<100\)


NZ-205.  Lake Callabona, South Australia  
>40,000

Presumed crop contents of Diprotodon, a giant herbivorous marsupial which became extinct in sub-recent time, presumably as the result of climate change. Orroroo, Lake Callabona, S Australia (29° 50' S Lat, 140° 05' E Long). Coll. by D. Mawson, Univ. of Adelaide, S Australia.

6700 \pm 250

4750 B.C.

NZ-206.

Dentine from lower-jaw teeth of Diprotodon. It had been believed that the “crop contents” NZ-205 were related to the animal whose teeth were dated NZ-206. Orroroo (29° 50' S Lat, 140° 05' E Long). Coll. by D. Mawson.

NZ-207.  Keilor, Victoria  
18,000 \pm 500

16,050 B.C.

Charcoal from aboriginal fireplace 5 ft 9 in. below level of cranium from Keilor Cranium Quarry in Keilor Terrace where Dry Creek enters Maribyrnong River, 1 mi N of Keilor, near Melbourne, Victoria (37° 52' S Lat, 144° 50' E Long). Coll. by E. D. Gill, Natl. Mus. of Victoria, Melbourne.

NZ-215.  Auckland  
29,000 \pm 1500

27,050 B.C.

Wood from outer portion of tree in growth position, in tuff covered by flows from Ihumatao volcanic center, S shore of Ihumatao, Mangere, Auckland (37° 00' S Lat, 174° 45' E Long), N42/273427. Coll. by E. J. Searle, Auckland Univ.
NZ-216. Auckland


NZ-217. Auckland

Peat underlying Panmure basin tuff in terrace of Tamaki River, Auckland (36° 55' S Lat, 174° 52' E Long), N42/382539. Coll. by E. J. Searle. *Comment:* result gives an older limit for volcanic activity at this center, and dates a constructional terrace.

Takapuna series, Auckland

NZ-218. Charred wood

NZ-219. Peat

Samples taken from peat bed underlying basalt and tuffs of Pupuke Volcano in Borough Council yard, corner Anzac St. and Tauhoroto Rd., Takapuna (36° 48' S Lat, 174° 46' E Long), N42/282679. Coll. by E. J. Searle. *Comment:* date places older limit on Pupuke volcanics and a younger limit on a low terrace on shore of Shoal Bay. (Searle, 1959b).

Rangitoto series, Auckland

Shells from ash-free sand (NZ-220) underlying Rangitoto ash. Charcoal from base of oven (NZ-221) in 8 ft thick Rangitoto ash, W side Administration Bay, Motutapu Island, near Rangitoto Island (36° 45' S Lat, 174° 54' E Long), N38/421726. Coll. by R. N. Brothers, Auckland Univ. *Comment:* Rangitoto Island is a very young volcano whose activity is suggested by Maori tradition. Samples span period of activity. (Brothers and Golson, 1959).

NZ-220. Motutapu Island, Auckland

NZ-221. Base of oven

NZ-222. Motutapu Island, Auckland

Sheels from ash free sand (NZ-220) underlying Rangitoto ash charcoal from base of oven (NZ-221) in 8 ft thick Rangitoto ash from W side Administration Bay, carbonized wood (NZ-222) underlying Rangitoto ash E side, Administration Bay, Motolapu Is. (36° 45' S Lat, 174° 54' E Long), N38/421726 and N38/423728. Coll. by R. N. Brothers, Auck. Univ. *Comment:* Rangitoto Is. is a very young volcano whose activity is suggested by Maori tradition samples span period of activity.
New Zealand Natural Radiocarbon Measurements I-V

NZ-223. Mt. Albert, Auckland >30,000
Charred branch beneath 15 ft of sub-recent lava in Oakley Creek Quarry, Mt. Albert, Auckland (36° 53' S Lat, 174° 42' E Long), N42/225565. Coll. by W. E. Begbie; subm. by E. J. Searle.

NZ-224. Auckland >42,000
Carbonaceous soil below tuff, 55 ft thick, from Onepoto tuff ring, in Bore 3, Harbor Bridge, Auckland (36° 49' S Lat, 174° 45' E Long), N42/266657. Coll. by E. J. Searle. Comment: date sets younger limit for volcanic activity at this center during a time of low sealevel.

NZ-225. Penrose, Auckland 9000 ± 160 7050 B.C.
Charcoal imbedded in basalt from Mt. Short volcano, Penrose, Auckland (36° 55' S Lat, 174° 49' E Long), N42/335530. Coll. by J. A. Bartrum; subm. by E. J. Searle.

NZ-226. Takapuna, Auckland Modern <200

NZ-227. Takapuna, Auckland >36,000
Charcoal from cinders in E face of Smales Quarry, Takapuna, Auckland (36° 47' S Lat, 174° 45' E Long), N42/277686. Coll. by E. J. Searle.

HOLOCENE STUDIES
POSTGLACIAL SEALEVELS
New Zealand

Hauraki Gulf series
Samples (NZ-265 to 273) collected to determine changes of younger post-glacial sealevel. Samples NZ-269 and NZ-271 were collected 7 mi N of the others and their projected position with respect to the bulk of the samples is given.

NZ-265. Kaiaua and Miranda 980 ± 60 A.D. 970

NZ-266. Miranda 1160 ± 60 A.D. 790

NZ-267. Miranda 1540 ± 60 A.D. 410
Shell 1270 yd from present ridge, 9 ft above mean sealevel. Halfway be-
tween Kaiaua and Miranda (37° 09' S Lat, 175° 18' E Long), N48/807244. Coll. by J. C. Schofield. *Comment:* dates sealevel of +1.5 ft.

**NZ-268. Miranda**

1760 ± 70

A.D. 190

Shell 1590 yd from present ridge, 10.5 ft above mean sealevel. Halfway between Kaiaua and Miranda (37° 09' S Lat, 175° 18' E Long), N48/804243. Coll. by J. C. Schofield. *Comment:* dates a sealevel of +0.5 ft.

**NZ-269. Kaiaua**

2370 ± 70

420 B.C.

Shell 113 yd from present ridge, 2 ft above mean sealevel. Equivalent position in main sequence 1840 yd, 3.5 mi N of Kaiaua near old gravel pit (37° 04' S Lat, 175° 18' E Long), N48/806353. Coll. by J. C. Schofield. *Comment:* dates sealevel of -1.0 ft.

**NZ-270. Miranda**

2730 ± 70

780 B.C.

Shell 90 yd inland from NZ-269, 3 ft above mean sealevel. Halfway between Kaiaua and Miranda (37° 09' S Lat, 175° 18' E Long), N48/799242. Coll. by J. C. Schofield.

**NZ-271. Miranda**

3150 ± 80

1200 B.C.


**NZ-272. Miranda**

3900 ± 90

1950 B.C.


**NZ-273. Miranda**

<250


**Christchurch Sealevel series**

The following shell samples (NZ-274 to 277) were collected from a well one mile inland from the coast. The faunas change from estuarine in NZ-276 to include open-water species in NZ-274. The faunas show sealevel rising faster than deposition, with the shoreline moving westward. Tectonic movement is not expected.

**NZ-274. Christchurch**

5520 ± 70

3570 B.C.

Shell depth 51 ft below sealevel (43° 30' S Lat, 172° 43' E Long), S84/072592. Coll. by R. P. Suggate.

**NZ-275. Christchurch**

7780 ± 80

5830 B.C.

Shell depth 74 ft below sealevel, Palmers Rd., Pumping Sta., Christchurch (43° 30' S Lat, 172° 43' E Long), S84/072592. Coll. by R. P. Suggate.
NZ-276. Christchurch
8530 ± 110
6580 B.C.

NZ-277. Christchurch
5270 ± 80
3220 B.C.
Peat from 2 ft below present sealevel and probably overlain by estuarine silt. Railway excavation Christchurch 5 mi W of coast (43° 33’ S Lat, 172° 39’ E Long), S84/010549. Coll. by R. P. Suggate.

NZ-278. Upolu I, Western Samoa
1180 ± 55
A.D. 750
Coral sand at base of Tafagamanu Sand, 5 ft above sealevel at Tafagamanu Village, Upolu I, Western Samoa (13° 57’ S Lat, 171° 58’ W Long). Coll. by B. L. Wood and D. Kear, N. Z. Geol. Surv. Comment: Tafagamanu Sand probably represents the accumulation of many hundreds of years of sealevels slightly higher than the present.

NZ-279. Geelong Victoria
5620 ± 90
3670 B.C.
Shells from emergent marine shell bed overlying bored freshwater Lara Limestone. From R bank Hovells Creek where crossed by Princes Highway near Geelong, Melbourne (38° 03’ S Lat, 144° 25’ E Long). Coll. by E. D. Gill.

NZ-280. Byrnes Creek, Queensland
3720 ± 85
1770 B.C.

NZ-281. Swan River Valley
9850 ± 130
7900 B.C.
Freshwater peat from 68 ft below sealevel in the valley of the Swan River, now submerged maximum of 140 ft. Narrows Bore, Swan River Valley, Western Australia (31° 57’ S Lat, 115° 51’ E Long). Coll. by D. M. Churchill, Botany Depart., Univ. of Western Australia.

NZ-282. Swan River Valley
7470 ± 120
5520 B.C.
Fossil marri (Eucalyptus calophylla) fruits, bark, wood and twigs, apparently in situ, from depth of 48 to 50 ft and overlain by black shelly estuarine sands. Narrows Bore, Swan River Valley, Western Australia (31° 57’ S Lat, 115° 51’ E Long). Coll. by D. M. Churchill. Comment: marri probably killed by rising sea so that sample dates a low sealevel.

Coral series, West Africa
Ahermatypic corals Dendrophyllia ramea and Madracis asperula from coral banks on the surface of trangressive Holocene sands. Banks are no longer

**NZ-283.** depth of 270 ft  

**NZ-284.** depth of 312 ft

*Comment:* if the banks formed at a level other than the present one compaction or isostatic or tectonic sinking must have occurred.

**HOLOCENE GENERAL**

*New Zealand*

**Ruahine Ranges series, North Island**

Samples collected for pollen analysis and dating to determine variations in recent climate and ages of two prominent pumice horizons. The pollen profiles are not yet completed.

**NZ-285.**  

Wood (*Dacrydium biforme*) in fine uniform peat. Wood was apparently buried by creep of peat on a 10° slope.

**NZ-286.**  

Wood (*Dacrydium biforme*) from peat now dominated by red tussock. Depth 12 in., 3 in. above Taupo pumice horizon.

**NZ-287.**  

Wood (*Dacrydium biforme*) 7 in. below NZ-286 and 3 to 4 in. below Taupo pumice horizon. Depth 19 in.

**NZ-288.**  

Peat from pumice lapilli slightly below NZ-289. Depth 24 to 27 in. Sample should have been the same age as NZ-289. Roots from above appear to have affected the date which is therefore only minimum for this ash shower.

**NZ-289.**  

Large log of *Dacrydium biforme* 5 in. below NZ-287 with layer of grass overlying bank and in contact with layer of Waimihia lapilli, 2.5 to 3 in. thick, which rises over it without change in thickness. Depth 20 to 24 in. Places an older limit on the Waimihia lapilli.

**NZ-290.**  

Log (*Dacrydium biforme*) 5 in. below NZ-289. Probing of bog indicated greatest concentration of wood at this level, although wood abundant both
above and below. Ratios of ages and depths show increased rate of deposition towards this level. Above sequence NZ-285 through NZ-290 0.25 mi due E of Ikawatea (Trig. E 4596 ft) from strip of bog at 4550 ft (39° 36' S Lat, 176° 16' E Long). Coll. by N. L. Elder, N. Z. Forest Service, Napier.

**NZ-291.**

Wood, probably root, below Taupo ash which rises over it. Group of tarns at 4580 ft 10 yd NW of site (39° 36' S Lat, 176° 16' E Long). Coll. by N. L. Elder.

**NZ-292.**

Wood (*Dacrydium biforme*) on margin of wind-blow in sandy peat. In wind-eroded hollow at depth of 10.5 ft 0.25 mi N of Ohawai (Trig. 81, 4,485 ft) (39° 36' S Lat, 176° 16' E Long). Coll. by N. L. Elder.

**NZ-293. Manawatu Wellington**

**A.D. 1095**


**NZ-294. Naike**

**A.D. 970**


**NZ-295. Cook Strait**

**A.D. 235**

Solitary corals (*Flabellum*), collected to determine whether specimens represent living forms or are excavated fossils. From Dominion Museum collection No. 180 from Cook Strait Canyon S of Palliser Bay at 900 ft (41° 28' S Lat, 176° 50' E Long). Subm. by D. F. Squires, Amer. Mus. Nat. Hist., New York. *Comment*: specimens could have died shortly before collection.

**NZ-296. Waiho River, Westland**

**A.D. 260**


**NZ-297. Granite Creek**

**B.C. 6040**

Wood from sand and silt 32 ft thick and 20 ft above creek level. Pollen analysis (W. F. Harris) shows a moist climate possibly warmer than present. Deposit formed during retreat of ice from maximum of Kumara III glacial
substage Granite Ck. 6 chain upstream from road bridge (42° 27' S Lat, 171° 47' E Long), S45/250882. Coll. by F. E. Bowen, N. Z. Geol. Sur.

**Palmer Road series, Westland**

Peat samples from bog behind a late last glacial moraine. SE margin of the bog is a postglacial fault scarp. Peat is light brown and fibrous at the top and dark brown, humified at the base, with a break marked by a mat of *Nothofagus cliffortioides* leaves and wood at 100 cm. Rate of accumulation has been uniform. Pollen analysis by N. T. Moar shows shrub and small tree vegetation at the base replaced by beech forest. Palmer Rd., Westland 0.25 mi S of crooked Mary Creek about halfway along ditch dug to drain bog (42° 24' S Lat, 172° 08' E Long), S46/568944. Coll. by R. P. Suggate.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth Range</th>
<th>Date Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZ-298</td>
<td>38-42 cm</td>
<td>1570 ± 65 A.D. 380</td>
</tr>
<tr>
<td>NZ-299</td>
<td>68-72 cm</td>
<td>2760 ± 75 810 B.C.</td>
</tr>
<tr>
<td>NZ-300</td>
<td>93-97 cm</td>
<td>3380 ± 75 1430 B.C.</td>
</tr>
<tr>
<td>NZ-301</td>
<td>118-122 cm</td>
<td>6560 ± 100 4610 B.C.</td>
</tr>
<tr>
<td>NZ-302</td>
<td>138-142 cm</td>
<td>9820 ± 155 7870 B.C.</td>
</tr>
</tbody>
</table>

**NZ-303. Shearers Swamp, S Westland**  


<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth Range</th>
<th>Date Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZ-304</td>
<td>1530 ± 60 A.D. 420</td>
<td></td>
</tr>
</tbody>
</table>

**NZ-304. Porters Pass, Canterbury**  

Charcoal from trees at depth of 0 to 3 in. below A horizon dates former widespread forest in area now vegetated by *Danthonia* tussock and *Dracophyllum* scrub gives older limit for destroying fire. Porters Pass Canterbury SE side of main ridge at 3500 ft (43° 18' S Lat, 171° 45' E Long), S74/218857. Coll. by B. P. J. Molloy, Dept. of Agriculture, Christchurch.

**Christchurch Formation series**

Samples from the Christchurch formation with a pollen flora (N. T. Moar) suggesting an environment moister than the present, perhaps because of higher ground-water table.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth Range</th>
<th>Date Estimates</th>
</tr>
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<tbody>
<tr>
<td>NZ-305</td>
<td>2040 ± 60 90 B.C.</td>
<td></td>
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</tbody>
</table>

Peat 12 in. thick at depth 4 ft. Pollen indicates Podocarp forest with *P. spicatus* and *P. dacrydiodes* common flora similar to younger NZ-86 (940 ±
New Zealand Natural Radiocarbon Measurements I-V

70 yr) corner Hills Rd. and Edgeware Rd., Christchurch (43° 31' S Lat, 172° 39' E Long), S84/018584. Coll. by N. T. Moar.

NZ-306. Gloucester Street

Peat from swamp forest with dominant Podocarp pollen, corner Gloucester St. and Cambridge Terrace, Christchurch (43° 32' S Lat, 172° 38' E Long), S84/001564. Subm. by N. T. Moar.

NZ-307. Conference Street

Peat with Podocarp flora corner of Conference and Durham Sts., Christchurch (43° 31' S Lat, 172° 38' E Long), S84/002572. Subm. by N. T. Moar.

AGGRADATION OF CHRISTCHURCH FORMATION

Christchurch series

The following give rates of Postglacial aggradation of alluvium in the Christchurch area.

NZ-308. Ilam Road, NW Christchurch


NZ-309. Council Yard, NW Christchurch


Southwest Christchurch

NZ-310. Council Well, SW Christchurch


NZ-311. Sparks Road, SW Christchurch

Wood from gravel, depth 5 ft. Aggradation had reached 30 ft at this time. Sparks Rd. Bridge, Christchurch (43° 35' S Lat, 172° 37' E Long), S84/982521. Coll. by B. W. Collins.

NZ-312. Woolston Park, SW Christchurch

Wood in estuarine silt, depth 9 ft; 2 ft below sealevel, sewer excavation Woolston Park, Christchurch (43° 33' S Lat, 172° 40' E Long), S84/037543. Coll. by B. W. Collins.
NZ-313. Auckland Island


Macquarie Island series

NZ-314.

Basal peat, depth 6 ft overlying bedrock and underlying gravel. Valley of Caroline Cove between Petrel Peak and Mt. Haswell alt ca. 7000 ft (54° 45' S Lat, 158° 49' E Long). Comment: gives minimum estimate of time when S end of Macquarie Island was substantially ice free.

NZ-315. A.D. 440

Basal peat depth 10 ft 400 yd up valley of Nuggets Creek near Nuggets Point, E coast Macquarie Island, alt 20 ft (54° 31' S Lat, 158° 58' E Long).

NZ-316. 1510 ± 55

Basal peat depth 11 ft back of raised beach terrace Eagle Point E Coast Macquarie Island (54° 30' S Lat, 158° 54' E Long). Comment: appears to date only upper portion of covering sediments. Coll. by A. B. Costin, Div. of Plant Industries CSIRO Canberra.

AUSTRALIA

Mt. Kosciusko series, Australia

NZ-317. Club Lake 4400 ± 90


NZ-318. Blue Lake <120

Peat from top of Carex swamp, buried by mineral soils. Cirque above Blue Lake between Carruther’s Peak and Mt. Twynam alt 7200 ft (36° 24' S Lat, 148° 19' E Long). Coll. by A. B. Costin. Comment: date suggests burial probably caused by grazing activities.

NZ-319. Angus River 3540 ± 230

Charcoal, from alluvium of Angus Plains soil association, which is younger than the Bremner Plains association, (without E-W dunes) and the Milang combination (with E-W dunes) N bank. Angus Rd., 5 mi N of Milang, 4 mi...
from Lake Alexandrina (35° 20' S Lat, 139° 00' E Long). Coll. by C. G. Stephens and C. Y. de Muoy, Div. of Soils, CSIRO, Adelaide. *Comment*: date adds to evidence that dune building ceased before the recent arid cycle.

**Boggy Lake series**

Samples from the humified peats of Boggy Lake, Western Australia that show climate changes in the upper postglacial (35° 00' S Lat, 116° 37' E Long). Coll. by D. M. Churchill.

**NZ-320. 2 m**

Peat, highly humified; depth 2 m from W Australian Pollen Zone IV above Transition zone from *Eucalyptus colophylla—Bankasia—Agonis* Scrub of the subboreal to open heath of the Subatlantic.

**NZ-321. 3 m**

Sedge peat, highly humified, depth 3 m. From W Australian Pollen Zone II/III, characterized by *Eucalyptus colophylla maxima* of the subboreal.

**NZ-322. 4 m**

Peat, humified, depth 4 m, from base of W Australian Pollen Zone II, characterized by the commencement of the sharp increase in *Eucalyptus colophylla* during the early Subboreal.

**NZ-323. Perth, Western Australia**

*Melaleuca* stump, 2 ft 6 in. diam, exposed by erosion of dunes. Present vegetation is coastal heath. Sample demonstrates striking floral change in modern times. 1 mi S of City Beach, Perth (31° 55' S Lat, 115° 45' E Long). Coll. by D. M. Churchill.

**NZ-324. Rottnest Island**

Blackboy stump, (*Xanthorrhoea* sp.) (W Australian mus. No. G 9066) depth 19 ft. Rottnest Island off Fremantle Western Australia (32° 00' S Lat, 115° 30' E Long). Genus not recorded in early historical accounts of the flora; its local extinction is attributed to desiccation during the Hypsithermal maximum. Coll. by D. M. Churchill.

**Dead Seas series**

Two (NZ-325, NZ-326) samples of carbonaceous material, in silty and sandy clay, above and below a body of rock salt, buried in lacustrine sediments, at S end of S Basin, Dead Sea (31° 09' N Lat, 35° 27' E Long). A third sample, NZ-327 (31° 12' N Lat, 35° 22' E Long), from a submerged fossil forest exposed by 5 m fall of lake level in 1957-61. Coll. by D. Neev, Geol. Surv. of Israel.

**NZ-325. 0 to 6.2 m sand clay**

(6.22 to 8.05)m rock salt

4410 ± 320

2460 B.C.
NZ-326. 8.05 to 30.00 m silty clay 9580 ± 150
7630 B.C.

NZ-327. Wood from submerged forest modern, i.e. <200

NZ-328. Dead Sea

A.D. 1020

Plant remains, from beneath 200 m of varved sediments and on top of thin salt layer. Water depth 29 m, Dead Sea (31° 19' N Lat, 35° 25' E Long). Coll. by D. Neev. Comment: in other nearby cores superincumbent sediments were thicker. Age is minimum for salt. Below depth of 40 m Dead Sea water is dense and does not mix with the shallower water. The salt layer could have been formed while lake level was falling or rising from the 40 m level. Present data support view that it was deposited during lake rise.

PLEISTOCENE STUDIES

New Zealand

NZ-329. Ngaruawahia

16,300 ± 270
14,350 B.C.

Fossilized herbs, interbedded with sediments of Hinuera Pumiceous Aggradation Terrace, 8 ft below terrace surface. From cut on Ngaruawahia-Glen Massey Rd. 1.5 mi from Ngaruawahia and 0.25 m N of Te Puroa Rd. (37° 41' S Lat, 175° 06' E Long), N56/619603. Coll. by D. Kear and J. C. Schofield.

NZ-330. Cambridge

20,000 ± 500
18,050 B.C.


NZ-331. Opunake

34,400 ± 1500
32,450 B.C.

Stem of shrub from peat lens between 7th and 8th lahar deposits from cliff top, 50 ft below Opunake surface, Opunake Beach, 200 yd WNW from Hihiwera Stream (39° 28' S Lat, 173° 51' E Long), N118/445428. Coll. by T. L. Grant-Taylor. Comment: dates second major episode of ring-plain formation since last interglacial. Pollen analysis (W. F. Harris) determines climate at sealevel as similar to that now on Mt. Egmont at 4,000 ft.

NZ-332. Wellington

>43,000

Peat alt 99 to 100 ft test bore in reclaimed area, Evans Bay, Wellington City (41° 19' S Lat, 174° 48' E Long), N164/364183. Coll. by M. T. Te Punga.

Hauraki Plains series

NZ-333. Piako Swamp

5370 ± 90
3420 B.C.

Peat immediately below a pumice horizon and with a pollen flora suggesting transition from period of greatest postglacial warmth seen in this pro-

**NZ-334. Piako Swamp**

11,900 ± 750
9950 b.c.

Peat from depth 10.25 m. Postdates a climatic amelioration representing the last large climatic fluctuation in this area (37° 25' S Lat, 175° 31' E Long), N53/103914. Coll. by W. F. Harris and J. C. Schofield.

**Wallaceville series**

**NZ-335. Wallaceville Swamp**

1420 ± 60
A.D. 530

**NZ-336.**

1750 ± 60
A.D. 200

Peat, from top and base of Gleichenia fern horizon dating a decrease in wetness of the swamp. Wallaceville Swamp near outlet (41° 08' S Lat, 175° 05' E Long), N161/618404. Coll. by W. F. Harris.

**South Island**

**Dunedin series**


**NZ-337.**

1130 ± 60
A.D. 820

Wood from outside of log 60 in. circumference charred charcoal at one end. Depth 18 in. in silty clay alluvium (45° 52' S Lat, 170° 30' E Long), S164/157724.

**NZ-338.**

1970 ± 70
20 b.c.

Small tree with depth 4 ft 6 in. in alluvial clay, within 8 ft layer of silty clay derived from loess and basalt.

**NZ-339.**

11,500 ± 170
9550 b.c.

Wood *Hoheria* from depth 8 ft, near base of stony gravel interbedded with silty clay derived from loess and basalt.

**NZ-340.**

11,900 ± 200
9950 b.c.

Wood from depth 8 ft 6 in. 6 in. below top of gravelly horizon interbedded with silty clay derived from loess and basalt.

**NZ-341. New Kaikorai Valley School**

31,300 ± 900
29,350 b.c.

Leaves and twigs 22 ft below 15 ft terrace, at top of stony bouldery
horizon, with matrix of silty clay (45° 53’ S Lat, 170° 28’ E Long), S164/122277.

**NZ-342.** 41,000 ± 2300
39,050 B.C.
Small tree from 5 ft 6 in. below surface from near base of clay loam.

**NZ-343.** >39,000
Wood from 3 ft below surface in silty clay horizon (45° 52’ S Lat, 170° 30’ E Long).

**Fiordland series**

A pollen profile in peat sequence shows strongly dominant conifer pollen at base changing to strongly beech pollen dominant above. At first *Nothofagus Menziesii* increases rapidly followed by greater increase of other species, apparently *N. fusca* and finally *N. Solanderi var. cliffortioides*, implying change from warm to cooler (and drier?) climate. Pollen analysis by W. F. Harris. Swamp on saddle E of Lake Monk, Fiordland (40° 00’ S Lat, 166° 59’ E Long). Subm. by W. F. Harris.

**NZ-344.** 9 in. 800 ± 60
A.D. 1150
Peat, depth 9 in., *N. Solanderi var. cliffortioides* very strongly dominant.

**NZ-345.** 12 in. 1680 ± 60
A.D. 270
Peat depth 12 in. Beech dominant.

**NZ-346.** 12-16 in. 1810 ± 65
A.D. 140
Peat depth 12 to 16 in. Conifers codominant with beech.

**NZ-347.** 16-19 in. 5610 ± 90
3660 B.C.
Peat depth 16 to 19 in. Conifers dominant.

**Australia**

**NZ-348. Gormanstown, Tasmania** >40,000
Wood-bearing bed abuts against and is older than steeply dipping till. Gormanstown, near Queenstown, Western Tasmania (42° 04’ S Lat, 145° 35’ E Long). Coll. by H. A. Bartlett. Univ. of Tasmania (Ahmad, Bartlett and Green, 1959).

**NZ-349. King Island, Tasmania** 37,500 ± 1900
5550 B.C.
*Nothofagus* driftwood, in alluvium 4 ft above sealevel, overlain by deeply leached dune sand of the Old Dune system. Associated flora suggests slightly cooler or wetter climate than the present. Shorelines at 26 ft and 45 ft are as-
signed to the last interglacial (41° 00’ S Lat, 144° 09’ E Long). Coll. by J. N. Jennings, Australian Nat. Univ., Canberra.

**Borneo**

**NZ-350. Brunei Town, Borneo**  
>40,900

Wood, from youngest of several raised terraces. Muara Rd. 3.5 mi from Brunei Town (04° 58’ N Lat, 114° 58’ E Long). Coll. by G. E. Wilford, Geol. Surv., Kuching Sarawak.

**NZ-351. Brunei Town, Borneo**  
>39,800

Wood from horizon similar to NZ-350, Muara Rd. 2.5 mi from Brunei Town (04° 57’ N Lat, 114° 58’ E Long).

**NZ-352. Lawas, Borneo**  
1950 ± 75  
A.D. 1


**NZ-353. Sipangao Island, Borneo**  
28,000 ± 600  
26,050 b.c.

Oyster shell from raised bench, 21 ft above high tide, N coast of Sipangao Island 8 mi S of Semporna, North Borneo (04° 22’ N Lat, 118° 36’ E Long). Coll. by H. J. C. Kirk, Geol. Surv., North Borneo. Comment: shell slightly recrystallized. Date is therefore a younger limit to the formation of the reef and the volcanic rocks on which it is built.

**ARCHAEOLOGY**

**New Zealand**

**Coromandel Peninsula series**

NZ-355 and 356 25 yd N, 359 50 yd N, 358 60 yd N, 357 70 yd N of stream cut gap in dunes, Moa-hunter site, Sarahs Gully, Coromandel Peninsula (36° 42’ S Lat, 175° 47’ E Long), N40/283799. All samples coll. by J. Golson, Auckland Univ.

**NZ-354. Mahinapua Bay**  
640 ± 50  
A.D. 1310

Charcoal, Level 4C Squares 3, 4, 5, with shell, moa egg shell and archaic (moa hunter) culture 4 ft 6 in. below surface. Mahinapua Bay, 150 yd N of mouth of Otama Creek (36° 43’ S Lat, 175° 48’ E Long), N40/287776.

**NZ-355. Level 4**  
600 ± 50  
A.D. 1350

Charcoal, Level 4 Area D Square F7. Thin, rich Moa hunter occupation 4 ft below blown sand of surface on terrace.

**NZ-356. Level 3**  
<200

Charcoal, from oven in culture Level 3 Area A Square G9, 1 ft 9 in. below surface. Dates an upper level in series of archaic layers.
NZ-357. Level 3A  
590 ± 50 A.D. 1360
Charcoal, from culture Level 3A Area B square G15 and 16 15 in. deep oven with moa pelvis on terrace.

NZ-358. Level 8  
810 ± 50 A.D. 1140
Wood from dwelling post culture Level 8 Posthole D Area A, dates building of intermediate archaic sequence.

NZ-359. Level 9  
650 ± 50 A.D. 1300
Charcoal, from culture Level 9 Area A Square H 11, 4 ft 3 in. below surface. From refuse pit representing earliest archaic occupation.

Western Samoa

NZ-360. Safata, W Samoa  
240 ± 50 A.D. 1710
Charcoal from hearths on W side of cave, 250 yds from entrance. Dist. of Safata 3 mi inland from Sanapu village, Samoa. Seuao lava tunnel (13° 59' S Lat, 171° 53' W Long). Coll. by J. Golson. Comment: occupation more recent than the traditional one during the Tongan invasion 19 generations ago.

Vailele Plantation series, W Samoa

NZ-361. Layer 5, upper  
1880 ± 60 A.D. 70
Charcoal, from culture Layer 5, top half, under house mound. Layer contains first pottery found in Samoa.

NZ-362. Layer 5, lower  
1850 ± 50 A.D. 100
Bottom half layer 5, 5 ft below surface of mound.

NZ-363. Below Layer 5  
1950 ± 120 A.D. 1
Immediately below layer 5, 6 to 6.5 ft below mound surface in a pit, associated with pottery.

Fromms Landing series, S Australia
Fromms Landing, Lower Murray River, S Australia (34° 46' S Lat, 139° 37' E Long). Coll. by D. J. Mulvaney, Univ. of Melbourne.

NZ-364. Basal occupation  
4800 ± 100 2850 B.C.
Unio shells, from 4 in. band near lowest level of human occupation at this site. Overlain by levels containing crescentic microliths and pirri points. Gives maximum age for the overlying artifacts.

NZ-365. Fromms Landing, 4 ft depth  
3240 ± 80 1290 B.C.
Charcoal, from layer of intense hearth occupation at a depth of 4 ft from
surface, marking a beginning of deterioration in production of techniques of stone and bone implements.

**NZ-366. Keilor Quarry, Melbourne**

15,000 ± 1500
13,050 b.c.

Charcoal from carbonaceous lens 6 ft 9 in. stratigraphically above NZ-207 (18,000 ± 500 yr) and at the same site, just below diastem. At another site charcoal from 2 ft 6 in. above diastem gave 8500 ± 250 (W-169, USGS II). Keilor Cranium Quarry in Keilor Terrace; where Dry Creek enters Maribyrnong River 1 mi N of Keilor near Melbourne (37° 52' S Lat, 144° 50' E Long). Coll. by E. D. Gill, Natl. Mus. of Victoria. Comment: Keilor Cranium came from at or near this stratigraphic level. Sample is combined carbon and carbonate, date represents order of magnitude only.

**NZ-367. Glen Aire, Victoria**

370 ± 45
A.D. 1580

Charcoal from depth of 5 ft 9 in. to 6 ft in Layer 4, the lowest layer to produce bone points similar to those collected from Warrnambool by E. D. Gill and dated (C-601) as 538 ± 200 yr. Rock shelter at Glen Aire, Cape Otway, Victoria (38° 46' S Lat, 143° 20' E Long). Coll. by D. J. Mulvaney.

**NZ-368. Rub’al Khali, Saudi Arabia**

5090 ± 200
3140 b.c.

Charcoal associated with Neolithic arrowheads from a camp site E of Jiladah, Rub’al Khali, Saudi Arabia (18° 48' N Lat, 50° 16' E Long). Coll. by B. Beverley; subm. by H. Field. Comment: Neolithic hunters apparently occupied this region at the time of the civilizations in Egypt, Mesopotamia.

**South America**

**NZ-369. Cabeza, Peru**

5020 ± 120
3070 b.c.


**Volcanology**

**New Zealand**

**NZ-370. Mayor Island**

8390 ± 135
6440 b.c.

Wood, in pumice breccia, of first eruptive phase that formed main cone of Mayor Island. From cliff section in crater wall of main cone behind Te Paritu Lake (37° 18' S Lat, 176° 17' E Long). Coll. by R. N. Brothers.

**NZ-371. Upper Waipa**

385 ± 50
A.D. 1565

Charcoal from beds of alluvial pumice sand and conglomerate. Upper Waipa, road cut, immediately E of bridge over Waipa River 0.5 mile downstream of Okurawhanga Stream mouth (38° 27' S Lat, 175° 26' E Long),
T. L. Grant-Taylor and T. A. Rafter

N83/980672. Coll. by D. Kear. Comment: although of similar appearance to the Taupo pumice alluvium NZ-1, 3, 4, etc. (1800 yr), sample dates either a younger eruption or a pre-European fire that led to massive alluviation.

NZ-372. Wellington City 8020 ± 130
          6070 b.c.

Wood and roots from carbonaceous alluvial muds 18 in. above a pumiceous ash bed 3 in. thick. Sewage tunnel 90 ft W of corner Drummond St. and Adelaide Rd. 0.5 mi from pre-European shoreline (41° 18' S Lat, 174° 47' E Long), N164/339196. Coll. by A. C. Beck and N. de B. Hornibrook, N. Z. Geol. Surv. Comment: date is minimum age for a violent rhyolitic eruption in the central volcanic district, some 180 mi N. Pollen analysis (D. J. McIntyre) gives a Dacrydium cupressinum-dominant flora, of warm postglacial type.

NZ-373. Wharekauri, Chatham Islands 39,600 ± 2000
          37,650 b.c.


NZ-374. Gataivai Village, W Samoa A.D. 1190


NZ-375. Gataivai Village, W Samoa A.D. 1235


NZ-376. Puapua Village, W Samoa A.D. 100

Coral sand 5 ft above present beach, overlain by Puapua Basalt, NW end of Puapua Village, Savaii Island (13° 35' S Lat, 172° 14' W Long). Coll. by B. L. Wood and D. Kear. Comment: dates a sealevel higher than the present and places an older limit on the Puapua Basalt.

NZ-377. Cape Tapaga, W Samoa A.D. 35

Coral fragments from slightly cemented 6 in. bed, interbedded with Vini Tuff. Upolo Island, inland side of hillock on Cape Tapaga (14° 03' S Lat, 171° 25' W Long). Coll. by B. L. Wood and D. Kear.

NZ-378. St Lucia, West Indies >40,000

Charred wood from volcanic ash that is among the latest within the Morne
New Zealand Natural Radiocarbon Measurements I-V


NZ-379. Dominica, West Indies

Charred wood from pumice tuffs that were among the last products from the Microtrin-Trois Pitons center. Small excavation in pumiceous tuffs below hairpin bend in last inland local road near Roseau, behind Woodbridge Bay, Dominica (15° 18' N Lat, 61° 23' W Long). Coll. by P. Martin-Kaye.

MISCELLANEOUS

New Zealand

NZ-380. Hokianga, Auckland


Australia

NZ-381. Orroroo, S Australia

Diprotodon Molar. 4 mi NE of Yalpara Station Homestead near Orroroo South Australia (32° 30' S Lat, 138° 55' E Long), Coll. by S. Australian Mus., Lake Callabona, field party 1955. Note: surface scraped and washed in dilute HCl. Comment: sample checks significance of NZ-206, 6700 ± 250 as against NZ-205 >40,000.

References

Date lists:

- New Zealand I Fergusson and Rafter, 1953
- New Zealand II Fergusson and Rafter, 1955
- New Zealand III Fergusson and Rafter, 1957
- New Zealand IV Fergusson and Rafter, 1959
- New Zealand V Grant-Taylor and Rafter, 1962
- USGS II Rubin and Suess, 1955


——— 1960, Carbon 14 date for a neolithic site in the Rub 'al Khali: Man., v. 60, p. 172 (article 214).


——— 1960b, Sea level fluctuations during the last 400 years as recorded by a chenier plain, Firth of Thames, New Zealand: New Zealand Jour. Geol. and Geophysics, v. 3, p. 467.


GRONINGEN RADIOCARBON DATES IV

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INTRODUCTION

An attempt has been made to assemble the large number of C\textsuperscript{14} dates measured in Groningen since the last date list was published in 1958. We have not succeeded in preparing all the measurements done in this time; the present list contains a more or less random selection. It is hoped the rest will be included in next year’s list.

The larger portion of these results were obtained by Hessel de Vries in the last two years of his life, years in which he contributed much to the problem of establishing an absolute chronology for the cultural and climatological events of the last ice age. A number of the samples were measured during the time the laboratory operated under the supervision of Prof. H. de Waard (Jan. 1960 to Sept. 1961). A few results obtained since one of us (J.C.V.) assumed responsibility for the laboratory in October 1961 have also been incorporated.

Since 1961 all ages have been given relative to 95\% of the activity of the NBS oxalic-acid standard containing a relative C\textsuperscript{13} depletion of \(8\text{C}_{13} = -19\%\). An analysis was made of the calibration samples used in the past and the relationship established between the old reference standard (recent wood) and the oxalic acid. It is therefore now possible to give the correction for the Suess effect of all previous Groningen dates. It appears the exact correction to be applied differs for the different counters and also changed during the course of time. In this paper the corrections have been applied, and to distinguish the new values from previously published figures the laboratory serial numbers are now preceded by the prefix GrN- instead of Gro-.

The number of years to be added to the different series of Gro-numbers is summarized in Table 1. With the aid of this table any Groningen C\textsuperscript{14} date with a Gro-number can be corrected for the Suess effect. With the correction applied a Gro-date automatically becomes a GrN-date with the same serial number. It is suggested that in new publications in which Groningen C\textsuperscript{14} dates are cited the Gro-values be replaced by GrN-values in this manner.

The ages are calculated on the basis of a half life of 5570 and are expressed in years before 1950. To convert these ages into dates B.C., 1950 years must be subtracted.

In many cases several measurements were performed on the same gas, thus acquiring more than one laboratory number for the analyses. Generally the ultimate weighted average is denoted by the highest number. In instances where a preliminary result has been communicated it is possible the serial number will differ from the one reported in a date list. In such cases the slightly differing figures should not be regarded as different analyses and the designations in the date list accepted throughout.

The samples were all subjected to a chemical pretreatment to remove contaminating carbonaceous material. In general the procedure was the same as

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Table 1

Corrections to be applied to all Groningen dates with Gro-Numbers*

<table>
<thead>
<tr>
<th>Counter</th>
<th>Period</th>
<th>Gro-Numbers</th>
<th>Correction (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small copper</td>
<td>1953-Oct. 1955</td>
<td>001-499</td>
<td>0 ± 20</td>
</tr>
<tr>
<td>Large copper</td>
<td>Feb. 1956-Aug. 1956</td>
<td>500-599</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apr. 1959-June 1960</td>
<td>2501-2646</td>
<td></td>
</tr>
<tr>
<td></td>
<td>July 1960-July 1961</td>
<td>2647-2800</td>
<td>+ 320 ± 7</td>
</tr>
<tr>
<td>Large quartz</td>
<td>Jan. 1956-Aug. 1957</td>
<td>901-1200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aug. 1957-July 1958</td>
<td>1501-1700</td>
<td>+ 240 ± 10</td>
</tr>
<tr>
<td></td>
<td>July 1958-June 1960</td>
<td>1801-2176</td>
<td></td>
</tr>
<tr>
<td>Small quartz</td>
<td>Nov. 1958-Apr. 1959</td>
<td>832-900</td>
<td>+ 200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2201-2210</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apr. 1959-Feb. 1961</td>
<td>2211-2371</td>
<td>+ 100 ± 30</td>
</tr>
</tbody>
</table>

* The statistical uncertainties attached to the corrections in the last column seldom change the statistical error of the sample because these two quantities are added quadratically.

described in Groningen II. All samples were treated with hot dilute hydrochloric acid to remove carbonates. In cases where humic substances were extracted with sodium hydroxide (old samples), this is stated in the text. Occasionally rootlets were removed from charcoal samples by digesting the sample in 12% sulphuric acid and oxidizing the rest with sodium hypochlorite.

For charred bones or material consisting mainly of burnt bone fragments, de Vries developed the following procedure. After rinsing in dilute acid, the sample is destructively digested in 20% HCl and washed. Then it is extracted with ca. 3 NaOH and the solubles precipitated with acid. This fraction was found to give a reliable result while the insoluble carbonaceous material often gave too young an age. Where several fractions of one sample were measured the highest age is to be considered the most reliable.

Sample descriptions and comments have been made on the basis of written communications by the submitters. They have been kept as short as possible. As a rule, only one recent reference to literature is given.

SAMPLE DESCRIPTIONS

I. OLD WORLD ARCHAEOLOGY

A. Palaeolithic of Europe

Istállóskő Cave series, Hungary

Two charcoal samples were dated from the Istállóskő Cave (ca. 47° 30’ N Lat, ca. 23° E Long), Bükk Mountains, Hungary (Vétes and de Vries, 1959).
There are two habitation layers, separated by 1 m of debris, in which a sedimentation hiatus can be demonstrated. Coll. by L. Vértes, Budapest.

GrN-1935. Istállóskö 2  
30,900 ± 600  
28,950 B.C.

Charcoal from fireplace in upper habitation layer (Aurignacian II). Coll. 1958; subm. by H. Gross, Bamberg, Germany. Comment: sample was given the full pretreatment for charred bone. The alkali soluble fraction was measured.

GrN-1501. Istállóskö 1  
31,540 ± 600  
29,590 B.C.

Charcoal from fireplace in lower habitation layer (Aurignacian I). Coll. 1951; subm. by H. Schwabedissen, Cologne, Germany. Comment: sample was given only an acid pretreatment; alkali pretreatment would have removed an important part of the small sample.  
General Comment: only the upper date can be considered reliable. The thick intercalated layer would, according to the collector, cover at least 5000 yr. See also Movius (1960).

GrN-2649. La Cotte de St. Brelade, Channel Islands  
47,000 ± 1500  
45,050 B.C.

Black ashes associated with a Late Acheulian type industry and a cold temperate fauna in the cave of St. Brelade (49° 12' N Lat, 2° 12' W Long), Jersey, Channel Islands. A Mousterian level occurs much higher in the stratigraphic succession. Coll. 1958-59 by Father C. Burdo and D. Le Cocq; subm. by K. P. Oakley, British Mus. (Nat. History), London. Comment: sample was treated only with dilute acid prior to combustion and could have contained recent humic material making it appear younger.

La Quina series, France

Two samples of charred bone were dated from the rock shelter of La Quina (45° 30' 35" N Lat, 0° 17' 50" E Long), Commune de Gardes-Le-Pontaroux, Charente, France. Coll. and subm. by Mlle G. Henri Martin, C.N.R.S., Paris.

GrN-1493. La Quina 1  
31,400 ± 350  
29,450 B.C.

Charred bone from Aurignacian I occupation layer.

GrN-2526. La Quina 2  
35,250 ± 530  
33,300 B.C.

Charred bone from the last Mousterian occupation level.  
General Comment: both samples were given the full pretreatment for charred bone. A further sample from a stratigraphically deeper layer was also submitted in 1959. The humic material extracted from this sample gave an age of 25,070 ± 220 (GrN-2325, unpub.), which is too young, but nevertheless so old that the other two dates can be considered quite reliable.

GrN-1491. Caminade, France  
29,100 ± 300  
27,150 B.C.

Bone charcoal from the lower of two culture layers included in a reddish
sand in the rock shelter of Caminade (44° 51' N Lat, 1° 13' E Long), commune de la Caneda, near Sarlat, Dordogne, France. The upper layer is Aurignacian II, the lower layer contains a probably evolved typical Aurignacian I (de Sonneville-Bordes and Mortureux, 1955). Coll. by M. R. Mortureux; subm. by F. Bordes, Univ. of Bordeaux, France. Comment: this date is discussed by Movius (1960, p. 367). The sample was fully pretreated as for charred bone.

**Grotte du Renne series, France**

Two samples were measured from the Grotte du Renne (47° 35' 54" N Lat, 3° 58' 30" E Long), Arcy-sur-Cure, Yonne, France (Leroi-Gourhan 1952). Coll. and subm. by A. Leroi-Gourhan, Musee de l'Homme, Paris, France.

| GrN-1717 | Grotte du Renne VII | 30,800 ± 250 B.C. |
| GrN-1742 | Grotte du Renne VIII | 33,860 ± 250 B.C. |

Charred bone from Level VII (Aurignacian II).
Charred bone from Level VIII (Chatelperron).

Comment: samples were given the pretreatment for charred bone. For a discussion of the dates, see Movius (1960, p. 366 and 367).

**Abri Pataud series, France**

From Movius' excavation at Abri Pataud (44° 50' N Lat, 1° 0' E Long), commune des Eyzies, Dordogne, France, a number of samples were dated. Extensive experiments were carried out on some of them in order to remove possible contamination. There are two levels: a Proto-Magdalenian and an underlying Perigordian VI horizon. Coll. 1958 and 1959 and subm. by H. L. Movius, Harvard Univ., Cambridge, Mass., U. S. A.

| GrN-1864 | Abri Pataud, Perigordian, “bone” fraction | 18,470 ± 280 B.C. |
| GrN-1892 | Abri Pataud, Perigordian, “rest” fraction | 21,540 ± 160 B.C. |

Ashes (burnt bone) from Perigordian horizon. Comment: sample pretreated as burnt bone.

| GrN-1857 | Abri Pataud, Proto-Magdalenian A | 20,960 ± 220 B.C. |
| GrN-1861 | Abri Pataud, Proto-Magdalenian B, “bone” fraction | 20,780 ± 170 B.C. |
| GrN-1885 | Abri Pataud, Proto-Magdalenian B, “rest” fraction | 19,300 ± 170 B.C. |

Ashes pretreated as charred bone. Comment: Movius (1960, p. 368) incorrectly describes this sample as “ash with humus extracted” (GrN-1861) and “ash without humus extracted” (GrN-1885).
Groningen Radiocarbon Dates IV

GrN-1862. Abri Pataud, Proto-Magdalenian C  
21,940 ± 250  
19,990 b.c.

Uncharred bone from the Proto-Magdalenian level. Remainder after extraction.

GrN-2081. Abri Pataud, Proto-Magdalenian D  
20,540 ± 140  
18,590 b.c.

New sample, remainder of bone after extraction (another experiment).

GrN-2115. Abri Pataud, Proto-Magdalenian D  
20,340 ± 200  
18,390 b.c.

The same sample; collagenous proteins.

GrN-2123. Abri Pataud, Proto-Magdalenian D  
19,780 ± 170  
17,830 b.c.

The same sample; collagenous proteins soluble in alkali.

General Comment: the submitter had expected a somewhat higher age for the Perigordian level. From the chemical point of view, however, there is no reason to assume a stronger contamination in the Perigordian sample than in the Proto-Magdalenian samples.

From the extensive experiments by de Vries on the uncharred bone sample D from the Proto-Magdalenian level, only those are given here that yielded the oldest dates. In view of the date of the charred bone sample A, they seem to be reliable. Measurements on different fractions gave ages between 5500 and 17,500 yr.

As to the ash samples from the Perigordian and Proto-Magdalenian level, it is peculiar that the “bone” fraction gives an apparently too low date for the Perigordian level, while in the case of the Proto-Magdalenian level it gives a higher age than the ashes after extraction. For further comments see Movius (1960, p. 368).

Laugerie-Haute Est series, France

Two samples were measured from the well-known rock shelter of Laugerie-Haute Est (44° 50' N Lat, 1° 0' E Long), near Les Eyzies, Dordogne, France. Excavation in 1958 by F. Bordes, who collected and submitted the samples.

GrN-1876. Laugerie-Haute: Proto-Magdalenian  
21,980 ± 250  
20,030 b.c.

Bone charcoal from the Proto-Magdalenian layer, labelled “F” by Peyrony and “36” by Bordes (1958). The layer is situated between the Perigordian III and the Lower Solutrean.

GrN-1888. Laugerie-Haute: Lower Solutrean  
20,890 ± 300  
18,940 b.c.

Bone charcoal from a fireplace at the bottom of the Lower Solutrean layer, labelled “H1” by Peyrony and “31” by Bordes (1958).

General Comment: dates have been discussed by Movius (1960, p. 369). Both samples were pretreated as charred bone and the alkali soluble fraction measured.
GrN-1632. Lascaux, France 17,190 ± 140 15,240 B.C.
Charcoal from culture layer in the cave of Lascaux (45° 3' 12" N Lat, 1° 10' 30" E Long), near Montignac, Dordogne, France. A stalagmite layer, which was dated at 8510 ± 100 (GrN-1182, Groningen III, p. 1553), overlies the present layer. The submitter considers it as contemporary to one of the periods of painting (Magdalenian). Coll. 1958 and subm. by Abbé A. Glory, Strassbourg. Comment: date seems to confirm the old Chicago date C-406: 15,516 ± 900 (Arnold and Libby, 1951, p. 112). For a further discussion of the Lascaux cave see Movius (1960, p. 371-2), who apparently did not know the new date at that time. The sample was treated as charred bone.

GrN-2036. Repolust Cave, Austria 13,370 ± 150 11,420 B.C.
Charred wood from fireplace in gray sands in the Repolust Cave (ca. 47° 13' N Lat, ca. 15° 22' E Long), near Peggau, SE Austria. Alt 525 m. Distance from entrance 22 m, depth 0.5 m. The sands and underlying loam contain rich archaeological remains, correlated with the Late Clactonian, the Tayacian and the Wildkirchli cultures, as well as rich faunal remains, including Ursus spelaeus deningeri. Expected age: end of Eem interglacial. Coll. 1948 by M. Mottl and V. Maurin; subm. by K. Murban, Mus. für Bergbau, Geologie und Technik, Graz, Austria. Comment: sample is much younger than was expected. It had been treated with candle wax whose carbon is presumably of recent origin, but this should have been removed by the applied pretreatment with chloroform and benzol.

GrN-2090. Schussenquelle B, Germany 13,090 ± 110 11,140 B.C.
Marly moss-peat ("mergeliger Braunmoostorf") situated between two layers of travertine ("Kalktuff") at the Schussenquelle (48° 01' 23" N Lat, 9° 39' 30" E Long), Baden-Württemberg, Germany. Depth ca. 3.00 m below surface. Pollen zone Ib (presumably Boëlling). Expected age ca. 13,000 yr. The lower layer of travertine overlies a moss-peat containing Magdalenian artifacts. This moss-peat (Pollen zone Ia) has been dated at 14,710 ± 385 (GrN-468, Groningen II, p. 6). Coll. 1953 by E. Wall; subm. by G. Lang, Landesammlungen für Naturkunde, Karlsruhe, Germany. Comment: date is according to expectation.

Grotte de la Vache series, France
Two samples were dated from the cave of la Vache (ca. 42° 50' N Lat, ca. 1° 40' E Long), commune d’Alliat, Ariège, France. The main culture layer belongs to the Magdalenian. They were coll. 1958 by R. Robert; subm. by F. Bordes.

GrN-2025. Grotte de la Vache 2 12,540 ± 105 10,590 B.C.
Charcoal and ash from Couche 2.

GrN-2026. Grotte de la Vache 4 12,850 ± 60 10,900 B.C.
Charcoal and ash from Couche 4.
**General Comment:** for a discussion of these dates, see Movius (1960, p. 371). Samples were treated as charred bone.

**GrN-1913. Angles-sur-l'Anglin, France**

14,160 ± 80  
12,210 B.C.

Charcoal and ash from middle Magdalenian (Magdalenian III) occupation layer in the rock shelter Roc aux Sorciers at Angles-sur-l'Anglin (46° 42' N Lat, 0° 53' E Long), Vienne, France (de Saint-Mathurin and Garrod, 1951). Coll. and subm. by S. de Saint-Mathurin. **Comment:** see Movius (1960, p. 370). Sample pretreated as charred bone.

**Budel series, Netherlands**

Charcoal samples were dated from two Upper Palaeolithic sites near Budel (51° 15' 18'' N Lat, 5° 37' 15'' E Long), province of Noord-Brabant, Netherlands (Bohmers, 1960). Coll. by A. Wouters; subm. by A. Bohmers, Biol.-Archaeol. Inst., State Univ., Groningen, Netherlands.

**GrN-1687. Budel IV**

11,070 ± 90  
9120 B.C.

Charcoal from Ahrensburgian habitation layer.

**GrN-1675. Budel II**

11,440 ± 120  
9490 B.C.

Charcoal from Tjongerian habitation layer. **General Comment:** dates are according to expectation. Both samples were treated with dilute acid and alkali.

**Duurswoude series, Netherlands**

Two samples were dated from the excavation of a combined Palaeolithic and Mesolithic settlement near Duurswoude (53° 03' 07'' N Lat, 6° 15' E Long), municipality of Opsterland, province of Friesland, Netherlands. The Mesolithic finds occurred near the surface, those of the Upper Palaeolithic Tjonger culture were found below a cover sand deposit. Coll. and subm. by A. Bohmers.

**GrN-1567. Duurswoude III A**

7700 ± 70  
5750 B.C.

Charcoal from Mesolithic fireplace.

**GrN-1565. Duurswoude II**

11,090 ± 90  
9140 B.C.

Charcoal from habitation layer of the Tjonger culture. **General Comment:** dates are according to expectation. Previous measurements on other Mesolithic sites in the same area had yielded 7700 ± 100 (GrN-1173) for Duurswoude I and 7710 ± 70 (GrN-1175) for Duurswoude III (Groningen III, p. 1553). Both samples were treated with acid and alkali.

**Milheeze series, Netherlands**

Two samples were dated from the excavation of a settlement of the Upper Palaeolithic Tjonger culture at Milheeze (51° 30' N Lat, 5° 49' E Long), province of Noord-Brabant, Netherlands (Bohmers, 1960). The habitation layer is situated in the soil profile of the Allerød period (Usselo layer) and is
covered by a layer of cover sand, deposited in the Younger Dryas period. On top of the cover sand Mesolithic finds occur. Coll. and subm. by A. Bohmers.

GrN-2318. Milheeze II  
Charcoal from Mesolithic fireplace on top of cover sand layer.  
8500 ± 160
6550 B.C.

GrN-2314. Milheeze I  
Charcoal from fireplace in habitation layer of the Tjonger culture, below the cover sand layer.  
10,880 ± 125
8930 B.C.

General Comment: dates are according to expectation.

Romanelli Cave series, Italy

A series of five charcoal samples was dated from the main occupation layer in the Romanelli Cave (ca. 40° 1’ N Lat, ca. 18° 24’ E Long), Castro, province of Lecce, Italy (Blanc, 1928). The cave contains archaeological remains of the so-called Romanellian, with backed blades and microburins, and a fauna pointing to cold steppe conditions. Coll. 1954 and subm. by the late A. C. Blanc.

GrN-2056. Romanelli A2  
9880 ± 100
7930 B.C.

GrN-2305. Romanelli A3  
10,320 ± 130
8370 B.C.

GrN-2153. Romanelli C1  
10,390 ± 80
8440 B.C.

GrN-2154. Romanelli C2  
9790 ± 80
7840 B.C.

GrN-2055. Romanelli D  
10,640 ± 100
8690 B.C.

General Comment: apart from GrN-2154 the dates follow the stratigraphical order. They all seem to fall within the Upper Dryas period. From Layer C a sample was dated in Italy (R-56: 11,930 ± 520, see Bella et al., 1958). Humus was removed from samples A2 and D by extraction with alkali.

B. Palaeolithic of Africa and Asia

Haua Fteah series, Libya

The large open cave site of Haua Fteah (32° 47’ N Lat, 21° 41’ E Long), lies on the coastal margin of the Jebel el Akhdar plateau, W of Darna, NE Libya (Cyrenaica). Excavations carried out by C. B. M. McBurney of the Dept. of Archaeol. and Anthropol., Univ. of Cambridge, U. K., have yielded a practically unbroken cultural sequence from Pre-Mousterian up to the present. The closely stratified sediments down to a depth of more than 42 ft apparently extend well into the last interglacial and have provided a wealth of material regarding cultural and climatological changes during the upper Pleistocene in this area. Reports have been published by McBurney, Trevor
and Wells (1953), McBurney (1960, p. 168ff. and 199ff.; 1961) and Higgs (1961). The purpose of the samples was to extend the range of dates previously obtained by Suess (USGS I). Coll. 1955 and subm. by McBurney.

**GrN-3541. Haau Fteah C10**

7000 ± 110
5050 B.C.

Charcoal immediately below interface of Layers VIII and X. Comment: dates earliest Neolithic and is “... very close indeed to the cultural interface between final Mesolithic (local variant of Capsian) and overlying Neolithic with earliest traces of domestic animals in the form of goat” (C.B.M. McB.). The result is in exact agreement with W-98 (USGS I). The sample was carefully pretreated with dilute acid and alkali.

**GrN-3167. Haau Fteah C11**

8400 ± 150
6450 B.C.

Charcoal from top of Layer X. Comment: sample dates “the final Mesolithic and (is) separated from the Neolithic only by the period of deposition of the lense called Layer IX” (C.B.M. McB.). Compare W-89 (Suess, 1954). Pretreatment same as GrN-3541.

**GrN-2586. Haau Fteah C87**

16,070 ± 100
14,120 B.C.

Soil containing charred bone from Layer XVII unconformably overlain by Layer XIV. Comment: sample predates the termination of the Upper Paleolithic Dabba culture and is to be compared with W-97, 12,300 ± 350 (USGS I) which comes from Layer XIV.

**GrN-2585. Haau Fteah C86**

18,620 ± 150
16,670 B.C.

Soil containing charred bone from Layer XVII. Comment: Dabba culture.

**GrN-2550. Haau Fteah C93**

33,100 ± 400
31,150 B.C.

Charred bone from Layer XX. Comment: associated with Dabba culture. The sample is definitely older than W-86, 28,500 ± 800 (USGS I) from Layers XX to XXII. During the formation of Layers XXII to XX the sediment again changes indicating a change from a relatively temperate phase to a (winter) frost climate which lasts through to Layer XV and is characterized by small angular limestone chips. Compare GrN-3260 from the site of Ed Dabba (see below).

**GrN-2564. Haau Fteah C38**

43,400 ± 1300
41,450 B.C.

Charred bone from Layer XXVIII. Comment: the change from Mousterian to the Upper Paleolithic Dabba culture occurs between this and GrN-2550 just below the interface of Layers XXV/XXIV. Again it is older than the comparable date W-85, 34,000 ± 2800 (USGS I). But Suess pointed out that this date might be too young.

**GrN-2023. Haau Fteah C46, “bone” fraction**

47,000 ± 3200
45,050 B.C.
GrN-2022. Haau Fteah C46, “rest” fraction  40,700 ± 1500  
38,750 B.C.
Charred bone from Layer XXXIII. Comment: Levalloiso-Mousterian. This layer produced the evolved Neandertaloid mandible described by Trevor and Wells in McBurney et al. (1954). They find the mandible most comparable to those from Mount Carmel; the culture, too, seems closely related to that of the Palestine sites—compare for instance GrN-2534, et Tabun B, dating upper Levalloiso-Mousterian (see below).

General Comment: all the charred bone samples were pretreated in the manner described in the introduction. The analysis of GrN-2022 was done on the organic material which does not dissolve in concentrated acid or dilute alkali and, as in other cases, gave a younger date. The higher value of GrN-2023 is definitely to be preferred.

GrN-3595. Ed Dabba, Libya  >39,500
GrN-3260. Ed Dabba, Libya  40,500 ± 1600  
38,550 B.C.

A soil sample with specks of charcoal from the Dabba cave (32° 44’ N Lat, 22° 00’ E Long), in the Jebel el Akhdar, NE Libya (Cyrenaica). This sample dates the transition from the lower to the upper substages of the Upper Paleolithic Dabba culture and is correlated archaeologically with Layer XX at the Haau Fteah (GrN-2550, see above). (McBurney, 1960, p. 196ff.) Coll. and subm. by C. B. M. McBurney. Comment: pretreated with acid and alkali. GrN-3595 is a measurement on the ca. 1% insoluble carbon; for GrN-3260 the alkali soluble fraction (ca. 0.4%) was added to obtain a more precise result. Date appears to be a little too early.

Et Tabun series, Israel

Two samples of charcoal (probably charred bone) were dated from the cave Mugharet et Tabun (ca. 32° 40’ N Lat, ca. 35° 5’ E Long), Mount Carmel, Israel (Garrod and Bate, 1937). Coll. 1959 by J. Waechter; subm. by J. Waechter and K. P. Oakley.

GrN-2534. Et Tabun B  39,700 ± 800  
37,750 B.C.

Upper Levalloiso-Mousterian. Depth 1 m below surface. Comment: this sample was expected to be of the same age as the one from Kebarch (GrN-2561, this list) and perhaps slightly younger than sample 38 from Ksår ’Akil (GrN-2579, this list). The sample was given the treatment for charred bone and agrees well with GrN-2561 (this list).

GrN-2729. Et Tabun C  40,900 ± 1000  
38,950 B.C.

Lower Levalloiso-Mousterian. Depth 2 m below surface. Comment: same pretreatment as et Tabun B.

GrN-2170. Et Tabun D  35,400 ± 900  
33,450 B.C.

Lower Levalloiso-Mousterian. Depth 3 m below surface. Comment: only
pretreated with acid. Obviously there is contamination with younger humic material.

Shanidar Cave series, Iraq

Samples from the Shanidar Cave (Solecki, 1958) (ca. 36° 50’ N Lat, 44° 13’ E Long), Erbil Liwa, N Iraq, had been dated at the Washington, Lamont and London (Inst. of Archaeol.) laboratories. Some proved to be infinite. At Groningen four samples were dated from the deeper layers. Coll. 1957 and subm. by R. Solecki, Dept. of Anthropol., Columbia Univ., New York, U.S.A.

GrN-1830. Shanidar 343 III, “bone” fraction 33,900 ± 900 31,950 B.C.

GrN-1494. Shanidar 343 III, “rest” fraction 34,000 ± 420 32,050 B.C.

Charcoal from hearth in Layer C with Baradostian blade and burin industry.

GrN-2016. Shanidar 553 III, “bone” fraction 35,440 ± 600 33,490 B.C.


Charcoal very close to the bottom of Layer C with Baradostian industry.

GrN-2527. Shanidar 318 III 46,900 ± 1500 44,950 B.C.

Charcoal from hearth in the very top of Layer D at short distance below the junction of the Layer C and D.

GrN-1495. Shanidar 314 III 50,600 ± 3000 48,650 B.C.

Charcoal from hearth in the top of Layer D (Mousterian). The sample would date the adult Neanderthal Skeleton Shanidar I.

General Comment: GrN-2016 and GrN-1830 can be compared with the dates W-180 (>34,300) (USGS II) and L-335 I (32,000 ± 300) (Lamont IV) from the same layer. The samples were all treated as charred bone. Of the first two samples, both the alkali soluble and the insoluble fractions were measured. The fact that the two fractions give practically the same age makes the dates very reliable. There seems to be a considerable break in the occupation between Layer C and D.

Ksar ’Akil series, Lebanon

From the rock shelter of Ksar ’Akil (33° 55’ N Lat, 35° 37’ E Long), Antelias, near Beirūt, Lebanon, two samples were dated. Coll. 1959 by B. Howe, H. E. Wright and F. Matson; subm. by R. J. Braidwood, Oriental Inst., Univ. of Chicago, U.S.A. For details on the site, which had been excavated some years ago, see Wright (1951) and Ewing (1947).

GrN-2195. Ksar ’Akil 40 28,840 ± 380 26,890 B.C.

Shells collected at 6 to 7.5 m level (Middle Aurignacian). Comment: rinsed in dilute acid.
GrN-2579. Ksār 'Akil 38  
*43,750 ± 1500*  
41,800 B.C.

Dark clay band at 16 m level (1 m below the top of the Upper Levalloisian-Mousterian). *Comment:* treated as charred bone.

GrN-2561. el Kebarch, Israel, “bone” fraction  
*41,000 ± 1000*  
39,050 B.C.

GrN-2551. el Kebarch, Israel, “rest” fraction  
*35,300 ± 500*  
33,350 B.C.

Small lumps of charred wood or bone from the upper Levalloiso-Mousterian level in the cave Mugharet el Kebarch (ca. 32° 40' N Lat, 35° 5' E Long), Mount Carmel, Israel. Depth 2.5 m below surface in cave. Comparable to et Tabun D (see above). Coll. 1958 by M. Stekelis; subm. by J. Waechter and K. P. Oakley. *Comment:* sample was treated as charred bone. As usual the alkali soluble fraction gave the higher age.

*C. Mesolithic*

GrN-1602. Hatert, Netherlands  
*7670 ± 110*  
5720 B.C.

Charcoal from Mesolithic fireplace at Hatert (51° 47' 57" N Lat, 5° 52' 35" E Long), municipality of Nijmegen, province of Gelderland, Netherlands (Bohmers and Wouters, 1957). Coll. by A. Wouters; subm. by A. Bohmers. *Comment:* date is according to expectation. The sample was treated with acid and alkali.

**Oirschot series, Netherlands**

Charcoal samples were dated from a Mesolithic and a Palaeolithic surface site near Oirschot (51° 29' 34" N Lat, 5° 22' 33" E Long), province of Noord-Brabant, Netherlands (Bohmers and Wouters, 1957). The settlements were situated a short distance from each other. Coll. and subm. by A. Bohmers.

GrN-1659. Oirschot Vb  
*8030 ± 50*  
6080 B.C.

Charcoal from fireplace in settlement Oirschot V. Coll. 1957.

GrN-2172. Oirschot Vc  
*6230 ± 60*  
4280 B.C.

Charcoal from fireplace in settlement Oirschot V.

GrN-2171. Oirschot VII  
*6690 ± 65*  
4740 B.C.

Charcoal particles scattered in the habitation layer of Oirschot VII (Tjonger culture).  
*General Comment:* only the first date is according to expectation; the others are much too young. Contamination is probably responsible for the anomaly. An earlier measurement on charcoal of another fireplace in Oirschot V gave 7510 ± 60 (GrN-1510, Groningen III, p. 1553).

GrN-3042. Rotsterhaule, Netherlands  
*8365 ± 75*  
6415 B.C.

Charcoal from fireplace D 15 in Mesolithic settlement at Rotsterhaule
(52° 54’ 15” N Lat, 5° 51’ 44” E Long), municipality of Haskerland, province of Friesland, Netherlands. The settlement occurs on top of a cover sand deposit and was overgrown by peat after the habitation. Coll. 1961 and subm. by A. Bohmers. Comment: date is according to expectation.

GrN-1559. Ermelo, Netherlands

Charcoal from Mesolithic fireplace at Ermelo (52° 18’ N Lat, 5° 38’ E Long), province of Gelderland, Netherlands (Bohmers and Wouters, 1957). Coll. and subm. by A. Bohmers. Comment: date agrees with other dates of Mesolithic settlements in this area. Treated with acid and alkali.

Rouffignac series, France

Four charcoal samples were dated from different Mesolithic levels in the cave of Rouffignac (45° 3’ 11” N Lat, 0° 58’ 30” E Long), Périgueux, France. Coll. 1960 by J. Verheyleweghen and Cl. Barrière; subm. by A. Bohmers.

GrN-2889. Rouffignac C 3

Pure Tardenoisian.

GrN-2913. Rouffignac C 4b

Upper Sauveterrian.

GrN-2895. Rouffignac C 4a

Middle Sauveterrian.

GrN-2880. Rouffignac C 4a1

Lower Sauveterrian.

General Comment: dates prove that the Sauveterrian precedes the Tardenoisian.

Tilburg series, Netherlands

Charcoal samples dated from two different Mesolithic surface settlements near Tilburg (51° 35’ N Lat, 5° 03’ E Long), province of Noord-Brabant, Netherlands. In both cases the charcoal was found scattered between flint artifacts. Coll. by A. Wouters; subm. by A. Bohmers.

GrN-2443. Tilburg-Pompstok

3820 ± 75
1870 B.C.

GrN-1597. Tilburg-Labé

6500 ± 120
4550 B.C.

General Comment: in view of other Mesolithic dates from the area, these dates are too young. GrN-2443 was only treated with dilute acid while GrN-1597 was treated with acid and alkali. The large difference between the ages suggests contamination.

GrN-2446. Maarheeze, Netherlands

Charcoal from Mesolithic fireplace at Maarheeze (51° 17’ 16” N Lat, 5° 38’ 24” E Long), province of Noord-Brabant, Netherlands (Bohmers and
J. C. Vogel and H. T. Waterbolk

Wouters, 1957). Coll. by A. Wouters; subm. by A. Bohmers. *Comment*: date is younger than most other Dutch Mesolithic sites. Contamination may be present.

**GrN-1683. De Leijen, Netherlands**  
7230 ± 65 5280 b.c.

Charcoal sample from fireplace in Mesolithic habitation layer near lake “de Leijen” (53° 9’ N Lat, 6° 3’ E Long), municipality of Smallingerland, province of Friesland, Netherlands (Bohmers and Wouters, 1957). This Mesolithic site differs from most other Dutch Mesolithic sites, and is related to the Maglemose culture. Coll. 1956 and subm. by A. Bohmers. *Comment*: an earlier measurement on charred hazel nuts from the same site gave 7200 ± 140 (GrN-685, Groningen III, p. 1553). These dates prove the site falls within the Atlantic period. Treated with acid and alkali.

**GrN-2001. La Torche, France**  
5970 ± 80 4020 b.c.

Charcoal from a Mesolithic kitchen midden at la Torche (ca. 47° 50’ N Lat, ca. 4° 17’ W Long), commune de Plomeur, Finistère, France (Giot et al., 1962). The midden was stratigraphically situated below a passage grave. Coll. and subm. by P. R. Giot, Univ. of Rennes, France. *Comment*: date is of interest for the dating of the coastal Mesolithic of Brittany.

*D. Neolithic of the Netherlands*

**Elsloo series, Netherlands**


**GrN-2311. Elsloo 501**  
6510 ± 100 4560 b.c.

Charcoal from grave pit belonging to the youngest stage of “Linearbandkeramik.” Depth 0.60 to 1.00 m below surface.

**GrN-2884. Elsloo 514**  
6055 ± 80 4105 b.c.

Charcoal from grave pit belonging to the youngest stage of “Linearbandkeramik.”

**GrN-2310. Elsloo 332**  
5080 ± 70 3130 b.c.

Charcoal from pit near house, belonging to the next but youngest stage of “Linearbandkeramik.” Depth 0.30 to 0.80 m below surface.

**GrN-2160. Elsloo 108**  
6150 ± 70 4200 b.c.

Charcoal from pit near house, belonging to the next but youngest stage of “Linearbandkeramik.” Depth 0.30 to 1.10 m below surface.

**GrN-2159. Elsloo 282**  
6320 ± 90 4370 b.c.

Charcoal from posthole of a house, belonging to the next but oldest stage
of “Linearbandkeramik.” Depth 0.30 to 0.80 m below surface.

**GrN-2164. Elsloo 130**

6270 ± 85 4320 B.C.

Charcoal from posthole of a house, belonging to the oldest stage of “Linearbandkeramik.” Depth 0.30 to 1.00 m below surface.

*General Comment:* samples 501 and 332 are, respectively, much older and younger than was expected. Contamination, however, can not be excluded, since there is an intensive animal life in the loess soils. The other dates can be compared with previously published Bandkeramik dates from Geleen and Sittard (GrN-320, GrN-422, GrN-423, Groningen II, p. 135; GrN-995, GrN-996, Groningen III, p. 1553). Those belonging to the earlier stages of “Linearbandkeramik” seem indeed to be higher than those from the later stages.

**GrN-2226. Odoorn, Netherlands**

4590 ± 80 2640 B.C.

Small quantity of charcoal found in a flat grave, containing two Funnel Beakers, underneath the mound of the megalithic Tomb D 32 at Odoorn (52° 51’ 24” N Lat, 6° 50’ 29” E Long), province of Drenthe, Netherlands (van Giffen, 1961a). Coll. and subm. by A. E. van Giffen, State Univ., Groningen, Netherlands. *Comment:* date is a *terminus post quem* for the construction of the megalithic tomb; it agrees with other dates relating to the Funnel Beaker culture in the area. Pretreated with acid and alkali.

**Vlaardingen series, Netherlands**

Several samples were dated from the Neolithic settlement at Vlaardingen (51° 54’ N Lat, 4° 19’ E Long), province of Zuid-Holland, Netherlands. Apart from the main settlement stage, belonging to the Neolithic Vlaardingen culture, there are also traces of a settlement of the Bell Baker culture. Both settlements were situated on the banks of a creek (natural levees) in a fresh to brackish delta environment under tidal influence. Between the times of the two settlement the creek was silted up and again cut into by a new creek (for a detailed description of the site see van Regeren Altena *et al.*, 1962). Coll. 1959-60 and subm. by W. Glasbergen, Univ. of Amsterdam, Netherlands.

**GrN-2419. Vlaardingen U XIb:77**

3910 ± 100 1960 B.C.

Charcoal from upper part of layer with Maritime Bell Beaker sherds. Trench 9b, Square U XIb, No. 77.

**GrN-3097. Vlaardingen U XIb:79**

3850 ± 50 1900 B.C.

Charcoal from lower part of same layer with Maritime Bell Beaker sherds. Trench 9b, Square U XIb, No. 79.

**GrN-2158. Vlaardingen U IXb**

3910 ± 30 1960 B.C.

Charcoal from layer with Maritime Bell Beaker sherds from which both samples mentioned above were also taken. Trench 9a, Square U IXb.
178

GrN-2481. Vlaardingen T XIa:114

Wood (at most 5 yr rings) from small post in layer with Maritime Bell Beaker sherds. Trench 9b, Square T XIa, No. 114.

GrN-2480. Vlaardingen U XIa:113b

Charcoal from the uppermost part (with little or no artifacts) of the refuse layer of the Vlaardingen culture habitation in the creekbed (in section). Trench 9b, Square U XIa, No. 113b.

GrN-2304. Vlaardingen N 8

Wood from worked post (at most the last 10 yr rings) in the settlement of the Vlaardingen culture on W creek bank. Trench 12, Square N 8.

GrN-2303. Vlaardingen MM 42a

Charcoal from habitation layer of the Vlaardingen culture on E creek bank. Trench 11, Square MM 42a.

GrN-2487. Vlaardingen M 20

Wood from worked post (at most 10 yr rings). Trench 10, Square M 20, Post 17.

GrN-2306. Vlaardingen JJ 42

Wood from trunk (at most the last 10 yr rings) found in subsoil on E creek bank. Sample probably is contemporaneous with the very first settlement stage of the Vlaardingen culture. Trench 17, Square JJ 42.

GrN-2286. Vlaardingen 2 E 7b

Charcoal from habitation layer of the Vlaardingen culture. Trench 1-2, Square 2 E 7b. Comment: date is ca. 1000 yr too young. Contamination by material from a recent ditch cannot be excluded. General Comment: dates for the Maritime Bell Beaker settlement stage lie very close together. As a mean value 3590 ± 25 (1940 b.c.) can be calculated. The dates for the Vlaardingen settlement do not scatter significantly; although the stratigraphically uppermost and lowermost samples are the youngest and oldest respectively. The average for the main occupation (GrN-2304, GrN-2303 and GrN-2487) is 4300 ± 40 (2350 b.c.). The dates agree with those of Haamstede (GrN-1577: 4410 ± 60, this list) and Hekelingen (GrN-254: 4200 ± 120, Groningen II, p. 135).

Haamstede series, Netherlands

In 1958 a site was excavated by J. A. Trimpe Burger at Brabers, municipality of Haamstede (51° 41' N Lat, 3° 43' E Long), province of Zeeland, Netherlands. There were two different culture layers, a lower one belonging to the Neolithic Vlaardingen culture, and an upper one, in which an earlier local Iron Age stage could be distinguished from a later stage, characterized by 2nd

**GrN-1577. Haamstede I**

4410 ± 60
2460 B.C.

Charcoal from Neolithic culture layer. Depth ± 1.00 m.

**GrN-1682. Haamstede II**

3070 ± 60
1120 B.C.

Charcoal from an intact vessel, belonging to the local Iron Age settlement stage. It was found in a pit at depth of 1.20 m.

*General comment:* for a discussion of the Neolithic date, see van Regteren Altena *et al.* (1962, p. 20-21). The Iron Age date is older than was expected. Both samples were pretreated with acid and alkali.

**GrN-2370. Angelslo, Netherlands**

4145 ± 100
2195 B.C.

Charcoal found in a flat grave, together with a human cremation and pottery belonging to a late stage of the Funnel Beaker Culture at Angelslo (52° 46’ 54” N Lat, 6° 55’ 0” E Long), municipality of Emmen, province of Drenthe, Netherlands. Expected age 2300-2200 B.C. Coll. and subm. by H. T. Waterbolk. *Comment:* first date for the latest stage of the Funnel Beaker Culture in the area.

**Anlo series, Netherlands**

In 1958 an important archaeological site was excavated near Anlo (53° 02’ 10” N Lat, 6° 43’ 08” E Long), province of Drenthe, Netherlands. Remains ranging in age from the Upper Palaeolithic to the Late Bronze Age were found near the surface or in pits with a depth of at most 1 m (Waterbolk, 1960). Coll. and subm. by H. T. Waterbolk.

**GrN-1969. Anlo 136**

8770 ± 80
6820 B.C.

Charcoal from a find-less pit preceding Bronze Age plow-soil. Depth 0.35 m.

**GrN-1970. Anlo 35**

8785 ± 95
6835 B.C.

Charcoal from a find-less pit. Depth 0.4 m.

**GrN-1980. Anlo 68 A**

9205 ± 70
7255 B.C.

Charcoal from a pit containing a Beaker sherd. It is to be noted charcoal content in this case was very small. Depth 0.21 m. *Comment:* charcoals are apparently much older than the sherd.

**GrN-853. Anlo 96 A**

4780 ± 80
2830 B.C.

Charcoal from a pit containing Early Bronze Age pottery. The distance from the preceding sample is only 3 m. Depth 0.63 m. *Comment:* anomalous date can be explained by assuming contamination by much older charcoal, the nearby presence of which is proved by the preceding measurement.
GrN-1824. Anlo 122 B  
Charcoal from a pit containing rich archaeological remains of the Havelte stage of the Funnel Beaker culture. Depth 0.88 m.

GrN-1855. Anlo 51  
Charcoal from flat grave with a Beaker-with-Protruding-Foot (early type). Depth 0.58 m.

GrN-1965. Anlo 61 A  
Charcoal from burnt coffin in find-less flat grave, supposed to be somewhat younger than preceding sample. Depth 0.68 m.

GrN-851. Anlo 49  
Charcoal from flat grave, containing two all-over-corded Beakers. Depth 0.55 m.

GrN-1976. Anlo 46b  
Charcoal from circular pit, dug into a flat grave with an all-over-corded Beaker. Depth 0.50 m.

GrN-2214. Anlo 78  
Charcoal from one of a group of enigmatic horseshoe-shaped depressions, the age of which is uncertain (Waterbolk, 1960, p. 89-90). Depth 0.80 m.

GrN-852. Anlo 1 A  
Charcoal from pit containing Early Bronze Age pottery. Depth 1.08 m.

GrN-1977. Anlo 69  
Charcoal from pit containing Early Bronze Age pottery. Depth 0.41 m.

**General Comment:** although the quantity of Mesolithic flints was very small, the first three dates show the presence of Mesolithic fireplaces at the site. The pit containing sample 68 must have been dug through such a fireplace. Mesolithic charcoal probably also caused the anomalous date of sample 96. The other dates are in the relative order as expected from the archaeological evidence. The peculiar horseshoe-shaped depressions are probably from the latest Neolithic or Early Bronze Age—see also Schipborg (GrN-2445, this list). Sample Anlo 51 was expected to be somewhat younger and closer in age to samples 61 and 49. Apart from the statistical uncertainty, there is the possibility of contamination, e.g., with charcoal from the Funnel Beaker settlement.

**Dertienhuizen series, Netherlands**

In 1960 two massive wheels, each made out of a single piece of oak wood, were found in a large raised bog at Dertienhuizen (52° 56' 26" N Lat, 7° 0' 54" E Long), near the village of Musselkanaal, municipality of Onstwedde,
province of Groningen, Netherlands. The wheels were lying in a depression between two cover sand uplifts. In view of the dates of other wheels of the same type, a Neolithic age was expected. Coll. by M. R. Walvius; subm. by J. D. van der Waals, Mus. of Drenthe, Assen, Netherlands.

**GrN-2878. Dertienhuizen A**

4015 ± 65  
2065 b.c.

**GrN-2879. Dertienhuizen B**

4070 ± 70  
2120 b.c.

*General Comment:* dates agree with GrN-1087, 4080 ± 55 for the trackway Nieuw-Dordrecht, near which a wheel of the same type was found (Groningen III, p. 1553). GrN-2368, 4025 ± 75 for a wheel of the same type found at the Eese (see below) and GRN-3238, 3960 ± 80 for a wheel from Gasselter Boerveen (see below). A paper on Neolithic wheels is being prepared by M. R. Walvius and J. D. van der Waals.

**GrN-2368. De Eese, Netherlands**

4025 ± 75  
2075 b.c.

Massive wheel, made of one piece of oak wood, found in a small bog at the Eese (52° 50’ 58” N Lat, 6° 07’ 34” E Long), municipality of Vledder, province of Drenthe, Netherlands. Coll. by W. van Zeist; subm. by H. T. Waterbolk. *Comment:* see Dertienhuizen series above.

**GrN-2986. Nieuw-Dordrecht, Netherlands**

4100 ± 55  
2150 b.c.


**GrN-3238. Gasselter Boerveen, Netherlands**

3960 ± 80  
2010 b.c.

Wood drilled from the core of a massive oak wheel, found in 1838 in the raised bog Gasselter Boerveen (53° 0’ 08” N Lat, 6° 51’ 12” E Long), municipality of Gasselte, province of Drenthe, Netherlands. The depth is indicated as more than 2 m. The wheel is of the same type as those from de Eese and Dertienhuizen (see above). It has been kept in the Museum without apparent treatment for preservation. Coll. and subm. by J. D. van der Waals. *Comment:* see Dertienhuizen series above.

**GrN-1676. Eext-Ketenberg, Netherlands**

3775 ± 55  
1825 b.c.

Charcoal from burnt coffin in an undated secondary grave in the Neolithic tumulus “Ketenberg” near Eext (52° 59’ 52” N Lat, 6° 43’ 08” E Long), municipality of Anlo, province of Drenthe, Netherlands, excavated by A. E. van Giffen in 1927 (van Giffen, 1930, p. 45-50). Coll. and subm. by A. E. van Giffen. *Comment:* grave is apparently Late Neolithic. Sample was treated with acid and alkali.
GrN-2996. St. Walrick, Netherlands

Charcoal from youngest grave in three-period barrow near St. Walrick (51° 47' 10" N Lat, 5° 47' 37" E Long), municipality of Overasselt, province of Gelderland, Netherlands, excavated in 1959 and 1961 (Groenman, van Waateringe, 1961a). The primary grave contained a Bell Beaker of Veluwe type, for the age of which the C\(^{14}\) date would give a terminus ante quern. On the basis of pollen analyses there should not be a great difference in age between the three barrow stages. Coll. and subm. by W. Glasbergen. Comment: date agrees with other dates relating to the Bell Beaker culture, e.g., Bennekom, GrN-326, 3865 ± 180 (Groningen II, p. 135). From the same Bennekom barrow another sample was dated at 3560 ± 130 as GrN-374 (Groningen II, p. 135). The description given is not correct; the sample is not from the primary grave, but from a later capping of the barrow.

GrN-2445. Schipborg, Netherlands

Charcoal from fireplace in one of a group of enigmatic horseshoe-shaped depressions, found during an excavation at Schipborg (53° 03' 36" N Lat, 6° 41' 09" E Long), municipality of Anlo, province of Drenthe, Netherlands (van der Waals, 1962). These depressions are of the same type as those at Anlo (this list), where they were supposed to be of Mesolithic age. At Schipborg, however, clear evidence was obtained for an earliest Bronze Age dating. Depth 0.8 to 0.9 m below surface. Coll. 1960 and subm. by J. D. van der Waals. Comment: date is according to expectation. It agrees also with one of the Anlo dates (GrN-2214, 3830 ± 65, this list), obtained from charcoal from a pit of the same type.

E. Neolithic of Europe and Asia, excluding the Netherlands

Elateia series, Greece

From a dwelling mound NE of Elateia (38° 37' N Lat, 22° 44' E Long), Greece, five samples of carbonized wood were measured for the purpose of dating Early Neolithic monochrome pottery (Weinberg, 1962). Coll. 1959 and subm. by S. S. Weinberg, Univ. of Missouri, U. S. A.

GrN-2973. Elateia 5

Charcoal from floor 3.10 m in NE quadrant of Trench 1. Associated with early Early Neolithic monochrome pottery and a fragment of imported Corinthian variegated ware.

GrN-3037. Elateia 4

Charcoal from floor of large bothros in Trench 3 at 2.70 m. Comment (S.S.W.): it was originally thought this sample was from the fill of the bothros, but the date rather suggests it was from the bunrt debris in the floor at 2.70 m. The pottery on this floor was all Early Neolithic monochrome, while that in the bothros was much later.
Groningen Radiocarbon Dates IV

GrN-3041. Elateia 6
7190 ± 100
5240 B.C.
Charcoal from floor 2.55 m in Trench 2 with Early Neolithic monochrome vases.

GrN-3039. Elateia 3
8240 ± 110
6290 B.C.

GrN-2454. Elateia 3, “humus” fraction
6370 ± 80
4420 B.C.

GrN-3502. Elateia 3, another portion
7040 ± 130
5090 B.C.
Charcoal from next higher floor, 2.30 m in Trench 2, with earliest painted pottery. Comment: first measurement (GrN-3039) gave too high an age, a new analysis on selected material (GrN-3502) seems compatible with the stratigraphic sequence.

GrN-2933. Elateia 1
8240 ± 75
6290 B.C.
Charcoal from 1.55 m level in W half of Trench 1. Comment (S.S.W.): sample was suspect.
General Comment: all samples were pretreated with acid and alkali. The fact that two samples gave dates of 8240 yr seems to indicate older charcoal is present at this site. For a full discussion of the importance of this sample series, see Weinberg (1962, p. 206-9).

Gornja Tuzla series, Yugoslavia

Two samples were dated from Gornja Tuzla (44° 27' N Lat, 18° 46' 30" E Long), district Tuzla, NE Bosnia, Yugoslavia. Coll. 1957 by A. Benac, Zemaljski Muzej, Sarajevo; subm. by H. T. Waterbolk.

GrN-1974. Gornja Tuzla 1
5580 ± 60
3630 B.C.
Charred beam from habitation layer belonging to Vinča C stage. Depth 3.50 m.

GrN-2059. Gornja Tuzla 2
6640 ± 75
4690 B.C.
Charcoal from dwelling pit in habitation layer belonging to Starčevo III culture. Depth ca. 5 m.
General Comment: first date is somewhat young in view of the dates of the Vinča D stage at Vinča and Banjica (this list); the second is of importance since the Starčevo culture is considered as one of the oldest Neolithic cultures in SE Europe, preceding, e.g., the Bandkeramik and Vinča cultures. See also Quitta (1960).

Vinča series, Yugoslavia

Two samples were dated from the classical site of Vinča (44° 45' N Lat, 20° 37' E Long), near Belgrade, Yugoslavia (Vasić, 1932). Subm. by H. T. Waterbolk.
GrN-1537. Vinča D  
5845 ± 160  
3895 B.C.

Charred grain, collected by Vasić during his excavation in 1908-11. (First number 362 c, see Vasić, 1932, II, pl. XCVI).

GrN-1546. Vinča A  
6190 ± 60  
4240 B.C.

Charred grain, collected by Vasić during his excavation in 1908-11. (First zontal charcoal layer to be seen in Vasić’s still standing tell section. It probably marks the end of the Vinča A stage (Vinča-Tordos).

General Comment: dates are much older than hitherto accepted on archaeologi-cal grounds. They are confirmed, however, by dates from the Bandkeramik and other Neolithic cultures in SE Europe. Quitta (1960) considers the Vinča D date too high, but it is confirmed by the date for the same stage at Banjica (GrN-1536, 5670 ± 120, this list).

GrN-1581. Zwenkau, Germany  
6160 ± 70  
4210 B.C.

Charcoal from posthole of house belonging to the “Linearbandkeramik” in a settlement, excavated in 1952-57 by H. Quitta, Berlin, near Zwenkau (51° 13' 47" N Lat, 12° 20' 50" E Long), Harth, Germany (Quitta, 1958, p. 68-73). Depth 0.60 to 1.00 m below the surface. Coll. by H. Quitta; subm. by P. J. R. Modderman. Comment: date agrees with dates obtained from Bandkeramik settlements in the Netherlands. Humus was removed by extraction with dilute alkali.

GrN-1993. Tiszapolgar-Czoszhalom, Hungary  
5845 ± 60  
3895 B.C.

Charcoal from the site of Tiszapolgar-Czoszhalom (47° 53' 30" N Lat, 21° 08' E Long), district Hajdu-Bihar, Hungary, belonging to the late Neolithic Herpály culture. Coll. 1957 by I. Kutzian; subm. by H. Quitta and H. T. Waterbolk. Comment: date is somewhat older than was expected. See also Quitta (1960).

Hamangia series, Rumania

Two charcoal samples were dated from the site of Hamangia (44° 42' N Lat, 28° 40' E Long), district of Istria, Rumania. Coll. 1952 by D. Berciu, Bucuresti, Rumania; subm. by H. Quitta and H. T. Waterbolk.

GrN-1986. Hamangia-Baia 1  
5880 ± 70  
3930 B.C.

Charcoal from the Hamangia culture.

GrN-1995. Hamangia 2  
4530 ± 65  
2580 B.C.

Charcoal from ocher grave.

General Comment: first date indicates a high age for the Hamangia culture. See also Quitta (1960). Humus was extracted with acid and alkali.

GrN-1542. Banjica, Yugoslavia  
5710 ± 90  
3760 B.C.

Charcoal from site of Banjica (44° 31' N Lat, 19° 7' 30" E Long),
Yugoslavia, belonging to the final stage of the Vinča culture. Coll. by M. Grbić, Archaeol. Inst., Yugoslav Acad. of Sci., Belgrade, Yugoslavia; subm. by H. T. Waterbolk. *Comment*: date does not differ significantly from other dates for stages C and D of the Vinča culture (see under Vinča and Gornja Tuzla, this list). See also Quitta (1960).

**Salcuta series, Rumania**

Two samples were dated from the excavation in 1951 at Salcuta, SW Rumania by D. Berciu, who collected the samples. The Salcuta culture is correlated with the Vinča C culture; subm. by H. Quitta and H. T. Waterbolk.

- **GrN-1989. Salcuta 1**
  - Charcoal.
  - 5450 ± 55 GrN-1989
  - 3500 B.C.

- **GrN-1990. Salcuta 2**
  - Charcoal from house 3.
  - 5475 ± 55 GrN-1990
  - 3525 B.C.

*General comment*: the archaeological correlation is proved by the C¹⁴ dates (cf. Vinča dates in this list). Humus was extracted with acid and alkali.

- **GrN-1987. Vărăştii, Rumania**
  - Charcoal from Vărăştii (44° 14' N Lat, 27° E Long), Boian Lake, district Câlărași, Rumania. The site belongs to the Gumelnita culture (Boian B). The traditional age estimation would be between 2500 and 2000 B.C. Coll. 1954 by N. Anghelescu, Câlărași Mus., Rumania; subm. by H. Quitta and H. T. Waterbolk. *Comment*: the Gumelnita culture is correlated with stages C and D of the Vinča culture. The C¹⁴ dates agree with the archaeological correlation. See also Quitta (1960). Humus was extracted with acid and alkali.

- **GrN-1985. Hăbășești, Rumania**
  - Charcoal from the Eneolithic site of Hăbășești (47° N Lat, 27° E Long), district of Tg. Frumos, Moldavia, Rumania. Depth 0.20 to 0.60 m below surface. The site belongs to a late stage of phase A of the civilization of Cucuteni. Cucuteni A is correlated with Vinča B. Coll. 1949-50 by V. Dumitrescu, Archaeol. Inst., Rumanian Acad., Bucuresti, Rumania; subm. by H. Quitta and H. T. Waterbolk. *Comment*: date is much older than was expected on the basis of the traditional chronology; it agrees, however, with dates of other Neolithic and Eneolithic sites in SE Europe (see, e.g., Vinča dates in this list). Humus was extracted with acid and alkali.

- **GrN-1982. Valea Lupului, Rumania**
  - Charred grain from the site of Valea Lupului (47° 10' N Lat, 27° 30' E Long), district of Jasi, Rumania. The site belongs to phase B of the civilization of Cucuteni. Expected age 2100-1900 B.C. Cucuteni B is correlated with the youngest phase of Vinča. Coll. 1954 in a pit at a depth of 3.00 m by M. Dinu,
Hist. Mus. of Moldavia, Rumania; subm. by H. Quitta and H. T. Waterbolk. *Comment:* see our remark on GrN-1985 above. Humus was extracted with acid and alkali.

**GrN-1966. Curnic, France**

5340 ± 60
3390 B.C.

Charcoal from a Neolithic habitation layer exposed on the shore at low tide at Curnic (48° 38' 23" N Lat, 4° 27' 34" W Long), commune de Guissény, Finistère, France. The layer is situated on top of a loess soil and is covered by fresh-water peat. The presence of postholes and foundation trenches proves the site was actually inhabited (Giot, 1960a). Coll. 1958 and subm. by H. T. Waterbolk, W. van Zeist and P. R. Giot, Univ. of Rennes, France. *Comment:* date is of importance for the dating of the Neolithic in Brittany; it agrees with that obtained from the passage grave of Carn (GrN-1968, see below). Humus was extracted with acid and alkali.

**GrN-1968. Carn, France**

5230 ± 75
3280 B.C.

Charcoal found in the chamber of an Early Neolithic passage grave on the isle of Carn (48° 34' 36" N Lat, 4° 41' 21" W Long), commune de Ploudalmézeau, Finistère, France. Coll. 1954 by P. R. Giot; subm. by H. T. Waterbolk. *Comment:* date agrees with other dates relating to the Breton primary Neolithic (Giot, 1960b). Humus was extracted with acid and alkali.

**Barnenez series, France**

Charcoals found in Chambers D and E of the megalithic monument of Barnenez (48° 40' N Lat, 3° 51' 53" W Long), commune de Plouézoch, Finistère, France. Coll. 1956 and subm. by P. R. Giot.

- **GrN-1526. Barnenez E 1**
  1000 ± 40
  A.D. 950

- **GrN-1538. Barnenez E 2**
  1065 ± 60
  A.D. 885

- **GrN-1972. Barnenez D**
  2135 ± 55
  185 B.C.

*General Comment:* charcoal was apparently brought into the chamber during the Middle Ages and the Roman period. It cannot have anything to do with the original construction and use of the monument (Giot, 1960b).

**GrN-2302. Örlenbach, Germany**

4475 ± 75
2525 B.C.

Wooden coffin (0.40 x 0.60 m), containing some coarse sherds, one ornamented sherd ("jüngere Linearbandkeramik"), remnants of two small copper rings (thickness 0.1 cm, size 2 cm) and of animal bones, found at Örlenbach (50° 08' 10" N Lat, 10° 08' 0" E Long), Kreis Bad Kissingen, Germany. Coll. and subm. by J. Wahra, Bad Kissingen. *Comment:* coffin seems to be younger than the Bandkeramik settlement. The presence of copper might point in the same direction.
Wildeshausen series, Germany

From excavations in the neighborhood of Wildeshausen (52° 53' 30" N Lat, 8° 29' 20" E Long), Kreis Oldenburg, Germany, conducted by the Staatliches Mus. für Naturkunde und Vorgeschichte in Oldenburg, Germany, under direction of J. Pätzold. A series of samples was submitted for dating. So far three of them have been measured. Coll. 1959 by J. Pätzold; subm. by H. T. Waterbolk.

GrN-3518. Wildeshausen, Katenbäker Berg 1: I 3630 ± 80 1680 B.C.
Charcoal from primary grave in Barrow 1. Depth 1.20 to 0.80 m. No finds.

GrN-3513. Wildeshausen, Katenbäker Berg 1: II 3550 ± 90 1600 B.C.
Charcoal from secondary grave in Barrow 1. Depth 2.10 to 1.00 m.

GrN-3542. Wildeshausen, Pestruper Gräberfeld 2440 ± 70 490 B.C.
Charcoal from cremation grave underneath burial mound ("Brandhügel"). Pottery of Jastorf B type was found as grave goods. Secondary to the barrow is an elongated earth bank (Langwall), surrounded by a ditch.

General Comment: the first two measurements provide a date for an otherwise undatable barrow. It is interesting to note that apparently synchronous findless barrow graves also occur in the Netherlands (e.g., Hijken, GrN-079: 3300 ± 150, Groningen I, p. 1143). The last date agrees very well with the archaeological dating of the Jastorf B stage.

GrN-1670. Kervingar, France 3550 ± 50 1600 B.C.
Wood from central grave in barrow, belonging to the second stage of the Armorican Early Bronze Age, excavated in 1954 at Kervingar (48° 25' 57" N Lat, 4° 44' W Long), commune de Plouarzel, Finistère, France (Giot, 1960). Coll. and subm. by P. R. Giot, Univ. of Rennes, France. Comment: date is somewhat older than was expected on archaeological grounds. Humus was extracted with acid and alkali.

Ipwegermoor series, Germany

In the Ipwegermoor (53° 12' 34" N Lat, 8° 16' 2" E Long), a raised bog N of Oldenburg, Germany, a great number of prehistoric trackways have been excavated by H. Hayen, Landesmus. für Naturkunde und Vorgeschichte, Oldenburg, Germany (Hayen, 1957a, p. 87-189; 1957b, p. 242-9; 1958, p. 33-48). Expected age: Bronze Age and Neolithic. Coll. by H. Hayen; subm. by H. T. Waterbolk.

GrN-3527. Ipwegermoor VII 3650 ± 75 1700 B.C.
Wood from Bohlendamm VII. Depth 0.50 m.
<table>
<thead>
<tr>
<th>GrN-Number</th>
<th>Site/Location</th>
<th>3320 ± 70</th>
<th>1370 B.C.</th>
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<td>GrN-3134</td>
<td>Ipwegermoor I</td>
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<tr>
<td></td>
<td>Wood from Bohlensteg I. Depth 0.50 m.</td>
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<tr>
<td>GrN-3530</td>
<td>Ipwegermoor LI</td>
<td>3110 ± 80</td>
<td>1160 B.C.</td>
</tr>
<tr>
<td></td>
<td>Wood from Pfahlsteg LI. Depth now only 0.15 m, but overlying peat has been dug away.</td>
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<tr>
<td>GrN-3514</td>
<td>Ipwegermoor V</td>
<td>3360 ± 70</td>
<td>1410 B.C.</td>
</tr>
<tr>
<td></td>
<td>Wood from Pfahlsteg V. Depth 2.70 m.</td>
<td></td>
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<tr>
<td>GrN-3529</td>
<td>Ipwegermoor LIX</td>
<td>3420 ± 75</td>
<td>1470 B.C.</td>
</tr>
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<td></td>
<td>Wood from Knüppelsteg LIX. Depth 0.40 m.</td>
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<tr>
<td>GrN-3509</td>
<td>Ipwegermoor XXV</td>
<td>3415 ± 65</td>
<td>1465 B.C.</td>
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<td></td>
<td>Wood from Pfahlsteg XXV. Depth 0.30 m.</td>
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*General Comment*: there does not seem to be much difference in age between the different trackways.

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<thead>
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<th>GrN-Number</th>
<th>Site/Location</th>
<th>3260 ± 70</th>
<th>1310 B.C.</th>
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<td>GrN-3036</td>
<td>Noordsleen, Netherlands</td>
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<tr>
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<td>Charcoal from burnt wooden coffin, supposed to be the primary grave of a barrow, excavated in 1960 at Noordsleen (52° 47' 50&quot; N Lat, 6° 47' 40&quot; E Long), municipality of Sleen, province of Drenthe, Netherlands. Another grave in the same barrow, thought to be contemporary, had yielded Early Bronze Age objects (Sögel stage). Depth 0.60 to 0.70 m below surface. Expected age 1500-1400 B.C. <em>Comment</em>: date is younger than was expected. Because of earlier digging at the site the stratigraphic circumstances were not quite clear.</td>
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</tbody>
</table>

**Totertfout-Halve Mijl series, Netherlands**

To complete the series of measurements of charcoal samples of the barrow cemetery of Totertfout-Halve Mijl (51° 25' N Lat, 5° 20' E Long), municipality of Veldhoven, province of Noord-Brabant, Netherlands (Glasbergen, 1954) twelve more samples were dated. For the previous measurements see Groningen III, p. 1554. The samples are listed in the order as suggested by pollen analysis of soil samples from the same barrows. Coll. and subm. by W. Glasbergen.

<table>
<thead>
<tr>
<th>GrN-Number</th>
<th>Site/Location</th>
<th>3380 ± 50</th>
<th>1430 B.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GrN-1821</td>
<td>Halve Mijl 87</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Charcoal (no. 87) from primary grave of Tumulus 4. <em>Comment</em>: an earlier measurement on charcoal from the same sample gave 3375 ± 200 (GrN-066, Groningen III, p. 1554), i.e., 1425 B.C.</td>
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<tr>
<td>GrN-1819</td>
<td>Halve Mijl 90</td>
<td>3365 ± 55</td>
<td>1415 B.C.</td>
</tr>
<tr>
<td></td>
<td>Charcoal (no. 90) particles lying scattered in places on the old surface at the centre of Tumulus 4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GrN-1828</td>
<td>Totertfout 74a</td>
<td>3420 ± 45</td>
<td>1470 B.C.</td>
</tr>
<tr>
<td></td>
<td>Charcoal (no. 74a) lying in the upper part of the primary urn (Hilver-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
sum urn). *Comment:* an earlier measurement on charcoal from the same sample gave $3450 \pm 100$ (GrN-050, Groningen III, p. 1554), i.e., 1500 B.C.

**GrN-1816. Halve Mijl 46**

$3310 \pm 50$

1360 B.C.

Charcoal (no. 46) with cremated bone deposited among the soils during the construction of Tumulus 5.

**GrN-1692. Halve Mijl 41**

$3175 \pm 60$

1225 B.C.

Charcoal from funeral repast (?) in SW quadrant of Tumulus 5. *Comment* (to GrN-1816 and GrN-1692): another charcoal sample (no. 42) from the same barrow had been dated before: $3300 \pm 50$, GrN-1003, and $3310 \pm 50$ GrN-989 (Groningen III, p. 1554), i.e., 1350 and 1360 B.C.

**GrN-1605. Halve Mijl 40**

$3260 \pm 50$

1310 B.C.

Charcoal from secondary grave in Tumulus 5.

**GrN-1822. Halve Mijl 49**

$3200 \pm 65$

1250 B.C.

Charcoal from primary grave of Tumulus 8. *Comment:* two earlier measurements of charcoal from the same sample gave $3055 \pm 90$ (GrN-049, Groningen I, p. 1142) and $3250 \pm 60$ (GrN-990, Groningen III, p. 1554), i.e., 1105 and 1300 B.C.

**GrN-1604. Halve Mijl 14a**

$3230 \pm 50$

1280 B.C.

Charcoal from primary grave of Tumulus 17.

**GrN-1820. Halve Mijl 58**

$3220 \pm 50$

1270 B.C.

Charcoal from boards lying alongside the primary grave of Tumulus 16.

**GrN-1817. Halve Mijl 57**

$3260 \pm 50$

1310 B.C.

Charcoal from patch under the slope of the primary barrow of Tumulus 16.

**GrN-1693. Halve Mijl 69**

$3550 \pm 50$

1600 B.C.

Charcoal from primary grave of Tumulus 14.

**GrN-1818. Halve Mijl 85a**

$3200 \pm 40$

1250 B.C.

Charcoal from primary grave of Tumulus 12.

*General Comment:* in agreement with the pollen evidence and archaeological considerations, an earlier group can be separated from a later. All samples were pretreated with acid and alkali.

**GrN-2997. Vogelenzang, Netherlands**

$3140 \pm 70$

1190 B.C.

Charcoal from pit belonging to a settlement of the Hilversum culture near
Vogelenzang (52° 18’ 55” N Lat, 4° 33’ 32” E Long), province of Noord-Holland, Netherlands (Groenman-van Waateringe, 1961b). Subm. by W. Glasbergen. Comment: date is younger than was expected.

The Hague series, Netherlands

Two charcoal samples were dated from a settlement site near the Hague (52° 03’ 47” N Lat, 4° 13’ 45” E Long), Netherlands. There were three cultural layers, belonging to the Bronze Age (I) and to the Iron Age (II-III) (Groenman-van Waateringe, 1961b). Subm. by W. Glasbergen.

GrN-2421. The Hague 1

Charcoal from Bronze Age settlement I (Hilversum culture). Expected age ca. 3300 B.P. (1350 B.C.).

GrN-3010. The Hague 2

Charcoal from first Iron Age settlement II. Expected age ca. 2500 B.P. (550 B.C.).

General Comment: dates are at least ca. 700 yr too high. There is as yet no explanation for this anomaly.

Eersel series, Netherlands

Two samples were dated from a prehistoric barrow, excavated in 1957, at Eersel (51° 23’ 8” N Lat, 5° 22’ 40” E Long), province of Noord-Brabant, Netherlands. The barrow was surrounded by a timber circle. In the center of the barrow an Iron Age urn was found. It was thought that timber circle and urn were contemporaneous. Coll. 1957 and subm. by P. J. R. Modderman.

GrN-1532. Eersel 5

Charcoal found in one of the postholes of the timber circle. Depth 0.50 m.

GrN-1531. Eersel 3

Charcoal found at the supposed old surface of the barrow near the place where the urn was placed. Depth 0.48 m.

General Comment: contrary to expectation, the timber circle and urn do not seem to be contemporaneous. The excavator hardly sees the possibility of assuming that an Early Bronze Age timber circle had surrounded an unrecognized very low barrow, in the top of which the Iron Age burial was placed. Humic material was thoroughly extracted with acid and alkali.

GrN-1994. Kosziderpadlás, Hungary

Charcoal from Bronze Age pottery kiln at Kosziderpadlás (46° 58’ N Lat, 18° 56’ E Long), Hungary, belonging to the Vatya culture. Coll. 1950 by A. Mozsolics, Budapest, Hungary; subm. by H. Quitta and H. T. Waterbolk. Comment: date is according to expectation. Humus was extracted with acid and alkali.
GrN-1552.  Bargeroosterveld, Netherlands 3240 ± 65 1290 B.C.

Wood from a unique ritual structure found in 1957 in a large raised bog at Bargeroosterveld (52° 46' 42" N Lat, 6° 48' 53" E Long), municipality of Emmen, province of Drenthe, Netherlands (Waterbolk and van Zeist, 1961). The structure consisted of two broad parallel oak planks, each with four holes, in which the lower parts of upright timbers were found. A stone circle surrounded the structure. No associated datable objects were found, but pollen analysis pointed to a Bronze Age date. The sample was taken from a piece of wood with adhering bark. Coll. and subm. by W. van Zeist and H. T. Waterbolk. Comment: supposed age is confirmed by C¹⁴ determination.

GrN-797.  Oostwoud, Netherlands 3025 ± 80 1075 B.C.

Charred wood from barrow at Oostwoud (52° 44' 20" N Lat, 5° 05' 40" E Long), province of Noord-Holland, Netherlands (Van Giffen, 1961b). The barrow overlies a plowed soil, with plow marks, containing Bell Beaker sherds. The barrow was surrounded by a circle of oval pits, one of which yielded the sample. Excavation in 1956 and 1957 by A. E. van Giffen, who collected and submitted the sample. Comment: barrow appears to be about the same age as others in the same area (e.g. Grotebroek, GrN-160, 2925 ± 140, Groningen I, p. 1143). The plowed soil may immediately precede the barrow, but the Bell Beaker sherds in it must be much older. Humus was extracted with acid and alkali.

Wervershoof series, Netherlands

In 1954 the Institute of Pre- and Protohistory of the University of Amsterdam excavated at Wervershoof (52° 43' N Lat, 5° 08' 48" E Long), province of Noord-Holland, Netherlands, the site of a Bronze Age barrow (no. 13) that had been removed before. Traces were found of two successive timber circles, which were followed by a two-period ring ditch (Van der Waals, 1961). Coll. 1954 and subm. by J. D. van der Waals.

GrN-2359.  Wervershoof 12 3015 ± 55 1065 B.C.

Charcoal from posthole of second timber circle. Depth 0.55 to 0.60 m below surface.

GrN-2168.  Wervershoof 16 2965 ± 45 1015 B.C.

Charcoal from filling of second ring ditch. Depth 0.50 to 0.55 m below surface. General Comment: dates agree with those of other barrows in the same area at Oostwoud (GrN-797, 3025 ± 80, this list) and Grotebroek (GrN-160, 2925 ± 140; Groningen I, p. 1143).

Holslot series, Netherlands

In 1957 a Late Bronze Age urnfield was excavated at Holslot (52° 44' 10" N Lat, 6° 47' 22" E Long), municipality of Sleen, province of Drenthe, Netherlands (Clason, 1959). Three charcoal samples were collected and submitted by H. T. Waterbolk.
1. Vogel and H. T. Waterbolk

**GrN-1563. Holsloot 7**

Charcoal from urn with cremation, being the central grave of a tumulus which was surrounded by a densely spaced double timber circle.

**GrN-1561. Holsloot 10**

Charcoal from the central cremation grave in a burial monument consisting of a rectangular wooden structure surrounded by an oblong ditch.

**GrN-1562. Holsloot 13**

Charcoal from a ritual pit containing also some small cremation fragments, situated in an opening in the above-mentioned oblong ditch.

*General Comment:* according to expectation the first date is older than the last two, which are apparently synchronous. The dates of these highly characteristic burial monuments agree well with the available archaeological evidence. All samples were pretreated with acid and alkali.

**GrN-1674. Hilvarenbeek, Netherlands**

Charcoal collected in oblong ditch of urn field Laag Spul (51° 28’ 30” N Lat, 5° 09’ 15” E Long), municipality of Hilvarenbeek, province of Noord-Brabant, Netherlands. Depth 0.80 m below old arable surface. Supposed age ca. 7th century B.C. Coll. and subm. by P. J. R. Modderman. *Comment:* although somewhat older than was expected, date is within the limits of the archaeological possibilities. The sample was thoroughly pretreated with acid and alkali.

**GrN-2881. Elp, Netherlands**

Charred grain found (1959) in a pit in one of the long houses of a Late Bronze Age settlement at Elp (52° 53’ 48” N Lat, 6° 37’ 40” E Long), municipality of Westerbork, province of Drenthe, Netherlands (Waterbolk, 1961). Depth 0.5 m. Coll. and subm. by H. T. Waterbolk. *Comment:* from the archaeological point of view a date not later than 900 B.C. was expected. The C¹⁴ date does not contradict this estimation.

### G. Iron Age and Later

**GrN-1973. Carate, France**

Charcoal from Barrow 15 in an Iron Age cemetery at la Grée de Carate (47° 43’ N Lat, 2° 27’ W Long), commune of Pluherlin, Morbihan, France. Coll. by A. Lepart; subm. by P. R. Giot, Univ. of Rennes, France and H. T. Waterbolk. *Comment:* date indicates barrow belongs to the Hallstatt period. The same and another sample from the same cemetery were dated at Gif (Giot, 1960b) as FG-46, 2540 (mean value of four determinations) for the same sample and FG-33, 2510 (mean value of two determinations) for a sample from Barrow 9, i.e., 590 and 560 B.C. Humus was extracted with acid and alkali.
GrN-1553. Gees, Netherlands

2460 ± 45
510 B.C.

GrN-2392. Gees, Netherlands

2360 ± 55
410 B.C.

Charred grain found in an early Iron Age settlement (Jastorf B) at Gees (52° 45' N Lat, 6° 41' 20" E Long), municipality of Oosterhesselen, province of Drenthe, Netherlands. Expected age ca. 400 B.C. Coll. and subm. by H. T. Waterbolk. Comment: these are two different samples from the same grain find. GrN-1553 was done in 1957, GrN-2392 in 1962. There is no significant difference between the two dates. Their mean value may be given as 2420 ± 35 yr (470 ± 35 B.C.)

GrN-2402. Ermelo, Netherlands

2460 ± 65
510 B.C.

Charred grain found in an Iron Age settlement at Ermelo (52° 17' N Lat, 5° 38' E Long), province of Gelderland, Netherlands. Coll. and subm. by W. van Zeist and H. T. Waterbolk. Comment: another sample from the same grain find was dated in 1956 at 2535 ± 100 (GrN-652, Groningen II, p. 136), i.e., 585 B.C.

GrN-1951. Broekpolder, Netherlands

2320 ± 70
370 B.C.

Wood from a worked post of a pre-Roman Iron Age settlement in the Broekpolder (51° 55' 40" N Lat, 4° 19' 20" E Long), municipality of Vlaardingen, province of Zuid-Holland, Netherlands. The peaty cultural layer was covered by a clay deposit. The excavation was directed by P. J. R. Modderman, who collected and submitted the sample. Comment: sample was thoroughly pretreated with acid and alkali.

GrN-3519. Grosses Moor, Germany

2150 ± 70
200 B.C.

Wood from trackway (Bohlenweg) in the raised bog Grosses Moor (52° 37' 40" N Lat, 8° 18' 40" E Long), between Lohne and Diepholz, N of the Diimmer Lake, Oldenburg, Germany (Hayen, 1957a). Depth 1.00 m. Expected age between A.D. 1 and 200. Coll. and subm. by H. Hayen, Oldenburg. Comment: date is somewhat older than was expected.

GrN-1673. Felsum, Netherlands

2060 ± 65
110 B.C.

Wood found at the bottom of a wooden well, together with pottery sherds from the beginning of our era at Felsum (53° 08' 20" N Lat, 6° 34' 28" E Long), near Spannum, municipality of Hennaderadeel, province of Friesland, Netherlands. Depth 1.60 m below present surface. Expected age 2nd century A.D. Coll. 1958 and subm. by P. J. R. Modderman. Comment: sample was thoroughly pretreated with acid and alkali.

Krommenie series, Netherlands

Two samples were dated from an Iron Age settlement at Krommenie (53° 30' N Lat, 4° 46' E Long), province of Noord-Holland, Netherlands, excavated by the Institute of Pre- and Protohistory, Univ. of Amsterdam. Ar-
Kindergarten

J. C. Vogel and H. T. Waterbolk

Archaeological dating A.D. 45 to 65 (Groenman-van Waateringe et al., 1961). Subm. by W. Glasbergen.

GrN-3075. Krommenie 5

Fragment of wooden post, used for building a house. Expected age A.D. 1 to 45.

GrN-3072. Krommenie 4

Charcoal from fireplace that was in use during habitation. Expected age A.D. 45 to 65.

General Comment: dates agree with the archaeological expectation.

GrN-1415. Valkenburg, Netherlands

Charred grain from the Roman Castellum of Valkenburg (52° 10' 50" N Lat, 4° 25' 40" E Long), province of Zuid-Holland, Netherlands. Archaeological date A.D. 70. Coll. by A. E. van Giffen; subm. by H. T. Waterbolk. Comment: there is no significant difference between the archaeological date and the C¹⁴ measurement.

GrN-793. Vries, Netherlands

Chaff-tempered potsherd from Iron Age settlement at Vries (53° 04' 28" N Lat, 6° 34' 28" E Long), province of Drenthe, Netherlands. Archaeological date 1st century A.D. (Van Es, 1958, p. 50-66). Coll. in 1957 by W. A. van Es; subm. by H. T. Waterbolk. Comment: date agrees with archaeological estimation; it shows the interesting possibility of dating chaff-tempered potsherds.

Denekamp series, Netherlands

In order to study the age and development of the so-called “es” fields in Twente (a part of the province of Overijssel) a series of charcoal samples was collected at Denekamp (52° 22' 30" N Lat, 2° 7' 30" E Long), province of Overijssel, Netherlands. Two successive “es” layers could be distinguished, resting in an older soil with two dark humic layers. The total thickness was ca. 2.00 m. In the lower part of the section Iron Age and older sherds occurred. The expected age of the “es” layers was 2000 to 500 yr. Coll. 1960 and subm. by T. van der Hammen, Univ. of Leiden, Netherlands.

GrN-2815. Denekamp-Klok 4

Top of lower “es” layer; depth 1.20 m.

GrN-2812. Denekamp-Klok 3

Base of lower “es” layer; depth 1.30 m.

GrN-2814. Denekamp-Klok 2

Upper dark layer of older soil; depth 1.60 m.
GrN-2813. Denekamp-Klok 1

Lower dark layer of older soil; depth 2.00 m.

*General Comment:* dates of the two upper samples are according to expectation; those of the lower samples are much older than originally expected, but pollen analysis of the soil-layers agrees with the age of the last-mentioned samples.

GrN-2299. Alkmaar, Netherlands

Small wooden post, found in an excavation in the town of Alkmaar (52° 38' 5" N Lat, 4° 44' 50" E Long), Netherlands. The post stood in a clay layer, covered by a peaty layer and nearly 3 m of medieval and later accumulation. Posts of this type are the oldest traces of human activity in this place. Expected age 11th century A.D. or much older. Coll. 1958 by W. R. Reder; subm. by P. J. R. Modderman. *Comment:* date is somewhat older than was expected.

GrN-2300. Brunssum, Netherlands

Charcoal at the border between the first and second stages in a medieval pottery kiln at Brunssum (50° 57' 20" N Lat, 5° 58' 7" E Long), province of Limburg, Netherlands. Expected age A.D. 1180 to 1190. Coll. 1959 by A. Bruijn; subm. by P. J. R. Modderman. *Comment:* sample is older than was expected. Find circumstances were, however, not quite clear.

GrN-2296. Heerlen-Meezenbroek, Netherlands

Wood (alder) from trackway in former brook valley, covered by 1 m of redeposited loess at Meezenbroek (50° 54' 5" N Lat, 5° 59' 13" E Long), municipality of Heerlen, province of Limburg, Netherlands. The track is supposed to be part of the Roman road from Heerlen to Xanten, dating probably from the middle of the 1st century A.D. Coll. 1958 by J. E. Bogaers; subm. by P. J. R. Modderman. *Comment:* date is not in agreement with the expectation. Direct proof of Roman age of the trackway is, however, lacking.

II. Absolute Dating of Pollen Diagrams

**Poueyferré series, Central Pyrenees, France**

In 1957 and 1958 samples were collected by H. Alimen, J. Menéndez Amor and F. Florschütz in the neighborhood of Poueyferré, Lake of Lourdes and Le Monge (ca. 43° N Lat, ca. 0° E Long), France, in depressions probably of glacial origin (de Vries et al., 1960; Alimen et al., 1962). They were submitted by F. Florschütz, Velp (G), Netherlands.

GrN-1677. Poueyferré 2.45 m  
7930 ± 85  
5980 B.C.

GrN-1889. Poueyferré 3.45 m  
9500 ± 100  
7550 B.C.

GrN-1681. Poueyferré 4.45 m  
12,670 ± 130  
10,720 B.C.
GrN-1879. Poueyferré 5.10 m 13,170 ± 135 11,220 B.C.
GrN-1679. Poueyferré 6.45 m 13,960 ± 110 12,010 B.C.
GrN-1904. Poueyferré 6.60 m 19,000 ± 160 17,050 B.C.
GrN-1671. Poueyferré 7.95 m 16,240 ± 120 14,290 B.C.

General Comment (F.FL): this series is highly interesting, because the continuous sedimentation (peat succeeding gyttja) starts very early. The dates constitute a logical sequence, except the one at a depth of 6.60 m which does not fit. This may be due to cryoturbation having caused a local upheaval of deeper layers. The oldest among the other dates (16,240 yr) indicates the beginning of the Late-glacial period. The lower part of the pollen diagram reflects, consequently, the end of the third stadial phase of the Würm glaciation. Evidently, at that time trees were scarce in the surroundings. Among the shrubs and herbs, Artemisia was rather frequent; Chenopodiaceae were also present. The landscape may have had the character of a moderate steppe. Afterwards, the Artemisia percentages rose, pointing to an accentuation of the steppe conditions during the Oldest Dryas time. The correlation with northern European Bölling stage is confirmed by the dates 13,170 and 12,670 yr. The further oscillations of the curve of AP and NAP suggest the presence of Older Dryas, Allerød, Younger Dryas, Pre-boreal and Boreal periods. The second half of Boreal time, indicated by the date of 7930 yr, was characterized by the existence of oak-pine-hazel-forests.

GrN-1835. Lake of Lourdes 3.50 m 3830 ± 80 1880 B.C.
GrN-1836. Lake of Lourdes 5.00 m 7070 ± 85 5120 B.C.
GrN-1834. Lake of Lourdes 6.50 m 17,650 ± 150 15,700 B.C.

General Comment (F.FL): the oldest date originates from a calcareous gyttja, deposited near the end of Pleniglacial time, ca. 1800 yr before the beginning of the Late-glacial. In the diagram the proportion AP to NAP is ca. 10: 90, indicating an almost treeless country. In the Late-glacial part of the diagram the periods of Oldest Dryas, Bölling, Older Dryas, Allerød and Younger Dryas, can be distinguished. During Boreal and Atlantic times, oak almost always dominated among the trees, accompanied by pine and hazel. The date 7070 refers to the first half of the Atlantic and the date 3845 to the middle of the Sub-boreal, where the percentages of alder exceed 60.

GrN-1838. Le Monge 3.50 m 6940 ± 90 4990 B.C.
GrN-1839. Le Monge 5.50 m 8690 ± 110 6660 B.C.
Groningen Radiocarbon Dates IV

GrN-1840. Le Monge 7.20 m
12,870 ± 130
10,920 B.C.

GrN-1955. Le Monge 7.60 m
14,865 ± 175
12,917 B.C.

General Comment (F.FL): the last-mentioned date indicates the Oldest Dryas and the penultimate of the Bolling period. The pollen diagram points to the existence of steppe during Oldest Dryas and part of Bolling. The dates 8600 and 6935 relate successively to the middle Boreal and the first half of Atlantic, during which mixed oak with hazel, and pine with hazel, respectively, dominate in the diagram.

GrN-1956. Forêt de Pinet, France
8120 ± 105
6170 B.C.

In 1958 a series of samples for pollen analysis was collected by F. Florschütz and H. J. Zwart from a layer of ca. 4.25 m peat and clay in the forêt de Pinet near Belcaire (42° 52' N Lat, 1° 59' E Long), in the Département de l'Aude, France. One sample for C¹⁴-dating was submitted by F. Florschütz. Comment (F.Fl.): as analysis is pending, it is not yet possible to correlate this date with the history of the vegetation.

Les Bouillouses series, France

In 1958 a series of samples for pollen analysis was collected by F. Florschütz and H. J. Zwart from a layer of ca. 11.50 m peat and clay in the lake-district “Les Bouillouses” (42° 34' N Lat, 2° 1' E Long), in the Département des Pyrénées Orientales, France. Two samples were submitted by F. Florschütz.

GrN-1954. Les Bouillouses II, 3.50 m
1540 ± 60
A.D. 410

GrN-1953. Les Bouillouses I, 6.12 m
2225 ± 65
275 B.C.

General Comment (F.FL): as pollen analysis is pending, it is not yet possible to correlate these dates with the history of the vegetation.

Riofrio series, Spain

Six samples were dated from a gyttja-deposit in a kar-lake or tarn and a superimposed peat-layer at Puertos de Riofrio (43° 10' 25" N Lat, 4° 50' 35" W Long), municipality La Vega de Liébana, province of Santander, Spain, alt 1700 m (Florschütz and Menéndez Amor, 1962). Coll. 1959 and 1960 by J. Menéndez Amor and F. Florschütz; subm. by F. Florschütz.

GrN-3022. Riofrio 1.50 m
2330 ± 65
380 B.C.

GrN-3057. Riofrio 2.50 m
3540 ± 65
1590 B.C.

GrN-3063. Riofrio 3.50 m
5160 ± 60
3210 B.C.
GrN-3015. Riofrio 4.50 m  
6550 ± 80  
4600 B.C.

GrN-3059. Riofrio 5.75 m  
8825 ± 100  
6875 B.C.

GrN-3018. Riofrio 7.00 m  
10,250 ± 115  
8300 B.C.

Comment (F.Fl.): as the glacier retired from the kar toward the end of the Late-glacial, there existed in the environment a park landscape with scattered pines and a steppelike character. It was replaced in the Pre-Boreal by pine-oak-birch-forests that maintained themselves during the Boreal, the Atlantic and a part of the Sub-Boreal, but the share of birch-pollen in the pollen rain decreased gradually. In the second half of the Sub-Boreal the forests evidently became thinner, a change that continued in the Sub-Atlantic so that finally a park landscape with pines and oaks developed again.

Hechtensee series, Austria

In order to have better possibilities for correlation with other pollen diagrams, a series of four samples was dated from a boring (1958) in the Hechtensee (47° 45' N Lat, 15° 15' E Long), near Mariazell, Steiermark, Austria. Coll. and subm. by F. J. J. van Heyst and G. A. Cramer, Geol. Dept., State Univ., Leiden, Netherlands.

GrN-2244. Hechtensee 1.43 m  
4250 ± 60  
2300 B.C.

Peat, first maximum of Fagus, Transition Sub-Boreal/Sub-Atlantic.

GrN-2245. Hechtensee 2.43 m  
6400 ± 40  
2450 B.C.

Peat; maximum of Picea. Beginning of Atlantic.

GrN-2247. Hechtensee 3.43 m  
9080 ± 70  
7130 B.C.

Lake marl; maximum of Corylus, beginning of Alnus. Transition Boreal/Atlantic.

GrN-2013. Hechtensee 4.83 m  
13,340 ± 145  
11,390 B.C.

Lake marl; dominance of Pinus. Pre-Boreal.

General Comment: the first three dates are according to expectation; GrN-2013 is, however, much older. A hiatus might be present.

Sittard series, Netherlands

In January 1958 a peat deposit sealed off by colluvial clay was sampled in the valley of the Geleen River at Sittard (52° 0' 14'' N Lat, 5° 52' 03'' E Long), province of Limburg, Netherlands. The palynological investigation of this peat deposit was undertaken in connection with the excavation of the Danubian settlements at Sittard and Geleen. According to pollen analysis peat formation started at the end of the Boreal period and continued until mediaeval time. Coll. by H. T. Waterbolk and W. van Zeist; subm. by W. van Zeist.
GrN-1660. Sittard 1

3380 b.c.

At this level the first pollen grains of *Plantago lanceolata* appear, suggesting the arrival of the Danubian farmers. Depth 2.22 to 2.26 m below surface. *Comment*: date is considerably younger than the C14-dates of charcoal from the Danubian settlements (e.g. Elsloo, this list).

GrN-1658. Sittard 2

280 b.c.

This sample corresponds with a conspicuous rise of the *Fagus* curve. Depth 2.00 to 2.04 m below surface. *Comment*: date is younger than was expected.

**Saint-Michel-de-Brasparts series, France**

In July 1958 a few series of samples were taken in the formerly large bog near Mont St.-Michel-de-Brasparts (48° 20' 42" N Lat, 3° 55' 38" W Long), Brittany, France. Pollen analysis suggests that in this area peat formation started in the course of the Atlantic period. Coll. by H. T. Waterbolk and W. van Zeist; subm. by W. van Zeist.

GrN-1983. St.-Michel-de-Brasparts 1

3460 b.c.

This sample corresponds with a marked decline of *Ulmus*. Depth 1.20 to 1.30 m below surface. *Comment*: date lies within the range of other dates of the elm decline in western and northwestern Europe.

GrN-2175. St.-Michel-de-Brasparts 2

1830 b.c.

At this level the percentages for *Plantago lanceolata* show a marked increase, indicating the arrival of tribes of herdsmen. Depth 0.50 to 0.60 m below surface. *Comment*: there is no reason to suspect this date (see also GrN-2161, this list).

**Spézet series, France**

In July 1958 a series of peat samples was collected in a bog between Spézet and Gourin (48° 09' N Lat, 3° 42' 55" W Long), Brittany, France. According to pollen analysis the sedimentation of organic material started in the course of the Sub-Boreal period. Coll. by H. T. Waterbolk and W. van Zeist; subm. by W. van Zeist.

GrN-2161. Spézet 1

1990 b.c.

This sample corresponds with the first increase of *Plantago lanceolata*. Depth 2.00 to 2.10 m below surface.

GrN-2165. Spézet 2

825 b.c.

From this level on *Fagus* shows a continuous curve. Depth 1.30 to 1.40 m below surface.

GrN-2315. Spézet 3

A.D. 275

In this part of the diagram a conspicuous decrease of human activity is
demonstrated. At the same time the *Fagus* percentages increase slightly. Depth 0.40 to 0.50 m below surface.

*General Comment*: date of Spézet 1 is somewhat older than that of the corresponding level in the diagram from the bog near Mont St.-Michel-de-Brasparts (GrN-2175, 3780 ± 55, see below). There is no reason to suspect the dates of Spézet 2 and 3.

**Flögeln series, Germany**

Five samples were dated from a standard pollen section in the largest raised bog between the Weser and Elbe Rivers at Flögeln (53° 41' Lat, 8° 49' E Long), 20 km NE of Bremerhaven, Germany (Grohne, 1956). The section is composed of two partly overlapping sequences 100 m apart. Coll. 1956 and subm. by U. Grohne, Niedersächsische Landesstelle für Marschen und Wurtenforschung, Wilhelmshaven, Germany.

**GrN-2285. Flögeln 1**

2910 ± 70
960 B.C.

Older Sphagnum peat; depth 2 m (section-part 2). Expected age ca. 600 B.C.

**GrN-2292. Flögeln 3**

2125 ± 50
175 B.C.

Younger Sphagnum peat; depth ca. 1.7 m (section-part 1). Expected age ca. 200 A.D.

**GrN-2294. Flögeln 4**

1730 ± 60
A.D. 220

Younger Sphagnum peat; depth ca. 0.9 m (section-part 1). Expected age ca. 700 A.D.

**GrN-2143. Flögeln 5**

1300 ± 40
A.D. 650

Younger Sphagnum peat; depth ca. 0.4 m (section-part 1). Expected age ca. 1200 A.D.

**GrN-2144. Flögeln 6**

790 ± 40
A.D. 1160

Younger Sphagnum peat; depth ca. 0.05 m (section-part 1). Expected age A.D. 1600-1700.

*General Comment*: dates are generally somewhat older than expected. The age estimation was, however, mainly based on earlier Groningen C14 dates which had not yet been corrected for the Suess effect (e.g. Emmen, Groningen II). Sample 2, from the same horizon in section-part 2 as sample 3 in section-part 1, has not been measured.

**References**

Date lists:
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- Groningen II Vries, Hessel de, Barendsen, G. W., and Waterbolk, H. T., 1958
- Groningen III Vries, Hessel de, and Waterbolk, H. T., 1958
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STOCKHOLM
NATURAL RADIOCARBON MEASUREMENTS V

H. GÖTE ÖSTLUND and LARS G. ENGSTRAND
Radioactive Dating Laboratory, Frescati, Stockholm 50, Sweden

INTRODUCTION

This date list includes samples and sample series finished between January and November 1962. It does not include samples from series not yet been completed, or samples of very limited scientific interest.

Since the technical description of our dating system was published (Östlund, 1957a) a continuous development has been carried out both for improvement of the outfit, and considerable expansion of the facilities. In our date lists (Stockholm I, II, III, IV) we have mentioned only briefly some of the improvements. For the immediate future we do not anticipate any major technical changes, and therefore take the opportunity of giving a summary of our carbon-dioxide proportional-counting system as of fall 1962.

Technical Description

The chemical system for the preparation of extremely pure CO₂ is almost unchanged compared with the description mentioned above, utilizing the “wet purification” method. For the last four years more than 800 samples have been run through this system, and an impure gas has been obtained only in a few cases where the impurities could be directly attributed to a leak in a vacuum system or exhausted fillings in the chromate or silver-copper ovens.

Compared with the 1957 description (Östlund, 1957a), the most extensive changes have been made regarding the CO₂ proportional counters, four of which we have now in continuous use for routine dating. For a long intermediate time we had a construction with teflon ends, which has been described in connection with the natural tritium work of this laboratory (Östlund, 1962). In our efforts to obtain a type of counter, technically as simple as possible, containing as few materials as possible and being free from outgassing, we finally arrived at the construction given in Fig. 1. This construction is now used for the three one-liter CO₂ counters in Stockholm, one in Miami (cf. Miami I) and two hydrogen Geiger counters for tritium. The copper counters are shielded with 25 mm of selected lead* inside a ring of 1 m cosmic ray Geiger counters and 10 to 20 cm of iron. The Geiger counters are quenched externally, which greatly increases their lifetime, now two to three years between refillings. All regular one-liter counters have backgroundfigures between 1.60 and 2.20, and a net modern carbon count rate of 18.5 counts/min at the normal operating pressure of 3 atm (1.3 plus 9.5 counts/min for the 0.5 L counter). Working voltage is 7 kv, with a plateau length of more than 700 v and a plateau slope of less than 1% per 100 v for C¹⁴. For a counter shielded by lead, smaller cosmic variation of net background is found than for the same counter shielded by mercury in an iron tank: \( \frac{\partial n_o}{\partial n_m} < 0.01 \) inside lead, versus 0.02 inside mercury.

* This lead is commercially available from Bolidens Gruvaktiebolag, Sturegatan 22, Stockholm C, Sweden, under the name “Laisvall A” lead.
Fig. 1. Constructional detail of 3 atm one-liter CO₂ proportional counter. Effective length of center wire 490 mm, equivalent to 1.00 l cylindric volume. Center wire 0.05 mm stainless steel. Material is copper tubing (electrolytic, commercial), and brass.

Standards and mode of calculation follow the recommendations given in the introduction to RADIOCARBON, v. 4. Even if it is not stated in the sample descriptions, most dates younger than 5000 yr have been corrected for isotopic fractionation by means of C¹³ measurements on the counting gas. δC¹³ was measured to ± 1‰. In each date without C¹³ measurements, ± 40 yr squared have been incorporated in the σ² of the age figure.

The extension of the facilities to four routine counters was completed during the summer of 1962, and the laboratory is now capable of dating 400 unknown samples a year, with two days counting time for each sample. All the technical routine work and part of the calculations are now handled by two women technicians. Final calculations, supervision of the work, trouble shooting, and special projects take most of the time of one of the authors.

ACKNOWLEDGMENTS

The expansion and improvements of the facilities were made possible by generous grants from the King Gustav VI Adolf Foundation for Swedish Culture and the Swedish Wenner-Gren Foundation.

We are indebted to Mrs. Ingrid Almstedt for having excellently performed most of the routine work. As usual, Dr. R. Ryhage and his staff at the mass-spectrometric laboratory of the Karolinska Institutet have been of very great help by making the C¹³ determinations.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Postglacial Strandlines

St-806. Långören

9300 ± 130
7350 B.C.

Wood from pine stumps found in sand ca. 3 m below present sealevel in the strait between the islands Lilla Långören and Stora Långören (56° 03' N Lat, 15° 49' E Long), in the Baltic Sea, S of Torhamn, Blekinge, Sweden. Coll. by A. Andersson; subm. by B. E. Berglund, Dept. of Quat. Geol., Univ. of Lund. Comment (B.E.B.): sample dates the transgression during the transition
Yoldia/Ancylus time (Preboreal/Boreal time). The date may be compared with three other samples from this area of the Baltic, St-333 pine wood 4.0 m below present sealevel 9000 ± 140 b.p. (Stockholm I), St-120 pine stumps 43 m below sealevel 9100 ± 120 b.p. and St-179 pine stumps 35 to 37 m below sealevel 9330 ± 120 b.p. (Stockholm II).

Sandbäcksviken series

Peat situated at shore line of postglacial transgression limit at Sandbäcksviken (56° 06' N Lat, 15° 39' E Long), on Štukö island, Blekinge, Sweden. Coll. and subm. by B. E. Berglund. Pollen-analytical dating is problematical.

St-810. Sandbäcksviken I 445 ± 80 a.d. 1505

Sample from uppermost part of a peat layer, 20 cm thick, below 30 cm of eolian sand. The peat is underlain by littoral sand of the old beach.

St-811. Sandbäcksviken II 815 ± 70 a.d. 1135

Sample from the lowest part of the same peat layer. Comment (B.E.B.): these two samples date the eolian activity on the island.

St-1003. Sandbäcksviken III 2010 ± 90 b.c.

Sample from peat layer below the above-mentioned littoral sand, supposed to date the Littorina beach. Comment (B.E.B.): of some unknown reason the date is too young.

Stockholm crustal uplift series

Samples of mud from the isolation level of peat bogs and fens in the Stockholm region, investigated in order to study the process of crustal uplift in this area. Subm. by H. Möller, Geol. Survey of Sweden.

St-808. Danderyd 2 1940 ± 100 a.d. 10

Vaucheria-mud from drained fen (59° 25' N Lat, 18° 03' E Long), 350 m ESE of Danderyd Church, N of Stockholm. Isolation level: 5 m above sealevel. Coll. by H. Möller.

St-807. Brännkyrka 6 4235 ± 110 2285 b.c.

Vaucheria-mud collected in a drained fen (59° 17' N Lat, 18° 00' E Long), 1850 m W of Brännkyrka Church, 6 km SW of central Stockholm. Isolation level: 22 m above sealevel. Coll. by H. Möller.

St-809. Sandasjömosseen 8 5020 ± 80 3070 b.c.

Mud collected in a profile of the bog Sandasjömosseen (59° 16' N Lat, 18° 11' E Long), 500 m W of the Lake Sandasjön, 8 km SE of central Stockholm. Sample is taken 325 to 330 cm below surface in the center of the bog. Isolation level: 36 m above sealevel. Coll. by C. Larsson, Geol. Survey of Sweden.
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St-789. **Snöromsmossen 8**

Mud collected in a profile of the bog Snöromsmossen (59° 17' N Lat, 18° 12' E Long), 1 km E of S shore of the Lake Källtorpssjön, 7 km ESE of central Stockholm. Sample was taken 335 to 340 cm below surface (core 15). Isolation level: 41 m above sealevel. Coll. by C. Larsson.

St-788. **Källtorpsmossen 4**

Mud collected in a profile of the bog Källtorpsmossen (59° 16' N Lat, 18° 11' E Long), 1 km E of N shore of Källtorpsjön, 7 km ESE of central Stockholm. Sample was taken 420 to 425 cm below surface (core 5). Isolation level: ca. 55 m above sealevel. Coll. by C. Larsson.

St-970. **Apelvreten 33**

Mud collected in a profile of a bog 700 m E of Apelvreten (59° 17' N Lat, 18° 25' E Long), 1700 m W of Ingarö Church, 18 km ESE of central Stockholm, 360 to 370 cm below surface (core 3). Isolation level: 34.5 m above sealevel. Coll. by C. Larsson.

St-968. **Blåbärsmossen 36**

Mud collected in a profile of the bog Stora Blåbärsmossen (59° 24' N Lat, 18° 13' E Long), 6 km SSE of Östra Ryd Church, 11 km NE of central Stockholm, 185 to 200 cm below surface (core 3). Isolation level: 32 m above sealevel. Coll. by C. Larsson.

St-969. **Fågelsången 3**

Mud collected in a profile of bog E of Fågelsången (59° 30' N Lat, 18° 06' E Long), 3 km ENE of Täby Church, 9 km N of central Stockholm, 305 to 320 cm below surface (core 3). Isolation level: ca. 22.5 m above sealevel. Coll. by C. Larsson.

**Alsmyren series**

Two samples of peat from the bog Alsmyren (61° 52' N Lat, 16° 12' E Long), ENE of Ljusdal, Hälsingland, Sweden. Samples were collected from clay at the isolation level, which is now 200 m above present day sealevel. Coll. 1961 and subm. by G. Lundqvist, Geol. Survey of Sweden.

St-879. **Alsmyren 10**

420 to 425 cm below surface.

St-875. **Alsmyren 9**

430 cm below surface.

**B. Recurrence Surfaces**

**Snöromsmossen series**

Peat collected in a profile of the bog Snöromsmossen (59° 17' N Lat, 18°
Stockholm Natural Radiocarbon Measurements V

12' E Long), 1 km E of the southern shore of the Lake Källtorpssjön, 7 km ESE of central Stockholm, Sweden. These samples were investigated in order to study the development of the bog, especially its recurrence surfaces. Coll. 1960 by C. Larsson; subm. by H. Möller.

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Location</th>
<th>Depth (cm below surface)</th>
<th>Age (A.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-966</td>
<td>Snöromsmossen 6</td>
<td>80 to 90 cm</td>
<td>1230 ± 90</td>
</tr>
<tr>
<td>St-967</td>
<td>Snöromsmossen 7</td>
<td>170 to 175 cm</td>
<td>2640 ± 100</td>
</tr>
</tbody>
</table>

**Tisjön series**

Peat samples from a raised bog, S of the lake Tisjön (60° 52' N Lat, 13° 03' E Long), NW Dalarna, Sweden. Investigated for its palynologic interest (Lundqvist, 1951), especially the development of recurrence surfaces. Coll. 1960 by C. Larsson; subm. by Uddeholm Ltd., through G. Lundqvist. Depth in cm below surface is given, each sample being 5 cm thick. Figures inside brackets refer to depth indications in the pollen-diagram of the cited paper.

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Location</th>
<th>Depth (cm below surface)</th>
<th>Age (A.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-761</td>
<td>Tisjön 1</td>
<td>35 (35) cm</td>
<td>720 ± 70</td>
</tr>
<tr>
<td>St-762</td>
<td>Tisjön 2</td>
<td>70 (70) cm</td>
<td>1270 ± 70</td>
</tr>
<tr>
<td>St-763</td>
<td>Tisjön 3</td>
<td>110 (110) cm</td>
<td>1700 ± 110</td>
</tr>
<tr>
<td>St-764</td>
<td>Tisjön 4</td>
<td>130 (135) cm</td>
<td>3040 ± 95</td>
</tr>
<tr>
<td>St-766</td>
<td>Tisjön 5</td>
<td>200 (205) cm</td>
<td>5150 ± 150</td>
</tr>
<tr>
<td>St-768</td>
<td>Tisjön 6</td>
<td>260 (260) cm</td>
<td>6030 ± 190</td>
</tr>
<tr>
<td>St-767</td>
<td>Tisjön 7</td>
<td>285 (310) cm</td>
<td>7630 ± 230</td>
</tr>
</tbody>
</table>

**Långsjömyren series**

Samples of peat from the bog Långsjömyren (61° 31' N Lat, 15° 28' E Long), near Voxna, Gästrikland, Sweden. Taken in order to date a recurrence surface. Coll. 1957 by C. Larsson; subm. by G. Lundqvist.

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Location</th>
<th>Depth (cm below surface)</th>
<th>Age (A.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-876</td>
<td>Långsjömyren 13</td>
<td></td>
<td>1050 ± 70</td>
</tr>
</tbody>
</table>

*Sphagnum* peat 90 cm below surface, just above the recurrence surface.

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Location</th>
<th>Depth (cm below surface)</th>
<th>Age (A.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-877</td>
<td>Långsjömyren 14</td>
<td></td>
<td>1700 ± 70</td>
</tr>
</tbody>
</table>

*Sphagnum* peat 100 cm below surface, just underneath the recurrence surface.
surface. Comment (G.L.): the surface apparently began to form 1700 B.P. but the peat growth did not commence again until 1050 B.P., which is a surprisingly large time difference.

C. Various Geologic Problems

Ageröd series

Peat and gyttja samples from the raised bog Ageröds mosse (55° 56’ N Lat, 13° 26’ E Long), 3 km NW of the lake Ringsjön. Skåne, Sweden. Dated as part of an extensive pollen-analytical investigation of bog development, recurrence surfaces, vegetational history, and human settlement in the surroundings. Most samples were cut out from a core (diam 6 cm) taken by a piston sampler (type Borro) in the central part of the bog (profile P 100). The samples from the uppermost 100 cm were taken in a dug wall. Coll. and subm. by Tage Nilsson, Dept. of Quat. Geol., Univ. of Lund, Sweden. Depth given is that below surface of the bog.

St-976. Ageröd 14
Fresh Sphagnum peat, 34 to 38 cm. 430 ± 80 A.D. 1520

St-977. Ageröd 26
Fresh Sphagnum peat, 85 to 90 cm. 1090 ± 85 A.D. 860

St-978. Ageröd 27
Fresh Sphagnum peat, 94 to 98 cm. 1250 ± 85 A.D. 700

St-979. Ageröd 32
Fresh Sphagnum peat, 118 to 121 cm. 1495 ± 85 A.D. 455

St-982. Ageröd 33
Highly humified Sphagnum peat, 122 to 127 cm. 1645 ± 95 A.D. 305

St-983. Ageröd 43
Highly humified Sphagnum peat, 169 to 175 cm. 1935 ± 80 A.D. 15

St-985. Ageröd 44
Humified Sphagnum peat, 175 to 181 cm. 2140 ± 85 190 B.C.

St-986. Ageröd 45
Highly humified Sphagnum peat with much Eriophorum vaginatum, 181 to 186 cm. 2205 ± 85 255 B.C.

St-987. Ageröd 46
Highly humified Sphagnum peat, 190 to 194 cm. 2845 ± 90 895 B.C.

St-988. Ageröd 51
Highly humified Sphagnum peat, 211 to 216 cm. 3205 ± 85 1255 B.C.
St-989. Ageröd 52
Highly humified Sphagnum peat with much Eriophorum vaginatum, 218 to 224 cm.

St-1050. Ageröd 55
Highly humified Sphagnum peat, 232-235 cm.

St-990. Ageröd 60
Highly humified Sphagnum peat, 256 to 260 cm.

St-996. Ageröd 69
Humified Sphagnum peat, 296 to 299 cm.

St-997. Ageröd 76
Highly humified Sphagnum peat, 325 to 329 cm.

St-998. Ageröd 77
Highly humified Sphagnum peat, 329 to 333 cm.

St-792. Ageröd 87
Carex-Sphagnum peat, 371 to 375 cm.

St-790. Ageröd 88
Carex-Sphagnum peat, 375 to 379 cm.

St-1000. Ageröd 95
Magnocaricetum peat, 404 to 409 cm.

St-791. Ageröd 100
Magnocaricetum peat, 427 to 431 cm.

St-794. Ageröd 111
Muddy Phragmites peat, 477 to 481 cm.

St-1001. Ageröd 120
Gyttja, 507 to 509 cm.

St-1002. Ageröd 132
Algae-gyttja, 536.5 to 539 cm.

St-1004. Ageröd 134
Algae-gyttja, 540 to 542 cm.

St-795. Ageröd 135
Algae-gyttja, 542 to 544 cm.

3315 ± 90  3560 ± 65  4000 ± 90  4000 ± 90  4510 ± 80  4510 ± 80  5090 ± 80  5090 ± 80  5060 ± 90  5060 ± 90  5950 ± 95  5950 ± 95  6170 ± 120  6170 ± 120  6570 ± 95  6570 ± 95  6800 ± 100  6800 ± 100  7320 ± 100  7320 ± 100  7950 ± 85  7950 ± 85  8160 ± 110  8160 ± 110  8450 ± 160  8450 ± 160  8550 ± 110  8550 ± 110  8695 ± 120  8695 ± 120  9000 ± 130  9000 ± 130  9410 ± 150  9410 ± 150  9820 ± 160  9820 ± 160  10100 ± 170  10100 ± 170  10400 ± 180  10400 ± 180  10700 ± 190  10700 ± 190  11000 ± 200  11000 ± 200  11300 ± 210  11300 ± 210  11500 ± 220  11500 ± 220
St-796. Ageröd 137
Algae-gyttja, 546.5 to 549 cm.

St-797. Ageröd 139
Algae-gyttja, 551.5 to 554 cm.

St-1018. Ageröd 143
Algae-gyttja, 561 to 563 cm.

St-800. Ageröd 144
Fine detritus gyttja transitional to lime-gyttja, Pre-boreal, 563 to 566 cm.

St-801. Ageröd 145
Fine detritus gyttja transitional to lime-gyttja, Pre-boreal, 566 to 569 cm.

St-805. Ageröd 146
Fine detritus gyttja transitional to lime-gyttja, Pre-boreal, 569 to 572 cm.

St-799. Ageröd 147
Clay-gyttja, Late-glacial, 572 to 574 cm.

St-798. Ageröd 148
Clay-gyttja with layers of fine sand, Late-glacial, 574.5 to 578 cm.

St-874. Långströmmen
Wood from stump in situ of a tree having grown on what is now the bottom of the river Ljusnan at Långströmmen (62° 05' N Lat, 14° 58' E Long), Jämtland, Sweden. The stump was revealed by the construction work for a dam. Coll. 1960 and subm. by G. Lundqvist.

St-780. Gallejaure
Sample of muddy silt from borings at Gallejaure (65° 09' N Lat, 19° 28' E Long), Västerbotten, Sweden. The silt was situated within varved fine-grained sediments, under ca. 17 m of moraine and other drift. The age of the organic matter is thus assumed to be interglacial or interstadial. The deposit contained no macroscopic remains. Coll. 1960; subm. and described 1962 by Ernest Magnusson, Geol. Survey of Sweden.

North Scandinavian Local Glaciation series
A series of peat samples collected in order to determine the variation in size of the pre-recent local glaciation in the Scandinavian mountains. This is partly a continuation of the Norwegian local glaciation series in Uppsala II. Subm. by Erik Bergström, Dept. of Geog., Univ. of Stockholm.
Stockholm Natural Radiocarbon Measurements V

St-928. Skanatjäkko

1305 ± 80

A.D. 645

Peat from the bottom of a bog situated inside a terminal moraine at Skanatjäkko (67° 27' N Lat, 18° 02' E Long), Lapland, Sweden. Coll. 1960 by Lennart Vilborg. Estimated age: <6000 yr.

St-936. Nakerivaara

4920 ± 80

2970 B.C.

Peat from the bottom of a lake inside a terminal moraine at Nakerivaara (68° 11' N Lat, 19° 45' E Long), Lapland, Sweden. Coll. 1962 by Erik Bergström. Estimated age: ca. 8000 yr.

St-927. Heimerdalsvand

3850 ± 80

1900 B.C.

Peat between boulders accumulated during the last Tapestransgression ca. 85 cm below surface at Heimerdalsvand (68° 18' N Lat, 13° 38' E Long), Lofoten, Norway. Coll. 1958 by Erik Bergström. Estimated age: between 3440 and 5860 yr B.P. Samples from this location have been dated in Uppsala (U-97, U-98 and U-99, Uppsala II).

Rangárbotnar series

Samples of charred wood from two important tephra (ash) horizons at Rangárbotnar (64° 04' N Lat, 19° 45' W Long), 10 km NE of the volcano Hekla, Iceland. Coll. and subm. by Sigurdur Thorarinsson, Dept. of Geol. and Geog., Mus. of Natl. History, Reykjavik.

St-813. Rangárbotnar, Cd 49

2820 ± 70

870 B.C.

A birch having been charred and covered by hot rhyolitic pumice from an explosive Hekla eruption. This layer has been called H₃ (Thorarinsson, 1951) and is the heaviest and most extensive postglacial tephra layer in Iceland, covering 80,000 km² on land (Thorarinsson, 1960). Its age was estimated to “not less than 2500—probably nearer 3000 yr” (Thorarinsson, 1951, p. 11). Peat immediately below this layer has been dated by the Yale laboratory (Y-85, Yale II) at 2720 ± 130 (Thorarinsson, 1954).

St-814. Rangárbotnar, Cd 50

2660 ± 80

710 B.C.

Charred remnants of another birch buried in a brown pumice layer a few hundred meters E of sample Cd 49. This layer, which is separated from layer H₃ by a layer of eolian soil and tephra, 30 cm thick, is also important, existing over large areas of S Iceland. Its age was roughly estimated to be ca. 2000 yr.

II. ARCHAEOLOGIC SAMPLES—SWEDEN

A. History of Iron Manufacturing

Grunuberg series

Charcoal imbedded in slag from two ancient iron manufacturing furnaces, so-called Osmund forges, at Orsa (61° 06' N Lat, 14° 51' E Long), Dalarna. Coll. 1961 by E. Berg; subm. by Jan Lundqvist.
St-880. Grunuberg 1
A.D. 1125
825 ± 80

St-881. Grunuberg 2
A.D. 1660
290 ± 75

St-956. Östnär
A.D. 1570
380 ± 75

Charcoal imbedded in iron furnace slag from a slag-mound, at Östnär (62° 55' N Lat, 14° 33' E Long), Jämtland. The fact that no tradition of iron manufacturing from bog-ore can be traced to this place indicates the sample is at least one or two hundred years old. Coll. 1962 by Maj Nodermann; subm. by Margareta Biörnstad, Royal Office of Natl. Antiquities, Stockholm.

B. History of Ship-Building

St-787. Kvillehed boat
185 B.C.
2135 ± 105

Wood from a boat made of a tree trunk found at Kvillehed (57° 48' N Lat, 11° 51' E Long), 11 km NW of Göteborg, Bohuslan. The boat, which has been investigated carefully, was excavated 1953 by A. Fredsjö. It was preserved by surface treatment with linseed oil, but the samples for C¹⁴ were taken from an uncontaminated part of the material by G. Lindman and O. Lindqvist. The boat has been dated to ca. A.D. 300, according to pollen and diatom analysis. Subm. by C. A. Moberg, Archaeol. Mus., Göteborg. Comment (C.A.M. and G.O.): the discrepancy between estimated age and C¹⁴ date may be due to the apparently high age of the tree from which the boat was made. Sample taken from “early” year rings.

St-784. Söderbysjön
A.D. 980
970 ± 80

Wood from a boat, found standing vertically with one end in the bottom mud at a water depth of ca. 2 m in the lake Söderbysjön (59° 17' N Lat, 18° 09' E Long), Nacka, SW of Stockholm. Coll. 1961 and subm. by H. Ahnlund, City Mus. of Stockholm.

St-916. Enköping boat
A.D. 1060
890 ± 65

Wood from a plank belonging to a ship discovered 176 cm below the surface of the street Munksundsgatan, at the ruins of the monastery church of Enköping (59° 38' N Lat, 17° 05' E Long), Uppland. The planks were lying upon a stratum of blue clay with separate splinters of brick and were covered with a layer of burnt occupation soil, 3 to 5 cm thick. This ship was clinker-built and is supposed to belong to the Medieval period. (Oral communication by Dr. O. Hasslöf, Natl. Maritime Mus. of Stockholm.) Coll. 1960 by O. Ehn, Upplands Mus.; subm. by S. Sjöberg, The Enköping Mus., Enköping.

St-786. Penningby boat
A.D. 890
1060 ± 70

Wood from a boat made from an oak trunk, found at the end of the nine-
teenth century by cutting peat in a bog near the lake Bergasjön (59° 41' N Lat, 18° 42' E Long), Penningby, 9 km S of Norrtälje, Uppland. The boat is 600 cm long and has a beam of 59 cm. It is now preserved and kept at Penningby Castle. Subm. by R. Holmerin.

C. Various Archaeologic Samples, Sweden, except Lappland

**Skedemosse series**

Wood samples from the drained fen Skedemosse (56° 50' N Lat, 16° 45' E Long), Öland. Another part of this series has been dated previously (Stockholm II) and the site was briefly described there. The site, which is archaeologically very rich, has been described by Ulf Hagberg, Royal Office of Natl. Antiquities (Hagberg, 1961, 1962), and the samples were subm. by him. Coll. 1960 and 1961 by Ulf Hagberg and L.-K. Königsson. Pollen analysis has been made by L.-K. Königsson on most of the samples.

**St-828. Skedemosse R 19 G**

4570 ± 75
2620 B.C.

Wooden stick in layer of Carex peat within the distal sandy part of the so-called Ancylus ridge, 27 cm below the surface.

**St-829. Skedemosse 9 G**

2460 ± 80
510 B.C.

Wooden stick in gyttja, 30 to 35 cm below the surface.

**St-830. Skedemosse 259**

8140 ± 115
6190 B.C.

Burned piece of pine-wood, imbedded in the sand layer representing the first stage of the lake. This stick might have served as a torch for the earliest fishermen. The sample should be connected with St-518 (9200 ± 160, Stockholm IV) when discussing the formation of the lake.

**St-832. Skedemosse 260:XI**

2700 ± 70
750 B.C.

Wooden pole, probably the remains of some sort of fishing-tackle.

**St-833. Skedemosse 260:VII**

2890 ± 75
940 B.C.

Another pole in the same system of poles as St-832.

**St-834. Skedemosse Ad 3 G**

9080 ± 140
7130 B.C.

Piece of wood within a sandy bar in the eastern part of the basin, 60 cm below surface.

**St-835. Skedemosse 5 G**

2750 ± 80
800 B.C.

Stick in a layer with molluscs (*Bithynia tentaculata, Planorbis* sp., *Limnaea* sp., *Valvata* sp.) and coarse detritus, 28.5 cm below surface.

**St-945. Västra Hagen**

2750 ± 150
800 B.C.

Charcoal from a Mesolithic settlement at Västra Hagen (57° 27' N Lat, 11° 56' E Long), Halland. The material was collected above and between the
stones of a hearth stratigraphically situated underneath a culture level. The top stones of the hearth reached up into the lowest part of this stratum. Artifacts of flint from this site are undoubtedly Mesolithic, but unfortunately artifacts directly connected with the hearth were lacking. According to Fredsjö (1953) the site has been used at two different periods, and the hearth in question should belong to the first occupation. Coll. 1952 by Åke Fredsjö, subm. by Carl-Axel Moberg, Gothenburg Archaeol. Mus. Comment (C.A.M.): cf. comment on Tosskärr series.

**Tosskärr series**

Charcoal from hearth in a presumed Mesolithic site at Tosskärr (57° 55’ N Lat, 11° 38’ E Long), Bohuslän. Coll. 1952 by Åke Fredsjö; subm. by Carl-Axel Moberg.

**St-944. Tosskärr I**

Location A, D:-5.

**St-946. Tosskärr II**


**St-947. Tosskärr III**

Location A, C:-3. Upper layer.

*General comment:* according to Fredsjö (1953) this hearth belongs to the settlement. The flint artifacts of the site are undoubtedly Mesolithic, but the possibility that the hearth is younger, cannot be entirely excluded. Additional samples from this site have been dated by H. Tauber in the Copenhagen C14 dating lab. They also indicate similar inconsistencies. (Oral communication by J. Troels-Smith, Natl. Mus., Copenhagen.)

**St-929. Vittene**

Materials from six resin cakes found by digging a ditch on the farm Högerna, at Vittene (58° 15’ N Lat, 12° 31’ E Long), N Björke, Västergötland. Coll. 1928; subm. by S. A. Hallbäck, Vänersborg Mus., Vänersborg. Resin cakes found very close to this find have been dated by us to 2945 ± 75 (St-690, Stockholm IV).

**Halleby series**

Charcoal from remains of a house and culture layers at Halleby (58° 42’ N Lat, 19° 57’ E Long), Östergötland. These samples were dated as a part of a large investigation of the early settlements and their agriculture, and to establish possible earlier devastations of cultivated land. All samples are charcoal from house remains, or charcoal horizons resulting from the intentional clearing of land by fire. Coll. 1960 to 1962; subm. and partly described by Sven-Olof Lindquist (1961), Dept. of Geog., Univ. of Stockholm.

**St-622. Halleby 7**

Posthole 70 cm below surface. House Ia.
Charcoal from the top of the lowest culture layer inside the hill fort:

**St-892. Darsgärde 38**

1625 ± 110

A.D. 325

**St-893. Darsgärde 39**

1610 ± 110

A.D. 340

Comment (B.A.): these two samples were found in a layer with artifacts belonging to the older stage ca. 500 B.C.), but the compressed stratigraphy of these turf charcoal layers may well be the cause of the younger age obtained.

Charcoal from buildings belonging to the later culture layer:

**St-894. Darsgärde 53**

1495 ± 90

A.D. 455

**St-895. Darsgärde 55**

1525 ± 80

A.D. 425

**St-785. Penningby palisade**

570 ± 70

A.D. 1380

Wood remnants of a palisade around a small hill, formerly an island, the site of a small fortress defending the passage from the Baltic to the Lake Väsbysjön at Penningby (59° 41' N Lat, 18° 42' E Long), 9 km S of the city of Norrtälje, Uppland. This fortress was probably burnt down. In the late Middle Ages it was replaced by the present Penningby Castle, situated on the lake ca. 3 km W of the hill. Subm. by R. Holmerin through the State Mus. of Natl. History.

C. Archaeology of Lappland

Malgomaj-Varris series

Charcoal from four settlements and a system of trapping pits at the lakes Varris and Grundsjön (64° 42' N Lat, 16° 24' E Long), S of Lake Malgomaj, 14 km NW of Vilhelmina, Lappland. The sites consist mostly of low moraine ridges, now covered with pine forests and surrounded by water and moor. They show no defined stratigraphy. Site 673 is quite empty of finds. Sites 654, 657 and 662 contain rich and varying material: stone artifacts, metals (bronze, iron, lead), molds of soapstone, asbestos ceramics. The finds seem to indicate a long period of settlement from the Late Neolithic period right into historical time. In some hearths, metal, ceramics and stone artifacts were found, in others only stone artifacts. Not all the finds are necessarily contemporary with the hearths. The C¹⁴ dating of this series is intended to reveal the time intervals during which the different hearths, cooking, and trapping pits have been in use. Thereby archaeological dating of the finds is greatly supplemented. Coll. 1956 and 1957 by Astrid Linder, Royal Office of Natl. Antiquities; subm. by Mats P. Malmer, State Mus. of Natl. Antiquities, Stockholm.

**Svartviksudden, site 654**

**St-899. Svartviksudden HH30**

1750 ± 80

A.D. 200

Cooking-pit. Charcoal 10 cm below surface.
St-938. Svartviksudden 8
Hearth 8. Charcoal 7 cm below surface.

Vallviksudden, site 657

St-848. Vallviksudden 3
Trapping pit 3. Charcoal 15 cm below surface.

St-849. Vallviksudden 4 A
Trapping pit 4. Charcoal from the upper part of the coal layer, 5 cm below surface.

St-850. Vallviksudden 4 B
Trapping pit 4. Charcoal from the lower part of the coal layer, 10 cm below surface.

St-939. Vallviksudden 6
Hearth 6. Charcoal 5 cm below surface.

St-940. Vallviksudden 7
Hearth 7. Charcoal 10 cm below surface.

St-941. Vallviksudden 9
Hearth 9. Charcoal 12 cm below surface.

St-942. Vallviksudden 10
Hearth 10. Charcoal 20 cm below surface.

St-949. Vallviksudden 11
Hearth 11. Charcoal 10 cm below surface.

St-950. Vallviksudden 13
Hearth 13. Charcoal 15 to 20 cm below surface.

St-951. Vallviksudden 14
Hearth 14. Charcoal 20 cm below surface.

Lappvallen, site 662

St-952. Lappvallen 2
Hearth 2. Charcoal 20 cm below surface.

St-953. Lappvallen 4
Hearth 4. Charcoal 30 cm below surface.
Stockholm Natural Radiocarbon Measurements V

St-954.  Lappvallen 5  530 ± 80  A.D. 1420
Hearth 5. Charcoal 15 cm below surface.

St-955.  Lappvallen 11  670 ± 90  A.D. 1280
Hearth 11. Charcoal 15 cm below surface.

St-1016. Lappvallen 25  1155 ± 70  A.D. 795
Charcoal from pit of unknown function.

Bräntudden, site 673

St-866.  Bräntudden 1 E  1070 ± 70  A.D. 830
Cooking pit 1. Charcoal from the E part of pit, 40 cm below surface.

St-867.  Bräntudden 1 W  1260 ± 70  A.D. 690
Cooking pit 1. Charcoal from W part of pit, 25 cm below surface.

St-868.  Bräntudden 2  1170 ± 65  A.D. 780
Cooking pit 2. Charcoal 10 cm below surface.

St-930.  Bräntudden 2 N  1265 ± 80  A.D. 685
Hearth 2. Charcoal from N part of hearth, 15 cm below surface.

St-937.  Bräntudden 2 S  1120 ± 65  A.D. 830
Hearth 2. Charcoal from S part of hearth, 10 cm below surface.

St-897.  Bräntudden 3  950 ± 75  A.D. 1000
Hearth 3. Charcoal 5 cm below surface.

St-898.  Bräntudden 4  2580 ± 80  630 B.C.
Hearth 4. Charcoal 10 cm below surface.

III. GEOCHEMICAL SAMPLES

A. Atmospheric Carbon Dioxide

Bredkalén series

Atmospheric CO₂ from Bredkalén (63° 54' N Lat, 15° 18' E Long), alt 400 m, Jämtland, Sweden. Samples were collected at 2 m above ground level in an open grassland area by bubbling air through a 2 M KOH solution, which was changed twice monthly. The sampling period in question is indicated below by the four digits for year and month. A refers to the first half and B to the second half of the month. Sampling was begun in January 1959 and is still going on. Subm. by Svante Odén, Internatl. Meteorological Inst., Stockholm. Only selected samples have been analysed.
Comment (G.O. and S.O.): the Δ values show a magnitude and a seasonal variation similar to that reported by others. Maximum occurs around August, and minimum half a year later. This is in accordance with conditions of the stratosphere (source) and the earth surface (sink). For some periods the absorption was incomplete and the yield of CO₂ rather low. This was connected with some isotopic fractionation (cf. δC¹³ figures) and leads to an increase of the uncertainty figures.

B. Reaction Kinetics of Organic Substances in Soil

Hildesheim-Fredriksdal-Halmstad series

Soil profiles from N Europe investigated to study the reaction kinetics of organic substances in soils. Subm. by Svante Odén.

Hildesheim

Soil profile between Harsum and Clausen (52° 18’ N Lat, 9° 55’ E Long), near Hildesheim, Germany. The soil belongs to the chernozem group, or black soils, and is degraded in this area. The soil profile has developed from calcareous loess and the depth of soil organic matter exceeds 150 cm. The soil is used as farmland. Coll. June 1958 by Svante Odén. Prior to combustion, the samples were treated with dilute HCl to remove carbonate.

<table>
<thead>
<tr>
<th>Sample</th>
<th>δC¹³</th>
<th>Δ</th>
<th>Apparent Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-681</td>
<td>-26</td>
<td>-155±7</td>
<td>1360 ± 60</td>
</tr>
</tbody>
</table>

8 to 11 cm below soil surface. Organic carbon: 1.63% of dry weight.
Stockholm Natural Radiocarbon Measurements V

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Age (±)</th>
<th>Carbon Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-1020</td>
<td>Hildesheim 30-50</td>
<td>2090 ± 70</td>
<td>1.06%</td>
</tr>
<tr>
<td>St-682</td>
<td>Hildesheim 68-71</td>
<td>3170 ± 65</td>
<td>1.10%</td>
</tr>
<tr>
<td>St-683</td>
<td>Fredriksdal 0-20</td>
<td>1045 ± 60</td>
<td>2.71%</td>
</tr>
<tr>
<td>St-1021</td>
<td>Fredriksdal 20-40</td>
<td>1030 ± 70</td>
<td>1.59%</td>
</tr>
<tr>
<td>St-554A</td>
<td>Halmstad A</td>
<td>600 ± 70</td>
<td>0.44%</td>
</tr>
<tr>
<td>St-554B</td>
<td>Halmstad B</td>
<td>760 ± 90</td>
<td>2.36%</td>
</tr>
</tbody>
</table>

Fredriksdal
Profile at Fredriksdal (56° 03’ N Lat, 12° 42’ E Long), near Hälsingborg, Skåne, Sweden. The soil consists of boulder clay from the NW moraine of Skåne. Organic matter is incorporated in the profile to a depth of 40 cm, and from 40 to 60 cm below the surface is a gley horizon indicating high water table. Chemical data show the soil belongs to the Brown forest-soil group. For many centuries this area has been cultivated as farm land. Coll. in May 1957 by E. Lotse. Prior to combustion, samples were treated by HCl.

Halmstad
Samples taken S of the city of Halmstad (56° 38’ N Lat, 12° 56’ E Long), Halland, Sweden, in a large peneplain of outwash containing organic matter to a depth of 19 cm. High water table has led to the formation of iron ore between 18 and 30 cm depth. The land has been cultivated as farm land for many centuries. Coll. Jan. 1960 and subm. by S. Odén. St-554A is an extraction of humic acids from the original sample, depth 0 to 19 cm, and St-554B contains the insoluble fraction consisting of humine and humus coal. The extraction was made with 0.1 M NaOH.
General comment to Hildesheim-Fredriksdal-Halmstad series (S.O.): C\textsuperscript{14} determinations of soil organic matter both from farm land and natural soils show a considerable apparent age, which is equivalent to a residence time of soil surface carbon of 200 to 2000 yr. On the other hand, the turnover time is much lower (10 to 50 yr) if independently measured by the inventory of carbon divided by the yearly flux. For a well mixed or exponential reservoir (cf. Eriksen, 1961) these times should be identical, and the observed difference for the soil organic matter indicates that the decomposition rate is not constant with time, but decreases, implying higher and higher resistance of the partially decomposed organic matter. From the knowledge of turnover time and residence time, one may compute coefficients for a decay function of the yearly amount of organic matter added to the soil (Odén, 1961). These coefficients seem to vary systematically both with latitude and the environment of the soil. The small age difference between St-554A and 554B (Halmstad) shows that humine and humus coal are not a “dead” carbon fraction in the soil, but are continuously decomposed and renewed. Besides these aspects of kinetics, the age distribution with depth of the Hildesheim profile gives interesting information concerning soil formation on loess. The low age at greater depth excludes the possibility of a continuous fossilization of soil organic matter as the loess deposition proceeds by eolian sedimentation.

Haboskogen series

Soil humus samples from a profile in a poor pine forest, ca. 40 yr old, on strongly podzolized medium sand, at state forest Haboskogen, Section II (57° 59' N Lat, 14° 00' E Long), county of Skaraborg, Sweden. Alt 240 m. Coll. 1934 and described by O. Tamm (1937); subm. by C. O. Tamm, Royal School of Forestry, Stockholm.

<table>
<thead>
<tr>
<th>( \delta C^{13} )</th>
<th>( \Delta )</th>
<th>Formal Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>-22.5</td>
<td>-40±8</td>
<td>330 ± 65</td>
</tr>
</tbody>
</table>

St-815. Haboskogen cot 5599

Dark brown cemented B\textsubscript{1} horizon (hardpan) with a loss on ignition of 3.2% (oven-dry material). Approximate depth 20 to 25 cm below the top of A\textsubscript{1} horizon.

St-816. Haboskogen cot 5600

Lighter brown B\textsubscript{2} horizon (no pan) below the B\textsubscript{1}, depth of sampled layer ca. 8 cm. Loss on ignition 2.1%.

Comment (C.O.T.): figures from this profile should be compared with the earlier dated soil profiles from Garpenberg (St-472, 473, and 474, Stockholm III) and Havtjärnsheden (St-575, 576, and 580, Stockholm IV). It is interesting to find in all three profiles formal ages of the B horizon humus ca. 400 yr. This can be taken as evidence of a dynamic equilibrium between supply and breakdown of organic matter in the B horizon of podzol profiles of the types studied. The early sampling (in 1934) of samples St-815 and 816 excludes any effect on the age determination of the recent contamination of the atmosphere with bomb produced C\textsuperscript{14}. 
Lapland B horizon series

Samples from B horizon of iron podzols in Lapland, Sweden. There are two samples from each site, one from a well-stocked forest area (F) and one from an open or poorly stocked area (O). Coll. and subm. by Hilmar Holmen, Royal School of Forestry, Stockholm.

<table>
<thead>
<tr>
<th>St.</th>
<th>Site</th>
<th>N Lat, E Long</th>
<th>Altitude above sea level, m</th>
<th>Organic carbon, %</th>
<th>cm below A1 horizon</th>
<th>δC13</th>
<th>Δ</th>
<th>Formal Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>610</td>
<td>F 66°36'19&quot;,42'</td>
<td>280</td>
<td>1.9</td>
<td>8-27</td>
<td>-25</td>
<td>-60±8</td>
<td>500±65</td>
</tr>
<tr>
<td>901</td>
<td>610</td>
<td>O 66°36'19&quot;,42'</td>
<td>320</td>
<td>1.8</td>
<td>6-32</td>
<td>-25</td>
<td>-56±8</td>
<td>460±65</td>
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<tr>
<td>902</td>
<td>967</td>
<td>F 65°36'18&quot;,24'</td>
<td>535</td>
<td>3.7</td>
<td>10-46</td>
<td>-19</td>
<td>-74±8</td>
<td>620±65</td>
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<tr>
<td>903</td>
<td>967</td>
<td>O 65°36'18&quot;,24'</td>
<td>520</td>
<td>4.3</td>
<td>5-31</td>
<td>-25</td>
<td>-145±7</td>
<td>1260±60</td>
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<tr>
<td>904</td>
<td>972</td>
<td>F 65°36'19&quot;,54'</td>
<td>435</td>
<td>3.0</td>
<td>4-30</td>
<td>-22</td>
<td>-71±9</td>
<td>590±75</td>
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<tr>
<td>905</td>
<td>972</td>
<td>O 65°36'19&quot;,54'</td>
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<td>1.4</td>
<td>6-26</td>
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<td>-80±8</td>
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<tr>
<td>906</td>
<td>991</td>
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<td>6-40</td>
<td>-24</td>
<td>-89±7</td>
<td>750±60</td>
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<tr>
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<td>991</td>
<td>O 66°36'18&quot;,54'</td>
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<td>1.3</td>
<td>8-40</td>
<td>-27</td>
<td>-107±8</td>
<td>910±65</td>
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<tr>
<td>908</td>
<td>992</td>
<td>F 66°36'19&quot;,00'</td>
<td>400</td>
<td>2.6</td>
<td>8-20</td>
<td>-27</td>
<td>-75±8</td>
<td>630±65</td>
</tr>
<tr>
<td>909</td>
<td>992</td>
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<td>400</td>
<td>2.0</td>
<td>3-18</td>
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<td>-59±7</td>
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<td>1404</td>
<td>F 67°00'20&quot;,24'</td>
<td>450</td>
<td>1.5</td>
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<td>-18</td>
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<td>730±80</td>
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<td>O 67°06'20&quot;,24'</td>
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<td>2.4</td>
<td>7-38</td>
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<td>-90±8</td>
<td>760±65</td>
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<tr>
<td>912</td>
<td>1405</td>
<td>F 67°42'21&quot;,18'</td>
<td>320</td>
<td>1.8</td>
<td>8-32</td>
<td>-23</td>
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<td>480±90</td>
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<tr>
<td>913</td>
<td>1405</td>
<td>O 67°42'21&quot;,18'</td>
<td>325</td>
<td>1.7</td>
<td>5-33</td>
<td>-20</td>
<td>-84±8</td>
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<tr>
<td>914</td>
<td>1416</td>
<td>F 67°12'22&quot;,12'</td>
<td>190</td>
<td>1.3</td>
<td>6-30</td>
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<tr>
<td>915</td>
<td>1416</td>
<td>O 67°12'22&quot;,12'</td>
<td>210</td>
<td>1.3</td>
<td>7-40</td>
<td>-21</td>
<td>-92±7</td>
<td>780±60</td>
</tr>
</tbody>
</table>

Comment (H.H.): samples were collected as part of an investigation of the long-time effect on forest sites of a removal or reduction of the forest stand, as has often resulted from bad silvicultural practice (so-called soil degeneration). At the same time it was considered desirable to know more of the “residence time” of the organic matter in the mineral soil, since the total amount of this organic matter is often much greater than that of the “humus layer,” even in iron podzols. The results are not quite conclusive, although it is clear that the average formal age of N Swedish B horizon humus is higher than that of podzol B horizon in S or middle Sweden (cf. St-474, 580, 815 and 816, Stockholm III and this list).

C. Chemical Paleoclimate

Sampling of ten raised peat bogs has been done in middle and S Sweden in order to estimate changes in the chemical climate of several thousand years ago. The bogs were selected both from a geologic point of view and with the object of obtaining localities far away from human activities. In each case, a 2 m profile was taken and sectioned at 4 cm intervals. Determinations have
been made of dry matter, total nitrogen, calcium, magnesium, iron, alumina, and silica. Other determinations are under way. Dating will give a fairly good figure of growth rates of the bog, and consequently of the annual fixation of gaseous components from the air (CO₂, NH₃, etc.), or deposition rates of the elements listed above. All profiles coll. 1956 by Mrs. G. Linnman, Geol. Survey of Sweden; subm. by S. Odén. δC¹³ figures in parenthesis are presumed values, not measured.

**Laskerud series**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (cm)</th>
<th>δC¹³</th>
<th>Δ</th>
<th>C¹⁴-Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-840</td>
<td>3-12</td>
<td>-22</td>
<td>-9 ± 7</td>
<td>75 ± 60</td>
</tr>
<tr>
<td>St-1022</td>
<td>20-24</td>
<td>-27</td>
<td>-76 ± 8</td>
<td>635 ± 70</td>
</tr>
<tr>
<td>St-1023</td>
<td>32-36</td>
<td>-27</td>
<td>-96 ± 8</td>
<td>810 ± 70</td>
</tr>
<tr>
<td>St-991</td>
<td>40-44</td>
<td>-25</td>
<td>-109 ± 8</td>
<td>925 ± 70</td>
</tr>
<tr>
<td>St-841</td>
<td>76-80</td>
<td>-23</td>
<td>-128 ± 9</td>
<td>1100 ± 75</td>
</tr>
<tr>
<td>St-919</td>
<td>100-104</td>
<td>(-25)</td>
<td>-158 ± 9</td>
<td>1380 ± 75</td>
</tr>
<tr>
<td>St-842</td>
<td>112-116</td>
<td>-28</td>
<td>-175 ± 6</td>
<td>1540 ± 50</td>
</tr>
<tr>
<td>St-920</td>
<td>148-152</td>
<td>(-25)</td>
<td>-207 ± 9</td>
<td>1850 ± 75</td>
</tr>
<tr>
<td>St-843</td>
<td>192-196</td>
<td>-27</td>
<td>-234 ± 9</td>
<td>2140 ± 75</td>
</tr>
</tbody>
</table>

**Ryholm series**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (cm)</th>
<th>δC¹³</th>
<th>Δ</th>
<th>C¹⁴-Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-992</td>
<td>12-16</td>
<td>-23</td>
<td>-45 ± 8</td>
<td>370 ± 65</td>
</tr>
<tr>
<td>St-871</td>
<td>24-28</td>
<td>-19</td>
<td>-61 ± 7</td>
<td>510 ± 60</td>
</tr>
<tr>
<td>St-993</td>
<td>60-64</td>
<td>-24</td>
<td>-110 ± 8</td>
<td>935 ± 70</td>
</tr>
<tr>
<td>St-872</td>
<td>120-124</td>
<td>-21</td>
<td>-131 ± 8</td>
<td>1135 ± 65</td>
</tr>
<tr>
<td>St-873</td>
<td>184-188</td>
<td>-17</td>
<td>-165 ± 7</td>
<td>1440 ± 60</td>
</tr>
</tbody>
</table>

**Mörhult series**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (cm)</th>
<th>δC¹³</th>
<th>Δ</th>
<th>C¹⁴-Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-836</td>
<td>4-8</td>
<td>-27</td>
<td>-18 ± 9</td>
<td>140 ± 70</td>
</tr>
<tr>
<td>St-918</td>
<td>32-36</td>
<td>(-25)</td>
<td>-68 ± 8</td>
<td>555 ± 65</td>
</tr>
<tr>
<td>St-837</td>
<td>60-64</td>
<td>-27</td>
<td>-92 ± 7</td>
<td>780 ± 60</td>
</tr>
<tr>
<td>St-838</td>
<td>112-116</td>
<td>-27</td>
<td>-122 ± 7</td>
<td>1050 ± 60</td>
</tr>
<tr>
<td>St-839</td>
<td>168-172</td>
<td>-25</td>
<td>-138 ± 10</td>
<td>1185 ± 80</td>
</tr>
</tbody>
</table>

**Yggeryd series**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (cm)</th>
<th>δC¹³</th>
<th>Δ</th>
<th>C¹⁴-Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-921</td>
<td>16-20</td>
<td>-27</td>
<td>+15 ± 8</td>
<td>negative</td>
</tr>
<tr>
<td>St-994</td>
<td>32-36</td>
<td>-24</td>
<td>-54 ± 8</td>
<td>445 ± 70</td>
</tr>
<tr>
<td>St-922</td>
<td>68-72</td>
<td>(-25)</td>
<td>-73 ± 9</td>
<td>610 ± 75</td>
</tr>
<tr>
<td>St-923</td>
<td>164-168</td>
<td>(-25)</td>
<td>-142 ± 8</td>
<td>1220 ± 70</td>
</tr>
</tbody>
</table>

**Comment** (S.O. and G.O.): the age increases very regularly with depth in these peat profiles. Growth rates at ca. 200 cm level range from 1.2 to 3.4 mm per year but are greatly decreased closer to surface (0.4 to 1.0 mm per year). At ca. 50 cm level both Laskerud and Yggeryd peat bogs show increased growth.
The determination of growth rates over a limited interval by the C\textsuperscript{14} method is, however, fairly uncertain owing to the large probable error (e.g., for the interval St-841 to St-919, Laskerud the growth rate may well be 0.56 to 1.85 mm per year). At least one figure (St-921) is definitely influenced by bomb produced carbon, presumably brought down to this depth (16 to 20 cm) by roots of surface vegetation. The C\textsuperscript{13} figures do not show any systematic trend. The effect of cyclic enrichment is not clearly noted.

Atlantic series

Samples of seawater from various parts of the N Atlantic and Arctic Sea, collected during various cruises by S. Fonselius, Gothenburg Oceanographic Inst., A. Swanson and K. Wärme at the Internatl. Meteorological Inst., Stockholm. Some of the dates (St-322, 331, 332, 334, 335, and 336) have been dealt with by Fonselius and Östlund (1959) and the results are here recalculated to the adopted NBS and PDB scales. Given in the description below: date of collection (yr, month, day), coordinates, depth, salinity and temperature.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>C\textsuperscript{13}</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-322. Gulf Stream</td>
<td>1957/03/30</td>
<td>-0.7</td>
<td>-35 ± 7</td>
</tr>
<tr>
<td>0 m; 35.37‰; +7.8°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St-331. Denmark Strait I</td>
<td>1957/04/02</td>
<td>-0.7</td>
<td>-60 ± 7</td>
</tr>
<tr>
<td>0 m; 32.72‰; -1.6°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St-332. Denmark Strait II</td>
<td>1957/04/10</td>
<td>0.0</td>
<td>-46 ± 7</td>
</tr>
<tr>
<td>0 m; 33.17‰; +6.0°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St-334. Denmark Strait III</td>
<td>1957/04/17</td>
<td>-0.5</td>
<td>-36 ± 9</td>
</tr>
<tr>
<td>0 m; 34.97‰; +0.7°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St-335. Barents Sea I</td>
<td>1957/07/03</td>
<td>-0.5</td>
<td>-38 ± 6</td>
</tr>
<tr>
<td>337 m; 34.98‰; -0.7°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St-336. Barents Sea II</td>
<td>1957/07/04</td>
<td>-0.5</td>
<td>-33 ± 6</td>
</tr>
<tr>
<td>0 m; 35.08‰; +4.9°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St-458. Norwegian Sea 1</td>
<td>1959/03/21</td>
<td>-2.6</td>
<td>-34 ± 11</td>
</tr>
<tr>
<td>0 m; ca. 34‰; +6.35°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St-459. Norwegian Sea 6</td>
<td>1959/03/23</td>
<td>-5.8</td>
<td>-40 ± 7</td>
</tr>
<tr>
<td>1000 m; 34.92‰; -0.93°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Kristineberg series

Samples of seaweed and water, collected in Gullmarsfjorden at the Kristineberg Marine Research Station (58° 16' N Lat, 11° 27' E Long), on W coast of Sweden. The seaweed samples were kindly submitted by Tore Levrting, Marine Botanical Inst., Univ. of Gothenburg. Before combustion, the plants were leached with acid to remove carbonate. The sea-water samples were collected by M. Fokuda, Gothenburg Oceanographic Inst. The CO₂ was extracted by the method described by Fonselius and Östlund (1959). This series was an early attempt to trace the industrial and the atomic bomb effects in coastal sea water. Activity figures are age-corrected.

ERRATUM

St-739. Igelsta 9 in Stockholm IV, the comment should read: “date is older than expected. This . . .”.

References

G. Lundqvist (1962) has published a summary of geologic problems having been dealt with at this laboratory until the middle of 1962. In that paper our laboratory is erroneously called “The Stockholm Natural Radiocarbon Station”.

<table>
<thead>
<tr>
<th>δ C¹³</th>
<th>Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>St-460. Norwegian Sea 7</td>
<td>-2.0</td>
</tr>
<tr>
<td>1959/03/23 (64° 15' N Lat, 05° 16' E Long); 0 m; 35.32%; +7.75°C.</td>
<td></td>
</tr>
</tbody>
</table>

St-421. Bay of Biscay | -3.0  | -22 ± 7 |
| 1958/08 (45° N Lat, 5° E Long); 0 m; salinity and temp. not recorded. |

St-365. Fucus 1905 | -13   | -31 ± 7 |
| Fucus serratus, coll. 1905 at 0.5 to 5 m depth. |

St-363. Fucus 1950 | -13   | -47 ± 7 |
| Fucus serratus, coll. 1950 at 0.5 to 5 m depth. |

St-355. Fucus 1958 | -13   | -34 ± 6 |
| Fucus serratus, coll. in June 1958 at 0.5 to 5 m depth. |

St-369. Surface water 1958 | 0     | -10 ± 7 |
| Surface water coll. in June 1958. |

St-364. Laminaria 1958 | -15   | -7 ± 6 |
| Laminaria Cloustonii, coll. in June 1958 at 20 m depth. |

St-370. Bottom water 1958 | 0     | -14 ± 7 |
| Water coll. in June 1958 at ca. 20 m depth. |

St-428. Fucus 1959 | -14   | +35 ± 7 |
| Fucus serratus, coll. in February 1959 at 0.5 to 5 m depth. |
Date lists:
    Miami I    Östlund, Bowman, and Rusnak, 1962
    Stockholm I    Östlund, 1957b
    Stockholm II    Östlund, 1959
    Stockholm III    Östlund and Engstrand, 1960
    Stockholm IV    Engstrand and Östlund, 1962
    Uppsala I    Olsson, 1959
    Uppsala II    Olsson, 1960
    Yale II    Preston, Person, and Deevey, 1955

    English).

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    German).

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    co), v. 1 (2), p. 27-43.

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    water from the North Atlantic and the Arctic Sea: Tellus, v. 11, p. 77-83.

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    Skr., v. 1953, no. 1, p. 32 and 105.

    (summary in German).

——— 1962, Fiskekatsen idag och för 3500 år sedan: Tor, v. 8, p. 229-243 (summary 
    in German).

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    tional Atomic Energy Agency, Vienna; Proc. Ser., "Tritium in the Physical and 
    Biological Sciences," v. 1, p. 333-341.


    measurements I: Radiocarbon, v. 4, p. 51-56.

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Tamm, O., 1937, Om de långproduktiva sandmarkerna å Hökensås och i övre Lagadalens: 
    Statens skogsförsöksanstalt, Meddelanden, v. 30, p. 1-66. (cf. fig. 3)


——— 1954, The tephra-fall from Hekla on March 29th 1947: The Eruption of Hekla 

    to excursion no. A2. p. 55-60.

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UNIVERSITY OF MICHIGAN
RADIOCARBON DATES VIII

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 VII in December 1961. The method is essentially the same as that used for the work described in the previous list. Two CO₂-C₅₂ Geiger counter systems are used. The equipment and counting technique 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 a half life of 5568 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 all previous Michigan date lists 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. The procedures for converting the dates to the more recent half life scale and to a scale having its zero at any time other than 1950 need not be given here as they have been covered in this journal and elsewhere. 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 of J. R. Parsons and T. J. Krajci in preparing the descriptions. The descriptions and comments are essentially those of persons submitting the samples.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Modern Marine And Freshwater Mollusc Shell series, Florida, California, Ohio, Michigan, Pennsylvania

The following series of shells of living specimens were dated in order to compare marine with freshwater species in connection with investigation of isotopic composition (C₁³:C₁² and 018:016) of marine and freshwater mollusc shell. Samples subm. by M. L. Keith, Pennsylvania State Univ., University Park. Comment (M.L.K.): results show negative correlation between C₁³:C₁² ratio and C₁⁴ “age.” The fluvial specimens, relatively deficient in C₁³, are also deficient in C₁⁴; the marine samples have the greatest enrichment of both C₁₈ and C₁⁴, and the single lacustrine sample is intermediate. It seems likely that C₁⁴ ages can be corrected by use of the C₁³:C₁₂ ratio.

M-1220. Key Largo, Florida

A.D. 1650

Marine gastropod shell (Strombus gigas) from Key Largo (24° 55’ N Lat, 81° 00’ W Long), Dade Co., Florida, Collected alive 1960 at ca. 1.5 m depth by R. Eichler, Pennsylvania State Univ.
M-1221. Balboa Beach, California  
A.D. 1910

Marine pelecypod shell (Tivela stultorum) from Balboa Beach (33° 00' N Lat, 117° 25' W Long), Newport, Orange Co., Calif. Collected alive 1959 at ca. 4 m depth by M. L. Keith.

M-1222. La Jolla, California  
A.D. 1825

Marine gastropod shell (Haliotis fulgens) from La Jolla (32° 31' N Lat, 117° 22' W Long), San Diego Co., Calif. Collected alive 1959 at ca. 6 m depth by Lee Cozad, Scripps Inst. of Oceanography.

M-1223. Put-in-Bay, Ohio  
A.D. 1510

Lacustrine pelecypod shell (Lampsilis siliquoidea) from Put-in-Bay on Lake Erie (41° 15' N Lat, 82° 45' W Long), Ottawa Co., Ohio. Collected alive 1959 at ca. 3 m depth by R. Eichler.

M-1224. Grand River, Michigan  
A.D. 60

Fluvial pelecypod shell (Elliptio dilatatus) from Grand River (43° 00' N Lat, 85° 15' W Long), 1 mi W of Saranac, Ionia Co., Michigan. Collected alive 1959 at ca. 0.5 m depth by R. Eichler.

M-1225. French Creek, Pennsylvania  
A.D. 940

Fluvial pelecypod shell (Actinonaias carinata) from French Creek (41° 40' N Lat, 80° 10' W Long), 5 mi N of Meadville, Crawford Co., Penn. Collected alive 1960 at ca. 0.3 m depth by M. L. Keith.

M-1226. Meramec River, Missouri  
350 B.C.

Fluvial pelecypod shell (Ligumia recta latissima) from Meramec River (38° 10' N Lat, 91° 00' W Long), near Sullivan, Franklin Co. Missouri. Collected alive 1959 at ca. 0.5 m depth by M. L. Keith.

M-1271a. Calumet, Michigan, 27 in. end of sampling tube  
3550 ± 125  
1600 B.C.

M-1271b. Calumet, Michigan, 68 in. end of sampling tube  
6400 ± 175  
4450 B.C.

Peat taken from Center Section 14, T56N, R33W, NW corner of Elm and Eighth Sts., Calumet (47° 15' N Lat, 88° 27.5' W Long), Houghton County, Michigan, in conjunction with study of the glacial deposits in the Keweenaw Peninsula, in progress since 1956. (J. D. Hughes, in progress). Peat occurs as a 41-in. bed beneath a 27-in. sand layer, whose surface is at alt 1210 ft, and overlying late Wisconsin till. Sample obtained using an Acker split-barrel soil sampler. Material from top and base of the peat bed (27-in. and 68-in. depth) were dated to obtain an indication of the time of peat accumulation. Coll. 1961, by J. D. Hughes, Calumet and Hecla, Inc., Calumet Div.; subm. 1961, by J. H. Zumbeerge, Univ. of Michigan, Ann Arbor. Comment (J.H.Z.): dates are obviously too young to be associated with glacial advances. Burial of this peat must have been caused by local factors. Pollen analysis is in progress.
M-1256. Trout Lake Dam Site No. 2, Washington

Wood (western hemlock? *id.* by R. Yarnell, Univ. of Mich., Ann Arbor) from Trout Lake Dam Site No. 2 (46° 01’ 07” N Lat, 121° 32’ 52” W Long), Klickitat Co., Washington. Sample taken from 251 ft below surface in drill hole 25, and was 1687.3 ft above mean sealevel. Occurred in a layer of sand and gravel below 210 ft of olivine basalt, in turn overlain by 40 ft of silt, clay, and gravel. A date on this sample will help fix the age of various stratigraphic units in the area (North Pacific Consultants, 1960). Coll. 1960 by O. O. Leaf, Spokane; subm. by E. E. Clouse, White Salmon, Wash. Comment (E.E.C.): in view of the stratigraphic position of the wood beneath massive lavas, it seems doubtful that the C^{14} dating is correct.

### II. ARCHAEOLOGIC SAMPLES

#### A. Upper Mississippi Valley and Great Lakes

M-1086. Erp Site, Ohio

Charcoal from Erp Site (40° 3’ N Lat, 84° 22’ W Long), Miami County, Ohio. Sample is from campfire 1.7 ft deep and 55 ft from wall toward center of site, an enclosure and village site on bluff top on W side of Stillwater River, directly W of Pleasant Hill. Sample associated with tubular clay pipes, Fort Ancient pottery, and small triangular points. Coll. 1959 and subm. by J. C. Allman, 1336 Cory Dr., Dayton 0, Ohio. Comment (J.C.A.): pottery is all grit-tempered, mostly with crushed quartz. This, plus other similarities, makes it probable that site was associated with the Steele Dam Site at Dayton. There were some evidences of Late Woodland, such as shallow side-notched projectile points and parallel-sided gorgets. Date given by sample agrees with those generally accepted for Fort Ancient.

M-1145a.


Wood (Appalachian oak, *id.* by S. B. Preston, Univ. of Michigan, Ann Arbor) from a shipwreck thought to be LaSalle’s ship, the Griffin, lost in 1679. Sample found ca. 190 ft underwater in the Mississagi Straits, between Lake Huron and North Channel (45° 30’ N Lat, 83° 15’ W Long), Michigan. Sample M-1145a consists of outer rings (rings 74 to 94), and M-1145b composed of the inside rings (rings 0 to 12) of a floating sequence of 102 rings (*id.* by R. E. Bell, Univ. of Oklahoma, Norman). An iron pin found with the wreckage underwent metallurgical analysis by M. W. Lightner, U. S. Steel Corp., Pittsburgh, Penn. Analysis indicates that the pin could have been forged from wrought iron produced by the Walloon Process, used from the 14th through the 18th centuries. Coll. 1960 and subm. by N. L. McCready, Great Lakes Underwater Exploration Co., Cheboygan, Michigan. Comment (J.B.G.): wood seems too recent to be from the “Griffin.”
University of Michigan Radiocarbon Dates VIII

M-1000. McDonough Lake Site, Illinois  780 ± 75  A.D. 1170

Charred acorns from McDonough Lake Site (42° 30’ N Lat, 91° 0’ W Long), Madison County, Illinois. Sample taken from 42-in. level in a deep refuse pit which, unlike nearby pits at the same level, contained thin, cord-marked Bluff culture sherds and no Mississippi pottery. Coll. 1958 and subm. by G. Perino, Thomas Gilcrease Foundation, Tulsa, Oklahoma.

Snyders Site series, Illinois

Wood charcoal from Snyders Site (39° 4’ 10” N Lat, 90° 40’ 16” W Long), Calhoun Co., Illinois. The artifact complex recovered from the features dated may be attributed to the middle span of Hopewelian developments in the lower Illinois and adjacent Mississippi valleys. Coll. 1960 and subm. by Stuart Struever, Univ. of Chicago. The site has been discussed briefly in several publications, among them Griffin (1952), Powell (1957), and Fowler (1955).

M-1154. Snyders Site, Feature 8c  1890 ± 75  A.D. 60

Wood charcoal caked inside bottom portion of a Havana Cord-marked vessel located within Feature 8c, 4 in. below its discernible upper limits. Feature 8c was an oval-shaped storage/refuse pit with dimensions 6 ft 10 in. by 8 ft 3 in.; depth 4 ft 7 in.

M-1155. Snyders Site, Feature 8d  1720 ± 75  A.D. 230

Charred wood from lens in Feature 8d, 6 in. beneath its discernible upper limits. Feature 8d was an oval-shaped storage/refuse pit with dimensions 4 ft by 6 ft 6 in.; depth 4 ft 3 in.

Mitchell Site series, Illinois


M-1298. Mitchell Site, Mound B  785 ± 75  A.D. 1165

Charred wood (wall post or roof support) from a burned structure, Feature 44, on top of Mound B (Coord. 38° 45’ 28” N Lat, 90° 05’ 27” W Long). Sample represents latest occupation of Mound B. Stratigraphic evidence indicates M-1298 should be later than M-1299. Sample No. IAS-21 coll. 1960 by Eugene Fugle.

M-1299. Mitchell Site, Pre-Mound B  875 ± 75  A.D. 1075

M-1300. Mitchell Site, Mound C  
A.D. 1165

M-1302. Mitchell Site, Mound H  
A.D. 1200

M-1303. Mitchell Site, Mound H  
A.D. 1000

M-1304. Mitchell Site, Feature 28  
A.D. 1165

M-1305. Mitchell Site, Feature 50  
A.D. 950
Air-dried sample taken from between inner and outer rings, in middle area of large bald-cypress log, found in Feature 50, 3.6 m below surface but above water table (Coord. 38° 45' 30" N Lat, 90° 05' 21" W Long). Sample No. IAS-28 coll. 1961 by Peter Taylor.

M-1306. Mitchell Site, Feature 62  
A.D. 1555
Charred corn from fill of pit (Feature 62) in Mound H, 15 to 40 cm below surface (Coord. same as M-1303). Dates last occupation of Mound H; should postdate three earlier ceremonial structures (Features 47, 77, 79). Sample No. IAS-29 coll. 1961 by Alan Harn. Comment (J.P.): date seems much too recent. The pit was just below plow line and as a result more recent materials may have intruded.

Fill Site series, Illinois
Samples from the Fill Site (20 B2-5; 38° 45' 24" N Lat, 90° 05' 30" W Long), Madison Co., Illinois. Coll. 1960 and subm. by James Porter. Samples were collected under pressure of highway construction, and no exact provenience data is available. Samples should date occupation of site, thought to be contemporary with last occupation of Mitchell Site (Middle Mississippian, from late Old Village to early Trappist).

M-1301. Fill Site  
A.D. 1040
Charred branches and thatch from burned house uncovered by bulldozers. Sample (IAS-24) from ca. 50-80 cm below surface.
M-1307. **Fill Site** *(not yet dated)*
Charred wall post found during scraper operations along S shore of Long Lake, ca. 50-80 cm below surface. Sample No. IAS-30.

**Klunk Mound Group series, Illinois**


M-1160. **Klunk Mound 7**

2870 ± 75
920 B.C.

Gathered from crematory basin No. 1 excavated into the original natural surface on the bluff. The basin dated was found under a rock and earth mound which in turn had been capped by a later Hopewell structure. Artifacts found in basin indicate the existence under Mound 7 of a Late Archaic or Early Woodland mound. Charred bones of ca. 10 individuals, plummets, beads, and copper were also recovered from this crematory.

M-1161. **Klunk Mound 1**

1775 ± 75
A.D. 175

Found on and in the original surface under the N edge of primary mound. A charred stump was burned when site was prepared. Mound 1 was constructed during classic Hopewell period and contained three log tombs, Hopewell Zoned vessels, and other representative artifacts. The date should be earlier than the construction of the mound.

M-1162. **Banks Mound 3**

875 ± 75
A.D. 1075

Carbon from Banks Mound 3 (35° 19' N Lat, 90° 12' W Long), Crittenden Co., Arkansas. From one of the post molds that circled outer edges of a crematory basin on top of Mound 3. Circle of post molds was 14 ft in diam to inside edge of posts. Coll. 1960 and subm. by Gregory Perino for the Thomas Gilcrease Foundation. *Comment* (G.P.): Mississippian culture, probably early Walls-Pecan Point. Caddo and Old Village influence was noted. Date seems reasonable (J.B.G.).

M-1182. **Warren Gresham Site**

1075 ± 75
A.D. 875

Charcoal from a small log section of pole fragments lying horizontally in excavation unit 35 R 3, upon house floor, in NW corner. Surface depth 12 in. Fire baked wattling clay covered specimen. Warren Gresham Site (39° 12' N Lat, 94° 40' 40" W Long), Platte Co., Missouri, is of the Steed-Kisker Focus; this is the first dating of Middle Mississippian culture from western Missouri and should be of value in considering other manifestations up the Missouri River and its tributaries. Coll. 1959 and subm. by J. M. Shippee, Univ. of Missouri. A report on the house is found in Shippee (1960).

M-1188. **Juntunen Site, Michigan: Ossuary 2**

630 ± 75
A.D. 1320

Charcoal from Ossuary 2, Juntunen Site (45° 49' N Lat, 84° 35' W Long), Bois Blanc Island, Mackinac Co., Michigan. Sample is from arbitrarily
defined Levels 1-2 of an ossuary (Feature 11) which yielded remains of 34 individuals, ranging from flesh interments to disarticulated bundles. Grave goods included two miniature vessels, one of Oneota style, and what is inferred to be the contents of a medicine kit. Ossuary represents a fairly late occupation of the site and stratigraphically overlies layers previously dated as M-1140 (890 ± 150), M-1141 (1050 ± 150), and M-1142 (1125 ± 150). See Michigan VI, p. 110. Coll. 1960 and subm. by Alan McPherron, Univ. of Michigan, Ann Arbor. A report on the site is in progress. Comment (A.M.): the four dates form a reasonable series and span major period of occupation. Absence of stab-and-drag decorated pottery from ossuary presents a problem, for this style of decoration is thought to have been prevalent at the time.

Riverton Site series, Illinois

Charcoal from the Riverton Site, Cw-170 (39° 01' 13" N Lat, 87° 34' 31" W Long), SE ¼, SE ¼, NE ¼, Sec. 25, TWP. 7 N, Range 11 W, Crawford Co., Illinois. Samples are from a stratified shell midden with maximum depth of over 8 ft. Cultural affiliations are with the Archaic Midcontinent tradition, (Lewis and Kneberg, 1959), which seems to be intrusive into the Wabash Valley from the Tennessee Valley. Heaviest shell concentrations are in bottom 3 ft of the midden, with shell virtually absent in upper 2 ft. Artifacts indicated repeated re-occupations by people of the Swan Island component of the Riverton culture (Winters and Stephens, ms.) of the Midcontinent Tradition. The Riverton culture is typified by a micro-tool industry in chert which includes gravers, projectile points, blades, and scrapers. Cultural change is not marked within the deposit, but in the upper level side-notched points seem to be replaced by expanding-stem points, notable for their small size. Samples were selected to cover most of the time span of the midden accumulation; to date the shift from intensive utilization of mussels to a more diversified hunting and gathering pattern; and to approximately date the time when mussels ceased to be a primary component of the diet. Dates will also be useful in establishing cross-ties with the nearby Robeson component of the Midcontinent tradition (see M-1288 and M-1289, this date list). The Swan Island and Robeson components, while sharing a common subsistence pattern and such diagnostic traits as antler gouges of the Robeson type and cloudblower pipes, have different projectile point conglomeries. Coll. 1961 by H. D. Winters, Illinois State Mus., Springfield; subm. by Thorne Deuel, Illinois State Mus.

M-1284. Sample No. 1

Charcoal from Level 4 (18 to 24 in. depth) in Square 0/80, at top of Zone III. Occurs at the juncture of the upper portion of the shell midden and overlying midden without shell. Sample should help date the end of utilization of mussel shell as a basic subsistence item by Archaic peoples in the central Wabash Valley. Comment (H.W.D.): in line with a predicted terminal date of after 1000 B.C. (Winters and Stephens, n.d.).

M-1285. Sample No. 2

Charcoal from Level 7 (36 to 42 in. depth) in Square 0/80, at bottom of
Zone III. Zone III is characterized by a mixed hunting and gathering pattern, with mussels an important part of the diet. Should date the shift in subsistence pattern from predominantly mussel gathering to a more diversified hunting and gathering. Comment (H.W.D.): obviously too early in respect to other samples of the series.

**M-1286. Sample No. 3**

3200 ± 100
1250 B.C.

Charcoal from Level 11 (60 to 66 in. depth) in Square 0/80, near middle of Zone IV is marked by very intensive use of mussels and repeated short-term occupations of the site. Should help date time span of intensive shell utilization. Sample was also selected because of its association with faunal material never before reported historically or archaeologically in Illinois.

**M-1287. Sample No. 4**

3270 ± 125
1320 B.C.

Charcoal from Level 14 (78 to 84 in. depth) in Square 0/80, at bottom of Zone IV. Sample should date the beginning of site occupation as well as the approximate time of entry of Archaic Midcontinent Tradition into the Wabash Valley. Comment (H.W.D.): a date of ca. 2000 B.C. had been predicted for this sample (Winters and Stephens, n.d.), but the date is acceptable. General Comment (H.W.D.): the four dates indicate that the deposit was accumulated in a very short time. Such a rapid rate of accumulation is not surprising in view of the frequent deposition of sand and clay by floods and the great bulk of mussel shell lenses.

**Robeson Hills Site series, Illinois**

Charcoal from Robeson Hills Site, Lw-1 (38° 42' 31" N Lat, 87° 31' 20" W Long), NE 1/4, NE 1/4, SE 1/4, Sec. 9 (interpolated), Twp. 3 N, Range 10 W, Lawrence County, Illinois. Samples are from a stratified shell midden with maximum depth of 4.5 ft. Cultural affiliations are with Archaic Midcontinent tradition. As with the Riverton Site, the Robeson Site seems to belong within a culture intrusive into the Wabash Valley. Samples were selected to date earliest occupation of the site and diagnostic artifacts in the shell midden. Dates will also be useful in cross-dating the Riverton and Robeson Sites (see M-1284 through M-1287, this date list). Coll. 1961 by H. D. Winters; subm. by Thorne Deuel. Site report prepared for publication by H. D. Winters and Denzil Stephens (n.d.) for the Illinois State Mus.

**M-1288. Sample No. 5**

3490 ± 100
1540 B.C.

Charcoal from fill of Pit S-14, which began at depth of 48 in. below surface in Test Pits B and D, in lower part of Zone II. Sample should provide date near the beginning of site occupation and the intensive utilization of mussels. In addition to quantities of bone and shell, the pit contained a cloudblower pipe and a perforated bear-canine pendant.

**M-1289. Sample No. 6**

3440 ± 125
1490 B.C.

Charcoal from fill of Pit S-3 which began more than 48 in. below the surface of the midden and was dug into the sterile subsoil. Bulldozing of midden
prevented exact determination of depth, but pit was adjacent to controlled excavation units. Sample should date earliest occupation of the site as the pit mouth occurred at the junction of the midden and sterile subsoil.

*General Comment* (H.D.W.): both M-1288 and M-1289 are quite acceptable, since they are close to the predicted date of 2000 B.C. (Winters and Stephens, n.d.).

**M-1290. Murdock Mound, Illinois**

Charcoal (Sample No. 7) from Murdock Mound (38° 38' 20'' N Lat, 90° 03' 20'' W Long), St. Clair Co., Illinois. Sample taken from post molds of a round structure in Village Level V, just below loess pyramid. Coll. 1941 by H. M. Smith; subm. by Thorne Deuel. Should date uppermost level of “Old Village” deposits below Murdock Mound. Smith has prepared a preliminary discussion of the site for publication by the Illinois State Mus. *Comment* (T.D.): date is too late.

**Cahokia series, Illinois**

Charcoal samples from several sites at this large clustering of Middle Mississippian occupations, E. St. Louis, Ill. Subm. by C. J. Bareis, Dept. of Anthropol., Univ. of Illinois, Urbana. See Griffin (1949) for ceramic descriptions.

**Cahokia, Site Ms-2-2 subseries**

Village location (38° 39' 46'' N Lat, 90° 05' 17'' W Long), ca. 200 yd NE of old Powell Mound area and 1.5 mi W of Monks Mound, Madison Co., Ill.

**M-1292. Cahokia, Site Ms-2-2, Feature 234, House 26**


**M-1293. Cahokia, Site Ms-2-2, Feature 227**

From fire basin (Feature 227) ca. 9 ft diam located within and near center of large rectangular wall trench structure (Feature 202, House 15) with long axis oriented NE-SW; Old Village—Trappist. Sample No. IAS-12 coll. 1960 by D. W. Lathrap.

**M-1294. Cahokia, Site Ms-2-2, Feature 217, House 21**

From floor of rectangular post structure with long axis oriented NW-SE. Old Village sherds were found on floor of house though house construction is of Bluff type. Sample No. IAS-13 coll. 1960 by C. J. Bareis.

**M-1295. Cahokia, Site Ms-2-2, Feature 197**

From Square J-1-36, Level 6, depth 31 in. in Feature 197, charcoal area. Near refuse pit but apparently not related to the pit. Sample No. IAS-14 coll.
1960 by D. W. Lathrap. Post structure and wall trench house were located nearby. These structure are apparently Old Village. Comment (C.J.B.): date is too early for Old Village occupation as well as Late Woodland occupation at the site. Specimen may be contaminated.

Cahokia, Site S-34-1 subseries

Village location at W border of Collinsville Airport property, ca. .5 mi SE of Monk’s Mound (38° 39’ 21” N Lat, 90° 03’ 15” W Long), St. Clair Co., Ill.

M-1296. Cahokia, Site S-34-1, House 3  
A.D. 1225


M-1297. Cahokia, Site S-34-1, Feature 1  
A.D. 1275

Charcoal and charred corn from large Trappist refuse pit (Feature 1); nonstratigraphic cut. Sample No. IAS-16 coll. 1961 by C. J. Bareis.

M-1150. Tinsley Hill Site, Ly 18B, Kentucky  
A.D. 1380

Charred wood from a Middle Mississippian Stone Grave Cemetery Site (37° 01’ 38” N Lat, 88° 03’ 23” W Long), Lyon Co., Kentucky (Schwartz, 1961). The site is located on a high bluff overlooking an extensive Middle Mississippian village in bottomland of the Cumberland River with a small mound on an adjacent bluff. The specimen was found 30 to 40 cm below surface, associated with a multiple burial in a partial stone grave (Burial #46a), and was in contact with undisturbed legs of a partly-disturbed burial. Trade material found on the site could be related to aboriginal material but not to the stone graves. This was probably left by later visitors and not by Indians who buried their dead there. Coll. 1959 by J. T. Carter; subm. by D. W. Schwartz, Univ. of Kentucky, Lexington. Comment: this is the first good date obtained from a well-documented stone grave site.

B. Lower Mississippi Valley and Southeast

Lawhorn Site series, Arkansas

Charred wood from the Lawhorn Site (35° 58’ N Lat, 90° 23’ W Long), Craighead Co., Arkansas. Subm. by John Moselage, Chucalissa Mus., Memphis, Tennessee. Samples should help assess the chronological position of the Mississippian component, which is difficult to place typologically because of the many variations from the standard Mississippian sites of this area. There are no publications to date, although one is planned as a future release of the Missouri Archaeol. Soc.

M-1156. Lawhorn Site, general midden  
A.D. 1325

Charred log (F.S. 78) very near Burial 21 but judged not in actual as-

**M-1157. Lawhorn Site, House 3**

Charred pole, possibly oak (F. S. 408) from floor of House 3, Mississippian component. Coll. 1960 by John Moselage. Comment (J.M.): a burned structure which yielded considerable data on house construction techniques and a large number of specimens in situ on the house floor, including a unique strap-handled water bottle. Evidence also indicated much of this site to be late in time; the date is about what was expected.

**M-1158. Lawhorn Site, House 1**

Charred pole, possibly oak (F. S. 518) from floor of House 1, Mississippian component. Coll. 1957 by John Moselage. Comment (J.M.): this house was essentially the same as House 3 although data was not as complete. Date indicates a rather long period of occupation at the site with little change in this aspect of technology.

**M-815. Spiro Site (Lf-Cr-1), Oklahoma**

Conch shell fragments from Craig Mound (35° 15' N Lat, 94° 20' W Long), Le Flore Co., Oklahoma. Shell fragments were associated with a large multiple burial (No. 62), deep within the conical portion of the mound. Burial 62 contained: two pottery bottles, four shell gorgets, 385 pieces of engraved conch shell, 18 conch shells, 77 pearl beads, several projectile points, five stone ear spools, two wooden ear spools, one stone ornament, one stone discoidal, one stone mace, one stone celt, one stone pipe, a wide variety of shell beads, one awl, one rim sherd, galena and black pigment (Bell, 1953). Sample should date the Gibson aspect at this site (Orr, 1946; 1952). Coll. 1937 by F. E. Clements, Univ. of Oklahoma, Norman; subm. by R. E. Bell. Comment (R.E.B.): this date agrees well with the results of the following Gibson-aspect samples from the Spiro Site: M-54, A.D. 1315 ± 250; M-309, A.D. 1477 ± 200; and 0-596, A.D. 1457 ± 100 (Bell, 1961). Another Gibson aspect sample from the Spiro Site dated at A.D. 789 ± 150 (Michigan V).

**Harlan Site (Ck-6) series, Oklahoma**

Charcoal samples from the Harlan Site (35° 55' N Lat, 95° 14' W Long), Cherokee Co., Oklahoma, in Sequoia State Park. Bell (1949) discusses the site. The three specimens are from superimposed layers within mound Unit 4, and represent a component of the Early Gibson aspect at this site. The charcoal is assumed to come from the house structures associated with each layer. Stratigraphically, Layer A is the youngest, Layer C the oldest, and Layer B intermediate. House patterns in Unit 4 have some minor differences; however, their outlines are basically square with four central roof supports and an entrance pasageway. Coll. 1949 by Leonard Johnson, Univ. of Oklahoma; subm. by R. E. Bell.
M-858.  Harlan Site, Layer A  
Charcoal from mound Unit 4, Square N1-L6, Layer A.  
610 ± 75  
A.D. 1340

M-859.  Harlan Site, Layer B  
Charcoal from mound Unit 4, Square N1-L5, Layer B.  
820 ± 75  
A.D. 1130

M-860.  Harlan Site, Layer C  
Charcoal from mound Unit 4, Square N1-L5.  
775 ± 75  
A.D. 1175

General Comment (R.E.B.): dates are quite in harmony with the stratigraphy, and agree closely with M-65, a.d. 1236 ± 200 (Bell, 1961). Specimen M-64, a.d. 676 ± 300 (ibid.), also from Unit 4, now appears to be somewhat too early, although not unreasonable.

M-1107. Williams Site (9-Go-507) Georgia  
Charred wood fragments from the Williams Site (ca. 34° 35’ N Lat, 84° 57’ W Long), Gordon Co., Georgia. Sample associated with charred corn cobs in Feature 7, which is apparently Early Woodland (Williams focus), estimated at ca. 500 to 250 B.C. Coll. 1960 and submitted by D. F. Morse, then of Georgia Hist. Comm., Atlanta. Comment (D.F.M.): date is younger than expected. Here there is no certainty that the corn is associated with the Williams focus, but there is a high probability, as this is the latest component at the site. M-1116, 2580 ± 200 b.p. and M-1117, 2490 ± 200 b.p. (this date list), were associated with the slightly earlier Mahan focus (Early Woodland), at the Mahan Site.

Bilbo Site series, Georgia  
Charcoal and bone from the Bilbo Site (32° 04’ 20” N Lat, 81° 03’ 57” W Long), Chatham Co., Georgia. Samples date two phases in Savannah River delta; M-1111 and M-1112 date time of introduction of pottery; M-1109, when compared with the preceding samples, should indicate the duration of Archaic materials for most of the occupation of the site. M-1111 and M-1112 would also date the time that sealevel had reached its present level. All the cultural material involved between the two sample levels belongs to the Archaic phase. See Caldwell (1952) for references to site. Coll. 1957 and subm. by W. G. Haag, Louisiana State Univ., Baton Rouge.

M-1109. Bilbo Site 3.0 to 3.5 ft layer  
Charcoal from 3.0 to 3.5 ft layer of nearly solid shell.  
3700 ± 125  
1750 B.C.

M-1111. Bilbo Site, 5.5 to 6.0 ft layer  
Charcoal from 5.5 to 6.0 ft layer, immediately above bottom limit of pottery.  
3820 ± 125  
1870 B.C.

M-1112. Bilbo Site, 5.5 to 6.0 ft layer  
Bone from 5.5 to 6.0 ft layer, immediately above bottom limit of pottery.  
3730 ± 125  
1780 B.C.

*General Comment:* dates are as anticipated and fit well with two other dates
for the Bilbo site area: Humble Co. sample no. 1046, 5500 ± 115 B.P.; Humble Co. sample no. 1047, 4125 ± 115 B.P.; private communication to W. C. Haag.

Mahan Site series, Georgia

Charred wood from the Mahan Site (34° 25' N Lat, 84° 42' W Long), Gordon Co., Georgia. Samples taken from the base of refuse pits below a 4 to 12 in. thick midden, which in turn underlay a 6 in. plow zone. Refuse pits extend into a drab sandy layer which contains evidence of an Archaic occupation. Both samples date from an Early Woodland occupation of the site and are associated with grit-tempered, fabric-impressed pottery. Coll. 1959 and subm. by J. H. Wear, Fairmont, Georgia.

M-1116. Mahan Site, Feature 20  
2580 ± 100  
630 B.C.

Charred wood (pine ?; id. by R. A. Yarnell) from within 2 in. of the base of a refuse pit (Feature 20). Besides grit-tempered pottery, Feature 20 contained limestone and sand-tempered sherd.

M-1117. Mahan Site, Feature 25  
2490 ± 100  
540 B.C.

Charred nuts (hickory; id. by R. A. Yarnell) from near the base of a refuse pit (Feature 25). Feature 25 contained some limestone and sand-tempered sherd in addition to the dominant grit-tempered ware.  

General Comment: previous publications (Caldwell, 1958; Sears and Griffin, 1950; Lewis and Kneberg, 1958) have reported Dunlap Fabric-marked (Early Woodland) as the earliest pottery in the Mahan-site area. It is now believed that Mahan site grit-tempered ware is ancestral to the Dunlap and Kellog sand-tempered series, and that these samples date the grit-tempered series, or just prior to the advent of the sand-tempered series.

Helena Crossing Site series, Arkansas

Charcoal from burial mounds ca. 1.5 m SW of Helena (34° 30’ 10” N Lat, 90° 36’ 40” W Long), Phillips Co., Arkansas. Coll. 1960 and subm. by J. A. Ford, Am. Mus. of Nat. Hist. Series dates burial vaults from the Hopewell culture of Marksville areal variant. Burial vaults B and D were both excavated into the ground surface beneath Mound C. They were constructed within a very short time, and were immediately covered over by the core of Mound C. This is indicated by the lack of water deposited soils in the tombs.

M-1196. Helena Crossing Site, Mound B  
1740 ± 75  
A.D. 210

Charcoal from the charred end of an oak log ca. 3 ft in diam. Log was a roofing timber for the large burial vault in Mound B.

M-1197. Helena Crossing Site, Mound C, Tomb B  
2100 ± 75  
150 B.C.

Charcoal apparently formed by slow oxidization of an 8 in. diam roofing timber placed over Tomb B in burial Mound C.
M-1198. Helena Crossing Site, Mound C, Floor of Tomb D  
A.D. 325

Charcoal from the floor of Tomb D. Vault had roofing timbers 3 to 4 ft in diam which had been burned after the structure was covered with 2 ft of earth.

M-1199. Helena Crossing Site, Mound C, Tomb D, Roofing Log  
A.D. 20

Charcoal from cast of a roofing log on W end of Tomb D. Judging from cast this was an oak log ca. 3.5 ft in diam.

M-1168. George C. Davis Site, Texas  
A.D. 1295

Charred corn kernels from Davis Site (ca. 31° 40’ N Lat, 95° 04” W Long), Cherokee County, Texas. Coll. 1939-1941 by H. P. Newell from a post-hole of Feature 31, a house outline, under the Davis mound. This feature was assigned by Krieger (Newell and Krieger, 1949, p. 180) to the Phase 1 occupation at the site. Kernels were submitted by J. B. Griffin from the collection sent to the Mus. of Anthropol. by Alex Krieger in 1947. A Chicago black carbon date of A.D. 398 ± 175 (C-153, Chicago II) was obtained on charred corn from the floor of a cache pit in Feature 31. Comment (J.B.G.): this sample was submitted in order to check it against the Chicago date which was regarded by some archaeologists as too early for the associated cultural complex. Other archaeologists felt the date was satisfactory. The M-1168 of ca. A.D. 1300 may err on the modern side but seems to be closer to the “true” date than the Chicago run.

C. Northeastern United States and Canada

M-1095. Oaklawn Steatite Quarry, Rhode Island  
A.D. 870

Charcoal from the Oaklawn steatite quarry (41° 46’ N Lat, 71° 30’ W Long), Providence Co., Rhode Island. Sample taken from depth of 5 ft below ground surface in an ash deposit, directly above a fine specimen of a platform stone pipe form. No stone bowl remains occurred with or beneath the sample. Numerous straight-platform and elbow-style stone pipe forms have been found in association with elongated side-notched projectile points at this quarry, which is stratittransitional between Late Archaic and Early Woodland (ceramic). Stratigraphic evidence from this quarry and from camp sites in the area indicate the projectile points are transitional between stone-bowl-making and ceramic horizons (Fowler, 1947, 1951). The quarry also shows all types of stone bowls which have been identified at other quarries in the area. Coll. 1959 by J. Hudson, Narragansett Archaeol. Soc. of Rhode Island; subm. by W. S. Fowler, Bronson Mus., Attleboro, Mass. Comment (W.S.F.): dates a period after manufacture of stone bowl had ceased, but during which stone pipes were still being made. This correlates well with evidence of stone-pipe making at the Locust Spring Site (Fowler, 1962), ca. 5 mi from the Oaklawn Quarry, where small platform-pipes seem to have been made into Early Woodland time.
Serpent Mound series, Ontario


M-1104. Shell midden

Wood charcoal from Square 60-S-2 of shell midden. Charcoal occurred 20 in. below the ground surface, resting on a yellow sandy loam which was everywhere the sterile foundation of the midden. Overlying the charcoal was 3 in. of shell-flecked, dark brown loam, a 12 in. shell layer, and a 5 in. sod zone. Provenience of sample suggests that it would date construction of midden at this point, or, perhaps better, indicate the time of the earliest shell accumulation. The charcoal was derived from what seems to be the old ground surface upon which the shell layer rests. Midden has produced a considerable ceramic sample, of which the earliest is of Vinette 2 character. A few Late Woodland (chiefly Glen Meyer) types have been recovered. This sample is the only direct means of establishing a chronological reference for the midden. A date for the midden will, of course, aid considerably in defining its relationship to the Serpent Mound, dated already at 1830 ± 200 B.P. (M-850, Michigan IV). Comment (R.B.J.): date corroborates placement of the lower midden levels on internal and comparative seriational evidence.

M-1105. Serpent Mound

Charcoal from an extensive concentration of pure charcoal that extended through two 5 ft squares (C12d 10-1, and C12c 10-10) near the southern extent of the mound. Charcoal mass was evidently the remains of several logs or a portion of a tree buried in mound fill an average of 2 ft below the surface, and ca. 1.5 ft above the buried old-sod layer. Sample should date construction of mound, at least that portion from which it was recovered. Comment (R.B.J.): materials dated as M-1105 (A.D. 302) and M-850 (A.D. 128), from different sections of the fill of the Serpent Mound, could be regarded as contemporary if adjusted within the indicated ranges of probable error. However, I would be inclined to accept the results at face value, as suggested by indirect internal evidence, indicating a difference of 174 yr between the two samples which were separated in the mound by ca. 111 ft. I would then, given a choice, consider the 174 yr age difference as a maximum. Both M-850 and M-1105, falling as they do in the early centuries A.D., would place construction of the Serpent Mound chronologically in the later portion of Adena and the middle range of Hopewell as it is understood from C14 dates in the Ohio Valley.

M-1163. Portage Site, New York

Charcoal from the Portage Site (43° 09' 56" N Lat, 79° 02' 49" W Long), Niagara Co., N. Y. Sample was from Late Point Peninsula pit, top of which was overlaid by 16 in. deposits containing Iroquois, French, and English
occupation, the whole being covered by 1.5 ft recent fill. Pit contained shark teeth and tubular beads made from conch shell. Coll. 1960 and subm. by R. L. McCarthy, 40 Grant St., Lockport, N. Y. (McCarthy, 1961, 1962). Comments (R.L.McC.): date is satisfactory.

M-1185. Oak Hill 7 Site, New York 625 ± 75 A.D. 1325

Charcoal from bottom of Pit 1, Oak Hill 7 (42° 57' 30" N Lat, 74° 40' 00" W Long), town of Minden, Montgomery Co., N. Y. Subsoil upon which sample rested, at depth of 18 in., was reddened from heat of fire. Many fire-broken stones, fragments of the major portion of a Chance Incised vessel with incised-platted neck decoration and check-stamp body surface treatment, a single rimsherd of the Durfee Underlined pottery type and a fragment of an undecorated trumpet pipe occurred in the pit fill. Sample should date the end of the Oak Hill horizon and beginning of the Chance horizon, early stages of New York Iroquois development. A paper on the Oak Hill horizon is being prepared for publication. Coll. 1960 and subm. by Donald Lenig, 5 Cottage St., St. Johnsville, N. Y. Comment (J.B.G.): date is acceptable.

M-1187. Bent Site, New York 3300 ± 100 1350 B.C.

Wood charcoal from the Bent Site (42° 51' N Lat, 74° 01' W Long), Schenectady Co., N. Y., found in close association with several projectile points of the Normanskill type, calcined animal bone, and carbonized nuts, within and under Feature 1. This feature consisted of a mass of burned stone cobbles and small boulders ca. 6 ft in diam and 13 in. thick, located in Sec. W130 S50 and W120 S50 at depth 9 to 22 in., below present ground surface. Overlying floodplain silt ca. 39 in., had been removed from site prior to excavation. Bent Site is the largest known component of a newly defined Archaic complex called the River Focus, and the Normanskill type point is diagnostic for this focus. For a formal description of the point type, see Ritchie (1961, p. 57-8); definition and description of the River Focus is yet to be published. Coll. 1960 and subm. by W. A. Ritchie, New York State Mus. and Sci. Service, Albany. Comment (W.A.R.): date seems too young.

M-1189. Winslow Site, Maryland 1125 ± 75 A.D. 825

Charcoal (charred hickory nuts) from the Winslow Site, 18-M09 (39° 04' 05" N Lat, 77° 23' 52" W Long), Montgomery Co., Maryland. From a storage pit belonging to Woodland occupation of site, which appears to have many similarities to the Owasco culture of New York State. This is the first dating for the Montgomery focus, one of the major Woodland occupations in Maryland. The site will be reported in a Bulletin of the Archeol. Soc. of Maryland. Coll. 1960 and subm. by W. A. Tidwell, 3701 Blackthorn, Chevy Chase, Maryland.

D. United States Great Plains

Site 25 DK7 series, Nebraska

Charcoal from post mold of a rectangular house at an Aksarben (formerly "Nebraska culture") site, 25 DK7 (42° 20' N Lat, 96° 30' W Long), Dakota
Co., Nebraska. Site includes house structures and a possibly associated ossuary burial. Part of a single charcoal sample was saturated with paraffin (M-1074), for purposes of comparison with an uncontaminated portion (M-1073) to test paraffin-extraction technique. If paraffin-extraction was successful both M-1073 and M-1074 should give the same date. Coll. 1940 and subm. by J. L. Champe, Univ. of Nebraska, Lincoln.

**M-1073. Uncontaminated charcoal sample**  
515 ± 75  
A.D. 1435

**M-1074. Paraffin-saturated charcoal sample**  
830 ± 75  
A.D. 1120

*General Comment (J.L.C.): experiment not conclusive.*

**M-1069. Squaw Creek Site, Kansas**  
390 ± 75  
A.D. 1560

Charcoal from the Squaw Creek Site (39° 59' N Lat, 95° 19' W Long), Doniphan Co., Kansas. Sample taken from the bottom of a pit exposed in a bank recently cut by a grader. The charred material was 2 ft in from the front of the cut and ca. 4 ft below the old ground surface, now covered by 2 ft of later deposit. A portion of what appeared to be a Middle Mississippi pot, and a large complete pot of very distinct Nebraska aspect were also found in the pit. Coll. 1959 and subm. by J. M. Shippe. *Comment (J.M.S.): date seems to be too recent according to estimates made over the years and date for the Budenbender Site (14-P04) which was A.D. 1199 ± 200 (M-869, Michigan V). Wedel (1961) suggests a date for the Nebraska aspect as A.D. 1300-1400. According to Meyer Rubin (private communication) the C¹⁴ level between A.D. 1300 and 1600 was higher than normal and would tend to reflect a younger reading.*

**E. Western United States**

**M-1131. Brewster Site, Wyoming**  
9990 ± 225  
8040 B.C.

Charcoal from the Brewster Site (43° 22' N Lat, 104° 04' W Long), 3 mi NE of Mule Creek oilfield, T.39N., R.60W., Niobrara Co., Wyoming. Sample collected from lower 6 in. in upper half of Unit C—a tannish-gray gypsiferous sandy-silt—which contains Agate Basin artifacts (Agogino and Frankforter, 1960; Roberts, 1961). A carbonaceous layer in Unit D, overlying Unit C, also contained Agate Basin artifacts, and was C¹⁴ dated at 9350 ± 450 yr B.P. (Humble Co., Sample 1252, private communication). The Folsom level underlying Unit C was dated at 10,375 ± 700 yr B.P. (Isotopes Inc., Sample 1-472, unpublished). Unit C sample was submitted in order to determine the earliest date of Agate Basin occupation in conjunction with climatic changes indicated in the stratigraphy. Coll. 1960 by G. A. Agogino, Harvard Univ., Cambridge, Massachusetts, W. D. Frankforter, Sanford Mus., Cherokee, Iowa, and C. V. Haynes, Univ. of Arizona, Tucson; subm. by Agogino. *Comment (G.A.G.): this sample series is interesting as all three were dated by different laboratories yet all agree with the stratigraphy at the site.*
Arlington Springs Site series, Santa Rosa Island, California

Shell from the Arlington Springs Site (34° 00' N Lat, 120° 10' 02" W Long), Santa Rosa Island, Calif. (Orr, 1960, 1962a, 1962b). The site consists of 37 ft of deposition with three cultural horizons: human bone at a depth of 37 ft, dated at 10,400 ± 200 B.P. (L-568-A), and 10,000 ± 200 B.P. (L-650) by the Lamont Geol. Observatory (Lamont VII); a midden at depth of ca. 11 ft, dated by the Michigan Memorial-Phoenix Proj. Lab. at 7350 ± 350 yr B.P. (M-1133, Michigan VII); and a second midden which occurs from immediately below the surface to a maximum depth of 3 ft. Coll. 1960 by P. C. Orr, W. A. Davis and William Merseilies; subm. by P. C. Orr, Santa Barbara Mus. of Nat. Hist., Santa Barbara, California.

M-1147. Second midden 2090 ± 100 140 B.C.

Shell (Mytilus californianus) from a depth of 18 in. below surface in site's uppermost midden. Sample taken 200 ft N of Datum B, at 127 ft above sea-level, ca. 35 ft directly above the human bone material. This should date one of the last occupations of the site.

M-1148. Modern shell specimen from off Tecolote Point 0 ± 75 A.D. 1950

Living specimen of Mytilus californianus. Dated for purposes of C¹⁴ control on archaeological sample.

F. Mexico and South America

M-1151. Mound 5-W, Yagul, Oaxaca 1060 ± 75 A.D. 890

Charred beam of unidentified species of wood from above intact cement floor related to Tomb 10, but lower than cement floor related to Tombs 10 and 13, Mound 5-W W mound facing on Patio 5 (16° 58' N Lat, 96° 27' W Long), Yagul, Oaxaca. Work at Yagul is reported in several publications, notably various issues of Boletin de Estudios Oaxaquenos (Paddock, 1958a, 1958b, 1958c; Leigh, 1958). Coll. 1955 by Gareth Lowe; subm. by John Paddock, Mexico City College, Km. 16, Carretera Mexico-Toluca, Mexico 10, D. F. Comment (J.P.): Tomb 10 id. by A. Caso as marking end of Monte Albán III-B or beginning of IV; Tombs 11 and 13, Monte Albán V. Sample definitely earlier than the two latter tombs which are of interest for having greca mosaic decorations. Site has remains of all known occupation periods for the region, so should be suitable source for dating the Oaxacan sequence, one of the three major subdivisions of Mesoamerica.

M-1164. Amapa Site, Nayarit, Mexico 700 ± 75 A.D. 1250

Charcoal from the Amapa Site (21° 49' N Lat, 105° 14' W Long), Nayarit, Mexico. Taken from Pit B-15 at depth of 4.15 to 4.25 m. Associated potsherds are equivalent to Kelly's Early Chametla (Kelly, 1938) which she estimates at A.D. 300-500; however, trade sherds in the same level seem to tie in with Gifford's Early Nayarit shaft-tomb complex (Gifford, 1950), which
may date at the beginning of the Christian era. Pottery from the Amapa Site charcoal sample level is stylistically older than Kelley’s “Suchil Engraved” (Kelley and Winters, 1960), which is dated at ca. A.D. 500. Coll. 1959 by C. Meighan, Univ. of California, Los Angeles; subm. for the Inst. of Andean Research by Clifford Evans, U. S. Natl. Mus., Washington, D. C. Comment (C.M.) : there is abundant stratigraphic and cross-cultural evidence to indicate that the date obtained cannot possibly apply to the associated cultural remains. The charcoal may somehow be intrusive from post-classic levels 2 m higher in the same pit.

**San Jeronimo Site series, Guerrero, Mexico**


**M-1165. San Jeronimo Site, 2.60 to 770 ± 75**

3.00 m depth  
A.D. 1180

Taken from road cut directly across from Excavation 1, approximately level with Excavation Level No. 8 (2.60 to 3.00 m). This should date the Early Post-classic period, Galeana phase.

**M-1166. San Jeronimo Site, 4.80 to 1360 ± 75**

4.83 m depth  
A.D. 590

Taken from side of previously excavated pit at 4.80 to 4.83 m below datum point, from Excavation Level 13. This should date the Classic period, Josefina phase with some of the pottery showing Teotihuacan similarities.

**Minguimalo series, Colombia**

The Minguimalo site (4° 52' N Lat, 76° 49' W Long), is located in the Chocó Dept., Colombia, along the San Juan River. All samples were taken from strata-cuts where they were associated with pottery and lithic artifacts. Coll. 1960 by Gerardo and Alicia Reichel-Dolmatoff, Inst. Colombiano de Antropol., Apartado Nac. 407, Bogotá, Colombia; subm. for the Inst. of Andean Research by Clifford Evans. Several cuts in this site, located on a silted-up arm of the main river, produced abundant cultural remains which were classified into three successive complexes: Murillo, Martincito, and Minguimalo, the latter being chronologically the latest. The same stratigraphic sequence was observed in other sites in the valley of the San Juan River.

**M-1167. Minguimalo Site 710 ± 75**

A.D. 1240

Charcoal taken from Cut I, at 90 cm below surface. Associated with Minguimalo complex materials. This complex which is widespread in the San Juan Valley, has been guess-dated at about the time of the Spanish Conquest or a few centuries earlier.
M-1168. Minguimalo Site  
\[1130 \pm 75\]  
A.D. 820

Charcoal taken from Cut I, at 1.85 m below the surface. Associated with Murillo complex material. Comment (G.R.D.): date corresponds well to stratigraphic observations and to a date (M-1169) obtained at another site, for the Murillo complex.

M-1171. Minguimalo Site  
\[530 \pm 75\]  
A.D. 1420

Wood taken from Cut I, at 2.60 m below the surface. This and other pieces of house posts belonged to a round structure built probably in protohistoric times. The posts had penetrated the underlying earlier Minguimalo and Martincito materials, and had come to rest in Murillo material. Should date closely to M-1167. Comment (G.R.D.): upper parts of the posts lying in Martincito and Minguimalo complex material had rotted away and only the pointed ends which were imbedded in very wet clay containing Murillo complex material, were preserved.

M-1169. Murillo Site  
\[1040 \pm 75\]  
A.D. 910

Charcoal taken from Murillo Site (4° 41’ N Lat, 76° 50’ W Long), Chocó Dept., Colombia, along the San Juan River. Sample taken from Cut I, at 70 cm below the surface. Associated with Murillo complex material. Comment (G.R.D.): this date pertains to an important phase of the Murillo complex and is consistent with the corresponding date from the Minguimalo Site (M-1168).

M-1170. Catanguero Site, Colombia  
\[2200 \pm 100\]  
250 B.C.

Charcoal from the Catanguero Site (4° 05’ N Lat, 77° 02’ W Long), Valle Dept., Colombia, along the lower Calima River. Taken from Cut I, at 1.80 m below the surface. Coll. 1960 by Gerardo and Alicia Reichel-Dolmatoff; subm. for the Inst. of Andean Research by Clifford Evans. Comment: at the time this site was investigated no comparable pottery was known and it was thought the complex might be a late intrusion from the upper Calima Valley and the neighboring Cauca Valley. However, recent (1962) research on the southern coast suggests that the Catanguero materials are closely related to early cultural materials from the Mataje River on the Ecuadorian border which, typologically, form part of the so-called Tumaco culture. The Catanguero complex seems to constitute the northernmost evidence for this culture which seems to have penetrated from the coast by following the San Juan River. Catanguero might well be related to the Calima culture of the Western Cordillera which, in turn, seems to be related to the San Agustín culture on the headwaters of the Magdalena River. If this should be the case and if the earlier Tumaco samples should give b.c. dates, the age of the Catanguero date would not be surprising.

M-1172. Chahuite Escondido Site, Costa Rica  
\[920 \pm 75\]  
A.D. 1030

Charcoal from the Chahuite Site (10° 55’ N Lat, 85° 43’ W Long), Santa
Elena Peninsula, Costa Rica. Taken from Cut 4, 0.90 to 1.05 m level. Ceramically this is the Late Chombo phase (Zoned Bichrome) or Early Santa Elena phase (Coe, ms.; Baudez, C. and Coe, M. D., 1960). Final classification is now in progress, but Meso-American dates suggest this sample should date from ca. A.D. 1 to ca. A.D. 600. Coll. 1959 by M. D. Coe, Yale Univ., New Haven, Conn.; subm. for the Inst. of Andean Research by Clifford Evans. Comment (M.C.): the date would appear too late (recent) for either the Zoned Bichrome or Early Polychrome phases; detailed pottery analyses have since shown that the stratigraphy of the deposit from which the sample taken is complex and there has been much intrusion by Late Polychrome sub-floor burials into the deeper strata. The late date is undoubtedly due to mixed strata, not evident at time of excavation and only proven by pottery type classification.

**M-1173. Matapalo Site, Costa Rica**

Charcoal from the Matapalo Site (10° 22' N Lat, 85° 49' W Long), Tamarindo Bay, Santa Elena Peninsula, Costa Rica. Taken from Cut 1, 0.60 to 0.75 m level. From Matapalo phase (Early Polychrome B period) which has affinities with other Middle American pottery sequences dated at ca. A.D. 500 ± 100 yr (same ref. as M-1172). Coll. 1959-1960 by M. D. Coe; subm. for the Inst. of Andean Research by Clifford Evans. Comment: checks well with previous archaeological estimates (A.D. 500-700) for Matapalo phase and for the Early Polychrome B period. Fits with the date of A.D. 565 ± 90 on the same phase from another sample dated by Yale Laboratory (Y-811), in Yale VI.

**Malambo Site series, Colombia**

Charcoal from the Malambo site (10° 50' N Lat, 74° 45' E Long), Atlantico Dept., Colombia. Coll. 1960 by Carlos Angula V., Inst. Colombiano de Antropol.; c/o Apartado 495, Barranquilla, Colombia; subm. for the Inst. of Andean Research by Clifford Evans.

**M-1174. Malambo Site, 0.40 to 0.50 depth**

A.D. 650

1270 ± 75

Taken from Cut 3, 0.40 to 0.50 m level. Associated with materials from the Plato-Zambrano phase, guess-dated at ca. A.D. 1000 to 1400, at least several centuries before the historic Tairona II occupation. Comment: reasonably good agreement with date estimated from other evidence.

**M-1175. Malambo Site, 0.60 to 0.70 depth**

A.D. 60

1890 ± 100

Taken from Cut 3, 0.60 to 0.70 m level. Sample associated with Plato-Zambrano phase material, but is stratigraphically below M-1174. Should date slightly older than M-1174 on basis of stratigraphic position and different ceramic complex. Comment (C.A.V.): within the estimated range of complex based on other evidence.

**M-1176. Malambo Site, 1.00 to 1.10 m depth**

120 B.C.

3070 ± 100

Taken from Cut 3, 1.00 to 1.10 m level. Represents the Malambo phase,
separated from the overlying Plato-Zambrano phase horizon by a sterile soil layer. Sample associated with Formative-period pottery which shows relationships to Momil and Barrancoid traditions. May date as early as 1000 to 500 B.C.  

**Comment** (C.A.V.): confirms the estimated range of this Formative period complex.

**M-1177. Malambo Site, 80 to 90 cm depth**

350 ± 75  
A.D. 1600

Taken from Cut 4, 80 to 90 cm level. Represents the Malambo phase, and should date equal to sample M-1176 due to association with Formative Period pottery that shows relationships to Momil and Barrancoid traditions. **Comment** (C.A.V.): impossible to explain the date; has no relationship to archaeological horizon.

**M-1178. Malambo Site, 90 to 1.00 m depth**

1385 ± 75  
A.D. 565

Taken from Cut 4, 90 to 1.00 m level. Represents the Malambo phase and should date slightly older than M-1177 and should be equal to M-1176 due to association with Formative period pottery that shows relationships to Momil and Barrancoid traditions. **Comment** (C.A.V.): impossible to explain the date in terms of the results for M-1176. Too recent to be associated with archaeological horizon of the Malambo phase.

**M-1283. Pyramid of the Sun, Teotihuacan, Mexico**

1870 ± 75  
A.D. 80

Carbonized wood and charcoal obtained by scraping N wall (Bay 89/90) of upper tunnel at head of stairs, near center of Pyramid of Sun (19° 40' N Lat, 98° 50' W Long), Teotihuacan, Mexico. Sample was found in scattered association with sherds of the Teo. I (Tzacualli) phase in midden fill. Coll. 1959 and subm. by R. F. Millon, Univ. of Rochester, New York. **Comment** (R.F.M.): age falling between 1861-2161 yr B.P. was expected. Two runs on a heterogeneous sample from the pyramid hearting (lower tunnel) were discordant: 2434 ± 500 and 1519 ± 200 (C-203, Chicago I). Teo. I associations are reported for an Oztoyahualco date of 1930 ± 80 (Y-644, Yale V). An account of work within the Pyramid is found in Millon and Drewitt (1961).

**G. Far East and Pacific**

**M-564. Kuliouou Shelter Cave (Site 01), Kuliouou, Oahu, Hawaii**

220 ± 75  
A.D. 1730

Charcoal from Kuliouou shelter cave (21° 17' 20'' N Lat, 157° 44' W Long), Kuliouou, Oahu, Hawaii. Sample taken from Square D7, in a cultural deposit 18 to 24 in. below present surface. Other charcoal collected at the bottom of Square D7, at a depth of 24 to 36 in., was dated by Libby as A.D. 1004 ± 180 (C-540, Chicago II). M-564, collected halfway between C-540 and the surface, was submitted in an attempt to substantiate the Chicago date. Coll. 1950, and subm. by K. P. Emory, Bernice P. Bishop Mus., Honolulu. See Emory, Bonk, and Sinoto (1959), and Emory and Sinoto (1961) for discussion relevant to the site. **Comment** (K.P.E.): because ti-leaves still retaining
green color were found within this level, the late date is not surprising. However, the closeness to the level of the older date inclines to the acceptance of (A.D. 1184 (A.D. 1004 ± 180) as probably nearer the true date.

**M-1245. Waiahukini Shelter Cave (Site H8), Kau, Hawaii**

Charcoal from Waiahukini shelter cave (18° 51' N Lat, 155° 42' W Long), Kau district, Hawaii Co., Hawaii. Sample taken from Square F5, 17 to 21 in. deep, marking the point above which notched two-piece hooks were no longer found. This sample was sent in for a third rechecking of the same charcoal sample. Previous dates were: M-863B, A.D. 1229 ± 200 (Michigan IV); GrN-2901 (unpub. date) less than 300 yr B.P. Coll. 1957, and subm. by K. P. Emory. Comment (K.P.E.): in view of the GrN date on the same sample, the second dating from the same sample by Michigan (M-1245) is reassuring for this very important point in the stratigraphy of Waiahukini shelter, which we have been employing as our control in cross-dating. Here we seem to have a laboratory error by Groningen not only in this date, but in a second, GrN-2149, Groningen IV) giving 110 ± 40 yr B.P., with a correction of plus 200 yr for Suess effect, or A.D. 1650, for the lowest level in the shelter. Michigan IV (M-666) had given A.D. 957 ± 200 for the same level.

**M-875. Bungo Cave, Philippines**

Charcoal from Bungo Cave (ca. 13° 15' N Lat, 121° 51' E Long), Malaking Pulo (Gasper Island), of the Tres Reyes group, SW of Marinduque Island, Philippines. The sample is from the 15 to 30 cm level in the 50 cm porcelain layer. Cultural deposit excavated to a maximum depth of 170 cm below surface. Coll. 1958 and subm. by Prof. E. Arsenio Manuel, Univ. of the Philippines, Quezon City.

**M-1181. Ungech'eon Shell Mounds, Korea**

Charcoal from the Ungech'eon shell mounds (35° 07' 02” N Lat, 128° 45’ 45” E Long), Mt. Jae-mi, Ung-ch'eon-myeon, Ch'ang-woen-gun, Kyeong-sang-nom-do, Korea. Sample taken from Location B, in shell layer 55 to 60 cm beneath the surface soil. Associated with a few iron implements, many bone and horn artifacts, and abundant pottery. Cultural remains seem to suggest that this is an early Korean Iron Age site. A similar site, the Keum-hae shell mound, was excavated in 1919 (Chosen Govt. General, 1922). Coll. 1959 by Choe Yeonghi, Korea Univ., Seoul; subm. by Kim Jeong-hak, Korea Univ.

**M-674. Amaknak-D Site, Aleutians**

Humus with some charcoal from the Amaknak site (53° 53’ 06” N Lat, 166° 33’ 36” W Long), Dutch Harbor, Unalaska Bay, Amaknak Isl., Aleutians. From Sec. 3 Shelf; 200 in. below surface datum, immediately above a 4 in. layer of shell and fish bone, the oldest cultural stratum at the site. Other Amaknak dates are published in Michigan IV (p. 193) and Michigan VI (p. 120). Areal cultural sequence is discussed in Bank (1953). Coll. 1951 and
subm. by T. P. Bank II, American Inst. for Exploration, Chicago Teachers College—North, Chicago, Illinois. Comment (T.P.B.): although this does not date the earliest human occupancy of the Aleutians, it does provide a date that approximates earliest occupation of the site, and corroborates previous dates (Laughton, 1951; Spaulding, 1953). Most significantly it tends to disprove part of Laughton’s (1951) and Hrdlicka’s (1945) contention that the Aleutians were occupied first by long-heads who were replaced by a broad-headed population less than 1000 yr ago.

References

Date lists:

Chicago I  Arnold and Libby, 1951
Chicago II  Libby, 1951
Groningen IV Vogel and Waterbolk, 1963
Lamont VII Olson and Broecker, 1961
Michigan IV Crane and Griffin, 1959
Michigan V Crane and Griffin, 1960
Michigan VI Crane and Griffin, 1961
Michigan VII Crane and Griffin, 1962
Yale V  Stuiver, Deevey, and Gralenski, 1960
Yale VI  Stuiver, Minze, and Deevey, 1961


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— 1958b, MCC field workers have busiest season ever at 1958 Yagul dig: Boletin de Estudios Oaxaquenos, no. 5, May 1, 1958.
Spaulding, A. C., 1953, A current status of Aleutian archaeology: Salt Lake City, Soc. for Am. Archaeology, Mem. no. 9.
LA JOLLA
NATURAL RADIOCARBON MEASUREMENTS III*

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INTRODUCTION

During 1962 the La Jolla Radiocarbon Laboratory continued to follow essentially the same technique as in previous years. Three counters were used:

1. The “Bern Counter,” an Oeschger-Houtermans instrument manufactured at the Physical Institute of the University of Bern; described in La Jolla I (p. 197).

2. The “Brussels Counter,” another Oeschger-Houtermans instrument, manufactured in Brussels by Manufacture Belge de Campes et de Matériel Électronique, S. A.; characterized in La Jolla II (p. 204).

3. The “400-cc La Jolla Counter,” recently constructed at the University of California, San Diego to facilitate the age determination of samples containing less than 1 g of carbon. Because the first model, now in use, was constructed of brass—not the optimal material—the background count is relatively high (ca. 5.0 counts/min). Advantages lie in its high stability. For samples that yield 0.5 L or more of acetylene, this counter can be used quite satisfactorily. Check runs, using the same sample in this counter and in the Bern and Brussels counters, agree closely. Following is an example (LJ-563):

<table>
<thead>
<tr>
<th>Counter</th>
<th>Manometer Reading</th>
<th>Apparent Age</th>
<th>1σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>400-cc La Jolla</td>
<td>1 atm</td>
<td>1440</td>
<td>300</td>
</tr>
<tr>
<td>Brussels</td>
<td>1 atm</td>
<td>1400</td>
<td>100</td>
</tr>
<tr>
<td>Brussels</td>
<td>440 mm</td>
<td>1540</td>
<td>100</td>
</tr>
<tr>
<td>Bern</td>
<td>440 mm</td>
<td>1400</td>
<td>100</td>
</tr>
</tbody>
</table>

A further example: dates obtained separately by the use of the Bern and Brussels counters for LJ-533 (34,400 ± 1000) agreed within 150 yr. In the analysis of C¹⁴ in seawater alternating determinations with the Bern and Brussels counters also yielded virtually identical results. Of the measurements herein described those from LJ-281 to 509 were run on the Bern Counter; those from LJ-511 to 539 more or less alternately on the Bern and Brussels counters; LJ-562 to 564 only on the 440-cc La Jolla Counter (with check runs on the other counters for LJ-563, as indicated above, and with the Brussels counter for LJ-562).

In order to include consideration of uncertainties in calibration, the drift in sensitivity of background, and other fluctuating factors, the error listed with each date, as in La Jolla I and II, is larger by ca. 100 yr than the one-sigma statistical counting error (which is the value quoted in other date lists); when the estimate is 1000 or more, no addition is made.

All samples were thoroughly pretreated with dilute HCl and NaOH.

* Contributions from the Scripps Institution of Oceanography, New Series.
During 1962 natural C¹⁴ measurements were obtained for 45 samples, in addition to 92 samples derived from seawater (these 92 are the only 1962 tests to be reported elsewhere). Two additional measurements (LJ-281 and 290), omitted from La Jolla II, are included, to make a total of 47.

A report on the "Radiocarbon Dating of Deep Water of the Pacific and Indian Oceans" was presented by G. S. Bien, N. W. Rakestraw, and H. E. Suess at the International Atomic Energy Authority Symposium on Radioactive Dating, at Athens, in November 1962. This report, with 114 "apparent age" estimates, has been issued in processed form and is being prepared for publication in a journal.

Particular stress has been maintained on datings that bear on changes in past conditions, biological as well as physical; especially on those that bear on the prehistoric life of man.

New applications bear on the recent and probably continuing formation of phosphorite on the sea-floor off Baja California (LJ-500, 509, 515), and of dolomite in a freshwater spring (LJ-527, 562-564); also on the time and rate of formation of caliche in Colorado (LJ-510) and of tufa in Lake LeConte (LJ-457, 458, 513). Other highlights in this report include the demonstration: (1) of a long and varied series of fillings of Lake LeConte; (2) prolonged occupation of a coastal midden site in southern California (LJ-453 and 454); (3) a new determination (11,690 ± 250, LJ-452) for ground-sloth dung from Gypsum Cave, Nevada; (4) the oldest date (2925 ± 340, LJ-505) yet obtained for the Maya; and (5) two measurements (LJ-411 and 533) from the Mohole Exploratory Drilling.

ACKNOWLEDGMENTS

The operation of the La Jolla Radiocarbon Laboratory continues under support from the National Science Foundation. Additional support has again come from the California State Water Resources Board. Both agencies have also provided research grants to the senior author, for studies that involve the Radiocarbon Laboratory.

Technical assistance in the operation of the Laboratory has been furnished by Sylvia F. Chillcott and Paula Sandoval, and the electronics have been maintained by Everett R. Hernandez. The senior author’s staff has included Jacquelin N. Miller, Laura C. Hubbs, Priscilla A. Sloan, and Betty N. Shor. Emery P. Chace has continued to identify molluscs.

SUBJECT INDEX

We continue to enter the datings in serial numerical order, which allows convenient reference, and again provide an index to the diverse subjects on which the tests seem to bear.

I. GEOLOGIC INFERENCES:

1. Quaternary Changes of Sealevel:
   California: LJ-456.
   Texas: LJ-521.
   Australia: LJ-451, 516.
2. Quaternary Soil History:
   California coastal terraces: LJ-449, 514.
   Colorado bog: LJ-539.

3. History of Lake Le Conte:
   Pleistocene period between or before fillings: LJ-532.
   Recession from Pluvial stage: LJ-528.
   Holocene freshwater stage: LJ-530.

4. History of Other Lakes in California:
   Lake Tahoe: LJ-503.


8. Diastrophism:
   Le Conte Basin and Colorado Delta: LJ-504.
   Coastal uplift, Golfo de California: LJ-522.
   (See also Quaternary Changes in Sealevel.)

9. Time Span for Processes:
   Dolomite formation in lake: LJ-527, 562-564.
   Caliche formation: LJ-510.
   Valley-fill (see Quaternary Soil History.)


III. PALEOCLIMATOLOGIC INFERENCES:
   1. Inferences from Lake Levels, California: LJ-450, 457, 458, 501, 503, 504, 513, 528, 530, 532.
   2. Inferences from Data on Dated Bog, Colorado: LJ-539.
   3. Inferences from Faunal Evidence:
      Ground sloth, Nevada: LJ-452.

IV. ARCHEOLOGIC INFERENCES:
   3. Channel Islands, California: LJ-514.
   4. Lake Le Conte, California: LJ-528, 532.

V. FAUNAL HISTORIES:

VI. TESTS BEARING ON RELIABILITY AND PRECISION OF THE DATES:
1. Orderly, Expected Sequences: LJ-382 (La Jolla II) and 448; LJ-453 and 454; LJ-457 compared with LJ-458 and 513; LJ-562-564; LJ-510.
3. Datings More or Less Contrary to Expectation: LJ-385 and 386 (La Jolla II) and LJ-449 and 512 (discrepancy in terms of depth explained as due to erosion and redeposition); LJ-505 and 508; LJ-517 contrasted with LJ-280 (La Jolla II) and LJ-520; LJ-523-525.

**LJ-281. Mississippi River alluvium, Illinois**

6600 ± 200
4650 B.C.

Wood from a tree trunk, 0.76 m in diameter, found standing erect 16.5 to 16.8 m below land surface, on the bank of Mississippi River near Wood River, Illinois; trunk, with root portion apparently charred, was uncovered during excavation of a Ranney Collector Well for Olin-Mathieson Chemical Co., 975 m W and 488 m S of NE corner, Sec. 29, T 5 N, R 9 W, Madison Co.; altitude of floodplain here is 126 m (ca. 38° 50.2' N Lat, 90° 06.7' W Long). Coll. 1960 and subm. 1961 by R. E. Bergstrom, Illinois State Geol. Survey. Comment: the alluvial sands and gravels in which the wood occurred were believed by the collector to be probably Recent but possibly of glacial valley-train origin. The outermost rings were dated (bark missing?).

**LJ-290. Lake Eminence, Indiana**

5000 ± 250
3050 B.C.

Wood from a log ca. 30 m in diameter and probably containing 300 to 400 rings, exposed in bank of E Fork of Mill Creek, 6.44 km SW of Clayton, Hendricks Co., in NE ¼ of SW ¼, Sec. 11, T 14 N, R 2 W (ca. 39° 40.0' N Lat, 86° 36.3' W Long). Coll. 1960 and subm. 1961 by W. J. Wayne, State of Indiana Geol. Survey (sample WJW-60-15). Comment (W.J.W.): section measured at the locality: (3) silt and sand, yellowish-brown, laminated to massive, not calcareous, 2.0 m; (2) sand and gravel, light yellowish-brown, calcareous, up to 1.0 m; (1) silt, medium-gray, calcareous, with abundant plant remains and gastropods, 0.3 m (base not exposed). Large logs rest on bed 1 and are embedded in its upper part; the snail fauna has some cool-climate elements normally found in intertill Pleistocene beds and lacks the species that
came with the postglacial forests. Bed 1 was interpreted as part of the bed of Lake Eminence (Thornbury, 1950), which is presumably early post-Wisconsin-maximum in age. No topographic disconformity was recognized, though one probably exists. The log was hypothesized to be as young as 4000 to 5000 yr if the top two beds are floodplain sediments (which they now appear to be), two to three times older if they are not.

**LJ-411. Exploratory Mohole Drilling—1**  

>35,000

Dolomite from depth of 232 m below sediment surface in San Diego Trough, off San Diego, California, at water depth of 935 m (32° 50.4' N Lat, 117° 37.3' W Long). Coll. 1961 by party from Scripps Inst. of Oceanography (Core Designation EM 3–5, 8.0 to 10.5 cm from top of core); subm. 1962 by E. D. Goldberg and D. L. Inman of that institution. *Comment:* date indicates Pleistocene or earlier age. The datability of newly precipitated dolomite is attested by LJ-527 and 562–564 (this date list). Organic material from a depth of 66.14 to 72.24 m in the same drill hole dates 34,400 ± 1000 (LJ-533, this date list).

**LJ-448. SIO Cliff Site, La Jolla, California—2**  

1050 ± 150  

A.D. 900

Pismo clam (*Tivela stultorum*) shells from midden described under LJ-382 (La Jolla II); from undisturbed soil in lower part of Decimeter 1 (top) of same pit (32° 52' 00" N Lat, 117° 15' 09" W Long). Coll. by J. N. Miller (sample 1960—XI: 21A); subm. 1962. *Comment:* this measurement provides the recent limiting date for this midden, the bottom three decimeters of which gave 3240 ± 240 (LJ-382, La Jolla II). Entire occupation appears to represent a cultural continuum from the La Jollan, preceding the Diegueño occupation of the same region.

**LJ-449. Spindrift Site, La Jolla, California—3**  

4770 ± 160  

2820 B.C.

California mussel (*Mytilus californianus*) shells from Decimeter 8 (from top) of midden described under LJ-385 and 386 (La Jolla II); from lime-indurated soil immediately below the upper, dark, friable soil from which sample for LJ-385 was obtained at Decimeter 6 and close to point where sample LJ-386 was obtained at Decimeter 11 (32° 51' 02" N Lat, 117° 15' 38" W Long). Coll. by J. N. Miller and K. W. Radford (sample 1961—IX: 28A); subm. 1962. *Comment:* although from an intermediate depth, this sample yields the oldest of the three dates from this midden, older than that of 3190 ± 200 (LJ-385, La Jolla II) for a deeper layer and 3500 yr older than that of 1270 ± 250 (LJ-386, La Jolla II) for shell from only two decimeter higher. Another date, 4650 ± 260 (LJ-512, this date list), like that for LJ-449, is for the top level of the older stratigraphic unit in this site. The explanation of the discrepancies between LJ-449 and LJ-385 and 386 seems to be that on this steeply sloping site erosion removed some soil of the La Jollan occupation before the soil from the Diegueño occupation accumulated, and that some of the soil of intermediate age, represented by LJ-385, was redeposited at a relatively low level in gullies. The color and consistency of the soil suggested this sequence.
LJ-450. Lake LeConte, California—6

Tufa (CaCO₃) coating wave-washed stones in a conspicuous horizon of shore pavement, overlying fanglomerate and overlain by generally 5 m or more of alluvium, in part fanglomerate but in part lacustrine; along a fragment of the NE shoreline of an ancient stage of Lake LeConte, in Riverside Co.; at the mouth of Box Canyon on the N side of State Highway 195 E of Mecca, in NE ¼, Sec. 12, T 7 S, R 9 E, alt 38 to 42 m (33° 34' 46" N Lat, 115° 59' 29" W Long; USGS Mortmar Quadrangle, 7.5' series, 1958). Coll. by G. M. Stanley and C. L. Hubbs (sample 1958—IV: 19C); subm. 1962. Comment: the first date for one of the Pleistocene (Pluvial) stages of Lake LeConte, represented by beachline fragments—this stage obviously freshwater. Other Pleistocene datings for this lake basin, all in this date list and in UCLA II, are 13,040 ± 200 (LJ-457), 37,100 ± 2000 (LJ-504), > 45,000 (LJ-532), 32,200 ± 2000 (UCLA-189), and > 34,000 (UCLA-191). A date for the presumed recession of the last Pluvial stage of the lake is 9630 ± 300 (LJ-528, this date list). Datings for Holocene stages of Lake LeConte are listed under LJ-530 (this date list).

LJ-451. Peat, Long Reef, Australia

Peat at Long Reef, from base of layer ca. 0.5 m thick, ca. 0.3 m above high-tide level, in the deposit of an old lagoon (probably an inter-barrier lagoon) that formed behind a Recent outer barrier, which is usually preserved along the coast, though now eroded at this site, on coast between Deewhy and Collaroy, near Sydney (33° 44.7' S Lat, 151° 19.3' E Long; from HO Chart 1904, 1942). Coll. 1961 by Trevor Langford-Smith, Univ. of Sydney (his sample 3) and F. P. Shepard, Scripps Inst. of Oceanography (his sample 1); subm. 1962 by Shepard. Comment (T.L.-S.): the peat is possibly indicative of a higher-than-present sea-stand; pollen analysis indicates that it is probably of brackish- or salt-water origin. Shell samples from Long Reef, from what was first interpreted as a raised beach, both dated 900 ± 150 (LJ-128 and 130, La Jolla I), now appear to be of midden origin. The problem of postglacial high sea-stands has lately been reviewed by Russell (1963).

LJ-452. Ground-sloth dung, Gypsum Cave

Ground-sloth dung from Room 3 in Gypsum Cave, Nevada, ca. 26 km E of Las Vegas, near head of E branch of Vegas Wash, in a spur of Frenchman Range (36° 13' 25" N Lat, 114° 54' 20" W Long; from Harrington, 1933, Fig. 2); alt ca. 610 m; from layer of unburned dung and soil lying directly on a limestone ledge, immediately beneath a Gypsum Cave dart point underlying a layer of partly burned sloth dung, in turn overlain by a rockfall containing a sloth skull (Harrington, 1933, fig. 20). Coll. 1929-1931 by M. R. Harrington; subm. 1962 by R. D. Simpson. Comment: checks the averaged solid-carbon measurements of 10,455 ± 340 for C-221 and of 8527 ± 250 for C-222 (Libby, 1955, p. 117-118), for ground-sloth dung from different depths in the deposits in Room 1 of the same cave (Harrington, 1933). This test provides further confirmation of the existence of man in North America in association
with extinct mammals toward the end of the Pleistocene, during a time of
greater-than-present rainfall.

**LJ-453. SIO Upper Cliff Site, La Jolla,** 1620 ± 160
California—1

A.D. 330

Pismo clam (*Tivela stultorum*) shells from Decimeter 1 (top) of the SIO
Upper Cliff Site, on the grounds of Scripps Inst. of Oceanography, at the site
of the building of the Inst. of Geophysics and Planetary Physics, Univ. of
California, San Diego, ca. 6 to 7 m from lip of cliff, immediately back of eroded
section (32° 52' 07” N Lat, 117° 15’ 09” W Long; USGS La Jolla Quadrangle,
7.5' series, 1953). Coll. by Scripps Inst. (K. W. Radford and party; sample
1961—XII: 3A); subm. 1962. *Comment:* dates terminal occupation of site
that appears to have persisted (intermittently?) for ca. 6 millennia, with no
trace of pottery or pressure-flaked artifacts. Further study is under way on
food remains and a few artifacts from the meter-square column. See also
LJ-454.

**LJ-454. SIO Upper Cliff Site, La Jolla,** 7530 ± 140
California—2

5580 B.C.

California mussel (*Mytilus californianus*) shells from Decimeter 16 (from
top) of the same meter-square column sampled for LJ-453, but at the bottom
decimeter-level of the midden (only 1 shell fragment occurred in Decimeter
17, none below). *Comment:* demonstrates long-term occupation of site (see
LJ-453). Date is the oldest (by a few years) for any W Coast shellfish-gather-
ing culture except for one dated 12,620 ± 200 (UCLA-141, UCLA 1), which
is definitely suspect because of possible contamination of comminuted charcoal
with asphalt. Many other dates from shell middens on the coast lie between
5000 and 7500, but no others are older than 7500.

**LJ-456. Buried wood, Stockton, California** >34,000

Wood, thought to be redwood, from a depth of 102 m, or 97 m below
sealevel, in the N part of Stockton, along N side of Mokelumne Aqueduct (of
East Bay Municipal Utility District), from the California Water Service Co.
Well 60-01; in a triangular lot lying between Woodstock St. and Pardee Lane
at foot of Ridgeway St.; Sec. 10, T 2 N, R 6 E (38° 59' 58” N Lat, 121° 17’
57” W Long; USGS Stockton W Quadrangle, 7.5' series, 1952). Coll. 1961 by
C. L. White, California Water Service Co.; subm. 1962 by A. A. Prucha, Cali-
ifornia State Bur. of Sanitary Eng. *Comment:* date bears on changes in relative
sealevel and on rate of valley-fill.

**LJ-457. Lake LeConte, California—7** 13,040 ± 200

11,090 B.C.

Dense tufa chipped from innermost 5 cm, where 0.45 to 0.6 m thick, on
NE face of Travertine Point, Imperial Co., 0.3 km S of Riverside Co. line;
alt ca. 20 m below sealevel (ca. 33 m below top of tufa) (33° 25' 23” N Lat,
116° 03' 25” W Long; USGS Oasis Quadrangle, 7.5' series, 1956). Coll. by
C. L. Hubbs and students (sample 1962—II: 4E). *Comment:* care was exer-
cised to minimize the chance of including recent surface coating, and the ex-
posed surface layers were removed by treatment with HCl. Test confirms view of Hubbs and Miller (1948, p. 103-112) that the “Main Stage” of Lake LeConte was much older than the “Last High Stage” (which probably involved two or more fillings, represented by the measurements listed under LJ-530, this date list). From the date and from the nature of the tufa and other ancillary circumstances it is obvious that a freshwater lake occupied the basin in Pluvial time, at approximately the same elevation and contour as the much more recent stage(s), and that the deposition of the massive tufa on a small granitic island (now represented by Travertine Point) began roughly 13,000 yr ago. The termination of the Pluvial stage(s) seems to be marked by the date of 9630 ± 300 (LJ-528, this date list). Datings of earlier and higher Pleistocene stages are referred to under LJ-450 (this date list). The outer part of the tufa at the same location on Travertine Point is dated at 1890 ± 500 and 1800 ± 200 (LJ-458 and 513, this date list). Evidence of an intervening marine stage dated at 3970 ± 100 (UCLA-190, UCLA II), as well as the evidence of recession at ca. 9630 ± 300 (LJ-528) indicates that the thick deposition of tufa on Travertine Point was intermittent, as Hubbs and Miller suggested.

**LJ-458. Lake LeConte, California—8**

1890 ± 500
A.D. 60

Dense tufa chipped from outermost 5 cm at the same location on Travertine Point from which the basal sample for LJ-457 was obtained (same collector and sample). *Comment:* date and ancillary circumstances indicate that deposition of tufa on Travertine Point continued (after at least one major interruption) during the period of the “Last High Stage” (or, more likely, the recent series of freshwater fillings to an alt of ca. 13 m). A duplicate measurement of 1800 ± 200 (LJ-513, this date list) was run on the same sample. See also comments under LJ-457 and LJ-530 (this date list).

**LJ-500. Phosphorite, Baja California—3**

17,660 ± 450
15,710 B.C.

Pellets of marine carbonate-apatite dredged from the continental shelf on the W coast of Baja California Sur N of Bahia Magdalena, at a depth of 91 m, ca. 46 km offshore (25° 45’ N Lat, 112° 34’ W Long). Coll. and subm. 1962 by B. F. d’Anglejan, Scripps Inst. of Oceanography (sample DBB–I). *Comment:* provides another relatively recent date for the extensive phosphorite deposits in this area. Three samples of pellets from the same grab were treated differently to measure time involved in growth of pellets: LJ-500 was run on untreated material; LJ-509, on pellets from which some of the outer part, 32% by weight, had been removed by treatment with HCl, to yield earlier-deposited apatite; LJ-515, on pellets from which 64% of the weight had been removed by HCl, to yield still earlier-deposited material. Results follow:

- LJ-500 (sample DBB–I), total pellets: 17,660 ± 450
- LJ-509 (sample DBB–II), inner 68%: 19,440 ± 600
- LJ-515 (sample DBB–III), inner 36%: 26,640 ± 600

The previous measurements on marine phosphorite are 19,300 ± 600 (LJ-268) and 9860 ± 200 (LJ-399, La Jolla II). It has generally been thought
(see review by Emery, 1961, p. 73-74) that the formation of phosphorite ceased in Tertiary or Pleistocene time.

**LJ-501. Tree stump, Eagle Lake, California**

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<th>Date</th>
<th>440 ± 110</th>
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<tr>
<td>A.D.</td>
<td>1510</td>
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Wood from tree stump, 181 cm in diameter, 0.6 m above surface of Eagle Lake, Lassen Co., in vicinity of Gallatin Beach at S end of lake (40° 33’ N Lat, 120° 47’ W Long). Coll. 1961 by J. F. Hannaford and R. T. Bean; subm. by M. B. Andrew, all of California Dept. of Water Resources (Specimen Y from Stump 1). *Comment*: datings on tree stumps now or in the past flooded by Western lakes will contribute significantly to questions of historic geology, paleoclimatology, and hydrology, along lines indicated by Harding (1935). According to evidence presented by that author Stump 1, which is definitely identifiable as the one figured on p. 89 of his paper, was below the lake level since 1875, until the lake was lowered by water diversion through a tunnel from 1924 to 1932 (when Harding made his study). Data regarding the hydrographic history and fauna of Eagle Lake were reviewed by Hubbs and Miller (1948, p. 37-38). Another tree-stump date, for Mono Lake, is 920 ± 90 (UCLA-118, UCLA 1).

**LJ-502. (See LJ-533)**

**LJ-503. Tree stump, Lake Tahoe, California**

<table>
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<th>Date</th>
<th>4790 ± 200</th>
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<td>2850 B.C.</td>
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Wood id. by R. A. Cockrell, School of Forestry, Univ. of California, Berkeley, as pine, possibly sugar pine (*Pinus lambertiana*), from tree stump ca. 76 cm in diameter, submerged 1.07 m below surface, alt 1896.9 m, off SW shore of Lake Tahoe; next to northwesternmost of five stumps off Kiva Picnic Area of Baldwin Beach (38° 56’ N Lat, 120° 04’ W Long). One of 11 stumps located in the immediate vicinity. Sample taken from stump where emerging from bottom; color was light red-brown on removal but darkened irreversibly within minutes on exposure to air. Coll. 1961 by J. F. Hannaford, L. A. Mullnix, and R. T. Bean; subm. by M. B. Andrew, all of California Dept. of Water Resources (Specimen C, from Stump 6). *Comment*: provides evidence of rise in lake level during the last five millennia. Since the lake level is determined by the height of the sill at the head of the rapid Truckee River, the submergence of the stumps during the past five millennia may be attributed either: (1) to the trees having grown during a drop in lake level below the outlet by reason of decreased precipitation, with subsequent return to external outflow due to increased precipitation; or (2) much more plausibly, to diastrophism. The lake basin may have been depressed subsequent to the tree growth, or the outlet area may have been elevated, probably along one of the very active faults that form the vast escarpment on the E side of the great tilted fault-block of the Sierras. Since no other submerged stumps have been reported in other areas of the lake, local depression is another hypothesis.

**LJ-504. Lake LeConte, California—9**

<table>
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<th>Date</th>
<th>37,100 ± 2000</th>
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<td>35,150 B.C.</td>
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Freshwater snail (*Physa* sp.) shells from dense *Physa* layer on fragment of ancient beachline ca. 3.2 km WNW of Plaster City, Imperial Co.; alt ca.
43 m in NE bank of northwesternmost gravel pit (perhaps subject to change), ca. 200 m S of S bank of Coyote Wash (32° 47' 55" N Lat, 115° 53' 07" W Long; USGS Painted Gorge Quadrangle, 7.5' series, 1957). Coll. by C. L. and L. C. Hubbs (sample 1962—V: 5C). *Comment:* provides a Pleistocene date, presumably in the Wisconsin Pluvial, for one of the very ancient stages—this a freshwater one—of Lake LeConte. This beachline fragment was discovered and definitely interpreted as such by G. M. Stanley, of Fresno State College, a collaborating specialist on lacustrine geology. The associated shell fauna is somewhat different from that of the terminal-Pluvial and Holocene stages of the lake. Because the level is ca. 30 m above the height of the Last High Stage(s) of Lake LeConte, which must have been the altitude of the sill separating the LeConte Basin from the Gulf of California, either the region of the sill (on the Colorado River Delta) must have been depressed or the region of the old beachline must have been elevated (or, quite plausibly, both events occurred). The shells, like those used for LJ-528, appeared to have retained their original aragonite composition and showed very little evidence of weathering.

Since this account was written, Thomas (1963) has announced the discovery of the same ancient beach-line, with particular attention to the same gravel pits. He has attributed the stranded beach-line of this high lake stage to the deposition of an ephemeral delta during Sangamon Interglacial to a height of 150 ft (45.7 m). A considerable body of evidence is inconsistent with this interesting interpretation.

**LJ-505. **Dzibilchaltún, Yucatán—2

2925 ± 340

975 B.C.

Charcoal from a rich deposit of ash and sherds from Structure 605, in the bottom stratigraphic level reached during the 1962 excavations; at the Dzibilchaltún Maya site in NE Yucatán, México, 16 km N of Mérida (ca. 21° 17.0' N Lat, 89° 35.8' W Long). Coll. and subm. 1962 by E. W. Andrews, Middle Am. Research Inst., Tulane Univ. (sample M–945). *Comment* (E.W.A.): date, associated with simple architectural construction, is by far the oldest pertaining to cultural remains in the Lowland Maya Area and confirms the view that Dzibilchaltún spanned the longest history of any of the investigated Lowland Maya sites; it represents what may tentatively be called the Dzibilchaltún “Formative” Stage I. Other dates for Dzibilchaltún include 2200 ± 200 (LJ-279, La Jolla II) and, in this date list: 2130 ± 200 (LJ-508) and 1520 ± 200 (LJ-531). Associated with the charcoal dated as LJ-505 is a large amount of pottery, now under study.

**LJ-508. **Dzibilchaltún, Yucatán—3

2130 ± 200

180 B.C.

Charcoal from deposit sealed under a thick and completely intact plaster floor in the same Structure (605) from which the charcoal used in LJ-505 was obtained. Coll. and subm. 1962 by E. W. Andrews (sample M–943). *Comment:* LJ-508 as well as LJ-505 are dates based on charcoal associated with the early construction phases of the same structure, and both appear to date architectural and ceramic remains of the “Formative” or “Pre-Mayan”
horizon encountered in the 1961 excavations. The discrepancy in the dates was unexpected. Collector regards date of 2130 ± 200 as definitely later than expected, because the associated artifacts suggest approximate contemporaneity with LJ-505, which carries a date (2925 ± 340) more in agreement with expectation.

**LJ-509. Phosphorite, Baja California—4**

19,440 ± 600  
17,490 B.C.

Reported above, under LJ-500.

**LJ-510. Caliche, Mesa Verde, Colorado**

21,000 ± 600  
19,050 B.C.

Caliche, sampled 20 to 30 cm below upper boundary of layer, ca. 100 cm thick, with ca. 54% CaCO₃, underlying a sequence of two loess layers, with a total thickness of 180 cm, on Chapin Mesa, Mesa Verde Natl. Park, Colorado (ca. 37° 03' N Lat, 108° 05' W Long). Coll. 1962 by Douglas Osborne, Supervisory Archeologist, Wetherill Mesa Archeolo. Proj., U. S. Dept. of Interior; subm. by Enrico Bonatti and Gustaf Arrhenius, Scripps Inst. of Oceanography (sample MVC 2). Comment: measurement on caliche desired in attempt to demonstrate its rate of deposition and the minimum age of its upper and lower surface. Soil and basement rock do not contain primary carbonates. Lower part of caliche layer, according to Osborne (personal comm., 1962) has been dated by Isotopes, Inc. at not less than 35,500 yr. Activity of upper part, corresponding to an “age” of 21,000 ± 600 yr, is in agreement with activities found in Wisconsin pluvial caliche layers from Arizona (Arizona IV). The upper and lower loess formations are separated by the eroded surface of an old soil horizon. At the base of the upper loess is a slight development of caliche, the activity of which is now being measured.

**LJ-511. Charcoal, Río Conchos, México**

2330 ± 220  
380 B.C.

Charcoal from one of two lens-shaped hearths of charcoal and cracked rock ca. 3 m apart, ca. 500 m from (on E side of) Río Conchos, Municipio de Meoqui, Chihuahua; in the mouth of an arroyo ca. 1.6 km above the dam on the Río Conchos that forms a reservoir, Presa Rosalilla, which does not flood into the arroyo mouth. The hearths were under 1.5 m of sterile alluvium in an arroyo that is level with third highest terrace above the river; alt ca. 1219 m (ca. 20° 42' N Lat, 106° 45' W Long). Coll. 1957 and subm. 1962 by R. H. Brooks (sample 1). Comment: it was thought that these hearths might provide evidence of very early man in northern México; instead, they seem to record an episode of erosion preceding an episode of alluviation, a sequence like many in SW U. S.

**LJ-512. Spindrift Site, La Jolla, California—4**

4650 ± 260  
2700 B.C.

Pismo clam (*Tivela stultorum*) shells from the Spindrift Site described under LJ-385 and 386 (La Jolla II) and LJ-449 (this date list); from the surface of the B soil horizon, directly associated with prone Burial 1 (32° 51' 02" N Lat, 117° 15' 38" W Long). Coll. 1961 and subm. 1962 by J. R. Moriarty, Scripps Inst. of Oceanography (sample 1961—IX: 28A). Comment: peculiar
nature of burial and location at contact between the B soil horizon containing remains of La Jollan culture and the A horizon with Diegueño remains led to inference that burial (and shell) might date from a transition between these cultures, but the old date suggests rather that the soil contact here represents surface erosion of the older midden levels, followed after an interval by deposition of the more recent (Diegueño) midden.

**LJ-513. Lake LeConte, California—10**

1800 ± 200

A.D. 150

A second, duplicate run confirming the measurement of 1890 ± 500 (LJ-458, this date list, q.v.).

**LJ-514. Midden, Santa Rosa Island, California—2**

970 ± 250

A.D. 980

Charcoal from definite hearth buried ca. 1.0 m, ca. 3 m above sealevel, exposed in a shell midden in a wave-cut bank about midway between East Pt. and Skunk Pt. at mouth of Rancho Viejo Valley (4.1 km from East Pt.), near E end of island, in soil overlying conglomerate; P. C. Orr’s locality 131.85 (33° 57’ 36” N Lat, 119° 58’ 24” W Long; Sheet 4 of War Dept. Map 29 E 2, 1943). Coll. by P. C. Orr, W. S. Broecker, G. F. Carter, and C. L. Hubbs (sample 1955—IX: 10A); subm. 1962 by Hubbs. Comment: age was not certainly determinable in field, though midden appeared to be and is now definitely interpreted as pertaining to a Canaliño village, with shallow pit houses, located on flat behind cliff. Cf. UCLA-135, 1820 ± 90, and UCLA-178, 900 ± 100 (UCLA II) for similar site on same island.

**LJ-515. Phosphorite, Baja California—5**

26,640 ± 600

24,690 B.C.

Reported above, under LJ-500.

**LJ-516. Shells, off coast of Australia**

16,910 ± 500

14,960 B.C.

Pelecypod (Chlamys senatorius) shells dredged at a depth of 132 m on top of terrace edge of Sahul Shelf, off NW coast of Australia (11° 57.5’ S Lat, 123° 50.4’ E Long). Coll. 1961 and subm. 1962 by J. R. Curray, Scripps Inst. of Oceanography (sample V—229). Comment: to establish date of sealevel in what is considered to be a stable area; it was thought possible that the shell would be too old for C14 dating, but the living depth range of the species, though presumed to be inner-shelf to littoral, is not well known.

**LJ-517. Shells, off W coast of México—2**

1480 ± 150

A.D. 470

Gastropod (Vermicularia pellucida) shells dredged at a depth of 104 m off the W coast of mainland México on ancient beachline of Pleistocene delta of Río Grande de Santiago (21° 40.7’ N Lat, 106° 15.0’ W Long). Coll. and subm. 1962 by J. R. Curray and R. H. Parker, Scripps Inst. of Oceanography (sample C-658). Comment: since species was thought to have a living range from intertidal to 2 or 4 m and is usually lagoonal, it was thought that test would establish date of sealevel at this depth. Environmental and depth parameters are similar to that of sample C-331 dated as 19,300 ± 400 (LJ-280, La Jolla II; see also LJ-520, 16,490 ± 600, this date list). The young date
was quite unexpected, and remains unexplained. Since the sample was rather small (25 g) it was necessary to mix the acetylene with background-counting gas.

LJ-518. Beach-ridge, W coast of México  

3175 ± 220  

1225 B.C.

Gastropod (*Agaronia testacea*) shells from midden on abandoned beachridge, approximately at sealevel, N of delta of Río Grande de Santiago, on W coast of mainland México S of Mazatlán (22° 02.6' N Lat, 105° 37.4' W Long). Coll. 1961 and subm. 1962 by J. R. Curray and R. H. Parker (sample C-517). *Comment*: to give a minimum age for beach-ridge on which shell and midden occur; attempt is being made to establish rate of progradation of coast by formation of new beach ridges; date anticipated was <3000 yr.

LJ-520. Shells, off W coast of México—3  

16,490 ± 600  

14,540 B.C.

Pelecypod (*Chione gnidia* and *Megapitaria squalida*) valves dredged at a depth of 114 m off the W coast of mainland México on ancient shoreline of Pleistocene delta of Río Grande de Santiago (22° 06.7' N Lat, 106° 17.8' W Long). Coll. 1960 and subm. 1962 by J. R. Curray and R. H. Parker (sample C-331). *Comment*: to check date of 19,300 ± 400 (LJ-280, La Jolla II), obtained for this beachline, which is inferred to be of Tazewell (late Wisconsin) age, from another mollusc species from same sample. The agreement is fair. The two species have a living range of ca. 2 to 18 m, somewhat deeper than shells used for LJ-280.

LJ-521. Shells, off coast of Texas  

33,250 ± 1000  

31,300 B.C.

Pelecypod (*Rangia cuneata*) shells collected, by diving, at a depth of 15 m, on a rocky bank off Freeport (28° 47.5' N Lat, 95° 18.0' W Long). Coll. 1956 and subm. 1962 by J. R. Curray and R. H. Parker (sample J-382). *Comment*: to date sealevel inferred to represent interstadial in middle of Wisconsin glaciation. Agreement is fair to excellent with previous dates from this line of rocks: 26,900 ± 1800 (for sample J-383) and 32,500 ± 3500 (for sample J-526); both dates by Shell Research and Devl. Co. (H. A. Bernard, personal comm., 1962). *Rangia cuneata* has a living range of 0 to 4 m, in brackish water.

LJ-522. Shore of Golfo de California—5  

2190 ± 200  

240 B.C.

Pelecypod (*Mulinia coloradoensis*) valves (ca. 100) from ancient beachridge ca. 5 km inland from modern beach system, from top 0.3 m of ridge 0.7 m high, ca. 30 km WNW of San Felipe, Baja California Norte, and ca. 5 km W of mean-sealevel shoreline (31° 17.4' N Lat, 114° 56.6' W Long; World Air Chart 472, 1947). Coll. by D. L. Inman and W. R. Gayman, Scripps Inst. of Oceanography (sample 29 Jan 62—28). *Comment*: collectors indicate these possible implications: sealevel stability, rates of longshore transport and coastal advance, and changes in ecologic conditions. Other dates in same series, all but
the last from beach ridges, are:

<table>
<thead>
<tr>
<th>Date (±)</th>
<th>Sample (La Jolla)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2190 ± 260</td>
<td>LJ-213, La Jolla II</td>
</tr>
<tr>
<td>2550 ± 220</td>
<td>LJ-214, La Jolla II</td>
</tr>
<tr>
<td>1970 ± 240</td>
<td>LJ-215, La Jolla II</td>
</tr>
<tr>
<td>1180 ± 250</td>
<td>LJ-220, La Jolla II</td>
</tr>
</tbody>
</table>

**LJ-523. Shore of Golfo de California—6**  

4830 ± 260

2880 B.C.

Pelecypod (*Chione fluctifraga*) valves (2) from ancient beach-ridge in middle of mud flat ca. 3.2 km E of contact between alluvium and tidal flat, from surface of ridge that now has a relief of only 0 to 0.15 m; ca. 35 km NNW of San Felipe (31° 20.6' N Lat, 114° 55.0' W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 8 Dec 61—20); subm. 1962. *Comment*: reported under LJ-522 (same implications). This is the oldest beach-ridge date yet obtained. However, it appears to be inconsistent with LJ-522 (from the same beach-ridge) and may be invalid.

**LJ-524. Shore of Golfo de California—7**  

1060 ± 300

A.D. 890

Pelecypod (*Chione fluctifraga*) valves (2) from youngest of three parallel beach-ridges, the older two of which have already been dated at 1180 ± 250 (LJ-220, La Jolla II) and at 775 ± 100 (Humble Oil and Refining Co., Run 0-1528; D. L. Inman, personal comm., 1962), from 4 to 6 m above mean sea-level, ca. 31.5 km N of San Felipe (31° 18.7' N Lat, 114° 53.3' W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 4 Apr 60—21); subm. 1962. *Comment*: reported under LJ-522 (same implications). Note discrepancy in serial dates for the three beach-ridges. Date suggests that shells analyzed may have been reworked from older deposits.

**LJ-525. Shore of Golfo de California—8**  

690 ± 130

A.D. 1260

Pelecypod (*Mulinia coloradoensis*) valves (38) from barrier island very recently constructed of *Mulinia* shell, from top of berm and from ridge 0.3 to 0.6 m high W of berm, ca. 39 km N of San Felipe (31° 22.3' N Lat, 114° 53.3' W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 10 Nov 61—11); subm. 1962. *Comment*: reported under LJ-522 (same implications). Since this deposit appears to be modern, the date suggests to collectors that the shells analyzed may have been reworked from older deposits.

**LJ-526. Shore of Golfo de California—9**  

7840 ± 250

5890 B.C.

Oyster (*Ostrea palmula*) valves (9) removed from granite cobbles and boulders that outcrop ca. 0.9 m above berm in 7.6-m cliff that terminates E side of alluvial terraces, at N end of 0.4-km-long beach bordering Ensenada Blanca, which is located between two cerros ca. 2.4 km NNE of San Felipe (31° 03.0' N Lat, 114° 49.5' W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 6 March 62—8A). *Comment*: implications by collectors: sealevel changes, rates of sedimentation, rates of uplift. This date is
much older than any obtained from ancient beach-ridges along the Golfo de California shore (see LJ-522, this date list). The oyster valves were cleaned of encrusting barnacles.

**LJ-527. Dolomite, Deep Spring Lake,**

**California—1**

Dolomite mud from surface sediment near edge of Deep Spring Lake, Inyo Co. (ca. 37° 17' N Lat, 118° 03' W Long). Coll. and subm. 1962 by M. N. A. Peterson, Univ. of California, San Diego (sample 1). Comment: sedimentary conditions suggested that the dolomite might have formed recently, and the date so indicates. Peterson and Bien find no previous demonstration of the recent formation of dolomite as a primary precipitate, and this appears to be the first dating of newly formed dolomite. This test (no. 1), the only one made on sample 1, was run on the chemically purified dolomite, without fractionation by size. Additional tests of three separated fractions (coarser, intermediate, and finer) from sample 2 of the same material have been run to test the hypothesis that the larger crystals are the older. Results of these tests (with size measured along edge of rombohedra) are as follows:

2. LJ-562, coarser particles (ave. size, 0.5µ), ave. of 2
datings ................................................................. 2700 ± 500

3. LJ-563, intermediate particles (ave. size, 0.3µ), ave. of
3 datings ................................................................. 1440 ± 400

4. LJ-564, finer particles (ave. size, 0.1µ) ................. 390 ± 150

These datings appear to provide a measurement of the time involved in the growth of the crystals. It appears that nucleation was definitely earliest in the largest crystals. Deep Spring Lake is in a deep enclosed basin that contained a Pluvial lake, probably a shallow one (Hubbs and Miller, 1948, p. 89). While this report was in press, Skinner, Skinner, and Rubin (1963) reported a possible age of only 1200 yr, or less, for dolomite deposited in a S Australian ephemeral lake.

**LJ-528. Lake LeConte, California—11**

Small freshwater gastropod (*Physa, Amnicola, Hydrobia*) shells from basin of Lake LeConte, at W end of the northernmost of the large boat slips at Desert Shores (formerly Fish Springs), Imperial Co.; bottom 30 cm, usually from bottom 10 cm, of a shell-rich sandy streak at the base of the 3-m-thick valley-fill alluvium that overlies a dusky-greenish, apparently deep-lacustrine clay deposit, which is 2 m thick down to present Salton Sea level; the alluvium overlying the sandy streak sampled is mostly sandy, with few pebbles and no cobbles, but with conspicuous streaks and pockets of sand and redeposited shell; alt. ca. 69 m below sealevel; in NE 1/4, Sec. 9, T 9 S, R 9 E (23° 24' 25" N Lat, 116° 02' 03" W Long; USGS Oasis Quadrangle, 7.5' series, 1956). Coll. by C. L. Hubbs and party (samples 1962—II: 3A and III: 3A, combined). Comment: interpretation of deposit is as follows: the underlying clay was deposited by a Pluvial stage of Lake LeConte, presumably dated also from
the innermost tufa of nearby Travertine Rock (13,040 ± 200, LJ-457, this date list); immediately after the rapid Postpluvial desiccation of the lake, corresponding in time to that of Lake Mohave (9640 ± 240, LJ-200, La Jolla II), the first alluvium of sand and shells was presumably redeposited here from the prior beachline 2.1 to 2.7 km to W, alt probably ca. 13 m. Since the layer sampled also contained numerous percussively flaked stone artifacts, which were presumably deposited in situ simultaneously with the shells, measurement also provides an almost certain date of early occupation by man—the earliest date for the basin and the earliest in California S of lakes Mohave and Manix. Occurrence of man when the lake had desiccated may be related to location beside large springs of long duration.

**LJ-529. Midden at Avila, California**

California mussel (*Mytilus californianus*) shells from edge of low cliff on the Marre property, N of Richfield Oil tanks and buildings, at Avila, San Luis Obispo Co. (35° 10′ 44″ N Lat, 120° 44′ 20″ W Long; USC & GS Chart 5386, 1961). Coll. and subm. 1962 by J. R. Moriarty, Scripps Inst. of Oceanography (Avila Site No. 1). *Comment*: collector indicated that the lithic material of this preceramic archeological site resembles La Jollan II in both type and stone-working technique and expected the date to be similar to that of other preceramic sites on the Pacific Coast of southern California and of Baja California. See also LJ-3, 6, 26, 27, 36, 77, 79, 107, 109, and 110, La Jolla I; LJ-202, 221, 225, 231, 256, 274-277, and 332-334, La Jolla II; and LJ-449, 454, and 512, this date list.

**LJ-530. Lake LeConte, California—12**

Compact, nodular tufa thinly coating upper surfaces of cobbles of Lake LeConte beachline alt ca. 13 m ca. 2.4 km W of Truckhaven, Imperial Co. (ca. 33° 17′ 30″ N Lat, 116° 00′ 00″ W Long). Coll. by C. L. and L. C. Hubbs and B. E. McCown (sample 1954—X: 17E); subm. 1962. *Comment*: to compare date of an obviously recent stage of Lake LeConte with the datings obtained from the much thicker tufa on Travertine Point (see LJ-457, 458, and 513, this date list). This thin tufa was apparently laid down early during what has been called “the Last High Stage” of the lake (Hubbs and Miller, 1948, p. 106-108), or, as now seems more probable, during an early filling in a recent series of fillings through distributaries of the Colorado River. That more than one filling occurred during the past two millennia seems probable from physiographic evidence of reworked longshore bars, as at site dated 450 ± 200 (M-596, Michigan III) and from the circumstances associated with a more recent dating of 270 ± 60 (UCLA-192, UCLA II), based on charcoal at a low lake level (alt ca. 52 m below sealevel) associated with remains of freshwater fish (*Xyrauchen texanus*) which presumably could not have survived in the saline lake after it had desiccated by evaporation to such a low level (and reduced area), but which would have arrived with a refilling of the lake from Colorado River. At least, the lake had then receded to below the low level of the camp site. Following are other Recent dates for stages of Lake LeConte:
Freshwater Stages

<table>
<thead>
<tr>
<th>Age (±)</th>
<th>Sample</th>
<th>Date (±)</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 ± 200</td>
<td>M-598 (Michigan III)</td>
<td>960 ± 100</td>
<td>LJ-106 (La Jolla I)</td>
</tr>
<tr>
<td>130 ± 200</td>
<td>M-597 (Michigan III)</td>
<td>1000 ± 200</td>
<td>LJ-7 (La Jolla I)</td>
</tr>
<tr>
<td>220 ± 100</td>
<td>LJ-102 (La Jolla I)</td>
<td>1440 ± 100</td>
<td>LJ-105 (La Jolla I)</td>
</tr>
<tr>
<td>270 ± 60</td>
<td>UCLA-192 (UCLA II)</td>
<td>1510 ± 180</td>
<td>LJ-530 (this date list)</td>
</tr>
<tr>
<td>300 ± 100</td>
<td>LJ-15 (La Jolla I)</td>
<td>1580 ± 200</td>
<td>LJ-101 (La Jolla I)</td>
</tr>
<tr>
<td>450 ± 200</td>
<td>M-596 (Michigan III)</td>
<td>1800 ± 200</td>
<td>LJ-513 (this date list)</td>
</tr>
<tr>
<td>760 ± 100</td>
<td>LJ-99 (La Jolla I)</td>
<td>1890 ± 500</td>
<td>LJ-458 (this date list)</td>
</tr>
</tbody>
</table>

Salt-water Stage

<table>
<thead>
<tr>
<th>Age (±)</th>
<th>Sample</th>
<th>Date (±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3970 ± 100</td>
<td>UCLA-190 (UCLA II)</td>
<td>1520 ± 200 A.D. 430</td>
</tr>
</tbody>
</table>

LJ-531. Dzibilchaltún, Yucatán—4

Charcoal from hearth area sealed under earliest floor at Structure 612, sub. at SE corner of site (ca. 21° 17.0' N Lat, 89° 35.8' W Long). Coll. and subm. 1962 by E. W. Andrews (sample M-1332). Comment (E.W.A.): this is the only datable material surely associated with the first phase of the Early Period on the Yucatan Peninsula—ca. A.D. 250-550. Will date large collection of Petén trade pottery associated with local wares. The copious associated material is clearly equivalent to the Tzakol phase at Uaxactún. There is some deviation from expectation, though not so troublesome as for LJ-508 (this date list).

LJ-532. Lake LeConte, California—13

Shredded, red-colored wood from depth of 29–30.5 m in a well recently drilled in the bed of ancient Lake LeConte near its W shore, Riverside Co.; near center of W line of Sec. 12, T 6 S, R 7 E, at the NE corner of Jackson St. and Ave. 65, 0.7 km NNE of the “Fish Traps”; surface alt ca. –32 m (33° 34' 37” N Lat, 116° 12' 50” W Long; USGS Valerie Quadrangle, 7.5' series, 1956). Coll. 1961 for G. M. Stanley, Fresno State College; subm. 1962 by him (sample Stanley, 1962, no. 1). Comment: this is the second date for the deep alluvial fill of the LeConte basin (the first, for a depth of 3 m, is 9630 ± 300, LJ-528, this date list). Obviously the total valley-fill must embrace considerable antiquity. Tangled into the shredded wood were pieces of seemingly completely charred wood having the appearance of hearth charcoal. The occurrence of the wood and especially of charcoal indicates that the date pertains to a Pleistocene period between or before lake fillings.

LJ-533. Mohole Exploratory Drilling—2

Carbon in organic fraction constituting >1% of 450 gms of powdered marine sediment from a depth of 66.14–72.24 m below sediment surface in San Diego Trough, off San Diego, California, at water depth of 935 m (32° 50.4' N Lat, 117° 37.3' W Long). Coll. 1961 by party from Scripps Inst. of Oceanography (Core Designation EM 3–1, 16–46 cm from top of core); subm. 1962 by D. L. Inman and E. D. Goldberg. Comment: to determine, for the first time, the rate of accumulation of inshore sediments of this type. The contributors
stated that “the organic phases may yield a reliable age on these samples which would be the most important scientific data in the first Mohole Drilling. K. O. Emery at USC has already demonstrated the advantages of organic carbon age determination with C\(^{14}\) from cores near surface.” See Emery, 1961, p. 249-258. A prior attempt (LJ-502) to obtain an adequate amount of gas from this sediment sample by wet combustion failed; dry combustion worked well. Dates obtained separately by the use of the Bern and Brussels counters agreed within 150 yr. Dolomite from a penetration depth of 232 m in the same drilling gave a date of >35,000 (LJ-411, this date list).

LJ-539. **Wood from Molas Pass Bog, Colorado**

Conifer-wood fragment, 15 cm diam \(\times\) 30 cm, from a depth of 60 to 70 cm in interval between a lower detrital gyttja and an upper coarse peat, in an open cut in Molas Pass Bog, on Highway 550, 0.6 km S of S entrance road to Molas Lake, near Silverton in San Juan Mtns.; in Subalpine vegetation zone at alt 3230 m (37° 45' N Lat, 107° 41' W Long). Coll. and subm. 1960 by L. J. Maher, Jr., Dept. of Geol., Univ. of Minnesota. Comment: wood sample occurs at end of warmest and driest period of the local Postglacial sequence (vegetation zones ca. 200 m higher than at present) as interpreted by pollen analysis of the bog coupled with data of recent pollen rain in region (Maher, 1961). Comparison of glacial geology with pollen sequence suggests that very young cirque glaciers in San Juan Mtns. may correlate with period of cool, wet climate that is represented by sediment lying just above the wood sample (vegetation zones at least 120 m lower than at present). The bog sediments rest on glacial debris as do the oldest organic sediments, in nearby Molas Lake, which have been dated as 15,450 ± 220 (Y-1147, Yale VIII); this gives an estimate of the time the two sites were exposed by retreat of the San Juan ice cap.

LJ-562. **Dolomite, Deep Spring Lake, California—2**

2700 ± 500

750 b.c.

LJ-563. **Dolomite, Deep Spring Lake, California—3**

1440 ± 400

A.D. 510

LJ-564. **Dolomite, Deep Spring Lake, California—4**

390 ± 150

A.D. 1560

All three reported under LJ-527, this date list.

**References**

Date lists:

- Arizona IV Damon, Long, and Sigalove, 1963
- La Jolla I Hubbs, Bien, and Suess, 1960
- La Jolla II Hubbs, Bien, and Suess, 1962
- Michigan III Crane and Griffin, 1958
- UCLA I Fergusson and Libby, 1962
- UCLA II Fergusson and Libby, 1963
- Yale VIII Stuiver, Deevey, and Rouse, 1963


272  Carl L. Hubbs, George S. Bien, and Hans E. Suess


Harding, S. T., 1935, Changes in lake levels in Great Basin area/Three hundred years of record studied to determine trend in available water supply: Civil Engineering, v. 5, no. 2, p. 87-90, 6 figs.


——— 1962, La Jolla natural radiocarbon measurements II: Radiocarbon, v. 4, p. 204-238.


TATA INSTITUTE RADIOCARBON DATE LIST I

S. KUSUMGAR, D. LAL and R. P. SARNA

Tata Institute of Fundamental Research, Bombay-5, India

The first series of C\(^{14}\) dates obtained in the C\(^{14}\) Laboratory of the above Institute, since it became operational in August 1961, are presented. The chemical and counting procedures adopted for the measurement of C\(^{14}\) in our laboratory have been described in some detail (Kusumgar et al., 1962). For the sake of completeness some points relevant to the determination of dates are described below.

The measurement of the specific activity of C\(^{14}\) in the samples was carried out by counting acetylene, synthesized from the sample carbon (Suess, 1954), in an Oeschger-Houtermans gas-proportional counter (Houtermans and Oeschger, 1958), at a filling pressure of 500 mm Hg. The background and net NBS oxalic-acid counting rates remained close to 1.35 and 12.2 counts/min throughout this work. Dates were calculated using the mean background and oxalic-acid standard counting rates measured before and after each set of sample countings. From the counter plateaus taken with a Co\(^{60}\) source for each sample and the observed variations in the counting rates of oxalic-acid standard, it was determined that the reproducibility and stability of the counting system are better than 0.5%. The procedure for converting samples into acetylene is that developed by Suess (1954). Minor modifications in this procedure, as adopted by Oeschger (personal communication), were introduced.

Dates are based on a value of 5568 yr for the half life of C\(^{14}\), and 95% of the activity of oxalic acid* as the value for pre-1900 age-corrected wood. The errors given on the dates take into account errors arising from counting statistics, uncertainty in the half life value (± 30 yr), instability of the counting system (± 0.5%) and isotopic fractionation effects (± 0.2%) in the preparation of acetylene.** We have not made any measurements of δC\(^{13}\); the estimate of the error arising from this source has been based on the experience of Suess and coworkers (Bien et al., 1960) who measured C\(^{13}\) values in several wood and ocean water samples.

Wood and charcoal samples, prior to their combustion for the preparation of CO\(_2\), were subjected to the usual pretreatment: (a) careful inspection and surface cleaning (any rootlets present were manually picked), (b) successive extraction with hot solutions of 1% HCl, 1% NaOH, 1% HCl, and (c) washing with distilled water and drying. If a sample was too soft, the NaOH treatment was avoided to prevent its complete dissolution. Because of the variability in the nature of samples dated and the pretreatment used, we have noted these details against individual samples in the date list.

A brief archaeological description of sites Ahar, Lothal and Nevasa, from which several samples have been dated, is given. Samples from other sites have

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* The standard oxalic acid was supplied to us by Prof. James R. Arnold to whom we are grateful.

** It should be pointed out, however, that the values of δC\(^{13}\) in tree rings have been found to range from −21 to −34 per mil with a standard deviation of ± 3.5 per mil (Suess, 1960). This corresponds to an error of ± 0.7% in the specific activity of C\(^{14}\).
been arranged alphabetically according to the name of the site. Whenever more than one measurement was made, samples are arranged in order of increasing age. This classification has been done primarily on the basis of archaeological evidence. When such an evidence is not at hand, the measured dates form the basis of this grouping. For further details about the archaeological sites, see Ghosh (1954-1960).

**INTERCOMPARISON WITH OTHER LABORATORIES**

In order to make an intercomparison with other laboratories we measured the C\(^{14}\) concentration in 1890 wood, and in a wood sample from the tomb of King Zoser (TF-56). In addition to these samples we discovered subsequent to our providing dates to the archaeologists that some of our samples came from the same sites previously dated by the University of Pennsylvania. In Table 1, we have made a comparison between samples which are expected to be contemporary as they derived from the same levels. Our pre-1900 standard, a rose wood sample representing the period A.D. 1885-1895, gave a net counting rate of 11.48 ± 0.09 counts/min compared to the value of 12.25 ± 0.08 counts/min observed for the oxalic-acid standard. The measured age-corrected value of 94.6 ± 1.0% oxalic acid activity as the reference value for modern wood agrees well with the international mean value of 95% adopted at the Groningen Conference 1959 (Godwin, 1959).

**Table 1**

Intercomparison of radiocarbon dates between Bombay and other laboratories

<table>
<thead>
<tr>
<th>Sample Site</th>
<th>C(^{14}) date (yrs B.P.) based on 5568 ± 30 yr for the half life of C(^{14})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charcoal</td>
<td>(a) Pennsylvania—P-481(^{40}) 3879 ± 72 (mean of three determinations)</td>
</tr>
<tr>
<td>Kalibangan</td>
<td>(b) Bombay—TF-25 3930 ± 110</td>
</tr>
<tr>
<td>Charcoal</td>
<td>(a) Pennsylvania—P-200(^{40}) 3457 ± 127</td>
</tr>
<tr>
<td></td>
<td>(b) Bombay—TF-39 3492 ± 128</td>
</tr>
<tr>
<td>Navdatoli</td>
<td>(b) Bombay—TF-59 3380 ± 105</td>
</tr>
<tr>
<td>Charcoal</td>
<td>(a) Pennsylvania—P-183(^{40}) 1846 ± 106</td>
</tr>
<tr>
<td>Nevasa</td>
<td>(b) Bombay—TF-39 1860 ± 100</td>
</tr>
<tr>
<td>Charcoal</td>
<td>(a) Pennsylvania—P-181(^{40}) 3106 ± 122</td>
</tr>
<tr>
<td>Nevasa</td>
<td>(b) Bombay—TF-40 3110 ± 110</td>
</tr>
<tr>
<td>Wood (Zoser’s Tomb)</td>
<td>(b) Arizona—A-219(^{40}) 4240 ± 150</td>
</tr>
<tr>
<td></td>
<td>(c) La Jolla—LJ 172 (Acacia)(^{40}) 4120 ± 2 ?</td>
</tr>
<tr>
<td>Egypt</td>
<td>(d) Bombay—TF-56 3990 ± 110</td>
</tr>
</tbody>
</table>

1) Robert Stuckenrath, Jr., Personal Communication.
2) University of Pennsylvania Radiocarbon Dates III.
4) Arizona Radiocarbon Dates III.
5) H. E. Suess, (1960).
GENERAL COMMENT ON DATES

The C\(^{14}\) dates lead to certain definite conclusions regarding the protohistoric chronology of India. The central Indian chalcolithic cultures that were archaeologically placed at ca. 1000 B.C. are now found to belong to the latter half of the second millennium B.C. Also, the end of the mature Harappa culture came appreciably earlier than that estimated archaeologically. Furthermore, the late phase of Harappa culture has been shown to be considerably earlier than the date given by the archaeologists.

Lastly it may be mentioned that the C\(^{14}\) date of a sample from Utnur (Barker and Mackey, 1960) shows that there flourished a neolithic culture in the South which was contemporary to the Harappa culture of the North.

ACKNOWLEDGMENTS

We are thankful to Mr. A. Ghosh, Dr. H. D. Sankalia and others who sent us samples for dating. The authors are grateful to them for much discussion pertaining to archaeological importance of the various samples, and the meaning of the C\(^{14}\) dates. We are particularly indebted to Mr. D. P. Agrawal, who has assisted us in the preparation of the date lists and advised us on many archaeological matters, and also critically read the manuscript. Any errors, or misinterpretations are, however, solely the responsibility of the authors. Finally our thanks are due to Prof. H. Oeschger for supplying us especially constructed low-level counters.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

Ahar (Ahad) series, Rajasthan

The mound of Ahar \(24^\circ 35' 9''\) N Lat, \(74^\circ 43' 8''\) E Long), situated near Udaipur Railway Sta. (Rajasthan, India), 460 m long, 245 m broad and 15 m high, lies on the left bank of the Ahar River, a tributary of Banas. The site has proved of great significance in tracing the land route of western Asiatic cultural influences. Two main periods of occupation are evident. Period I is protohistoric and claims the major portion of the accumulation. On top of the mound alone are found traces of Period II, which is early historic. In comparison with the archaeological material from Navdatoli, the lower phase of Ahar should be earlier than Phase I of the former site.

The site was first excavated in 1954 by R. C. Agarwal, Superintendent of Archaeol., Rajasthan. The excavation was resumed in 1961 under the joint auspices of the Universities of Poona and Melbourne and supervision of Dr. H. D. Sankalia (Sankalia, 1962).

The measured dates for four charcoal samples supplied by Dr. H. D. Sankalia, Director, Deccan College, Poona, from Layers 5, 7 and 8 show a spread in time of ca. 450 yr (ca. 1750-1300 B.C.). These dates may prove the contacts of black-and-red ware of Rajasthan (Ahar) with that of the Saurashtra Harappan (Lothal). Samples from Layer 1 were found to be ca. 200 yr old, showing that this site was reinhabited in recent years.
TF-31. Copper Age Culture 3130 ± 105
1180 B.C.
Charcoal (mixed with little mud) from Trench X, depth 1.98 m below datum, Layer 5, Field No. 2488. Selected pieces of charcoal treated with HCl and NaOH. From top layers of the Copper Age deposits.

TF-32. Copper Age Culture 3400 ± 105
1450 B.C.
Very soft charcoal (mixed with little mud) from Trench A, depth 4.9 m below datum, Layer 5, Field No. 1038. Selected pieces of charcoal treated with HCl only. Some visible rootlets were present in the sample.

TF-34. Copper Age Culture 3570 ± 135
1620 B.C.
Charcoal with little soil from Trench E, depth 11.5 m below datum, Layer 7, Field No. 2533. Selected pieces of charcoal treated with HCl and NaOH. Comment: the measured date of this sample, in relation to TF-31 and TF-32, is consistent with the expectations based on stratigraphic evidence.

TF-37. Copper Age Culture 3165 ± 110
1215 B.C.
Charcoal (mixed with little mud and dirt) with little powder charcoal from Trench J, depth 12.1 m below datum, Layer 8, Field No. 2590. Selected pieces of charcoal treated with HCl only. Comment: this sample was expected to be older than TF-34 (Layer 7) as it is from a lower layer. Further dating of samples from the latter layer seems necessary to confirm the identification of this layer, since both TF-34 and TF-37 seem to be ideally suited for C14 dating.

TF-18. Late Medieval Culture A.D. 1760
Charcoal (mixed with some mud) from Trench H, length (along) 5 m EW, breadth (away) 1.67 m SN, depth 0.15 m below surface, Layer 1. Selected charcoal pieces treated with HCl and NaOH. Traces of rootlets were present in the sample. Comment: originally all samples collected from the Ahar mound were believed to be in the neighborhood of ca. 1500-2000 B.C. After the above date was obtained, we were informed that further excavations at the site revealed the presence of polychrome glass bangles and Muslim burials which confirm this date and show that the site was reoccupied after 14-15th century A.D.

Lothal series, Gujarat
Lothal (22° 31’ N Lat, 72° 15’ E Long), is situated at the head of the Gulf of Cambay in Dist. Ahmedabad (Gujarat State, India). It is a low and extensive mound and represents the largest Harappan settlement in India. The site has become well-known for its most ancient dockyard, a trapezoidal structure measuring 216 m × 36.5 m. Interesting exotic finds, besides indicating seaborne trade, are valuable for fixing the dates of the site from an archaeological standpoint. On archaeological evidence, two main periods of occupation have been determined: Period I—ca. 2500-1500 b.c., Period II ca. 1500-1000 B.C. The site was excavated by S. R. Rao of the Archaeol. Survey of India
Six samples, whose dates have been determined, were collected by S. R. Rao and submitted to us by A. Ghosh, Director General of Archaeol. in India, New Delhi-11. The site was flooded and waterlogged in the past. All samples were found to contain traces of rootlets. These were carefully removed manually before the pretreatment. Comment: C$^{14}$ dates show that the ages of the upper levels of Period I and the entire Period II have been underestimated by archaeologists. C$^{14}$ dates establish the chronological probability of contact of the black-and-red ware cultures of Lothal and Ahar.

TF-23. Harappa Culture

Charcoal (mixed with mud and dirt) from Trench No. SRG54, Locus XLIII-XLVIII/4, depth 1.22 m, Field No. 28, Phase-VA (Period II). Sample is from posthole of mud wall of Phase VA, built on flood debris of Phase IV (Period I). Large selected pieces of charcoal treated with HCl and NaOH.

TF-19. Harappa Culture

Charcoal (mixed with mud and dirt) from Trench No. SRG11, Locus 5B, depth 2.19 m to 2.25 m, Field No. 6, Phase VA (Period II). From debris sealing the western embankment wall of the dock. Selected soft charcoal pieces containing some mud treated with HCl and NaOH.

TF-29. Harappa Culture

Charcoal (mixed with little mud and dirt) from Trench No. SRG55, Locus XII-XVIII/7, depth 2.11 m, Field No. 53, Phase IVA (Period I). Sample is from waterlogged debris of cesspool in which sullage water probably accumulated. Large selected pieces of charcoal sample treated with HCl and NaOH.

TF-22. Harappa Culture

Charcoal (mixed with soil) from Trench No. SRG2, Locus E 13/9 (sealing wall of Phase III), depth 1.88 m, Field No. 29, End of Phase IIIB (Period I). Loose ashy layer sealing flood debris and wall of Phase IIIB. Sample containing little mud) treated with HCl only.

TF-27. Harappa Culture

Charcoal (mixed with mud and dirt) from Trench No. SRG2, Locus D13/7A, depth 1.98 m, Field No. 32A, Phase IIIB. From flood debris, loam etc. accumulated against wall of IIIB (Period I). Selected pieces of soft charcoal (containing little mud) treated with HCl only.

TF-26. Harappa Culture

Charcoal (coarse and fine grain) from Trench SRG2, Locus D.13/7A, depth 1.98 m to 2.26 m, Field No. 32. From flood debris and loam accumulated against wall of IIIB (Period I). Selected coarse charcoal pieces treated with HCl and NaOH.
Nevasa series, Maharashtra

Nevasa (19° 34' N Lat, 74° 54' E Long), is a small town on the bank of Pravara, a tributary of the Godavari, in Ahmednagar Dist. (Maharashtra, India). Excavations revealed a sequence of cultures extending from the Chalcolithic to the Medieval periods. The site is of great importance as it shows a link between the Northern Chalcolithic and the Southern Neolithic traits. Period III (Chalcolithic) here is very rich in the variety of tools and ceramics. The central date for Period III is believed to be ca. 1200 B.C. The two subsequent early historic periods (Period IV, V) have been put within the time bracket of ca. 150 B.C.-A.D. 200. The site was excavated by Dr. H. D. Sankalia (Sankalia, Deo, Ansari and Ehrhardt, 1960). Four samples supplied to us by Dr. Sankalia have been dated. These measurements confirm the dates based on archaeological evidence influenced by C14 dates measured by the University of Pennsylvania.

TF-38. Indo-Roman Culture

Charcoal in the form of charred grains (mixed with little soil). Trench 180B, depth 0.15 m below surface, Layer 4, Field No. 4197. Selected pieces treated with HCl and NaOH. Traces of rootlets were found. Sample belongs to Period V, dated ca. 50 B.C. with the help of coins and ceramics.

TF-41. Early Historic Culture

Charred grains mixed with little soil from Trench 14B, Layer 2, Field No. 4463a. Depth not measured. Selected charred grains treated with HCl and NaOH. Sample belongs to Period IV, dated ca. 150 B.C. to 50 B.C. with the help of coins and ceramics.

TF-39. Early Historic Culture

Charred grains with little mud from Trench 101B, depth 0.56 m below surface, Layer 4 (disturbed by pits), Field No. 4132. Selected charred grains treated with HCl and NaOH. Some visible rootlets were present. Sample belongs to Period IV dated ca. 150 B.C.-50 B.C.

TF-40. Chalcolithic Culture

Charcoal from Trench No. 181B, depth 1.34 m below surface N section, Layer 5, Field No. 4463. Selected pieces treated with HCl and NaOH. Sample believed to date ca. 1500-1000 B.C., on archaeological evidence.

Afye series, Nubia

Samples from Afye (22° 30' N Lat, 31° 50' E Long), subm. by A. Ghosh. Comment: this important site, dated ca. 3000 B.C. on the basis of Egyptian chronology, was excavated by the Indian Archaeol. Exped. led by B. B. Lal. The archaeological evidence unearthed is expected to throw light on the origins of Megalithic Culture of India.
TF-48. A-Group Culture

Charcoal from Locus B5, depth 0.35 m, Stratum 2, Field No. AFH1/158. Selected pieces treated with HCl and NaOH.

**279**

TF-47. A-Group Culture

Charcoal from Locus A4, depth 0.45 m to 0.55 m, Stratum 3, Field No. AFH1/157. Selected pieces treated with HCl and NaOH.

**Burzahom series, Kashmir**

Samples from Burzahom (34° 10' N Lat, 74° 52' 30" E Long). Subm. by A. Ghosh. Comment: these are the first dates obtained for the beginning of Neolithic economy in Kashmir and will help trace its connections from Central Asia and Iran (Lal, 1961).

TF-10. Neolithic Culture

Charcoal with mud in the form of powder. Locus III_v—VII_y, Trench BZH1, depth 1.55 m, Stratum 6. Sample is from “Mud Phase.” Charcoal with mud in form of powdered treated with HCl, CO_2 obtained by wet oxidation.

**2580 ± 100**

TF-15. Neolithic Culture

Burnt material (probably birch and hay) with soil. Locus C2SW, Trench BZH3, depth 1.85 m below surface, Pit A. Burnt material treated with NaOH and HCl, CO_2 evolved by wet oxidation. No visible rootlets present.

**3390 ± 105**

TF-13. Neolithic Culture

Charcoal with very little soil. Locus A2NW, Trench BZH3, depth 1.93 m below surface, Pit 12. Selected pieces treated with HCl and NaOH. Some visible rootlets were present.

**3690 ± 125**

TF-43. Chalcolithic Culture

Charcoal sample with some mud. Trench 8, depth 0.86 m below datum, Layer 2, Field No. 249A. Selected pieces treated with HCl and NaOH. A few rootlets were removed.

**2905 ± 100**
TF-42. Chalcolithic Culture

Charcoal (mixed with soil). Trench 2, depth 0.5 m below datum, Layer 2, Field No. 249. Selected pieces treated with HCl and NaOH. Some rootlets were present.

TF-25. Kalibangan, India, Harappa Culture

Charcoal mixed with charred bones from Kalibangan (29° 25' N Lat, 74° 05' E Long), Ganganagar, Rajasthan, Trench No. KLB-2, Square F, Locus F1-2.15 m x F2-8.20 m, depth 0.37 m below surface. Subm. by A. Ghosh. Selected pieces treated with HCl and NaOH. Comment: on the basis of its contacts with contemporary West Asian civilization, Harappa Culture is believed to date ca. 2500-1500 B.C. (Lal, 1962). Dating of the sample is considered important for establishing time of the existence of Harappa Culture in Rajasthan in relation to other parts of the Indian sub-continent, thereby determining the direction of the movement of the Harappa Culture.

TF-55. Lalitpur, India

Charred wood found in a sandy layer along with Palaeolithic tools from Lalitpur (24° 42' N Lat, 78° 25' E Long), Dist. Jhansi, U. P., Trench 1, depth 0.2 m below the surface, Layer 2, Field No. 1. Subm. by Dr. H. D. Sankalia. Selected pieces treated with HCl and NaOH. Comment: age is much below expectation and can be explained on the basis of the possibility of redeposition, as the layer from which the sample came is sealed only by a layer of humus.

TF-59. Navdatoli, India, Chalcolithic Culture

Charcoal (mixed with soil) from Navdatoli (22° 11' N Lat, 75° 36' E Long), Dist. Nimar, Locus NVT.Md.IV., Trench IA1, depth 2.75 m below surface, Stratum 9, Field No. 1. Subm. by Dr. H. D. Sankalia. Selected soft pieces treated with HCl. Traces of rootlets were present. Comment: on archaeological evidence the sample should date at least ca. 1000 B.C. (Sankalia et al., 1958). Sample was collected from a trench which was exposed for two years after excavations followed by waterlogging. As the sides of the trench had also partly collapsed, a possibility of contamination from the upper layers should be borne in mind.

Rajgir series, India

Samples from Rajgir (25° N Lat, 85° 25' E Long), India. Subm. by A. Ghosh. Comment: on the basis of occurrence of the Northern Black Polished Ware and punch marked coins, date is estimated to be ca. 600 B.C. (Lal, 1954-55).

TF-46. Rajgir, Early Historic Culture

Charcoal part of the burnt building material found in Pit 3 cut into Layer 5 filled with ashy materials of Layer 4 below the mud rampart, Locus VI-0 m
S × 1.02 m E, depth 8.7 m below surface. From a cutting across the southern defences near SW corner bastion. Selected pieces treated with HCl and NaOH.

**TF-45. Rajgir, Early Historic Culture**

Charcoal which was (coated with little mud) part of the burnt building material found in Layer No. 4 below the mud rampart, Locus VII-1X pegs, depth 7.05 m below surface from a cutting across the southern defences near SW corner bastion. Selected pieces treated with HCl and NaOH.

**TF-56. Wood from Zoser’s Tomb, Egypt**

Wood sample (Acacia) supplied by Prof. J. R. Arnold of School of Sci. and Eng., La Jolla, California. The sample is identical to C-1 dated by Anderson, Arnold and Libby (Libby, 1952). Sample cut into small pieces and treated with HCl and NaOH. Comment: sample is believed to be 4650 ± 75 yr B.P. according to Egyptian chronology. Other C14 dates are given in Table 1.

**II. GEOLOGIC SAMPLES**

**TF-58. Balahapura, Ceylon**

Wood found along with precious stones, Balahapura (7° 25’ N Lat, 80° 3’ E Long), Sabaramamuwa, from a depth of 5.8 m below surface in gem pit, Field No. F.L.7. Subm. by K. A. Chowdhury, Dept. of Botany, Aligarh Univ. Cut into small pieces and treated with HCl and NaOH. Comment: sample contains micro-fibrils which show some change in their angle.

**TF-57. Pelmadulla, Ceylon**

Wood found along with precious stones at Pelmadulla (7° 25’ N Lat, 80° 3’ E Long), Sabaramamuwa, from a depth of 17.1 m below surface in a gem pit, Field No. M.F.4. Subm. by K. A. Chowdhury. Cut into small pieces and treated with HCl and NaOH. The date is calculated by taking two standard deviations from the combined sample and background counting rates.

**References**

Date lists:
- Arizona III Damon and Long, 1962
- British Museum II Barker and Mackey, 1960
- Pennsylvania III Ralph, 1959


__________ 1960, Secular changes in the concentration of atmospheric radiocarbon: Preprint.
ARIZONA RADIOCARBON DATES IV*

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INTRODUCTION

C14 measurements reported here were made in this laboratory between December 1, 1961 and October 1, 1962. Sample descriptions are classified as follows:

I. Tree-ring dated samples.
II. Modern shells from Santa Barbara County, California.
III. Archaeologic samples.
IV. Palynologic samples.
V. Geologic samples.
VI. C14 content of caliche.
VII. Water samples.
VIII. Modern organic sample.

Except for the caliche samples and samples A-209, A-210 and A-296, Part V, all samples have been reported in the usual manner either as ages in years or as Δ values (Lamont VIII). Because of the slow and variable rate of accumulation of caliche, the use of % modern activity, where modern activity is taken as 95% of standard oxalic acid, is less misleading. Standard deviations are computed from random counting errors only.

All organic samples were treated with 2% NaOH, when possible to do so without dissolving the sample itself, and with HCl to remove carbonate. The surfaces of carbonate samples were leached with HCl to remove a thin outer portion before collecting the CO2 by hydrolysis with 50% H3PO4 or HNO3.

In order to evaluate the veracity of wood and charcoal dates, we have determined the C14 content of a number of wood samples of known age. The University of Arizona Laboratory of Tree Ring Research supplied us with dendrochronologically dated Pinus ponderosa and Sequoia gigantea (sample description, Part I). W. Y. Adams supplied us with acacia samples from the 12th dynasty reign of Pharaoh Sesostris (= Senusret) III (sample description, Part III and Arizona III). The Δ values for these samples are shown in Figure 1. The value for an additional acacia sample from Zoser’s tomb, Sakkarra, Egypt (A-219, Arizona III) is also plotted. The Δ values are computed relative to 95% standard oxalic acid as modern activity and the year A.D. 1950 as zero time. Because the δ C14 figures from which Δ is computed are age-corrected (Lamont VI), the known age becomes zero time and Δ measures a C14 anomaly. The standard error of Δ and the age uncertainty are given as vertical and horizontal lines. The half life of C14 is taken as 5570 yr but a reference line for T1/2 = 5730 is also given for comparison.

* University of Arizona Geochronology Contribution No. 60.
The youngest Sequoia sample (A-255:6) definitely shows the Suess effect. The *Pinus ponderosa* samples were specifically selected to check the de Vries maximum at A.D. 1690 (de Vries, 1959, p. 81). Our results definitely confirm the large positive $\Delta^{14}C$ fluctuation at that time. With the exception of the A.D. 1690 maximum and the wood sample affected by industrial carbon, all samples fall within $\Delta = \pm 1.5\%$ of the $T_{1/2} = 5730$ reference line from the 1st century B.C. to the present time. Samples beyond 2500 B.P. have steadily increasing $\Delta$ values.

The 12th dynasty acacia samples are of particular importance because the key astronomical date for fixing in time of the Egyptian Middle Kingdom occurs in the 7th year of the reign of Pharaoh Sesostris III (Hayes, *et al*., 1962, p. 1-2). These samples are also valuable because the acacia wood is probably not much older than the structure in which it was found. Many wood samples, e.g., large planks of cedar, are undoubtedly much older than the structure in which they are found and therefore must be rejected where precise dating is necessary. The dates for the reign of Pharaoh Zoser are much less certain, as indicated in the diagram by the horizontal uncertainty line.

The cause of the large apparent excess of $^{14}C$ beyond 2500 B.P. does not appear to be the result of an underestimation of the half life of $^{14}C$ as indicated by the fairly close agreement for younger samples. Two remaining possible causes are (1) variation in the $^{14}C$ production rate and (2) fluctuation of the total CO$_2$ content of the atmospheric reservoir. Although the first possibility cannot be eliminated at this time, it would seem to the authors that fluctuation of the total content of the atmospheric reservoir is not only possible but quite probable. Much more work is necessary before this phenomenon can be proper-
ly evaluated. However, such large fluctuations of the initial C\textsuperscript{14} content of wood call for caution in the evaluation of C\textsuperscript{14} dates as absolute sidereal years. In particular, the fixing by C\textsuperscript{14} dating, of floating archaeologic chronologies such as the Babylonian chronology (Libby, 1955, p. 81-82), cannot be successfully accomplished without reference to the C\textsuperscript{14} content of samples of known age. Knowledge of the C\textsuperscript{14} content of contemporaneous samples of known age has been used by Satterthwaite and Ralph (1960) to correlate the Mayan calendar with the Christian. Their work illustrates the correct approach to the solution of such correlation problems. As more data on the C\textsuperscript{14} content of samples of known age become available, determination of absolute C\textsuperscript{14} ages will become increasingly accurate.

ACKNOWLEDGMENTS

The authors are indebted to W. G. McGinnies and M. V. Stokes of The University of Arizona Laboratory of Tree Ring Research for supplying dendrochronologically dated wood specimens. W. Y. Adams, UNESCO Programme Specialist, Khartoum, Sudan, supplied archaeologically dated samples of acacia from the reign of Sesostris III.

The C\textsuperscript{13} data reported in this date list were all provided through the kind cooperation of W. R. Eckelmann of Jersey Production Research Corporation.

We are particularly appreciative of the cooperation provided by J. C. Vogel of the Physikalisches Institut, University of Heidelberg, in the setting up of equipment for the dating of water samples and to J. G. Ferris of the U. S. Geological Survey for advice and guidance in the selection of samples.

W. M. Harrison provided the modern shells used as controls on C\textsuperscript{14} shell dates. Catheryn MacDonald assisted in laboratory analyses.

SAMPLE DESCRIPTIONS

I. TREE-RING DATED SAMPLES

**Ponderosa pine FL-9 series, Arizona**


<table>
<thead>
<tr>
<th>Sample</th>
<th>Tree rings</th>
<th>(\delta C^{14},%)</th>
<th>(\delta C^{13},%)</th>
<th>(\Delta%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-354:1</td>
<td>13 ± 5</td>
<td>-22.4</td>
<td>8 ± 5</td>
<td></td>
</tr>
<tr>
<td>A-354:2</td>
<td>27 ± 5</td>
<td>-22.4</td>
<td>22 ± 5</td>
<td></td>
</tr>
<tr>
<td>A-354:3</td>
<td>8 ± 4</td>
<td>-21.7</td>
<td>2 ± 4</td>
<td></td>
</tr>
</tbody>
</table>

**Sequoia No. 3 series, California**

subm. by M. A. Stokes. Comment: tree began growth ca. 215 B.C. and was cut in A.D. 1950.

A-255:1. Tree rings
124 B.C. to 60 B.C. age span.
$^{13}C$ value is average of four analyses for Sequoia No. 3 wood.

A-255:7. Tree rings
6 B.C. to A.D. 4 age span.

A-255:2. Tree rings
A.D. 310 to A.D. 330 age span.

A-255:3. Tree rings
A.D. 643 to A.D. 660 age span.

A-255:4. Tree rings
A.D. 1235 to A.D. 1270 age span.

A-255:5. Tree rings
A.D. 1725 to A.D. 1770 age span.

A-255:6. Tree rings
A.D. 1910 to A.D. 1949 age span.

Sequoia D-21 series, California


A-326. Tree rings
641 B.C. to 566 B.C. age span.

A-327. Tree rings
1211 B.C. to 1195 B.C. age span.

II. Modern Shells from Santa Barbara County, California

These samples were run as controls for similar shells from four distinct sites in Santa Barbara Co. (sample descriptions, Part III) ranging in age from over 6000 yr to the Colonial period. All dates are reported as usual relative to 95% oxalic acid taken as modern activity and without $^{13}C$ correction; only the standard deviation due to counting statistics has been used. Comment: shells appear to be 150 ± 50 yr older than modern charcoal corrected for the Suess effect and bomb effect. As ages of carbonates, so computed, should be zero or negative, the apparent age may be due to upwelling of “old” water off the
Santa Barbara coast or it may be a pre-bomb Suess effect. The different ages may be due entirely to statistical error and different amounts of C$^{13}$/C$^{12}$ fractionation. However, a variable contribution of bomb C$^{14}$ is also possible.


$$210 \pm 50$$

A.D. 1740

*Haliotis rufescens* collected off Santa Rosa Island (33° 55' N Lat, 120° 5' W Long), near Santa Barbara, water depth ca. 20 ft. Coll. 1961 by D. Wilson, Santa Barbara, Calif.; subm. by W. M. Harrison, Univ. of Arizona.

A-357. Pink Abalone, RC-1

$$170 \pm 50$$

A.D. 1780

*Haliotis corrugata* collected off San Miguel Island (34° 5' N Lat, 120° 20' W Long), near Santa Barbara, water depth ca. 20 ft. Coll. 1961 by D. Wilson; subm. by W. M. Harrison.

A-358. Mussel shell, RC-3

$$80 \pm 50$$

A.D. 1870

*Mytilus californianus* collected at Dos Pueblos Ranch near Santa Barbara (34° 30' N Lat, 120° 0' W Long). Coll. 1961 by W. M. and E. S. Harrison; subm. by W. M. Harrison.

### III. Archaeologic Samples

A-204. Tucson, Arizona

$$850 \pm 180$$

A.D. 1100

Organic material mixed with ash from isolated hearth, SE 1/4 of residential lot, 6730 N Casas Adobes Drive (32° 14' N Lat, 110° 53' W Long). Coll. 1959 and subm. 1960 by J. D. Hayden, Dept. of Anthropol., Univ. of Arizona. No artifacts were associated with hearth but both oxidized and unoxidized artifacts and cairns containing basal stones with heavy ground patina are found along trails in this area. *Comment*: although the oxidized artifacts in the area are of San Dieguito I pattern, the hearth is evidently much younger, i.e. of ceramic age. Carbonates were removed by leaching in dilute HCl. Sample was free of rootlets.

**Semna series, Sudan**

Wood from mud brick fortress of Semna on bank of the Nile, ca. 60 mi S of the Egyptian frontier (21° 30' N Lat, 30° 58' E Long). Coll. 1960 and subm. by W. Y. Adams, UNESCO Programme Specialist, P. O. Box 178, Khartoum, Sudan.

A-205. Semna I

$$3290 \pm 120$$

1340 B.C.

From timber near base of S wall.

A-206. Semna II

$$3300 \pm 120$$

1350 B.C.

From timber 10 yd from Semna I timber. *Comment*: hieroglyphic texts associate the building of the fortress with the Pharaoh Sesostris (= Senusret) III. His reign has been determined by the astronomical chronology as beginning at 1887 B.C. and ending 1849 B.C.
Although additions were made as late as 1500 B.C., Adams believes it certain that the girdle walls are among the original features of the site. This discrepancy is of the same magnitude and direction as observed for other Egyptian sites (e.g., see A-207 and A-219, Arizona III). Because of their importance, we made three separate burnings of A-205 and two separate burnings of A-206, and the results are averaged.

**Gua Sirih Cave series, Borneo**


**A-280. Charcoal, 30 to 36 cm depth**  
<1600

Excavation coordinates (5 ft grid) S half M10, *Comment*: only 0.1 L of CO₂ was obtained from this minute charcoal sample. According to Solheim, stone tools from approximately this level are typologically Mesolithic and similar to Mesolithic tools from Niah Cave. It appears charcoal was not related to the tools.

**A-281. Charcoal, 5 to 10 cm depth**  
620 ± 260  
A.D. 1330

Excavation coordinates, M10.

**A-282. Hearth sample**  
714 ± 330  
A.D. 1236

Excavation coordinates, D8, from small hearth directly on “sterile” soil at base of deposit. *Comment*: expected age, according to Solheim, is close to 2000 B.P. dating the earliest occupation of the cave by pottery-making people related to the pottery makers from Niah Cave (Solheim, 1961).

**A-283. Hearth sample, 30 to 36 cm depth**  
4480 ± 100  
2530 B.C.

Excavation coordinates, C9, from hearth in S wall of trench. *Comment*: expected age, according to Solheim, is between 500 and 2000 B.P. Artifacts indicate relation with Late Neolithic-Early Iron Age level in Niah Cave.

**A-284. Natural Cave, Arizona**  
603 ± 60  
A.D. 1347

Panic grass seeds found with squash seeds and red and white tepary beans contained in a twined-woven bag, under 5 ft of bat guano on floor of Natural Cave in Trigo Mtns. of W Yuma Co. (33° 15' N Lat, 114° 35' W Long), 8 mi E of Colorado River. Coll. 1961 by H. and D. Yowell; subm. by E. W. Haury, Arizona State Mus., Univ. of Arizona. *Comment*: only panic grass seed used for assay.

**Buhen Old Kingdom series, Sudan**

Charcoal from copper smelting site at Buhen in Nubia near Wadi Halfa, Sudan (21° 51' N Lat, 31° 17' E Long). Coll. 1962 by W. B. Emery; subm. by W. Y. Adams. Site was discovered December 1961 and is currently under excavation by the Egypt Exploration Soc. under direction of Prof. W. B. Emery of London Univ. College. According to Adams, it represents the first
substantial evidence of Egyptian Old Kingdom occupation in Nubia. It is dated both by an abundance of Old Kingdom pottery and by inscribed jar seals and ostraka. The names of King Khafre and Menkaure of the 4th dynasty and Userkaf, Sahure and Nuserre of the 5th dynasty have been recognized. The site comprises a complex of domestic and workshop buildings extending along the bank of the Nile for at least 0.25 mi and enclosed by a crude stone fortification wall. The site has been repeatedly inundated by the Nile. Evidence for copper smelting consists of cylindrical furnaces, copper ore and slag, and pottery moulds and crucibles scattered throughout the site.

A-330. Charcoal  
3960 ± 60  
2010 B.C.

A-331. Charcoal  
3960 ± 60  
2010 B.C.

A-332. Charcoal  
3820 ± 50  
1870 B.C.

These three samples are from loose sand within 20 cm of surface and above habitation floors which can definitely be ascribed to 4th or 5th dynasties. Comment: according to Hayes, et al. (1962), the 4th and 5th dynasties extend from ca. 2610 B.C. to 2340 B.C. (4560 B.P. to 4290 B.P.)

A-333. Charcoal  
4190 ± 60  
2240 B.C.

A-334. Charcoal  
4090 ± 50  
2140 B.C.

Both samples are from 1.5 m below the intact habitation floors of the 4th or 5th dynasties above and in a deposit of sand and refuse which may date from the 2nd dynasty (based on the size of broken bricks found in the same deposit). Comment: according to Hayes, the 2nd dynasty terminates ca. 2690 B.C. (4640 B.P.). Thus the C¹⁴ date is definitely younger than expectation, based upon the archaeologic provenience (see comment, Semna series).

Dos Pueblos Ranch Colonial series, California

Charcoal and shells from the Dos Pueblo Ranch site, 4SBA78 Area 1 Section A, occupied during Colonial time, ca. A.D. 1542 to A.D. 1800, Santa Barbara Co. (34° 30' N Lat, 120° 0' W Long). Five-foot grid pattern used throughout. Coll. 1958 and subm. by W. M. Harrison. Samples were run as a control for C¹⁴ age determination on neighboring sites. See Part II (sample descriptions) for modern shells from off Santa Barbara coast. Note that charcoal sample (A-298) and the two abalone shells (A-300, A-301) do not show the 150-yr difference which would be expected from the activity of modern shells.

A-297. Charcoal, RC-4  
0 ± 55  
A.D. 1950

Burnt log resting on floor of structure (N14 W16). Comment: modern "date" of this sample is not irreconcilable with known age of the site in light of work done by de Vries (1959, p. 81) and this laboratory. De Vries has
demonstrated, from measurements of charred wheat and trees from the Bavarian and Spesart forests, the existence of an atmospheric C\(^{14}\) maximum of ca. 4\% to 5\% above modern at A.D. 1690. To check this, we measured A.D. 1690 pine tree rings (A-354:2, Part I) from Flagstaff and got 60 ± 50 B.P.

**A-298. Charcoal, RC-5**

A.D. 1700

Burnt log with one end lying on floor of feature and other end projecting a few inches above floor (N14 W17). *Comment*: this specimen, not showing the anomalously young age of A-297, probably more closely represents the true age of the feature. The portion analyzed, however, may have come from the center of a log while A-297 may have come from the younger, outer circumference or from a smaller log. There is no way to determine for sure whether the differences measured in these samples are initial atmospheric, tree ring, or real age differences.

**A-300. Abalone shell, RC-7**

A.D. 1770

_Haliotis (?)_ from within 2 in. above floor of Feature 1 (N12 W15).

**A-301. Abalone shell, RC-8**

A.D. 1700

_Haliotis cracherodi_ from ca. 1 in. above floor of Feature 1 (N15 W18).

**Rincon Point series, California**

Shells and charcoal from Rincon Point, 4 SBa 119, Santa Barbara Co. (34° 25' N Lat, 119° 30' W Long). Quadrant system used in 9' x 10' pit. Subm. by W. M. Harrison.

**A-323. Red Abalone, RC-13**

1320 B.C.

_Haliotis rufescens_ from 38 in. below surface, associated at pelvis of skeleton and within rock cairn outlining grave at Burial 4, SW quadrant. Coll. 1959 by Patricia Lyon.

**A-324. Black Abalone, RC-14**

1470 B.C.

_Haliotis cracherodi_ from Association No. 2 of Burial 8 occurring under the fragmented end of the right ulna, NE quadrant. Coll. 1960 by Patricia Lyon.

**A-325. Charcoal, RC-15**

27,050 B.C.

From 36 to 42 in. level, in soil from the grave matrix of Burial 2, i.e., entirely outside of the disturbed grave soil, NE quadrant, Coll. 1959 by W. M. Harrison. *Comment*: in light of the other dates of this site (especially A-340) and the archaeological context, this charcoal must have been redeposited from an old burned forest.

**A-340. Clam Shell, RC-16**

1580 B.C.

_Tivela stultorum_ from 42 to 48 in. level, below and outside of the grave of Burial 2, NE quadrant. Coll. 1959 by W. M. Harrison.
Aerophysics series, California

Shells from 4 SBa 53, Santa Barbara Co. (34° 30' N Lat, 119° 50' W Long). Five-foot grid pattern employed. Coll. 1956-57 and subm. by W. M. Harrison. Comment: contrary to tentative archaeologic sequence as derived by Harrison based on burial position of human skeleton, the Aerophysics cemetery appears to be older than Rincon Point cemetery. These sites are midden matrix and cultural material is not abundant in them.

A-302. Clam, RC-11

\[4890 \pm 80\] 2940 B.C.

*Tivela stultorum* from an extensive layer of this species between 15 and 18 in. level below the modern surface (N1 E8, Area B).

A-303. Abalone, RC-12

\[4620 \pm 80\] 2670 B.C.

*Haliotis rufescens* from 12 to 18 in. below the modern surface (N1 W18, Area A).

A-363. Abalone, RC-26

\[4980 \pm 60\] 3030 B.C.

*Haliotis rufescens* from 24 to 30 in. below present surface (N13 E26, Area A).

Dos Pueblos Ranch, older series, California

Shells from 4SBa 78, Santa Barbara Co. (34° 30' N Lat, 120° 0' W Long). Coll. 1959 and subm. by W. M. Harrison. Comment: based largely on burial positions and very sparse or lack of cultural associations, the expected time range was 7000 B.C. (Stratum C) to A.D. 1800 (Stratum A). Estimates were tentative, as ultimate chronology is to rest on C¹⁴ results. From the above dates, Stratum A is not contemporary to the Colonial site at Dos Pueblos, and the oldest date thus far is less than 5000 B.C.

A-349. Abalone, RC-10

\[4110 \pm 80\] 2160 B.C.

*Haliotis rufescens* from Stratum A of the cemetery, resting against skull of Burial 9 (N144 E60, Area 3). Comment: considering the dates listed below from Stratum B beneath this specimen, this shell probably was a relic or souvenir buried with the body rather than remains of a meal. Bones from Burial 9 will be dated when available.

A-377. Clam, RC-27

\[3700 \pm 80\] 1750 B.C.

*Tivela stultorum* from 18 to 24 in., lowest level in Stratum A (N145 E60, Area 3).

A-345. Clam, RC-19

\[3860 \pm 80\] 1910 B.C.

*Tivela stultorum* from 18 to 24 in. below present surface (top 6 in. of Stratum B), (N145 E59 and N146 E59, Area 3, Section A).

A-346. Clam, RC-20

\[4530 \pm 180\] 2580 B.C.

*Tivela stultorum* from 24 to 30 in. below present surface, 6 to 12 in. below top of Stratum B (N145 E59 and N145 E60, Area 3, Section A).
A-376. Clam, RC-28

*Tivela stultorum* from 24 to 30 in. below present surface, 6 to 12 in. below top of Stratum B, burial matrix of Burial 19 (N146 E60 and N146 E59, Area 3, Section A). *Comment*: this shell may have been redeposited by grave diggers from deeper in this nearly homogeneous midden.

A-347. Clam, RC-22

*Tivela stultorum* from 30 to 36 in. below modern surface in Stratum C (N146 E59 and N146 E60, Area 3, Section A).

A-348. Clam, RC-23

*Tivela stultorum* from 30 to 36 in. below modern surface in Stratum C (N146 E59 and N146 E60, Area 3, Section A).

A-362. Mussel, RC-25

*Mytilus californianus* from 30 to 36 in. below present surface in Stratum C (N145 E59 and N145 E60, Area 3, Section A).

A-356. Clam, RC-18

*Tivela stultorum* from 22 in. below present surface near pelvis of Burial 2 (W edge of Pit N2 W25, Area 1, Test Pit 3) tentatively correlated as 6 in. below top of Stratum B.

IV. PALYNOLOGIC SAMPLES

Murray Springs series, Arizona


A-186. Earth

Sample from 210 cm below surface containing some disseminated charcoal. Dominant pollen type: Chenopods (Martin, et al., 1961). *Comment*: date must be considered minimal because of possible post-depositional contamination.

A-187.

Earth sample from 270 cm below surface with low organic content. *Comment*: sample was leached with HCl to remove high carbonate content and many rootlets were removed. Dominant pollen type: Compositae (Martin, idem). Martin, *et al.*, correlated this sample with their Pollen Zone V (see Double Adobe series below). The date does not confirm this interpretation. If samples A-186 and A-187 were not affected by post-depositional contamination,
they represent Altithermal deposition. Sedge, cattail, and tree pollen are slightly more abundant between 200 and 300 cm than higher in the section.

**Double Adobe series, Arizona**


A-190. **Carbonaceous earth**

7910 ± 200
5960 B.C.

Sample from Martin’s Pollen Zone V, dominated by Compositae, (Martin, *idem*). Coll. 1959 and subm. by P. S. Martin.

A-191. **Carbonaceous earth**

8000 ± 60
6050 B.C.

Sample from 100 cm below bench surface in sediment of Sulphur Spring age, representing the base of Martin’s Pollen Zone VI, dominated by Compositae. Coll. 1959 and subm. by P. S. Martin.

A-189. **Charcoal**

8960 ± 100
7010 B.C.

Soil with disseminated charcoal

A-194. **Whitewater Draw, Arizona**

2860 ± 440
910 B.C.

Organic material in earth from pithouse of San Pedro stage on E bank of Whitewater Draw, 2.8 mi NW of McNeal generating plant, T22S R26E Sec. 8, (31° 32' N Lat, 109° 43' W Long), Cochise Co. Sample taken 135 to 145 cm below bottom of pithouse. Dominant pollen type: Cheno-ams. Coll. 1959 by D. Shutler; subm. by P. S. Martin. *Comment*: the probability of post-depositional contamination of this type of sample is greater than for a date on charcoal. A charcoal sample from floor of the pithouse, A-193, was dated at 3860 ± 200 (Arizona III).

**Matty Canyon series, Arizona**

Matty Canyon-Cienega Creek area, T19S R17E Sec. 17, Pima Co. (31° 51' N Lat, 110° 35' W Long). Other dates from the Matty Canyon are: for upper stratum, A-88 bis, 2010 ± 150; Sh-5664-7, 1850 ± 70; and for lower stratum, A-92, 2220 ± 150; Sh-5665-10, 2470 ± 100 (Arizona III).
A-196. Cienega material  

2190 ± 100  
240 BC.


A-227A. Carbonaceous earth  

2140 ± 60  
190 BC.

A-227B. NaOH-soluble fraction  

1790 ± 400  
A.D. 160

Sample taken 375 ft upstream from Section MC6 (Eddy and Cooley, idem), E bank, 630-650 cm below surface. Dominant pollen type: Compositae. Coll. 1958 and subm. by P. S. Martin. Comment: A-227A was treated in the usual manner. A-227B is the NaOH soluble fraction leached from A-227A. The soluble fraction appears to be younger but the two numbers are within standard deviation.

A-256. Laguna Salada  

7300 ± 110  
5350 BC.

Dark colored, clay-silt sample from alluvial fill exposed near Floy in a large arroyo leading into the NW end of Laguna Salada near Rte. 665 between Show Low and Concho, Apache Co. (34° 21' N Lat, 110° 17' W Long). Sample collected ca. 1 m below soil surface and ca. 15 cm above a distinct gray sand and gravel lens, ca. 15 m upstream from the old bridge abutments. Coll. 1961 by R. H. Hevly and M. E. Cooley; subm. by P. S. Martin, Chicago Nat. History Mus., Chicago, and R. H. Hevly, Geochronology Labs., Univ. of Arizona. Comment: this sample contained many fine fibrous rootlets which were meticulously removed by hand picking. The sample was leached in HCl to remove carbonate but was not leached with NaOH. Contribution of younger carbon is probably quite low but some contamination may be present. It post-dates a maximum in pine-spruce pollen and coincides with a maximum in Compositae pollen.

A-268. Chuska Mountains, New Mexico  

24,700 ± 3900  
22,750 BC.

Core segment from Deadman Lake (36° 15' N Lat, 108° 55' W Long), Chuska Mtns. San Juan Co., N. Mex., 312-318 cm depth, in core No. 5826, just above sharp peak in the pine-pollen curve and a corresponding depression in the curve for Artemisia pollen (Bent, 1960). Coll. 1958 and subm. by H. E. Wright, Dept. of Geol., Univ. of Minn., Minneapolis 14, Minn. Comment: another date from same core: 7.25-735 m level, >28,000 (A-213, Arizona III); nearby core: 9 to 12 cm level, 3900 ± 300 (L-515A, Lamont VII).

A-306. Chuska Mountains, New Mexico  

1270 ± 610  
A.D. 680

Organic material from core taken 17 to 19 cm below surface at Whisky Lake (35° 59' N Lat, 108° 48' W Long), San Juan Co., N. Mex. Sample dates the end of the alpine or subalpine vegetation phase (Artemisia-spruce zone) and beginning of the pine-pollen zone in the core. Coll. 1958 and subm. by
H. E. Wright. Comment: sample from pine zone, 25 cm above Artemisia-spruce zone at Deadman Lake was dated at 3900 ± 300 (L-515A, Lamont VII). Contamination in A-306 is quite possible considering that it is from near the top of the pond sediments. Large error is the result of a low CO₂ yield from the core.

V. GEOLOGIC SAMPLES

Elegante Crater series, Sonora, Mexico

Travertine samples from delta deposits in Elegante Crater, Pinacate Mountains, Sonora, Mexico (31° 48' N Lat, 113° 31' W Long). Coll. 1958 and subm. by P. E. Damon. Comment: according to Jahns (1959), the delta was built along the margin of a lake that occupied the crater soon after its collapse. Lake appears to have been at least 200 ft deep during most of its history followed by episodic recession, as suggested by remnants of well-defined topset benches at lower levels. Jahns believes the presence of this lake indicates the existence of the crater during the last pluvial period. Data bear out this expectation.

A-208. Delta on W side of crater 12,970 ± 560
11,020 B.C.

A-261. Delta on E side of crater 17,200 ± 220
15,250 B.C.

San Augustin Plains series, New Mexico

Organic-rich clay from San Augustin Plains, N. Mex. (33° 45' N Lat, 107° 30' W Long). Samples were collected 0.5 mi apart, each from 4 in. below surface near center of dry lake. Coll. 1960 by A. Long and C. Halva; subm. by Long.

A-209. San Augustin, modern 107.8 ± 3.0% modern

A-210. San Augustin, modern 109.5 ± 3.8% modern

Comment: post-modern count indicates sedimentation in the dry lake area has occurred since the atomic bomb tests.

A-296. San Jon, New Mexico 1.4 ± 0.6% modern

Carbonate nodules in laminated red clay from San Jon "formation," San Jon site (35° 01' N Lat, 103° 22' W Long), Quay Co., New Mexico. Sample is believed to be precipitated from a pond and thus to be contemporaneous with laminated red clay zone. Coll. 1961 and subm. by J. Harbour, Mus. of New Mexico. Comment: the activity of modern carbonate can be considered the same (within 5%) as contemporary wood, but limestone, which may contribute half the carbon atoms in a bicarbonate solution, has zero activity. If one assumes the initial activity of the carbonate was 50% that of contemporary wood, the date would be 28,700 ± 1900. The initial value for carbonate precipitated from ground water solution should lie between 50% and 100%, so the true date may be even older. Evidently the laminated red clay of Zone 3 of the San Jon "formation" is older than the blue-gray pond clay which contains human artifacts (Judson, 1953).
A-221. Willecox Playa, Arizona  

Organic material from core in center of Willecox Playa (32° 9' N Lat, 109° 51' W Long), Cochise Co. Sample from 140-ft core drilled for Geochronology Labs. Pleistocene pollen study, at depth of 5 ft below surface in green clays just below the oxidized zone. Coll. 1960 by B. C. Arms, Geochronology Labs., Univ. of Arizona; subm. by A. Long. Comment: the very low organic content of the sample necessitated dilution even for the 0.5 L counter; the age, a minimum, is at least not out of line with A-352 (this date list).

Willecox Playa carbonate series, Arizona

Carbonate fractions from core in Willecox Playa (32° 9' N Lat, 109° 51' W Long), Cochise Co. Levels are depths from top of 140-ft core drilled for Pleistocene pollen study. A-351 contained no pollen; A-352 and A-353 contained over 95% pine pollen. Coll. 1960 by B. C. Arms; subm. by P. S. Martin.

A-351. Willecox Playa, 19-27 in.  
8615 ± 110  
6665 b.c.

A-352. Willecox Playa, 6 ft 3 in. to 7 ft  
23,000 ± 500  
21,050 b.c.

A-353. Willecox Playa, 7 ft 8 in. to 8 ft 5 in.  
22,000 ± 500  
20,050 b.c.

Comment: there was no discrete carbonate layer or even visible crystals, but the X-ray diffraction pattern of the clay showed calcite lines. Since sample A-351 is above the water table, this date must include modern contamination and should be considered minimal. A-352 and A-353 may represent the age of the sediments, but because of ground water movement in the area and the extremely small size of the carbonate crystals, mixing is possible. Interpretation of these numbers awaits assay of carbonate from ground water in this basin.

A-359. Dahlac Archipelago

Carbonate sample from fossil reef ca. 6 m above sealevel, Dahlac Archipelago, E of Massaua, Ethiopia in S Red Sea (15° 53' N Lat, 39° 55' E Long). Coll. 1962 and subm. by Yaacov Nir, State of Israel Geol. Survey, Jerusalem. Comment: Dahlac Archipelago is situated at the western border of the Syrian-African rift system and at the northern edge of the Dankaiian Horst. According to Nir, this sample dates the time of the last uplift of the Archipelago and confirms the very recent age of the Dahlac. Sample was washed in dilute HCl before hydrolysis to remove possible recent contamination.

VI. C¹⁴ CONTENT OF CALICHE

Several samples of caliche were collected, mostly from Arizona, in order to compare C¹⁴ contents of caliche of different types and depths, and from different climatic environments. This was in connection with a study of the origin of caliche. Generally, they were found to be more radioactive nearer the surface of the ground, indicating formation by means of evaporation of meteoric water infiltrating through the unsaturated zone rather than evaporation of
vadose water from the ground-water table. Also, the caliche found in presently more humid climates tended to contain more C¹⁴, indicating a more rapid rate of formation in the grasslands than in the deserts. The results are reported as percent modern, i.e., 95% NBS oxalic acid. Standard deviation includes counting statistics only.

A. Caliche from Santa Cruz Valley, Arizona

**Oracle Junction series**

Caliche layer below soil zone, 1.5 ft thick, from recently excavated pit ca. 5 mi E of Oracle Junction (32° 35' N Lat, 110° 55' W Long), Pima Co., Arizona. Coll. 1961 and subm. by J. J. Sigalove.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
<th>Modernity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-224.</td>
<td>Top of caliche zone</td>
<td>31.4 ± 0.8% modern</td>
</tr>
<tr>
<td>A-222.</td>
<td>9 in. below top</td>
<td>10.4 ± 0.6% modern</td>
</tr>
<tr>
<td>A-223.</td>
<td>19.5 ft below top</td>
<td>&lt;3.1% (2σ criterion)</td>
</tr>
</tbody>
</table>

**Arivaca Junction series**

Caliche, beginning 4 ft below surface, from recently excavated pit 40 mi S of Tucson near Arivaca Junction (31° 45' N Lat, 111° 5' W Long), Santa Cruz Co., Arizona. Coll. 1961 and subm. by J. J. Sigalove.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
<th>Modernity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-240.</td>
<td>Top, 4 ft below surface</td>
<td>4.0 ± 1.4% modern</td>
</tr>
<tr>
<td>A-239.</td>
<td>10 ft below surface</td>
<td>3.0 ± 0.5% modern</td>
</tr>
</tbody>
</table>

**A-251. Sahuarita, Arizona**

“Brick-yard” locality (31° 55' N Lat, 110° 58' W Long), Pima Co., Arizona. Sample from calichified layer in which remains of *Equus, Mammutthus* and *Bison* were found ca. 10 ft below ground surface. Caliche was encrusting bones which are of Late Pleistocene age (J. F. Lance, oral communication). Coll. 1957 by J. F. Lance, Univ. of Arizona; subm. by J. J. Sigalove.

**A-212. Tucson, Arizona**

Surface of wash bank, 50 yd E of First Ave, and ca. 1.5 mi N of River Road (32° 15' N Lat, 110° 50' W Long). Caliche covering cobbles and boulders of Catalina gneiss as well as making up part of the unconsolidated sediment in which cobbles and boulders were found. Coll. 1960 and subm. by J. J. Sigalove.

B. Caliche from Tucson Mountains, Arizona

These rocks are basic volcanics for the most part. The caliche, instead of forming in soil zones, forms in crevices and bottoms of drainage ditches. Locality is in Pima Co., Arizona (32° 15' N Lat, 111° 10' W Long).

**A-218. Little “A” Mountain**

A-321. Tumamoc Hill 20.0 ± 0.4% modern
   Caliche 6 in. deep, from shallow drainage ditch along road to radio tower. Coll. 1962 and subm. by P. E. Damon.

A-308. Brown Mountain 2.8 ± 0.5% modern
   Caliche from arroyo at southern base of mountain. Coll. 1962 and subm. by P. E. Damon. Comment: sample from outer surface of thick caliche veneer observed on banks and extending into bottom of arroyo. The C14 content is consistent with formation during last pluvial episode.

C. Caliche from Other Parts of Southern Arizona and New Mexico

Vaughn series, New Mexico
   A-249. Land surface 20.9 ± 1.2% modern
   A-248. Base of cut, 11 ft depth <3.2% (2 σ criterion)

Oracle series, Arizona
   A-265. Oracle, surface 19.4 ± 1.0% modern
   A-266. Oracle, surface 20.2 ± 0.6% modern
   25 ft downslope from A-265, receiving more drainage.

Safford series, Arizona
   Samples from road cut on Rte. 666 3 mi N of Rte. 86, S of Safford (32° 28’ N Lat, 109° 40’ W Long), Graham Co. Coll. 1961 and subm. by J. J. Sigalove.
   A-262. 2 ft below surface 2.0 ± .8% modern
   A-263. 5 ft below surface <1.4% (2 σ criterion)

D. Caliche from San Francisco Volcanic Fields, Flagstaff, Arizona
   Samples were collected from the exposed surface of flows of different volcanic stages, as described by Colton (1950), from oldest (Stage 1) to the youngest (Stage V) to compare the occurrence and C14 content. As expected, caliche was thickest on the oldest flows and contained the most C14 on the youngest flows. Coll. 1961 and subm. by P. E. Damon and J. J. Sigalove.

Merriam Flow series (Stage IV)
   Collected on road to Grand Falls, alt 55 ft, ca. 2 mi from Merriam Crater
Arizona Radiocarbon Dates IV

(35° 20' N Lat, 111° 15' W Long), Coconino Co. This flow is considered post-Pleistocene by Colton (1950).

A-259. Merriam, 9 in. below land surface, not directly beneath A-260 73.5 ± 1.1% modern

A-250. Merriam, surface. Surface coating on boulders lying on land surface 71.5 ± 1.1% modern

Comment: on this and other quite young material of this type, an estimate of the duration of accumulation of the CaCO₃ (caliche) deposit and hence the age of the surface or flow may be calculated from the equation:

\[ A_{T_{oT}} = \frac{1}{\lambda t} \left( 1 - e^{-\lambda t} \right) \]

and by making the assumption of a uniform rate of accumulation. \( A_{T_{oT}} \) is the total activity in the accumulated layer, equal to the ratio, sample/modern (% modern ÷ 100); \( \lambda \) is the decay constant and \( t \) is the duration of the accumulation up to the present; or, in this case, the age of the Merriam Flow. Using \( A_{T_{oT}} = .72 \), the “age” comes out 5600 yr, a plausible number. This calculation has not been used on the older caliches because the rate of accumulation is almost certainly not constant.

Cedar Ranch Road series (Stage III)

Samples from a road cut in Cedar Ranch Road in a Stage III flow (35° 30’ N Lat, 111° 40’ W Long), Coconino Co.

A-272. Top of caliche, 5 in. depth 36.3 ± 0.8% modern

A-273. Bottom of caliche, 20 in. depth 12.1 ± 0.8% modern

A-271. Stage II Flow 23.2 ± 1.0% modern

Caliche from flow on top of Black Point flow along Rte. 89 (35° 40’ N Lat, 111° 30’ W Long), Coconino Co. Sample from 6 to 10 in. below surface, at top of the calichified zone, in which the caliche was coating and cementing the cinders.

Black Point Flow series (Stage I)

From road cut in Rte. 89 N of Flagstaff (35° 41’ N Lat, 111° 30’ W Long).

A-270. Black Point, top 2 ft below surface, top of calichified zone 14.0 ± .8% modern

A-285. Black Point, boulder Caliche plate covering bottom of boulder; whole layer, ¾ in. thick 12.4 ± 1.0% modern

A-286. Black Point boulder, outer ¼ in. of A-285 14.5 ± 1.0% modern

A-287. Black Point boulder, inner ¼ in. of A-285 0.8 ± 0.5% modern
Leupp Road series

Samples from road cut (35° 21' N Lat, 111° 12' W Long), Coconino Co. Exposed section consisted of two caliche zones, apparently of different ages. The lower zone, 18 in. thick, is in an old soil profile in a Stage I flow buried by cinders. The upper caliche zone is 2 in. thick in the cinder layer 2 ft below the land surface, 3.5 ft separate the two caliche zones.

A-277. Upper caliche zone  42.5 ± 1.0% modern
A-278. Top of lower caliche  12.9 ± 1.0% modern
A-279. Bottom of lower caliche  9.6 ± 1.0% modern

VII. WATER SAMPLES

An apparatus has been built for the extraction of CO₂ from water, patterned after the one at the Physikalisches Institut, Univ. of Heidelberg (Vogel, written communication). Studies are now under way to measure residence times in ground-water reservoirs, travel rates in aquifers, and contamination of water by bomb-produced C¹⁴. A rigorous interpretation of the ages will be withheld until the study is more advanced. Standard deviations reported include only counting uncertainty.

A-264. Tucson, Arizona  58.9 ± 1.4% modern

A-292. Tucson, Arizona  60.4 ± 1.5% modern

A-317. Pinaleno Mountains, Arizona  92.4 ± 1.4% modern
   Water from Columbine Spring, alt 7500 ft, Mt. Graham (maximum alt, ca. 10,700 ft), Graham Co. (32° 35' N Lat, 109° 51' W Long). Water is from a perennial spring believed to be transported down the mountain through a series of fractures. Coll. 1961 and subm. by J. J. Sigalove.

A-320. Safford, Arizona  31.9 ± 2.4% modern
   Sample of warm water from a 1200-ft well S of Safford (32° 51' N Lat, 109° 42' W Long), Graham Co. Coll. 1961 and subm. by J. J. Sigalove.

Window Rock series, Arizona

Water samples were collected from a spring below the recharge area and from three wells in a ground-water system amenable to treatment by a mathematical model, from Window Rock (35° 45' N Lat, 109° 5' W Long), Apache Co. Coll. 1962 by J. J. Sigalove and H. H. Schumann; subm. by Sigalove. The recharge area, spring and wells are in the De Chelly and Coconino sandstones, Paleozoic aquifers, sandwiched by shales (Chinle above, Supai below).

A-344. Spring  84.7 ± 2.1% modern
   Located ca. 2 mi from the main recharge area at base of Chinle shale
which overlies the aquifer. This spring represents the recharge into the Coconino formation, partly rejected here because of local geologic structure.

**A-341. Mormon Church well** \(45.7 \pm 1.5\%\) modern

Alt 6955 ft, depth to water 23 ft, located ca. 3 mi from main recharge area.

**A-342. St. Michael Chapter House well** \(54.1 \pm 1.6\%\) modern

Alt 6800 ft, depth to water 37 ft, located ca. 4 mi from main recharge area, 0.7 mi from A-341.

**A-343. Window Rock well** \(12.4 \pm 1.7\%\) modern

Alt 6617 ft, depth to water is 83 ft, located ca. 5 mi from main recharge area, 1.4 mi from A-342.

### VIII. Modern Organic Sample

<table>
<thead>
<tr>
<th>A-329. Tucson, Arizona</th>
<th>(\delta^{14}C_{%o})</th>
<th>(\delta^{13}C_{%o})</th>
<th>(\Delta_{%o})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tucson, Arizona</td>
<td>310 ± 6</td>
<td>-22.4</td>
<td>303 ± 6</td>
</tr>
</tbody>
</table>

Leaves from mulberry tree growing in outskirts of Tucson (32° 14' N Lat, 110° 53' W Long). Coll. May 20, 1962 and subm. by P. E. Damon. Comment: these leaves are from the same tree as L-523 (Lamont VIII) collected April 4, 1959. At that time \(\Delta = 187 \pm 8\%o\).

### References

Date lists:
- Arizona III Damon and Long, 1962
- Lamont IV Broecker, Kulp and Tucek, 1959
- Lamont VII Olson and Broecker, 1961
- Lamont VIII Broecker and Olson, 1961


GEOLOGICAL SURVEY OF FINLAND
RADIOCARBON MEASUREMENTS II

E. HYYPÄ, A. ISOLA, and V. HOFFRÉN

C14-Laboratory, Geological Survey of Finland, Otaniemi, Finland

The following results represent measurements carried out since our first date list was prepared. Nearly all the dates given were obtained by using two proportional counters. The pretreatment of the samples and the production of pure CO2 followed the method described in Finland I.

SAMPLE DESCRIPTIONS
GEOLoGIC SAMPLES

Su-14. Mantsinsaari, NE shore Lake Ladoga 8400 ± 250
6450 B.C.

Carex Equisetum deciduous tree peat (alt 15.3 to 15.4 m) from section of drainage channel under embankment, Härkämäki bog, Mantsinsaari (61° 22' N Lat, 31° 38' E Long), USSR. Coll. 1937 by Esa Hyypä. Comment: pollen analysis places horizon in latter half of Pre-Boreal period (Hyppä, 1942a, p. 151-156).

Su-15. Kihniö, W Finland 9850 ± 320
8000 B.C.


Su-16. Koivisto, Karelian Isthmus, USSR 7000 ± 180
5050 B.C.

Peat from hand-dug section under Littorina sand bar at railroad cut W of Koivisto railroad station (60° 21' N Lat, 28° 37' E Long). Coll. 1935 by Esa Hyppä. Comment: according to pollen analysis, horizon represents beginning of first Littorina transgression (LI), which is in accord with C14-dating (Hyppä, 1937).

Su-17. Rovaniemi, southern Finnish Lapland 4350 ± 130
2400 B.C.

Sphagnum-Carex peat 1.1 to 1.2 m, alt 91 m, taken with piston drill especially constructed for C14 samples. Mustonlampi bog (66° 25' N Lat, 23° 30' E Long), S side of Rovaniemi. Coll. 1958 by Esa Hyypä. Comment: according to pollen analysis, vigorous spread of spruce began in area at that time, considerably earlier than at Pello (Su-25, 3250 ± 140, this date list).

Su-18. Kertteenjärvi lake, Kuorevesi, W Finland 4990 ± 140
3040 B.C.

Coarse detritus and remains of wood underlying silt layer ca. 2 m thick, recording flooding possibly caused by isostatic tilting of lake basin on N side of Kerttee River (62° 03' N Lat, 24° 30' E Long). Coll. by W. Silfversparre
and Esa Hyypää. Comment: date represents flooding at end of Atlantic period in region of Näsijärvi chain of lakes.


Wood fragment, 5×5×15 cm, dislodged from upper end of stub of dead tree, probably *Juniperus procera*, in shorewater of Wanchi crater lake, 65 mi WSW of Addis Ababa (8° 48' N Lat, 37° 52' E Long). Coll. 1957 by Helmer Smeds. Comment: dead trees rise ca. 3 m from bottom to surface of lake, which must have risen at least that much. Recent hypothesis of Julius Büdel (1954) seeking to explain changes in other parts of Ethiopia by tectonic and volcanic events—as opposed to former hypotheses relating the changes to alternation of pluvials and interpluvials—seems to be confirmed by dating of present sample.

Su-20. Salmivaara, Salla, E part of southern Finnish Lapland 8200 ± 250 6250 B.C.

Fine-detritus gyttja 4.5 to 4.6 m. Sample series taken with piston drill. Ruokoaapa peat bog (66° 52' N Lat, 28° 41' E Long), alt 194.4 m. Coll. 1961 by Esa Hyypää. Comment: according to C14-dating, the Betula time would seem to extend up to Boreal zone in northern Lapland.

Su-21. Taivalkoski, E part of southern Finnish Lapland 8120 ± 240 6170 B.C.

Coarse detritus gyttja 4.35 to 4.5 m Heinälampi peat bog alt 275 m (65° 34' N Lat, 28° 15' E Long). Coll. 1961 by Esa Hyypää, sample series taken with piston drill. Comment: horizon corresponds to upper part of Betula maximum zone, as in preceding bog, whose C14-date is also similar.

Su-22. Pello, 4.6 m, W Finnish Lapland 5630 ± 160 3690 B.C.

Betula wood 4.6 m, bog on NE side of village of Pello alt 288 m (66° 46' N Lat, 24° 04' E Long). Samples taken with piston drill, Coll. 1961 by Esa Hyypää. Comment: dated horizon belongs to first half of Atlantic.

Su-23. Pello, 5.5 m 7400 ± 190 5450 B.C.

Betula wood 5.5 m. Comment: end of Boreal (Pinus begins decline to Atlantic minimum), which is also in keeping with C14-dating.

Su-24. Pello, 6.3 m 8150 ± 210 6200 B.C.

Betula wood, 6.3 m, 20 cm above bottom, in terrestrial peat. Comment: Betula culminates, Pinus rising toward Boreal maximum, Pinus maximum time did not begin in Pello area, according to C14-dating, until ca. 6000 B.C., as also suggested by Salla (Su-20) and Taivalkoski (Su-21).

Su-25. Pello, 84-m bog 3250 ± 140 1300 B.C.

Carex-Sphagnum peat in a lower-lying bog in Pello 1.2 to 1.3 m, surface alt 84 m Tornio River valley (66° 46' N Lat, 24° 04' E Long). Coll. 1955 by Esa Hyypää. Comment: dating made from same horizon as Su-10 (4700 ±
100, Finland 1), which seemed to give too great an age for general spread of Picea in Pello area.

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Date list:
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Büdel, Julius, 1954, Results of investigations into climatically controlled landforms carried out in Ethiopia during spring 1953: Erdkunde, v. 8, no. 2, p. 139-156.
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BERN RADIOCARBON DATES III

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This list covers part of the measurements made at the Radiocarbon Dating Laboratory, Physics Department, University of Bern from summer 1960 until summer 1962. Two low-level counters with incorporated anticoincidence arrangement (Houtermans and Oeschger, 1958) are used for routine C\textsuperscript{14} measurements.

As modern reference source we have taken the activity of NBS oxalic-acid standard $\times 0.950$. Errors given are the standard deviations derived from the number of counted particles and the statistical errors of background and modern standard. Results are calculated with the half life of 5568 yr. No C\textsuperscript{13} corrections are made.

Since the beginning of 1962 samples have been converted into methane using the method described by Fairhall et al. (1961).

This work was financed by the Schweizerischer Nationalfonds. The authors wish to thank Trudi Riesen for the reliable and careful preparation of the samples and her assistance in setting up the methane conversion line, H. Loosli for his assistance in the measurement of part of the samples. They also thank Max Welten and H. G. Bandi for their help in selecting and discussing the samples.

SAMPLE DESCRIPTIONS

B-199. Eggen, Wallis, Switzerland

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>5250 ± 80</td>
</tr>
<tr>
<td>3300 B.C.</td>
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</table>

Peat of sedges and Hypnaceae from a bog behind the lateral moraine of the ancient Aletsch Glacier, N of Blatten and Brig-Naters, Wallis (46° 22' 13" N Lat, 7° 59' 22" E Long, alt 1650 m). Coll. 1956 by Max Welten and Otto Hegg; subm. by Max Welten, Univ. of Bern. Comment (M.W.): good supplement to the Eggen series, B-201, B-200, B-198 (Bern II). Series is consistent (Welten, 1958).

B-204. Belalp, Wallis, Switzerland

<table>
<thead>
<tr>
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<tr>
<td>4240 ± 80</td>
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<td>2290 B.C.</td>
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B-290. Le Cruilles 150.3 cm depth

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<tr>
<th>Date</th>
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<tr>
<td>4920 ± 120</td>
</tr>
<tr>
<td>2970 B.C.</td>
</tr>
</tbody>
</table>

Sphagnum peat from Les Cruilles, near Le Pont, Vallé de Joux (46° 39' 4" N Lat, 6° 18' 36" E Long, alt 1040 m) western Jura. Coll. 1958 by Samuel Wegmüller, Univ. of Bern; subm. by Max Welten. Comment (M.W.): dates
the beginning of the Picea phase. Part of a consistent series with B-288, B-289, B-290 (Bern II).

**Sèche de Gimel series, western Jura, Switzerland**

Peat samples from a sphagnum bog at Sèche de Gimel, near Col du Marchairuz, western Jura (46° 33' 05" N Lat, 6° 14' 00" E Long, alt 1300 m). Coll. 1958 by Alfred Wasserfallen and Samuel Wegmüller, Univ. of Bern; subm. by Max Welten. *Comment* (M.W.): B-295 and B-294 date the Picea phase in the western Jura, B-293 the beginning of it.

- **B-295. Sèche de Gimel 97.8 cm depth**
  - 1060 ± 100 A.D. 890

- **B-294. Sèche de Gimel 172.2 cm depth**
  - 1500 ± 100 A.D. 450

- **B-293. Sèche de Gimel 248 cm depth**
  - 3070 ± 160 1120 B.C.

**Egelsee series, Simmental, Switzerland**

Samples from a bog profile in Simmental near Diemtigen, Bernese Oberland (46° 39' N Lat, 7° 32' 35" E Long, alt 1000 m), (compare B-50 to B-56, Bern I). Coll. 1957 by J. Liechti and Max Welten; subm. by Max Welten. *Comment* (M.W.): reliability of C14 dating of peat was to be examined by comparison with wood found at the same depth. B-306 and B-307 are congruent within the limits of error, even if we do not suspect that the twig was younger and sank a little into the peat.

- **B-306. Egelsee 80 cm depth, sphagnum peat**
  - 2530 ± 100 580 B.C.

- **B-307. Egelsee 80 cm depth, wood of twig**
  - 2350 ± 100 400 B.C.

**B-309. Aare, Aarau, Switzerland**

Trunk of oak from the bed of the river Aare, Aarau (47° 24' 10" N Lat, 8° 03' 55" E Long). Coll. 1960 by Mr. Blesi, Juracementfabrik Aarau; subm. by W. Schmid, Mus. für Natur- und Heimatkunde, Aarau. *Comment* (Mr. B): dates high-water stage during which trunk was floated into the Aare.

**B-318. Monbijoubrücke**


**Creux du Croue series, western Jura, Switzerland**

Sphagnum peat from a bog at Creux du Croue, near Le Noirmont, in western Jura (46° 29' 48" N Lat, 6° 7' 17" E Long, alt 1360 m). Coll. 1958 by Alfred Wasserfallen and Samuel Wegmüller; subm. by Max Welten. *Comment* (M.W.):
ment (M.W.) : B-331 dates the beginning of the Piceae-phase, B-330 the phase of Corylus.

B-331. Creux du Croue 176.4 cm depth 4350 ± 100 2400 b.c.

B-330. Creux du Croue 386.2 cm depth 8430 ± 120 6480 b.c.

Axel Heiberg-Island series, NWT, Canada

Samples from organic and inorganic sediments in front of White Glacier. The profile was opened naturally by the erosion of a glacier-river (79° 26' N Lat, 90° 24' W Long). Coll. 1960 by Otto Hegg, Univ. of Bern; subm. by Max Welten. Comment (M.W. and O.H.) : series of deposits was supposed to give dates of advances and retreats of the glaciers connected with upheaval of the area. In the lower part the profile seems to show a normal deposition up to ca. 100 cm below surface, while the upper one shows an inversion probably caused by redeposition of older materials. Definite evaluation demands further researches on similar places in the area (Hegg, 1961).

B-333. Axel Heiberg 35 cm depth 4950 ± 200 3000 b.c.

Drepanocladus-peat layers interbedded with thin sand layers.

B-334. Axel Heiberg 80 cm depth 3070 ± 120 1120 b.c.

Drepanocladus peat.

B-311. Axel Heiberg 135 cm depth 2900 ± 120 950 b.c.

Drepanocladus peat.

B-313. Axel Heiberg 255 cm depth 4210 ± 100 2260 b.c.

Rhizome peat.

La Tourbière series, Ct. de Vaud, Switzerland

Gyttja with chalk and clay from a bog at La Tourbière near Coinsins (46° 25' 40" N Lat, 6° 13' 50" E Long, alt 480 m). Coll. 1961 by Samuel Wegmüller; subm. by Max Welten. Comment (M.W.) : samples date the phase of Betula-Pinus (Alleröd) in the western part of Switzerland. The slight inconsistency of the series falls within the limits of error, but makes far-reaching conclusions unwarranted.

B-336. La Tourbière 507 cm depth 10,950 ± 200 9000 b.c.

B-337. La Tourbière 511 cm depth 11,530 ± 200 9580 b.c.

B-338. La Tourbière 514.5 cm depth 11,200 ± 200 9250 b.c.

B-339. La Tourbière 518 cm depth 11,750 ± 200 9800 b.c.
B-355. Davos-Platz

Larch wood from ca. 2 m depth in soft soil and peat at Davos-Platz, Canton Graubünden (46° 49' N Lat, 9° 50' E Long). Coll. 1961 by R. Haefeli and H. R. in der Gand; subm. by Krähenbühl and Büher, architects, Davos. Comment (R.H.) : either the yearly sedimentation of coarse- and fine-grained soil (deposited by the river Land-Wasser) was extremely small, or erosion, alternating with deposition, has removed much of the section (Lutschg, 1944).

B-361. Sangenholz, Egnach, Thurgau

Charcoal from a cultivated field at Sangenholz, Egnach, Canton Thurgau (47° 32' 06" N Lat, 9° 23' 48" E Long). Coll. by M. Trächsel; subm. by W. U. Guyan, Mus. zu Allerheiligen, Schaffhausen.

Aletschgletscher series, Switzerland

Two larch trunks from moraine on right side of Grosser Aletschgletscher, 30 m above present ice level, Zenbächen (46° 25' N Lat, 8° 02' 5" E Long, alt 1850 m). Trees were lying parallel, a few meters apart, the smaller ends pointing S. Coll. 1961 by R. Haefely and Forstmeister Ritz; subm. by R. Haefely, Susenbergstr. 193, Zürich. Comment (R.H.) : it is possible but not certain that the trees were overridden by the advancing glacier. Transport by avalanches is not excluded. There is no doubt that the trees were uncovered by the retreat of the glacier in the early 1900's or late 1800's. Compare B-32 and B-71 (Bern I), wood samples found at the right side of the tongue of the Grosser Aletschgletscher, but at an alt of 1600 m (Oeschger and Röthlisberger, 1961).

B-362/1. Aletschgletscher III

B-362/2. Aletschgletscher IV

B-379. Hofwiesen I, Bargen, Schaffhausen

Sample from charcoal deposit below water-meadow near Hofwiesen, Bargen, Canton Schaffhausen (47° 47' 48" N Lat, 8° 35' 03" E Long). Coll. 1961 by Margrit Sauter; subm. by W. U. Guyan, Comment (W.G.) : dates an iron furnace.

Goeschenenalp series, Switzerland

During construction of the earth dam for the Goeschenenalp reservoir, Canton Uri (46° 38' 51" N Lat, 8° 29' 29" E Long, alt 1687 m to 1698.4 m), extensive drilling and excavations were carried out in thick valley fill which contained, at different levels, various organic material from scattered driftwood and roots to peat and remnants of forests. Coll. 1960 by Louis Kläy, Federal Inst. of Technol. Zürich, and Heinrich Zoller, Univ. of Basel; subm. by Sect. of Hydrology and Glaciology, for Hydraulic Research and Soil Mechanics,
Bern Radiocarbon Dates III

Federal Inst. of Technol., Zürich, and Heinrich Zoller. Comment (Hans Röthlisberger): B-380 and B-381 date a boulder zone by bracketing it; the boulder zone, av. thickness 8 to 10 m of considerable lateral extent, imbedded in alluvium, suggests a glacier advance of 2 to 3 km beyond the 1850 maximum. The boulders may represent a rockslide onto the glacier. B-382 (trunk of Larix) shows that the glacier advanced into a forest. Pollen profiles are under investigation.

**B-381.** Goeschenenalp 1a

1400 ± 80 A.D. 550

**B-381/1.** Goeschenenalp 1b

1650 ± 80 A.D. 300

**B-380.** Goeschenenalp 2

2280 ± 120 330 B.C.

**B-384.** Goeschenenalp 3

2840 ± 80 890 B.C.

**B-382.** Goeschenenalp 4

3340 ± 120 1390 B.C.

**Tour St. Martin series, Mollondin, Switzerland**

Small bits of burnt wood from Tour St. Martin, Canton Vaud (46° 45' 3" N Lat, 6° 45' 00" E Long). From thick layer of burnt wood mixed with dry sand underneath a cobblestone pavement (empierrment). Coll. 1961 and 1962 and subm. by E. André, Service des Bâtiments de l'Etat, Lausanne. Comment: the two tests show that the pavement belongs to a medieval structure, not to a Roman or even pre-Roman one as had been thought. Gives earliest occupation of hill.

**B-392/2.** Tour St. Martin

1190 ± 100 A.D. 760

**B-392/4.** Tour St. Martin

1260 ± 120 A.D. 690

**Vorderrhein series, Ilanz, Graubünden, Switzerland**

Oak trunks found in river clay and gravel at the bank of the Rhein River after high water near Ilanz, Canton Graubünden (46° 46' 32" N Lat, 9° 9' 48" E Long). Coll. 1961 by J. Montalta and H. Calortscher, Ilanz; subm. by H. Brunner, Naturh. Mus. Chur, Graubünden. Comment (H.B.): postglacial landslide of Flims has dammed the Vorderrhein from Ilanz to Truns. The drifted oak wood, imbedded in sedimenting clay and gravel, may possibly date the landslide (Staub, 1938).

**B-395a.** Vorderrhein

8320 ± 120 6370 B.C.

Sample from big oak trunk below bark.

**B-395b.** Vorderrhein

8570 ± 130 6620 B.C.

Sample from center of same oak trunk (ca. 300 tree rings below bark).
B-395c. Vorderrhein

Sample of small oak trunk.

B-397. Speicher, Hohrüti, Switzerland

Root and stem, excavated during construction of a building, found interstratified in upper and lower boulder clay, 250 to 280 cm depth (47° 25' 01" N Lat, 7° 06' 15" E Long, alt 940 m). Coll. 1961 and subm. by Hermann Eugster, collaborator of Swiss Geol. Comm. Comment (H.E.): root and stem evidently belong to a landslide, not to a Riss-Würm interglacial deposit.

Il Fuorn series, Unterengadin, Switzerland

Peat of sedges and Hypnaceae mixed with some sand of dolomite rocks from slightly inclined bog, W of the Ofenpass road near the Hotel of Il Fuorn (46° 39' 35" N Lat, 10° 12' 12" E Long, alt 1805 m). Coll. 1958 and subm. by Max Welten. Comment (M.W.): the three determinations form a consistent series in a profile formerly thought to record influences of a primitive iron industry on vegetation. The dates confirm the pollen diagrams in demonstrating an age much older than Iron Age and a long span of time for the deposition (Welten, 1962).

B-405. Il Fuorn 112 cm depth

4100 ± 100

2150 B.C.

B-406. Il Fuorn 168 cm depth

5410 ± 100

3460 B.C.

B-407. Il Fuorn 226 cm depth

6490 ± 100

4540 B.C.

Lai Nair series, Unterengadin, Switzerland

Samples from a little basin on the right bedrock slope under former Inn glacier, filled, successively, with clay and chalk-gyttja in late-glacial time, with gyttja in Boreal and Atlantic times and later with peat of sedges and Hypnaceae. Boring by Hiller sampler, E of Tarasp near the thermal station of Schuls (46° 46' 23" N Lat, 10° 16' 40" E Long, alt 1546 m). Coll. 1958 and subm. by Max Welten. Comment (M.W.): a very consistent series dating the best pollen-diagram available in the neighborhood of the climatically continental Swiss National Park. The early invasion of Picea is dated, as well as the renewed dominance of Pinus in more recent times (Welten, 1962).

B-408. Lai Nair 88 cm depth

1310 ± 80

A.D. 640

Peat of sedges and Hypnaceae

B-409. Lai Nair 222 cm depth

1830 ± 80

A.D. 120

Peat of sedges and Hypnaceae.

B-410. Lai Nair 277 cm depth

2730 ± 130

780 B.C.

Peat of sedges and Hypnaceae, with gyttja.
B-411. Lai Nair  331 cm depth  
Gyttja.

B-412. Lai Nair  410.7 cm depth
Chalk-gyttja.

Juf Plan series, Unterengadin, Switzerland

Peat of sedges and Hypnaceae from great alpine inundation plain, formed partly by peat, partly by clay and sand. Boring by Hiller sampler, E of the Ofenpass near the Swiss National Park (46° 37' 18", 10° 15' 20", alt 2223 m). Coll. 1958 and subm. by Max Welten. Comment (M.W.): unexpectedly the profile goes back to the early part of the Atlantic period; the pollen diagram is monotonous and confused by much pollen of long-distance transport, and had not been thought to be so old. The rate of growth of this alpine peat seems to have been very low, and there is no indication of truncation or of cessation of growth in recent times (Welten, 1962).

B-413. Juf Plan  30 cm depth
3520 ± 120
1570 B.C.

B-414. Juf Plan  61 cm depth
6380 ± 120
4430 B.C.

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Date lists:
Bern I  Oeschger, Schwarz and Gfeller, 1959
Bern II  Gfeller, Oeschger and Schwarz, 1961


YALE NATURAL RADIOCARBON MEASUREMENTS VIII
MINZE STUIVER, EDWARD S. DEEVEY, JR., and IRVING ROUSE

Geochronometric Laboratory, Department of Biology,
and Department of Anthropology, Yale University, New Haven, Connecticut

INTRODUCTION

No important instrumental modifications have been made since publication of our last list (Yale VII). As before, we are indebted to many collaborators for samples and for assistance with descriptions and comments. Technical assistance has been provided by George Young, Carolyn Haupt, and Jonathan Wood. The generous support of the National Science Foundation, under grants G-19080 (to Stuiver), G-19335 (to Deevey), and G-24049 (to Rouse) is gratefully acknowledged.

As in our previous lists, dates are reported in terms of the Libby half life of C\(^{14}\), 5570 ± 30 yr, and geochemical measurements are expressed as \(\Delta\), the normalized deviation from 95 percent of the NBS oxalic-acid standard. Infinite dates are reported as beyond a limit equal to \(3\sigma\) above background.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Eastern North America

Y-1164. Birthday River, Québec

Nonsphagnous moss and sedge peat with chitinous fragments, lowest 5 cm of a layer 30 cm thick, 213 cm below surface, overlain by sphagnous peat, underlain by marine silty clay with Hiatella sp., exposed in undercut left bank, \(\frac{1}{2}\) mi from junction of Birthday River and Harricanaw River (50° 42' N Lat, 79° 20' W Long), Abitibi Territory, James Bay Lowland, Québec. Coll. 1961 and subm. by C. J. Durden, Yale Univ., for Geol. Surv. Branch, Dept. of Nat. Res., Québec. Comment (C.J.D.): dates earliest land vegetation, following post-glacial emergence, at a point 36 mi SE of the present coast. Basal peat in a similar section on Attawapiskat River, Ontario, was dated 4700 ± 80 (Gro-1925, Groningen, unpublished). Extrapolating from the date of Y-1164, assuming constant postglacial uplift, the age of the highest beach W of Seven Mile Island, on Harricanaw River, is 7900 B.P. This is comparable to dates of shells from highest marine deposits in Ontario (7875 ± 200, Isotopes II; 7280 ± 80, Gro-1698, Groningen, unpublished).

Y-1165. Seven Mile Island, Québec

Nonsphagnous moss peat, in laminae 1 to 3 mm thick, interbedded with silt and angular quartz sand, 731 cm depth below surface; part of a section of rhythmites, >10 m thick, with couplets 3 to 20 mm thick, overlain with gradational contact by bluish-gray sticky clay containing Hiatella sp., 122 cm thick, then by river gravel, 396 cm thick. Exposed in undercut left bank of Harricanaw River, 2 mi below Seven Mile Island (50° 35' N Lat, 79° 09' W Long), Abitibi Territory, James Bay Lowland, Québec. Coll. 1961 and subm.
by C. J. Durden for Geol. Surv. Branch, Dept. of Nat. Res., Québec. Comment (C.J.T.) : the date, from a point 250 couplets below transition to marine beds, gives age of marine inundation of James Bay. The rhythmites are correlated with the Missinaibi beds of Ontario, with an age of >53,000 (Gro-1435, Groningen, unpublished). This is the first indication of the possibility that James Bay was ice-free during a Wisconsin interstadial.

**Maine bog series**

Peat and gyttja from deepest part, overlying mineral substratum, in a series of bogs in eastern Maine, situated in a belt trending NNE-SSW from nr Houlton to nr Belfast. Bogs were selected from a larger series, in which origin, rate of upward growth, and vegetation are under study by Harold Young and Richard Kennedy, School of Forestry, and E. G. Stoeckeler, Soils Laboratory, Univ. of Maine, Orono. Bogs selected are in kettles or otherwise closely related to glacial lakes; some are above and others below the probable limit of late-glacial marine overlap; deposits sampled are usually the thickest known in each district. Quadrangle references to USGS topographic maps, 15-min series; coll. 1962 by Davis peat borer and subm. by Richard Kennedy.

**Y-1259. Littleton HL-6**

From HL-6, a small bog nr Littleton, Houlton quadrangle, Aroostook County (46° 13' N Lat, 67° 52' W Long), surface alt 440 ft, 41½ to 42 ft depth.

**Y-1253. Hershey SH-2**

From SH-2, a large bog nr Hershey, Sherman quadrangle, Penobscot County (45° 49' N Lat, 68° 26' W Long), surface alt 420 ft, 13½ to 13¾ ft depth.

**Y-1256. Topsfield WA-3**

From WA-3, a large bog nr Topsfield, Waite quadrangle, Washington County (45° 27' N Lat, 67° 45' W Long), surface alt 550 ft, 25½ to 26 ft depth.

**Y-1257. Codyville WA-6**

From WA-6, a large bog nr Codyville, Waite quadrangle, Washington County (45° 26' N Lat, 67° 41' W Long), surface alt 370 ft, 23 to 23½ ft depth.

**Y-1252. Chester LN-1**

From LN-1, a small bog nr Chester, Lincoln quadrangle, Penobscot County (45° 30' N Lat, 68° 33' W Long), surface alt 280 ft, 19 to 19¾ ft depth.

**Y-1249. Howland PA-9**

From PA-9, a small bog nr Howland, Passadumkeag quadrangle, Penobscot County (45° 13' N Lat, 68° 43' W Long), surface alt 220 ft, 9½ to 9¾ ft depth.
Y-1251. Passadumkeag PA-23

9620 ± 150
7670 B.C.

From PA-23, a small bog nr Passadumkeag, Passadumkeag quadrangle, Penobscot County (45° 13' N Lat, 68° 35' W Long), surface alt 160 ft, 29 1/2 to 29 3/4 ft depth.

Y-1250. Alton PA-16

5410 ± 80
3460 B.C.

From PA-16, a small bog nr Alton, Passadumkeag quadrangle, Penobscot County (45° 02' N Lat, 68° 44' W Long), surface alt 220 ft, 4 1/2 to 4 3/4 ft depth. Comment: this anomalously young sample proved not to be the deepest in the bog; Y-1312 gives an acceptable result.

Y-1312. Alton PA-16, bottom

8940 ± 120
6990 B.C.

From PA-16, a new sample to check Y-1250, 7 1/4 to 7 1/2 ft depth.

Y-1255. Bingham BG-1

9410 ± 120
7460 B.C.

From BG-1, a small bog nr Bingham, Bingham quadrangle, Somerset County (45° 04' N Lat, 69° 54' W Long), surface alt 440 ft, 28 to 29 ft depth.

Y-1258. Stillwater OR-3

9730 ± 160
7780 B.C.

From OR-3, a small bog nr Stillwater, Orono quadrangle, Penobscot County (44° 56' N Lat, 68° 42' W Long), surface alt 120 ft, 12 1/2 to 13 ft depth.

Y-1254. Hermon BA-8

9610 ± 120
7660 B.C.

From BA-8, a large bog nr Hermon, Bangor quadrangle, Penobscot County (44° 48' N Lat, 68° 54' W Long), surface alt 130 ft, 29 3/4 to 30 ft depth.

Y-1260. Searsport CT-1

9630 ± 150
7680 B.C.

From CT-1, a large bog nr Searsport, Castine quadrangle, Waldo County (44° 29' N Lat, 69° 57' W Long), surface alt 240 ft, 27 to 28 ft depth. Comment: despite a considerable range of maximum thickness of organic deposit, from ca. 10 to ca. 42 ft, the oldest organic samples are remarkably uniform in age, 9690 ± 430 yr, over a wide geographical and altitudinal range. Deglaciation of the sites was evidently nearly simultaneous; the time lag before inception of organic deposition, often thought to invalidate such dates as a measure of time of deglaciation, seems hardly to have exceeded the statistical uncertainty of any single date. If there are differences, apart from the difficulty, in large and complex bog systems, of finding the deepest and oldest deposits, they may be of two sorts: those due to early emergence of high altitudes from a stagnant ice sheet, and those due to delayed uncovering of low-lying bogs by the late-glacial sea. WA-3 (Y-1256) may be the oldest bog for the first reason; PA-23, OR-3, and BA-8 (Y-1251, 1258, 1254), all below 220 ft, may be examples of the second, being younger, though not significantly so, than LN-1 and SH-2 (Y-1252, 1253), which lie above 280 ft. Emergence of Maine's
coastal belt from the late-glacial sea, the result of crustal upwarping, brought strandline features to altitudes of 200 ft near the coast and 300 ft farther inland (Bloom, 1960). The inference that uplift occurred about 10,000 yr ago is not in serious conflict with Bloom’s argument, drawn from two pollen diagrams, that emergence took place early in the time of the pine zone, an estimated 7000-8000 yr ago. Pine-pollen time is not directly dated in coastal Maine, and may well have begun before 10,000 B.P. Evidence that isostatic response to glacial unloading was immediate and rapid is given for Greenland by Washburn and Stuiver (1962).

**Barnstable Marsh series, Massachusetts**

Salt-marsh peat, collected by piston corer at four localities on marsh fringing S side of Sandy Neck, a spit that shelters Barnstable Harbor (Hyannis quadrangle, USGS topog. map; USC & GS Chart 339), N shore of Cape Cod, Massachusetts. Coll. 1961 by A. C. Redfield and A. E. Doe, Woods Hole Oceanographic Inst., to determine (a) rate of vertical accretion of marsh during intertidal stage, before high-marsh stage has been reached, and (b) chronology of eastward growth of Sandy Neck. Dates covering vertical accretion of high-marsh peat were obtained by the USGS laboratory, with results implying upward growth (and relative rise of sealevel) of 0.33 ft per century since 2100 B.P., and of 1.0 ft per century prior to that time (Redfield and Rubin, 1962). Bottommost peat samples, overlying sandy substratum, were dated at each locality in order to minimize errors of vertical position due to compaction, and one sample at intermediate depth was also dated at three of the four localities. Depths were measured below marsh surface, which is approximately at MHW. Samples were 6 in. long. Subm. by A. C. Redfield.

**Y-1184. Cove, C 3.3**

Bottommost silty peat, 3.3 ± 0.25 ft depth, Cove (41° 43' 38" N Lat, 70° 17' 33" W Long), 4700 ft W of tip of Sandy Neck.

**Y-1185. Bass Creek, BA 3.0**

Fibrous peat, 3.0 ± 0.25 ft depth, Bass Creek (41° 43' 34" N Lat, 70° 18' 10" W Long), 2300 ft W of Cove.

**Y-1186. Bass Creek, BA 7.9-2**

Bottommost organic sand, 7.9 ± 0.25 ft depth, Bass Creek; the more organic of two samples at this level.

**Y-1187. Braileys, BR 6.5**

Silty peat, 6.5 ± 0.25 ft depth, Braileys (41° 43' 45" N Lat, 70° 19' 15" W Long), 5450 ft W of Bass Creek.

**Y-1190. Braileys, BR 7.8**

Organic silt nr bottom, 7.8 ± 0.25 ft depth, Braileys. Maximum depth of peat (by probing) was 9.0 ft at this site, but no deeper sample could be obtained.
Y-1188. Keith’s, K 3

Fibrous peat, 3.0 ± 0.25 ft depth, Keith’s (41° 43’ 50” N Lat, 70° 20’ 52” W Long), 7110 ft W of Braileys, nr base of Sandy Neck.

Y-1189. Keith’s K 13.7

Bottommost organic sand, 13.7 ± 0.25 ft depth, Keith’s. Comment (A.C.R.): a sample previously obtained, W-1099 (see Redfield and Rubin, 1962) from near the base of Sandy Neck and 11,200 ft W of Keith’s indicated that marsh had developed in the shelter of the spit by 3170 ± 300 B.P., thus giving a minimal age for the spit. Combining this date with those of the oldest samples of the present series, the fringe of marsh sheltered by Sandy Neck spread eastward for the first two miles at a rate of ca. 11 ft per yr. For the second two miles the rate was ca. 9 ft per yr, and for the last half mile ca. 2 ft per yr. The sand spit presumably grew eastward in advance of the peat fringe, but at approximately the same rates. It has advanced at ca. 2 ft per yr during the past 100 yr. Sample Y-1190 from Braileys has been neglected in these estimates. It is younger than the bottom sample at Bass Creek and it is possible that the marsh at Braileys was destroyed by erosion during its earlier history. The rate of vertical accretion of the peat cannot be commented on profitably until the complete series of samples at intermediate depths has been dated. The deeper layers of peat in this series developed at intertidal levels and grew upward at rates determined by sedimentation rather than by rising sea level. Because of more rapid accretion during the intertidal stage, the age of the bottom sample is less than that of samples from similar depths at places where high-marsh peat has developed as the upland was flooded by rising sea levels.

Hammock River marsh series, Connecticut

Peat, peaty sand, and wood from a layer underlying a wedge of estuarine mud in S part of Hammock River tidal marsh (41° 15.7’ N Lat, 72° 30.7’ W Long), Clinton, Connecticut. The overlying mud thickens toward NE from ca. 3 to ca. 36 ft. Most samples coll. 1961 by Davis borer at the top of the peat bed have been displaced by, and measure the amount of, compaction; samples at base of peat, overlying firm sandy substratum, mostly coll. 1962, give more reliable data on rate of marine submergence (Bloom and Stuiver, 1963). Datum is marsh surface, which is within ± 0.2 ft of MHW. The marsh is the deepest and oldest yet discovered on the Connecticut coast. Subm. by A. L. Bloom, Cornell Univ., Ithaca, N. Y.

Y-1055. Hammock River 7-14-1

Peaty sand, 33.3 ± 0.4 ft below surface.

Y-1056. Hammock River 7-13-6

Sedge peat from top 2 in. of a 1.2-ft layer, 27.2 ± 0.3 ft below surface.
Y-1057. Hammock River 7-13-5
3540 ± 130
1590 B.C.
Sedge peat from top 2 in. of 2.6-ft layer, 18.6 ± 0.3 ft below surface.

Y-1058. Hammock River 7-13-1
3450 ± 160
1500 B.C.
Sedge peat from top 2 in. of a 3.2-ft layer, 15.6 ± 0.3 ft below surface.

Y-1059. Hammock River 7-12-3
1280 ± 150
A.D. 670
Sedge peat from top 2 in. of a 2.8-ft layer, 10.7 ± 0.3 ft below surface.

Y-1074. Hammock River 35.7 ft
6130 ± 90
4180 B.C.
Sedge peat from top 3 in. of a 2.3-ft layer, 35.7 ± 0.4 ft below surface.

Y-1175. Hammock River 6-6-1
3020 ± 90
1070 B.C.
Sedge peat from bottom 2 in. of a 3.5-ft layer, 9.1 ± 0.6 ft below surface.

Y-1176. Hammock River 6-6-3
3220 ± 90
1270 B.C.
Sedge peat from bottom 3 in. of a 3.5-ft layer, 11.4 ± 0.5 ft below surface.

Y-1177. Hammock River 6-5-1
4880 ± 120
2930 B.C.
Wood and bark from base of 3-ft peat layer, 19.6 ± 0.5 ft below surface.

Y-1178. Hammock River 6-7-1
11,240 ± 160
9290 B.C.
Sedge peat, composite of 2 samples 50 ft apart, 36.6 ± 0.5 to 37.7 ± 0.3 ft below surface.

Comment: disregarding samples affected by compaction, Bloom and Stuiver (1963) computed the submergence between 7060 B.P. (Y-1055) and 3020 B.P. (Y-1175) to have been 0.6 ft per century, from −33 to −9 ft below present MHW. Thereafter, as also shown at Barnstable Marsh (Redfield and Rubin, 1962), the rate decreased by about half, to 0.3 ft per century. Because the slope of the buried valley under the Hammock River marsh, to seaward of Y-1055, is not uniform, the relation of Y-1178 to the other samples is problematical; older but not much deeper than the others, the sample is believed to give only a minimum figure for submergence between 11,240 and 7060 B.P.

Y-1054. East Norwalk, Connecticut
1400 ± 70
A.D. 550
Root from tree stump, exposed in drainage ditch on tidal marsh, ca. 400 ft S of Saugatuck Avenue on SE edge of Shorehaven Golf Course (41° 06' N Lat, 73° 23.3' W Long), East Norwalk, Connecticut. Stump roots penetrated gravel, probably glacial drift, through a zone 36 to 48 in. below surface of marsh. Tree probably killed by salt-water inundation of root system 48 in. below present MHW; stump is overlain by muddy salt-marsh peat recording at
least 48 in. of marine submergence. Coll. 1961 and subm. by A. L. Bloom. Comment: no correction for compaction is needed; sample agrees closely with Y-840 and Y-855 (Yale VI) in establishing recent submergence along Connecticut shore at a rate of 0.3 ft per century. Relation of this sample and calculated rate to other Connecticut data is shown by diagram in Bloom and Stuiver (1963, fig. 1).

Y-1077. North Haven, Connecticut

3560 ± 80
1610 B.C.

Log, overlain by 6 ft of estuarine peat, underlain by 3.5 ft of gray sandy silt, S side of clay pit (41° 22' N Lat, 72° 53' W Long), North Haven, Connecticut. Log lies 18 ± 0.5 ft below surface of tidal marsh, but overlying peat has been compacted, and underlying silt has been faulted, by artificial fill; downthrow on fault, measured as 1 to 2 ft, is a minimum figure for displacement of log, which therefore relates to a sealevel at -16 ft or higher. Coll. and subm. by A. L. Bloom. Comment: one of the samples affected by compaction, rejected by Bloom and Stuiver (1963) in drawing their curve of relative marine submergence.

Plum Bank Creek series, Connecticut

Peat from a layer of undertermined thickness, occupying a closed depression under estuarine mud, S part of Plum Bank Creek tidal marsh (41° 15.9' N Lat, 72° 23.4' W Long), Old Saybrook, Connecticut. Coll. 1961 and subm. by A. L. Bloom.

Y-1075. Plum Bank Creek 38 ft

3500 ± 130
1550 B.C.

From 37 ft 10 in. to 38 ft, immediately below base of estuarine mud.

Y-1076. Plum Bank Creek 24 ft

3630 ± 140
1680 B.C.

From 24 ft 3 in. below surface, 1.5 in. below base of estuarine mud, on flank of depression. Comment: compaction has evidently lowered both samples; they were rejected by Bloom and Stuiver (1963).

Y-1179. Westport, Connecticut

2710 ± 90
760 B.C.

Freshwater peat from bottom 3 in. of a bed 3 ft thick, overlain by ca. 7 ft of estuarine mud and salt-marsh peat, Longshore Country Club (41° 06' N Lat, 73° 21.5' W Long), Westport, Connecticut. Sample dates 10.4 ± 0.4 ft of coastal submergence. Coll. and subm. by A. L. Bloom. Comment: sample falls ca. 2 ft below line of sealevel rise established by bottommost samples at Hammock River, Clinton (Bloom and Stuiver, 1963), implying either (a) some displacement by compaction, or (b) a mean carbon age for 3 in. of sample that is ca. 300 yr too young.

Y-451 bis. Meriden Airport, Connecticut

>40,000

Tamarack wood (id. by W. L. Stern) from 3.5-ft log imbedded in till at base of section of till and silt, 14 ft thick, overlying bedrock, 1.2 mi S of school in South Meriden (41° 27' N Lat, 72° 48' W Long), Wallingford, Connecticut.
Dated previously (Y-451, Yale III) at 32,000 ± 2800. Coll. 1956 and subm. by P. M. Hanshaw, U. S. Geol. Surv., Denver, through R. F. Flint. Comment (R.F.F.) : confirms the infinite dates (>35,000, W-518 and W-519, USGS V) obtained by the Washington laboratory for samples of the same specimen.

**Y-923. Broad Brook, Connecticut**

Calcareous concretion from a lamina in lacustrine silt and clay (Hartford clay of Flint), 32 ft below top of silt-clay body, W bank of Broad Brook (41° 55' N Lat, 72° 33' W Long), Broad Brook, Connecticut. Coll. and subm. by R. F. Flint. Comment: measured to test the assumptions that carbonate was deposited from connate lake water soon after deposition, and that CO₂ in lake water was in equilibrium with the atmosphere. As the Hartford clay is late-glacial and known to be older than 10,710 B.P. (Y-253, Yale II), the concretion is evidently younger than the inclosing deposit, invalidating the first assumption, and the second assumption is not tested.

**Rogers Lake series, Connecticut**

Gyttja from core ROG-2, taken with 2-in. Livingstone sampler in 10 m of water, center of S basin of Rogers Lake (41° 22' N Lat, 72° 18' W Long), Lyme, Connecticut. Measured as part of a study of sedimentation rates and paleolimnology in a soft-water lake where contribution of C¹⁴ deficient ground water should be minimal. Sample depths measured above bottom of each meter of core; small corrections applied afterward are for compaction during extrusion. Coll. 1961 and subm. by Margaret B. Davis, Univ. of Michigan, Ann Arbor, and E. S. Deevey.

- **Y-947. Rogers 2-20, 19.74 to 19.68 m**
  From 60 to 65 cm above bottom of core 2-20.  
  9740 ± 160
  7790 B.C.

- **Y-943. Rogers 2-20, 19.99 to 19.93 m**
  From 40 to 45 cm above bottom of core 2-20.  
  9970 ± 170
  8020 B.C.

- **Y-938/39. Rogers 2-20, 20.31 to 20.18 m**
  From 15 to 25 cm above bottom of core 2-20.  
  10,910 ± 180
  8960 B.C.

- **Y-936. Rogers 2-20, 20.50 to 20.37 m**
  From 0 to 10 cm above bottom of core 2-20.  
  11,470 ± 160
  9520 B.C.

- **Y-958/59. Rogers 2-21, 20.85 to 20.75 m**
  From 65 to 75 cm above bottom of core 2-21.  
  11,760 ± 180
  9810 B.C.

- **Y-954/55. Rogers 2-21, 21.10 to 20.95 m**
  From 40 to 55 cm above bottom of core 2-21.  
  13,150 ± 150
  11,200 B.C.

- **Y-952/53. Rogers 2-21, 21.30 to 21.10 m**
  From 20 to 40 cm above bottom of core 2-21.  
  13,280 ± 220
  11,330 B.C.
Y-950/51. Rogers 2-21, 21.50 to 21.30 m 14,240 ± 240
12,290 B.C.

From 0 to 20 cm above bottom of core 2-21.
Comment: Rogers Lake, despite its softness, proves to contain appreciable amounts of old carbon from ground water; surface sediments (Y-1261, 1262, this date list) have an average C\textsuperscript{14} assay of -100\%, or an “age” of 770 yr. Dates reported here are calculated from this as zero time, so assuming the carbonate error to have been systematic. The error is smaller here than in medium-hard Linsley Pond, where pre-H-bomb mud has δC\textsuperscript{14} = -212\% (Y-1182, this date list), and where ca. 10\% of the deep-water CO\textsubscript{2} is contributed by carbonates (Deevey and Stuiver, in press). Preliminary estimates of sedimentation rate (Deevey, in press) are not affected by uncertainty as to absolute age; they indicate wide variation within this series, from 1.62 to 13.3 cm per century. Relation of the variations to changing climate and vegetation is being studied by Margaret B. Davis, as are absolute fallout rates of pollen. Organic deposition was approximately parallel to total deposition, proving that the major variations are not the consequence of massive injection of silt, as by solifluction. Disregarding variations, the overall rate over the first (late-glacial) 4500 yr of the lake’s history was about half the postglacial rate, as judged from the fact that the overlying 9.7 m of sediment accumulated since 9740 B.P. The great age of the deepest samples is noteworthy, as it is consistent with the dates for the pollen sequence at Totoket Bog, in the same district (Leopold, 1956; Deevey, 1958).

Norfolk district series, Virginia-North Carolina

Wood and peat from significant stratigraphic positions in the vicinity of Norfolk, Virginia, related to a detailed study of Pleistocene geology of the district, supported by Grant 609 (40), Office of Naval Research. Samples were selected to fix time limits for critical stratigraphic units. Subm. by various collectors through R. F. Flint.

Y-1146. Dismal Swamp 7670 ± 60
5720 B.C.

Fibrous peat from two cores, 1 m apart, 3.55 to 3.59 m depth in core 61-123 and 3.52 to 3.56 m depth in core 61-118, Dismal Swamp Station DS49 on Jericho Ditch, 3.4 km N of Lake Drummond (36° 39' 13" N Lat, 76° 28' 45" W Long). From base of peat, close to transition to underlying clay. Coll. and subm. by D. R. Whitehead, Williams Coll., Williamstown, Massachusetts. Comment: dates inception of the Dismal Swamp Peat.

Y-924. Sandbridge, Virginia

A.D. 1220

Stump of pine (id. by G. Burns), rooted in firm peaty clay, ca. 1 ft below MLW, Old False Cape Coast Guard Station (36° 36.2' N Lat, 75° 53' W Long), Sandbridge, Virginia. Coll. 1960 by Wyman Harrison, D. Oglesby, and C. S. Sherwood, III; subm. by Harrison, Norfolk Coll. of William and Mary, Norfolk 8, Virginia. Comment (R.Q. Oaks, Jr.) : dates a position of sealevel at least 8 ft below present sealevel.
Y-1272. Aydlett, North Carolina
>40,000
Wood from peat exposed in cliff face, alt 2 ft, overlying beach sand, overlain by 15 ft of eolian (?) sand, Aydlett (36° 20' N Lat, 75° 54' W Long), North Carolina. Coll. and subm. by R. Q. Oaks, Jr., Yale Univ. Comment (R.Q. Oaks, Jr.): peat, noticed first by W. H. Harris, dates youngest of a sequence of barrier bars (Sandbridge fm), which are probably of Sangamon age.

Y-1194. Mears Corner, Virginia
>40,000
Wood, probably driftwood, alt 5 ft above MSL, 7 ft below ground surface, in section of sand (Kempsville fm), overlying shell-rich sand (Norfolk fm), overlain by sandy clay (Sandbridge fm), exposed in borrow pit, Mears (Bonneys) Corner (36° 47' 30'' N Lat, 76° 10' 19'' W Long), S of Kempsville, Virginia. Coll. and subm. by R. Q. Oaks, Jr. Comment (R.Q. Oaks, Jr.): dates a stratigraphic unit known to be older than Y-1272 (this date list and series).

Y-1271. Benns Church, Virginia
>40,000
Peat, alt ca. -2 ft, N side of Muddy Cross Creek, Benns Church (36° 55' N Lat, 76° 35' W Long), Isle of Wight County, Virginia. Overlies gray sand overlying Miocene Yorktown fm; peat unit is basal part of a valley fill. Coll. and subm. by J. E. Sanders, Yale Univ. Comment (R.F.F.): confirms expectation.

Y-1047. Churchland, Virginia
>47,000
Taxodium wood from boring, 45 to 48 ft below surface (ca. 26 to 29 ft below MSL), South Street Baptist Church (36° 51' 10'' N Lat, 76° 22' 54'' W Long), Bowers Hill quadrangle, Churchland, Virginia. May be correlative with extensive buried forest at similar altitude that underlies Norfolk, to the E. Coll. 1961 by E. F. Caldwell and Wyman Harrison; subm. by Harrison. Comment (R.F.F.): date implies that the sample, inferred to have grown not far above sealevel of the time, is not of Wisconsin age. Its latest probable age is late Sangamon.

Y-1102. Zionsville, Indiana
>42,000
Wood fragments from section exposed in streamcut in NE 1/4 SE 1/4 SE 1/4 sec. 29, T 17 N, R 2 E (39° 53' N Lat, 86° 19' W Long), Zionsville quadrangle, Indiana. From till immediately above contact of till with underlying silt. Till is overlain by a sequence of gravel and till layers; silt is underlain by dense gray till. Coll. 1959 by Wyman Harrison and others; subm. by Harrison through R. F. Flint. Comment (R.F.F.): wood fragments from same zone in till gave >38,000 (W-814, USGS V); wood fragments at contact of this till with underlying silt, nr Trader's Point, Indiana, were dated at >37,000 (W-578, USGS V). Collector expected a post-Sangamon age for the till. The new dating does not deny that expectation; it merely increases the minimum date by 4000 yr over that of W-814.

B. Minnesota

Kirchner Marsh series, Minnesota
Pollen-dated peat and gyttja from Kirchner Marsh, SW 1/4 NE 1/4 sec. 17, T 115 N, R 19 W, Dakota County (44° 16' 15'' N Lat, 93° 07' 30'' W Long),
17 mi S of Minneapolis, Minnesota. The marsh, an ice-block depression, is situated in the St. Croix moraine of Cary age; during the Mankato sub-age the Des Moines lobe overlapped the St. Croix moraine and advanced to within 4 mi of the marsh, which was then a lake. Pollen stratigraphy was reported by Winter (1962) and is discussed in full by Wright, Winter, and Patten (ms subm. for pub.). Coll. by T. C. Winter and others; subm. by H. E. Wright, Univ. of Minnesota, Minneapolis 14.

**Y-1155. Kirchner Marsh 175 cm**  
1660 ± 80 A.D. 290

At base of sub-zone of rising pine pollen, 175 cm depth, in Zone C-c, Core 1.

**Y-1139. Kirchner Marsh 517-523 cm**  
5450 ± 70  
3500 B.C.

At top of Zone C-b (prairie period), at beginning of oak-pollen rise, 517 to 523 cm depth, Core 1.

**Y-1140. Kirchner Marsh 777-783 cm**  
7120 ± 110  
5170 B.C.

At base of Zone C-b (prairie period), at beginning of oak-pollen minimum, 777 to 783 cm depth, Core 1.

**Y-1141. Kirchner Marsh 982-988 cm**  
10,230 ± 110  
8280 B.C.

Near base of Zone B, at sharp birch-pollen maximum, 982 to 988 cm depth, Core 1.

Comment: Kirchner Marsh provides a standard pollen diagram for the deciduous-forest region of southern Minnesota, and the four C¹⁴ dates in its post-glacial part are in close agreement with expectation. Correlation with other pollen-dated sections shows, however, that the pollen-zone boundaries are not necessarily synchronous over wide areas of Minnesota. Some discrepancies are noted at Cedar Bog Lake (this date list) 50 mi to the N, and correlation over greater distances, as with Madelia (Jelgersma, 1962; Winter, 1962) at the prairie border in the SW part of the state, or with Weber Lake (Fries, 1962) in the conifer forest in the NE part, is not made easy by the information available so far. The sharp birch-pollen peak seems to be an excellent horizon-marker, now dated at three sites (Kirchner Marsh, 10,230 ± 110, Y-1141; Cedar Bog Lake, 10,840 ± 160, Y-1198, this date list; Weber Lake, 10,550 ± 300, W-873, USGS V, and 10,180 ± 160, U-176, Uppsala III); it also occurs at Madelia but is not closely dated there. As a reflection of the first post-glacial immigration of birch woodland, however, it is unlikely to be synchronous at all sites.

**Cedar Bog Lake series, Minnesota**

Pollen-dated gyttja from Cedar Bog Lake (= Cedar Creek Bog), NW 1/4 NW 1/4 sec. 27, T 34 N, R 23 W (45° 24' 40" N Lat, 93° 11' 50" W Long), Anoka County, Minnesota. Age of the underlying drift, i.e. the Anoka Sand-plain, laid down during retreat of the Grantsburg sub-lobe toward the SW, is considered to be Mankato (Wright and Rubin, 1956; Leighton and Wright,
1957), partly on evidence of W-466 (11,830 ± 200, USGS IV) from a deep sample in this bog. It is the locality of classic investigations by Lindeman (1941); a sample from the top of Lindeman’s pine-pollen zone was dated 7988 ± 420 (C-332, Chicago I; Flint and Deevey, 1951). Pollen stratigraphy is being investigated by E. J. Cushing. Coll. by Cushing and others and subm. by Wright.

**Y-1196. Cedar Bog C-b/C-c**

4150 ± 120
2200 B.C.

At boundary of pollen-zones C-b and C-c, 2 10-cm samples (1 in. diam) from each of two adjacent cores, 395 to 405 cm depth in Core B-1 and 408 to 418 cm depth in Core C-2; correlation of the two cores based on sediment stratigraphy.

**Y-1197. Cedar Bog 940-950 cm**

7880 ± 120
5930 B.C.

In dark gyttja layer recording lowest postglacial water level, 940 to 950 cm depth, Core B-6; pollen stratigraphy places it within Zone C-b.

**Y-1198. Cedar Bog 1420-1430 cm**

10,840 ± 160
8890 B.C.

At birch-pollen peak, boundary of Zones A and B, 1420 to 1430 cm depth, Core CE-10.

*Comment:* Zone C-b represents the prairie maximum in this region, presently occupied by deciduous forest; its top, in Cedar Bog Lake, appears to be clear, but the date, 4150 ± 120 (Y-1196) is appreciably younger than the correlated horizon at Kirchner Marsh (5450 ± 70, Y-1139, this date list). The discrepancy may reflect the difficulty of tracing pollen-stratigraphic boundaries where climatic change was gradual and slight. The bottom of the zone, in Cedar Bog Lake, is even less well marked, and Y-1197 was chosen within the zone because it marks a definite lithologic unit; but the date, 7880 ± 120, makes it older than the C-a/C-b boundary at Kirchner Marsh (7120 ± 110, Y-1140, this date list). On this evidence the date of C-332, 7988 ± 420 (Chicago I), which was taken at a stratigraphically lower level, now appears to be ca. 2000 yr too young. The age of the birch-pollen maximum, 10,840 ± 160 (Y-1198), is in line with others (listed under Kirchner Marsh series), though slightly older.

*C. Alaska*

**Imuruk Lake series, Alaska**

Silty gyttja from pollen-dated core in Imuruk Lake (65° 34’ N Lat, 163° 12’ W Long), Seward Peninsula, Alaska. Arboreal pollen is notably deficient throughout the 8-m-long core, indicating that tundra conditions have prevailed in the region throughout the recorded history, which includes the latest dry-land episode of the Bering Land Bridge (Colinvaux, in press). Pollen stratigraphy is divisible into 12 zones; their correlation with glacial and interglacial stages, or, alternatively, with substages of the Wisconsin and Holocene, depends on their absolute ages. Full description by Colinvaux is in course of publication. Coll, 1960 and subm. by Paul A. Colinvaux, Duke Univ. (present address: Queen’s Univ., Belfast, N Ireland).
Y-1144. Imuruk 0.35 m  
12,355 ± 160  
10,405 B.C.

At base of high-Alnus (latest) Zone L. Comment: unexpectedly great age of this sample, supposedly near top of a tripartite postglacial sequence, is approximately confirmed by date of 13,250 ± 700 (I-588, Isotopes, Inc., unpublished) for a slightly deeper sample (0.5 m).

Y-1142. Imuruk 1.2 m  
>34,500

At middle of Zone J, where Betula pollen begins its latest rise; supposedly at base of tripartite postglacial sequence. Comment: evidently sample is early Wisconsin or older.

Y-1143. Imuruk 2.6 m  
>37,000

At middle of Zone I, where arboreal pollen (Betula, Alnus, Picea) is relatively high. Comment: in light of the date, the high-AP zone, formerly thought to be of Allerød and/or Bølling age, is most reasonably interpreted as either Sangamon or a mid-Wisconsin interstadial. Older episodes of the same sort, recorded between 1.2 and 8 m, are clearly beyond the reach of C¹⁴ dating. An Isotopes, Inc, date, 21,700 ± 2000 (I-415, unpublished) for the 7.5-m level, is shown to be more probably infinite by this sample and Y-1142.

Anaktuvuk Pass series (continued), Alaska

Wood and organic matter from deposits related to glaciation in the Anaktuvuk Pass district, Alaska. Coll. 1961 and subm. by Stephen C. Porter, Univ. of Washington, Seattle 5. A full account, by Porter, has been subm. for publication.

Y-1082. Summit Lake 14 ft  
7240 ± 100  
5290 B.C.

Organic matter, 14 ft depth, from perennially frozen lacustrine silt in an Eskimo cellar beside Summit (Eleanor) Lake (68° 09' N Lat, 151° 43' W Long). Silt was deposited in a small temporary lake marginal to wasting ice during a retreatal phase of the Echoka glaciation. A sample from the same unit, at 9 ft depth below surface, was dated 6260 ± 160 (Y-770, Yale VI). Comment (S.C.P.): provides a minimum age for a late readvance during the Itkillik glaciation in the Anaktuvuk Valley.

Y-1083. Anaktuvuk River  
A.D. 670  
1280 ± 80

Peat and willow twigs from layer of fine sand near middle of an 8-ft section of stratified sand and gravel in cutbank of Anaktuvuk River, ca. 3 mi S of Banded Mountain (68° 32' N Lat, 151° 15' W Long). Comment (S.C.P.): sample gives maximum age for cutting of lowest terrace in outwash from a moraine that represents a readvance of the Itkillik ice intermediate between those dated by Y-1084 and Y-1082.

Y-1084. Anayaknaurak Creek  
13,270 ± 160  
11,320 B.C.

Willow twigs from yellowish lacustrine sand overlying gravel (outwash), 7 ft thick, and stony till, 15 ft thick, overlain by till and outwash, cutbank on
Anaktuvuk River 0.5 mi N of mouth of Anayaknaurak Creek (68° 31' N Lat, 151° 17' W Long). Comment (S.C.P.): dates a glacial readvance during the Itkillik glaciation along Anaktuvuk River.

Y-1085. Anayaknaurak Creek, outwash  

Organic matter underlying 15 in. of pebble gravel and 18 in. of till (?), overlying 10 ft of cobble gravel, cutbank of Anaktuvuk River nr mouth of Anayaknaurak Creek (68° 30' N Lat, 151° 18' W Long). Comment (S.C.P.): sample description was erroneous; no till is present in section. Sample gives minimum date for beginning of dissection of outwash fan associated with a glacial readvance intermediate between those dated by Y-1082 and Y-1084.

Y-1086. Shainin Lake + 5 ft  

Willow twigs from stratified deltaic sand, S end of Shainin Lake (68° 20' N Lat, 151° 03' W Long), 5 ft above base of cutbank nr mouth of Alapah Creek. Delta was built into a lake dammed by ice of the Echouka glaciation that occupied the basin now filled by Shainin Lake. Comment: see Y-1087.

Y-1087. Shainin Lake + 9 ft  

Willow twigs from same locality and unit as Y-1086, 9 ft above base of cutbank. Comment (S.C.P.): delta, interpreted as glacial, is clearly younger than the glacial advance dated at 7240 ± 100 by Y-1082. The two dates, Y-1086 and Y-1087, are in reverse of stratigraphic order, possibly by interchange of their numbers, but both are reasonable. The older is similar to that of Y-771 (2830 ± 120, Yale VI), which dates the maximum stand of the Alapah Mountain glaciation, and to that of Y-871 (2760 ± 150, Yale VI) on similar sediment in the Anaktuvuk Valley. The younger is similar to that of Y-872 (1120 ± 90, Yale VI) in the Anaktuvuk Valley. The implication is that sedimentation in both valleys was more or less continuous from ca. 3000 to ca. 1000 B.P.

D. Guatemala

Laguna de Petenxil series (continued), Guatemala

Gyttja from a core under ca. 4 m of water, Laguna de Petenxil (16° 55' N Lat, 89° 50' W Long), the first lake E of Flores in an E-W chain of lakes, Dept. of El Peten, Guatemala. Description is given in Yale VI, where the geographic position is wrongly reported. Subm. by G. E. Hutchinson and Ursula Cowgill, Yale Univ.

Y-1289. Petenxil II, 86-87, 90-91 cm  

Core II, 86 to 87 and 90 to 91 cm depth; small maximum in exchangeable K.

Y-1286. Petenxil II, 161-163 cm  

Core II, 161 to 163 cm depth; greatest maximum in exchangeable K.
Y-1285. Petenxil II, 250-251 cm

Bottom of Core II, 250 to 251 cm depth; small maximum in exchangeable K.

Comment (U.C.): first two sections of Core II are equivalent to the whole of Core III (Yale VI) in time. The rate of sedimentation is the same for the period 2170 ± 85 to 1305 ± 140 B.P., but there is an increase from 0.09 cm per yr in the top portion of Core III that is not reflected in Core II.

E. Hawaii

Molokai series, Hawaii

Peat from bog at Pepeopae (21° 07' 30" N Lat, 156° 55' W Long), alt 1214 m, ca. 22 km E of Molokai Airport, Molokai Island. Borings were made in the vicinity of Localities 1 and 9 as shown by Selling (1948, p. 61). Pollen stratigraphy is under investigation to supplement that by Selling. Coll. 1961 by Lucy Cranwell Smith, Dick Shutler, Jr., and Calvin Heusser; subm. by Heusser, Amer. Geog. Soc., New York 32, N. Y.

Y-1103. Pepeopae 1 m

From 1 m depth, Selling’s Localities 1 and 2.

Y-1104. Pepeopae 2 m

From 2 m depth, Selling’s Localities 1 and 2.

Y-1106. Pepeopae 3.2 m

From 3.3 to 3.4 m depth, Locality 1 and 3.2 m depth, Locality 2.

Comment: Selling (1948) established three zones in his Hawaiian pollen sections, Periods I and III being drier and probably cooler than Period II; correlation with Europe and the Americas suggested that I was late-glacial, II hypsithermal, and III post-hypsithermal. The dates support this interpretation. The published pollen diagram (Selling, 1948, pl. 24) indicates that the bottom few cm may belong to Period I, though Selling did not make this assignment; the date of Y-1106 places the sample farther back in the Wisconsin glacial age than was expected. Y-1104 lies well up in the hypsithermal zone, and Y-1103 lies at the transition to Period III. Both dates are as expected, and the Sub-Atlantic age of the zone boundary is in striking agreement with Selling’s correlation.

F. Australia

Kosciusko series, New South Wales

The Kosciusko area contains a variety of frost soils and minor landscape features believed to have originated during periglacial conditions. One such group of features, solifluction lobes and terraces, are being studied in detail. The lobes and terraces occur in stepwise arrangement on wind-exposed, well-drained slopes between 5° and 30°, mainly on metasediments, in the alpine tract above ca. 6500 ft. Present vegetation is fjaeldmark (dwarf open heath).
There are no indications of soil activity at present. In section, lobes and terraces show up to 2 ft of stony soil, with abundant fines and small stones, overlying a stony layer (frost debris without fines) that rests abruptly on bedrock. In places a relatively organic stone-free lens occurs between the stony upper soil and the stony layer, from which small carbonized fragments of fjældmark shrubs can be extracted. Some of these were coll. by A. B. Costin and B. Thom, C.S.I.R.O. Div. of Plant Industry, Canberra, and subm. by Costin.

**Y-1090. Kosciusko 1**  \[170 \pm 100\]  
A.D. 1780

Wood fragments, mainly *Epacris petrophila*, from nr base of terrace \((36^\circ 25' S \text{ Lat.} \ 148^\circ 17' E \text{ Long})\), between Mount Northcote and Mount Lee.

**Y-1091. Kosciusko 3**  \[120 \pm 130\]  
A.D. 1830

Same locality as Y-1090, but from nr base of an adjacent, lower terrace.

**Y-1092. Kosciusko 5**  \[2910 \pm 130\]  
\[960 \text{ B.C.}\]

Wood fragments from base of terrace \((36^\circ 26' S \text{ Lat.} \ 148^\circ 17' E \text{ Long})\), Mount Northcote.

**Y-1093. Kosciusko 6**  \[2980 \pm 180\]  
\[1030 \text{ B.C.}\]

From base of same terrace as Y-1092, 4½ ft farther downslope.

**Y-1094. Kosciusko 8**  \[2380 \pm 160\]  
\[910 \text{ B.C.}\]

From base of a terrace nr Y-1092 and Y-1093.

**Y-1095. Kosciusko 9**  \[2250 \pm 130\]  
\[300 \text{ B.C.}\]

From base of same terrace as Y-1094, a few feet farther downslope.

**Y-1096. Kosciusko 10**  \[1540 \pm 160\]  
A.D. 410

From buried layer in same terrace as Y-1094 and Y-1095, at slightly greater depth.

*Comment* (A.B.C.): the principal inference from the dates, most of which lie between 2250 and 3000 B.P., is that solifluxion has been active through a time known elsewhere as the Little Ice Age. In the most exposed areas between Mount Northcote and Mount Lee, activity appears to have continued at least up till the 18th century A.D. The stony layer beneath the organic lenses indicates a more severe period of frost action prior to the oldest dated episode of solifluxion (ca. 1000 B.C.); this may well have occurred during a glacial age. The rate of downslope movement of the lobe and terrace features appears to have been fairly rapid; at least it was too fast to be detected by C\(^{14}\) dating within a single body of material, as shown by the identity of dates for one pair (Y-1092 and Y-1093) and reversal of ages within another (Y-1094 and Y-1095). Fuller accounts of solifluxion and other periglacial features in the Kosciusko area are being prepared.
Murrumbidgee Plain series, New South Wales

Transported wood samples in alluvium, coll. by Trevor Langford-Smith as part of a study of geomorphic history of a sector of Australia’s inland plains (ca. 34° to 36° S Lat, 143° to 147° E Long) (Langford-Smith, 1960). The extensive, nearly flat alluvial plain, bordering the Eastern Highlands on the W and N, is being dissected by through-flowing rivers including the Murrumbidgee, a major tributary of the Murray, but was obviously deposited by older rivers, some of whose courses can still be traced and shown to be unrelated to the present drainage pattern. A network of distributary channels, implying an enormous subaerial delta or series of coalescent deltas, emerges from reconnaissance mapping; only its point of debouchment from the mountain front, nr Narrandera, is related to the present courses of the Murrumbidgee. Most of the prior watercourses are now dry throughout their length, and the region is without clearly defined surface drainage. The latest series of distributaries is believed to have been active in Wisconsin time and to have carried at least some water two or three times since then; their maximum discharge, as measured by wavelengths of meanders, implies a markedly pluvial climate in the middle to late Wisconsin. Time relations within the series and between the latest and older generations of prior watercourses are problematic.

Subm. by Langford-Smith, Univ. of Sydney.

Y-861. Darlington Point, 1A

\[11,140 \pm 160\] 9190 B.C.

From levee bank, 2.5 ft below present surface, accompanied by freshwater shells (35° 06’ S Lat, 146° 00’ E Long). Possibly related to an aboriginal midden.

Y-862. 4 mi NW of Darlington Point, 1B

\[2480 \pm 80\] 530 ± B.C.

From levee bank, ca. 3 ft below present surface (35° 00’ S Lat, 145° 58’ E Long), 4 mi downstream from Y-861 in same prior stream.

Y-864. 5 mi W of Wilbriggie, 1C-ii

\[4700 \pm 80\] 2850 B.C.

From pit in stream bed, part of cutoff and therefore possibly older than the latest prior-stream alluvium here (34° 54’ S Lat, 145° 56’ E Long), ca. 8 mi downstream from Y-862 in same prior stream. Part of deposit of driftwood, definitely not roots, 2 ft below present surface.

Y-865. Morundah Road, 2

\[4090 \pm 90\] 2140 B.C.

From bed of prior stream, ca. 3 ft below surface, Morundah Road, 6 mi S of Sturt Highway (34° 40’ S Lat, 146° 00’ E Long).

Y-867. Colleambally Sand Quarry, 4

\[>28,000\]

From current-bedded sand, 12 to 15 ft below present surface, Colleambally Sand Quarry, 6 mi S of Sturt Highway (34° 45’ S Lat, 146° 16’ E Long); in bed of prior stream considered on geomorphic evidence to be older than no. 1 (Y-861, 862, 864).
Yale Natural Radiocarbon Measurements VIII

Y-868.  Myrtlebank Station, Lake Cowal, 5  
19,270 ± 520  
17,320 B.C.

From bed of prior stream in another system (33° 35' S Lat, 147° 35' E Long), 17 ft below present surface.

Y-869.  Ca. 6 mi SW of Jemalong Weir, 6 A.D. 1650  
300 ± 70

From bed of same prior stream as Y-868, ca. 20 mi upstream (33° 28' S Lat, 147° 45' E Long), 1.5 ft below surface, but not certainly part of alluvium.  
Comment: sample may be part of a modern root, and is rejected as dating alluvium at this locality.

Y-870.  Warren-Gulargambone Road, 7 A.D. 520  
1430 ± 80

From levee of prior stream in another system, 150 mi N of Y-868 (31° 30' S Lat, 148° 00' E Long), ca. 1.5 ft below original surface (before recent erosion).  
Comment: as suspected, the latest series of distributaries was active through much or all of Wisconsin time, and continued to carry water in at least two widely separated places until a few hundred or thousand years ago; renewed activity after Australia's Great Arid Period is not ruled out and is rather favored by the clustering of dates into an old group, 11,000 yr or older, and a younger group, 4700 yr or younger. Within the series as a whole the time relations are too complex to be settled by so small a set of C¹⁴ dates; the geomorphic evidence of youthfulness is not entirely trustworthy, especially when comparisons are made over long distances. In the same prior stream, nr Darlington Point, N.S.W., Y-864 is slightly older than Y-862, as expected, but the date of Y-868, nr Lake Cowal, N.S.W., in a different system, proves it to be at least in part older than stream no. 1, in the Darlington Point district. A summary of the problem is given by Langford-Smith (1962); a fuller account is in preparation but is awaiting more field work and dating.

G. South Africa

Y-468.  Sedgefield, Knysna Division, S Africa  
37,700 ± 2000  
35,750 B.C.

Marine shells from a beach ca. 4 m above sealevel (4 m above top of marine layer at Groenvlei, which was bracketed between dates of 6870 ± 160, Y-466, and 1905 ± 60, Y-467; Yale IV); buried below a flat sandy plain, believed to be formed subaerially whose surface forms a terrace at Sedgefield (34° 01' S Lat, 22° 48' E Long), 2 mi W of Groenvlei and ca. 2 mi inland from the present coast. Upper sandy portion of section contains a red cemented band, thought to be part of a fossil soil and postdating the shells; shells include Calliostoma jultoni, not now living S of Delagoa Bay, 8° of latitude farther N, and Cerithium kochi, an Indo-Pacific species of similar implication, though still found at Algoa Bay, ca. 180 mi E and 1° of latitude N of Sedgefield. Coll. 1956 and subm. by A. R. H. Martin, Univ. of Sydney, N.S.W., Australia.  
Comment: shell bed is thought to belong to an older, higher sealevel than that recorded at Groenvlei (Martin, in press).  Calliostoma jultoni is recorded from
a similar beach at Klein Brak River, 40 mi W, where it was regarded as evidence of a postglacial hypsithermal interval (Krige, 1927), or as Last Interglacial (Maarleveld and van der Hammen, 1959). Older, higher marine features in the district, recording a sealevel at least 7 or 8 m above the present one, belong to a group commonly thought to be of last interglacial (Monastirian II) age. Features at 4 to 5 m above present sealevel, including the dated beach at Sedgefield, were ascribed by Krige to “a resting stage in the last emergence,” and may belong to the Epimonastirian of Zeuner, which may date from the interval between Early and Main Würm. The date, and the geomorphic evidence of youthfulness, favor such an assignment, but the climatic implication of the shells (sea-surface temperatures ca. 5° C higher than today’s) does not. A postglacial date is clearly ruled out, and there is no evidence of a postglacial sealevel more than 1.5 m above the present one in the Knysna district. The possibility of slight contamination of the shells by modern (atmospheric) C¹⁴, always present when very old carbonate is used for dating, makes it impossible to be sure that the Sedgefield deposit is not beyond the limit of C¹⁴ dating, and therefore probably of last interglacial age; but the shells were not exposed to air until collection, and contamination is not particularly likely.

II. Iran

Y-1160. Lake Zeribar, Iran, 16.25 m 14,800 ± 300 12,850 B.C.

Carbonate fraction of calcareous silty gyttja, Core I-12, 16.25 m depth, Lake Zeribar, Merivan (35° 31’ N Lat, 46° 07’ E Long), Iran. Pollen stratigraphy reported by van Zeist and Wright (1963); chemical analysis reported by Hutchinson and Cowgill (1963). A sample at a stratigraphically higher level in a different core, I-13, was dated 5460 ± 120 (Y-934, Yale VII, p. 255; the sample no. was omitted by mistake). Coll. 1960, as part of Oriental Inst. Exped., by H. E. Wright, Jr., and associates; subm. 1962, after chemical sampling, by G. E. Hutchinson, Yale Univ. Comment: sample falls nr top of Zone A, a high-chenopodiaceous-pollen zone, interpreted as cold and dry, at a maximum of Artemisia pollen. The implication, that the transition from cold to warm climate occurred at ca. 13,000 B.P., is elaborated by van Zeist and Wright. Zone A sediments are the most calcareous in this core; Hutchinson and Cowgill consider that this implies lack of an outlet, at least for considerable periods, and confirms the dry climate as inferred from pollen. Other samples from the same core contained too little carbon, either organic or inorganic, for dating.

II. ARCHAEOLOGIC SAMPLES

A. Northeastern United States

Y-933. St. Jones River site, Delaware 2330 ± 80 380 B.C.

at the West River site for the eastern dispersal of Adena: 75 B.C. (M-418, Michigan I; see also Ritchie and Dragoo, 1960).

Y-1168. **Wapanucket No. 8 site, Massachusetts**

Charcoal from Feature 32 at the Wapanucket No. 8 site (41° 52' 30" N Lat, 70° 52' 30" W Long), on the north shore of Assawompsett Lake in Middleboro, Plymouth County, Massachusetts. Coll. August 1960 by Maurice Robbins; subm. by G. A. Agogino, Boston College. **Comment:** Wapanucket No. 8 site seems to contain two components, one Paleo-Indian and the other Archaic, though they are not separated stratigraphically. This date evidently pertains to the Archaic occupation, since it agrees with three dates previously obtained from the Wapanucket No. 6 site, which is Late Archaic: 2300 B.C. (M-764), 2370 B.C. (W-363), and 2350 B.C. (M-969). (Robbins, 1959; Michigan IV.)

Y-1157. **Hartland, Vermont**

Charcoal from Squares N35/E10 and N40/E10, Level 4, site VT 35A-3 at Sumner Falls (43° 32' N Lat, 72° 23' W Long), on the Connecticut River, Hartland, Vermont. Coll. 1952 and subm. by H. R. Sargent, Claremont, N. H. **Comment:** associated with an Archaic deposit, underlying a ceramic occupation. Date is at the top of the range for this type of culture (see preceding and following dates).

Y-1169. **Bent site, New York**

Charcoal from Feature 12 in Section, E10S10, Bent site (Ams 73), Schenectady County, New York (42° 51' N Lat, 74° 1' W Long). Coll. May 1961 by R. E. Funk; subm. June 1962 by W. A. Ritchie, New York State Mus. and Sci. Service, Albany. **Comment (W.A.R.):** feature was a hearth, 29 in. below the present surface, which contained, besides the charcoal and burned stones, a Normanskill-type projectile point, the characteristic type of the newly defined River focus, Late Archaic period, of which this is the largest known station.

Y-1170. **Snook Kill site, New York**

Charcoal from Feature 4, a fire pit, 32 in. deep in the Snook Kill site (Sev 19-2), Saratoga County, New York (43° 13' 42" N Lat, 73° 35' 36" W Long). Coll. May 1960 by W. H. Rice; subm. June 1962 by W. A. Ritchie. **Comment (W.A.R.):** Material came from basal 8 in. of pit, which contained no artifacts. Pit is believed to pertain to the Snook Hill focus, Late Archaic period (Ritchie, 1958, p. 91-98).

Y-1171. **Morrow site, New York**

Charcoal from a cremation in situ on the Marrow site, Honeoye, Ontario County, New York (42° 47' N Lat, 77° 30' W Long). Depth ca. 30 in. from the surface. Coll. October 1956 and subm. June 1962 by W. A. Ritchie. **Comment (W.A.R.):** this feature, Burial 1, contained grave goods typical of the Meado-
wood focus (formerly termed the early Point Peninsula culture), Early Woodland period.

**Y-1172. Wickham site, New York**

Charcoal from the Wickham site (Sry 1), Section 2, at Brewerton, Oswego County, New York (43° 13' 58" N Lat, 76° 08' 31" W Long). From depth of 19 in. in stratified midden deposits. Coll. 1950 and subm. June 1962 by W. A. Ritchie. **Comment (W.A.R.)**: pertains to the late Point Peninsula culture, late Middle Woodland period (Ritchie, 1946).

**Y-1173. Maxon-Derby site, New York**

Charcoal from large hearth, Feature 38, in Section E50S20, Maxon-Derby site (Bwv B-3), Onondaga County, New York (43° 03' 42" N Lat, 76° 26' 46" W Long). Coll. August 1960 and subm. June 1962 by W. A. Ritchie. **Comment (W.A.R.)**: this is a large village site of an early phase of the Owasco culture, Late Woodland period.

**Y-1174. Bates site, New York**

Combined charcoal from Features 1A, B and 80, Bates site (Grn 1), 2½ mi S of Greene, Chenango County, New York (42° 17' 50" N Lat, 75° 47' 42" W Long). Feature 1 A, B (Section W10N100) consisted of two overlapping storage pits, 25 and 32 in. deep respectively. It contained much carbonized organic material, pottery, and other artifacts. Sample coll. from it July 1957 and subm. June 1962 by W. A. Ritchie. Feature 80 (Section EON110) was a large storage pit, 29 in. deep. Charcoal found in basal 8 in., together with restorable pot and other artifacts. Coll. August 1958 and subm. June 1962 by W. A. Ritchie. **Comment (W.A.R.)**: a single component site of a middle phase of the Owasco culture, Late Woodland period.

**B. Middle America**

**Y-1149. Porrúa manuscript**

Portion of mammal skin, painted with hieroglyphs of Maya style, provenience not known; a facsimile edition has been published (Librería de Manuel Porrúa, 1957). Subm. by Manuel Porrúa, Apdo. Post. 14470, México 1, México. **Comment**: although C¹⁴ dating is too full of small uncertainties to be successfully applied to objects so young, the date obtained makes it very unlikely that this document is a pre-Conquest survival.

**Salinas La Blanca series, Guatemala**

Salinas La Blanca (14° 30' N Lat, 92° 10' W Long), is a small village site on the E bank of the Naranjo River, in the Department of San Marcos, Guatemala; it is not far from the village of Ocós, and only 1¾ km from the Pacific Ocean. The site consists of two broad, low mounds built up from refuse deposits. Excavations were confined to two contiguous cuts in Mound 1, which had been partly carried away by the river; sterile deposits were reached at a
depth of 6.5 m. The lowermost 4.5 m of the mound produced materials of a newly defined culture, the Cuadros phase, characterized by a predominance of neckless, globular jars, by a lack of figurines, and by an economy based in part upon maize farming and in part upon the collection of fauna in the estuaries and mangrove forests. Mineralized cobs found in Cuadros refuse are the oldest specimens of maize yet found in Guatemala. Cuadros is believed to predate the Ocós culture, previously found at La Victoria in the same region, but the evidence is not conclusive. Samples coll. 1962 by M. D. Coe and K. V. Flannery under the Inst. for Andean Research program “Interrelationships of New World Cultures;” subm. by M. D. Coe.

Y-1150. Cuadros phase

Charcoal from small hearth in northeast corner of Cut 2, 3.38 m below datum in Level 0 (3.20-3.40 m). Comment (M.D.C.): should be late in the Cuadros phase.

Y-1151. Cuadros phase

Charcoal from hearth in northeast quadrant of Cut 2, 4.50 m below datum in Level U (4.40-4.60 m). Comment (M.D.C.): should be older than Y-1150.

Y-1154. Cuadros phase

Charcoal from refuse layer in Cut 1, Level BB (5.80-6.00 m). Comment (M.D.C.): sample is early in the Cuadros phase.

Y-1166. Cuadros phase

Sample probably consisted entirely of charred bone; it dissolved completely in an alkali solution. The alkali precipitate has been dated. From hearth, northwest quadrant of Cut 1, Level CC (6.00-6.20 m). Comment (M.D.C.): this should be the oldest sample in the series, lying just above sterile deposits and immediately above the water table. All of the above dates are not inconsistent with each other, considering the statistical error, but are somewhat later than expected.

Y-1167. Río Naranjo site

Charcoal extracted from hearth in face of mound cut by the Naranjo River, lying approximately halfway between Salinas La Blanca and the sea, near Ocós, San Marcos, Guatemala. Coll. 1962 by M. D. Coe and K. V. Flannery; subm. by M. D. Coe. Comment (M.D.C.): cut face of mound produced abundant ceramics of the Conchas phase, and thus should date the Middle Formative period in this part of the Pacific Coast of Guatemala, previously estimated as 800-300 B.C. It should postdate the Cuadros phase, probably by more than a century.

Nicaragua series

Charcoal samples from the Isthmus of Rivas and Ometepe Island in Lake Nicaragua (11° 30’ N Lat, 85° 30’ W Long), Department of Grenada,
Nicaragua. Coll. 1961 by A. H. Norweb; subm. by G. R. Willey, Peabody Mus. of Archaeol. and Ethnol., Harvard Univ., Cambridge, Mass. Like the preceding Guatemala series, this was a project of the Inst. for Andean Research program “Interrelationships of New World Cultures.”

Y-1122. Rivas, Gr-5, 195 cm $1380 \pm 70$

Charcoal from Cut 2 in the Ayala site (Gr-5) on the Isthmus of Rivas, depth of 195 cm. Comment (G.R.W.): dates the beginning of the Santa Isabel phase, probably on the line between the Early Polychrome A and B periods.

Y-1124. Rivas, Gr-5, 285 cm $1390 \pm 100$

Charcoal from Cut 2 in the Ayala site (Gr-5) on the Isthmus of Rivas, depth of 285 cm. Comment (G.R.W.): San Jorge phase, probably in the upper range of the Zoned Bichrome period. Should be earlier than Y-1122.

Y-1125. Ometepe Island, Ri-7 $1170 \pm 120$

Charcoal from Cut 2 in the Cruz site (Ri-7) on Ometepe Island ca. 500 m S of Puerto Gracia, depth of 260 cm. Comment (G.R.W.): dates the end of the Santa Isabel phase, on the line between the Early Polychrome B and Middle Polychrome periods. General comment: these determinations agree well with the $^{14}$C dates previously obtained for the nearby province of Guanacaste, Costa Rica (Yale VI). They also confirm the sequence of periods worked out by M. D. Coe and C. F. Baudez for northwestern Costa Rica (Coe, 1962, Fig. 3).

C. Northern South America

Y-927. La Pitía, Venezuela $1880 \pm 100$

Charcoal from Section SS-110, depth of 1.5 m in the shell heap of La Pitía (11° 13' N Lat, 71° 57' W Long), near Paraguaipoa, state of Zulia, Venezuela. Associated with culture of the Hokomo phase dated in Period II of the Cruxent-Rouse chronology (Gallagher, 1962). Coll. 1960 and subm. by Patrick Gallagher, George Washington Univ., Washington, D. C. Comment: agrees with other dates for the latter part of Period II.

Rancho Peludo series, Venezuela

Rancho Peludo is a village on the Río Guasare (11° 4' N Lat, 72° 3' W Long), ca. 50 km NW of Maracaibo, state of Zulia, Venezuela. Refuse is eroding out of the bank of the river between the depths of 1 and 2 m. J. M. Cruxent, of the Inst. Venezolano de Inv. Cient., collected the first sample (Y-578) in 1957; remaining samples coll. 1961 by Cruxent and Irving Rouse, to check the validity of the first determination; subm. by Rouse (Rouse and Cruxent, 1963, in press).
Y-578. Rancho Peludo, Cruxt excavation  4630 ± 150
Charcoal from a depth of 1.80 in the original Cruxt excavation.

Y-1108-I. Rancho Peludo, A1, 1.00 to 1.25  2330 ± 80
Charcoal scattered through Section A-1, Level 1.00 to 1.25 m, of the
Cruxt-Rouse excavations.

Y-1108-II. Rancho Peludo, A1, 1.25 to 1.50  2680 ± 80
Charcoal scattered through Section A1, Level 1.25 to 1.50 m.

Y-1108-III. Rancho Peludo, A1, 1.50 to 1.75  6190 ± 90
Charcoal scattered through Section A1, Level 1.50 to 1.75 m.

Y-1108-IV. Rancho Peludo, A1, 1.75 to 2.00  13,920 ± 200
Charcoal scattered through Section A1, Level 1.75 to 2.00 m.

Y-1109. Rancho Peludo, B1, 1.50 to 1.75  3750 ± 80
Charcoal scattered through Section B1, Level 1.75 to 2.00 m, of the
Cruxt-Rouse excavations.

Y-1110. Rancho Peludo, C1, 1.75 to 2.00  3810 ± 90
Charcoal scattered through Section C1, Level 1.75 to 2.00 m, of the
Cruxt-Rouse excavations.

General comment: all these samples are consistent with each other, as well as
with their relative depths in the deposit, except Y-1108-III and -IV, which may
have been contaminated with charcoal from an underlying Paleo-Indian de-
posit, brought up through the digging of graves. Otherwise, the samples date
a Meso-Indian deposit with pottery of the Rancho Peludo style, referred to
Period I and early Period II on the relative time scale.

Paria series, Venezuela
Charcoal samples from three sites near the end of the Peninsula of Paria,
state of Sucre, Venezuela. Coll. 1961 by J. M. Cruxt and Irving Rouse;
subm. by Rouse.

Y-1111. Amacuro  690 ± 70
A.D. 1260
Charcoal from Section A1, Level 0.25-0.50 m in the Amacuro site at the
tip of the Peninsula of Paria (10° 40' N Lat, 61° 57' W Long). Associated
with pottery of the Guayabita style, Period IV.

Y-1112. Cabrantica  1320 ± 100
A.D. 630
Charcoal from Sections A-C, Level 0.50 to 0.75 m in the Cabrantica site,
near Güiria (10° 39' N Lat, 62° 14' W Long). Associated with pottery of the
Irapa style, Period III.
Y-1113. Punta de Piedras 1680 ± 80
A.D. 270
Charcoal from Section G-5, depth of 0.50 m, in the Punta de Piedras site (10° 33' N Lat, 62° 27' W Long). Associated with the Irapa style of Period II. General comment: the dates are consistent with the relative chronology for the Peninsula of Paria and with the age of the one sample from there previously analyzed, A.D. 325, which is associated with the Irapa style (Y-290, Yale II; see also Rouse and Cruxent, 1963).

D. West Indies

Y-650. Troumassée, St. Lucia 1220 ± 100
A.D. 730
Charcoal from Pit 6, depth of 60 to 66 in. in field No. 13-11, Troumassée site (13° 50' N Lat, 60° 53' W Long), St. Lucia, British West Indies. Coll. 1957 and subm. by Marshall McKusick, State Univ. of Iowa, Iowa City. Comment: Troumassée is the type site for the Period III style of St. Lucia. The date agrees with expectation.

Y-1115. Grand Anse, St. Lucia 1460 ± 80
A.D. 490
Charcoal from Grande Anse site (14° 1' N Lat, 60° 53' W Long), St. Lucia, British West Indies, depth of 66 to 72 in. Coll. Feb. 1961 by W. G. Haag, Louisiana State Univ.; subm. by Irving Rouse. Comment: dates the Troumassée style of Period III and is to be compared with the preceding sample; it is earlier than expected.

Y-1116. La Salle, Martinique 1770 ± 80
A.D. 180
Charcoal from La Salle site (14° 46' N Lat, 61° 0' W Long), Sainte Marie, Martinique, French West Indies, depth of 24 to 30 in. Coll. May 1961 by W. G. Haag; subm. by Irving Rouse. Comment: dates the earliest, Sáladoid pottery of the island, apparently marking the first movement of Neo-Indians from Venezuela into the Antilles. Agrees fairly well with the date of A.D. 270 for the supposed source of the movement in the Irapa style on the Peninsula of Paria, Venezuela (this list, Y-1113); see also next series.

Morel series, Guadeloupe

Morel (16° 19' N Lat, 61° 19' W Long), is a large village site at La Moule on the NE coast of Grande-Terre, Guadeloupe, French West Indies. Coll. 1961 by Edgar Clerc; subm. by Irving Rouse.

Y-1136. Morel, Sector 5 1380 ± 100
A.D. 570
Charcoal from the base of the refuse, 2.0 m deep, in Sector 5.

Y-1137. Morel, Sector 2 1730 ± 70
A.D. 220
Charcoal from the base of the refuse, 1.5 m deep, in Sector 2.

Y-1138. Morel, Sector 3 1710 ± 100
A.D. 240
Charcoal from the base of the refuse, 2.0 m deep, in Sector 3.
General comment: these samples are associated with the earliest, Saladoid pottery of the island and therefore should date the colonization of the Antilles by Neo-Indians from Venezuela, as does the preceding sample (Y-1116). The agreement between the two is quite good.

White Marl series, Jamaica

White Marl (17° 55' N Lat, 77° 3' W Long), is a village site in St. Catherine Parish, Jamaica, British West Indies. Coll. June 1961 and subm. by R. R. Howard, Univ. of Wisconsin, Milwaukee. Comment: White Marl was inhabited by Sub-Taino, who should date from late Period III or Period IV. The following C\(^14\) determinations confirm this.

Y-1117. White Marl 3, 50 to 60 in. 1020 ± 100 A.D. 930
Charcoal and coney bone from test trench in midden No. 3, Level 50 to 60 in.

Y-1118. White Marl 2, 40 to 50 in. 1070 ± 100 A.D. 880
Charcoal and coney bone from test trench in midden No. 2, Level 40 to 50 in.

Y-1119. White Marl 3, 40 to 50 in. 620 ± 100 A.D. 1330
Charcoal and coney bone from midden No. 3, Level 40 to 50 in.

E. Angola

Feti la Choya series, Angola

Charcoal from a large midden, traditional burial place of Choya, legendary primal queen of the Ovimbundu; part of a large fortified site containing stonework and evidence of intensive iron smelting, nr confluence of Kuene and Kunyongamua Rivers (13° 26' S Lat, 15° 53' E Long), Angola, Social anthropology and folklore of the Ovimbundu was described by Childs (1949); site is described in Bol. Inst. Angola, no. 10, p. 55-75, 1957. Samples collected by G. M. Childs, anthropologist and missionary, in a shaft sunk (by treasure hunters) at S side of midden, where sterile soil was encountered at 2.5 m depth. Subm. 1958 by M. W. Ennis, 63 N Hancock St., Lexington 73, Mass., for Childs, c.p. 230, Nova Lisboa, Angola.

Y-587. Feti la Choya, bottom 1240 ± 100 A.D. 710
From bottom layer, overlying sterile soil, accompanied by pottery and animal bones, not yet studied.

Y-588. Feti la Choya, 1 m 700 ± 65 A.D. 1250
From lower layer of midden, ca. 1.5 m above sterile soil, in same shaft as Y-587.

Comment: Childs notes that while the older date is much older than any previously estimated (for Iron Age material) for Angola, it is not out of line with C\(^14\) dates for Iron Age sites in Rhodesia and South Africa. J. Desmond Clark,
Univ. of California, Berkeley, comments that the dates bracket the time, ca. A.D. 1100, when the first stone walling was being constructed at Zimbabwe, in Rhodesia. Full significance of the Fetila Choya finds in relation to other sites cannot be appraised without study of the pottery, now in the U.S.

III. GEOCHEMICAL SAMPLES

The following samples complete the list begun in Yale VI and Yale VII. A paper on carbon isotopes in Linsley Pond is in press (Deevey and Stuiver, in press). Mud-surface samples from Rogers Lake have been used to calculate ages of older sediments (Rogers Lake series, this date list).

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<thead>
<tr>
<th>YALE NO.</th>
<th>DESCRIPTION</th>
<th>δC¹⁴</th>
<th>δC¹³</th>
<th>Δ</th>
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<tr>
<td>Y-1080</td>
<td>Linsley Potamogeton, outlet, 1961</td>
<td>+68.2 ± 10</td>
<td>-16.6</td>
<td>+50.3 ± 10</td>
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<td>Potamogeton, nr outlet, Sept, 6, 1961</td>
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<td>Y-1081</td>
<td>Linsley Nuphar, September 1961</td>
<td>+202.6 ± 10</td>
<td>-23.8</td>
<td>+205.5 ± 10</td>
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<td>Nuphar, Sept. 6, 1961</td>
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<tr>
<td>Y-1126</td>
<td>Linsley deep December 1961</td>
<td>-0.2 ± 7</td>
<td>-12.0</td>
<td>-26.2 ± 7</td>
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<td>Water from 13 m depth, Dec. 12, 1961</td>
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<tr>
<td>Y-1127</td>
<td>Linsley surface December 1961</td>
<td>+0.7 ± 7</td>
<td>-6.9</td>
<td>-35.5 ± 7</td>
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<td>Surface water, Dec. 12, 1961</td>
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<td>Y-1128</td>
<td>Linsley inlet December 1961</td>
<td>-37.7 ± 8</td>
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<td>Water from N inlet, Dec. 12, 1961</td>
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<td>Y-1148</td>
<td>Linsley deep March 1962</td>
<td>-93.9 ± 8</td>
<td>-8.0</td>
<td>-124.7 ± 8</td>
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<td>Water from 13 m depth, under ice, Mar. 10, 1962</td>
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<td>Y-1180</td>
<td>Linsley surface mud, 1st</td>
<td>-133.0 ± 10</td>
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<td>From 0 to 5 cm below mud-water interface in core, 14.1 m depth, coll, June 14, 1962 by E. S. Deevey.</td>
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<tr>
<td>Y-1181</td>
<td>Linsley surface mud, 2nd</td>
<td>-145.0 ± 10</td>
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<tr>
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<td>From 5 to 10 cm depth below</td>
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</table>
YALE NO.  | DESCRIPTION                                                                 | $\delta^{14}C$ | $\delta^{13}C$ | $\Delta$
         |                                                                                         | %o       | %o       | %o       

mud-water interface, same core as Y-1180.

**Y-1182.** Linsley surface mud, 3rd

$-212 \pm 10$

From 10 to 15 cm below mud-water interface, same core as Y-1180.

**Y-1183.** Linsley surface mud, 4th

$-172 \pm 10$

From 15 to 20 cm below mud-water interface, same core as Y-1180.

**Y-1070.** Wononscopomuc pondweeds 1961

$+10.4 \pm 10$  
$-16.1$  
$-7.4 \pm 10$


**Y-1072.** Queechy pondweeds 1961

$-130.8 \pm 10$  
$-17.3$  
$-144.2 \pm 10$

Potamogeton, Queechy Lake, July 17, 1961.

**Y-1101.** Queechy well 1961

$-289.1 \pm 10$  
$-12.4$  
$-307.0 \pm 10$

Hard-water well on Kontak property, Queechy Lake, Sept. 24, 1961.

**Y-1067.** Rogers Nuphar 1961

$+179.6 \pm 10$  
$-23.6$  
$+176.3 \pm 10$


**Y-1068.** Rogers pondweeds 1961

$+47.2 \pm 10$  
$-16.1$  
$-7.4 \pm 10$


**Y-1261.** Rogers surface mud, 1st

$-103.0 \pm 10$

From 0 to 9 cm below mud-water interface, in core, 10 m depth, S basin, Rogers Lake, Sept. 10, 1962.

**Y-1262.** Rogers surface mud, 2nd

$-78.0 \pm 12$

From 9 to 23 cm below mud-water interface, same core as Y-1261.
Date lists:

- Isotopes I: Walton, Trautman, and Friend, 1961
- Chicago I: Arnold and Libby, 1951
- Michigan I: Crane, 1956
- Michigan IV: Crane and Griffin, 1959
- Uppsala III: Olsson et al., 1961
- USGS IV: Rubin and Alexander, 1958
- USGS V: Rubin and Alexander, 1960
- Yale II: Preston, Person, and Deevey, 1955
- Yale III: Barendsen, Deevey, and Gralenski, 1957
- Yale IV: Deevey, Gralenski, and Hoffren, 1959
- Yale VI: Stuiver and Deevey, 1961
- Yale VII: Stuiver and Deevey, 1962

References


Robbins, Maurice, 1959, Wapanucket No. 6, an Archaic village in Middleboro, Massachusetts: Attleboro, Massachusetts Archaeol. Soc.


ABSTRACT

PRETREATMENT OF WOOD AND CHAR SAMPLES

HYMAN SCHULTZ, L. A. CURRIE, F. R. MATSON, and W. W. MILLER

The Pennsylvania State University, University Park, Pennsylvania

It has been shown that contamination from humic acids, chitin, fungal products, etc., contributing young carbon, and from bitumen and carbonate, contributing old carbon, may not be completely removed from wood and char samples by the usual hydrochloric acid and sodium hydroxide pretreatments of the samples. A procedure is offered for the isolation of a pure chemical substance from such samples, cellulose from wood and uncombined carbon from char, that must represent the original material. Cellulose is prepared by boiling the resin-free sample in 1.25% H₂SO₄ and 1.25% NaOH, adding Schweitzer's reagent, filtering, and precipitating from the filtrate by acidification. Uncombined carbon is separated from char samples as the flocculant precipitate remaining after boiling in 70% HNO₃, followed by settling overnight from a large volume of 6M HNO₃. A simple procedure for the chemical examination of char samples is also offered for the estimation of the amounts of bitumen, carbonate, combined, and uncombined carbon in char.

In a particular example, wood and char samples from the Cape Krusenstern, Alaska site dated at Bern with no pretreatment (B-267A,B: 2500 B.P., Bern II) and at the University of Pennsylvania after an alkali pretreatment (P-404: 2850 B.P., P-400: 3700 B.P., from E. K. Ralph, unpublished) were dated by counting methane made from cellulose extracted from the wood and from uncombined carbon extracted from the char. The fractions so measured are coeval, with a mean age of 4600 ± 400 B.P.

Experimental details are contained in the Ph.D. Thesis of Hyman Schultz, The Pennsylvania State University, 1962. Microfilm copies may be obtained from University Microfilms, Inc., Ann Arbor, Mich. A fuller account has been submitted to Analytical Chemistry.

REFERENCE

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 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 have inadvertently been published with the code designation S (Pringle and others, 1957, Science, v. 125, p. 69-70). We substitute Ma in conformity with the wishes of the laboratory, as do McNutt and Wheeler in their bibliography (1959, Am, Antiquity, v. 24, p. 232-234).
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.
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<table>
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<td>Dr. Ingrid Olsson</td>
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<td>UCLA</td>
<td>Prof. G. J. Fergusson and Dr. W. F. Libby</td>
<td>Institute of Geophysics, University of California, Los Angeles 24, California</td>
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Radiocarbon

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