

## UCLA RADIOCARBON DATES V\*

RAINER BERGER and W. F. LIBBY

Institute of Geophysics, University of California, Los Angeles 90024

The measurements reported have been carried out during 1965 in the Isotope Laboratory of the Institute of Geophysics and Planetary Physics as a continuation of the UCLA date lists I through IV. Samples were analyzed as CO<sub>2</sub>-gas at one atm in a 7.5 L proportional counter with three energy channels. Dates have been calculated on the basis of a 5568 yr half-life as was recommended by the Sixth International C<sup>14</sup> and H<sup>3</sup> Dating Conference, June 1965, in Pullman, Washington. The standard for the contemporary biosphere remains as 95% of the count rate of NBS oxalic acid for radiocarbon laboratories. Background determinations have been made with CO<sub>2</sub> obtained from marble. The error listed is always at least a one-sigma statistical counting error.

All measurements have been classified in the following way:

- I. Archaeologic-Historic Dates
  - A. United States
  - B. Mexico
  - C. South America
  - D. Pacific and Far East
  - E. Europe
  - F. Egypt
  - G. Africa
- II. Geophysical, Geological-Climatological and Biological Measurements
  - A. C<sup>14</sup> in Atmospheric Carbon Dioxide
  - B. Bomb C<sup>14</sup> in Foodstuffs
  - C. Bomb C<sup>14</sup> in Human Tissues
  - D. Bomb C<sup>14</sup> in Plants
  - E. Oceanic Measurements
  - F. Vegetation and Climate
  - G. Geological Processes

### ACKNOWLEDGMENTS

We are indebted to the National Science Foundation for Grant GP 1893 for continued financial support and acknowledge the competent assistance of Darakant Chamnirokasant, Gonenc Ciliv, Bette L. Davis, C. R. Atluri, Ralph Staudenmayer, Deborah Y. Tubbs, and R. Ervin Taylor.

\* Publication number 480, Institute of Geophysics and Planetary Physics, University of California, Los Angeles.

## SAMPLE DESCRIPTIONS

## I. ARCHAEOLOGIC-HISTORIC DATES

## A. United States

**Panamint Valley series, California**

This study is concerned with establishment of radiocarbon chronology of environmental changes in this valley since the Pleistocene and its occupancy by prehistoric man. Panamint Valley is located close to California/Nevada state line at approx.  $36^{\circ} 20' N$  Lat,  $117^{\circ} 20' W$  Long. Coll. and subm. by E. L. Davis, UCLA.

**UCLA-989. Panamint**

**10,020  $\pm$  120**  
**8070 B.C.**

Organic material at 4 to 6 ft depth below present fan surface following curve of former lake bed. *Comment* (E.L.D.): material underlies more recent soils containing charcoal lenses and cultural waste (stone flakes) probably associated with Lake Mohave culture (Campbell, 1937).

**UCLA-990. Panamint**

**10,520  $\pm$  140**  
**8570 B.C.**

Burnt reeds at approx. 14 in. below surface in Trench #2 at N end of Lake Hill. *Comment* (E.L.D.): no cultural material found in soil directly overlying sample. However it is contained in an organic rich layer probably associated stratigraphically with UCLA-989.

**Santa Rosa Island, Fire Area series, California**

In ca. 1 mi of sea cliffs on Santa Rosa Island, there are approx. 100 fire areas exposed in Tecolote member of Santa Rosa Island formation (Orr, 1960), which are uniform in structure of 2 types.

1. A "U"-shaped pit, ca. 2 ft in diam and depth
2. A saucer-shaped area 6 to 8 ft in diam

Both of these indicate very hot fires for a long time in a confined space which burned the clay a brick red. Many of the fire areas contain charred dwarf mammoth or bird bones. It has been suggested that these fire areas may be the work of Pleistocene man (Orr, 1956a).

Dates for similar areas are L-290-R at  $29,700 \pm 3000$  and L-290-T at  $12,500 \pm 500$  (Lamont IV); M-599 at  $16,700 \pm 1500$  (Michigan III); UCLA-106 at  $11,800 \pm 800$  (UCLA I).

The following dates are part of an extensive investigation into the possible presence of Pleistocene man on Santa Rosa which will be discussed in greater detail elsewhere. Coll. and subm. by P. C. Orr, Santa Barbara Mus. of Nat. History, California, and R. Berger, UCLA.

**UCLA-748. Santa Rosa Island**

**11,300  $\pm$  160**  
**9350 B.C.**

Black muck and charcoal chunks from center of fire area, 22 in. thick at center and overlaid by bright brick red burned earth from Arlington Springs site #131.173 (Santa Barbara Mus. of Nat. History),

Santa Rosa Island (34° 00' N Lat, 120° 10' W Long). At depth of 10 ft in mammoth-bearing Tecolote member of Santa Rosa Island formation, slightly deeper, stratigraphically, than human bone (L-650 at 10,000 ± 200, Lamont VII; Orr, 1962a, 1962b) and ca. 10 ft below M-1133 (7350 ± 350, Michigan VII).

**UCLA-746. Santa Rosa Island**

**27,000 ± 800**

**25,050 B.C.**

Charcoal from typical "U"-shaped fire area, ca. 2 ft in diam and 9 ft below surface in upper Tecolote member of Santa Rosa Island formation at Otter Point, Santa Rosa Island (34° 20' 00" N Lat, 120° 12' 08" W Long). Fire lies ca. 100 yd W of similar fire area dated at 16,700 ± 1500 B.P. (M-599, Michigan III) at depth of 6 ft and both dates indicate slow rate of deposition on head of Garanon alluvial fan at a time when sea-level was -45 to -50 fathoms (Fairbridge, 1960; Curry, 1960) and the shoreline between 4.7 and 5.2 nautical mi from present.

**UCLA-749. Santa Rosa Island**

**>37,000**

Rich charcoal from elliptical fire area ca. 3 ft in diam at depth of 80 ft in Tecolote member of Santa Rosa Island formation E of Arlington Canyon, Santa Rosa Island (34° 25' 00" N Lat, 120° 10' 30" W Long).

**UCLA-732. Santa Cruz Island, California**

**220 ± 80**

**A.D. 1730**

Charcoal from depth of 4 ft in Canalino Indian midden in Cueva Escondito, Santa Cruz Island (34° N Lat, 119° W Long). Coll. and subm. by P. C. Orr. Associated with shell, bird bones, sticks and well-preserved feathers of cormorant *Phalacrocorax penicillatus* (id. by Mrs. Roxie C. Laybourne, U. S. Div. of Wildlife Research). Preservation of these feathers is remarkable for a semi-sea cave; quantity of feathers suggests cave was used as "poultry market" rather than habitation site.

**UCLA-745. Santa Rosa Island, California**

**750 ± 80**

**A.D. 1200**

Black organic muck from humus layer, 30 in. below surface exposed in 24 ft cut bank of Canada Verde, Santa Rosa Island (34° 00' 15" N Lat, 120° 06' 25" W Long). Date represents period of moist humus producing conditions near terminus of deposition period which began as valley fill ca. 10,000 B.P. (see L-290-C at 9050 ± 600, Lamont IV; UCLA-662 at 7600 ± 400, UCLA IV; Orr, 1966).

**Southern California archaeological sites**

This suit of dates will permit coordination of a number of site remains for which there are at present only guess dates, particularly for those locations within past 2000 yr which are at present more poorly dated than older sites and hence more difficult to fit into general culture history of southern California. Subm. by C. W. Mcighan, UCLA.

All shell samples have been measured based on shell carbonate. For conditions of southern California coast, correction of  $-2 \pm 1\%$  equivalent to 160 yr has been applied, to bring apparent age of shell carbonate dates into line with other biospheric dates (see section on Oceanic Measurements, this list). A more detailed evaluation of the following dates will appear elsewhere in the future.

### Malibu, Los Angeles County, series

Malibu site is one of the deepest containing cultural material in southern California, surpassed only by Malaga Cove site. Unlike Malaga Cove site, Malibu ( $34^\circ 2' \text{ N Lat}$ ,  $118^\circ 40' 30'' \text{ W Long}$ ) was excavated under controlled conditions. Coll. by C. King, UCLA.

**UCLA-918A. Malibu** **970  $\pm$  80**  
**A.D. 980**

*Mytilus californianus* shells from 42 in. depth of Area II.

**UCLA-918. Malibu** **2120  $\pm$  80**  
**170 B.C.**

*Mytilus californianus* shells from 65 in. depth of Area II.

**UCLA-918C. Malibu** **2510  $\pm$  80**  
**560 B.C.**

*Mytilus californianus* shells from 120 in. dept of Area II.

**UCLA-918E. Malibu** **2715  $\pm$  80**  
**765 B.C.**

*Mytilus californianus* shells from 180 in. depth of Area II.

**UCLA-918F. Malibu** **6310  $\pm$  100**  
**4360 B.C.**

*Mytilus californianus* shells from 0 to 6 in. depth of Area III, Pit II.

**UCLA-918G. Malibu** **6870  $\pm$  100**  
**4920 B.C.**

*Hinnites giganterum* shells from 18 in. depth of Area III, Pit 6.

*General Comment:* UCLA-918A through E fall into estimated age range according to analysis of artifacts. UCLA-918F and G are from approx. 1300-2000 yr earlier than anticipated.

**UCLA-919A. Deer Canyon, Ventura County,** **1770  $\pm$  80**  
**California** **A.D. 180**

*Mytilus californianus* shells from coastal shell midden Ven-7 ( $34^\circ 04' \text{ N Lat}$ ,  $118^\circ 59' \text{ W Long}$ ), Pit F-28, 48 to 54 in., N wall, 5 in. from E wall. Associated with Canalino or Late Horizon sites in Ventura County. Coll. by E. Gerow and P. Best, UCLA.

**UCLA-920. Paradise Cove, Los Angeles** **4300  $\pm$  80**  
**County, California** **2350 B.C.**

*Haliotis cracherodii* shell from Site LAn-222 at a sea terrace 100 ft above sealevel containing several burial areas on W side of Ramera

Canyon (34° 01' 15" N Lat, 118° 47' W Long), Pits 1 and 2, Trenches A and Z, 27 in. below surface. Coll. by J. Smith, UCLA.

**UCLA-922A. Little Sycamore Canyon, Ventura County, California** **2610 ± 80**  
**660 B.C.**

*Tivela stultorum* shell from Site Ven-1 at mouth of canyon (34° 3' 30" N Lat, 118° 57' 30" W Long). From Pit B-3, 6 to 12 in. of shell midden deposit. Coll by W. Wallace, Univ. of Hawaii.

**UCLA-922B. Little Sycamore Canyon, Ventura County, California** **6960 ± 100**  
**5010 B.C.**

*Haliotis cracherodii* from same site as 922A. *Comment:* greatly different ages of UCLA-922A and B suggest occupation of site at different times.

**UCLA-926. Big Tujunga, Los Angeles County, California** **1515 ± 80**  
**A.D. 435**

Charcoal from confluence of Big and Little Tujunga Washes in San Fernando Valley (34° 17' N Lat, 118° 22' W Long). From lowest cultural stratum, 36 to 38 in. below surface of LAn-167. Coll. by J. Ruby and G. Kritzman, Univ. of California, Santa Barbara.

### Bone Collagen Dating series

In order to illuminate the problem of contamination of bones with soil organics of different radiocarbon age, several Indian bones were obtained from highly disturbed site at Malaga Cove, Palos Verdes, California (33° 49' N Lat, 118° 23' W Long) through courtesy of M. Reiter, Los Angeles Harbor College.

Collagen was isolated by method of Berger, Horney, and Libby (1964). Half of this collagen was analyzed without subsequent treatment as UCLA-1008A. The other portion was treated overnight with 0.1 N NaOH at room temperature to remove alkali-soluble contaminants like humic acids. After filtration on Büchner funnel and repeated washing with distilled water, sample was measured as UCLA-1008B. Resulting age discrepancy again stresses need for pretreatments as discussed by Olson and Broecker, 1958, and used routinely in this lab.

**UCLA-1008A. Untreated collagen** **215 ± 80**  
**A.D. 1735**

**UCLA-1008B. NaOH-treated collagen** **1790 ± 160**  
**A.D. 160**

**UCLA-1010. Cave Painting, California** **< 100 yr**

Charcoal associated with Indian cave painting from painted cave in Ventura County discovered in 1964 by Stanford Univ. geology crew. Apparently cave had not been visited by whites before since an excellent steatite bowl was still *in situ* on cave floor. Coll. and subm. by C. Grant,

Santa Barbara Mus. of Nat. History, Santa Barbara, California. *Comment* (C.G.): on basis of my studies of Chumash Indians (Grant, 1965), painting is very likely of late prehistoric or early historic date (early 1800's).

### **Falcon Hill Basketry series, Nevada**

The following series of dates is continuation of project (see UCLA IV) to date materials from seven caves at Falcon Hill, located at N end of Winnemucca Dry Lake in Washoe County, Nevada (40° 19' 20" N Lat, 119° 20' 40" W Long). More detailed analysis of significance of following dates will be published in a monograph by Nevada State Mus. Samples subm. by R. Shutler, Univ. of Hawaii and Charles Rozaire, Los Angeles County Mus. of Nat. History. Comments by Charles Rozaire.

#### **UCLA-904. Falcon Hill**

**2175 ± 80**

**225 B.C.**

Basketry (coiled) No. 1966 from Site Wa-198, Washoe County, Nevada, 30 to 36 in. level. *Comment*: constitutes earliest date from site.

#### **UCLA-905. Falcon Hill**

**3660 ± 80**

**1710 B.C.**

Twined basketry No. 1096-1 from Site Wa-196, Washoe County, Nevada, Burial 3, Trench A, 0 to 12 in. Coll. by D. Tuohy, Nev. State Mus., Carson City. *Comment*: dates the technique of plain, 2 element Z-twining with false embroidery and one-strand half-twist overlay decorative technique.

#### **UCLA-906. Falcon Hill**

**1240 ± 80**

**A.D. 710**

Basketry (Lovelock Wicker) from Site Wa-200, Washoe County, Nevada, No. 406, 333, 405, 397, 400, 401 and 398. Area 2, 42 to 48 in. deep. Coll. by R. Shutler. *Comment*: though found relatively deep in deposit, it constitutes latest date at site and is 160 yr later than earliest occurrence of this type of basketry in caves at Falcon Hill.

#### **UCLA-931. Falcon Hill**

**3325 ± 90**

**1375 B.C.**

Basketry fragment (close, plain 2-element S-twined basket) No. 368A from Site Wa-202, Washoe County, Nevada. From Burial No. 1, 40 in. from surface, 32.5 in. from datum plane, 43 in. SE of rear wall to datum plane. Coll. by R. Shutler. *Comment*: may be remnant of a cap. Earliest date from Site Wa-202.

#### **UCLA-932. Falcon Hill**

**3745 ± 90**

**1795 B.C.**

Matting (warp face, plain 2-element Z-twined) No. 2136 from Site Wa-196, Washoe County, Nevada. From Grotto No. 3, Sec. G, 36 in. below wire. Coll. by R. Shutler.

- UCLA-933. Falcon Hill** **1725 ± 120**  
**A.D. 225**  
Basketry (close, plain 2-element Z-twined with stiff rod warp) No. 556 from Site Wa-198, Washoe County, Nevada. 11 to 13 in. along W wall, 18 to 24 in. deep. Coll. by R. Shutler.
- UCLA-976. Falcon Hill** **3620 ± 80**  
**1670 B.C.**  
Basketry No. 2134, part of a cache from Site Wa-196, Washoe County, Nevada. Grotto No. 3, Sec. H, 48 in. of datum line between G & H, 63 in. to datum line along W wall. Coll. by D. Tuohy. *Comment:* finely woven Z-twined basketry fragment with decoration. Constitutes latest date for Site Wa-196.
- UCLA-978. Falcon Hill** **4030 ± 85**  
**2080 B.C.**  
Fisherman's kit, 2-ply cord around a tule bag, No. 498, from Site Wa-200, Washoe County, Nevada, 12 to 18 in. deep. *Comment:* earliest date for Site Wa-200.
- UCLA-979. Falcon Hill** **3660 ± 100**  
**1710 B.C.**  
Basketry fragment, No. 1096, from Site Wa-196, Washoe County, Nevada. From Trench A, Burial 3, 10.5 to 15.5 in. deep. Coll. by R. Shutler.
- UCLA-980. Falcon Hill** **3760 ± 80**  
**1810 B.C.**  
Basketry fragment, No. 1069-D, from Site Wa-196, Washoe County, Nevada. From Trench A, Burial 4, 0 to 12 in. deep. Coll. by D. Tuohy. *Comment:* bottom portion of an S-twined basket.
- UCLA-981. Falcon Hill** **6730 ± 90**  
**4780 B.C.**  
Grass fragments, No. 237, from Site Wa-205, Washoe County, Nevada. Cache 1, Level 2. Coll. by D. Tuohy.
- UCLA-982. Falcon Hill** **390 ± 80**  
**A.D. 1560**  
Grass, No. 282A, from Site Wa-205, Washoe County, Nevada, Burial 1. Coll. by D. Tuohy. *Comment:* the latest date for caves at Falcon Hill.
- UCLA-983. Falcon Hill** **3850 ± 100**  
**1900 B.C.**  
Matting fragment, No. 1513, from Site Wa-196, Washoe County, Nevada, 81 in. below datum, Burial 2. Coll. by D. Tuohy. *Comment:* earliest occurrence of twined matting at Site Wa-196.
- UCLA-984. Falcon Hill** **3700 ± 80**  
**1750 B.C.**  
Basketry fragment, No. 1961, from same site as UCLA-983. Sec. F and G, 41 to 53 in. below datum No. 1. Coll. by D. Tuohy.

**UCLA-985. Falcon Hill****406 ± 80****A.D. 1550**

Cache bag (outer), No. 210, from Site Wa-205, Washoe County, Nevada, 13 in. below surface. Coll. by D. Tuohy. *Comment:* the latest date for a twined bag in caves at Falcon Hill.

**UCLA-986. Falcon Hill****595 ± 80****A.D. 1395**

Tule matting fragment, No. 54, from Site Wa-198, Washoe County, Nevada. From rope cache, 20 in. deep. Coll. by B. Shutler. *Comment:* the latest date for twined Tule matting in caves at Falcon Hill. It is latest date for Site Wa-198.

*B. Mexico***La Venta series II, Tabasco**

The four charcoal samples described below were recovered by R. J. Squier during June-July, 1964, test excavations conducted at site of La Venta, Tabasco. All samples were taken from a single test pit (Pit C-1964) which was excavated in a large habitation area S of main La Venta pyramid (Complex C). Levels assignable by their ceramic materials to Early Preclassic, Middle Preclassic (La Venta), and Late Preclassic phases occurred in stratigraphic association in area in which pit was excavated. Stratigraphic sequence as revealed in test pit does not appear, however, to be uninterrupted, i.e., later subphase (s?) of Early Preclassic and earlier subphase (s?) of Middle Preclassic (La Venta) phase apparently are missing in this Pit C-1964 sequence. The missing subphase (s?) of Early Preclassic was present in another 1964 test pit (Pit B-1964) in another location at La Venta, but no evidence of beginning developments of Middle Preclassic phase has been found at La Venta to date. These statements respecting La Venta sequence are derived from preliminary laboratory analysis of materials from the 1964 season and are subject to later revision.

None of the samples described below is entirely satisfactory as to exact original provenience of charcoal being dated. No actual fire hearths or other such definitive charcoal-bearing features were found in Pit C-1964. Charcoal in each sample was picked from small scattered pieces in soil matrices. Possibility of redeposition of older charcoal-bearing soil is therefore present in each case, although this is perhaps minimal for sample 788B. No evidence of such redeposition has been detected in cultural materials recovered from any level in this test pit. Subm. by R. J. Squier, Univ. of Kansas and R. F. Heizer, Univ. of California, Berkeley.

**UCLA-788B. La Venta****2650 ± 240****700 B.C.**

Wood charcoal from small burned soil zone at top of sandy clay layer in Pit C-1964, depth 210 to 214 cm below surface. Charcoal occurred as scattered small pieces embedded in burned soil. No cultural materials



occurred in burned soil lens. *Comment* (R.J.S.): stratigraphic position of sample agrees with assignment to either latest Early Preclassic or earliest Middle Preclassic activity in area sampled by Pit C-1964. Date would agree with assignment to earlier part of Middle Preclassic (La Venta) phase.

**UCLA-788C. La Venta**

**3760 ± 80  
1810 B.C.**

Wood charcoal from habitation level in Pit C-1964, depth 270 to 285 cm below surface. Charcoal and sherds very abundant in this level. *Comment* (B.J.S.): brief comparison of ceramic materials from this level with materials from Tehuacan Valley, through courtesy of R. S. MacNeish, suggests this level coeval with early part of Late Ajalpan Phase of Tehuacan Valley, with expected dating of approx. 1100-1300 B.C.

**UCLA-788D. La Venta**

**9750 ± 160  
7800 B.C.**

Wood charcoal from habitation level at base of Pit C-1964 deposit, depth 360 to 365 cm below surface. Sherds and charcoal very abundant in this level. *Comment* (R.J.S.): preliminary study of ceramic materials from this level show some differences from materials in level of sample 788C. Date expected, approx. 1300-1500 B.C. Charcoal probably from *in situ* or redeposited soil into which Early Preclassic cultural materials intruded, perhaps by trampling.

**UCLA-1012. Tequilita, Nayarit, West Mexico**

**1850 ± 100  
A.D. 100**

Conch shell trumpet, *Xancus angulatus* Solander, of Gulf of Mexico-Caribbean origin found in shaft tomb at Tequilita, Nayarit (21° 15' N Lat, 104° 35' W Long). Inner carbonate fraction was dated and no corrections were applied. Coll. and subm. by P. T. Fürst, UCLA. *Comment* (P.T.F.): date is highly significant as it pinpoints for the first time the most widespread tomb figurine style of Western Mexico popularly called "Chinesca Period." Tomb from which shell was collected in 1965 was looted 3 yr ago, but salvage excavation yielded 129 conch shell trumpets, over 100 whole or partial ceramic vessels and several figurines or fragments. Date is well within expected age range when compared with earlier radiocarbon dates (UCLA-593A-C, UCLA IV) and fits in with most recent dates from Teotihuacan. Several conches are decorated in a style closely resembling similar shells of the Teotihuacan II period, A.D. 100-250 (Teotihuacan series, UCLA IV).

**UCLA-966. San Sebastian, Jalisco, West Mexico**

**1730 ± 80**

**A.D. 220**

Bone collagen from left tibia of a human skeleton from last occupation period of shaft tomb No. 1, Hacienda de San Sebastian, Municipio de Etzatlan, Jalisco, Mexico (20° 40' N Lat, 104° 00' W Long). Coll. 1963 by S. Long; subm. by S. Long and R. E. Taylor, UCLA. *Comment* (S.L.): expected date of sample was between 1400-1700 yr ago according

to another C<sup>14</sup> date (derived from shell, UCLA-593C, 1710 ± 100, UCLA IV) believed to be coeval with this sample. Both UCLA-593-C and UCLA-966 appear to date last period of San Sebastian tomb occupation and last part of tomb complex found in Magdalena Lake basin.

**840 ± 80**

**UCLA-1017. Las Cuevas, Jalisco, West Mexico A.D. 1110**

Charcoal from Pit #9, 60 to 80 cm from Las Cuevas, Municipio de Etzatlan, Palisco, Mexico (20° 40' N Lat, 104° 00' W Long). Coll. 1963 by M. Glassow, UCLA; subm. by S. Long and R. E. Taylor. *Comment* (S.L.): expected age of sample was between 750-1050 yr. Sample dates upper portion of next to last pre-conquest cultural period in Magdalena Lake Basin.

*C. South America*

**Peruvian Archaeological series**

All samples in series were collected at dry sites in Peruvian coastal desert to provide determinations for critical points in absolute chronology of area. Subm. by J. H. Rowe, Univ. of California, Berkeley.

**4720 ± 80**

**UCLA-967. Ancón, Encanto camp site**

**2770 B.C.**

*Tillandsia* charcoal from Site PV45-25, camp site on Loma Encanto, on E side of Pampa del Canario, N of Ancón, central coast of Peru (11° 44' S Lat, 77° 7' W Long). From a deposit consisting of ash-stained sand containing abundant charcoal and sea shells, some broken and burnt stones, and a few stone chips. Depth of deposit ca. 25 cm. Sample taken from a 2 x 2 m test pit at depth of 5 to 25 cm. Coll. Nov. 1961 by Edward P. Lanning. *Comment* (J.H.R.): sample should date Encanto complex, briefly preceding establishment of cotton using preceramic villages near shore. Date could be an acceptable age for an Encanto associated complex.

**4200 ± 80**

**UCLA-968. Ancón, Tank site**

**2250 B.C.**

Wood charcoal from Tank site, PV45-2, on slope S of Ancón, central coast of Peru (11° 47' S Lat, 77° 11' W Long). Taken from deepest level of a trench on W side of site and associated with occupation refuse of final preceramic culture at Ancón, characterized by twined cotton textiles, straight-shanked shell fish hooks, and large percussion flaked projectile points. Coll. May 1962 by Jorge C. Muelle. *Comment* (J.H.R.): sample should briefly antedate introduction of ceramics on central coast of Peru. Date is 200-400 yr earlier than expected.

**3050 ± 80**

**UCLA-969. Ica, Erizo site**

**1100 B.C.**

Wood charcoal from Erizo site, PV62-191, Hacienda Collango, Ica Valley, S coast of Peru (14° 26' 45" S Lat, 75° 39' 40" W Long). Site consists of occupation refuse on a desert terrace on W bank of Ica River; it

has been severely eroded by wind. Sample is from pocket of undisturbed refuse representing earliest occupation of site and was associated with distinctive pottery, cotton textiles, a stone adze, and abundant vegetable remains but no maize. Taken from area less than 2 m across and from depth of 5 to 30 cm. Coll. Aug 1963 by J. H. Rowe and J. J. Lyon. *Comment* (J.H.R.): sample should date near beginning of Initial Period (i.e., shortly after introduction of pottery at Ica). Geochron Labs., Inc., has made two measurements on samples from same association: GX-0185,  $3890 \pm 90$ ; GX-0186,  $3820 \pm 85$ , (Geochron I). These measurements are consistent with other recent radiocarbon results from Peruvian coast but substantially earlier than UCLA-153,  $2960 \pm 90$ , (UCLA II), which, on archaeological grounds, should be nearly contemporary with Erizo occupation.

**1590  $\pm$  80**

**UCLA-970. Ica, Peña de Ocucaje cemetery** **A.D. 360**

Slender branch of wood from small cemetery site near Site PV62-38 on Peña de Ocucaje, Ica Valley, S coast of Peru ( $14^{\circ} 20' S$  Lat,  $75^{\circ} 41' 30'' W$  Long). Sample was part of roofing material of buried tomb (Rubini Collection, Burial 27) which contained pottery of Ocucaje Phase 10. Surface of sample may be contaminated by newspaper storage. Coll. April 1956 by Aldo Rubini. *Comment* (J.H.R.): sample should date to last epoch of Early Horizon and should be about a century older than the following sample. Expected age, about 2300 yr.

**1790  $\pm$  80**

**UCLA-971. Ica, Peña de Ocucaje** **A.D. 160**  
**habitation site**

Animal or human dung from Site PV62-38, Peña de Ocucaje, Ica Valley, S coast of Peru ( $14^{\circ} 22' S$  Lat,  $75^{\circ} 41' 30'' W$  Long). Taken from Cut 1, Level 2, which consisted of sandy refuse with abundant vegetable matter and pottery exclusively of Nasca Phase 1. Coll. Feb 1960 by L. E. Dawson. *Comment* (J.H.R.): sample should date to about middle of first epoch of Early Intermediate Period and should be about a century more recent than preceding sample. Expected age, about 2300 yr.

**880  $\pm$  80**

**UCLA-972. Ica, Pampa de las Animas** **A.D. 1070**  
**Alta site**

Animal or human dung from Site PV62-153, Pampa de las Animas Alta, Hacienda Callango, Ica Valley, S coast of Peru ( $14^{\circ} 30' S$  Lat,  $75^{\circ} 37' 30'' W$  Long). From depth of 5 to 20 cm in shallow deposit of refuse on low sandy rise in alluvial plains of Callango Basin. Refuse deposit contains pottery exclusively of Nasca Phase 9. Coll. 1959 by L. E. Dawson. *Comment* (J.H.R.): sample should date to first epoch of Middle Horizon. Univ. of Pennsylvania lab. has made a measurement on a sample dating to this epoch: P-511,  $1345 \pm 118$ . This measurement is consistent with other recent radiocarbon results from Peruvian coast and present sample should be of about same age.

*General Comment* (R. Berger): a recent discussion of Peruvian chronologies by Mason (1964) includes the following sequences by J. H. Rowe to which are here compared the present UCLA measurements. Radiocarbon measurements by different laboratories and this chronology, with the addition of the most recent Colonial Period, have also been discussed by Rowe (1965).

Period	Duration	UCLA	Date
Late Horizon	A.D. 1476-1534		
Late Intermediate Period	A.D. 1100-1476		
Middle Horizon	A.D. 800-1100	972	A.D. 1070
Early Intermediate Period	A.D. 150-800	971	A.D. 160
Early Horizon	700 B.C.-A.D. 150	970	A.D. 360
Initial Period	1400 - 700 B.C.	969	1100 B.C.
		968	2250 B.C.
		967	2770 B.C.

**1650 ± 120**

**UCLA-754. Brazilia**

**A.D. 300**

Charcoal from a 1 to 2 m deep trench under a well-developed "cerado" (clump of stunted trees on cattle grazing land) at a location in Brazilia (16° S Lat, 48° W Long). Part of an investigation into the possibility of man-made brush fires set by ancient Indians. Coll. by C. T. Rizzini, Botanical Garden, Rio de Janeiro; subm. by J. Reynolds, Univ. of California, Berkeley.

*D. Pacific and Far East*

**Palawan/Sarawak series**

This suit of dates is designed to elucidate the temporal relationships of different cultures of man in the Pacific. A recent discussion is that by Shutler (1965) and a forthcoming paper by R. B. Fox. Previous measurements are found in UCLA III. Samples coll. by R. B. Fox, Nat. Mus., Manila, Philippines; subm. by R. B. Fox and Richard Shutler, Jr.

**4070 ± 100**

**UCLA-698. Guri cave, Palawan**

**2120 B.C.**

Nevita shells from Guri Cave, Lipuun Point, Quezon, Palawan, Philippines (9° 20' N Lat, 117° 45' E Long). Square 13-B, depth 60 to 70 cm below stratum. Nat. Mus. catalog 1962-P-791. Uncorrected carbonate date. *Comment* (R.S.): brings the Tabonian flake-tool tradition into coexistence with polished stone tools and as persisting later than a small-flake-and-blade industry. Sample dated later in time than expected. Only non-charcoal sample from Tabon caves so far.

**23,200 ± 1000**

**UCLA-699. Tabon cave, Palawan**

**21,250 B.C.**

Charcoal from Tabon cave, Palawan, Philippines (9° 20' N Lat, 117° 45' E Long). Square 26-d, depth 139 to 149 cm. Nat. Mus. catalog 1962-I-9745. *Comment* (R.S.): flake-tool industry III. Flake tools, ham-

mer stones, a few basalt choppers; soft bones of bats, birds and small mammals; charcoal and fossil human bones in a thick uneven occupation zone.

**UCLA-957. Niah cave, Sarawak** **37,500 ± 1600**  
**35,550 B.C.**

Oysters (*Oyster gigas*) from the great Niah Cave, Sarawak, Gan Kiva (3° 58' N Lat, 113° 45' E Long), Y 1 x 5, 6 to 12 in. *Comment* (R.S.): dates highest ocean level at Niah in late Pleistocene, and confirms the >40,000 yr age of *Homo sapiens* skull, as shell layer stops just above skull. Oyster shell is used extensively in the cave for tools.

**UCLA-958. Tabon cave, Palawan** **30,500 ± 1100**  
**28,550 B.C.**

Charcoal from Tabon cave, Palawan, Philippines (9° 20' N Lat, 117° 45' E Long). Square 21-N, L, R-28 cm, In-Out 27 cm, depth from surface 121 cm. *Comment* (R.S.): flake-tool industry IV, the earliest evidence of man so far discovered in Palawan and the oldest radiocarbon date so far in the Philippines.

**UCLA-992A. Manunggul cave, Palawan** **2840 ± 80**  
**890 B.C.**

Charcoal from Manunggul cave, Quezon, Palawan, Philippines (9° 20' N Lat, 117° 45' E Long), from Chamber A, subsurface. Nat. Mus. catalogue 1964-M-86. Associated with Early Iron-age with Sa-Huy'nh funerary pottery.

**UCLA-922B. Manunggul cave, Palawan** **2660 ± 80**  
**710 B.C.**

Charcoal from same location as UCLA-992A. Nat. Mus. catalog 1964-M-48, 49, 57. Should be similar age as above.

**UCLA-992C. Manunggul cave, Palawan** **2140 ± 100**  
**190 B.C.**

Charcoal from same cave, but Chamber B, surface and sub-surface. Nat. Mus. catalog 1964-M-136, 137. Associated with jar burial assemblage with iron.

**UCLA-994. Duyong cave, Palawan** **5680 ± 80**  
**3730 B.C.**

Charcoal from Duyong cave, Iwaig, Palawan, Philippines (9° 20' N Lat, 118° 5' E Long). Square II, depth 30 cm. Associated with jar burial assemblage with pottery of Sa-Huy'nh tradition.

**UCLA-965 Chinese statue** **110 ± 80**  
**A.D. 1840**

Sandalwood statue of a Chinese deity whose origin was believed to be much older. Coll. and subm. by S. Chang, 207 E. 7th St., Los Angeles, California.

*E. Europe***17,600 ± 1000****UCLA-930. Banolas mandible****15,650 B.C.**

Travertine surrounding Banolas mandible, suspected to be from Neanderthal man found 1887 near Gerona, Spain. Carbonate-based date. Subtracted 2400 yr for correction (UCLA III). Obtained through M. Fusté, Univ. of Barcelona, Spain, and K. P. Oakley, British Mus., London; subm. by K. P. Oakley and J. D. Clark, Univ. of California, Berkeley. *Comment:* for a Neanderthal, present date is too recent. The possibility of more modern travertine contaminating older travertine to yield a more recent composite date, or the relocation of an ancient mandible into travertine is open.

**UCLA-959. Painting****Modern**

Wood and canvas from painting believed to be by Antonio Correggio, 1489-1534. Coll. and subm. by R. DeGrasse, Glendale College, Los Angeles, California.

**European Medieval Architecture series**

Dates listed below are a continuation of investigation into Aisled Medieval Timber Hall (UCLA III and IV). Oakwood samples coll. and subm. by Walter Horn, Univ. of California, Berkeley and R. Berger. The Frocester and Middle Littleton barns are discussed in detail in Horn, Charles and Berger (1966); Beaulieu St. Leonard by Horn and Born (1965). Frocester barn is located 5 mi W of city of Stroud (51° 44' N Lat, 2° 19' W Long); Middle Littleton, NW of Evesham, Worcestershire (52° 10' N Lat, 1° 50' W Long); Leicester Hall, Leicester, Leicestershire (52° 34' N Lat, 1° 7' W Long). Beaulieu St. Leonard, SW of Portsmouth (50° 40' N Lat, 1° 28' W Long).

**UCLA-950. Frocester**

Truss 2, collar beam, waney edge.

**485 ± 80**  
**A.D. 1465****UCLA-951. Frocester**

Cruck blade, Truss 5.

**660 ± 80**  
**A.D. 1290****UCLA-952. Frocester**

Waney edge from beam, Truss 5.

**Modern****UCLA-1001. Frocester**

Bark from Truss 12, N blade.

**450 ± 60**  
**A.D. 1500****UCLA-1002. Frocester**

Sapwood/hardwood from S blade, Truss 5.

**320 ± 80**  
**A.D. 1630**

<b>UCLA-1003. Frocester</b>	<b>270 ± 80</b> <b>A.D. 1680</b>
Sapwood near heartwood from principal collar beam, Truss 5.	
<b>UCLA-953. Middle Littleton</b>	<b>730 ± 80</b> <b>A.D. 1220</b>
N post of Truss 2, waney edge.	
<b>UCLA-954. Middle Littleton</b>	<b>785 ± 80</b> <b>A.D. 1165</b>
Wedge of first W cruck truss, N blade, waney edge.	
<b>UCLA-1004. Middle Littleton</b>	<b>600 ± 80</b> <b>A.D. 1350</b>
Sapwood from N post, Truss 11. Probably contaminated.	
<b>UCLA-1005. Middle Littleton</b>	<b>935 ± 60</b> <b>A.D. 1015</b>
Heartwood from N post, Truss 11.	
<b>UCLA-1006. Middle Littleton</b>	<b>Modern</b>
Sapwood from N blade, Truss 3, above wedge.	
<b>UCLA-941. Leicester</b>	<b>1245 ± 80</b> <b>A.D. 705</b>
Norman capital on landing close to center of tree.	
<b>UCLA-942. Leicester</b>	<b>1185 ± 80</b> <b>A.D. 765</b>
Post f', Truss F, aisle face, S edge.	
<b>UCLA-943. Leicester</b>	<b>640 ± 80</b> <b>A.D. 1310</b>
Longitudinal brace from post e' to roof plate, between post e' and d'.	
<b>UCLA-944. Leicester</b>	<b>505 ± 80</b> <b>A.D. 1445</b>
Truss E, trans. brace from post e' to tie beam upper fare of brace connecting post e'.	
<b>UCLA-945. Leicester</b>	<b>595 ± 80</b> <b>A.D. 1355</b>
Roofplate between Truss D and E S of post e', nave side.	
<b>UCLA-946. Leicester</b>	<b>285 ± 80</b> <b>A.D. 1665</b>
Roofplate between posts f and g, W range.	
<b>UCLA-947. Leicester</b>	<b>410 ± 80</b> <b>A.D. 1540</b>
Tiebeam, Truss B, waney edge.	



- 530 ± 80**
- UCLA-948. Leicester** **A.D. 1420**  
Elbow brace from tiebeam of Truss E to E principal rafter over Truss E.
- 605 ± 80**
- UCLA-949. Leicester** **A.D. 1345**  
Lower purlin, W side, between post C and c.
- 100 ± 60**
- UCLA-1014. Beaulieu St. Leonard** **A.D. 1850**  
Lintle over wagon doors, sapwood.
- 155 ± 60**
- UCLA-1015. Beaulieu St. Leonard** **A.D. 1795**  
Lintle over wagon doors, bark, same beam as UCLA-1014. *Comment* (R.B.): bark of oak trees has growth increments analogous to, but not like, tree rings. This particular bark has ca. 40 and more growth increments which become indistinguishable near outside of bark.
- 220 ± 80**
- UCLA-1016. Beaulieu St. Leonard** **A.D. 1730**  
Lintle over wagon doors, heartwood, same beam as UCLA-1014. *General Comment* (W.H.): results of UCLA-1014, 1015, and 1016 are expected. Beam has appearance of belonging to wall plate system of original 13th century barn of Beaulieu St. Leonard. It is archaeologically difficult to understand how a beam of these large dimensions and scantlings suitable for a very large building should have been made so recently and be incorporated into a much smaller late medieval restoration of a portion of the original barn.

#### *F. Egypt*

- 4120 ± 80**
- UCLA-928. V Dynasty Linen** **2170 B.C.**
- Check sample to test accuracy of radiocarbon dates. V Dynasty linen from W cemetery at Giza, excavated in 1932 in Pit B of G 2220. Burial was intact and linen is part of padding of well-preserved woman's body, wrapped to simulate her dress and form. It lay in a large wooden coffin, also well-preserved and unopened since burial. Tomb is published in G. A. Reisner (1942). Obtained through courtesy of W. S. Smith, Mus. of Fine Arts, Boston, Mass. Subm. by R. Berger. *Comment* (R.B.): linen is dated by Reisner's experience of the development of building methods and structural types as well as the topography of the cemetery (Smith, 1965, pers. commun.) and not by actual inscriptions. Therefore its historical age has some margin. If the new half-life of 5730 yr is used, linen dates from 4250 ± 80 yr or 2300 B.C. According to Hayes chronology (1962), the V Dynasty lasted from 2350-2500 B.C.



*G. Africa*

The following three series on man in prehistoric Africa are a continuation of measurements reported in earlier date lists such as Groningen V, Lamont V, UCLA III and IV. Later Pleistocene cultures of Africa have been discussed recently by Clark (1965). Samples subm. by J. D. Clark.

**Travertine series**

Samples come from South Africa, Northern Rhodesia, and Angola. All are Upper Pleistocene age and confirm wide extent of cooler and wetter climatic conditions in S. Africa equating with later part of Würm/Wisconsin Glaciation. "Middle Stone Age" cultural material is directly associated with first two samples. Travertine samples have been age-corrected, as stated in UCLA IV.

**UCLA-706. Witkranz cave, Taungs, Cape 33,150 ± 2500  
Province, South Africa 31,200 B.C.**

Travertine associated with lower breccia. Cave was partly excavated by the late Dr. F. E. Peabody in 1951 and contains a late Upper Pleistocene fauna and a Petersburg-type occurrence, a flake of which is still embedded in the specimen (Specimen No. 38/I. 5.119). Estimated age 35-20,000 yr. Coll. by F. E. Peabody.

**UCLA-707. Twin Rivers cave, Lusaka, Northern  
Rhodesia >33,200**

Travertine from middle of main breccia section. A good "Middle Stone age industry" is associated with the previously dated sample (UCLA-229, UCLA III) but only a sparse, indeterminate industry occurs in the cave or sink-hole. Coll. by C. K. Brain.

**UCLA-708A. Huila Plateau limestones, Sa Da  
Bandeira district, SW Angola >34,000**

Leba 2 cave; travertine from approx. 5 ft below top of red breccia and interbedded with it. Breccia is sealed by travertine sheet represented by sample UCLA-708B below. Associated with Upper Pleistocene fauna but no industry. Coll. by J. D. Clark.

**UCLA-708B. Huila Plateau limestones, Sa Da 30,800 ± 1700  
Bandeira district, SW Angola 28,850 B.C.**

Leba 2 cave; travertine sheet sealing red breccia believed to be of Upper Pleistocene age. Coll. by J. D. Clark.

**UCLA-708C. Huila Plateau limestones, Sa Da 29,800 ± 1650  
Bandeira district, SW Angola 27,850 B.C.**

Leba 3 Fissure; travertine and grey/cream breccia incorporating fossil bone. Grey/cream breccia was believed to be of lower Pleistocene age

on identification of fossil fauna, but evidently is also Upper Pleistocene. It is important to confirm this for this site. Coll. by J. D. Clark.

**UCLA-708D. Huila Plateau limestones, Sa Da  
Bandeira district, SW Angola >34,000**

Cangalonge 3 breccia filled fissures; travertine interbedded with red-brown breccia containing much fauna of Upper Pleistocene age. Sample from upper levels at S end of exposure. Coll. by J. D. Clark.

**Northern Rhodesia series**

Fossil bone associated with Stone age occupation sites in Middle Zambezi (Gwembe) Valley. Carbonate-dates were unavoidable due to lack of collagen.

**UCLA-720. Siachingola Village area 2520 ± 80  
570 B.C.**

Bone from top levels of buff alluvium associated with late Magosian industry. Coll. 1957 by J. D. Clark. *Comment* (J.D.C.): date is later than expected if artifacts are Magosian.

**UCLA-722. Siasuntwe Village area 2010 ± 80  
60 B.C.**

Bone from eroded midden of Later Stone age Wilton date. Coll. 1957 by J. D. Clark. *Comment* (J.D.C.): date is compatible with late Wilton age.

**UCLA-723. Kalundo mound, Kalomo 960 ± 80  
A.D. 990**

Charcoal from occupation site of early Iron age Kalomo culture. From Pit I at depth of 9 ft, cut into bedrock. Estimated age of 1000 B.P. confirmed. These come from end of oldest levels of Kalomo culture yet known. Coll. by B. M. Fagan.

**South West Africa series**

Associated with foundations of windbreaks and bedding places and with perishable cultural material of Late Erongo culture, preserved by dry climatic conditions. Culture is believed to be identifiable with BergDama negroids.

**UCLA-724A. Great Elephant Shelter, Erongo 2550 ± 80  
Mountains 600 B.C.**

Charcoal from depth of 3 to 6 in. Estimated age 2 to 300 yr but might be older. Coll. by R. MacCalman.

**UCLA-724B. Great Elephant Shelter, Erongo 1400 ± 80  
Mountains A.D. 550**

Charcoal from depth of 6 to 9 in. Estimated age as above. Coll. by R. MacCalman. *Comment* (J.D.C.): both dates older than expected.

**West African series**

A number of first radiocarbon dates of post-medieval and medieval towns for West Africa. Subm. by R. A. Mauny, Sorbonne, Paris.

**UCLA-695A. Tondi Koiré** **455 ± 80**  
**A.D. 1495**

Charcoal from post-medieval ruins of site occupied by Songai rulers before fall of their empire to Moroccans in 1591. Tondi Koiré, République du Niger (13° N Lat, 1° 10' E Long). Coll. by M. Toucet, IFAN, Niamey, Nigeria.

**UCLA-695B. Tondi Koiré** **395 ± 80**  
**A.D. 1555**

Charcoal from same site as UCLA-695B.

**UCLA-696. Tegdaoust** **1150 ± 80**  
**A.D. 800**

Charcoal from medieval ruins of Tegdaoust, République Islamique de Mauritanie (17° 25' N Lat, 10° 20' W Long). *Comment* (R.A.M.): Tegdaoust first mentioned A.D. 905. It was very prosperous Saharan oasis during all of 10th century. Town was destroyed in 1054 by Almoravids. Date is somewhat earlier than expected for Tegdaoust's most flourishing period.

## II. GEOPHYSICAL, GEOLOGICAL-CLIMATOLOGICAL AND BIOLOGICAL MEASUREMENTS

### *A. C<sup>14</sup> in Atmospheric Carbon Dioxide*

**Atmospheric Radiocarbon Activity series, California**

This series is a continuation of data published in UCLA IV. The C<sup>14</sup> content in ground level atmospheric CO<sub>2</sub> is monitored monthly at China Lake, California (35° 37' N Lat, 117° 41' W Long). Samples are collected with the cooperation of Gilbert Plain, Acting Head, Research Dept. Naval Ordnance Test Station, China Lake, California.

The following list contains exposure times of the NaOH solutions to air and the percent increase of C<sup>14</sup> above the reference level of 1890 or 0.95 NBS oxalic acid. Data are graphed in Fig. 1.

<b>UCLA-494.</b>	<b>28 Nov. - 5 Dec. 1964</b>	<b>+78.8</b>
<b>UCLA-495.</b>	<b>26 Dec. - 2 Jan. 1965</b>	<b>+80.2</b>
<b>UCLA-496.</b>	<b>30 Jan. - 6 Feb. 1965</b>	<b>+73.7</b>
<b>UCLA-497.</b>	<b>27 Feb. - 6 Mar. 1965</b>	<b>+90.6</b>
<b>UCLA-499.</b>	<b>26 Mar. - 3 April 1965</b>	<b>+75.2</b>
<b>UCLA-1101.</b>	<b>29 April - 6 May 1965</b>	<b>+77.4</b>
<b>UCLA-1103.</b>	<b>29 May - 5 June 1965</b>	<b>+77.8</b>
<b>UCLA-1106.</b>	<b>26 June - 3 July 1965</b>	<b>+80.1</b>
<b>UCLA-1114.</b>	<b>31 July - 7 Aug. 1965</b>	<b>+75.2</b>

<b>UCLA-1119.</b>	<b>2 Sept. - 9 Sept. 1965</b>	<b>+75.9</b>
<b>UCLA-1122.</b>	<b>1 Oct. - 8 Oct. 1965</b>	<b>+76.1</b>
<b>UCLA-1126.</b>	<b>30 Oct. - 6 Nov. 1965</b>	<b>+72.7</b>
<b>UCLA-1127.</b>	<b>27 Nov. - 4 Dec. 1965</b>	<b>+69.2</b>

The unusually high value of UCLA-497 for the collection period 27 Feb.-6 March 1965 may be coupled to a period of strong northerly winds originating in the general area of Alaska ( $65^{\circ}$  N) as can be seen from meteorological charts for the 500 and 700 mb pressure level. Proof of this relation must await additional analyses.

### B. Bomb $C^{14}$ in Foodstuffs

#### Wheat Bread series

Regular white bread was obtained and analyzed for its radiocarbon content, which is expressed as the percent increase over the reference level of 1890 or 0.95 NBS oxalic acid.

<b>UCLA-498.</b>	<b>Los Angeles, Calif</b>	<b>April 1965</b>	<b>+96.7</b>
<b>UCLA-1102.</b>	<b>Los Angeles, Calif.</b>	<b>May 1965</b>	<b>+86.4</b>
<b>UCLA-1108.</b>	<b>Los Angeles, Calif.</b>	<b>July 1965</b>	<b>+94.1</b>
<b>UCLA-1109.</b>	<b>Melbourne, Australia</b>	<b>July 1965</b>	<b>+59.4</b>
<b>UCLA-1115.</b>	<b>Bogota, Colombia</b>	<b>Aug. 1965</b>	<b>+60.7</b>

#### Beef

<b>UCLA-500.</b>	<b>Los Angeles, Calif.</b>	<b>April 1965</b>	<b>+70.5</b>
------------------	----------------------------	-------------------	--------------

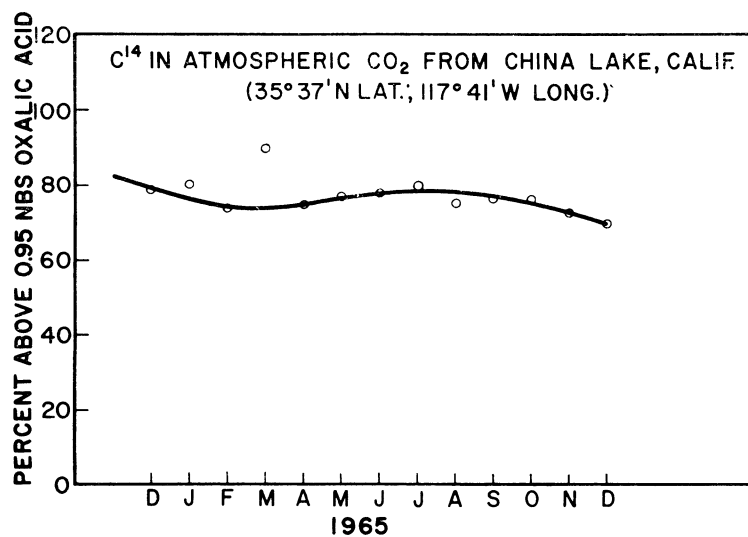


Fig. 1.  $C^{14}$  enrichment over NBS standard of atmospheric  $CO_2$  during 1965 at China Lake, California.

*C. Bomb C<sup>14</sup> in Human Tissues*

This is a continuation of measurements reported in UCLA IV. The radiocarbon activity is expressed as percent increase over the 1890 level or 0.95 NBS oxalic acid, Samples subm. with the cooperation of J. F. Mead and G. V. Alexander, UCLA; D. Chamnirokasant and G. Ciliv, IAEC-fellows.

<b>UCLA-828. Blood plasma protein</b>	<b>+55.6</b>
From healthy young Australian, 30 days in N hemisphere. Coll. Dec. 1964.	
<b>UCLA-829. Erythrocyte protein</b>	<b>+34.6</b>
Same blood as UCLA-828.	
<b>UCLA-830. Blood plasma protein</b>	<b>+45.6</b>
From healthy young S. African, 14 days in N hemisphere. Coll. Dec. 1964.	
<b>UCLA-831. Erythrocyte protein</b>	<b>+33.7</b>
Same blood as UCLA-830.	
<b>UCLA-832. Cranial hair</b>	<b>+45.2</b>
From 24 yr old healthy Thai, Bangkok-Los Angeles, May 1965. Coll. by D. Chamnirokasant.	
<b>UCLA-833. Cranial hair</b>	<b>+41.0</b>
From 78 yr old Australian (Melbourne) with myocardial failure, April 1965. Coll. by S. E. Freeman, Univ. of Melbourne.	
<b>UCLA-834. Cranial hair</b>	<b>+32.8</b>
From 71 yr old Australian (Melbourne) with coronary occlusion, April 1965. Coll. by S. E. Freeman.	
<b>UCLA-835. Cranial hair</b>	<b>+30.6</b>
From healthy 29 yr old Australian (Heathcote, N.S.W.), May 1965. Coll. by M. Dingeldei.	
<b>UCLA-836. Cranial hair</b>	<b>+47.2</b>
From barbershop, Santiago, Chile, June 1965. Coll. by C. Maggiolo, Univ. Catolica de Chile, Santiago.	
<b>UCLA-837. Cranial hair</b>	<b>+42.0</b>
From healthy 26 yr old Thai, Bangkok, April 1965. Coll. by V. Jiravathana.	
<b>UCLA-838. Erythrocyte protein</b>	<b>+83.5</b>
Los Angeles resident, July 1965.	
<b>UCLA-839. Blood plasma protein</b>	<b>+62.0</b>
Same blood as UCLA-838.	

- UCLA-840. Myelin** +37.9  
From 74 yr old female, Los Angeles, Caucasian. Died 19 Aug. 1962. Coll. by J. F. Mead and D. Long, UCLA.
- UCLA-841. Myelin** +31.0  
From 54 yr old female, Los Angeles, Negro. Died 21 Aug. 1962. Coll. by J. F. Mead and D. Long.
- UCLA-842. Brain** +51.7  
Total brain protein from 69 yr old Melbourne, Australia female. Partial gastrectomy, carcinoma of stomach. Died 26 Sept. 1965. Coll. by W. P. Freeman, Univ. of Melbourne.
- UCLA-843. Liver** +56.4  
Total liver protein. Same person as UCLA-842.
- UCLA-844. Heart** +62.9  
Total heart protein. Same person as UCLA-842.
- UCLA-845. Brain** +63.9  
Total brain protein from 62 yr old Melbourne, Australia female. Ostler's disease, cardiac failure. Died 25 Sept. 1965. Coll. by W. P. Freeman.
- UCLA-846. Liver** +48.5  
Total liver protein. Same person as UCLA-845.
- UCLA-847. Heart** +51.3  
Total heart protein. Same person as UCLA-845.
- UCLA-825. Human DNA** +34.8 ± 10.6  
From healthy liver obtained fresh from autopsy, July 1964, through J. F. Ross, UCLA. Prepared by R. Staudenmayer and R. Berger according to method of Zamenhof, 1958. Yield 2.74 g per 1.2 kg of liver.

*D. Bomb C<sup>14</sup> in Plants*

- UCLA-1124. Lichen** +77.6  
Rock-growing lichen from Pike's Peak, Colorado area. Coll. Nov. 1965 and subm. by W. F. Libby.

*E. Oceanic Measurements***Seawater series**

A continuation of seawater C<sup>14</sup> measurements from southern California coast (see UCLA IV). Radiocarbon activity expressed as previously.

- UCLA-1111. Seawater** +12.9  
From Zuma Beach, Los Angeles County, California, 27 July 1965.  
Coll. by R. Staudenmayer and S. Libby, UCLA.
- UCLA-1112. Seawater** +10.0  
From Santa Monica, Los Angeles County, California, 4 Aug. 1965.  
Coll. by R. Staudenmayer and S. Libby.
- UCLA-1113. Seawater** +8.1  
From Pacific Palisades, Los Angeles County, California, 11 Aug.  
1965. Coll. by R. Staudenmayer and R. Sherman, UCLA.
- UCLA-1116. Seawater** +8.7  
From Oxnard, Ventura County, California, 17 Aug. 1965. Coll. by  
R. Staudenmayer and J. Libby.
- UCLA-1117. Seawater** +12.9  
From San Clemente, San Diego County, California, 2 Sept. 1965.  
Coll. by R. and H. Staudenmayer.

#### Mexican and Californian Marine Shells series

Application of these measurements of modern but pre-bomb marine shells to shell-based archaeological dates will be discussed elsewhere. The radiocarbon measurements are corrected for  $C^{13}$  and are numerically equal to  $\Delta$  but are expressed as percent deviation from the count rate of 0.95 NBS oxalic acid, rather than as per mil. The  $\delta C^{13}$  (‰) measurements with reference to the Chicago PDB standard were carried out by Isotopes, Inc., Westwood, New Jersey. Shells obtained and subm. by R. E. Taylor and R. Berger, UCLA.

- UCLA-913. Shell** -3.08  
*Anadara grandis* (B&S) shell from Mazatlan, Sinaloa. Coll. 1939 by  
Allen; subm. by G. D. Webster, Dept. of Geology, UCLA. Uncorrected  
 $\delta C^{14}$  measurement,  $-3.41 \pm .56$ ;  $\delta C^{13}$  measurement,  $-1.7$ .
- UCLA-914. Shell** -6.98  
*Tivela bryonensis* (Gray) shall from Kino Bay, Sonora. Coll. 1935  
by H. N. Love; subm. by E. P. Chase, Nat. Hist. Mus., San Diego, Cali-  
fornia. Uncorrected  $\delta C^{14}$  measurement,  $-7.05 \pm .59$ ;  $\delta C^{13}$  measurement,  
 $-0.4$ .
- UCLA-915. Shell** -3.21  
*Ostrea fischeri* (Dall) shell from Manzanillo, Colima. Coll. 1930 by  
H. N. Lowe; subm. by E. P. Chase. Uncorrected  $\delta C^{14}$  measurement,  
 $-3.0 \pm .58$ .  $\delta C^{13}$  measurement  $+1.10$ .

- UCLA-917. Shell** **-7.06**  
*Strombus granulatus* (Swainson) shell from Carmen Island, Gulf of Calif. Coll. 1911 by P. Bartsch; subm. by J. Rosewater, Smithsonian Institution, Washington, D. C. Uncorrected  $\delta^{14}$  measurement,  $-6.97 \pm .60$ .  $\delta^{13}$  measurement,  $+0.5$ .
- UCLA-916. Shell** **-4.54**  
*Strombus granulatus* (Swainson) shell from Cape San Lucas, Baja, Calif. Coll. 1932 by T. Crocker; subm. by L. G. Hertlein, Calif. Acad. of Sciences, San Francisco. Uncorrected  $\delta^{14}$  measurement,  $-4.65 \pm .52$ .  $\delta^{13}$  measurement,  $-0.6$ .
- UCLA-936. Shell** **-3.38**  
*Hexaplex regius* (Wood) shell from Isabel Island, Nayarit. Coll. 1938 by G. Willett; subm. by J. McLean, L.A. County Mus. Uncorrected  $\delta^{14}$  measurement,  $-3.46 \pm .58$ .  $\delta^{13}$  measurement,  $-0.4$ .
- UCLA-940. Shell** **-2.39**  
*Strombus gracilior* (Sowerby) shell from Banderas Bay, Jalisco. Coll. 1938 by G. Willett; subm. by J. McLean. Uncorrected  $\delta^{14}$  measurement,  $-2.55 \pm .58$ .  $\delta^{13}$  measurement,  $-0.8$ .
- UCLA-939. Shell** **-3.34**  
*Anadara (Anadara) tuberculosa* (Sowerby) shell from Magdalena Bay, Baja, Calif. Coll. 1938 by G. Willett; subm. by J. McLean. Uncorrected  $\delta^{14}$  measurement,  $-3.65 \pm .62$ .  $\delta^{13}$  measurement,  $-1.6$ .
- UCLA-963. Shell** **-2.49**  
*Pecten (Lyropecten) subnodosus* (Sowerby) shell from Cedros Island, Baja, Calif. Coll. 1939 by H. B. Allen; subm. by L. R. Saul, Dept. of Geology, UCLA. Uncorrected  $\delta^{14}$  measurement,  $-2.53 \pm .60$ .  $\delta^{13}$  measurement,  $-0.2$ .
- UCLA-938. Shell** **-2.56**  
*Turritella leucostoma* (Valenciennes) shell from Guatulco Bay, Oaxaca. Coll. 1938 by G. Willett; subm. by J. McLean. Uncorrected  $\delta^{14}$  measurement,  $-2.4 \pm .50$ .  $\delta^{13}$  measurement,  $+0.8$ .
- UCLA-149. Shell** **-2.0 ± .65**  
*Mytilus californianus* (Conrad) shell from Santa Cruz County, Calif. Coll. 1878 by L. G. Yates; subm. by P. C. Orr, Santa Barbara Mus. of Nat. History, California. No  $\delta^{13}$  available.
- UCLA-1033. Shell** **-1.74**  
*Lunatia lewisii* (Gould) shell from Seal Beach, Calif. Coll. 1921 by C. E. White; subm. by L. R. Saul. Uncorrected  $\delta^{14}$  measurement,  $-1.84$ .  $\delta^{13}$  measurement,  $-0.5$ .



F. *Vegetation and Climate***California Pleistocene Floras series**

The following dates represent additional ages for previously described late Pleistocene floras of California (Lamont IV, UCLA II and III). They confirm previous estimates of their ages as based on geologic and paleobotanic evidence. Samples are from paleobotanical collections, Univ. of California, Berkeley, and where subm. and commented on by D. I. Axelrod, UCLA.

**UCLA-735. San Bruno flora, San Mateo County, California** **10,170 ± 120**  
**8220 B.C.**

Wood of *Pseudotsuga menziesii* from San Bruno flora, described by Potbury (1932) from alluvial gravels near San Bruno, California (37° 37' N Lat, 122° 27' W Long). *Comment*: flora suggests higher rainfall and cooler climate than that at San Bruno today, and the young date is consistent with assignment to waning part of last glacial stage.

**UCLA-736. Tomales flora, Marin County, California** **29,050 ± 1100**  
**27,100 B.C.**

*Pinus radiata* cones from Millerton Head (38° 7' N Lat, 122° 52' W Long) in Millerton formation. Date supports reference of flora to late Pleistocene, as shown by geologic occurrence and composition of associated flora (Mason, 1934). *Comment*: date for flora implying relatively cool climate and corresponding to a time prior to last glacial advance is significant because warm-water marine invertebrates occur in same beds (see Mason, 1934, p. 103-106). Whether local or due to worldwide warming, warmer sea offshore may account for increased precipitation, with greater cloudiness and slightly lower temperature indicated by flora.

**UCLA-737A. Rancho La Brea Tar Pits** **23,300 ± 510**  
**21,350 B.C.**

Date is based on cypress wood in collection at Univ. California, Berkeley, from tar pits (34° 03' 45" N Lat, 118° 21' 25" W Long). *Comment*: other dates of cypress wood are much younger—14,500 B.P. (Howard, 1961). Taken together with date of 32,350 ± 1400 yr for live oak leaves (see below) from tar pits, it is apparent that flora is not a floristic unit, but was assembled in the pits over a long period of time. This evidence makes interpretation of flora simpler, for it contains such ecologically disparate plants as juniper and Monterey pine (see Axelrod, 1966). The drier flora (juniper, walnut, etc.) and the more humid ones (Monterey pine, Bishop pine, cypress) probably are to be referred to interglacial and glacial ages respectively.

**UCLA-737B. Rancho La Brea Tar Pits** **32,350 ± 1400**  
**30,400 B.C.**

Date based on *Quercus agrifolia* leaves, from collections at Univ. California, Berkeley. Both samples UCLA-737A and B were continuously extracted with ether similar to the following La Brea series.

**UCLA-728. McKittrick flora, Kern County, California** **38,000 ± 2500**  
**36,050 B.C.**

Date based on stems in collection at Univ. California, Berkeley, from S edge of McKittrick, California (35° 17' N Lat, 119° 38' W Long). *Comment*: age of flora has not previously been placed closely, though it was referred to late Pleistocene (Mason, 1944). Flora represents a pinyon-juniper woodland like that now in San Rafael Mts., a few tens of miles to SW, and indicates 10 to 15 in. more precipitation than at McKittrick today (5 in.).

**UCLA-966. Point Sal Ridge** **26,700 ± 800**  
**24,750 B.C.**

Unaltered wood of *Pinus muricata* provided basis for date. Wood and pine cones are in Orcutt Sand in canyon directly W of head of Corralillos Canyon, several mi SW of Guadalupe, California (34° 55' N Lat, 129° 39' W Long). *Comment*: Orcutt Sand represents oldest terrace deposit in Santa Maria region, and has a wide distribution. Since the Orcutt is deformed (dips of 11° to -20°) on flanks of anticlines in the region, the date of 26,700 yr provides measure of rate of deformation. Cones of *Pinus muricata* are abundant in the Orcutt Sand, and cones of *P. radiata* and *P. remorata* are also present. They suggest a moister climate than that in the area today.

#### La Brea Tar Pit series

Wood from La Brea tar pits, Los Angeles, California (34° 03' 45" N Lat, 118° 21' 25" W Long). Coll. during 1913-1915 excavations by Los Angeles County Mus. Part of an extensive modern analysis of materials found in the pits. See also LH-55, LJ-89, LJ-21 (LaJolla I) and Y-354 and Y-355 (Yale IV) for other La Brea dates and literature sources. More recent publications are Marcus (1960), Howard (1962) and Stock (1963).

Samples were extracted continuously with ether in a Soxhlet extractor for specified length of time until free from tar. Subm. by Th. Downs, Los Angeles County Mus.

**UCLA-773A. La Brea** **33,700 ± 1600**  
**31,750 B.C.**  
Pit 4, 5 ft depth. 5 months extraction.

**UCLA-773B. La Brea** **>40,000**  
Pit 9, 10½ ft depth. 5 months extraction.

**UCLA-773C. La Brea** **37,000 ± 2660**  
**35,050 B.C.**  
Pit 77, no record of depth. 5 months extraction.

**UCLA-773D. La Brea** **13,300 ± 160**  
**11,350 B.C.**  
Pit 9, 8½ ft depth. 5 months extraction.

**UCLA-773E. La Brea** >40,000  
Pit 16, 12 ft depth. 8½ months extraction.

**UCLA-773F. La Brea** >40,000  
Pit 9, 16 ft depth. 9½ months extraction.

**UCLA-773G. La Brea** >40,000  
Pit 16, 6½ ft depth. 9½ months extraction.

*General Comment* (T.D.): data greatly amplify the known history of La Brea. Difference in ages of pits is apparently confirmed.

### **Douglas Fir, Humboldt County, California Series**

Study is concerned with past conditions of Douglas fir-redwood area in Humboldt County, California.

Douglas fir heartwood samples were obtained from trunks buried in alluvium at various depths from Bull Creek Drainage in Humboldt County (40° 29' N Lat, 124° W Long). Coll., subm. and commented on by E. C. Stone and R. B. Vasey, Univ. of California, Berkeley.

**UCLA-997. Douglas fir from 29 ft depth** 9540 ± 120  
7590 B.C.

**UCLA-998. Douglas fir from 53 ft depth** 9500 ± 120  
7550 B.C.

**UCLA-999. Douglas fir from 102 ft depth** 9450 ± 120  
7500 B.C.

*Comment:* data indicate that mass of alluvium (>100 ft deep) was deposited over a period not longer than 330 yr. Such deep deposition over such a relatively short period suggests major flooding and deposition some 9500 yr ago. Together with deposition measurements of more recent times (Stone *et al.*, 1962), major flooding and heavy deposition appear to be a natural part of area's environment.

**UCLA-1018. Mt. San Gorgonio, California** <100

Wood from central section of large dwarf limber pine at 10,300 ft elevation on lateral moraine of San Gorgonio (11,485 ft) (32° 2' N Lat, 116° 48' W Long). Date was run to determine if trees were very old or of average age, in hearing of U.S. House of Representatives on the need for preservation of this wilderness area. Apparently the measurement corroborates reports of lack of vegetation at this location during conquest of the summit in 1872. Perpetual snow was reported on Gorgonio during the last century. Coll. and subm. by R. W. Tosh, Redlands, California.

### **Neotoma Midden series, SW States**

Series is part of a dating program begun with UCLA III and IV to use the plants of packrat middens to infer environmental conditions at

time of deposition. Coll. and subm. by P. V. Wells, Univ. of Kansas, Lawrence.

**UCLA-934. Burro Mesa, Texas** **> 36,600**

Site #2, ca. 4000 ft elev. *Comment* (P.V.W.): a woodland assemblage of *Pinus cembroides* and *Juniperus pinchotii* associated with a tortoise shell (*Gopherus*).

**9450 ± 90**

**UCLA-935. Spotted Range, Nevada** **7500 B.C.**

Site #2, ca. 5100 ft elev. *Comment* (P.V.W.): woodland assemblage of *Pinus monophylla*, *Juniperus ostiosperma* and *Acer glabrum*.

*G. Geological Processes*

**UCLA-908. Mammoth Mountain** **920 ± 80**  
**A.D. 1030**

Charcoal and wood from under 18 to 20 in. of pumice at Mammoth Mountain Inn, California (37° 38' N Lat, 119° 2' W Long), 300 yd ESE of ski headquarters and ca. 150 yd S of road and 100 ft above road in altitude. Coll. by R. Bumbaugh, Ch. Bailes and E. Pemberton; subm. by E. Pemberton and D. I. Axelrod.

**UCLA-1007. Beeri sulfur quarries, Israel**  $\Delta = -980 \pm 175$   
 $\delta C^{14} = 98.2\%$

Fossil mats, apparently algal, found as layers in sulfur-rich sandstone ridges parallel to the E Mediterranean coast from vicinity of Beeri sulfur quarries, Israel, 9 km S of Gaza (31° 28' N Lat, 34° 29' E Long). Original growth environment is thought to be lagunal. *Comment* (I.R.K.): apparent age is 32,350 ± 1400 yr,  $\delta C^{13}$  (PDB scale in per mil) -83 (T. A. Rafter, Wellington, New Zealand), and -85 and -89 (S. R. Silverman Chevron Research Co., La Habra, California). This appears to be lowest  $C^{13}/C^{12}$  ratio of any solid organic material yet measured, implying fractionation of an organic carbon source by microorganisms. But this mechanism cannot account for the  $C^{14}$  depletion alone, which must be the result of age.

**California Tufa Series**

A series of measurements of organic and inorganic fractions of tufas, to be discussed elsewhere after  $C^{13}$  analyses are available. Inorganic dates have been corrected by subtracting 2500 yr and increasing the error to 500 or 1000 yr, depending on apparent age (Broecker and Walton, 1959).

For isolation of the organic carbon, raw tufa was treated in 1 N HCl to remove all inorganic carbon. Then, after washing and drying, the treated tufa was heated in a stream of oxygen. Resulting  $CO_2$  was absorbed in 4 N NaOH. Rn was removed by flushing the NaOH-solution. Finally  $CO_2$  was liberated for standard purification. Coll. by E. L. Davis and R. Staudenmayer; subm. by R. Staudenmayer and R. Berger.

<b>UCLA-1110-I. Tufa</b>	<b>16,600 ± 1000</b> <b>14,650 B.C.</b>
Inorganic portion. From Panamint Valley (36° 9' 12" N Lat, 117° 16' 20" W Long), 1150 ft elev.	
<b>UCLA-1110-0. Tufa</b>	<b>13,400 ± 200</b> <b>11,450 B.C.</b>
Organic portion.	
<b>UCLA-1118-I. Tufa</b>	<b>24,500 + 1000</b> <b>22,550 B.C.</b>
Inorganic portion. From Panamint Valley (36° 26' N Lat, 117° 24' W Long), 1900 ft elev.	
<b>UCLA-1118-0. Tufa</b>	<b>12,500 = 800</b> <b>10,550 B.C.</b>
Organic portion.	
<b>UCLA-1121-I. Tufa</b>	<b>8000 ± 500</b> <b>6050 B.C.</b>
Inorganic portion. From Ridgecrest-Trona highway, California (35° 39' N Lat, 117° 30' W Long).	
<b>UCLA-1121-0. Tufa</b>	<b>3150 ± 150</b> <b>1200 B.C.</b>
Organic portion.	
<b>UCLA-1123-I. Tufa</b>	<b>13,450 ± 100</b> <b>11,500 B.C.</b>
Inorganic portion. From Panamint Valley (36° 26' N Lat, 117° 24' W Long), 1800 ft elev.	
<b>UCLA-1123-0. Tufa</b>	<b>12,000 ± 260</b> <b>10,050 B.C.</b>
Organic portion.	
<b>UCLA-1125-I. Tufa</b>	<b>10,150 ± 1000</b> <b>8200 B.C.</b>
Inorganic portion. From Ridgecrest-Trona highway, California (35° 39' N Lat, 117° 21' W Long).	

## REFERENCES

## Date lists:

Gochron I	Krueger and Weeks, 1965
Groningen V	Vogel and Waterbolk, 1964
La Jolla I	Hubbs, Bien and Suess, 1960
Lamont IV	Broecker and Kulp, 1957
Lamont V	Olson and Broecker, 1959
Lamont VII	Olson and Broecker, 1961
Michigan III	Crane and Griffin, 1958
Michigan VII	Crane and Griffin, 1962
Pennsylvania VI	Stuckenrath, 1963
UCLA I	Fergusson and Libby, 1962
UCLA II	Fergusson and Libby, 1963

- UCLA III            Fergusson and Libby, 1964  
 UCLA IV            Berger, Fergusson and Libby, 1965  
 Yale IV             Deevey, Gralenski and Hoffren, 1959
- Axelrod, Daniel I., 1966, The Pleistocene Soboba flora of southern California: Univ. California Publ. Geol. Sci., in press.
- Berger, R., Horney, A. G., and Libby, W.F., 1964, Radiocarbon dating of bone and shell from their organic components: *Science*, v. 144, p. 999.
- Berger, R., Fergusson, G. J., and Libby, W. F., 1965, UCLA radiocarbon dates IV: *Radiocarbon* v. 7 p. 336.
- Broecker W. S. and Kulp, J. L., 1957, Lamont natural radiocarbon measurements IV: *Science*, v. 126, p. 1324.
- Broecker, W. S. and Walton, A., 1959, The geochemistry of C-14 in fresh-water systems: *Geochim. et Cosmochim. Acta*, v. 16, p. 15.
- Campbell, E. W. C., 1937, The archeology of Pleistocene Lak Mohave: Southwest Mus. Papers, No. 11, Southwest Mus., Los Angeles, California.
- Clark, J. D., 1965, The Later Pleistocene cultures of Africa: *Science*, v. 150, p. 833.
- Crane, H. R. and Griffin, J. B., 1958, Univ. of Michigan radiocarbon dates III: *Science*, v. 128, p. 1117.
- 1962, Univ. of Michigan radiocarbon dates VII: *Radiocarbon*, v. 4, p. 183.
- Curry, J. R., 1960, Sediments and history of holocene transgression, continental shelf, northwest Gulf of Mexico: Am. Assoc. Petroleum Geologists Publ.: Recent sediments, northwest Gulf of Mexico, 1951-1958, Tulsa, Oklahoma.
- Deevey, E. S., Gralenski, L. J. and Hoffren, V., 1959, Yale natural radiocarbon measurements IV: *Am. Jour. Sci. Radioc. Supp.*, v. 1, p. 144.
- Fairbridge, R. W., 1960, The changing level of the sea: *Scientific American*, v. 202, p. 70.
- Fergusson, G. J. and Libby, W. F., 1962, UCLA radiocarbon dates I: *Radiocarbon*, v. 4, p. 109.
- 1963, UCLA radiocarbon dates II: *Radiocarbon*, v. 5, p. 1.
- 1964, UCLA radiocarbon dates III: *Radiocarbon*, v. 6, p. 318.
- Grant, C., 1965, The rock paintings of the Chumash: Univ. California Press, Berkeley-Los Angeles.
- Hayes, W. C., 1962, Chronology: Egypt-to the end of the 20th dynasty. A fascicle of the Cambridge Ancient History in process of revision: Cambridge, Cambridge Univ. Press, Edwards, I. E. S., Gadd, C. J., and Hammond, N. G. L., general ed., p. 1-23.
- Horn, W. and Born, E., 1965, The barns of the Abbey of Beaulieu at its granges of Gt. Coxwell and Beaulieu St. Leonards: Univ. California Press, Berkeley and Los Angeles.
- Horn, W., Charles, F. W. B., and Berger, R., 1966, Two dateable medieval barns in cruck construction: *Jour. Soc. Architectural Historians*.
- Howard, H., 1961, Significance of carbon-14 dates for Rancho La Brea: *Science*, v. 131, p. 712-714.
- 1962, A comparison of avian assemblages from individual pits at Rancho La Brea, California: *Contrib. in Science, Los Angeles County Mus.*, No. 58.
- Hubbs, C. L., Bien, G. S., and Suess, H. E., 1960, La Jolla natural radiocarbon measurements I: *Am. Jour. Sci. Radioc. Supp.*, v. 2, p. 197.
- Krueger, W. H. and Weeks, C. F., 1965, Geochron Laboratories, Inc. radiocarbon measurements I: *Radiocarbon*, v. 7, p. 47.
- Marcus, L. F., 1960, A census of the abundant large Pleistocene mammals from Rancho La Brea: *Contrib. in Science, Los Angeles County Mus.*, No. 38.
- Mason, H. L., 1934, Pleistocene flora of the Tomales formation: *Carnegie Inst. Washington Pub.* 415, p. 81-179.
- 1944, A Pleistocene flora from the McKittrick asphalt deposits of California: *Proc. California Acad. Sci.*, 4th ser., v. 25, p. 221-234.
- Mason, J. A., 1964, The ancient civilizations of Peru: Penguin Books, Baltimore, Maryland.
- Olson, E. A., and Broecker, W. S., 1958, Sample contamination and reliability of radiocarbon dates: *New York Acad. Sci. Trans.*, ser. II, v. 20, p. 593.
- 1959, Lamont natural radiocarbon measurements V: *Am. Jour. Sci. Radioc. Supp.*, v. 1, p. 1.
- 1961, Lamont natural radiocarbon measurements VII: *Radiocarbon*, v. 3, p. 141.

- Orr, P. C., 1956, Dwarf mammoth and man on Santa Rosa Island: Univ. of Utah Press, Anthropol. Papers, no. 26, p. 74.
- 1960, Late Pleistocene marine terraces on Santa Rosa Island: Bull. Geol. Soc. America, v. 71, p. 1113.
- 1962a, Arlington Springs man: Science, v. 135, p. 219.
- 1962b, Arlington Springs site, Santa Rosa Island: Am. Antiquity, v. 27, p. 417.
- 1966, Geochronology of Santa Rosa Island: Proc. of the Symposium on the Biology of the California Channel Islands, Santa Barbara Botanical Garden, in press.
- Potbury, S., 1932, A Pleistocene flora from San Bruno, San Mateo County, California: Carnegie Inst. Wash. Pub. 415, p. 25-44.
- Reisner, G. A., 1942, A History of the Giza Necropolis: Cambridge, Harvard Univ. Press, p. 451.
- Rowe, J. H., 1965, An interpretation of radiocarbon measurements on archeological samples from Peru: Proc. Internatl. Conf. C-14 and H-3 Dating, Pullman, Washington, in press.
- Shutler, R., Jr., 1965, Radiocarbon dating in the Pacific: Proc. Internatl. Conference C-14 and H-3 Dating, Pullman, Washington, in press.
- Stock, C., 1963, Rancho La Brea: Sci. Ser., no. 20, Los Angeles County Mus.
- Stone, E. C. *et al.*, 1962, Redwood Ecology: Annual report, School of Forestry, Univ. California, Berkeley.
- Stuckenrath, R., Jr., 1963, Univ. of Pennsylvania radiocarbon dates VI: Radiocarbon, v. 5, p. 82.
- Vogel, J. C. and Waterbolk, H. T., 1964, Groningen radiocarbon dates V: Radiocarbon, v. 6, p. 349.
- Woodring, W. P. and Bramlette, M. N., 1950, Geology and paleontology of the Santa Maria district, California: U.S. Geol. Surv. Prof. Paper 222.
- Zamenhof, S., 1958, Deoxyribonucleic acid: Biochemical Preparations, v. 6, p. 8.