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UCLA RADIOCARBON DATES IX*

RAINER BERGER and W. F. LIBBY

Institute of Geophysics, University of California
Los Angeles 90024

The measurements reported have been carried out during the first half of 1968 in the Isotope Laboratory of the Institute of Geophysics and Planetary Physics as a continuation of the UCLA date lists I through VIII. Samples were analyzed as CO_2-gas at close to one atm in a 7.5 L proportional counter with three energy channels described in earlier publication. Radiocarbon ages have been calculated for uniformity on the basis of a 5568 yr half-life in accord with a recommendation by the Sixth International C^{14} and H^3 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 based on CO_2 obtained from marble. The error listed is always at least a one-sigma statistical counting error. In critical cases C^{13}/C^{12} isotope ratio measurements were made to correct the dates for fractionation. All samples were subjected to accepted NaOH, HCl or other special chemical pretreatments discussed below depending on the individual case to exclude contamination.

The most recent summary of the history of radiocarbon dating is that by Libby, 1967.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

A. United States

Laguna Beach excavation series

In 1933 W. H. Wilson of Laguna Beach, California found during street grading portions of human skull and bone fragments from ca. 5 ft below present surface in sediments of alluvial fan emanating from

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coastal mts. behind city. After many inconclusive inspections in different insts. bones were submitted for radiocarbon dating by L. S. B. Leakey, Natl. Mus., Nairobi, Kenya. Because of great age of skull deduced by C^{14} analysis, excavation was begun on site of original find to collect additional material corroborating dating. Archaeologic direction of excavation was under J. D. Sackett.

UCLA-1233A. Laguna skull **17,150 ± 1470 / 15,200 B.C.**

Dated by collagen method (Berger, Horney, and Libby, 1964). N content of skull bones 0.26%, F 0.30%, 60 ppm U as U_3O_8. After mechanical cleaning, 78.5 g of bones extracted continuously with ether (anal. grade), treated with dilute HCl and removed humic acids with NaOH.

UCLA-1233B. Laguna bone fragments **>14,800**

Human long bone fragments assoc. with skull dated similar to UCLA-1233A; 23 g of bones gave insufficient CO_2 for finite date. N content of bones 0.23%, 0.34% F, 63 ppm U as U_3O_8. One of bones contained in hollow *Mytilus californianus* Conrad fragments.

UCLA-1349. Mussel shells **8950 ± 80 / 7000 B.C.**

Layer of broken *Mytilus* ca. 2 ft below present surface.

UCLA-1364. Mussel shells **8300 ± 80 / 6350 B.C.**

Layer of broken *Mytilus* ca. 6 to 7 ft below present surface.

General Comment (R.B.): skull measuring 17,150 yr and bone fragments at >14,800 were bracketed in reverse stratigraphy between shell layers 8950 and 8300 yr old. This condition is possible only if skull and bones intruded into present deposit which originates as alluvial fan from canyon at higher elev. of Laguna Mtns. with ultimate redeposition in present site. Consequently, human bones were in all likelihood redeposited and chances of finding more corroborating material are slim. T. D. Stewart finds skull not dissimilar to recent Indians of Santa Barbara coast. Since skull date is minimum considering possible contamination by humic acids not entirely removed, Stewart's analysis places independent apparent maximum limit on age which cannot be greater than Cro-Magnon man in Europe whose morphology is indistinguishable from modern Caucasians. Excavations are continuing and a full report will appear elsewhere.

UCLA-1059. Bishop's Cap Cavern **1590 ± 80 / A.D. 360**

Human bones reportedly taken from Bishop's Cap Cavern in White Sands proving-ground area, S-central New Mexico (32° 12′ N Lat, 106° 36′ W Long). Bones stem from human skeletons recovered 1927 under relatively uncontrolled excavations at depth varying from 21 to 35 ft

below present surface of cavern. Reportedly remains occurred at depths greater than Pleistocene fauna also found in cavern. Subm. by G. A. Agogino, E New Mexico Univ., Portales, 88130. *Comment* (R.B.): because of likely coating of bones with preservatives this was removed as completely as possible with continuous Soxhlet extraction by acetone and alcohol according to method of Agogino (1968). Find appears surrounded by similar circumstances encountered in Gypsum Cave discussed by Heizer (Radiocarbon, 1967, v. 9, p. 479).

New Mexico series

Part of study on nature and distribution of archaeologic sites through time in Cimarron, New Mexico area. Coll. by G. R. Baker and M. A. Glassow; subm. by J. N. Hill and M. A. Glassow for doctoral dissertation of M. A. G. (all UCLA).

1200 ± 80

UCLA-1369A. Philmont Scout Ranch **A.D. 750**

Charcoal from base of roasting pit of Area 2 on NP-1(9-1) of small village site on open terrace above N Poñil Stream on grounds of Philmont Scout Ranch, Cimarron, N.M. (104° 59′ 35″ N Lat, 36° 37′ 10″ W Long). Coll. Sept. 1967.

1195 ± 80

UCLA-1369B. Philmont Scout Ranch **A.D. 755**

Charcoal from lowest layer of roasting pit from same site (3D-1). Coll. Sept. 1967.

855 ± 50

UCLA-1369C. Philmont Scout Ranch **A.D. 1095**

Burnt timber coll. 1962 from roof of structure at Site NP-17 on rock ring on high promontory overlooking N Poñil Canyon (36° 38′ N Lat, 105° W Long). *Comments* (M.A.G.): rock ring sites are suspected to predate ceramic manifestations in this region of NE New Mexico. (R.B.): considering secular variations of C^{14} in wood based on Suess (1965) UCLA-1369A and B are 8th to 9th century A.D., 1369C is ca. A.D. 1100-1250.

2320 ± 60

UCLA-1370. Trancas Canyon **370 B.C.**

Haliotis rufrescens from Pit 1 assoc. with Burial 20 between 40 cm overburden and sterile rock-gravel of Indian cemetery on knoll W of Trancas Canyon, Los Angeles Co. on Pacific Ocean (34° 01′ N Lat, 118° 51′ W Long). Purpose of excavation is reconnaissance and salvage due to impending freeway construction. Coll. April 1968 by N. N. Leonard and subm. by J. M. Beaton, UCLA Arch. Survey. Date corrected −150 yr for oceanic conditions according to Berger, Taylor, and Libby (1966).

B. Mesoamerica

La Venta series

Continuation of dating program concerning age of La Venta, Tabasco, site (18° 10′ N Lat, 94° 5′ W Long). Previous dates and interpretations are found in Radiocarbon, 1968, v. 10, p. 150 and p. 404. Samples coll. and subm. by R. F. Heizer and R. Berger.

UCLA-1350. La Venta **1150 ± 60 A.D. 800**

Charcoal from interior of stone-ringed "temescal" near round stone bowl (Monument 45) of Stirling site in post-occupation drift sands. Coll. 1968 by R. F. Heizer. Should date last time bowl was used. Tree-ring calibrated C^{14} dating offers choice of A.D. 750 or 900 for last use. Y-2378 dates same feature at 1370 ± 80.

UCLA-1351. La Venta **2460 ± 80 510 B.C.**

Charcoal from Stirling site from lower part of red-yellow mottled clay in which monuments 39-41 and 44 were imbedded (Pit 9). Depth 40 to 42 in. below surface. *Comment* (R.F.H.): age acceptable, dates last construction of Stirling site.

UCLA-1352. La Venta **2910 ± 80 960 B.C.**

Charcoal from same location as previous sample, 46 to 49 in. deep. Coll. 1968. *Comment* (R.F.H.): age acceptable.

UCLA-1355. La Venta **2900 ± 80 950 B.C.**

Charcoal from 10-ft depth 30 ft W of W end of Drain 1 of Stirling site at ground water level. Lowest construction is deeper. *Comment* (R.F.H.): age acceptable and comparable to Phase 1 at La Venta main site.

UCLA-1356. La Venta **1940 ± 80 A.D. 10**

Charcoal from Trench 1968-8 at 190 cm in dark gray clays over sterile clay of trash deposit SW of pyramid. Assoc. with San Lorenzo phase ceramics. *Comment* (R.F.H.): age too recent.

UCLA-1357. La Venta **1890 ± 60 A.D. 60**

Charcoal from Mound A-2, Phase III fills just N of edge of pit containing massive offering No. 2. Complex A. *Comment* (R.F.H.): age too recent for Phase III fills.

UCLA-1358. La Venta **2330 ± 80 380 B.C.**

Charcoal from Trench V of Complex A. *Comment* (R.F.H.): archaeologically probably Phase II but age somewhat too recent.

2730 ± 80
780 B.C.

UCLA-1359. La Venta

Charcoal from E end of Trench W, 48 in. deep of Complex A. *Comment* (R.F.H.): acceptable as Phase II.

General Comment (R.F.H.): Stirling group appears contemporary to main La Venta site and was probably special annex. Abandonment of Stirling site and Complex A is indicated at roughly same time (Heizer, Drucker, and Graham, 1968). Complex A dates support revised dating of La Venta (Heizer, Graham, and Napton, 1968; Berger, Graham, and Heizer, 1967).

Tlatelolco, Mexico series

Charcoal coll. at Tlatelolco, 1 of 2 main divisions of Aztec Mexico which saw some of bitterest fighting between Aztecs and Cortez. Samples can give independent radiometric age assessment of Aztec chronology extrapolated from written records. Subm. R. F. Heizer.

680 ± 60

UCLA-1360. Tlatelolco $\delta C^{13} = -23.66‰$

Charcoal (ocote?) from near tzompantli (skull rack). Pottery assoc. indicates Aztec III, archaeol. dated ca. A.D. 1400. Coll. 1966 by E. Contreras, INAH, Mexico. *Comment* (R.B.): no tree-ring correction available. Tree-ring calibrated date is mid 13th century. Possibly wood is of earlier tzompantli structure.

610 ± 60

UCLA-1361. Tlatelolco $\delta C^{13} = -23.43‰$

Carbonized wood assoc. with incomplete remains of human sacrifice. Ceramic assoc. Aztec II-III attributed to A.D. 1325-1425. *Comment* (R.B.): tree-ring calibrated C^{14} date is 14th century.

475 ± 90

UCLA-1362. Tlatelolco $\delta C^{13} = -23.94‰$

Charcoal from soil in immediate contact with flexed burial of dignitary (?) Ceramic assoc. Aztec II-III. Last 2 samples coll. 1968 by E. Contreras and R. F. Heizer. *Comment* (R.B.): tree-ring calibrated C^{14} dating is 1st third of 15th century.

General Comment (R.F.H.): C^{14} dates appear to support archaeologic chronology which has been developed.

San Pablo, Morelos series

Measurements were made as part of doctoral dissertation of D. C. Grove (1968) under H. B. Nicholson, UCLA, on Morelos Preclassic and Highland Olmec problem.

UCLA-1350A. San Pablo **Modern**

Collagen date based on human bones from Pit 4, Burial (Sp-4, Ent. 2) treated according to Berger, Horney, and Libby (1964) from San Pablo, Morelos near Tlaltizapan (18° 42′ N Lat, 99° 6′ W Long).

UCLA-1305B. San Pablo **Modern**

Collagen date based on human bones from Pit 4, Burial I (SP-4, Ent. 1) treated similarly, but with specially prolonged NaOH extraction of humic acids. *Comment*: comparison with secular variations may place age of bones up to 300 yr into past. However, this is not in concert with expected archaeologic context, Lower-Middle Preclassic.

Tikal beams series

Last extensive radiometric investigation of Maya Calendar correlation problem is that of E. Ralph (1965). In the meantime two improvements could be made: (1) consideration of secular variations of radiocarbon in wood, not as well known earlier, and (2) more specific selection of wood samples of known position in original trees from which Tikal beams were cut. Wood samples originate from G. Bernoulli collection in Mus. für Völkerkunde, Basel, Switzerland and were obtained through courtesy of G. Baer of that mus. Details of this investigation are published elsewhere (Berger, 1968).

UCLA-1373A. Tikal **1250 ± 50**
$\delta C^{13} = -25.44‰$

Sapwood close to edge of tree (*Manilkara* [*Achras*] *sapote*) from Lintel 3, Temple IV at Tikal, Guatemala (17° 13′ N Lat, 89° 24′ W Long). From top portion, right edge, left outer plank of relief.

UCLA-1373B. Tikal **1370 ± 50**
$\delta C^{13} = -24.80‰$

Sapwood from same carving, 3. Wood plank from left of relief, middle right edge.

UCLA-1373C. Tikal **1400 ± 60**
$\delta C^{13} = -25.54‰$

Sapwood from outermost right plank, lower right hand edge.

General Comment: wood used for relief probably cut toward end of 7th century A.D. when curve of secular variations is applied. Three alternate dates for 1373A are reduced to one in context with other measurements. Closest calculated correlation to this C^{14}-derived date is that by Goodman-Thompson-Martinez (Thompson, 1950) similar to conclusions by Ralph. Earlier measurements C-948, C-949 without tree-ring and secular variation corrections weighted average of 1503 ± 110 yr (Libby, 1955). Within exptl. error this overlaps with oldest of present measurements.

C. Pacific

UCLA-1372. Madai Cave, Sabah **10,800 $^{+80}_{-2000}$**

Food shells from deposit 54 to 60 in. deep in Madai Cave, E coast of Sabah or N Borneo (ca. 6° N Lat, 116° E Long). This limestone cave meets many criteria for site likely to contain early human materials with-

out submergence, and animal disturbance. Stratigraphy of cave starts with Iron age, neolithic deposits to 30 in., below 42 in. abundant stone artifacts similar to very old levels at Niah Cave (Radiocarbon, 1966, v. 8, p. 479, UCLA-957) and likely human deposits for another 70 in. Shells dated id. as *Melanoides* (*Stenomelania*) cf. *M.* (S.) *rustica* Mousson, sweet water mollusk. Coll. 1968 by T. and B. Harrison, Cornell U. and subm. by R. Shutler, Jr., Univ. of Victoria, B.C. *Comment* (R.B.): nature of shells introduces large error with amplified apparent age, but date was run nevertheless to guide excavation planning.

D. Near East

Aq Kupruk, Afghanistan series

Following samples all from rock shelters near Aq Kupruck (36° 5′ N Lat, 66° 51′ E Long) have been dated in investigation of archaeology of NE Afghanistan, so far little understood. Coll. by L. Dupree, Am. Univ. Field Staff, U.S. Embassy, Kabul, Afghanistan and subm. by J. L. Davidson, UCLA.

1750 ± 60

UCLA-1363A. Snake Cave **A.D. 200**

Charcoal (containing bone) from Snake Cave, cut 50 to 200 cm. Coll. 1965.

1320 ± 60

UCLA-1363B. Snake Cave **A.D. 630**

Charcoal from same site, cut 50 to 220 cm. Coll. 1965.

1640 ± 60

UCLA-1363C. Snake Cave **A.D. 310**

Charcoal (containing bone) from same site, Cut 41 1, 210 to 330 cm. Coll. 1965.

1460 ± 60

UCLA-1363D. Snake Cave **A.D. 490**

Charcoal from same site, Cut 1a; red earth under nomad level. Coll. 1962.

2350 ± 85

UCLA-1363E. Horse Cave **400 B.C.**

Charcoal from Horse Cave, Cut 1b, 90 to 135 cm, hearth below pot. Coll. 1965.

4500 ± 60

UCLA-1363F. Horse Cave **2550 B.C.**

Charcoal from Horse Cave, Cut 5m, Hearth 2. Coll. 1965. *Comment* (R.B.): full evaluation of dates expected later after additional samples have been analyzed.

E. Africa

UCLA-1319. Omo River site **15,500 ± 300 / 13,550 B.C.**

Collagen date prepared by method of Berger, Horney, and Libby (1964) based on mixture of mammalian bones from Omo R. site (ca. 5° N Lat, 36° E Long). Following collagen dates prepared similarly with careful humic acid extraction. Coll. 1967 by Kenya expedition under direction of L. S. B. Leakey and R. Leakey.

UCLA-1321. Olduvai Bed V **10,100 ± 600 / 8150 B.C.**

Collagen date based on mammalian bones from aeolian deposit of Bed V at 5th fault of Olduvai Gorge (ca. 2° 50′ S Lat, 35° 13′ E Long). Date fixes upper limit for age of Kenya Capsian and places beginning of dry period after last phase of Gamblian pluvial there. Date discussed in detail in Leakey, Protsch, and Berger (1968). *Comment* (R.B.): measurement gives age for termination of Upper Pleistocene and beginning of Holocene at Olduvai. Fits well with dates for event in other continents (Berger, 1966).

UCLA-1322. Lake Baringo **2080 ± 110 / 130 B.C.**

Collagen date from mammalian bones from new terrice site on Ndau R., W of Lake Baringo (38′ N Lat, 36° 17′ E Long), assoc. with much pottery and stone tools. Date establishes site as relatively young in general archaeol. exploration of Kenya. Subm. by L. S. B. Leakey.

UCLA-1323. Mt. Suswa **4730 ± 250 / 2780 B.C.**

Collagen date from mammalian bones from new site on slopes of Mt. Suswa (1° 10′ S Lat, 36° 21′ E Long) assoc. with human skeletons. Date establishes location in time of site which could not be dated otherwise. Subm. by L. S. B. Leakey.

F. Europe

European Medieval Architecture series

Continuation of investigation into potential and limitations of radiocarbon dating in Middle Ages (Horn, 1969; Berger, 1969). For highest precision δC^{13} measurements are included, sample location in respective timber as well as comparison with secular variations of C^{14} concentration in dendrochronologically dated wood (Suess, 1965). Samples coll. 1967, subm. and commented on by W. Horn, Univ. of California, Berkeley, and R. Berger.

UCLA-1304. Méréville **400 ± 50** / $\delta C^{13} = -24.69‰$

Oak heartwood from central shake in Post j 30 rings inside tree from market-hall of Méréville, Seine-et-Oise (ca. 48° 17′ N Lat, 2° 13′ E Long). Erection of building is attributed to Etienne le Fevre, Vicomte

de Méréville (1456-1472). *Comment*: C^{14} age corresponds to either ca. A.D. 1460 or 1600. Previous sample UCLA-572 (Radiocarbon, 1965, v. 7, p. 349) resolves ambiguity and causes date for erection of hall to be placed near A.D. 1440-1460 in good agreement with historical date.

550 ± 40

UCLA-1345. Lenham minor $\delta C^{13} = -24.94‰$

Oak heartwood from one of principle posts 40 yr inward from heartwood/sapwood interface of minor barn at Lenham, Kent (ca. 51° 13′ N Lat, 38′ W Long). Since heartwood/sapwood interface occurs after ca. 20 yr in mature oaks, tree-ring correction of 60 yr is indicated. *Comment*: calculated historical age is somewhere in 14th century due to plateau in correction curve.

640 ± 40

UCLA-1346. Lenham major $\delta C^{13} = -24.12‰$

Oak heartwood 30 yr inside waney edge of principle post in W row, 3rd truss from N. *Comment*: calculated historical age is ca. A.D. 1310.

550 ± 40

UCLA-1347. Lenham minor $\delta C^{13} = -20.77‰$

Oakwood from tenon of fallen post from minor barn. *Comment*: calculated historical age range is similar to UCLA-1345 based on same tree-ring correction. Both dates reported in this list gave age range whereas previous dates were definitive (UCLA-1089 and 1090, Radiocarbon, 1967, v. 9, p. 486-7). These dates suggest construction of Lenham minor about turn of 13-14th century in agreement with historical evidence placing event some time after A.D. 1298.

General Comment: it is now possible to evaluate more clearly potential and limitations of radiocarbon dating for the period of Middle ages based on our measurements of structures of known age published in previous date lists. The following procedures were found to give best results for dating timber samples:

1. Select sample from least likely contamination.
2. Remove mechanically gross contamination.
3. Treat with HCl and distilled water.
4. Determine C^{14} content of sample.
5. Measure C^{13}/C^{12} ratio for isotopic fractionation.
6. Compare resulting age with curve for secular variations of radiocarbon in dendrochronologically dated wood.
7. Consider any necessary tree-ring allowance.

Thus, when all pertinent correction factors are taken into account much more precise dating is feasible for those periods in which curve for secular variations has near vertical trend. This is especially true for 13th and 15th centuries. On the other hand where secular variation curve flattens out into a plateau—as during the 11th, 12th, and 14th centuries—only a general date range can be obtained, extending over as much as 100 or even 150 yr. In 16th and 17th centuries, where secular variation

curve rises and falls in rapid succession we have to take our choice between 2 and on occasion even 3 alternative dates. Which is correct one must be decided by independent evidence or special sample selection.

Many radiocarbon dates measured prior to advent of tree-ring calibrated radiocarbon dating are perfectly acceptable today since the curve correlating radiocarbon and tree-ring ages often approaches very closely the theoretical ideal relationship without variations.

It is evident that additional closer spaced and independent calibration measurements for the curve are desirable to understand its entire nature. We have found only minor deviations based on historically dated samples; on the whole the course of the curve is supported by our known dates. In fact, all our measurements of samples from different locations in same timber yield radiocarbon dates in about the right order and spacing in time according to the course of the curve for secular variations.

In addition to analysis of more dendrochronologically dated wood check measurements based on well-dated parchment charters are under way. The ultimate assessment of radiocarbon dating in the Middle Ages will be made in the future after many more precise measurements have been carried out. At present our procedures allow much more accurate dating than has been hitherto possible.

II. CLIMATOLOGIC, GEOCHEMICAL, AND GEOLOGIC SAMPLES

Malibu Coast series

Geomorphic analysis suggests that although shells dated occur in assoc. with beach sand, gravel, and boulders at widely different alt of Malibu, California coast, all were deposited on the tectonically deformed lowest terrace above present sea level. C^{14} dates were run to determine if shells were deposited immediately prior to last Wisconsin fall of sea level. Samples coll., subm. and commented on by R. V. Cooke, Univ. College, London.

UCLA-961. Malibu shells **>40,000**

Shells from E end of Escondido beach, Pacific coast hwy at 34° 1′ 45″ N Lat, 118° 45′ 40″ W Long at +103 to 107 ft.

UCLA-962. Malibu shells **>40,000**

Shells from cliff sec. ¾ mi E of Bass Rock at +25 ft Malibu, California (34° 3′ 45″ N Lat, 118° 58′ 49″ W Long). *Comment*: this shore line (ca. +100 to 125 ft) E of Point Dume has estimated age on the order of 100,000 yrs (Yerkes and Wentworth, 1965; Rosholt, 1967). Field inference is not incorrect. Measurements may be correlated with others discussed by Bradley (1956) and Orr (1960).

Saanich Inlet series

Measurement of C^{14} level of interstitial water from sediments beneath 200m water of Saanich Inlet, B.C. (ca. 48° 28′ N Lat, 123° 22′ W Long, E side of S tip of Vancouver Is.). Coll. 1968. Total dissolved CO_2

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liberated with phosphoric acid in vacuum. Assoc. details to be discussed by Presley, Nissenbaum, Kolodny and Kaplan (1968). Subm. by A. Nissenbaum and I. R. Kaplan, UCLA.

UCLA-1194A. Saanich Inlet $\delta C^{14} = -6.6 \pm 0.9\%$

CO_2 from interstitial water from sediment 15 to 30 cm in core.

UCLA-1194B. Saanich Inlet $\delta C^{14} = -10.6 \pm 0.9\%$

CO_2 from interstitial water from sediment 200 to 225 cm in core. *Comment* (R.B.): these core results are not dissimilar to C^{14} activity in soil humus. No bomb-C^{14} is as yet detectable in these samples.

California fossil wood series

Study of Pleistocene vertebrate fauna of Los Angeles basin and vicinity (Miller, 1968). Coll. by W. E. Miller, subm. by W. E. Miller and D. E. Savage, Univ. of California, Berkeley, through D. I. Axelrod, Univ. of California, Davis.

UCLA-1324. El Toro **42,500 ± 4400**
40,550 B.C.

Fossil wood from Costeau pit, El Toro, California (33° 36′ N Lat, 117° 40′ W Long) in clayey silt yielding well-preserved mammals 20 ft below original land surface. *Comment* (W.E.M.): fauna similar to that from Rancho La Brea. However, differences include bison recovered at Costeau Pit is predominantly *B. latifrons* as opposed to the abundant *B. antiquus* at Rancho La Brea. Ground cloth specimens (*Paramylodon*) from the Costeau Pit site averages smaller in size. Small as well as large equid have been recovered from this locality. Only large equid is known from Rancho La Brea.

UCLA-1325. La Mirada **8550 ± 100**
6600 B.C.

Fossil wood from Coyote Creek, La Mirada, California (33° 56′ N Lat, 118° 3′ W Long) from sandy silt 12 ft below surface. Extinct Pleistocene mammals have been found immediately above and below this wood-bearing stratum. *Comment* (W.E.M.): fauna very similar to Rancho La Brea. All mammals recovered from this site (species level) are known from the asphalt pits such as: *Equus, Mammut americanus, Bison antiquus, Camelops hesternus, Ursus, Canis.*

UCLA-1348. Ballinamore, Ireland **630 ± 60**
$\delta C^{13} = -24.58‰$

Alder roots from buried soil horizon in townlands of Creevy and Cleendargan, Ballinamore, Co. Leitrim, (54° 3′ N Lat, 7° 47′ W Long), part of study of soil development. Question if alder roots are indigenous or intrusive in soil stratum. Coll. and subm. by J. Mulqueen, Agricultural Inst. Cleendargan. *Comment* (R.B.): because higher stratum yields age of 11,310 ± 720 yr, roots are intrusive.

Gatun Basin, Panama series

The following measurements supplement our previous dates on vegetational and climatic changes of the Gatun Basin, Panama, since 12,000 yr ago with special reference to eustatic sea level changes (Radiocarbon, 1967, v. 9, p. 498). Subm. 1968 by E. S. Barghoorn and A. Bartlett, Harvard Univ.

6230 ± 80

UCLA-1353. Gatun **4280 B.C.**

Wood fragments (TDS-2, HU-66) 43 ft below sea level (9° 11′ + 1951 ft Lat, 79° 57′ + 1499 ft Long).

4750 ± 100

UCLA-1354. Gatun **2800 B.C.**

Silty peat (TDS-4, HU-150) 42 ft below sea level (9° 11′ + 1209 ft N Lat, 79° 57′ + 243 ft W Long). *Comment* (R.B.): data agrees well with inferred sea level stands since 10,000 yr ago. Full evaluation to appear in Bartlett, Barghoorn, and Berger, in press.

Neotoma Midden series, Baja California

Series is part of dating program begun with Radiocarbon, 1964, v. 6, p. 318 on use of identifiable macrofossil plant residues to infer environmental conditions at time of deposition. Part of study to determine conditions along Pacific coast vs. inland (Wells and Berger, 1967). Coll. and subm. P. V. Wells, Univ. of Kansas, Lawrence.

10,200 ± 135

UCLA-1365. Baja California **8250 B.C.**

Midden from Aguajito Llano, elev. 1950 ft. Lower front of top center portion of deposit. Contains seeds and twigs of *Juniperus*.

10,150 ± 130

UCLA-1366. Baja California **8200 B.C.**

Same location but upper rear and top center with similar plant contents.

10,000 ± 125

UCLA-1367. Baja California **8050 B.C.**

Same location, lower part of left-hand deposit with similar plant contents. *Comment*: deposition of massive midden must have occurred within short period of time.

Calico Hills Site series

In recent years an exploratory excavation has been carried out on large site in arid Calico Hills NE of Yermo (34° 55′ N Lat, 116° 50′ W Long) E of Barstow, California. Site can be reached via Minneola Rd. turnoff N of U.S. Hwy. 91. Material found at site appears to be concentrated within one massive alluvial fan forming Yermo formation which includes cherts, tuffaceous andesites and variety of intrusive igneous rocks presumably derived from Mule Canyon. Geomorphologi-

cally, especially based on subsequent downcutting and decimation of the Yermo Fan, site appears older than "classical" Wisconsin but more recent than late Middle Pleistocene in view of absence of intense weathering and relative degree of preservation of unconsolidated body of alluvium. Exacavations are under direction of L.S.B. Leakey, R. D. E. Simpson, San Bernardino Co. Mus., and T. Clements, Univ. S California, Los Angeles (Leakey, Simpson, and Clements, 1968).

The following measurements were made in attempt to date site more precisely. Due to highly alkaline soil ancient organic materials like wood, roots, or other accumulations of any consequence no longer survive. Samples coll., subm., and commented on by R. Berger.

UCLA-1368. Roots $\delta C^{14} = +9 \pm 2\%$

Fine hairy roots from M2/K11, S wall, 250 to 287 cm below surface. *Comment*: due to highly consolidated soil plus secondary cementation roots appeared initially to be old. However C^{14} measurements places them into late 1950's.

UCLA-1371A. Secondary Carbonate Cementation

Secondary carbonate cementation around rock detritus from M1/P23/SW¼, 480 cm below surface and lowest excavation level May 1968.

UCLA-1371E. Secondary Carbonate Cementation

Secondary carbonate cementation around rock detritus from M1/R21/W½, 400 cm below surface and upper level below which suspected artifacts are found.

General Comment: secondary carbonate cementation or calcrete is easily recognized as having been precipitated from groundwater due to characteristic deposition around rocks. Partially consists of carbonates of geologic or infinite age and C^{14} introduced by CO_2 exchange between groundwater and air. Ratio of atmospheric C to geologic C is at least 1:1 or better in favor of atmospheric C. Without measurable $C^{14}O_2$ in sample gas this secondary cementation must have occurred at least more than 34,000 yr ago which applies to stratigraphic levels of archaeologic interest from 400 to 480 cm. Butzer and Hansen estimate age of Yermo Fan at $>30{,}000$ and $<120{,}000$ yr. Present measurements support lower limit and agree with age of oldest finds on Santa Rosa Is., Calif. (Orr and Berger, Berger and Orr, 1966).

Pacific subsurface water series

Continuation of seawater radiocarbon measurements reported in Radiocarbon, 1968, v. 10, p. 156. Previously seawater had been obtained from 33° 20.5′ N Lat, 118° 17.5′ W Long off Catalina Is., California at 200 ft depth. This water showed considerable exchange between CO_2 content and atmospheric CO_2. However, the question remained if exchange might have been induced by enzymes contained in sewage outfall

of greater metropolitan Los Angeles area. Therefore more seawater from similar depth, but more than 200 mi from coast was coll. with cooperation of Capt. White, "USS Baya," San Diego.

UCLA-1506. Seawater $\delta C^{14} = +20.7\%$

Coll. July 1968 at (31° 40′ N Lat, 120° 20′ W Long) in 2200 fms at 250 ft. Not exposed to air.

UCLA-1507. Seawater $\delta C^{14} = +37.1\%$

Same seawater, aliquot exposed for 65 hrs at China Lake, California where all UCLA atmospheric $C^{14}O_2$ monitoring is done. Flow rate of air: standard 200 L/hr. *Comment* (R.B.): exchange is confirmed for subsurface water in which contamination by man can be virtually ruled out. Details to be publ. elsewhere.

III. ATMOSPHERIC MEASUREMENTS

Atmospheric Radiocarbon Activity, California, series

This series is continuation of data published in our previous date lists. C^{14} content in ground level atmospheric CO_2 was monitored continuously in one-week increments at China Lake, California (35° 37′ N Lat, 117° 41′ W Long). Samples coll. with cooperation of G. Plain, Assoc. Head, Research Dept., Naval Weapons Center, China Lake, California.

The following list contains exposure times of NaOH solutions to air and percent increase of C^{14} above reference level of 1890 or 0.95 NBS oxalic acid.

Sample no.	Exposure time	δC^{14}, ‰
UCLA-1189	28 Dec. — 4 Jan. 1968	+60.5
UCLA-1192	11 Jan. — 18 Jan. 1968	+60.3
UCLA-1190	18 Jan. — 25 Jan. 1968	+59.8
UCLA-1193	25 Jan. — 1 Feb. 1968	+57.5
UCLA-1195	1 Feb. — 8 Feb. 1968	+58.0
UCLA-1196	8 Feb. — 15 Feb. 1968	+60.3
UCLA-1197	15 Feb. — 22 Feb. 1968	+59.6
UCLA-1198	22 Feb. — 29 Feb. 1968	+56.3
UCLA-1199	29 Feb. — 7 Mar. 1968	+58.4
UCLA-1500	7 Mar. — 14 Mar. 1968	+58.3
UCLA-1501	14 Mar. — 21 Mar. 1968	+57.8
UCLA-1502	3 Apr. — 10 Apr. 1968	+60.4

Comment (R.B.): previous samples were coll. once a month. This experiment was run to see if, by continuous monitoring, appreciable changes in radioactivity due to stratospheric air mixing with that of troposphere might be detected as in earlier winters. This was apparently not the case during last winter for area around China Lake even though tropospheric and stratospheric $C^{14}O_2$ levels are as yet not equilibrated (L. Machta, pers. commun.)

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UCLA II	Fergusson and Libby, 1963
UCLA III	Fergusson and Libby, 1964
UCLA IV	Berger, Fergusson, and Libby, 1965
UCLA V	Berger and Libby, 1966
UCLA VI	Berger and Libby, 1967
UCLA VII	Berger and Libby, 1968
UCLA VIII	Berger and Libby, 1968

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