[RADIOCARBON, VOL. 5, 1963, P. 254-272]

LA JOLLA NATURAL RADIOCARBON MEASUREMENTS III*

CARL L. HUBBS, GEORGE S. BIEN, and HANS E. SUESS
University of California, San Diego

INTRODUCTION

During 1962 the La Jolla Radiocarbon Laboratory continued to follow essentially the same technique as in previous years. Three counters were used:

1. The "Bern Counter," an Oeschger-Houtermans instrument manufactured at the Physical Institute of the University of Bern; described in La Jolla I (p. 197).

2. The "Brussels Counter," another Oeschger-Houtermans instrument, manufactured in Brussels by Manufacture Belge de Campes et de Matériel Électronique, S. A.; characterized in La Jolla II (p. 204).

3. The "400-cc La Jolla Counter," recently constructed at the University of California, San Diego to facilitate the age determination of samples containing less than 1 g of carbon. Because the first model, now in use, was constructed of brass—not the optimal material—the background count is relatively high (ca. 5.0 counts/min). Advantages lie in its high stability. For samples that yield 0.5 L or more of acetylene, this counter can be used quite satisfactorily. Check runs, using the same sample in this counter and in the Bern and Brussels counters, agree closely. Following is an example (LJ-563):

Counter	Manometer Reading	Apparent Age	1σ
400-cc La Jolla	1 atm	1440	300
Brussels	1 atm	1400	100
Brussels	440 mm	1540	100
Bern	440 mm	1400	100

A further example: dates obtained separately by the use of the Bern and Brussels counters for LJ-533 (34,400 ± 1000) agreed within 150 yr. In the analysis of C^{14} in seawater alternating determinations with the Bern and Brussels counters also yielded virtually identical results. Of the measurements herein described those from LJ-281 to 509 were run on the Bern Counter; those from LJ-511 to 539 more or less alternately on the Bern and Brussels counters; LJ-562 to 564 only on the 440-cc La Jolla Counter (with check runs on the other counters for LJ-563, as indicated above, and with the Brussels counter for LJ-562).

In order to include consideration of uncertainties in calibration, the drift in sensitivity of background, and other fluctuating factors, the error listed with each date, as in La Jolla I and II, is larger by ca. 100 yr than the one-sigma statistical counting error (which is the value quoted in other date lists); when the estimate is 1000 or more, no addition is made.

All samples were thoroughly pretreated with dilute HCl and NaOH.

* Contributions from the Scripps Institution of Oceanography, New Series.

During 1962 natural C^{14} measurements were obtained for 45 samples, in addition to 92 samples derived from seawater (these 92 are the only 1962 tests to be reported elsewhere). Two additional measurements (LJ-281 and 290), omitted from La Jolla II, are included, to make a total of 47.

A report on the "Radiocarbon Dating of Deep Water of the Pacific and Indian Oceans" was presented by G. S. Bien, N. W. Rakestraw, and H. E. Suess at the International Atomic Energy Authority Symposium on Radioactive Dating, at Athens, in November 1962. This report, with 114 "apparent age" estimates, has been issued in processed form and is being prepared for publication in a journal.

Particular stress has been maintained on datings that bear on changes in past conditions, biological as well as physical; especially on those that bear on the prehistoric life of man.

New applications bear on the recent and probably continuing formation of phosphorite on the sea-floor off Baja California (LJ-500, 509, 515), and of dolomite in a freshwater spring (LJ-527, 562-564); also on the time and rate of formation of caliche in Colorado (LJ-510) and of tufa in Lake LeConte (LJ-457, 458, 513). Other highlights in this report include the demonstration: (1) of a long and varied series of fillings of Lake LeConte; (2) prolonged occupation of a coastal midden site in southern California (LJ-453 and 454); (3) a new determination (11,690 ± 250, LJ-452) for ground-sloth dung from Gypsum Cave, Nevada; (4) the oldest date (2925 ± 340, LJ-505) yet obtained for the Maya; and (5) two measurements (LJ-411 and 533) from the Mohole Exploratory Drilling.

ACKNOWLEDGMENTS

The operation of the La Jolla Radiocarbon Laboratory continues under support from the National Science Foundation. Additional support has again come from the California State Water Resources Board. Both agencies have also provided research grants to the senior author, for studies that involve the Radiocarbon Laboratory.

Technical assistance in the operation of the Laboratory has been furnished by Sylvia F. Chillcott and Paula Sandoval, and the electronics have been maintained by Everett R. Hernandez. The senior author's staff has included Jacquelin N. Miller, Laura C. Hubbs, Priscilla A. Sloan, and Betty N. Shor. Emery P. Chace has continued to identify molluscs.

SUBJECT INDEX

We continue to enter the datings in serial numerical order, which allows convenient reference, and again provide an index to the diverse subjects on which the tests seem to bear.

I. GEOLOGIC INFERENCES:

1. Quaternary Changes of Sealevel:
   - California: LJ-456.
   - W coast of México: LJ-517, 518, 520, 522-526.
   - Texas: LJ-521.
   - Australia: LJ-451, 516.

https://doi.org/10.1017/S0033822200036882 Published online by Cambridge University Press

2. Quaternary Soil History:
   California coastal terraces: LJ-449, 514.
   California valley-fills: LJ-456, 532.
   Colorado bog: LJ-539.
   Glacial terrain, Illinois and Indiana: LJ-281, 290.
3. History of Lake LeConte:
   Pleistocene period between or before fillings: LJ-532.
   Pleistocene freshwater stages: LJ-450, 457, 458, 504, 513.
   Recession from Pluvial stage: LJ-528.
   Holocene freshwater stage: LJ-530.
4. History of Other Lakes in California:
   Eagle Lake: LJ-501.
   Lake Tahoe: LJ-503.
   Deep Spring Lake: LJ-527.
5. Inferred Long Continuity of Springs: LJ-527, 528.
6. Longshore Transport, Sedimentation, and Coastal Advance: LJ-518, 522-526.
7. Deep-sea Sedimentation: LJ-533.
8. Diastrophism:
   LeConte Basin and Colorado Delta: LJ-504.
   Coastal uplift, Golfo de California: LJ-522.
   (See also Quaternary Changes in Sealevel.)
9. Time Span for Processes:
   Phosphorite formation in sea: LJ-500, 509, 515.
   Dolomite formation in lake: LJ-527, 562-564.
   Tufa formation: LJ-457, 458, 513.
   Caliche formation: LJ-510.
   Valley-fill (see Quaternary Soil History.)

II. AGE OF SEAWATER: LJ-412-418, 425-433, 435, 436, 439-447, 460-499, 534, 535, 538, 540-561 (these 92 measurements on dissolved CO_2 are to reported elsewhere).

III. PALEOCLIMATOLOGIC INFERENCES:

1. Inferences from Lake Levels, California: LJ-450, 457, 458, 501, 503, 504, 513, 528, 530, 532.
2. Inferences from Data on Dated Bog, Colorado: LJ-539.
3. Inferences from Faunal Evidence:
   Ground sloth, Nevada: LJ-452.
   Snail fauna, Indiana: LJ-290.

IV. ARCHEOLOGIC INFERENCES:

1. Gypsum Cave, Nevada: LJ-452.
2. Preceramic, Mainland Coast, California: LJ-449, 453, 454, 529.
3. Channel Islands, California: LJ-514.
4. Lake LeConte, California: LJ-528, 532?

5. W Coast of México: LJ-518.
6. Prolonged Habitations: LJ-453, 454.
7. Maya Chronology: LJ-505, 508, 531.

V. FAUNAL HISTORIES:

1. Ground Sloth, Nevada: LJ-452.
2. Snail Fauna, Indiana: LJ-290.

VI. TESTS BEARING ON RELIABILITY AND PRECISION OF THE DATES:

1. Orderly, Expected Sequences: LJ-382 (La Jolla II) and 448; LJ-453 and 454; LJ-457 compared with LJ-458 and 513; LJ-562-564; LJ-510.
2. Datings Consonant with Pleistocene Geology: LJ-450, 452, 456, 457, 504, 510, 528.
3. Datings More or Less Contrary to Expectation: LJ-385 and 386 (La Jolla II) and LJ-449 and 512 (discrepancy in terms of depth explained as due to erosion and redeposition); LJ-505 and 508; LJ-517 contrasted with LJ-280 (La Jolla II) and LJ-520; LJ-523-525.
4. Agreement between Repeated Tests: LJ-458 and 513.

LJ-281. Mississippi River alluvium, Illinois **6600 ± 200**
4650 B.C.

Wood from a tree trunk, 0.76 m in diameter, found standing erect 16.5 to 16.8 m below land surface, on the bank of Mississippi River near Wood River, Illinois; trunk, with root portion apparently charred, was uncovered during excavation of a Ranney Collector Well for Olin-Mathieson Chemical Co., 975 m W and 488 m S of NE corner, Sec. 29, T 5 N, R 9 W, Madison Co.; altitude of floodplain here is 126 m (ca. 38° 50.2′ N Lat, 90° 06.7′ W Long). Coll. 1960 and subm. 1961 by R. E. Bergstrom, Illinois State Geol. Survey. *Comment*: the alluvial sands and gravels in which the wood occurred were believed by the collector to be probably Recent but possibly of glacial valley-train origin. The outermost rings were dated (bark missing?).

LJ-290. Lake Eminence, Indiana **5000 ± 250**
3050 B.C.

Wood from a log ca. 50 cm in diameter and probably containing 300 to 400 rings, exposed in bank of E Fork of Mill Creek, 6.44 km SW of Clayton, Hendricks Co., in NE ¼ of SW ¼, Sec. 11, T 14 N, R 2 W (ca. 39° 40.0′ N Lat, 86° 36.3′ W Long). Coll. 1960 and subm. 1961 by W. J. Wayne, State of Indiana Geol. Survey (sample WJW–60–15). *Comment* (W.J.W.): section measured at the locality: (3) silt and sand, yellowish-brown, laminated to massive, not calcareous, 2.0 m; (2) sand and gravel, light yellowish-brown, calcareous, up to 1.0 m; (1) silt, medium-gray, calcareous, with abundant plant remains and gastropods, 0.3 m (base not exposed). Large logs rest on bed 1 and are embedded in its upper part; the snail fauna has some cool-climate elements normally found in intertill Pleistocene beds and lacks the species that

https://doi.org/10.1017/S0033822200036882 Published online by Cambridge University Press

came with the postglacial forests. Bed 1 was interpreted as part of the bed of Lake Eminence (Thornbury, 1950), which is presumably early post-Wisconsin-maximum in age. No topographic disconformity was recognized, though one probably exists. The log was hypothesized to be as young as 4000 to 5000 yr if the top two beds are floodplain sediments (which they now appear to be), two to three times older if they are not.

LJ-411. Exploratory Mohole Drilling—1 **>35,000**

Dolomite from depth of 232 m below sediment surface in San Diego Trough, off San Diego, California, at water depth of 935 m (32° 50.4′ N Lat, 117° 37.3′ W Long). Coll. 1961 by party from Scripps Inst. of Oceanography (Core Designation EM 3–5, 8.0 to 10.5 cm from top of core); subm. 1962 by E. D. Goldberg and D. L. Inman of that institution. *Comment*: date indicates Pleistocene or earlier age. The datability of newly precipitated dolomite is attested by LJ-527 and 562–564 (this date list). Organic material from a depth of 66.14 to 72.24 m in the same drill hole dates 34,400 ± 1000 (LJ-533, this date list).

LJ-448. SIO Cliff Site, La Jolla, California—2 **1050 ± 150**
A.D. 900

Pismo clam (*Tivela stultorum*) shells from midden described under LJ-382 (La Jolla II); from undisturbed soil in lower part of Decimeter 1 (top) of same pit (32° 52′ 00″ N Lat, 117° 15′ 09″ W Long). Coll. by J. N. Miller (sample 1960—XI: 21A); subm. 1962. *Comment*: this measurement provides the recent limiting date for this midden, the bottom three decimeters of which gave 3240 ± 240 (LJ-382, La Jolla II). Entire occupation appears to represent a cultural continuum from the La Jollan, preceding the Diegueño occupation of the same region.

LJ-449. Spindrift Site, La Jolla, California—3 **4770 ± 160**
2820 B.C.

California mussel (*Mytilus californianus*) shells from Decimeter 8 (from top) of midden described under LJ-385 and 386 (La Jolla II); from lime-indurated soil immediately below the upper, dark, friable soil from which sample for LJ-385 was obtained at Decimeter 6 and close to point where sample LJ-386 was obtained at Decimeter 11 (32° 51′ 02″ N Lat, 117° 15′ 38″ W Long). Coll. by J. N. Miller and K. W. Radford (sample 1961—IX: 28A); subm. 1962. *Comment*: although from an intermediate depth, this sample yields the oldest of the three dates from this midden, older than that of 3190 ± 200 (LJ-385, La Jolla II) for a deeper layer and 3500 yr older than that of 1270 ± 250 (LJ-386, La Jolla II) for shell from only two decimeter higher. Another date, 4650 ± 260 (LJ-512, this date list), like that for LJ-449, is for the top level of the older stratigraphic unit in this site. The explanation of the discrepancies between LJ-449 and LJ-385 and 386 seems to be that on this steeply sloping site erosion removed some soil of the La Jollan occupation before the soil from the Diegueño occupation accumulated, and that some of the soil of intermediate age, represented by LJ-385, was redeposited at a relatively low level in gullies. The color and consistency of the soil suggested this sequence.

https://doi.org/10.1017/S0033822200036882 Published online by Cambridge University Press

LJ-450. Lake LeConte, California—6 **>35,000**

Tufa ($CaCO_3$) coating wave-washed stones in a conspicuous horizon of shore pavement, overlying fanglomerate and overlain by generally 5 m or more of alluvium, in part fanglomerate but in part lacustrine; along a fragment of the NE shoreline of an ancient stage of Lake LeConte, in Riverside Co.; at the mouth of Box Canyon on the N side of State Highway 195 E of Mecca, in NE ¼, Sec. 12, T 7 S, R 9 E, alt 38 to 42 m (33° 34′ 46″ N Lat, 115° 59′ 29″ W Long; USGS Mortmar Quadrangle, 7.5′ series, 1958). Coll. by G. M. Stanley and C. L. Hubbs (sample 1958—IV: 19C); subm. 1962. *Comment*: the first date for one of the Pleistocene (Pluvial) stages of Lake LeConte, represented by beachline fragments—this stage obviously freshwater. Other Pleistocene datings for this lake basin, all in this date list and in UCLA II, are 13,040 ± 200 (LJ-457), 37,100 ± 2000 (LJ-504), >45,000 (LJ-532), 32,200 ± 2000 (UCLA-189), and >34,000 (UCLA-191). A date for the presumed recession of the last Pluvial stage of the lake is 9630 ± 300 (LJ-528, this date list). Datings for Holocene stages of Lake LeConte are listed under LJ-530 (this date list).

LJ-451. Peat, Long Reef, Australia **3980 ± 150**
2030 B.C.

Peat at Long Reef, from base of layer ca. 0.5 m thick, ca. 0.3 m above high-tide level, in the deposit of an old lagoon (probably an inter-barrier lagoon) that formed behind a Recent outer barrier, which is usually preserved along the coast, though now eroded at this site, on coast between Deewhy and Collaroy, near Sydney (33° 44.7′ S Lat, 151° 19.3′ E Long; from HO Chart 1904, 1942). Coll. 1961 by Trevor Langford-Smith, Univ. of Sydney (his sample 3) and F. P. Shepard, Scripps Inst. of Oceanography (his sample 1); subm. 1962 by Shepard. *Comment* (T.L.-S.): the peat is possibly indicative of a higher-than-present sea-stand; pollen analysis indicates that it is probably of brackish- or salt-water origin. Shell samples from Long Reef, from what was first interpreted as a raised beach, both dated 900 ± 150 (LJ-128 and 130, La Jolla I), now appear to be of midden origin. The problem of postglacial high sea-stands has lately been reviewed by Russell (1963).

LJ-452. Ground-sloth dung, Gypsum Cave **11,690 ± 250**
9740 B.C.

Ground-sloth dung from Room 3 in Gypsum Cave, Nevada, ca. 26 km E of Las Vegas, near head of E branch of Vegas Wash, in a spur of Frenchman Range (36° 13′ 25″ N Lat, 114° 54′ 20″ W Long; from Harrington, 1933, Fig. 2); alt ca. 610 m; from layer of unburned dung and soil lying directly on a limestone ledge, immediately beneath a Gypsum Cave dart point underlying a layer of partly burned sloth dung, in turn overlain by a rockfall containing a sloth skull (Harrington, 1933, fig. 20). Coll. 1929-1931 by M. R. Harrington; subm. 1962 by R. D. Simpson. *Comment*: checks the averaged solid-carbon measurements of 10,455 ± 340 for C-221 and of 8527 ± 250 for C-222 (Libby, 1955, p. 117-118), for ground-sloth dung from different depths in the deposits in Room 1 of the same cave (Harrington, 1933). This test provides further confirmation of the existence of man in North America in association

https://doi.org/10.1017/S0033822200036882 Published online by Cambridge University Press

with extinct mammals toward the end of the Pleistocene, during a time of greater-than-present rainfall.

LJ-453. SIO Upper Cliff Site, La Jolla, California—1 **1620 ± 160**
A.D. 330

Pismo clam (*Tivela stultorum*) shells from Decimeter 1 (top) of the SIO Upper Cliff Site, on the grounds of Scripps Inst. of Oceanography, at the site of the building of the Inst. of Geophysics and Planetary Physics, Univ. of California, San Diego, ca. 6 to 7 m from lip of cliff, immediately back of eroded section (32° 52′ 07″ N Lat, 117° 15′ 09″ W Long; USGS La Jolla Quadrangle, 7.5′ series, 1953). Coll. by Scripps Inst. (K. W. Radford and party; sample 1961—XII: 3A); subm. 1962. *Comment*: dates terminal occupation of site that appears to have persisted (intermittently?) for ca. 6 millennia, with no trace of pottery or pressure-flaked artifacts. Further study is under way on food remains and a few artifacts from the meter-square column. See also LJ-454.

LJ-454. SIO Upper Cliff Site, La Jolla, California—2 **7530 ± 140**
5580 B.C.

California mussel (*Mytilus californianus*) shells from Decimeter 16 (from top) of the same meter-square column sampled for LJ-453, but at the bottom decimeter-level of the midden (only 1 shell fragment occurred in Decimeter 17, none below). *Comment*: demonstrates long-term occupation of site (see LJ-453). Date is the oldest (by a few years) for any W Coast shellfish-gathering culture except for one dated 12,620 ± 200 (UCLA-141, UCLA I), which is definitely suspect because of possible contamination of comminuted charcoal with asphalt. Many other dates from shell middens on the coast lie between 5000 and 7500, but no others are older than 7500.

LJ-456. Buried wood, Stockton, California **>34,000**

Wood, thought to be redwood, from a depth of 102 m, or 97 m below sealevel, in the N part of Stockton, along N side of Mokelumne Aqueduct (of East Bay Municipal Utility District), from the California Water Service Co. Well 60-01; in a triangular lot lying between Woodstock St. and Pardee Lane at foot of Ridgeway St.; Sec. 10, T 2 N, R 6 E (38° 59′ 58″ N Lat, 121° 17′ 57″ W Long; USGS Stockton W Quadrangle, 7.5′ series, 1952). Coll. 1961 by C. L. White, California Water Service Co.; subm. 1962 by A. A. Prucha, California State Bur. of Sanitary Eng. *Comment*: date bears on changes in relative sealevel and on rate of valley-fill.

LJ-457. Lake LeConte, California—7 **13,040 ± 200**
11,090 B.C.

Dense tufa chipped from innermost 5 cm, where 0.45 to 0.6 m thick, on NE face of Travertine Point, Imperial Co., 0.3 km S of Riverside Co. line; alt ca. 20 m below sealevel (ca. 33 m below top of tufa) (33° 25′ 23″ N Lat, 116° 03′ 25″ W Long; USGS Oasis Quadrangle, 7.5′ series, 1956). Coll. by C. L. Hubbs and students (sample 1962—II: 4E). *Comment*: care was exercised to minimize the chance of including recent surface coating, and the exposed surface layers were removed by treatment with HCl. Test confirms view of Hubbs and Miller (1948, p. 103-112) that the "Main Stage" of Lake LeConte was much older than the "Last High Stage" (which probably involved two or more fillings, represented by the measurements listed under LJ-530, this date list). From the date and from the nature of the tufa and other ancillary circumstances it is obvious that a freshwater lake occupied the basin in Pluvial time, at approximately the same elevation and contour as the much more recent stage(s), and that the deposition of the massive tufa on a small granitic island (now represented by Travertine Point) began roughly 13,000 yr ago. The termination of the Pluvial stage(s) seems to be marked by the date of 9630 ± 300 (LJ-528, this date list). Datings of earlier and higher Pleistocene stages are referred to under LJ-450 (this date list). The outer part of the tufa at the same location on Travertine Point is dated at 1890 ± 500 and 1800 ± 200 (LJ-458 and 513, this date list). Evidence of an intervening marine stage dated at 3970 ± 100 (UCLA-190, UCLA II), as well as the evidence of recession at ca. 9630 ± 300 (LJ-528) indicates that the thick deposition of tufa on Travertine Point was intermittent, as Hubbs and Miller suggested.

LJ-458. Lake LeConte, California—8 **1890 ± 500**
A.D. 60

Dense tufa chipped from outermost 5 cm at the same location on Travertine Point from which the basal sample for LJ-457 was obtained (same collector and sample). *Comment*: date and ancillary circumstances indicate that deposition of tufa on Travertine Point continued (after at least one major interruption) during the period of the "Last High Stage" (or, more likely, the recent series of freshwater fillings to an alt of ca. 13 m). A duplicate measurement of 1800 ± 200 (LJ-513, this date list) was run on the same sample. See also comments under LJ-457 and LJ-530 (this date list).

LJ-500. Phosphorite, Baja California—3 **17,660 ± 450**
15,710 B.C.

Pellets of marine carbonate-apatite dredged from the continental shelf on the W coast of Baja California Sur N of Bahía Magdalena, at a depth of 91 m, ca. 46 km offshore (25° 45′ N Lat, 112° 34′ W Long). Coll. and subm. 1962 by B. F. d'Anglejan, Scripps Inst. of Oceanography (sample DBB–I). *Comment*: provides another relatively recent date for the extensive phosphorite deposits in this area. Three samples of pellets from the same grab were treated differently to measure time involved in growth of pellets: LJ-500 was run on untreated material; LJ-509, on pellets from which some of the outer part, 32% by weight, had been removed by treatment with HCl, to yield earlier-deposited apatite; LJ-515, on pellets from which 64% of the weight had been removed by HCl, to yield still earlier-deposited material. Results follow:

LJ-500 (sample DBB–I), total pellets: 17,660 ± 450

LJ-509 (sample DBB–II), inner 68%: 19,440 ± 600

LJ-515 (sample DBB–III), inner 36%: 26,640 ± 600

The previous measurements on marine phosphorite are 19,300 ± 600 (LJ-268) and 9860 ± 200 (LJ-399, La Jolla II). It has generally been thought

https://doi.org/10.1017/S0033822200036882 Published online by Cambridge University Press

(see review by Emery, 1961, p. 73-74) that the formation of phosphorite ceased in Tertiary or Pleistocene time.

LJ-501. Tree stump, Eagle Lake, California **440 ± 110**
A.D. 1510

Wood from tree stump, 181 cm in diameter, 0.6 m above surface of Eagle Lake, Lassen Co., in vicinity of Gallatin Beach at S end of lake (40° 33′ N Lat, 120° 47′ W Long). Coll. 1961 by J. F. Hannaford and R. T. Bean; subm. by M. B. Andrew, all of California Dept. of Water Resources (Specimen Y from Stump 1). *Comment*: datings on tree stumps now or in the past flooded by Western lakes will contribute significantly to questions of historic geology, paleoclimatology, and hydrology, along lines indicated by Harding (1935). According to evidence presented by that author Stump 1, which is definitely identifiable as the one figured on p. 89 of his paper, was below the lake level since 1875, until the lake was lowered by water diversion through a tunnel from 1924 to 1932 (when Harding made his study). Data regarding the hydrographic history and fauna of Eagle Lake were reviewed by Hubbs and Miller (1948, p. 37-38). Another tree-stump date, for Mono Lake, is 920 ± 90 (UCLA-118, UCLA I).

LJ-502. (See LJ-533)

LJ-503. Tree stump, Lake Tahoe, California **4790 ± 200**
2850 B.C.

Wood id. by R. A. Cockrell, School of Forestry, Univ. of California, Berkeley, as pine, possibly sugar pine (*Pinus lambertiana*), from tree stump ca. 76 cm in diameter, submerged 1.07 m below surface, alt 1896.9 m, off SW shore of Lake Tahoe; next to northwesternmost of five stumps off Kiva Picnic Area of Baldwin Beach (38° 56′ N Lat, 120° 04′ W Long). One of 11 stumps located in the immediate vicinity. Sample taken from stump where emerging from bottom; color was light red-brown on removal but darkened irreversibly within minutes on exposure to air. Coll. 1961 by J. F. Hannaford, L. A. Mullnix, and R. T. Bean; subm. by M. B. Andrew, all of California Dept. of Water Resources (Specimen C, from Stump 6). *Comment*: provides evidence of rise in lake level during the last five millennia. Since the lake level is determined by the height of the sill at the head of the rapid Truckee River, the submergence of the stumps during the past five millennia may be attributed either: (1) to the trees having grown during a drop in lake level below the outlet by reason of decreased precipitation, with subsequent return to external outflow due to increased precipitation; or (2) much more plausibly, to diastrophism. The lake basin may have been depressed subsequent to the tree growth, or the outlet area may have been elevated, probably along one of the very active faults that form the vast escarpment on the E side of the great tilted fault-block of the Sierras. Since no other submerged stumps have been reported in other areas of the lake, local depression is another hypothesis.

LJ-504. Lake LeConte, California—9 **37,100 ± 2000**
35,150 B.C.

Freshwater snail (*Physa* sp.) shells from dense *Physa* layer on fragment of ancient beachline ca. 3.2 km WNW of Plaster City, Imperial Co.; alt ca.

43 m in NE bank of northwesternmost gravel pit (perhaps subject to change), ca. 200 m S of S bank of Coyote Wash (32° 47′ 55″ N Lat, 115° 53′ 07″ W Long; USGS Painted Gorge Quadrangle, 7.5′ series, 1957). Coll. by C. L. and L. C. Hubbs (sample 1962—V: 5C). *Comment*: provides a Pleistocene date, presumably in the Wisconsin Pluvial, for one of the very ancient stages—this a freshwater one—of Lake LeConte. This beachline fragment was discovered and definitely interpreted as such by G. M. Stanley, of Fresno State College, a collaborating specialist on lacustrine geology. The associated shell fauna is somewhat different from that of the terminal-Pluvial and Holocene stages of the lake. Because the level is ca. 30 m above the height of the Last High Stage(s) of Lake LeConte, which must have been the altitude of the sill separating the LeConte Basin from the Gulf of California, either the region of the sill (on the Colorado River Delta) must have been depressed or the region of the old beachline must have been elevated (or, quite plausibly, both events occurred). The shells, like those used for LJ-528, appeared to have retained their original aragonite composition and showed very little evidence of weathering.

Since this account was written, Thomas (1963) has announced the discovery of the same ancient beach-line, with particular attention to the same gravel pits. He has attributed the stranded beach-line of this high lake stage to the deposition of an ephemeral delta during Sangamon Interglacial to a height of 150 ft (45.7 m). A considerable body of evidence is inconsistent with this interesting interpretation.

LJ-505. Dzibilchaltún, Yucatán—2 **2925 ± 340**
975 B.C.

Charcoal from a rich deposit of ash and sherds from Structure 605, in the bottom stratigraphic level reached during the 1962 excavations; at the Dzibilchaltún Maya site in NE Yucatán, México, 16 km N of Mérida (ca. 21° 17.0′ N Lat, 89° 35.8′ W Long). Coll. and subm. 1962 by E. W. Andrews, Middle Am. Research Inst., Tulane Univ. (sample M–945). *Comment* (E.W.A.): date, associated with simple architectural construction, is by far the oldest pertaining to cultural remains in the Lowland Maya Area and confirms the view that Dzibilchaltún spanned the longest history of any of the investigated Lowland Maya sites; it represents what may tentatively be called the Dzibilchaltún "Formative" Stage I. Other dates for Dzibilchaltún include 2200 ± 200 (LJ-279, La Jolla II) and, in this date list: 2130 ± 200 (LJ-508) and 1520 ± 200 (LJ-531). Associated with the charcoal dated as LJ-505 is a large amount of pottery, now under study.

LJ-508. Dzibilchaltún, Yucatán—3 **2130 ± 200**
180 B.C.

Charcoal from deposit sealed under a thick and completely intact plaster floor in the same Structure (605) from which the charcoal used in LJ-505 was obtained. Coll. and subm. 1962 by E. W. Andrews (sample M–943). *Comment*: LJ-508 as well as LJ-505 are dates based on charcoal associated with the early construction phases of the same structure, and both appear to date architectural and ceramic remains of the "Formative" or "Pre-Mayan" horizon encountered in the 1961 excavations. The discrepancy in the dates was unexpected. Collector regards date of 2130 ± 200 as definitely later than expected, because the associated artifacts suggest approximate contemporaneity with LJ-505, which carries a date (2925 ± 340) more in agreement with expectation.

LJ-509. Phosphorite, Baja California—4 **19,440 ± 600** **17,490 B.C.**

Reported above, under LJ-500.

LJ-510. Caliche, Mesa Verde, Colorado **21,000 ± 600** **19,050 B.C.**

Caliche, sampled 20 to 30 cm below upper boundary of layer, ca. 100 cm thick, with ca. 54% $CaCO_3$, underlying a sequence of two loess layers, with a total thickness of 180 cm, on Chapin Mesa, Mesa Verde Natl. Park, Colorado (ca. 37° 03′ N Lat, 108° 05′ W Long). Coll. 1962 by Douglas Osborne, Supervisory Archeologist, Wetherill Mesa Archeolo. Proj., U. S. Dept. of Interior; subm. by Enrico Bonatti and Gustaf Arrhenius, Scripps Inst. of Oceanography (sample MVC 2). *Comment*: measurement on caliche desired in attempt to demonstrate its rate of deposition and the minimum age of its upper and lower surface. Soil and basement rock do not contain primary carbonates. Lower part of caliche layer, according to Osborne (personal comm., 1962) has been dated by Isotopes, Inc. at not less than 35,500 yr. Activity of upper part, corresponding to an "age" of 21,000 ± 600 yr, is in agreement with activities found in Wisconsin pluvial caliche layers from Arizona (Arizona IV). The upper and lower loess formations are separated by the eroded surface of an old soil horizon. At the base of the upper loess is a slight development of caliche, the activity of which is now being measured.

LJ-511. Charcoal, Río Conchos, México **2330 ± 220** **380 B.C.**

Charcoal from one of two lens-shaped hearths of charcoal and cracked rock ca. 3 m apart, ca. 500 m from (on E side of) Río Conchos, Municipio de Meoqui, Chihuahua; in the mouth of an arroyo ca. 1.6 km above the dam on the Río Conchos that forms a reservoir, Presa Rosalilla, which does not flood into the arroyo mouth. The hearths were under 1.5 m of sterile alluvium in an arroyo that is level with third highest terrace above the river; alt ca. 1219 m (ca. 20° 42′ N Lat, 106° 45′ W Long). Coll. 1957 and subm. 1962 by R. H. Brooks (sample 1). *Comment*: it was thought that these hearths might provide evidence of very early man in northern México; instead, they seem to record an episode of erosion preceding an episode of alluviation, a sequence like many in SW U. S.

LJ-512. Spindrift Site, La Jolla, California—4 **4650 ± 260** **2700 B.C.**

Pismo clam (*Tivela stultorum*) shells from the Spindrift Site described under LJ-385 and 386 (La Jolla II) and LJ-449 (this date list); from the surface of the B soil horizon, directly associated with prone Burial 1 (32° 51′ 02″ N Lat, 117° 15′ 38″ W Long). Coll. 1961 and subm. 1962 by J. R. Moriarty, Scripps Inst. of Oceanography (sample 1961—IX: 28A). *Comment*: peculiar nature of burial and location at contact between the B soil horizon containing remains of La Jollan culture and the A horizon with Diegueño remains led to inference that burial (and shell) might date from a transition between these cultures, but the old date suggests rather that the soil contact here represents surface erosion of the older midden levels, followed after an interval by deposition of the more recent (Diegueño) midden.

LJ-513. Lake LeConte, California—10 **1800 ± 200**
A.D. 150

A second, duplicate run confirming the measurement of 1890 ± 500 (LJ-458, this date list, *q.v.*).

LJ-514. Midden, Santa Rosa Island, California—2 **970 ± 250**
A.D. 980

Charcoal from definite hearth buried ca. 1.0 m, ca. 3 m above sealevel, exposed in a shell midden in a wave-cut bank about midway between East Pt. and Skunk Pt. at mouth of Rancho Viejo Valley (4.1 km from East Pt.), near E end of island, in soil overlying conglomerate; P. C. Orr's locality 131.85 (33° 57′ 36″ N Lat, 119° 58′ 24″ W Long; Sheet 4 of War Dept. Map 29 E 2, 1943). Coll. by P. C. Orr, W. S. Broecker, G. F. Carter, and C. L. Hubbs (sample 1955—IX: 10A); subm. 1962 by Hubbs. *Comment*: age was not certainly determinable in field, though midden appeared to be and is now definitely interpreted as pertaining to a Canaliño village, with shallow pit houses, located on flat behind cliff. Cf. UCLA-135, 1820 ± 90, and UCLA-178, 900 ± 100 (UCLA II) for similar site on same island.

LJ-515. Phosphorite, Baja California—5 **26,640 ± 600**
24,690 B.C.

Reported above, under LJ-500.

LJ-516. Shells, off coast of Australia **16,910 ± 500**
14,960 B.C.

Pelecypod (*Chlamys senatorius*) shells dredged at a depth of 132 m on top of terrace edge of Sahul Shelf, off NW coast of Australia (11° 57.5′ S Lat, 123° 50.4′ E Long). Coll. 1961 and subm. 1962 by J. R. Curray, Scripps Inst. of Oceanography (sample V—229). *Comment*: to establish date of sealevel in what is considered to be a stable area; it was thought possible that the shell would be too old for C^{14} dating, but the living depth range of the species, though presumed to be inner-shelf to littoral, is not well known.

LJ-517. Shells, off W coast of México—2 **1480 ± 150**
A.D. 470

Gastropod (*Vermicularia pellucida*) shells dredged at a depth of 104 m off the W coast of mainland México on ancient beachline of Pleistocene delta of Río Grande de Santiago (21° 40.7′ N Lat, 106° 15.0′ W Long). Coll. and subm. 1962 by J. R. Curray and R. H. Parker, Scripps Inst. of Oceanography (sample C-658). *Comment*: since species was thought to have a living range from intertidal to 2 or 4 m and is usually lagoonal, it was thought that test would establish date of sealevel at this depth. Environmental and depth parameters are similar to that of sample C-331 dated as 19,300 ± 400 (LJ-280, La Jolla II; see also LJ-520, 16,490 ± 600, this date list). The young date was quite unexpected, and remains unexplained. Since the sample was rather small (25 g) it was necessary to mix the acetylene with background-counting gas.

LJ-518. Beach-ridge, W coast of México **3175 ± 220**
1225 B.C.

Gastropod (*Agaronia testacea*) shells from midden on abandoned beach-ridge, approximately at sealevel, N of delta of Río Grande de Santiago, on W coast of mainland México S of Mazatlán (22° 02.6′ N Lat, 105° 37.4′ W Long). Coll. 1961 and subm. 1962 by J. R. Curray and R. H. Parker (sample C-517). *Comment*: to give a minimum age for beach-ridge on which shell and midden occur; attempt is being made to establish rate of progradation of coast by formation of new beach ridges; date anticipated was <3000 yr.

LJ-520. Shells, off W coast of México—3 **16,490 ± 600**
14,540 B.C.

Pelecypod (*Chione gnidia* and *Megapitaria squalida*) valves dredged at a depth of 114 m off the W coast of mainland México on ancient shoreline of Pleistocene delta of Río Grande de Santiago (22° 06.7′ N Lat, 106° 17.8′ W Long). Coll. 1960 and subm. 1962 by J. R. Curray and R. H. Parker (sample C-331). *Comment*: to check date of 19,300 ± 400 (LJ-280, La Jolla II), obtained for this beachline, which is inferred to be of Tazewell (late Wisconsin) age, from another mollusc species from same sample. The agreement is fair. The two species have a living range of ca. 2 to 18 m, somewhat deeper than shells used for LJ-280.

LJ-521. Shells, off coast of Texas **33,250 ± 1000**
31,300 B.C.

Pelecypod (*Rangia cuneata*) shells collected, by diving, at a depth of 15 m, on a rocky bank off Freeport (28° 47.5′ N Lat, 95° 18.0′ W Long). Coll. 1956 and subm. 1962 by J. R. Curray and R. H. Parker (sample J-382). *Comment*: to date sealevel inferred to represent interstadial in middle of Wisconsin glaciation. Agreement is fair to excellent with previous dates from this line of rocks: 26,900 ± 1800 (for sample J-383) and 32,500 ± 3500 (for sample J-526); both dates by Shell Research and Devl. Co. (H. A. Bernard, personal comm., 1962). *Rangia cuneata* has a living range of 0 to 4 m, in brackish water.

LJ-522. Shore of Golfo de California—5 **2190 ± 200**
240 B.C.

Pelecypod (*Mulinia coloradoensis*) valves (ca. 100) from ancient beach-ridge ca. 5 km inland from modern beach system, from top 0.3 m of ridge 0.7 m high, ca. 30 km WNW of San Felipe, Baja California Norte, and ca. 5 km W of mean-sealevel shoreline (31° 17.4′ N Lat, 114° 56.6′ W Long; World Air Chart 472, 1947). Coll. by D. L. Inman and W. R. Gayman, Scripps Inst. of Oceanography (sample 29 Jan 62—28). *Comment*: collectors indicate these possible implications: sealevel stability, rates of longshore transport and coastal advance, and changes in ecologic conditions. Other dates in same series, all but the last from beach ridges, are:

2190 ± 260 (LJ-213, La Jolla II)	4830 ± 260 (LJ-523, this date list)
2550 ± 220 (LJ-214, La Jolla II)	1060 ± 200 (LJ-524, this date list)
1970 ± 240 (LJ-215, La Jolla II)	690 ± 130 (LJ-525, this date list)
1180 ± 250 (LJ-220, La Jolla II)	7840 ± 250 (LJ-526, this date list)

LJ-523. Shore of Golfo de California—6 **4830 ± 260**
2880 B.C.

Pelecypod (*Chione fluctifraga*) valves (2) from ancient beach-ridge in middle of mud flat ca. 3.2 km E of contact between alluvium and tidal flat, from surface of ridge that now has a relief of only 0 to 0.15 m; ca. 35 km NNW of San Felipe (31° 20.6′ N Lat, 114° 55.0′ W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 8 Dec 61—20); subm. 1962. *Comment*: reported under LJ-522 (same implications). This is the oldest beach-ridge date yet obtained. However, it appears to be inconsistent with LJ-522 (from the same beach-ridge) and may be invalid.

LJ-524. Shore of Golfo de California—7 **1060 ± 300**
A.D. 890

Pelecypod (*Chione fluctifraga*) valves (2) from youngest of three parallel beach-ridges, the older two of which have already been dated at 1180 ± 250 (LJ-220, La Jolla II) and at 775 ± 100 (Humble Oil and Refining Co., Run 0-1528; D. L. Inman, personal comm., 1962), from 4 to 6 m above mean sea-level, ca. 31.5 km N of San Felipe (31° 18.7′ N Lat, 114° 53.3′ W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 4 Apr 60—21); subm. 1962. *Comment*: reported under LJ-522 (same implications). Note discrepancy in serial dates for the three beach-ridges. Date suggests that shells analyzed may have been reworked from older deposits.

LJ-525. Shore of Golfo de California—8 **690 ± 130**
A.D. 1260

Pelecypod (*Mulinia coloradoensis*) valves (38) from barrier island very recently constructed of *Mulinia* shell, from top of berm and from ridge 0.3 to 0.6 m high W of berm, ca. 39 km N of San Felipe (31° 22.3′ N Lat, 114° 52.0′ W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 10 Nov 61—11); subm. 1962. *Comment*: reported under LJ-522 (same implications). Since this deposit appears to be modern, the date suggests to collectors that the shells analyzed may have been reworked from older deposits.

LJ-526. Shore of Golfo de California—9 **7840 ± 250**
5890 B.C.

Oyster (*Ostrea palmula*) valves (9) removed from granite cobbles and boulders that outcrop ca. 0.9 m above berm in 7.6-m cliff that terminates E side of alluvial terraces, at N end of 0.4-km-long beach bordering Ensenada Blanca, which is located between two cerros ca. 2.4 km NNE of San Felipe (31° 03.0′ N Lat, 114° 49.5′ W Long; WAC 472, 1947). Coll. by D. L. Inman and W. R. Gayman (sample 6 March 62—8A). *Comment*: implications by collectors: sealevel changes, rates of sedimentation, rates of uplift. This date is much older than any obtained from ancient beach-ridges along the Golfo de California shore (see LJ-522, this date list). The oyster valves were cleaned of encrusting barnacles.

LJ-527. Dolomite, Deep Spring Lake, California—1 **290 ± 150**
A.D. 1660

Dolomite mud from surface sediment near edge of Deep Spring Lake, Inyo Co. (ca. 37° 17′ N Lat, 118° 03′ W Long). Coll. and subm. 1962 by M. N. A. Peterson, Univ. of California, San Diego (sample 1). *Comment*: sedimentary conditions suggested that the dolomite might have formed recently, and the date so indicates. Peterson and Bien find no previous demonstration of the recent formation of dolomite as a primary precipitate, and this appears to be the first dating of newly formed dolomite. This test (no. 1), the only one made on sample 1, was run on the chemically purified dolomite, without fractionation by size. Additional tests of three separated fractions (coarser, intermediate, and finer) from sample 2 of the same material have been run to test the hypothesis that the larger crystals are the older. Results of these tests (with size measured along edge of rhombohedra) are as follows:

2. LJ-562, coarser particles (ave. size, 0.5μ), ave. of 2 datings .... 2700 ± 500
3. LJ-563, intermediate particles (ave. size, 0.3μ), ave. of 3 datings .... 1440 ± 400
4. LJ-564, finer particles (ave. size, 0.1μ) .... 390 ± 150

These datings appear to provide a measurement of the time involved in the growth of the crystals. It appears that nucleation was definitely earliest in the largest crystals. Deep Spring Lake is in a deep enclosed basin that contained a Pluvial lake, probably a shallow one (Hubbs and Miller, 1948, p. 89). While this report was in press, Skinner, Skinner, and Rubin (1963) reported a possible age of only 1200 yr, or less, for dolomite deposited in a S Australian ephemeral lake.

LJ-528. Lake LeConte, California—11 **9630 ± 300**
7680 B.C.

Small freshwater gastropod (*Physa, Amnicola, Hydrobia*) shells from basin of Lake LeConte, at W end of the northernmost of the large boat slips at Desert Shores (formerly Fish Springs), Imperial Co.; bottom 30 cm, usually from bottom 10 cm, of a shell-rich sandy streak at the base of the 3-m-thick valley-fill alluvium that overlies a dusky-greenish, apparently deep-lacustrine clay deposit, which is 2 m thick down to present Salton Sea level; the alluvium overlying the sandy streak sampled is mostly sandy, with few pebbles and no cobbles, but with conspicuous streaks and pockets of sand and redeposited shell; alt ca. 69 m below sealevel; in NE ¼, Sec. 9, T 9 S, R 9 E (23° 24′ 25″ N Lat, 116° 02′ 03″ W Long; USGS Oasis Quadrangle, 7.5′ series, 1956). Coll. by C. L. Hubbs and party (samples 1962—II: 3A and III: 3A, combined). *Comment*: interpretation of deposit is as follows: the underlying clay was deposited by a Pluvial stage of Lake LeConte, presumably dated also from the innermost tufa of nearby Travertine Rock (13,040 ± 200, LJ-457, this date list); immediately after the rapid Postpluvial desiccation of the lake, corresponding in time to that of Lake Mohave (9640 ± 240, LJ-200, La Jolla II), the first alluvium of sand and shells was presumably redeposited here from the prior beachline 2.1 to 2.7 km to W, alt probably ca. 13 m. Since the layer sampled also contained numerous percussively flaked stone artifacts, which were presumably deposited *in situ* simultaneously with the shells, measurement also provides an almost certain date of early occupation by man—the earliest date for the basin and the earliest in California S of lakes Mohave and Manix. Occurrence of man when the lake had desiccated may be related to location beside large springs of long duration.

LJ-529. Midden at Avila, California **5020 ± 250**
3070 B.C.

California mussel (*Mytilus californianus*) shells from edge of low cliff on the Marre property, N of Richfield Oil tanks and buildings, at Avila, San Luis Obispo Co. (35° 10′ 44″ N Lat, 120° 44′ 20″ W Long; USC & GS Chart 5386, 1961). Coll. and subm. 1962 by J. R. Moriarty, Scripps Inst. of Oceanography (Avila Site No. 1). *Comment*: collector indicated that the lithic material of this preceramic archeological site resembles La Jollan II in both type and stone-working technique and expected the date to be similar to that of other preceramic sites on the Pacific Coast of southern California and of Baja California. See also LJ-3, 6, 26, 27, 36, 77, 79, 107, 109, and 110, La Jolla I; LJ-202, 221, 225, 231, 256, 274-277, and 332-334, La Jolla II; and LJ-449, 454, and 512, this date list.

LJ-530. Lake LeConte, California—12 **1510 ± 180**
A.D. 440

Compact, nodular tufa thinly coating upper surfaces of cobbles of Lake LeConte beachline alt ca. 13 m ca. 2.4 km W of Truckhaven, Imperial Co. (ca. 33° 17′ 30″ N Lat, 116° 00′ 00″ W Long). Coll. by C. L. and L. C. Hubbs and B. E. McCown (sample 1954—X: 17E); subm. 1962. *Comment*: to compare date of an obviously recent stage of Lake LeConte with the datings obtained from the much thicker tufa on Travertine Point (see LJ-457, 458, and 513, this date list). This thin tufa was apparently laid down early during what has been called "the Last High Stage" of the lake (Hubbs and Miller, 1948, p. 106-108), or, as now seems more probable, during an early filling in a recent series of fillings through distributaries of the Colorado River. That more than one filling occurred during the past two millennia seems probable from physiographic evidence of reworked longshore bars, as at site dated 450 ± 200 (M-596, Michigan III) and from the circumstances associated with a more recent dating of 270 ± 60 (UCLA-192, UCLA II), based on charcoal at a low lake level (alt ca. 52 m below sealevel) associated with remains of freshwater fish (*Xyrauchen texanus*) which presumably could not have survived in the saline lake after it had desiccated by evaporation to such a low level (and reduced area), but which would have arrived with a refilling of the lake from Colorado River. At least, the lake had then receded to below the low level of the camp site. Following are other Recent dates for stages of Lake LeConte:

Freshwater Stages

120 ± 200	M-598 (Michigan III)	960 ± 100	LJ-106 (La Jolla I)
130 ± 200	M-597 (Michigan III)	1000 ± 200	LJ-7 (La Jolla I)
220 ± 100	LJ-102 (La Jolla I)	1440 ± 100	LJ-105 (La Jolla I)
270 ± 60	UCLA-192 (UCLA II)	1510 ± 180	LJ-530 (this date list)
300 ± 100	LJ-15 (La Jolla I)	1580 ± 200	LJ-101 (La Jolla I)
450 ± 200	M-596 (Michigan III)	1800 ± 200	LJ-513 (this date list)
760 ± 100	LJ-99 (La Jolla I)	1890 ± 500	LJ-458 (this date list)

Salt-water Stage

3970 ± 100 UCLA-190 (UCLA II)

LJ-531. Dzibilchaltún, Yucatán—4 **1520 ± 200**
A.D. 430

Charcoal from hearth area sealed under earliest floor at Structure 612, sub. at SE corner of site (ca. 21° 17.0′ N Lat, 89° 35.8′ W Long). Coll. and subm. 1962 by E. W. Andrews (sample M-1332). *Comment* (E.W.A.): this is the only datable material surely associated with the first phase of the Early Period on the Yucatan Peninsula—ca. A.D. 250-550. Will date large collection of Petén trade pottery associated with local wares. The copious associated material is clearly equivalent to the Tzakol phase at Uaxactún. There is some deviation from expectation, though not so troublesome as for LJ-508 (this date list).

LJ-532. Lake LeConte, California—13 **>45,000**

Shredded, red-colored wood from depth of 29–30.5 m in a well recently drilled in the bed of ancient Lake LeConte near its W shore, Riverside Co.; near center of W line of Sec. 12, T 6 S, R 7 E, at the NE corner of Jackson St. and Ave. 65, 0.7 km NNE of the "Fish Traps"; surface alt ca. –32 m (33° 34′ 37″ N Lat, 116° 12′ 50″ W Long; USGS Valerie Quadrangle, 7.5′ series, 1956). Coll. 1961 for G. M. Stanley, Fresno State College; subm. 1962 by him (sample Stanley, 1962, no. 1). *Comment*: this is the second date for the deep alluvial fill of the LeConte basin (the first, for a depth of 3 m, is 9630 ± 300, LJ-528, this date list). Obviously the total valley-fill must embrace considerable antiquity. Tangled into the shredded wood were pieces of seemingly completely charred wood having the appearance of hearth charcoal. The occurrence of the wood and especially of charcoal indicates that the date pertains to a Pleistocene period between or before lake fillings.

LJ-533. Mohole Exploratory Drilling—2 **34,400 ± 1000**
32,450 B.C.

Carbon in organic fraction constituting >1% of 450 gms of powdered marine sediment from a depth of 66.14–72.24 m below sediment surface in San Diego Trough, off San Diego, California, at water depth of 935 m (32° 50.4′ N Lat, 117° 37.3′ W Long). Coll. 1961 by party from Scripps Inst. of Oceanography (Core Designation EM 3–1, 16–46 cm from top of core); subm. 1962 by D. L. Inman and E. D. Goldberg. *Comment*: to determine, for the first time, the rate of accumulation of inshore sediments of this type. The contributors

https://doi.org/10.1017/S0033822200036882 Published online by Cambridge University Press

stated that "the organic phases may yield a reliable age on these samples which would be the most important scientific data in the first Mohole Drilling. K. O. Emery at USC has already demonstrated the advantages of organic carbon age determination with C^{14} from cores near surface." See Emery, 1961, p. 249-258. A prior attempt (LJ-502) to obtain an adequate amount of gas from this sediment sample by wet combustion failed; dry combustion worked well. Dates obtained separately by the use of the Bern and Brussels counters agreed within 150 yr. Dolomite from a penetration depth of 232 m in the same drilling gave a date of >35,000 (LJ-411, this date list).

LJ-539. Wood from Molas Pass Bog, Colorado **4940 ± 300**
2990 B.C.

Conifer-wood fragment, 15 cm diam × 30 cm, from a depth of 60 to 70 cm in interval between a lower detrital gyttja and an upper coarse peat, in an open cut in Molas Pass Bog, on Highway 550, 0.6 km S of S entrance road to Molas Lake, near Silverton in San Juan Mtns.; in Subalpine vegetation zone at alt 3230 m (37° 45′ N Lat, 107° 41′ W Long). Coll. and subm. 1960 by L. J. Maher, Jr., Dept. of Geol., Univ. of Minnesota. *Comment*: wood sample occurs at end of warmest and driest period of the local Postglacial sequence (vegetation zones ca. 200 m higher than at present) as interpreted by pollen analysis of the bog coupled with data of recent pollen rain in region (Maher, 1961). Comparison of glacial geology with pollen sequence suggests that very young cirque glaciers in San Juan Mtns. may correlate with period of cool, wet climate that is represented by sediment lying just above the wood sample (vegetation zones at least 120 m lower than at present). The bog sediments rest on glacial debris as do the oldest organic sediments, in nearby Molas Lake, which have been dated as 15,450 ± 220 (Y-1147, Yale VIII); this gives an estimate of the time the two sites were exposed by retreat of the San Juan ice cap.

LJ-562. Dolomite, Deep Spring Lake, California—2 **2700 ± 500**
750 B.C.

LJ-563. Dolomite, Deep Spring Lake, California—3 **1440 ± 400**
A.D. 510

LJ-564. Dolomite, Deep Spring Lake, California—4 **390 ± 150**
A.D. 1560

All three reported under LJ-527, this date list.

REFERENCES

Date lists:

Arizona IV	Damon, Long, and Sigalove, 1963
La Jolla I	Hubbs, Bien, and Suess, 1960
La Jolla II	Hubbs, Bien, and Suess, 1962
Michigan III	Crane and Griffin, 1958
UCLA I	Fergusson and Libby, 1962
UCLA II	Fergusson and Libby, 1963
Yale VIII	Stuiver, Deevey, and Rouse, 1963

Crane, H. R., and Griffin, J. B., 1958, University of Michigan radiocarbon dates III: Science, v. 128, no. 3332, p. 1117-1123.

Damon, P. E., Long, Austin, and Sigalove, J. J., 1963, Arizona radiocarbon dates IV: Radiocarbon, v. 5, p. 283-301.

Emery, K. O., 1961, The sea off southern California: New York and London, John Wiley & Sons, xi, 366 p., 248 figs.
Fergusson, G. J., and Libby, W. F., 1962, University of California, Los Angeles, natural radiocarbon measurements I: Radiocarbon, v. 4, p. 109-114.
——— 1963, University of California, Los Angeles, natural radiocarbon measurements II: Radiocarbon, v. 5, p. 1-22.
Harding, S. T., 1935, Changes in lake levels in Great Basin area/Three hundred years of record studied to determine trend in available water supply: Civil Engineering, v. 5, no. 2, p. 87-90, 6 figs.
Harrington, M. R., 1933, Gypsum Cave, Nevada: Southwest Mus. Papers, no. 8, p. i-ix, 1-197, figs. 1-77, pls. 1-19.
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. 197-223.
——— 1962, La Jolla natural radiocarbon measurements II: Radiocarbon, v. 4, p. 204-238.
Hubbs, C. L., and Miller, R. R., 1948, The Great Basin, with emphasis on Glacial and Postglacial times: II. The zoological evidence: correlation between fish distribution and hydrographic history in the desert basins of western United States: Utah Univ. Bull., v. 38, no. 20 (Biol. Ser., v. 10, no. 7), p. 18-166, figs. 1-29, 1 map.
Libby, W. F., 1955, Radiocarbon dating, 2d ed.: Chicago, Univ. Chicago Press, ix, 175 p.
Maher, L. J., Jr., 1961, Pollen analysis and postglacial vegetation history in the Animas Valley region, southern San Juan Mountains, Colorado: Ph. D. thesis, Univ. of Minnesota, 85 p.
Russell, R. J., 1963, Recent recession of tropical cliffy coasts: Science, v. 139, no. 3549, p. 9-14.
Skinner, H. C. W., Skinner, B. J., and Rubin, M., 1963, Age and accumulation rate of dolomite-bearing carbonate sediments in South Australia: Science, v. 139, p. 335-336.
Stuiver, Minze, Deevey, E. S., and Rouse, Irving, 1963, Yale natural radiocarbon measurements VIII: Radiocarbon, v. 5, p. 312-341.
Thomas, Robert G., 1963, The late Pleistocene 150 foot fresh water beach line of the Salton Sea area: Bull. Sou. Calif. Acad. Sci., v. 62, pt. 1, p. 9-17, figs. 1-4.
Thornbury, W. D., 1950, Glacial sluiceways and lacustrine plains of southern Indiana: Indiana Geol. Surv. Bull. 4, p. 1-21, figs. 1-3, pls. 1-2.