

UNIVERSITY OF PENNSYLVANIA RADIOCARBON DATES XVII

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INTRODUCTION

This date list includes most of the archaeologic and geologic samples dated in this laboratory since publication of our last date list (R, v 13, p 367-381), as well as some samples dated previously, which lacked adequate sample information. Known-age samples are reported in Univ of Pennsylvania Radiocarbon Dates XVI, this issue. The BP ages are based on AD 1950, and have been calculated with the half-life value of 5568 yr. All samples were counted at least twice for periods of not less than 1000 min each. Errors quoted for each sample are derived from the measurement of the sample, the background, and several counts of our mid-19th century standard Oak sample, but do not include the half-life error. All samples were pretreated with 3N HCL, and some, where noted, were given additional pretreatment with 2% NaOH for the removal of possible humic acid contaminants.

Our mid-19th century calibration samples have an average age of 126 yr. When corrected for this age, they have ^{14}C contents equal to 95% of the NBS oxalic acid standard. The average ^{13}C relationship between the Oak standards and the NBS limestone standard #20 is $-25.7 \pm 1.3\%$ as measured on the Univ of Pennsylvania mass spectrograph. Where $\delta^{13}\text{C}_w$ is reported, the ^{13}C relationship has been measured with respect to the Oak standard and the results are accordingly corrected for isotopic fractionation.

The MASCA corrected ranges, appearing in the sample comments, are maximum ranges and have been arrived at by applying appropriate correction factors to dates calculated with the 5730 half-life. For further explanation, see Univ of Pennsylvania Dates XVI, this issue, and Ralph *et al*, 1973.

I wish to thank Ray Costa for his careful work in processing these samples.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

A. Mediterranean

1. Italy

Cosa series

Samples from inner Harbor area at Cosa, Ansedonia, Italy (42° 24' N, 11° 17' E). Coll Aug 1972; subm by A M McCann, Univ California at Berkeley. For additional dates for this site, see P-1594 and -1722 (R, 1973, v 15, p 368).

General Comment: wood id by R C Koeppen, Forest Prods Lab, US Dept Agric, Madison, Wisconsin.

P-1931. PC-72-WS-1**2550 ± 60
600 BC**

Wood, Sample PC-72-WS-1, red pine group, (*Pinus*) from fragment of ancient Roman beam from device in Roman Fountain House, over underground springs. Water-lifting device believed to date from later stages of Fountain House, with latest pottery material from 2nd century AD. *Comment*: MASCA corrected range: 740 to 840 BC.

P-1932. PC-72-WS-2**1990 ± 50
40 BC**

Plank, PC-72-WS-2, European Spruce (*Picea abies*) from cofferdam surrounding Roman rubble wall in Tr YZ #3 ancient layer silted over 1st century BC. Cofferdam thought to be a dock from that date, or a fishing tank of a later date. *Comment*: MASCA corrected range: AD 60 to 110 BC.

P-1933. PC-72-WS-3**3270 ± 70
1320 BC**

Wood, PC-72-WS-3, white oak group, (*Quercus*) from cofferdam, Tr IA, to S of Pedestal #3. *Comment*: MASCA corrected range: 1520 to 1710 BC.

P-1934. PC-72-WS-4**1980 ± 60
30 BC**

Wood, PC-72-WS-4, pine, (*Pinus*) from cofferdam surrounding rubble wall, from Tr IB, W face of wall, believed to be fish tank of 2nd century AD. *Comment*: MASCA corrected range: AD 70 to 120 BC.

P-1935. PC-72-WS-5**1860 ± 60
AD 90**

Wood, PC-72-WS-5, red oak group, (*Quercus*) from cofferdam surrounding ancient Roman wall, believed to be a dock. Sample from Tr U1, to E of Wall U. *Comment*: MASCA corrected range: AD 130 to 60.

2. Greece**Franchthi Cave series**

Franchthi Cave (37° 26' N, 23° 8' E) is near W tip of high, rugged headland, directly across bay from village of Koilada near Porto Cheli in S Argolid, Peloponnese, Greece. Site is especially important for its apparently continuous stratigraphic sequence from late Paleolithic through Mesolithic and the critical transition to Neolithic. There are no stratified prehistoric remains beyond Late Neolithic. Samples coll 1971; subm by T W Jacobsen, Indiana Univ, Bloomington, and M H Jameson, Univ Mus, Univ Pennsylvania, Philadelphia (Jacobsen, 1968; 1969a, b, and c). For additional dates from this site, see R, 1971, v 13, p 364-367.

General Comment: with exception of P-1920 (cf) all dates are beyond range of MASCA correction factors now available (Oct, 1973). See Pennsylvania XVI, this issue, and Ralph *et al*, 1973.

P-1920. F/A Balk, Unit 83S **6170 ± 60**
4220 BC

Charcoal mixed with dark reddish gray earth from F/A Balk, Unit 83S, underlying P-1660: 5260 ± 60 (R, 1971, v 13, p 364). Date expected to be late Neolithic. *Comment:* MASCA corrected range: 5050 to 5240 BC.

P-1921. F/A Balk, Unit 102S **8410 ± 90**
6460 BC

Charcoal mixed with dark reddish brown earth from F/A Balk, Unit 102S, underlying P-1920 (cf P-1920). Date expected to be Late Neolithic.

P-1922. F/A Balk, Unit 129N **6790 ± 90**
4840 BC

Charcoal mixed with dark brown earth from F/A Balk, Unit 129N. Date expected to be Middle Neolithic.

P-1922-A. F/A Balk, Unit 129N **6730 ± 70**
4780 BC

Same as P-1922. *Comment:* NaOH pretreatment. Sample was run with and without NaOH pretreatment as a test for humic contamination in site. Date expected to be Middle Neolithic.

P-1824. F/A Balk, Unit 137N **6670 ± 70**
4720 BC

Charcoal and dark brown earth from F/A Balk, Unit 137N, underlying P-1922 (cf). Date expected to be Middle Neolithic.

P-1923. H-1, Unit A181 **11,240 ± 140**
9290 BC

Charcoal and dark red earth with many crushed snail shells, overlying P-1520: 11,090 ± 260 (R, 1971, v 13, p 367). Date expected to be upper Paleolithic.

P-1827. H-1, Unit A199 **12,540 ± 180**
10,590 BC

Charcoal and reddish brown earth; same level as P-1520; 11,090 ± 260 (R, 1971, v 13, p 367). Date expected to be Upper Paleolithic.

B. Near East

1. Iran

Hajji Firuz Tepe series

Hajji Firuz Tepe (37° N, 45° 29' E), is a small mound SE of Hasanlu Tepe on S shore of Lake Urmia, in Solduz valley of Azerbaijan Prov, Iran. Excavated by Univ Mus, 1958, 1959, 1961, and 1968. Samples coll 1968; subm by R H Dyson, Jr, Univ Mus, Univ Pennsylvania, Philadelphia (1965, 1969; Lawn, 1970; Ralph, 1959; Stuckenrath, 1963; Stuckenrath *et al*, 1966).

P-1839. HF 68-S-68 **870 ± 50**
AD 1080
 $^{13}C_w = +1.90\%$

Reed matting, burnt *in situ*, from bottom or rectangular pit in F 11 (2). Sample dates Islamic occupation of mound and assoc ceramic assemblage. *Comment*: NaOH pretreatment. $^{13}C/^{12}C$ was measured as some reed samples are known to be fractionated; this one, however, had not. MASCA range: AD 1100 to 1040.

P-1841. HF 68-S-70 **5460 ± 80**
3510 BC

Charcoal, from Operation F 10 (2) 1 dates Chalcolithic (Pisdeli or Hasanlu VIII period) occupation of site. For other dates for this period see P-866: 5450 ± 70 (R, 1966, v 8, p 350); P-157: 5450 ± 160 (R, 1959, v 1, p 50); P-504: 5520 ± 80 and P-505: 5640 ± 80 (R, 1963, v 5, p 89). *Comment*: MASCA corrected range: 4270 to 4400 BC.

P-1842. HF 68-S-73 **5370 ± 80**
3420 BC

Charcoal from Operation F 10 (3a) 4 dates Chalcolithic occupation (Pisdeli or Hasanlu VIII period) of site. For other dates for this period, see P-1841 (cf). *Comment*: MASCA corrected range: 4100 to 4380 BC.

P-1843. HF 68-S-76 **6870 ± 100**
4920 BC

Charcoal from Operation H 12 (6) 2 on lower floor of "Stolper House", assoc with trash heap and Burial 3 (Dyson, 1969). For date from stratigraphically equivalent samples, see P-502: 6900 ± 80, and P-455: 7270 ± 90 (R, 1963, v 5, p 90). *Comment*: this sample is beyond range of MASCA correction factors now available (Oct, 1973). See Pennsylvania XVI, this issue, and Ralph *et al*, 1973.

2. Lebanon

Sarafand series

Sarafand (ancient Sarepta), Lebanon (33° 27' N, 35° 17' E) is adjacent to harbor of village of Sarafand, ca 12.87km S of Sidon on road to Tyre. Site represents most extensive and best stratigraphic remains of Phoenician civilization yet excavated. Samples coll 1972, subm 1972 by J B Pritchard, Univ Mus, Univ Pennsylvania, Philadelphia.

P-1944. II-D-6 **3160 ± 60**
1210 BC

Charcoal from firing chamber of Kiln S. *Comment*: NaOH pretreatment. MASCA corrected range: 1460 to 1600 BC.

P-1945. Rm 65, Level 4A kiln **2360 ± 60**
410 BC

Charcoal. *Comment*: NaOH pretreatment. MASCA corrected range: 430 to 660 BC.

P-1946. II-A-9, Level 7 **3000 ± 50**
1050 BC

Charcoal. *Comments:* NaOH pretreatment. MASCA corrected range: 1220 to 1400 BC. (JBP): MASCA corrected range agrees well with analysis of pottery assoc with this level. Pottery assoc with other levels are not yet analyzed.

P-1947. II C-4, Level 7-9 **2880 ± 60**
930 BC

Charcoal. *Comment:* MASCA corrected range: 1020 to 1260 BC.

P-1948. II-B-4, Level 8 **2920 ± 50**
970 BC

Charcoal. *Comment:* MASCA corrected range: 1110 to 1300 BC.

P-1950. II-C-5, Level 8-3 **2950 ± 50**
1000 BC

Charcoal from Level 8-3*sealed. *Comment:* NaOH pretreatment. MASCA corrected range: 1160 to 1360 BC.

P-1951. II-C-5, Level 10-1 **2990 ± 50**
1040 BC

Charcoal from Level 10-1*sealed. *Comment:* NaOH pretreatment. MASCA corrected range: 1220 to 1390 BC.

3. Turkey

Korucu Tepe series

Korucu Tepe is a medium-sized mound in the Altimova plain E of Elazig, Turkey (38° 42' N, 39° 30' E), at alt ca 824m. Samples coll 1970; subm by Maurits van Loon, Inst Prae-en Protohist, Univ Amsterdam, Amsterdam, Netherlands (van Loon and Buccellati, 1969, 1970; Mellink, 1969, 1970). For more dates from this site, see P-1611-1618 and P-1626-1629 (R, 1971, v 13, p 368-369).

P-1927. KRC 70-S439 **3950 ± 70**
2000 BC

Charcoal from Operation O 16, Area 4, Level 10. From area next to heavy mud brick wall of Early Bronze III public building on top of Korucu Tepe, assoc with fluted black burnished pottery and clay figurines of ca 2300 to 2000 BC. Early Bronze III building was abandoned, but never burned and charcoal was found next to burned Early Bronze II level, into which foundations were dug. Thus, sample may predate ca 2300 BC. *Comment:* NaOH pretreatment. MASCA corrected range: 2420 to 2670 BC.

P-1926. KRC 70-S670 **4340 ± 70**
2390 BC

Charcoal, from Operation P 17, Area 13, Level 5, from floor of burned room containing relief-decorated black burnished pottery and a clay "andiron", similar to those found in Amuq Phase H-1 (Braidwood

& Braidwood, 1960, p 358-368; 398-403; 518-519). Dating this locus will establish whether it is contemporary with loci elsewhere on Korucu Tepe which yielded undecorated black burnished pottery with the following dates: P-1617-A, 4110 ± 70 ; P-1617-b, 4070 ± 60 ; P-1618, 4220 ± 60 ; P-1628, 3990 ± 60 ; and P-1629, 3960 ± 70 (R, 1971, v 13, p 368-369). *Comment*: NaOH pretreatment. MASCA corrected range: 2970 to 3180 BC.

P-1928. KRC 70-S948

5150 \pm 80

3200 BC

Charcoal from Operation K 12, Area 14, Level 22, on Floor W. Coll from floor of burned room containing chaff-faced pottery comparable to Amuq F ware (Braidwood & Braidwood, 1960, p 232-238; 513-514) and some pie-shaped clay structures which probably served as pot stands. K 12, Level 22 is above K 12, Level 27, dated 5370 ± 40 , GrN-5286, and 5330 ± 40 , GrN-5287 (pers commun). *Comment*: NaOH pretreatment. MASCA corrected range: 3820 to 4090 BC.

P-1929. KRC 70-S757

6310 \pm 70

4360 BC

Charcoal from Operation K 13, Area 5, Level 27. Coll from burned horizontal timber incorporated into plastered mud brick house wall in earliest building level found at Korucu Tepe. Assoc pottery is black or brown burnished, with a few Halaf and Ubaid-like sherds, pointing to a date ca 4500 to 4000 BC (Braidwood & Braidwood, 1960, p 157-168; 509-511). *Comment*: NaOH pretreatment, MASCA corrected range: 5180 to 5300 BC.

4. Syria

Selenkahiye series, Syria

Selenkahiye is a fortified mound 87km E of Aleppo, Syria ($36^{\circ} 6' N$, $38^{\circ} 3' E$) on W bank of Euphrates R. Samples coll 1967 during excavations by Oriental Inst Univ Chicago; subm 1970 by Maurits van Loon (1968, 1969; van Loon and Dornemann, 1969).

Phase 1: 1st occupation on natural levee along Euphrates R, apparently Early Dynastic period, ca 2600 to 2300 BC.

P-1788. SLK S67-192

3900 \pm 60

1950 BC

Charcoal from Operation W41, Area 6, Level EL, ca 20cm above virgin soil. *Comment*: NaOH pretreatment. MASCA corrected range: 2210 to 2580 BC.

P-1789. SLK S67-194

3860 \pm 70

1910 BC

Charcoal from Operation W41, Area 6, to virgin soil in level E-H. *Comment*: NaOH pretreatment. MASCA corrected range: 2190 to 2560 BC.

Phase 2: construction of mud brick city wall with stairs at regular intervals—possibly Early Akkad period, ca 2300 to 2225 BC.

P-1790. SLK S67-101**12,810 ± 230****10,860 BC**

Charcoal from Operation W41, Area 5, bottom of Level 5. *Comment:* not tested for bitumen because all of sample had already been processed for dating. Cf P-1791, below.

+2890**32,040****-2130****P-1791. SLK S67-141****30,090 BC**

Charcoal, from Operation W41, Area 5, bottom of Level E2. *Comment:* NaOH pretreatment. After dating, an unburnt portion of sample was tested and found to be contaminated with bitumen. Use of bitumen is recorded in excavation rept (van Loon and Dornemann, 1969, p 66).

Phase 4: renovation of public building—possibly Ur III period, ca 2150 to 2000 BC. This phase ended in wholesale slaughter and fire.

P-1792. SLK S67-124**3970 ± 70****2020 BC**

Charcoal from Operation W43, Area 4, floor of Level 3. *Comment:* NaOH pretreatment. MASCA corrected range: 2480 to 2780 BC.

P-1793. SLK S67-193**3790 ± 60****1840 BC**

Charcoal from charred roof of burnt building in Operation X43, Area 4, Level 2. *Comment:* NaOH pretreatment. MASCA corrected range: 2170 to 2460 BC.

P-1794. SLK S67-437**3620 ± 50****1670 BC**

Charcoal from burnt roof beams found on floor of doorway in Operation X43, Area 4, Level 5. *Comment:* NaOH pretreatment. MASCA corrected range: 2070 to 2160 BC.

Phase 5: re-occupation of ruined public building by private households—possibly ca 2000 to 1950 BC.

P-1795. SLK S67-315**3930 ± 60****1980 BC**

Charcoal from Operation W42, Area 3, floor next to oven of Level 1. *Comment:* NaOH pretreatment. MASCA corrected range: 2340 to 2610 BC.

P-1796. SLK S67-391**3880 ± 60****1930 BC**

Charcoal from Operation W42, Area 3, level next to oven. *Comment:* NaOH pretreatment. MASCA corrected range: 2190 to 2560 BC.

Phase unknown.

P-1797. SLK S67-191 **3740 ± 70**
1790 BC

Charcoal from Operation Q26, Area 2, Level 14, from locus next to E balk. *Comment:* NaOH pretreatment. MASCA corrected range: 2150 to 2330 BC.

P-1798. SLK S67-83 **4080 ± 60**
2130 BC

Charred grain and soil from Operation Q26, Area 2, Level 7. *Comment:* NaOH pretreatment. MASCA corrected range: 2610 to 2910 BC.

C. Southwest Asia

1. Afghanistan

Ai-Khanoum series

Ai-Khanoum in Bactria, N Afghanistan (37° 10' N, 69° 24' E) is 1st Hellenistic site discovered there. Samples coll 1969; subm by Paul Bernard, Dir, Delegation Archéol Française en Afghanistan, Kabul, Afghanistan. All charcoal (*Platanus orientalis*) id by R C Koepfen.

P-1872. Hypostyle Hall, late floor **2780 ± 60**
830 BC

Charcoal from burnt roof beam. Expected date 1st century BC. *Comment:* NaOH pretreatment. MASCA corrected range: 910 to 1100 BC.

P-1873. Hypostyle Hall, late floor **2180 ± 60**
230 BC

Charcoal from burnt roof beam. Expected date 1st century BC. *Comment:* NaOH pretreatment. MASCA corrected range: 200 to 410 BC.

P-1874-A. Hypostyle Hall, late floor **2110 ± 40**
160 BC

Charcoal from burnt roof beam. Expected date 1st century BC. *Comment:* NaOH pretreatment. MASCA corrected range: 120 to 380 BC.

P-1875. Temple á redans, late floor **3690 ± 70**
1740 BC

Charcoal. Expected date 1st century BC. *Comment:* NaOH pretreatment MASCA corrected range: 2110 to 2180 BC.

P-1876. Temple á redans, late floor **2170 ± 50**
220 BC

Charcoal. Expected date 1st century BC. *Comment:* NaOH pretreatment. MASCA corrected range: 170 to 400 BC.

P-1877. Temple á redans, late floor **2650 ± 50**
700 BC

Charcoal. Expected date 1st century BC. *Comment:* NaOH pretreatment. MASCA corrected range: 810 to 910 BC.

P-1878. Hypostyle Hall

2650 ± 50

700 BC

$\delta^{13}C_w = +19.53\text{‰}$

Charcoal and burnt reed under earliest foundation of W wall. Expected date 3rd century BC. *Comment:* MASCA corrected range: 800 to 900 BC.

P-1879. Hypostyle Hall

2330 ± 50

380 BC

$\delta^{13}C_w = +9.67\text{‰}$

Charcoal and burnt reed under earliest foundation of W wall. Expected date ca 3rd century BC. *Comment:* MASCA corrected range: 420 to 640 BC.

P-1880. Hypostyle Hall

2540 ± 50

590 BC

$\delta^{13}C_w = +24.41\text{‰}$

Charcoal and burnt reed under earliest foundation of W wall. Expected date ca 3rd century BC. *Comment:* MASCA corrected range: 740 to 810 BC.

D. North America

1. USA

Alaska

Dixthada series

Dixthada is a multicomponent site in central Alaska, USA, (63° 28' N, 143° 26' W), with a core and blade technology underlying a late prehistoric Athapaskan occupation characterized by extensive bone and copper utilization. Samples coll 1971 by J P Cook and R A McKennan; subm 1971 by J P Cook, Univ Alaska, College, Alaska (Cook & McKennan, 1970; Rainey, 1939; 1940).

P-1833. S106/E/98/E1/2

390 ± 50

AD 1560

Charcoal, Sample 5, Sq S106/E/98/E1/2, from lowest part of late Athapaskan midden; under spruce layer, multiple floors to non-organic dark soil. *Comment:* MASCA corrected range: AD 1520 to 1420.

P-1832. S106/E102

770 ± 40

AD 1180

Charcoal, Sample 3, Sq S106/E102, from lowest part of late prehistoric Athapaskan midden; lowest floor above yellow silt. *Comment:* MASCA corrected range: AD 1240 to 1180.

P-1834. S102/E100

2420 ± 60

470 BC

Charcoal, Sample 1, Sq S102/E100, in yellow silt, 6 to 10cm below late prehistoric midden deposit. Directly assoc with microblade (N73/E1SO). *Comment:* MASCA corrected range: 440 to 740 BC.

Anangula series

Anangula site (53° 00' N, 168° 51' W), is on Anangula (*Ananiulak*) I, in E Aleutians. This is a single component site, 17 to 20m above present sea level, characterized by unifacial tools, including many lamellar-flake tools. Samples coll June and July 1970 and subm by J S Aigner, Univ Connecticut, Storrs, Connecticut. For additional dates from this site, see P-1102, -1103, -1105, -1107 and -1108 (R, 1967, v 9, p 336-337) (Black & Laughlin, 1964; Laughlin, 1963; Laughlin & Marsh, 1954).

General Comment: these samples are beyond range of correction factors now available. See Pennsylvania XVI, this issue and Ralph *et al*, 1973.

P-1836. F-12-s, w-11 **6990 ± 90**
5040 BC

Charcoal from living zone outside house, on soil formed on volcanic ash, at depth ca 1.5 from modern surface. Estimated age: 7800 to 8500 BP. *Comment:* NaOH pretreatment.

P-1837. F-24-III & Vd and F-25-III & Vd **7790 ± 110**
5480 BC

Charcoal, Samples F-24-III, F-24-Vd, F-25-III, and F-25-Vd from continuous carbonaceous zone, ca 1.5 to 1.7m from modern surface; probably temporally equivalent remains from zone clearly within a small hearth area. Hearth and house floor are resting on volcanic ash. Estimated age: 8000 to 8400 BP. *Comment:* NaOH pretreatment.

P-1835. F-6-e-V, F-11-w-V **7000 ± 90**
5050 BC

Charcoal, Samples F-6-e-V and F-11-w-V, from zone believed to relate to initial occupation, at depth ca 1.68m from modern surface, probably outside major house in E and beneath fill from latter. Occupation rests on volcanic ash layer. *Comment:* NaOH pretreatment.

*New Jersey***Savich Farm series**

Savich Farm site, consisting of a village midden and burial, is in Marlton, Evesham Township, Burlington Co, New Jersey (39° 53' N, 74° 53' W). Samples coll 1968, 1969; subm by Richard Regensburg, Univ Mus, Univ Pennsylvania, Philadelphia.

P-1777. Feature 114 **610 ± 30**
AD 1340

Charcoal from late woodland refuse pit in top soil and extending into subsoil and archaic component. Pit contained 215 potsherds of 1 type, 1 triangular point, 1 whetstone, and many hearth stones. Same type of pottery from Overpeck site was dated AD 1200. *Comment:* MASCA corrected range: AD 1370 to 1300.

610 ± 50
AD 1340

P-1778. Feature 114

Same as for P-1777, above, except that this sample was baked for 20 min at 300°F the same day it was excavated. It was thought that bacterial action could alter results. *Comment:* this limited test proved theory was false. MASCA corrected range: AD 1380 to 1260.

3640 ± 60
1690 BC

P-1779. Feature 128

Charcoal from hearth pit, typical of many from terminal Archaic component. Pit contained 1 quartzite point, 4 aragonite bases, red ocher, and 85 hearth stones. Miller Field site, N New Jersey, has same point types below level dated at 1700 BC. *Comment:* NaOH pretreatment. MASCA corrected range: 2080 to 2160 BC.

3530 ± 70
1580 BC

P-1780. Feature 135

Charcoal from terminal Archaic hearth pit (different from P-1779, above) sealed off from Woodland component floor by at least 10.2cm of soil. *Comment:* MASCA corrected range: 1920 to 2110 BC.

3820 ± 60
1870 BC

P-1781. Feature 157

Charcoal will help date village midden and cremation cult of terminal Archaic component. Estimated date: ca 2000 BC. *Comment:* MASCA corrected range: 2180 to 2480 BC.

4290 ± 60
2340 BC

P-1782. Feature 215

Charcoal from Feature 215, deeper than most of other features, and contained 2 points of period 3500 to 4000 BC? *Comment:* NaOH pretreatment. MASCA corrected range: 2930 to 3150 BC.

E. Central America

1. El Salvador

Chalchuapa series

Area of sites is near Chalchuapa, El Salvador (13° 59' N, 89° 41' E). Samples are from the following excavations: Laguna Cuzcachapa (LC), stratified Preclassic ceremonial and occupational deposit; and El Trapiche mound group (TR), late Preclassic ceremonial center. Samples coll 1967 and 1969; subm by R J Sharer, (1969) Univ Mus, Univ Pennsylvania, Philadelphia.

Laguna Cuzcachapa

1720 ± 60
AD 230

P-1803. LC-2-8.5A

Charcoal from Test Pit 2-8, Level 5. Date should be no later than late Preclassic. *Comment:* MASCA corrected range: AD 320 to 170.

P-1807. LC-2-3.11(W) **3610 ± 60**
1660 BC

Charcoal from Test Pit 2-3, Level 11 (lowest level). Date should be no later than terminal Early Preclassic. *Comment:* undersized sample, 85.63%. MASCA corrected range: 2050 to 2150 BC.

El Trapiche Mound

P-1547. TR-10-1-38A **1840 ± 40**
AD 130

Charcoal found within an intact ceramic cache vessel (Aguacate Orange; Atecozol variety) typical of Caynace Ceramic complex, ca 300 BC to AD 200 or Late Preclassic. Stratigraphic position of cache indicates its contemporaneity with period of active use of structure E 3-1. *Comment:* undersized sample, 92.39%. MASCA corrected range: AD 180 to 110.

P-1550. TR-10-2-30A **2040 ± 40**
90 BC

Charcoal found within vessel from Cache 10. Vessel type (Pinos black-brown: Apopa variety) as well as others from same cache, are all from Caynac Ceramic complex, (ca 300 BC to AD 200). Cache was assoc with particular construction phase of Structure E 3-1, (Stage 5), and sealed by subsequent construction phase. *Comment:* undersized sample, 96.08%. MASCA corrected range: AD 10 to 160.

P-1805. TR-10-7.3(A) **1970 ± 60**
20 BC

Charcoal from fill of Structure E 3-1. Date should be no later than Late Preclassic. *Comment:* MASCA corrected range: AD 70 to 110 BC.

P-1806. TR-10-7.3(B) **2390 ± 60**
440 BC

Charcoal from fill of Structure E 3-1. Date should be no later than Late Preclassic. *Comment:* MASCA corrected range: 430 to 730 BC.

P-1808. TR-10-15.B **2450 ± 60**
500 BC

Charcoal from fill of Structure E 3-1. Date should be no later than Late Preclassic. *Comment:* MASCA corrected range: 480 to 780 BC.

P-1551. TR-10-3-11A **2790 ± 60**
840 BC

Charcoal found within apparently primary deposit of domestic debris at base of structure E 3-1. Deposit is dated as Terminal Early Preclassic, based on ceramic content, sherds of Tok Ceramic complex, ca 1000 to 900 BC. It overlay sterile soil (talpetate) and underlay Late Preclassic fill of Structure E 3-1. *Comment:* MASCA corrected range: 940 to 1100 BC.

P-1548. TR-10-1-40C **5280 ± 70**
3330 BC

Charcoal from carbonized wood beneath construction fill of Structure E 3-1 and directly assoc with top layer of sterile volcanic deposit, predating any known occupation at Chalchuapa. *Comment*: MASCA corrected range: 4020 to 4330 BC.

2. Honduras

Port Royal series

Port Royal, Isla de Roatan, Islas de la Bahia, Honduras (16° 20' N, 86° 20' W) is an underwater site lying at E end of Port Royal Bay. Wreck was covered with sand and turtle grass. Water depth in vicinity varies from ca 1.8 to 9.1m. Ship thought to date at least AD 1515 (Sauer, 1966). Samples coll 1971 by J J Berrier, Jr; subm by H R Sharp, Univ Mus, Univ Pennsylvania, Philadelphia.

P-1799. PRI WD UP#6 **230 ± 40**
AD 1720

Sample taken from lower deck, stern sec. *Comment*: MASCA corrected range: AD 1760 to 1670.

P-1930. PRI WBP UP#8 **310 ± 40**
AD 1640

Mahogany, a species of *Swietenia*, id by R C Koeppen, was from port bilge pump just aft of mast step. *Comment*: MASCA corrected range: AD 1680 to 1590.

F. South America

1. Peru

Chilca Canyon series

Samples from prehistoric sites in dry canyon 4km from central Pacific coast, 67km S of city of Lima, subm by Frederic Engel, Inst Anthropol y Agric Precolumbina, Lima, Peru.

P-1593. 12B-VII-3080 **3400 ± 60**
1450 BC

Charcoal, Sample v 2521, from Level 100 refuse probably from hearth, from Village 12B-VII-3080, Chilca Canyon (12° 25' 26" S, 76° 38' 39" W) at alt + 450m. Sample dates a late Precolumbian village in a *loma* with circular huts surrounded by small walls. Coll 1967 by Bernardino Ojeda. *Comment*: NaOH pretreatment. MASCA corrected range: 1960 to 1950 BC.

P-1605. 12B-V-206 **1320 ± 60**
AD 630

Sample v 1166 is from a beam of house in Antival, Site 12B-V-206, upper Chilca Canyon (12° 15' 30" S, 76° 24' 30" W) and dates possible late-Nascoïd re-occupation yielding undecorated, undefined chocolate-brown pottery from large above ground houses and elaborate rectangular *chulpas*. Lower levels are pre-Chavin, with age of 3700 ± 110, GX-1833

(pers commun). Coll by Frederic Engel. *Comment*: MASCA corrected range: AD 720 to 600.

P-1844. 16A-II-40

5560 ± 80
3610 BC

Sample v 2990, from Level 100 of shell and refuse mound at Site 16A-KK40, Bay of San Nicholas, S coast of Peru (15° 13' S, 73° 13' W) ca sea level. Coll 1970 by Frederic Engel and Bernadino Ojeda. *Comments*: NaOH pretreatment. MASCA corrected range: 4400 to 4510 BC. (FE): the range, 4400 to 4510 BC, confirms Strong's judgement about pre-agricultural character of shell mounds found along the Bay of San Juan, N of Harbor of Marcona, S Peru.

P-1845. 11B-IX-390

3390 ± 70
1440 BC

Wood, Sample v 2781, from broken beam on floor of decorated building or "temple" at Los Trisos, Site 11B-IX-390 in Chillón Valley (11° 44' 30" S, 78° 58' 30" W), alt +550m. Coll 1970 by Frederic Engel. *Comments*: MASCA corrected range: 1680 to 1950 BC. (FE): the range, 1680 to 1950 BC, establishes preceramic character of this large complex, comparable with El Paraiso, ca 40 km W, along S bank of Chillón R. Site 11B-IX-390 was considered late prehispanic, as it had been reoccupied, but architecture, with clay-plastered and painted walls, is typical of final phase of preceramic horizons.

P-1846. 17B-V-740

630 ± 40
AD 1320

Charcoal, Sample v 2886, from Quebrada Honda, Site 17B-V-740 (15° 50' 51" S, 74° 18' W), alt +25m. Coll 1970 by Frederic Engel. *Comments*: NaOH pretreatment. MASCA corrected range: AD 1350 to 1260. (FE): dates large settlement of Quebrada Honda found in a rocky cove just N of Chala. Pottery shows Inca types, but large terraces found all around in the *lomas* are Nazca. Date seems slightly early for an Inca settlement.

P-1848. 9a-V-10

3240 ± 60
1290 BC

Wood, Sample v 2791, from House 9, Level 3 at Culebras, Site 9a-V-10 on N coast of Peru (9° 56' 42" N, 78° 14' 8" S) alt +40m. *Comments*: NaOH pretreatment. MASCA corrected range: 1500 to 1680 BC. (FE): result places Culebras preceramic settlement where it was expected, in the last phase of preceramic horizons, with subterranean houses still being used, contrary to above ground houses found in Rio Seco and Asia for the same period.

P-1849. 16C-X-140

4090 ± 70
2140 BC

Charcoal, Sample v 2877, from Level 100, Quebrada Vaca, Chala, Site 16C-X-140 (16° 18' S, 73° 24' 30" W) a preceramic site on a terrace overhanging beach, alt +40m. *Comment*: NaOH pretreatment. MASCA corrected range: 2610 to 2920 BC.

G. South Pacific

1. Guadalcanal

Fotoruma Cave series

Fotoruma Cave is in the Poha Valley, Guadalcanal I, British Solomons I (9° 25' S, 159° 54' E). Top stratum represents World War II battlefield; bottom stratum dated by I-2874, 2920 ± 110 (pers commun) is earlier than earliest Melanesian radiocarbon date for is E of New Guinea. Samples coll 1966-1968; subm by William Davenport, Univ Mus, Univ Pennsylvania, Philadelphia.

P-1941. P4 **1030 ± 40**
AD 920

Charcoal ca 48cm below datum (D3, E) from ash and charcoal underlying that dated by I-2876, 765 ± 95 (pers commun). *Comment:* NaOH pretreatment. MASCA corrected range: AD 1000 to 800.

P-1939. P2 **300 ± 40**
AD 1650

Charcoal from earth oven ca 61cm below datum (D8, H). Stratum is below that dated by I-2876, 765 ± 95 and above I-2875, 1310 ± 100 (pers commun). *Comment:* NaOH pretreatment. MASCA corrected range: AD 1630 to 1470.

P-1942. P5 **2550 ± 60**
600 BC

Charcoal ca 152cm below datum (D5, E) from earth oven in stratum underlying P4. *Comment:* NaOH pretreatment, MASCA corrected range: 760 to 810 BC.

P-1943. P6 **2630 ± 60**
680 BC

Charcoal ca 183cm below datum (D5, E). Age expected to be > P5. *Comment:* MASCA corrected range: 800 to 900 BC.

P-1940. P3 **720 ± 40**
AD 1230

Charcoal ca 185cm below datum (D11, K) from earth oven in stratum below P5 and P6. *Comment:* NaOH pretreatment. MASCA corrected range: AD 1290 to 1200.

II. GEOLOGIC SAMPLES

A. U S A

Havasu Creek series

Samples are from Havasu Creek, Arizona, coll 1969; subm by Robert Giegengack, Geol Dept, Univ Pennsylvania, Philadelphia.

General Comment (RG): this study endeavors to assess empirically the validity of radiocarbon dates of calcareous tufa (see Giegengack & Ralph, mss in preparation), and is, thus far, successful for selected samples of stream-precipitated CaCO₃ from Havasu Creek, Arizona.

The water of Havasu Creek rises from perennial springs and mixes turbulently with the atmosphere as it falls through 457.5m in ca 16.1km

(10 mi) of flow. Loss of CO_2 causes precipitation of CaCO_3 on bed and bank obstructions as well as on foreign bodies that fall into the stream. Especially interesting are fragments of wood falling into the stream as trees die after their roots are flooded by channel changes caused by systematic growth and periodic collapse of tufa structures.

A point ca 16.1km (10 mi) upstream from the confluence of Havasu Creek with the Colorado R was arbitrarily selected to represent the center of water seepage on the floor of Havasu Canyon. The number in sample titles refer to mileage downstream from the springs to points at which tufa-encrusted wood was coll.

We have assumed that the innermost cylinder of CaCO_3 around each wood sample was precipitated shortly after the contributing tree died. Hence, an age difference between the outermost wood and innermost tufa is a crude measure of isotopic disequilibrium between the stream water, from which the CaCO_3 precipitated, and the atmosphere, from which the wood carbon is derived, at the time the tree died and for the point in the stream course at which precipitation began.

Assuming no sample was carried downstream after precipitation started, then any systematic downstream decrease in age differences between wood and tufa dated samples expresses the rate of equilibration of the carbon-isotope spectrum in the atmosphere with that of the stream water, presumably as a result of turbulent mixing of the water with the atmosphere.

6.49km downstream of origin of Havasu Creek

(36° 15' N, 112° 42' W)

P-1632. 69HC 4.03W

240 ± 40

AD 1710

$\delta^{13}\text{C}_w = +6.5\text{‰}$

Wood, probably mesquite, encrusted with calcareous tufa.

P-1642. 69HC 4.03T

17,410 ± 420

15,460 BC

$\delta^{13}\text{C}_w = +25.9\text{‰}$

Tufa encrusting wood Sample P-1632 (*cf.*). *Comment:* tufa age less wood age = 17,170.

8.05km downstream of origin of Havasu Creek

(36° 15' N, 112° 42' W)

P-1987. 69HC 5.00W

<20

$\delta^{13}\text{C}_w = -2.91\text{‰}$

Wood, encrusted with calcareous tufa.

P-2044. 69HC 5.00W

<20

Wood, same as P-1987 (*cf.*). *Comment:* R G thought wood should be older, thus more of same sample was dated.

P-1988. 69HC 5.00T

16,560 ± 190

14,610 BC

$\delta^{13}C_w = +27.5\text{‰}$

Tufa encrusting wood Sample P-1987 (cf). *Comment:* tufa age less wood age = 16,540.

9.25km downstream of origin of Havasu Creek
(36° 16' N, 112° 43' W)

P-1899. 69HC 5.75W

190 ± 50

AD 1760

$\delta^{13}C_w = -1.95\text{‰}$

Wood encrusted with calcareous tufa. Wood id by R C Koeppen as species of *Populus*, either aspen or cottonwood.

P-1898. 69HC 5.75T

15,400 ± 270

13,450 BC

$\delta^{13}C_w = +22.5\text{‰}$

Tufa encrusting wood Sample P-1899 (cf). *Comment:* tufa age less wood age = 15,210.

9.66km downstream of origin of Havasu Creek
(36° 16' N, 112° 43' W)

P-1897. 69HC 6.00W

420 ± 40

AD 1530

$\delta^{13}C_w = -.97\text{‰}$

Wood encrusted with calcareous tufa. Wood id as species of *Populus*, either aspen or cottonwood (R C Koeppen, cf P-1899).

P-1896. 69HC 6.00T

14,900 ± 210

12,950 BC

$\delta^{13}C_w = +19.56\text{‰}$

Tufa encrusting wood Sample P-1897 (cf). *Comment:* tufa age less wood age = 14,480.

10.83km downstream of origin of Havasu Creek
(36° 17' N, 112° 44' W)

P-1694. 69HC 6.73W

490 ± 60

AD 1460

$\delta^{13}C_w = -4.7\text{‰}$

Wood encrusted with calcareous tufa.

P-1695. 69HC 6.73T

13,530 ± 90

11,580 BC

$\delta^{13}C_w = +27.4\text{‰}$

Tufa encrusting wood Sample P-1694 (cf). *Comment:* tufa age less wood age = 12,930.

11.51km downstream of origin of Havasu Creek
(36° 17' N, 112° 44' W)

I-7343. 69HC 7.15W <20

Wood encrusted with calcareous tufa. *Comment:* sample was too small; thus, was dated by Isotopes, Inc.

14,800 ± 190**P-2039. 69HC 7.15T****12,850 BC** $\delta^{13}C_w = +27.00\text{‰}$

Tufa encrusting wood Sample I-7343 (*cf.*) *Comment:* tufa age less wood age = 14,780.

15.34km downstream of origin of Havasu Creek

(36° 18' N, 112° 45' W)

180 ± 50**P-1631. 69HC 9.53W****AD 1770** $\delta^{13}C_w = -.45\text{‰}$

Wood encrusted with calcareous tufa.

13,050 ± 300**P-1641. 69HC 9.53T****11,110 BC** $\delta^{13}C_w = +25.2\text{‰}$

Tufa encrusting wood Sample P-1631 (*cf.*) *Comments:* tufa age less wood age = 13,260. (RG): P-1631 and -1641 were lying on boulder in center of stream and were probably carried downstream by a flood after precipitation of tufa had begun.

15.61km downstream of origin of Havasu Creek

(36° 18' N, 112° 46' W)

570 ± 40**P-2037. 69HC 9.70W****AD 1380** $\delta^{13}C_w = +8.33\text{‰}$

Wood encrusted with calcareous tufa.

16,830 ± 240**P-2038. 69HC 9.70T****14,880 BC** $\delta^{13}C_w = +26.83\text{‰}$

Tufa encrusting wood Sample P-2037 (*cf.*) *Comments:* tufa age less wood age = 16,260. (RG): samples were lying at margin of stream and were probably carried downstream by flood after precipitation of tufa had begun.

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