

UNIVERSITY OF PENNSYLVANIA RADIOCARBON DATES III

ELIZABETH K. RALPH

Radiocarbon Laboratory, University of Pennsylvania
Philadelphia, Pennsylvania

INTRODUCTION

The radiocarbon laboratory at the University of Pennsylvania is sponsored jointly by the University Museum and the Physics Department. In this laboratory our primary function is to date archaeological samples from those four regions of the world in which the University Museum studies are concentrated, namely, the Near East, South America, Central America, and the Arctic. Dates for sites in the first two regions are included in this list, and a long series of temple lintels from Tikal, Guatemala is now being processed. Dates for the Arctic were obtained intermittently from 1953 through 1955 (with solid-carbon counting); others, more recently. The materials for many of the Arctic dates, however, were not reliable; that is, they were physically contaminated before processing in the laboratory. We hope that better samples can be found for future Arctic dating. Our Arctic dates which now furnish tentative age ranges for Punuk, Birnirk, Kachemak Bay III, Okvik, Old Bering Sea, Ipiutak, Norton, Dorset, Kachemak Bay I, Choris, Firth River (Early Mountain Phase), Sarqaaq, and Denbigh Flint Complex Periods have been submitted to *American Antiquity* (Rainey and Ralph, in press) along with detailed discussions of possible contaminations.

At the end of 1955 we changed to the proportional counting of pure carbon dioxide technique with equipment similar to that described by Fergusson (1955). Our counter is filled with approximately 8 liters of carbon dioxide at 1 atmosphere pressure (corrected for our standard temperature of 25.85°C). The background counting rate has decreased gradually during the last two years from an initial value of 13 counts/min and is now 8.5 counts/min. The maximum net rate for zero age is 32.3 counts/min. All organic samples are pretreated with hydrochloric acid before combustion. The few comparison tests with alkali treatment (as described by Olson and Broecker, 1958, p. 598) which have been made on wood and charcoal indicate that humic-acid contamination is not a significant factor with these materials in the comparatively young age ranges reported in this list.

As our early measurements in 1952 and 1953 indicated that modern wood samples afforded unexpectedly low counting rates (Ralph, 1955), this pitfall was avoided by basing our starting point for age calculations on a series of determinations of archaeologically known age samples. For convenience for weekly control measurements we now use 10-year intervals of a sample of 175- to 200-year-old oak (probably *Quercus alba*) from Hopewell Township (40° 20' 30" N Lat, 74° 50' 0" W Long), Mercer County, New Jersey, U.S.A. Counting rates of this oak, when corrected for age, agree with an average curve drawn through our series of knowns and it is, therefore, be-

lieved to have a representative C^{14} content for archaeological measurements. No mass spectrographic determinations of C^{13}/C^{12} ratios have been made.

The dates given are based on 5568 years as the half-life of carbon-14 (Libby, 1955, p. 42). The error quoted with each sample includes the standard statistical counting error of the particular measurement for the usual counting period of 1000 minutes and the uncertainties in the zero age and background control values at the time of the unknown counting run. These last two are average values of the weekly control runs, variations of which are normally within the statistical counting errors of individual determinations. Fluctuations of anti-coincidence counting rates with changes in barometric pressure are not apparent, although our shield consists only of 8 in. of steel and 1 in. of mercury. The location of our laboratory below ground level in the basement of a four-story building may afford a partial explanation of our lack of barometric pressure fluctuations.

The B.P. dates in this list were recorded in 1958.

ACKNOWLEDGMENTS

The author wishes to acknowledge with gratitude the continuous support and advice of Dr. Froelich Rainey and members of the Museum staff and Dr. William E. Stephens, Professor of Physics; and to thank Robert Stuckenrath for his tireless work in the preparation and counting of the samples in this date list.

SAMPLE DESCRIPTIONS

I. NEAR EAST

A. Turkey

Gordion series

Gordion (39° 45' N Lat, 31° 55' E Long), on the Sangarius River, 70 mi SW of Ankara, Turkey is the site of a Phrygian Kingdom which fell before an invasion of Cimmerian barbarians early in the 7th century B.C. The town, the City Mound, was rebuilt in the time of the Persian Empire, but most of the numerous tomb mounds were undisturbed until excavations were begun in 1950 by the University Museum of Philadelphia under the direction of Rodney S. Young (Young, 1958a, b, c, d).

The largest of these mounds, which contained "Gordius'" Tomb, is the biggest tumulus in Asia Minor. Samples P-127, P-128, P-133, and P-134 are from "Gordius'" Tomb. It is situated at ground level but covered with a mound of clay 174 ft high and 918 ft in diameter. The mound was excavated and samples collected and submitted in 1957 by R. S. Young, who has determined the date of completion of the tomb by parallels with Assyrian objects in the time of Sargon II who reigned from 2680 to 2663 B.P.

Samples P-135, P-136, and P-137 are from the City Mound which was destroyed around 2643 B.P. as determined from traditional dates in Greek literature, and built at least as early as 2708 B.P. as estimated by evidences of stratification. Coll. and subm. by R. S. Young.

- P-134. "Gordius" Tomb** **2606 \pm 117**
Fragments of organic matter, possibly food, from bowl #148 in "Gordius" Tomb, Tumulus MM.
- P-128. "Gordius" Tomb** **2631 \pm 90**
Pieces of wool and linen blankets from foot of bed in "Gordius" Tomb, Tumulus MM.
- P-127. "Gordius" Tomb** **2701 \pm 90**
Juniperus drupacea from outer wall of "Gordius" Tomb, Tumulus MM. Sample was taken from outer part of this unfinished log.
- P-133. "Gordius" Tomb** **2939 \pm 122**
Pinus nigra pallasiana from squared beam of inner wall of "Gordius" Tomb, Tumulus MM. This sample was taken from the outer surface of the beam, but it is not known whether or not these trees grew large enough for a hundred or so years of growth rings to have been removed in the shaping of this squared beam by the builders of "Gordius" Tomb.
- P-135. City Mound** **2623 \pm 119**
Charred wood, possibly *Pinus nigra pallasiana*, part of roof beam from the City Mound, Megaron 3. This sample was covered by debris of the city, all of which was covered by 10 to 13 ft of clay. Coll. 1957. Estimated date of destruction: ca. 2643 B.P.
- P-136. City Mound** **2690 \pm 120**
Charcoal from City Mound, Megaron 3, Phrygian level CC, from North Room of Burnt House. Coll. 1955. Estimated age: 2658 \pm 25 B.P.
- P-137. City Mound** **3113 \pm 125**
Charcoal, part of beam in deep trench, from City Mound, Megaron 3, North Central Trench, Phrygian level IVa. Coll. 1950. Estimated: Hittite to Phrygian, possibly 2860-2760 B.P.

B. Egypt

- P-227. Seti I** **3055 \pm 91**
Wooden beam with cartouche containing the name of Seti I who reigned from about 3276 to 3256 B.P. This beam was supplied by the University Museum of Philadelphia. Its collection date and original location in Egypt are not known. This is another portion of the same sample as P-5 which was measured in 1953 by the solid-carbon method (3106 \pm 280) (Ralph, 1955).
- P-11. Sarcophagus of Aha-nakht** **3710 \pm 98**
Wood (probably cedar) from outer sarcophagus of Aha-nakht, El Bersheh (27° 45' N Lat, 30° 45' E Long), Egypt. Found in tomb which was covered with earth. This coffin was presumably excavated by natives at the same time as the El Bersheh coffins obtained for the British Museum by E. A. W. Budge after A.D. 1895 (Budge, 1920, p. 358). University Museum of Philadelphia Cat. No. E16218a-b. Accepted age: 3808 to 3958 B.P. (R. Anthes, personal communication).

P-216. Pyramid of Sneferu 4082 \pm 102

Cedar wood from the logs of the upper chamber of the Southern Pyramid of Sneferu at Dahshur (29° 45' N. Lat, 31° 15' E Long), Egypt. Found in superstructure of a stone pyramid by the Service des Antiquités of the Egyptian Government in 1947. Subm. by the British Museum. Accepted age: 4658 \pm 150 B.P. (R. Anthes, personal communication).

P-215. Tomb of King Zet, Saqqara 4594 \pm 91

Wood from tomb of King Zet (or Waji), Saqqara (29° 50' N Lat, 31° 15' E Long), Egypt. Found in subterranean brick structures of tomb. Should be a generation older than the grave of Den; Ist Dynasty. Accepted age: 4958 \pm 200 B.P. (R. Anthes, personal communication). *Comment*: other portions of this sample were dated by the Groningen laboratory (Gro-1100, 4120 \pm 60; Gro-1109, 4220 \pm 55; de Vries and Waterbolk, 1958). Coll. 1953 by W. B. Emery; subm. by the British Museum.

P-214. Tomb of Hemaka, Saqqara 4447 \pm 150

Acacia wood (probably *Acacia arabica*) from tomb of Hemaka, Saqqara (29° 50' N Lat, 31° 15' E Long), Egypt. Found in subterranean structure of tomb, Ist Dynasty. Coll. 1937 by W. B. Emery; subm. by the British Museum. Accepted age: 4958 \pm 200 B.P. (R. Anthes, personal communication). *Comment*: another portion of this sample was dated by the British Museum (BM-27, 4100 \pm 150; Barker and Mackey, 1959).

General comment

Our C¹⁴ dates for these five Egyptian samples are younger than their accepted ages by the following percentages:

General comment

Lab. No.	% Young	Average Estimated Age B.P.
P-227.	6.46 \pm 2.94	3266
P-11.	4.46 \pm 3.17	3883
P-216.	12.37 \pm 3.89	4658
P-215.	7.34 \pm 4.44	4958
P-214.	10.31 \pm 5.04	4958

Some of the discrepancy for samples P-216, P-215, and P-214 can be attributed to the uncertainty of the accepted ages, but samples P-227 and P-11 have been placed in time with the benefit of an astronomical fix and are widely accepted as known within the tolerances quoted. I think, therefore, that the C¹⁴ half-life value (5568 \pm 30) and fluctuations in the cosmic ray intensity must be considered as possible explanations for the remaining discrepancy of the order of 5%. We are now measuring a long series of known ages which we hope will elucidate these questions or, at least, provide an effective value of the C¹⁴ half-life for archaeologic age determinations.

*C. Saudi Arabia***P-206. Ain Jawan Tumulus, Saudi Arabia 1926 ± 92**

Charcoal from a tumulus at Ain Jawan Quarry (26° 42' N Lat, 50° 0' E Long), near Ras Tanura, al-Hasa Province, east coast of Saudi Arabia. Coll. 1951 by Frederico Vidal; subm. by R. H. Dyson, Jr., University Museum of Philadelphia. This limestone tumulus contained a number of chambers with gold and carnelian jewelry, glass and pottery objects of Graeco-Roman type. *Comment:* the date agrees with the estimated age from the typology of the objects.

*D. Iran***Hasanlu Tepe series**

Hasanlu (37° N Lat, 45° 28' E Long) is located near the town of Nagadeh in Azerbaijan province of Iran, about halfway between Nagadeh and the south shore of Lake Urmia, just S of the small freshwater lake known as Hasanligut or Shor Gol. Coll. 1957 by R. H. Dyson, Jr., director of the Joint Expedition of the University Museum of Philadelphia and the Archaeological Service of Iran, who submitted samples from the Citadel and Outer Town areas of the mound. Three phases of occupation are represented by the samples in this list, namely, the "Grey Ware Phase," the "Button Base Phase," and the "Painted Orange Ware Phase." The most recent in this group, the "Grey Ware Phase," with characteristic spouted pitchers, was ended by the sacking of the site. The date of this would perhaps fit historically with a known Urartian campaign in the area at the end of the 9th century B.C. This phase overlies the "Button Base Phase" which is characterized by the presence of small grey ware cups with loop handles and disk bases, and simple painted buff ware vases with similar bases. This material is known elsewhere to fall in the middle second millenium B.C. Below this the "Painted Orange Ware Phase" occurs above virgin soil in three deep soundings (IV, V, VI) made in the Outer Town area of the mound. All of the strata in this phase contain a particular carinated bowl type and painted, grit-tempered pottery. The excavations are described by Dyson (1958).

The radiocarbon samples consisted of occupation ash from house floor levels or levels associated with walls. The material was too fine to permit specific identification, but much of it probably represented ash from animal dung which is the chief local fuel along with some small brush.

P-186. Hasanlu, "Grey Ware Phase" 2881 ± 119

Ash from Citadel area, Oper. VII, section E-F. This sample overlies P-111 stratigraphically, and was expected to be younger than P-111. The lower end of its tolerance (2762 yr), however, overlaps the date for P-111.

P-111. Hasanlu, "Grey Ware Phase" 2770 ± 130

Ash from Citadel area, Oper. II, stratum 3, ash below outer defence wall of Oper. VII, section C-D.

P-187. Hasanlu, "Grey Ware Phase" 2765 ± 117

Ash from Outer Town area, Oper. IV, stratum 3 top, South Balk. *Comment:* the dates of P-111 and P-187 (average 2768 ± 124) agree closely

with the dating of the end of this phase suggested by historical evidence (ca. 2758 B.P.).

P-198. Hasanlu, "Grey Ware Phase" 3083 \pm 122

Small lumps of charcoal mixed with ash from Outer Town area, Oper. VI, stratum 3, above burial 13, East Balk. *Comment:* this is one of the earlier burials and suggests a spread in time of about 300 yr for the "Grey Ware Phase."

P-185. Hasanlu, "Button Base Phase" 3000 \pm 120

Ash from Citadel area, Oper. I, stratum 5d. *Comment:* although a little younger than expected, this date may be correct for the end of this phase.

P-191. Hasanlu, "Painted Orange Ware Phase" 4021 \pm 134

Ash from Outer Town area, Oper. VI, stratum 4, floor 2, West Balk.

P-188. Hasanlu, "Painted Orange Ware Phase" 3981 \pm 135

Ash from Outer Town area, Oper. IV, stratum 16, floor 8, West Balk.

P-194. Hasanlu, "Painted Orange Ware Phase" 4115 \pm 136

Ash from Outer Town area, Oper. VI, stratum 6, floor 3, burned room.

P-189. Hasanlu, "Painted Orange Ware Phase" 3960 \pm 134

Ash from Outer Town area, Oper. V, stratum 21.

P-190. Hasanlu, "Painted Orange Ware Phase" 3960 \pm 134

Ash from Outer Town area, Oper. V, stratum 34 basal, above sterile sand. *Comment:* no correlations with outside materials have yet been made to cross-check these results, but the dates of these five "Painted Orange Ware Phase" samples show a short duration for the period around an average date of 4007 \pm 134 yr.

Pisdeli Tepe series

Pisdeli Tepe (36° 29' N Lat, 45° 28' E Long) is a small mound NE of Hasanlu, near Nagadeh, Azerbaijan, Iran. Coll. 1957 and subm. by R. H. Dyson, Jr., University Museum of Philadelphia. Pisdeli Tepe yielded a collection of objects (plain straw-tempered pottery, painted pottery, obsidian blades, clay spindle whorls, bone awls, and an animal figurine) typologically similar to the Northern Ubaid culture of Iraq but of a local variety.

P-130. Pisdeli Tepe, Islamic Level 927 \pm 97

Ash from 8 in. below surface of Sounding I, contained in a hearth made of Islamic bricks; bricks characterized by three diagonal grooves made by drawing three fingers across the wet surface. Associated with plain, grit-tempered domestic pottery.

P-157. Pisdeli Tepe, Pre-Islamic Level 5460 \pm 160

Ash (carbonaceous occupational debris) from 8 ft 2 in. below surface of Sounding I. Associated with pottery typologically reminiscent of Ubaid pottery in Iraq. *Comment:* this date supports the suggested relative correlation and

places the material earlier in time than the "Painted Orange Ware Phase" at Hasanlu, a position indicated by stratigraphic evidence at Hasanlu but not yet demonstrated conclusively.

P-199. Geoy Tepe 4400 \pm 142

Ash from occupational level from Geoy Tepe (37° 30' N Lat, 45° 20' E Long), slightly SW of Rezaieyeh, Azerbaijan, Iran. Coll. 1957 and subm. by R. H. Dyson, Jr. Taken from SE corner of Pit I, 30 ft 10 in. below present surface, approximating the interval 432-456 in the published west section from a stratum lying in "K Period". ("K Period" is indicated between marks 240 and 504) (Burton-Brown, 1951, fig. 2)). *Comment:* the youngest subdivision of this period, K₃, appears to be related to the "Painted Orange Ware Phase" at Hasanlu.

E. West Pakistan

Kot Diji series

Samples from Kot Diji Excavations (26° 52' N Lat, 68° 30' E Long), near Khairpur, in Sind, about 25 mi E of Mohenjo-daro, W. Pakistan. The site was excavated and samples collected by F. A. Khan, now Director of Archaeology, Pakistan. The site is a mound, 40 ft high and 600 ft long, in which cuttings have revealed 18 to 20 successive layers of occupation. The uppermost half-dozen represent a village or small town of normal Indus Valley type. Beneath the Indus town lay a deposit of burnt material, and from that point down to the bedrock was the piled accumulation of an essentially alien culture (including a strongly fortified citadel) to which the specific name "Kot Diji" has been given. The median date for this site is expected to be within the vicinity of 4500 B.P. Kot Diji is described in the *Illustrated London News* (May 24, 1958) and by Khan (n.d.).

P-195. Kot Diji 3925 \pm 134

Ash and charcoal mixed with burnt earth from Citadel area, square B IV/1, layer 4, a thick band of ashy and charred material. Coll. 1958 and subm. by F. A. Khan.

P-180. Kot Diji 4083 \pm 137

Charcoal mixed with sand from Citadel area, square B VI/6, layer 5. Coll. 1957 and subm. by R. Curiel.

P-179. Kot Diji 4161 \pm 151

Ash and charcoal mixed with sand from Lower City area, square B V/7, layer 5. Coll. 1957 and subm. by R. Curiel.

P-196. Kot Diji 4421 \pm 141

Ash and charcoal mixed with sand from Citadel area, square B IV/2, layer 14, above early foundations of defences. Coll. 1958 and subm. by F. A. Khan.

F. India

Nevasa series

Nevasa is a small Taluka town on the south bank of the Pravara River in

Ahmadnagar District (19° 14' and 19° 43' N Lat, 74° 41' and 75° 13' E Long), Bombay State, India. The culture sequence of the site ranges from that of the Chalcolithic (probably earlier than 2500 B.P.) to that of 500 B.P. Chalcolithic is a hitherto undocumented period in the Central Deccan (slightly S of Central India). Coll. 1956 by Deccan College Postgraduate and Research Institute, Poona-6, India; subm. by H. D. Sankalia, Director. A review of the site has been edited by A. Ghosh (1954-55, 1955-56).

P-183. Nevasa, Sātavāhana Period 1846 ± 106

Charred grain (the grains are popularly known as Bājārī, a kind of millet) from Trench H, Soak Pit No. 4. The pit in which this sample was collected was sealed by several layers and lies at a depth of 15 ft below the surface. This horizon is ascribed to the Sātavāhana Period, about 2200 B.P. *Comment:* it is interesting to note that on the evidence of coins and of imported pottery from this pit it can be dated in the range of 2200-1800 B.P.

P-184. Nevasa, Chalcolithic Culture 2545 ± 115

Fragments of charred wooden post from Trench F, Locus MD I, Layer 11, depth 3 ft 11 in. below datum, that is, about 22 ft below the surface, in the flooring, sealed by Layer 10. *Comment:* bottom of shipping container was broken when received in the laboratory, and some modern sawdust may have mixed with the charcoal.

P-181. Nevasa, Chalcolithic Culture 3106 ± 122

Dry clean charcoal (wood) from Trench H, Locus MD I, depth 4 ft 8 in. below datum, that is, 22 ft 8 in. from surface, Layer 11. *Comment:* these two (P-184 and P-181) are the first C¹⁴ dates for any Chalcolithic site in India and can only be compared with those from Navdatoli (P-200, P-201, P-202, P-204, and P-205). The date of Nevasa appears to be slightly later, but it must be remembered that these samples are from the top layer of the Chalcolithic habitation at Nevasa.

Navdatoli series

Navdatoli is on the south bank of the Narmada River, opposite Maheshwar (22° 11' N Lat, 75° 36' E Long), Nimar District, Madhya Pradesh, India. Coll. 1958 by Deccan College Postgraduate and Research Institute, Poona-6, and the M.S. University of Baroda, Baroda, India; subm. by H. D. Sankalia, Director. The samples are from the various layers of the Chalcolithic habitation and, according to the pottery, should be dated between 2700 and 3200 B.P. The site is described by Ghosh (1958), Sankalia, Subbarao, and Deo (1958), and Sankalia (1958). These samples may be compared with two from Nevasa (P-184 and P-181).

P-205. Navdatoli, Chalcolithic Culture 3294 ± 125
Burnt wheat from Trench I, Sub-Sq. M, Layer 2.

P-204. Navdatoli, Chalcolithic Culture 3449 ± 127
Charcoal from Trench I, Sub-Sq. G, Layer 3.

P-202. Navdatoli, Chalcolithic Culture 3503 ± 128
Charcoal from Trench I, Sub-Sq. A. 18, Layer 6.

- P-201. Navdatoli, Chalcolithic Culture** **3492 \pm 128**
Charcoal from Trench II, Sub-Sq. D, Layer 8.
- P-200. Navdatoli, Chalcolithic Culture** **3457 \pm 127**
Charcoal from Trench II, Sub-Sq. W, Layer 8.

II. SOUTH AMERICA

*A. Venezuela***Nericagua Culture, Upper Orinoco, Territory of Amazonas, Venezuela**

These nine samples comprise a series of dates from the tropical forest of the northern part of South America, where the region has a high annual rainfall and the soil is damp and suffers leaching. Except for one sample, which is below the occupation refuse, all samples came from levels associated with pottery. From the classification of over 30,000 potsherds from 10 stratigraphic cuts representing 56 different levels, coupled with three additional sites having surface collections only, a sequence was established on the change of pottery types through time. This was called the Nericagua Phase. Approximately three months after the establishment of the sequence on pottery types, the carbon-14 dates were received and matched with their respective levels. They fall into almost perfect sequence. The dates are listed below in order of their appearance in the Nericagua Phase sequence beginning with the most recent. All samples were collected in February, 1957 by Clifford Evans and Betty J. Meggers of the Smithsonian Institution and José M. Cruxent of the Museo de Ciencias Naturales, Caracas and submitted by them for dating. A generous financial contribution from the Creole Foundation via the Smithsonian Institution aided in the dating of these nine samples.

This work is reported by Evans, Meggers, and Cruxent (in press). All of the dates fall within the expected time scale for these tropical forest cultures and correlate with the seriated pottery sequence, suggesting that the extremely moist conditions of this part of the tropical forest do not affect the datability of the samples.

- P-163. Nericagua Culture, Cat. No. 6-79** **Average: 544 \pm 113**
Charcoal lumps from Site AM-4, Sitio Martinez, Cut 2 in Mound 3, Level 60 to 80 cm, at the junction of the Orinoco and Atabapo Rivers (4° 5' N Lat, 67° 50' W Long). *Comment:* the dates of two counting runs of the same CO₂ taken 1 month apart are 513 \pm 131 and 575 \pm 92.

- P-164. Nericagua Culture, Cat. No. 6-103** **Average: 585 \pm 93**
Small lumps of very clean charcoal from Site AM-7, Canaraven, Cut A, Level 40 to 60 cm, Orinoco River (4° 8' N Lat, 67° 52' W Long). *Comment:* the dates of two counting runs of the same CO₂ taken 1 month apart are 546 \pm 93 and 624 \pm 93.

- P-162. Nericagua Culture, Cat. No. 6-74** **Average: 619 \pm 103**
Charcoal lumps from Site AM-4, Sitio Martinez, Mound 2, Cut 1, Level 100 to 120 cm, on Orinoco River at junction of Orinoco and Atabapo Rivers

(4° 5' N Lat, 67° 50' W Long). *Comment:* the dates of two counting runs of the same CO₂ taken 1 month apart are 672 ± 113 and 566 ± 93 .

P-165. Nericagua Culture, Cat. No. 6-104, 6-105

Average: 654 ± 93

Clean charcoal lumps from Site AM-7, Canaraven, Cut A, Level 60 to 100 cm, Orinoco River (4° 8' N Lat, 67° 52' W Long). *Comment:* the dates of two counting runs of the same CO₂ taken 1 month apart are 661 ± 94 and 647 ± 93 .

P-166. Nericagua Culture, Cat. No. 6-109 **Average: 843 ± 96**

Charcoal lumps from Site AM-8, Sitio Morillo, Strata Cut, Level 40 to 60 cm, Orinoco River (4° N Lat, 67° 49' W Long). *Comment:* the dates of two counting runs of the same CO₂ taken 1 month apart are 805 ± 95 and 881 ± 97 .

P-169. Nericagua Culture, Cat. No. 6-123 **850 ± 95**

Charcoal lumps from Site AM-9, Minisia Vieja, Cut 2, Level 60 to 80 cm, Orinoco River (3° 50' N Lat, 67° 25' W Long).

P-160. Nericagua Culture, Cat. No. 6-52 **Average: 1189 ± 93**

Semi-charred palm nuts of *Mauritia* genus from Site AM-2, Nericagua, Cut 4, Level 20 to 40 cm, Orinoco River (4° 28' N Lat, 67° 53' W Long). *Comment:* the dates of two counting runs of the same CO₂ taken 1 month apart are 1182 ± 88 and 1195 ± 99 .

P-161. Nericagua Culture, Cat. No. 6-53 **Average: 1159 ± 122**

Semi-charred palm nuts of *Mauritia* genus from Site AM-2, Nericagua, Cut 4, Level 40 to 60 cm, Orinoco River (4° 28' N Lat, 67° 53' W Long). *Comment:* the dates of two counting runs of the same CO₂ taken 1 month apart are 1250 ± 142 and 1067 ± 97 .

P-158. Pre-occupation Level, Cat. No. 6-38 **Average: 6953 ± 181**

Charcoal lumps from Site AM-2, Nericagua, Cut 1, Level 80 to 100 cm, below the level of occupation refuse, Orinoco River (4° 28' N Lat, 67° 53' W Long). *Comment:* this sample is below the level of human occupation refuse and is probably the result of water-washed charcoal from forest fires. The dates of two counting runs of the same CO₂ taken 1 month apart are 6964 ± 188 and 6941 ± 174 .

B. BOLIVIA AND PERU

The following four series from Bolivia and Peru are the first yet obtained from the Andean highlands. They are all from the Lake Titicaca Basin from sites between 12,500 and 13,000 ft above sealevel. They should prove to be of interest for this reason as well as for their importance in providing a starting point for comparative dating of coastal and highland cultures.

Tiahuanaco series, Bolivia

Charcoal and charred bone from two pits at Tiahuanaco (16° 33' 26" S Lat, 68° 48' 6" W Long), S of Lake Titicaca, Bolivia; excavated in 25-cm levels by Alfred Kidder II and W. R. Coe. Pit Tia-A is directly adjacent to

Bennett's (1934, p. 378) Pit V. Pit Tia-B is directly adjacent to Bennett's (1934, p. 387) Pit VIII. So few diagnostic decorated sherds occurred in Tia-A that exact assignment of many of the arbitrary levels to Bennett's (1934, p. 445) Tiahuanaco style divisions is not possible with certainty. Final analysis of the collection is pending. Coll. 1955 and subm. by Alfred Kidder II and W. R. Coe, University Museum of Philadelphia.

P-121, 121A, 122. Tia-A6 and Tia-A7 1423 \pm 175

Slightly charred animal bones from levels 6 and 7 (1.25 to 1.75 m). Two sherds of Classic Tiahuanaco style occurred in these levels. Later levels contained no surely Classic sherds and did not produce enough material for analysis.

P-120. Tia-A9 1702 \pm 103

Fine bits of charcoal from level 9 (2.00 to 2.25 m), probably still within the range of Classic Tiahuanaco.

P-120A. Tia-A8, Tia-A9, and Tia-A10 1226 \pm 100

Slightly charred bone from levels 8, 9, and 10 (1.75 to 2.50 m). Level 10 appears to be as early as Classic Tiahuanaco style occurs. *Comment:* this sample was counted three times. The first count, a doubtful run, was 1552 ± 300 . The CO₂ was then repurified, and the date recorded is an average of the last two (1260 ± 100 and 1192 ± 100).

P-149. Tia-A12 1707 \pm 93

Charcoal from level 12 (2.75 to 3.00 m). Should fall in latter part of Early Tiahuanaco.

P-150. Tia-A14 1692 \pm 104

Animal bones from level 14 (3.25 to 3.50 m). Contains Early Tiahuanaco material. *Comment:* should be earlier than P-149 and P-120.

P-123. Tia-A15 1817 \pm 103

Damp charcoal from level 15 (3.50 to 3.75 m), marked by a charcoal concentration and Early Tiahuanaco materials. Excavation continued to 4.75 m, with no pottery below 4 m.

P-146. Tia-B1 949 \pm 98

Charcoal from level 1 (0 to .75 m) to level of stone pathway (Bennett, 1934, p. 389). A mixed surface level, with Classic, Decadent, and later pottery.

P-147. Tia-B6 and Tia-B7 1576 \pm 104

Wet, slightly charred bones from levels 6 and 7 (1.80 to 2.30 m), nearing groundwater level. *Comment:* Early Tiahuanaco materials. A preliminary doubtful count of this sample was 2030 ± 500 . The CO₂ was then repurified and the date listed was recorded.

P-119. Tia-B8 1460 \pm 200

Slightly charred bone from level 8 (2.30 to 2.85 m), all but 5 cm of which is under apparently permanent ground water (Bennett, 1934, p. 390). Excavation continued below it for only 10 cm without reaching sterile soil. *Comment:* this Early Tiahuanaco level should be at least as early as P-149

and P-150 and probably as early as P-123. It appears that these slightly charred bones from lower levels were contaminated with younger carbon from ground water, etc. The difference in ages of samples P-120 (charcoal) and P-120A (bones) indicates that the lower level dates for bones may be erroneously young from this contamination by as much as 500 yr.

Chiripa series, Bolivia

Wood charcoal and some charred tubers from the burned thatched roofs of houses and refuse pits at Chiripa (approx. 16° 24' S Lat, 68° 49' W Long), near the shore of Lake Titicaca on the Taraco Peninsula, Bolivia. Dates cover the circle of houses described by Bennett (1936, p. 413-436) and earlier remains. Final analysis of 1955 excavation by Alfred Kidder II, W. R. Coe, and A. R. Sawyer is pending. Coll. 1955 and subm. by Alfred Kidder II and W. R. Coe, University Museum of Philadelphia.

P-116. Ch-A4 2377 ± 110

Charcoal lumps from fill above floor of House 5 at approximate level of bin sills, well below upper mixed fill and Decadent Tiahuanaco burials.

P-141. Ch-A5 2275 ± 116

Charcoal lumps from just above floor level and at floor level of House 5.

P-118. Ch-A9 1928 ± 105

Charcoal lumps from base of inner east wall and adjacent floor level, House 5.

P-144. Ch-A9 2193 ± 111

Same as P-118. *Comment:* this and P-118 should be at least as old as P-116 and P-141.

P-117. Ch-A Subfloor Pit 1937 ± 104

Charcoal lumps from stone-lined pit below floor level of House 5.

P-143A. Ch-A Subfloor Pit 2177 ± 112

Charred tubers from same pit as P-117.

P-143B. Ch-A Subfloor Pit 2318 ± 113

Charcoal lumps from same pit as P-117 and P-143A. Since the floor above the pit was not discernible, it is not clear whether it was dug after the house was burned or whether it antedates the house. *Comment:* P-117, P-143A, and this sample should be more nearly contemporaneous.

P-115. Ch-B2B Pit IV 2468 ± 133

Charcoal lumps from fire debris removed from House 3 after it was burned.

P-142. Ch-B2B Pit IV 2281 ± 113

Same as P-115.

P-124. Ch-B3 Pit I 2291 ± 115

Charcoal from refuse pit that should be contemporaneous with Houses 2 and 3, i.e. the circle of houses discovered by Bennett (1936, p. 420). Should be close to P-125, P-142, P-116, P-141, P-118, P-144.

P-125. Ch-B3 Pit I **2386 \pm 114**

Same as P-124.

P-126. Ch-B6B **2550 \pm 116**

Charcoal from deposits below Houses 2 and 3 and above Houses Sub 1 and Sub 2. This should be a significantly older sample than P-124, P-125, P-142, P-116, P-141, P-118, and P-144.

P-145. Ch-B8A **2970 \pm 120**

Charcoal from 0 to .25 m in test excavation below Houses Sub 1 and Sub 2 in Bennett's (1936, p. 430) "pre-mound" strata.

P-129. Ch-B8B **3240 \pm 130**

Charcoal from .25 to .50 m in same excavation as P-145.

Pucara series, Peru

Seven wood-charcoal samples taken from a deposit of pure Pucara style rubbish at Pucara (15° 3' S Lat, 70° 22' W Long), Department of Puno, Peru. This deposit is on a gentle slope; the samples may be expected to be closely contemporaneous. For preliminary statements on Pucara see Kidder (1943, 1948) and Bennett (1948). Coll. 1955 and subm. by Alfred Kidder II, University Museum of Philadelphia.

P-152. Pu-A1. **2101 \pm 108**

P-170. Pu-A2. **2032 \pm 106**

P-154. Pu-A3. **1847 \pm 106**

P-217. Pu-A3. **1960 \pm 90**

Sample P-217 treated with alkali before combustion.

P-172. Pu-A4. **2040 \pm 109**

P-153. Pu-A5, Pu-A6. **2041 \pm 107**

Qaluyu series, Peru

The Qaluyu site (approx. 15° 1' S Lat, 70° 22' W Long), Peru, has not been fully described. It lies about 4 km N of Pucara and shows Pucara buildings and stone sculpture near the surface. A small test excavation by Alfred Kidder II and M. Chavez Ballón produced a new pottery style underlying Pucara wares. Final report pending. Coll. 1955 and subm. by Alfred Kidder II, University Museum of Philadelphia.

P-155. Qa-A5, Qa-A6, and Qa-A7 **2522 \pm 114**

Charcoal from 1.00 to 1.75 m in Qaluyu test trench. All these contain Qaluyu-style pottery.

P-156. Qa-B **2962 \pm 120**

Charcoal from Qaluyu levels 6 and 7 (1.25 to 1.75 m). Should be approximately the same age as P-155.

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