[RADIOCARBON, VOL. 8, 1966, P. 413-422]

SMITHSONIAN INSTITUTION RADIOCARBON MEAUREMENTS III*

AUSTIN LONG and JAMES E. MIELKE
Radiation Biology Laboratory, Smithsonian Institution
Washington, D. C. 20560

INTRODUCTION

Most of these analyses were performed during 1965 with equipment and techniques previously employed at this laboratory. A cold (—40°C) charcoal trap stage was added to the CO_2 purification to remove radon, which eliminates the lag time between CH_4 preparation and counting (Long, 1965b).

Unless otherwise noted, all samples were submitted by Smithsonian staff members, each of whom supplied information pertaining to the samples and contributed generously to discussions of results.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

A. Eastern United States

Elm Hill series, Virginia

Charcoal from site on left bank of Roanoke River (36° 36′ 40″ N Lat, 78° 16′ 20″ W Long), in Mecklenburg County. Coll. 1964 by H. A. MacCord; subm. by Clifford Evans. Pottery analysis by Evans places site in Clarksville series.

SI-154. **280 ± 70**
A.D. 1670

Feat. 30 (refuse pit), Sec. 6D, Square 11, 40 in. depth below surface.

SI-155. **2470 ± 70**
520 B.C.

Feat. 23 (refuse pit), Sec. 6B, Squares 80 and 90, 39 in. depth below surface. *Comment:* specimen apparently contaminated with older material.

B. Central United States

Domebo site series, Oklahoma

Two fractions of bone of *Mammoth* from Domebo site (34° 57′ N Lat, 98° 16′ W Long), Caddo County. Bone was treated and organic carbon fractionated by Vance Haynes, Geochronology Lab., Univ. of Arizona. Coll. 1962 by A. D. Anderson; subm. by F. C. Leonhardy, Mus. of the Great Plains, Lawton, Oklahoma. *Comment:* previous (unpub.) dates from this site are as follows: 4952 ± 300 (Texas Bio-nuclear) on

* Published with the approval of the Secretary of the Smithsonian Institution.

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

tusk; and 10,120 ± 280 (SM-610), 11,045 ± 645 (SM-645), both on wood. The present analyses indicate the tusk analysis includes more recent carbon contaminates.

11,220 ± 500
SI-172. Fraction C **9270 B.C.**

Organic matter soluble in 2 N HCl after initial 2% NaOH extraction.

11,200 ± 600
SI-175. Fraction B **9250 B.C.**

Organic matter soluble in 2% NaOH after initial 2% NaOH extraction and subsequent decalcification of bone.

Herl series, Kansas

Charred bone from 14GL401 (38° 42′ N Lat, 101° 37′ W Long), in Greeley County. Coll. 1961 and subm. by P. W. Bowman, Kansas Anthropol. Assoc., Wallace, Kansas. Hilltop site with fireplaces and trash-filled pits containing bison and antelope bone; stemmed projectile points, no pottery. One burial pit contained Angostura-like point, probably intrusive. *Comment* (W. R. Wedel): date much younger than expected.

1020 ± 100
SI-132. **A.D. 930**

Feat. 2A, a shallow trash pit, 1.2 to 2.5 ft below surface.

1180 ± 120
SI-134. **A.D. 770**

Feat. 2, 0.4 to 1.4 ft below surface, shallow trash pit connected by short trench to Feat. 2A. Should be contemporaneous with Feat. 2A.

1000 ± 110
SI-133. **A.D. 950**

Feat. 7, trash pit, 1.7 ft below surface.

940 ± 90
SI-143. Frank Wetmore site, Kansas **A.D. 1010**

Charred bone from 14MD502 (37° 26′ N Lat, 100° 20′ W Long), Meade County. From 8 to 24 in. depth in refuse pit at site totally devoid of potsherds, and containing much bone and a few projectile points and other stone work. Coll. 1964 and subm. by W. R. Wedel. *Comment* (W.R.W.): date is younger than expected.

Miller site series, Kansas

Charcoal from 14GE21 (39° 09′ 26″ N Lat, 96° 54′ 27″ W Long), Geary County, Kansas. Coll. 1964 by J. E. Sperry, Univ. of Nebraska, Lincoln; subm. by Wedel. All samples associated with shell-tempered, shoulder-incised pottery. *Comment* (J.E.S.): SI-230 and SI-231 are in good agreement with dating of Budenbender site (see Michigan V, p.

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

41), 14PO4, which contained identical ceramics. SI-232, being only 0.2 ft below plow zone, is likely contaminated.

SI-230. **No. 992/4; F 116, x114 cache pit fill** — **920 ± 90** / **A.D. 1030**

SI-231. **No. 1006/5; F 289, x121 cache pit fill** — **770 ± 80** / **A.D. 1180**

SI-232. **No. 3119/6; F 313, x121 beam fragments** — **410 ± 100** / **A.D. 1540**

Medicine Creek Reservoir sites series, Frontier County, Nebraska

SI-126. Site 25FT18 — **1580 ± 100** / **A.D. 370**

Charcoal grab sample (No. XX) (40° 24′ N Lat, 100° 14′ W Long). Coll. 1964 by M. F. Kivett and G. S. Metcalf; subm. by Wedel. *Comment:* only a single culture component is recognized at this site, Keith Focus, Woodland pattern. Another sample from the same site, M-841, gave 1130 ± 200, A.D. 820 (Michigan V, p. 40). The present date is more in line with cultural associations.

SI-193. Site 25FT36 — **800 ± 100** / **A.D. 1150**

Charcoal (sample no. 1375) (40° 08′ N Lat, 100° 14′ W Long). Feat. 3, 4 to 14 in. depth in midden. Coll. 1948 by Metcalf and Kivett; subm. by Wedel. *Comment:* Upper Republican aspect (Kivett, 1949).

SI-194. Site 25FT16 — **930 ± 80** / **A.D. 1020**

Charred wood from Feat. 8 (40° 18′ N Lat, 100° 13′ 54″ W Long). Coll. 1948 by Metcalf and Kivett; subm. by Wedel. *Comment:* Upper Republican aspect (Kivett, 1949). Another sample from this site dated A.D. 1235 ± 125 (I-583, Isotopes III, p. 73).

SI-195. Site 25FT16 — **Modern**

Charcoal, Feat. 11, 15 to 50 in. depth. Coll. 1948 by Kivett and Metcalf. *Comment:* too recent, see SI-194, above.

SI-196. Site 25FT39 — **670 ± 120** / **A.D. 1280**

Wood sample no. 1501 (40° 08′ N Lat, 100° 14′ W Long). House 2, posthole in NW corner, 20 in. depth. Coll. 1948 by Kivett and Metcalf; subm. by Wedel. *Comment:* Upper Republican aspect (Kivett, 1949). Other data from this site, A.D. 1200 ± 65 (SI-56, Smithsonian I, p. 184).

SI-197. Site 25FT70 — **1260 ± 80** / **A.D. 690**

Charcoal sample no. 406 from Feat. 2 (house) (40° 08′ N Lat, 100° 14′ W Long). Coll. 1948 by Kivett and Metcalf; subm. by Wedel. *Com-*

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

ment: Upper Republican aspect (Kivett, 1949). Other dates from this site: SI-47, A.D. 1160 ± 65; SI-50, A.D. 880 ± 70; SI-53, 1105 ± 65 (Smithsonian I, p. 184). Possibly represents a component of the Keith Woodland Period which underlays a part of the site (M.F.K.).

720 ± 80

SI-213. Fire Heart Creek site, North Dakota A.D. 1230

Charred wood from a Thomas Riggs focus house (46° 00′ N Lat, 100° 33′ W Long). Coll. 1964 and subm. by D. Lehmer, Dana College, Blair, Nebraska. Dates the northern center of the Thomas Riggs distribution.

Huff site series, North Dakota

Samples from 32MO11 (46° 37′ 05″ N Lat, 100° 38′ 35″ W Long), Morton County, ascribed to Huff focus by W. R. Wood, Univ. of Missouri, Columbia, Mo. 65202. Coll. 1960 by Wood and subm. by Wedel. *Comment* (W. R. Wood): two of these dates are rejected: SI-183 is much too late, for the site is prehistoric, and SI-182 is regarded as impossibly early. The remaining three dates are within an expectable range of variation. SI-179 is consistent with the range of A.D. 1485 to A.D. 1543 obtained by tree ring analysis of site timbers by G. F. Will (Will, 1946), and SI-178 is consistent with presence of La Roche focus trade pottery at Huff. SI-180 is regarded as probably too recent, but fact that it is late is consistent with superposition of House 8 over pre-existing pits filled with refuse from same occupation as that represented by the rest of the village. See Will and Hecker (1944).

310 ± 190

SI-178. Charcoal, House 3, fireplace A.D. 1640

470 ± 90

SI-179. Wood post, House 3, NE wall A.D. 1480

180 ± 120

SI-180. Charcoal, House 8, floor A.D. 1770

SI-182. Charcoal, House 12, pit in floor (Feat. 167) 770 ± 140 A.D. 1180

SI-183. Wood post, House 12, wall Modern

740 ± 80

SI-212. Steinheimer site, Iowa A.D. 1210

Charcoal from site 13ML222 (41° 05′ 07″ N Lat, 95° 47′ 37″ W Long) from a posthole of House 1, less than a foot below surface. Sample is associated with Beckman and McVey pottery wares with a few Woodland sherds. Coll. 1963 by L. A. Brown; subm. by R. W. Neuman. *Comment:* apparently this sample which is situated low in the valley is of no significant difference in age from those higher in the valley (e.g., Stonebrook, SI-210 and SI-211).

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

Stonebrook site series, Iowa

Charcoal from a plains site 13ML219 (41° 04′ 28″ N Lat, 95° 47′ 25″ W Long) in SW Iowa. Coll. 1963 by Brown and subm. by Neuman. Pottery from this site is of Nebraska aspect, Beckman and McVey types (Anderson, 1961).

SI-210. No. 61, House 1, center post, 2.2 ft below surface — **670 ± 70 A.D. 1280**

SI-211. No. 388, House 2, fill, 2.1 ft below surface — **1050 ± 90 A.D. 900**

C. Central and South America

Marin series, Costa Rica

Charcoal from Marin site (10° 10′ N Lat, 83° 36′ W Long), near Williamsburg. Coll. 1964 and subm. by M. W. Stirling, Natl. Geog. Soc. Detailed analysis of the cultural materials are in progress.

SI-144. (W-4) Grave 7, 3.5 ft depth — **900 ± 90 A.D. 1050**

SI-145. (W-6) Grave 2, 3.0 ft depth — **480 ± 90 A.D. 1470**

SI-146. (W-1) Grave 4, 3.0 ft depth — **1330 ± 120 A.D. 620**

SI-147. (W-2) Grave 11, 4.0 ft depth — **1360 ± 90 A.D. 590**

Puerto Hormiga series, Colombia

Charcoal (SI-151) and shell material (SI-152, SI-153) of genus *Pitar* from Puerto Hormiga shell mound (10° 08′ N Lat, 75° 29′ W Long), Dept. de Bolivar. Coll. 1963 by G. and A. Reichel-Dolmatoff; subm. by Evans. Associated pottery is crude and some of it fiber tempered. *Comment:* results agree well with unpub. shell date from this site (4875 ± 170 B.P., I-445).

SI-151. No. 1, Cut IV, 80 cm below surface — **4820 ± 100 2870 B.C.**

SI-152. No. 2, Cut IV, 75 cm below surface — **4970 ± 70 3020 B.C.**

SI-153. No. 3, Cut IV, 110 cm below surface — **5040 ± 70 3090 B.C.**

SI-171. La Compañia site, Ecuador — **220 ± 60 A.D. 1730**

Charcoal from inside burial urn from Mound B at site R-B-3 (1° 50′ S Lat, 79° 33′ W Long), Los Rio Province. Coll. 1961 by Evans, B. J.

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

Meggers, E. Estrada; subm. by Evans. Sample probably represents pre-contact period of Milagro culture, as it is not associated with trade goods.

160 ± 90

SI-149. Guadalupe mound, Venezuela A.D. 1790

Charcoal from Mound 2, Cut 7, Level 4, 60 to 80 cm depth at Guadalupe mound complex (10° N Lat, 69° 40′ W Long), Jimenez, State of Lara, associated with a primitive form of maize. Coll. 1963 by M. Sanoja; subm. by Evans. *Comment:* in view of previous dates from this complex (SI-120, A.D. 1570 ± 50; SI-121, A.D. 1570 ± 50, Smithsonian II, p. 252), both on shell, and this date, the charcoal apparently is dating a recent intrusion in the mound and not the maize.

Espinheiros I series, Brazil

Charcoal from sambaqui Espinheiros I (26° 18′ 05″ S Lat, 48° 50′ 38″ W Long), Municipio de Joinville, Santa Catarina. Coll. 1963 by W. F. Piazza, Faculdade de Filosofia, Ciências e Letras, Universidade de Santa Catarina, Florianópolis, Santa Caterina; subm. by Evans.

		2220 ± 240
SI-224.	**No. 1, Level III, Sector 2, 93 cm depth**	**270 B.C.**
		2870 ± 100
SI-225.	**No. 2, Level V, Sector 2**	**920 B.C.**
		2920 ± 100
SI-226.	**No. 3, Level VI, Sector 2, 170 cm depth**	**970 B.C.**

Ponta Das Almas series, Brazil

Marine shell (*Anomalocardia brasiliana Gmelin*) and charcoal from sambaqui Ponta das Almas (27° 35′ 32″ S Lat, 48° 27′ 33″ W Long), Florianópolis, Santa Catarina. Coll. 1963 by Piazza; subm. by Evans.

		2400 ± 250
SI-220.	**No. 1, shell, Trench F, Sector F'1**	**450 B.C.**
SI-221.	**No. 2, shell, Trench G, Sector G'l, depth 60 cm**	**2220 ±250 270 B.C.**
SI-222.	**No. 4, shell, Sector B'2 Level 1, 15 to 30 cm depth**	**4280 ± 400 2330 B.C.**
SI-223.	**No. 5, charcoal, Sector B'2, Level II, 30 to 45 cm depth**	**3690 ± 100 1740 B.C.**

910 ± 200

SI-227. Casa de Pedra Cave, Brazil A.D. 1040

Charcoal from 30 cm depth in test pit in central part of cave (28° 00′ 40″ S Lat, 49° 05′ 22″ W Long), Municipio de Urubici, Santa Catarina, which contained 70 cm of non-ceramic refuse and artifacts. Coll.

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

1963 by Piazza; subm. by Evans. Brazilian sites devoid of ceramics are not necessarily of great antiquity.

Rio Grande do Sul series, Brazil

Charred palm nuts (organic fraction run) from rock shelter OSO-1 (29° 37′ 00″ S Lat, 50° 17′ 15″ W Long), near Osório, Rio Grande do Sul. Samples are associated with non-ceramic cultural materials, including various types of stone projectile points. Coll. 1965 by E. T. Miller, Escola Técnica Industrial, Taquara, Rio Grande do Sul, Brazil; subm. by Evans.

SI-233.	**No. 1, coordinates: 12-13, V-VI, 0.95 m depth**	**4280 ± 180 2330 B.C.**
SI-234.	**No. 2, coordinates: 12-13, V-VI 1.32 m depth**	**5950 ± 190 4000 B.C.**
SI-235.	**No. 3, coordinates: 12-13, V-VI-VII 1.75 m depth**	**5680 ± 240 3730 B.C.**

D. Middle East

SI-156. Tepe Sabz, Iran **5770 ± 120 3820 B.C.**

No. TS-14-300-310, carbonized wood, seeds, and goat dung from Tepe Sabz (32° 26′ N Lat. 47° 16′ E Long), SW Iran. From midden area, 300 to 310 cm depth in stratigraphic zone A_3, containing pottery of Bayat phase, roughly equivalent to Le Breton's "Susiana *d*," and related to late Ubaid. Coll. 1963 by J. A. Neely, Rice Univ. Expedition to Iran; subm. by K. V. Flannery. *Comment* (K.V.F.): would seem to check perfectly with other dates for same phase.

SI-160. Tepe Ali Kosh, Iran **8920 ± 100 6970 B.C.**

SI-160R. Replicate analysis of SI-160 **8890 ± 200 6940 B.C.**

Ash and carbonized seeds of *Prosopis* (No. AK-67-117) from midden area in stratigraphic zone A_2 at Tepe Ali Kosh, SW Iran (32° 20′ N Lat, 47° 16′ E Long). Midden dates to beginning of Mohammad Jaffar phase, containing oldest pottery known from SW Iran, and directly overlying preceramic village levels. Coll. 1963 by Frank Hole and Flannery; subm. by Flannery. *Comment* (K.V.F.): expected date would have been in the neighborhood of 6000 B.C.

Kunji Cave series, Iran

Charcoal from Mousterian levels in Kunji Cave, Khorramabad Valley, Luristan, W Iran (33° 30′ N Lat, 48° 20′ E Long). Samples were associated with flint chips and broken animal bones, including *Bos, Cervus* and *Equus,* dating to Middle Paleolithic. Coll. 1963 by Hole and

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

Flannery; subm. by Flannery. *Comment* (K.V.F.): this is expected dating for the Mousterian of the Zagros Mountains.

SI-247. No. K-7-135, Square 7, depth 135 cm, stratigraphic unit 12 **>40,000**

SI-248. No. K-7-145, Square 7, depth 145 cm, stratigraphic unit 12 **>40,000**

II. GEOLOGIC SAMPLES

Willcox Playa ostracode series, Arizona

Samples of ostracode fragments collected from lacustrine sediments at E edge of Willcox Playa (32° 10′ N Lat, 109° 46′ W Long), Cochise County, Arizona. Three samples collected from different auger holes by R. C. Robinson; subm. by J. F. Schreiber, Jr., Univ. of Arizona, Tucson.

SI-176. Sample WP-334-G **>30,000**
From 4139.5 to 4139.0 ft elev.

SI-177A. Sample WP-359-N **>30,000**
From 4132.7 to 4132.0 ft elev.

SI-177B. Sample WP-360-K **>30,000**
From 4132.7 to 4132.4 ft elev.

Willcox Playa carbonate series, Arizona

Carbonate samples from vicinity of Willcox Playa (32° 16′ N Lat, 109° 54′ W Long). Coll. 1965 and subm. by Long. List is supplementary to the one published in Arizona V. Stratigraphic units referred to, from youngest to oldest, are: UGC = upper green clay; IG = intermediate gravel; LGC = lower green clay; WWM = Willcox white marl. Willcox white marl is equivalent to part of the lower green clay.

6720 ± 80
SI-270. Caliche **4770 B.C.**
25 cm below surface and above UGC in gravel pit N of playa. Date is minimum age for host sediment (elev 4185 ft).

8140 ± 130
SI-271. Caliche **6190 B.C.**
30 cm below SI-270 and 70 cm above UGC (elev 4184 ft). Date is minimum age.

12,470 ± 150
SI-272. Calcrete **10,520 B.C.**
In bottom of ancient stream bed exposed in lime pit (elev 4165 ft).

12,860 ± 200
SI-273. Top of WWM **10,910 B.C.**
Exposed in drainage ditch (elev 4205 ft).

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

SI-274. WWM — **22,670 ± 200 / 20,720 B.C.**

80 cm below SI-273 in WWM (elev 4203 ft).

SI-275. Caliche — **5000 ± 100 / 3050 B.C.**

Above UGC at the Croton Springs locality, W of the playa (elev 4170 ft).

SI-276. Top of WWM — **15,220 ± 250 / 13,270 B.C.**

In lime pit E of the playa (elev 4170 ft).

Comment: results are discussed in detail by Long (1966). Results are reported here as ages based on 0.95 NBS oxalic acid although it is understood that care must be taken when comparing dates from fresh water carbonates and dates from wood or charcoal. Certain carbonates, e.g., caliche, were not formed in discrete events, and interpretation of the "date" depends entirely on stratigraphic context of sample.

San Augustin Plains series, New Mexico

Carbonate samples (tufa) at ground surface from San Augustin Plains (33° 45′ N Lat, 108° 18′ W Long). Coll. 1962 and subm. by Long. Tufa zones in this area are associated with terraces of Pleistocene Lake San Augustin (see Antevs, 1955; Powers, 1939); a core from center of basin has been analyzed by Clisby *et al.* (1956).

Comment: these dates are supplementary to those in Arizona V. Results are discussed in detail and interpreted by Long (1966). Ages are calculated based on 0.95 NBS oxalic acid, since actual A_0 is not known. Uncertainty associated with these ages is greater than with wood or charcoal samples, but lacustrine (i.e., not spring-deposited) tufa samples have been shown to be reasonably reliable in most cases (Broecker and Kaufman, 1965).

SI-277. Tufa, 6940 ft elev — **10,360 ± 150 / 8410 B.C.**

SI-288. Tufa, 6980 ft elev — **19,040 ± 300 / 17,090 B.C.**

SI-289. Tufa, 6965 ft elev — **14,380 ± 300 / 12,430 B.C.**

Myrtle Beach series, South Carolina

Peat from Myrtle Beach (33° 40′ N Lat, 78° 54′ W Long). Coll. 1964 and subm. by Long. *Comment:* one or more of these samples are possibly equivalent to Frey's (1952) "Myrtle Beach Peat."

SI-249. Peat — **Modern**

From zone just above high tide level.

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press

SI-250. Peat **>35,000**

From zone just below low tide level.

Cornfield Harbor series, Maryland

Wood and clam shells in and above Pleistocene Pamlico formation at Cornfield Harbor (38° 02′ N Lat, 76° 20′ W Long). Coll. 1964 and subm. by Long from a low cliff formed by wave action. Upper six feet of the marine Pamlico formation is exposed, overlain by ca. four feet of brown silt and gravel, apparently alluvial.

SI-184. Recent shell **Modern**

From 4 ft above top of Pamlico, in shell layer.

SI-251. Pamlico shells **>38,000**

From near top of Pamlico.

SI-252. Pamlico wood **>41,000**

From near top of Pamlico.

Date lists:

Arizona V	Damon, Haynes and Long, 1964
Isotopes III	Trautman, 1963
Michigan V	Crane and Griffin, 1960
Smithsonian I	Sigalove and Long, 1964
Smithsonian II	Long, 1965

REFERENCES

Anderson, Adrian, 1961, The Glenwood sequence: Jour. Iowa Archaeol. Soc., v. 10, no. 3.

Antevs, Ernst, 1955, Geologic-climatic dating in the west: Am. Antiquity, v. 20, no. 4, p. 317-340.

Broecker, Wallace S., and Kaufman, Aaron, 1965, Radiocarbon chronology of Lake Lahontan and Lake Bonneville II, Great Basin: Bull. Geol. Soc. America, v. 76, p. 537-566, 8 figs.

Clisby, K. H., Foreman, Fred, and Sears, Paul B., 1956, San Augustin Plains—Pleistocene climatic changes: Science, v. 124, p. 537-539.

Crane, H. R., and Griffin, James B., 1960, Univ. of Michigan radiocarbon dates V: Am. Jour. Sci. Radioc. Supp., v. 2, p. 31-48.

Damon, Paul E., Haynes, C. Vance, and Long, Austin, 1964, Arizona radiocarbon dates V: Radiocarbon, v. 6, p. 91-107.

Frey, David G., 1952, Pollen analysis of the Horry Clay and a seaside peat deposit near Myrtle Beach, South Carolina: Am. Jour. Science, v. 250, p. 212-225.

Kivett, Marvin F., 1949, Archaeological investigations in Medicine Creek reservoir, Nebraska: Am. Antiquity, v. 14, no. 4, p. 278-284.

Long, Austin, 1965a, Smithsonian Institution radiocarbon measurements II, Radiocarbon, v. 7, p. 245-256.

———— 1965b, Techniques of methane production for C-14 dating: Paper presented at IV Internat. Radiocarbon and Tritium Dating Conf., Pullman, Washington.

———— 1966, Late Pleistocene and Recent chronologies of playa lakes in Arizona and New Mexico: unpub. PhD dissert., Univ. of Arizona.

Powers, W. C., 1939, Basin and shore features of extinct Lake San Augustin, New Mexico: Jour. Geomorphol., v. 2, p. 345-356.

Sigalove, J. J., and Long, Austin, 1964, Smithsonian Institution radiocarbon measurements I: Radiocarbon, v. 6, p. 182-188.

Trautman, Milton A., 1963, Isotopes Inc. radiocarbon measurements III: Radiocarbon, v. 5, p. 62-79.

Will, George F., 1946, Tree ring studies in North Dakota: North Dakota Agricultural College Bull. 338, Fargo.

Will, George F., and Hecker, Thad. C., 1944, The Upper Missouri River Valley aboriginal culture in North Dakota: North Dakota Hist. Quarterly, v. 11, nos. 1, 2.

https://doi.org/10.1017/S0033822200000254 Published online by Cambridge University Press