

**UNIVERSITY OF TEXAS AT AUSTIN
RADIOCARBON DATES VI**

S. VALASTRO, JR., E. MOTT DAVIS, and CRAIG T. RIGHTMIRE

Radiocarbon Laboratory, Balcones Research Center,
The University of Texas at Austin

This laboratory is now a part of the Bureau of Economic Geology, The University of Texas at Austin. The present list reports C^{14} measurements made in dating projects completed in the year ending November, 1967, and some measurements for projects still in progress. Age calculations are based on C^{14} half-life of 5568 yr and a modern standard of 95% of NBS oxalic acid. The deviations reported are based on the counting statistics of the sample, background, and modern, and are $\pm 1\sigma$ except that when the sample count approaches either the modern or the background, 2σ limits are reported. The laboratory continues to use liquid scintillation counting of benzene, using Li_2C_2 and vanadium activated catalyst in preparation, as described in Texas IV and earlier lists. Chemical yields now average 85%.

Rightmire's caliche dating (done for an M.A. thesis in the Dept. of Geol.) is the principal project reported in this list; in addition to the research he prepared the samples in our laboratory and wrote the statements which accompany the list. Valastro is in charge of all technical operations in the laboratory, and he and Davis share the administrative responsibilities. Davis, who handles sample screening (with the aid of an Advisory Committee) and archaeological appraisal, compiled the list.

ACKNOWLEDGMENTS

We acknowledge with gratitude the work of R. B. Wiggins, L. A. Andron II, Alejandra G. Varela, and R. D. Andron in the preparation of samples; the secretarial assistance of Mary Ann Hammond and Kathy L. Corbin; the administrative assistance of Josephine Casey of the main office of the Bureau of Economic Geology; and the support of Peter T. Flawn, Director of the Bureau, and the other members of the Advisory Committee, E. William Behrens, Ernest L. Lundelius, Jr., Leon A. Long, and Dee Ann Story.

I. GEOLOGIC SAMPLES

A. Caliche deposits, West Texas

The accompanying list results from development of a method of age determination for freshwater inorganic carbonate deposits based on C^{14} and C^{13}/C^{12} composition. This statement abstracts full report of method in preparation by C. T. Rightmire and Earl Ingerson. Most caliche contains C^{12} and C^{13} derived from limestone and soil air CO_2 . C^{14} is incorporated in a given proportion to the C^{13} and C^{12} of the soil air CO_2 , permitting age correction. After carbonate sources are analyzed for C^{13}/C^{12} ratio, δC^{13} values of caliche sample (δC_{sm}^{13}), lime-

stone source (δC_{1s}^{13}) and soil air CO_2 (δC_s^{13}) can be inserted into the equation:

$$P = \frac{\delta C_{sm}^{13} - \delta C_s^{13}}{\delta C_s^{13} - \delta C_{1s}^{13}}$$

to give P, the desired correction factor in terms of C^{13} (Ingerson and Pearson, 1964). This factor can be applied to measured activity (A_m) to give corrected activity (A_c):

$$A_c = \frac{A_m}{P}$$

which can be used directly in the age equation:

$$t = 8033 \ln \frac{A_o}{A_m}$$

in which t = age in yrs, 8033 = mean life of C^{14} atom, A_m = background-corrected C^{14} activity of sample, and A_o = background-corrected activity of a standard assumed to be identical activity of the sample. The true age can then be calculated:

$$t = 8033 \ln \frac{A_o}{A_c}$$

Listed below are results for 48 samples from 16 caliche profiles in the Finlay area, Hudspeth County, far W Texas ($31^\circ 10'$ to $31^\circ 17'$ N Lat, $105^\circ 38'$ to $105^\circ 45'$ W Long). C^{13}/C^{12} ratio and C^{14} activity were determined for each sample, and C^{13}/C^{12} ratios were determined for 5 soil air samples. Samples which might be contaminated by recent organic material or limestone were omitted. Samples used for C^{13}/C^{12} analyses were split from those prepared for C^{14} work. It is assumed that soil air CO_2 is in exchange equilibrium with the atmospheric carbon reservoir, and that concentration of CO_2 in soil air of an arid or semi-arid sandy soil is 5 times that of atmospheric CO_2 . If these assumptions are valid, corrected ages are valid. In any case, corrected ages more closely approximate true age of "young" inorganic carbonate than any ages of same material determined by the C^{14} method thus far.

In the list, each profile is signified by letters and a number (e.g., CGA-4). Coll. and subm. 1966 by C. T. Rightmire, Dept. of Geol., Univ. of Texas at Austin.

Sample No.	Field No.	Depth (In.)	δC^{13}	Uncorrected Age	Corrected Age
Tx-387	CGA-4-A	6-8	-3.66	20,800 \pm 500	6,470 \pm 500
Tx-386	CGA-4-B	20-25	-4.37	28,070 \pm 1160	15,700 \pm 1160
Tx-406	CGA-4-C	33-36	-5.14	34,280 \pm 2450	23,580 \pm 2450
Tx-372	CGA-5-A	10-15	-4.79	25,130 \pm 1270	13,740 \pm 1260
Tx-373	CGA-5-B	28-31	-4.94	26,350 \pm 960	15,250 \pm 960
Tx-378	CGA-5-C	45-50	-5.28	31,820 \pm 1850	21,400 \pm 1860

Sample No.	Field No.	Depth (In.)	δC^{13}	Uncorrected Age	Corrected Age
Tx-374	CGA-6-A	4-8	-3.88	22,810 \pm 620	9,200 \pm 620
Tx-375	CTA-6-B	18-22	-4.85	23,450 \pm 660	12,190 \pm 660
Tx-379	CGA-6-C	45-50	-4.93	29,750 \pm 1390	18,650 \pm 1390
Tx-376	CGA-7-A	10-14	-5.66	18,330 \pm 380	8,580 \pm 380
Tx-377	CGA-7-B	32-36	-4.01	22,950 \pm 630	9,710 \pm 630
Tx-381	CGA-7-C	51-56	-3.98	23,710 \pm 860	10,370 \pm 860
Tx-380	CGA-8-A	0-1	-3.75	21,040 \pm 510	7,040 \pm 510
Tx-403	CGA-8-B	9-12	-4.05	21,750 \pm 750	8,610 \pm 760
Tx-404	CGA-8-C	33-40	-4.33	24,050 \pm 710	11,590 \pm 710
Tx-405	BA-3-A	5-9	-4.45	24,430 \pm 760	12,280 \pm 1210
Tx-431	BA-3-B	14-18	-4.72	27,180 \pm 1040	15,610 \pm 1040
Tx-407	BA-3-C	34-40	-4.72	34,210 \pm 2490	22,650 \pm 2500
Tx-408	BA-7-A	5-9	-4.81	16,650 \pm 290	5,290 \pm 290
Tx-409	BA-7-B	17-23	-4.22	25,480 \pm 840	12,750 \pm 840
Tx-410	BA-7-C	36-42	-4.14	32,060 \pm 3900	19,130 \pm 1900
Tx-430	AC-2-B	20-23	-3.84	31,780 \pm 1840	18,050 \pm 1840
Tx-432	AC-2-C	27-31	-3.96	36,030 \pm 3210	22,050 \pm 1240
Tx-433	AC-2-D	50-54	-4.10	>37,000	>37,000
Tx-434	AC-5-A	4-6	-3.84	23,220 \pm 680	9,480 \pm 680
Tx-435	AC-5-C	21-25	-3.72	25,450 \pm 770	10,560 \pm 770
Tx-436	AC-5-D	43-47	-4.40	26,570 \pm 980	14,310 \pm 990
Tx-411	R80S-8-A-2	26-30	-3.73	22,250 \pm 900	8,210 \pm 900
Tx-412	R80S-8-B	44-48	-3.66	26,080 \pm 910	11,840 \pm 910
Tx-413	R80S-8-D	70-74	-3.48	29,950 \pm 1470	15,100 \pm 1470
Tx-414	R80S-9-A	7-11	-4.38	22,560 \pm 1220	10,230 \pm 1220
Tx-415	R80S-9-B	20-24	-4.08	27,670 \pm 1100	14,580 \pm 1100
Tx-417	R80S-9-C	32-36	-4.29	35,300 \pm 2890	22,760 \pm 2810
Tx-421	TT-5-A-1	0-1	-3.11	20,730 \pm 500	4,650 \pm 490
Tx-422	TT-5-B	10-13	-4.96	24,100 \pm 890	13,070 \pm 850
Tx-423	TT-5-C	23-27	-3.65	29,940 \pm 1470	15,670 \pm 1460
Tx-424	TT-6-A-2	14-17	-3.43	27,170 \pm 1080	12,180 \pm 1120
Tx-425	TT-6-B	24-27	-3.68	28,820 \pm 1270	14,620 \pm 1270
Tx-426	TT-6-C	34-38	-4.02	30,790 \pm 1580	17,550 \pm 1580
Tx-427	TT-7-A-1	8-12	-3.21	17,390 \pm 340	1,700 \pm 330
Tx-428	TT-7-C	39-41	-3.94	30,630 \pm 1550	17,240 \pm 1550
Tx-429	TT-7-D	51-55	-4.49	32,710 \pm 2420	20,650 \pm 2420
Tx-418	CP3-II-B	13-16	-3.98	20,770 \pm 490	7,420 \pm 490
Tx-419	CP3-II-C	21-24	-3.84	27,180 \pm 860	13,460 \pm 860
Tx-420	CP3-II-E	38-41	-4.43	34,820 \pm 2670	22,700 \pm 2610
Tx-437	CP3-III-A-2	18-22	-3.64	27,640 \pm 1100	13,320 \pm 1100
Tx-438	CP3-III-B	33-37	-3.93	31,300 \pm 1770	17,820 \pm 1770
Tx-439	CP3-III-C	57-61	-4.21	32,270 \pm 3600	19,540 \pm 2780

General Comment (C.T.R.): Caliche was formed as pedologic process from CO₂ in rainwater and soil air. Carbon isotope composition of deposits varies with type of vegetation which, in turn, varies with climate; therefore, this type of analysis may eventually lead to determination of climate at time of secondary carbonate deposition.

Corrected C¹⁴ ages show that major carbonate accumulation occurred 10,000 to 15,000 yr ago, but sample at base of AC-2 profile is "dead," indicating that caliche has been forming on these surfaces for >37,000 yr. Thickening and deepening of sections toward present course of Rio Grande (ca. 7 mi distant) indicates that drainage over at least total time studied was toward that river, except in minor topographic depressions.

Decrease of δC¹³ with depth through 9 of the 16 profiles may indicate lessening of influence of plants on carbon composition with time. Studies of this type may enable correlation of terrace surfaces between closed basins. Additional C¹³/C¹² studies on soil air and rainwater are needed, as well as studies of CO₂ concentration in soil air in different climates.

B. Carbonate Samples, W Texas and N Mexico

Samples coll. 1965-67 and subm. by C. C. Reeves, Jr., Dept. Geosci., Texas Tech. College, Lubbock, Texas. Comments by C. C. R., Jr.

Tx-463. Oscar Roberts Spring, Mound Lake **34,460 ± 2540**
32,510 B.C.

Carbonate from N edge of playa, Mound Lake, Lynn and Terry Counties, Texas (33° 13' N Lat, 102° 05' W Long). Believed nearly contemporary; dated to see whether carbonate is currently being deposited. *Comment:* coring in summer 1967 shows Oscar Roberts dolomite wedge definitely predates Tahoka Clay; thus date not too surprising, but probably a few thousand yr too old. Surface configuration of dolomite illustrates either solution and redeposition or erosion.

Mound Depression series, II

Organic mud from core in playa of Mound Lake (see above, Tx-463). Core taken off drilling pad on road leading to large central island. Dates on earlier series from this core are Tx-270 through Tx-273 (Texas IV).

Tx-327. ML 14 **31,720 ± 2930**
29,770 B.C.
Depth 14 ft.

Tx-328. ML 18-18 1/2 **>36,000**

Combined samples, 18 and 18½ ft deep. *Comment:* dates indicate that lacustrine sec. beneath modern fill predates Tahoka Clay sec.

Guthrie Depression series

Limestone samples from 3 carbonate zones in pit dug in volcanic ash in Guthrie Depression, 7 mi N of Tahoka and 300 yd W of U.S. Hwy 87, Lynn County, Texas (33° 04' N Lat, 101° 48' W Long). Ash

id. as Pearlette, but previous dates on these samples by Humble (see below) indicate much younger age than Pearlette; present dates serve as additional checks.

Tx-346. GLL-2 **24,740 ± 1000**
22,790 B.C.

From deepest carbonate zone. Humble date on this sample (O-2261, Reeves, pers. commun.) is 31,750 ± 2500 B.P.

Tx-347. GLM-2 **>37,000**

From middle carbonate zone, 5.5 ft below present surface. Humble date on this sample (O-2052, Reeves, pers. commun.) is 34,400 ± 3450.

Tx-348. GLU-2 **34,160 ± 2470**
32,210 B.C.

From uppermost carbonate zone. Humble date (O-2260, Reeves, pers. commun.) is 30,625 ± 220 B.P.

General Comment: discrepancies between dates from Austin and Humble labs indicate contamination, undoubtedly by dead carbon. Even so, dates collectively show that ash is not Pearlette and thus not of Kansan age.

Brownfield Lake series

Inorganic carbonate samples from Ozark-Mahoney Lake #1, W side of road, Brownfield Lake basin, 15 mi SE of Brownfield, Terry County, Texas (33° 07' N Lat, 102° 07' W Long).

Tx-382. Brownfield Lake B-1 **29,370 ± 1400**
27,420 B.C.

At N end of Lake, beneath Tahoka Clay sec.

Tx-383. Brownfield Lake B-2 **15,900 ± 280**
13,950 B.C.

At N end of Lake; probably represents Vigo Park Interval.

Tx-384. Brownfield Lake B-3 **21,290 ± 500**
19,340 B.C.

From E side of Lake, beneath Tahoka Clay sec.

Tx-385. Brownfield Lake, F-1 **12,360 ± 380**
10,410 B.C.

At N end of Lake, from lower part of Zone 2, 6 ft below present surface, in Tahoka Clay sec.

General Comment: Tx-382 correlates with other dates on dolomites deposited during Rich Lake interpluvial. Tx-383 represents Vigo Park dolomite; somewhat young age results from greater size of Brownfield Lake. Tx-385 is from base of lacustrine sand, probably deposited during Blackwater Subpluvial.

Shafter Lake series

Inorganic carbonate from N side of Shafter Lake basin, just S of Highway, 8 mi NW of Andrews, Andrews County, Texas (32° 22' N Lat,

102° 43' W Long). Dated to determine relation of Shafter Lake dolomites to those found in more northern pluvial lake basins.

Tx-349. Shafter Lake SLU **13,890 ± 230**
11,940 B.C.

Tx-350. Shafter Lake SLL **15,240 ± 340**
13,290 B.C.

General Comment: stratigraphic position and couplet of carbonates suggest Vigo Park age, but both dates are somewhat too young. Contamination is suspected.

Tx-355. Silver Lake S 3-4 **12,170 ± 190**
10,220 B.C.

Inorganic carbonate from depth 3 to 4 ft, N edge of Silver Lake playa, 16 mi NE of Morton, Cochran, and Hockley Counties, Texas (33° 46' N Lat, 102° 39' W Long). Dated to determine possible age of carbonate wedge in Silver Lake. *Comment:* date indicates playa formed on ancient rather than Recent lacustrine debris. High water table has minimized deflation compared to other basins.

Tx-464. Lake Palomas, Chihuahua **27,150 ± 1060**
25,200 B.C.

Carbonate from base of La Mota abandoned shoreline, Lake Palomas basin, NW Chihuahua, Mexico, ca. 120 km SW of Juarez (31° 35' N Lat, 107° 15' W Long). Dated to determine age of shoreline and lacustrine sediments. *Comment:* surprisingly young date for high-level La Mota shoreline (elev. ca. 4000 ft). Probably correlates with early Bonneville-Sehoo shoreline formations of Nevada and Utah.

C. Oregon

Tx-487. Muir Creek, Oregon **6940 ± 120**
4990 B.C.

Charcoal found enclosed in pumice lapillistone believed to derive from major eruption of Mt. Mazama (Williams, 1942). From road cut on NW side Oregon Hwy 230, 200 m SW of Muir Creek bridge (43° 02' N Lat, 122° 22' W Long). Found at least 5 m below existing soil profile. Exposed thickness of lapillistone is ca. 8.5 m; overlain by 1 to 6 m of stratified and sorted pumiceous volcanic sandstone, on which is ca. 1 m of soil. This is same locality as sample C-247 (6453 ± 250; Libby, 1955, p. 118) which was also run as M-21 (6500 ± 500; Michigan I). Date from another locality relating to Mazama eruption is W-858 (6640 ± 250, USGS V). Present sample also dated by Gakushuin (GaK-1124, 7010 ± 120; L. Johnson, pers. commun.). Coll. 1965 by L. S. Cressman and L. R. Kittleman; subm. by Kittleman and L. Johnson, Jr., Univ. of Oregon, Eugene. *Comment* (L.J., Jr.): date is almost identical to GaK-1124 for same charcoal sample and agrees within 1σ with M-21. Tx-487 and GaK-1124 provide most reliable dates, so far, for major eruption of Mt. Mazama.

II. ARCHAEOLOGIC SAMPLES: CADDOAN AREA

The following samples are 1st of large series being run from Caddoan archaeological area in adjacent parts of Texas, Oklahoma, Arkansas, and Louisiana. Caddoan assemblages represent horticultural, village-dwelling peoples and are classed either as Gibson aspect, usually earlier, or Fulton aspect which extends into historic (post—A.D. 1600) period.

A. Oklahoma

Except as noted, samples coll. by D. G. Wyckoff, Oklahoma R. Basin Survey, and subm. by R. E. Bell, Dept. Anthropol., Univ. of Okla., Norman. Comments by Wyckoff.

Fine site series

Charcoal samples from Fine site (Sq-13), 4 mi S and 1.5 mi E of Vian, Sequoyah County, Oklahoma (35° 26' N Lat, 94° 57' W Long). Site has both late Gibson aspect and early Fulton aspect components. Coll. 1967.

500 ± 70

Tx-519. Fine site, House 1 **A.D. 1450**

From charred post in Trench I, House pattern 1, Sq. 0-N1, at depth 15 inches. Small rectangular structure, early Fulton aspect. *Comment:* date compatible with early Fulton aspect assignment.

840 ± 60

Tx-485. Fine site, Trench C **A.D. 1110**

Charred posts of incomplete structure in Trench C, S ½ of Sq. 0-W1. Late Gibson aspect. *Comment:* date seems early for late Gibson.

560 ± 90

Tx-479. Beaver site, House 3 **A.D. 1390**

Charcoal from Post 39, House 3, Beaver site (Mc-1), directly N of old Hochatown Bridge over Mountain Fork R., McCurtain County, SE Oklahoma (34° 12' N Lat, 94° 41' W. Long). Oval house pattern, believed assoc. with early Fulton aspect component. Coll. 1965. *Comment:* date compatible with early Fulton assignment. Agrees with Tx-488 from Bill Hughes site (below) which is similar archaeologically.

540 ± 60

Tx-488. Bill Hughes site, Feature 2 **A.D. 1410**

Charcoal from burned area (Feature 2) containing charred Fulton aspect pottery, Bill Hughes site (Mc-21), on ridge N of where Bee Creek enters flood plain of Mountain Fork R., McCurtain County, Oklahoma (34° 13' 50" N Lat, 94° 40' 50" W Long). From same feature, another sample was dated at 294 ± 170 (SM-887; R. E. Bell, pers. commun.) which is thought to be too recent. Coll. 1964. *Comment:* date agrees with early Fulton assignment better than SM-887. Agrees with Tx-479 from Beaver site (above), which is similar archaeologically.

Tx-486. Harvey site, Feature 5 **390 ± 60**
A.D. 1560

Charcoal from Feature 5 at Harvey site (Sq-18), 4 mi W and 5 mi S of Sallisaw, Oklahoma (35° 22' 45" N Lat, 94° 52' 10" W Long). Feature 5 is bell-shaped pit with artifacts of Ft. Coffee focus, late Fulton aspect. Coll. 1967. *Comment*: date agrees well with late Fulton assignment. Although it agrees within 1σ with Tx-519 from Fine site (this date list), it suggests, as does archaeological evidence, that Harvey is more recent than Fine.

Tx-489. Sheffield, Feature 4 **790 ± 200**
A.D. 1160

Charcoal, separated by flotation from fill dirt inside Feature 4, Sheffield site (Sq-22), 3 mi S and 2 mi W of Vian, Sequoyah County, Oklahoma (35° 27' N Lat, 95° 00' W Long). Feature 4 was circular house, early Ft. Coffee focus, early Fulton aspect. Should be earlier than Tx-486 (above). Large error quoted is due to small size of sample. Coll. 1966. *Comment*: even with large error, date seems too early. Archaeologic evidence suggests only slightly earlier time than Harvey site (Tx-486, above).

Tx-490. Baldwin site, Feature 1 **610 ± 70**
A.D. 1340

Charcoal from Feature 1, Baldwin site (Mc-84), S side Long Creek ¾ m SE of Ringgold, McCurtain County, Oklahoma, in Pine Creek Reservoir area (34° 12' 45" N Lat, 95° 06' 00" W Long). Feature 1 is trash pit with primarily shell-tempered pottery, believed part of Fulton aspect component. Coll. 1965 by Stephen Israel. *Comment*: date compatible with Fulton assignment.

Tx-493. Cat Smith, House 2 **770 ± 70**
A.D. 1180

Charred pole from W wall, House 2, Cat Smith site (Ms-52), 3 mi NW of Gore, Muskogee County, Oklahoma (35° 34' N Lat, 95° 10' W Long). House is affiliated with early Fulton aspect of Arkansas R. valley. Coll. 1966 by T. P. Barr. *Comment*: date seems early, but both Gibson and Fulton ceramics were found in what is believed to be single component. Perhaps date refers to growth period of wood rather than to occupation of site.

B. Louisiana

Belcher site series

Charcoal samples from remains of burned structures at Belcher site, ½ m E of Belcher, Caddo Parish, NW Louisiana (32° 44' N Lat, 93° 48' W Long). Site, described in detail by Webb (1959), covers 4 periods: Belcher I (earliest), late Gibson aspect, Alto-Haley materials; Belcher II, related to Bossier focus; Belcher III, fully-developed Belcher focus; Belcher IV, late Belcher focus. Present samples dated to check earlier

dating, as shown; further dating is planned. Coll. 1936-37 (except as noted) and subm. by C. H. Webb, 1560 Line Ave., Shreveport, La. 71101. Comments by C. H. W.

320 ± 70

Tx-476. Belcher, House 1 **A.D. 1630**

From House 1, Belcher IV component, latest prehistoric; no evidence of European contact. *Comment*: date quite feasible, since this is final occupation and some sherds approach Natchitoches (historic) materials in types and appearance.

320 ± 70

Tx-477. Belcher, House 2 **A.D. 1630**

From House 2, Belcher II component. See also Tx-473, below. *Comment*: House 2 underlies House 1 (Tx-476, above) and there are distinct pottery differences, hence date should be earlier. Cult material, Spiro-like, in burials originating from this level should be in 15th or 16th centuries.

280 ± 70

Tx-473. Belcher, House 7 **A.D. 1670**

From House 7, on primary mound level overlying House 8 (Tx-474, below). Early Belcher III; should be close to same age as House 2 (Tx-477, above). From same house came samples Tx-142, 555 ± 80 (Texas III), and O-322, 200 ± 100 (Webb, 1959, p. 207) which is too recent. Coll. 1953-4. *Comment*: date tending later than Tx-476 (above) for House 1, is inconsistent with stratigraphy. Culturally should be, like House 2, in 15th or 16th century.

640 ± 50

Tx-472. Belcher, House 4 **A.D. 1310**

From House 4, sub-mound, Belcher I period; earliest house stratigraphically and stylistically. From same house came sample O-320, 1100 ± 100 (Webb, 1959, p. 207) which was thought to be 200-300 yr too early. Present sample should be same age as Tx-474 (below). *Comment*: consistent with other dates reported here in that it should be earliest. May represent true age but 100-200 yr earlier would seem more consistent with archaeological evidence.

360 ± 70

Tx-474. Belcher, House 8 **A.D. 1590**

From House 8, pre-mound, late Belcher I period; should be approx. same age as, or slightly later than, Tx-472 (above). Coll. 1953-4. *Comment*: consistent in that house should date later than House 4 (Tx-472) and earlier than House 7 (Tx-473), which it underlies. Should be nearer House 4 date.

2190 ± 120

Tx-480. McKinney mound, A **240 B.C.**

From Ralph McKinney mound, 2 mi NW of Hosston, Caddo Parish, Louisiana, on Black Bayou Lake ($32^{\circ} 53' N$ Lat, $93^{\circ} 54' W$ Long).

Sample is charcoal scattered in fill of deeper levels of single-unit, unstratified mound, 2 to 5 ft below plowed surface. Nearby in mound and believed to be contemporaneous were cremations assignable to Bellevue focus (Fulton and Webb, 1953); should equate in time with Marksville. Part of present sample was dated by Humble at 800 ± 105 (0-1134, Webb, pers. commun.); archaeologic evidence indicates Humble date is too recent. Coll. 1958-9 by R. McKinney; subm. by C. H. Webb. *Comment*: date may approximate actual age, but is earlier than anticipated. Bellevue focus seems to be on Marksville time level, but since McKinney mound had copper and stone beads, not found at other Bellevue sites, it may be somewhat earlier than other Bellevue.

C. Texas

Resch site series

Fragments of charred nuts from fill of Resch site (41 HS 16), on Potter's Creek 12 mi S of Marshall, Harrison County, Texas ($32^{\circ} 24'$ N Lat, $94^{\circ} 15'$ W Long). Unstratified site excavated in 5 ft squares and 0.5 ft levels; thus, Level 4 is 1.5 to 2 ft below surface. Levels 1 and 2, almost sterile; Levels 3 and 4, some arrow points, Gibson aspect and Coles Creek sherds, mostly dart points and heavy bone and clay-tempered sherds; Level 5, bone-, clay-, and sand-tempered sherds, a few Caddoan and several Marksville sherds, mostly dart points, hence seems mixed; Level 6, like Level 5 but rare Caddoan and Coles Creek, more frequent Marksville and Tchefuncte, many fire stones, heaviest occupation; Levels 7 and 8, mostly sand-tempered sherds, grooved axes, dart points, rare Tchefuncte or Marksville sherds. Each sample made up of materials from several squares, in most cases adjacent squares close to origin of grid. Coll. 1965-6 by Forrest Murphey; subm. by C. H. Webb. Comments by Webb.

Tx-482. Resch, Levels 3 and 4

**2250 ± 140
300 B.C.**

Comment: date earlier than expected.

Tx-484. Resch, Level 5

**2360 ± 130
407 B.C.**

Comment: earlier than anticipated from this level, which should not date before Marksville times.

Tx-481. Resch, Level 6

**2150 ± 100
200 B.C.**

Comment: date consistent with occurrence of Tchefuncte sherds on this level, but by stratigraphy should be earlier than Tx-482 and Tx-484.

Tx-483. Resch, Levels 7 and 8

**1850 ± 90
A.D. 100**

Comment: too recent in view of dates from higher levels and indications of pre-Tchefuncte or Tchefuncte time range.

General Comment: dates are generally satisfactory in that major occupation is on Tchefuncte and Marksville time level, judging from trade sherds. Vagaries in distribution of sherds and of charred nut hulls from which dates were obtained are explainable by aboriginal churning of light sand midden and subsequent heavy gopher disturbance.

Coral Snake series

Charcoal from in and beneath primary fill of Coral Snake mound (16 SA 48), 2 mi E of Pendleton Crossing of Sabine R., Sabine Parish, Louisiana, in Toledo Bend Reservoir basin (31° 38' N Lat, 93° 42' W Long). Artifacts in primary fill included Marksville, Marksville-like, and Tchefuncte materials; later secondary fill had Caddoan sherds. Previous date, presumed to be from primary fill, is Tx-265, 1650 ± 90 (Texas IV). Coll. and subm. by H. P. Jensen, Jr., S Methodist Univ., Dallas, Texas.

1970 ± 100

Tx-442. Coral Snake 28 **20 B.C.**

At base of primary mound, assoc. with Marksville Stamped sherd and trapezoidal copper pendant; N496.7/E500.5, elev. 95.75 ft.

1770 ± 80

Tx-443. Coral Snake 36 **A.D. 180**

Within primary mound fill; no direct assoc. N494/E505, elev. 98 ft.

3210 ± 210

Tx-444. Coral Snake 112 **1260 B.C.**

From Feature 45, fire basin; N498/E487, elev. 94.3 to 93.5 ft, 2 ft W of westernmost extension of sub-floor pit at mound base, ca. 1 ft below original ground surface. Believed to be placed in prepared area before construction started.

General Comment (H.P.J., Jr.): Tx-442 agrees well with accepted dates for Marksville. However, Tx-443 is midway between Tx-442 and Tx-265 and agrees with both within 1σ. We thus remain uncertain as to date of primary mound construction. Since Tx-265, -442, -443 are in proper sequence with respect to relative elevation, perhaps mound was built over several centuries. Tx-444 is far too early for assoc. with mound construction; probably dates previous Archaic occupation.

III. OTHER ARCHAEOLOGIC SAMPLES

A. Texas

Ingleside Cove series, Gulf Coast

Charcoal and scallop shells (*Aequipecten irradians*) from Ingleside Cove site (41 SP 43), shell midden on NE shore of Ingleside Cove, Corpus Christi Bay 2.3 mi SSW of Ingleside, Texas (27° 50' N Lat, 97° 13' W Long). Midden buried in upper 2.0 to 2.5 ft of bluff; lower zone (Zone 2b) has preceramic, Late Archaic remains; upper zones (2c, 2d) have Rockport focus materials. Samples dated are from Late Archaic

occupation. Each sample was split into 2 parts which were prepared and counted separately; dates are averages. Coll. 1967 and subm. by Dee Ann Story, Dept. of Anthropol., Univ. of Texas at Austin.

Tx-520. Ingleside Cove 118 **780 ± 40**
A.D. 1170

Charcoal from Feature 4, small hearth, Sq. N100/W120, 2.0 to 2.5 ft below surface; lower Zone 2b.

Tx-521. Ingleside Cove 162 **820 ± 50**
A.D. 1130

Shell from near Feature 4 (Tx-520, above); should be approx. same age. Sq. N100/W120, 2.0 to 2.5 ft deep; lower Zone 2b.

Tx-522. Ingleside Cove 171 **710 ± 40**
A.D. 1240

Shell, upper Zone 2b; N122.5/W123, 1.6 to 1.9 ft below surface. Should be approx. same age as Tx-523 (below).

Tx-523. Ingleside Cove 178 **820 ± 50**
A.D. 1130

Shells from edge of Feature 7, hearth at contact between Zones 2b and 2c. N98.5/128, 0.9 ft below surface. Should be approx. same age as Tx-522 (above).

General Comments (D.A.S.): no previous C¹⁴ ages from central Texas coast are available for comparison, but present dates are internally consistent and may well accurately reflect lateness of Archaic occupation in this area as well as rapid rate of midden accumulation. (S.V., Jr.): shell agrees with charcoal, but since only 1 charcoal sample is involved, more work is needed before validity of shell dates in this environment is certain.

Greenhaw series, Edwards Plateau

Samples of carbon-stained earth from Midden F at Greenhaw site (41 HY 29), at junction of Cottonwood and Little Bear Creeks 7.5 mi W of Buda, Hayes County, Texas (30° 07' N Lat, 97° 57' W Long). This is burned rock midden site. Midden F contained dart points of types Pedernales, Bulverde, and some others; typologically Middle Archaic. Samples coll. to study techniques of obtaining dates from carbon-bearing earth. Coll. 1965, 1967 and subm. by Frank A. Weir, Dept. Anthropol., Univ. of Texas at Austin.

Tx-360. Greenhaw c-1 **800 ± 110**
A.D. 1150

From Sq. S160/W400, 0.5 to 1.0 ft level; directly assoc. with stem of Pedernales point. Sample prepared for submission to lab by bathing in 20% HCl, washing and centrifuging in distilled water; whole procedure carried out 3 times, then repeated with bath of HF.

2850 ± 90
900 B.C.

Tx-451. Greenhaw 274

From Sq. S151/W425, 3.0 to 3.5 ft level. Near Pedernales point and corner-notched point. Sample treated in lab as follows: minute charcoal particles recovered by repeated flotation in distilled H₂O and passage through 100 mesh U. S. Std. screen. Intrusive carbonates removed by HCl bath. HCl removed by repeated bathing in distilled H₂O, settling, decanting supernatant. Sample then dried and burned.

2650 ± 80
700 B.C.

Tx-453. Greenhaw 272

From Sq. S151/W420, 1.5 to 2.0 ft level. Pretreated as Tx-451. Should be younger than Tx-451, older than Tx-360.

2900 ± 100
950 B.C.

Tx-465. Greenhaw 264

From Sq. S160/W400, 1.25 to 1.50 ft level. Pretreated as Tx-451. Pedernales and Bulverde points were in this level.

General Comments (F.A.W.): by all current estimates of age of central Texas Middle Archaic, Tx-360 is at least 1500 yr too young. Probable explanation is downward movement of modern charcoal (from burning brush and stumps on midden), especially via soil cracks as much as 1 ft deep which form in dry seasons. Other 3 dates, from deeper in midden, are younger than expected for Middle Archaic and are possibly affected by humic acid saturation; however, expectations were based only on guesses. (S.V., Jr.): wide discrepancy between Tx-360 and other dates would not be due to different pretreatment or variable degree of humic acid contamination; therefore, contamination by modern charcoal is most likely explanation.

Dunlap Midden 1 series, Edwards Plateau

Charcoal samples from fill of Midden 1 at Dunlap site complex (41 CX 5), approx. 8 mi E of Pecos R. and 2.5 mi N of U. S. Hwy. 290, on Old Spanish Trail (30° 43' N Lat, 101° 36' W Long). Midden 1 was burned-rock midden containing slab-lined basins presumed to be pits for roasting sotol. Enser dart points and arrow points were found in midden but not in direct assoc. with basins. Samples occurred as small fragments of charcoal in fill between and under slabs of basins. Coll. 1966 by C. A. Calhoun, E. M. Davis *et al.*, Texas Archeol. Soc.; subm. by Davis.

670 ± 80
A.D. 1280

Tx-351. Dunlap A

From fill between 2 superimposed slab-lined basins, Feature 2.

940 ± 120
A.D. 1010

Tx-310. Dunlap B

From among rocks in NW ¼ of Feature 1, large slab-lined basin.

Tx-357. Dunlap C **630 ± 90**
A.D. 1320

From among stones in another part of Feature 1 (see Tx-310, above); should be same age.

Tx-359. Dunlap D **570 ± 100**
A.D. 1380

From between lining slabs of 2 superimposed basins of Feature 2 (see Tx-351, above); should be same age.

Tx-358. Dunlap E **540 ± 80**
A.D. 1410

From dark stratum just above NE rim of Feature 1 (see Tx-310, -357, above).

General Comment (E.M.D.): no significant differences among dates except for Tx-310 which is early (although consistent within 2σ). Midden I apparently dates from ca. 14th century.

Devil's Mouth series, Amistad Reservoir

Charcoal samples from Devil's Mouth site (41 VV 188), stratified river terrace site at confluence of Devil's R. and Rio Grande, ca. 1 mi above Amistad Dam, Val Verde County, Texas (29° 27' N Lat, 100° 03' W Long). Initial excavation of site reported by Johnson (1964); present samples from more recent work. Coll. 1967 by W. M. Sorrow; subm. by J. R. Ambler, Texas Archeol. Salvage Project, Univ. of Texas at Austin.

Tx-525. Devil's Mouth 708, Zone O **4900 ± 100**
2950 B.C.

From Pit 10, Bench 1, Level 4, Zone O, Feature 3. In Zone O were several points called "Early Barbed" by Johnson (1964, p. 33); therefore, should be similar in age to Tx-314 (7430 ± 240, Texas V) for "Early Barbed" points at nearby Devil's Rock-shelter. *Comments* (W.M.S. and S.V., Jr.): much later than Tx-314. Sample, charcoal flecks in silt, so small that after picking over and pretreatment, whole sample (charcoal and silt) was burned. No evidence of redeposition or intrusion in field, and everything satisfactory in laboratory; thus, no field or lab explanation for lateness of date. Archaeologically, "Early Barbed" point category includes such wide range of forms that long time span could be represented; note Tx-313 (5360 ± 170, Texas V) for "Early Barbed" date closer to present date. Obviously, more dates needed.

Tx-526. Devil's Mouth 707-822, Zone P **8780 ± 310**
6830 B.C.

Combined sample from Zone P: #707 from backhoe profile, W side Unit 15; #822 from Unit 13, upper 1/2 ft of zone. Zone P is stratum of limestone gravels (above Johnson's "Upper Gravels") containing expanding-stem points like those called "Paleo-Indian" by Johnson (1964, Figs. 17, L, and 18, A). Possibly earliest occupation zone at site. *Comment* (W.M.S.): date compatible with possibility of late Paleo-Indian time.

B. Midden Sites, W Texas and New Mexico

The following are charcoal samples from midden circles and similar sites in W Texas and S New Mexico, coll. as part of continuing study of this type of site. Coll. 1965 and subm. by J. W. Greer, Dept. of Anthropol., Univ. of Texas at Austin, via E. M. Davis. Comments by J. W. G.

Tx-361. Cammack Sotol Pit, B **610 ± 80**
A.D. 1340

Charcoal from Cammack Sotol Pit (41 VV 260; Greer's site Tx-14), W bank of tributary of Cow Creek, 2 mi SE of Comstock, Val Verde County, Texas (29° 39' N Lat, 101° 10' W Long). Combined sample from all units of Trench III, 1 to 2 ft below surface. Should date early Neo-Indian occupation with predominantly expanding-stem and contracting-stem arrow points (Livermore and Perdiz types). Probably equivalent to Livermore focus. Another sample from this site previously dated at 625 ± 185 (Tx-227, Texas IV). *Comment:* agrees with previous date from site and is nearly identical with original estimate.

Tx-362. Hodge site **710 ± 80**
A.D. 1240

Charcoal from Hodge site (41 VV 247; Greer's site Tx-21), SE bank of small tributary of Big Fielder canyon, 12 mi W of Pecos R., ca. 16 mi WSW of Pandale, Val Verde County, Texas (30° 08' N Lat, 101° 42' W Long). From lower half of deposit in ashy soil of central depression; 1.5 to 2.5 ft below surface in Units 5, 6, 7. Assoc. artifacts indicate middle Late Archaic, late Montell-Marshall, or early Ensor-Frio. *Comments:* more recent than expected; much later than Tx-291 (2560 ± 100, Texas V) from Felton Cave, 50 mi NE of here, which probably represents approx. same cultural period. (E.M.D.): dates from Arenosa Shelter 30 mi SSE of here (Tx-284-286, 311, Texas V) indicate ca. 1850–2600 B.P. for Montell-to-Ensor time, so that Felton Cave date seems more nearly correct than Hodge site date.

Pow Wow site series

Samples from Pow Wow site (Greer's site Tx-2), just N of Pow Wow Arroyo, 27 mi E of El Paso, Texas (31° 51' N Lat, 106° 02' W Long); center of Midden 1 (Unit 4), from 0.3 ft below surface to underlying sterile caliche. Pottery seems to indicate early Jornada branch, Mogollon.

Tx-363. Pow Wow, A **960 ± 80**
A.D. 990

Tx-364. Pow Wow, B **1110 ± 60**
A.D. 840

General Comment: dates should be identical; average agrees with Lehmer's estimate of ca. A.D. 900 for beginning of Jornada branch (Lehmer, 1948).

Tx-365. Carlsbad A-07 **780 ± 90**
A.D. 1170

Charcoal from Site A-07 (Greer's NM-1) in Carlsbad Caverns Nat. Park, New Mexico; at head of Oak Springs Canyon and Bat Cave Draw (32° 11' N Lat, 104° 27' W Long). From Midden 2, central depression, Unit 4; combined sample from entire unit, from surface to bedrock. Pottery suggests possibly early Jornada branch, possibly late "Guadalupe Basket Maker." *Comment:* agrees with previous age estimates for pottery types found here (Lehmer, 1948).

Tx-366. Carlsbad A-23 **620 ± 80**
A.D. 1330

Charcoal from Site A-23 (Greer's NM-2) in Carlsbad Caverns Nat. Park, New Mexico, on ridge-top S of tributaries to Walnut Canyon and W of Bat Cave Draw (32° 10' N Lat, 104° 28' W Long). From central depression, Midden 2, Units 4 and 35, combined sample from surface to bedrock. Chupadero Black-on-White sherds were found in excavation; on surface of neighboring midden (site A-22) were sherds of Chupadero Black-on-White, El Paso Brown, and Lincoln Polychrome. Probably late Jornada branch, phase unknown. *Comment:* agrees with previous estimates for pottery types represented here (Lehmer, 1948).

Carlsbad A-59 series

Charcoal samples from middens at Site A-59 (Greer's NM-82) in Carlsbad Caverns Nat. Park, N side of mouth of Slaughter Canyon (32° 06' N Lat, 104° 34' W Long). Pottery indicates site probably relates to El Paso phase of Jornada branch, but might relate to Mesilla and Dona Ana phases.

Tx-367. Carlsbad A-59, A **790 ± 80**
A.D. 1160

From central depression of Midden 3; Excavation Unit 1, 1.9 to 2.9 ft below surface.

Tx-368. Carlsbad A-59, B **850 ± 100**
A.D. 1100

Same provenience as Tx-367 (above), 2.9 ft below surface to bedrock.

Tx-369. Carlsbad A-59, C **510 ± 80**
A.D. 1440

From central depression of Midden 5, Excavation Unit 2, 0.3 ft below surface to bedrock.

Tx-370. Carlsbad A-59, D **460 ± 90**
A.D. 1490

From central depression of Midden 5, Excavation Unit 1, 0.3' below surface to bedrock.

General Comment: dates from Midden 3 are slightly earlier than expected, since it was assumed close in time to Midden 5. All dates agree with previous estimates of age of pottery types represented here (Lehmer, 1948).

*C. Mexico***Tx-441. Huipilli precolombino** **660 ± 80**
A.D. 1290

Fragment of woven cotton garment from Mexico, believed pre-columbian. Purchased from native collector; original provenience unknown; possibly Chilapa, Guerrero (Johnson and Franco, 1967). Dated in hope of validating precolumbian age. Subm. by Donald Cordry, Austin, Texas. *Comment* (D.C.): date validates precolumbian age.

*D. Sudan***Atbara River series**

Charcoal from 2 late Neolithic sites near Atbara R., Sudan. Coll. 1967 and subm. by J. L. Shiner, S. Methodist Univ., Dallas, Texas.

Tx-445. Small Butana, A **4410 ± 90**
2460 B.C.

From Small Butana site (N-125), 65 m E of Atbara R. channel, 2.2 km N of Butana bridge, near Khashm el Girba (15° 06' N Lat, 35° 58' E Long). Top center of mound, 30 cm below surface. Previously unknown archaeological complex: chipped and flaked stone, animal bones, ceramics with incised designs, seemingly later than those of Tx-446; may be ancestral to Iron age Jebel Moya.

Tx-446. Sudan N-120, A **3050 ± 90**
1100 B.C.

From Site N-120, 10 mi E of Atbara R., 2500 ft S of RR from Khashm el Girba to Kassala (15° 04' N Lat, 36° 01' E Long). SE quarter of site, 1 to 1.3 m below surface. Hitherto unknown industry now named Hagiz; incised ceramics and microliths; thought to be late Neolithic. Should be earlier than Tx-445.

General Comment (J.L.S.): expected sequence reversed by unexpectedly early date for Tx-445. If this date approx. true age, it suggests even earlier Neolithic in this area, which would not be derived from Egypt.

REFERENCES

- Date lists:
- | | |
|------------|-------------------------------|
| Michigan I | Crane, 1956 |
| Texas III | Pearson <i>et al.</i> , 1965 |
| Texas IV | Pearson <i>et al.</i> , 1966 |
| Texas V | Valastro <i>et al.</i> , 1967 |
| USGS V | Rubin and Alexander, 1960 |
- Crane, H. R., 1956, University of Michigan radiocarbon dates I: *Science*, v. 124, p. 664-672.
- Fulton, R. L. and Webb, C. H., 1953, The Bellevue Mound: *Texas Archeol. Soc. Bull.*, v. 24, p. 18-24.
- Ingerson, Earl, and Pearson, F. J., Jr., 1964, Estimation of age and rate of motion of ground water by the carbon-14 method, *in*: Koyama, Tadashiro (ed.), *Mazuren, Toyko, Recent researches in the fields of hydrosphere, atmosphere, and nuclear geochemistry*, p. 263-283.
- John, LeRoy, Jr., 1964, The Devil's Mouth site: Dept. of Anthropol., Univ. of Texas, *Archeol. Ser.* no. 6.

- Johnson, I. W. and Franco, J. L., 1967, Un huipilli precolombino de Chilapa, Guerrero: *Revista Mexicana de Estudios Antropológicos*, v. 21, p. 149-189.
- Lehmer, D. J., 1948, The Jornada Branch of the Mogollon: *Univ. of Arizona Bull.* no. 17.
- Libby, W. F., 1955: *Radiocarbon Dating*, 2nd ed., Chicago, Ill., Univ. Chicago Press.
- Pearson, F. J., Jr., Davis, E. M., and Tamers, M. A., 1966, University of Texas radiocarbon dates IV: *Radiocarbon*, v. 8, p. 453-466.
- Pearson, F. J., Jr., Davis, E. M., Tamers, M. A., and Johnstone, R. W., 1965, University of Texas radiocarbon dates III: *Radiocarbon*, v. 7, p. 296-314.
- Rubin, Meyer and Alexander, Corrinne, 1960, U. S. Geological Survey radiocarbon dates V: *Am. Jour. Sci. Radiocarbon Suppl.*, v. 2, p. 129-185.
- Valastro, S., Jr., Pearson, F. J., and Davis, E. M., 1967, University of Texas Radiocarbon Dates V: *Radiocarbon*, v. 9, p. 439-453.
- Webb, C. H., 1959, The Belcher Mound: *Soc. Am. Archaeol., Mem.*, no. 16.
- Williams, Howel, 1942, The geology of Crater Lake National Park, Oregon: *Carnegie Inst. Washington Pub.* 540, p. 162.