Radiocarbon Dates from a Tomb in Mexico

Abstract. *The first series of radiocarbon dates to be obtained from a deep shaft-and-chamber tomb of the type restricted in Mesoamerica to parts of Nayarit, Jalisco, and Colima in western Mexico ranges from 2230 ± 100 years to 1710 ± 80 years. Examination of the evidence indicates that for the present a date equivalent to A.D. 250 should be accepted for at least one phase, possibly a late phase, of the shaft tomb culture and for the hollow, polychrome figurines associated with the tombs.*

The absence of absolute or reliable relative dates for the Nayarit-Jalisco-Colima deep shaft tombs and the burial offerings associated with them has long presented a major problem in West Mexican archeology. Thousands of tomb figurines, in a variety of sizes and styles, are found in museums and private collections throughout the world, but all have been obtained as the result of illegal excavation, without benefit of scientific control, and generally with little or no evidence as to provenance or association. While a typological seriation on the basis of style, modeling technique, surface texture, and perhaps even posture and gesture, may be attempted and should lead to fruitful results in establishing local chronological sequences, the overall tomb-figurine complex of western Mexico is so distinctive as to make it difficult to relate most of the styles clearly and satisfactorily to any other tradition in Mesoamerica.

Estimates for the date of this complex have ranged from several centuries B.C. to the 13th century A.D. Although Kelly (*1*) tentatively ascribed the construction of multichambered shaft tombs to a period corresponding to Teotihuacan III, somewhere between A.D. 300 and 600, more recent literature suggests a hypothetical time span of nearly a millenium, from A.D. 300 to 1250, for figurines of presumably deep shaft tomb origin from Jalisco and Nayarit (*2*).

A series of carbon-14 dates has now been obtained (*3*) which should serve to place West Mexican shaft tombs and figurines of specific styles more firmly and realistically within the context of the overall history of Mesoamerican culture and which should reduce or eliminate the need for speculative dating. The material dated consists of shell artifacts (shells altered by human hand) from a well-furnished deep shaft tomb discovered near Etzatlán, Jalisco. The ages yielded by the shells are, respectively: 2090 ± 100 years (UCLA-593A) (*3*), 2230 ± 100 years (UCLA-593B), and 1710 ± 80 years (UCLA-593C) (*4*). These are the first radiocarbon dates to be obtained from organic material found in any of the West Mexican single- or multichambered shaft tombs or in association with specific figurine types (see Fig. 1).

Fig. 1. Two West Mexican tomb figurines of the Etzatlán-Magdalena, Jalisco style. The figures formed part of the burial furniture in a single-chambered deep shaft tomb found near Etzatlán, Jalisco, with associated sea shell artifacts estimated by radiocarbon dating to be 1710 ± 80 years old. Left, 38.5 cm high; right, 46 cm high.

The discrepancy among the three dates, giving a range of over 500 years for artifacts found in association with the same tomb, may be explained as follows. The tomb consists of a large, single, vaulted burial chamber, which is reached by a vertical, rectangular shaft, 4.6 m in depth. The burial chamber, reported to contain about a dozen individuals, nine of them in the form of articulated skeletons, was discovered accidentally on the property of the Hacienda de San Sebastian, Municipio de Etzatlán (20°40′N; 104°00′W). The same hacienda is also the location of the hill of El Arenal, where several multichambered tombs reached by shafts of varying depths, one of them measuring 16 m, have been found in the past (*5*). The contents of the latest tomb—including 17 hollow polychrome ceramic male and female figurines ranging in height from 27 cm to 52 cm, 40 polychrome dishes and bowls, several ceramic boxes with covers, assorted large and small shell and obsidian ornaments such as "mirrors," shell trumpets, and other artifacts—were purchased at the site by a private individual and later presented to the Los Angeles County Museum as a gift, for study and exhibition. Although the actual excavation was carried out without scientific control, the site itself and the circumstances of excavation were carefully investigated shortly thereafter by a competent field archeologist (*6*) whose observations and measurements left little doubt as to the authenticity of the reported association of the collected material. Additional material of no artistic but great scientific value, including small artifacts, shells, and considerable quantities of human bone, were also recovered at the time of the investigation.

A large conch shell trumpet (UCLA-593A) and a smaller shell ornament (UCLA-593B), part of the original grave lot, were dated by their radiocarbon content in 1963 (*7*), when the two earlier dates, equivalent to approximately 127 and 267 B.C. (± 100 years), respectively, were obtained. The dating method used was that described by Berger, Horney, and Libby (*8*). Because of its small size, sample

UCLA-593B was destroyed during the dating procedure, but sample UCLA-593A remained substantially intact, a triangular section of sufficient size and weight having been removed for testing from the underside of the shell, opposite the inner lip. While the early dates of the two samples came as a surprise, it was thought that the discrepancy between them might be attributable to the repeated use of the tomb over several generations, an explanation suggested by the large number of skeletons and piles of unarticulated bones found in the chamber. There is also the possibility, however, that several persons were killed to accompany the main occupant, or occupants, of the tomb.

The discrepancy between the early dates thus appeared to require further investigation. In the summer of 1964, while on a field trip in Mexico, I examined several conch shell trumpets found in West Mexican grave sites, including a large specimen from the region of Sayula, Jalisco, and a smaller one found near Comala, Colima. The large specimen was identified as *Strombus gigas* Linné, popularly known as the Queen conch, a fairly common shell native to the Caribbean, with a range including Southeast Florida, the West Indies, and Bermuda; the small specimen was identified as *Xancus angulatus* Solander, the West Indian chank, also a Caribbean shell with a range including the Bahamas, Key West, Cuba, Yucatan, and Bermuda (*9*). Neither species is native to the western American coast, indicating pre-Columbian cross-continental trade in conch shells or shell trumpets at a time equivalent to the late pre-Classic (*10*).

Because of the possibility that such movement of shells from the eastern coast might account for the surprisingly early dates registered by the two shell artifacts from the Etzatlán tomb, the remaining sample, UCLA-593A, and other artifactual and nonartifactual shell material from the same tomb were submitted to the Los Angeles County Museum for determination of species, genus, and native range (*11*). The large conch shell, sample UCLA-593A, was identified as *Strombus gigas* Linné, and therefore from the Caribbean; another, considerably smaller, shell trumpet turned out to be a *Xancus angulatus* Solander, again a Caribbean shell. The other shells, with one possible exception (*12*), were, however, positively identified as West Coast species, with a general range including the Gulf of California to Peru.

Because of the possibility of a considerable time lag between the harvesting of the *Strombus gigas* in the Caribbean and its eventual arrival and final burial in Jalisco, it was now deemed advisable to date a third shell (UCLA-593C) from the Etzatlán tomb, a shell unquestionably of West Coast origin. The shell selected was a small *Murex nigritus* Philippi, native to the Jalisco coast, with a range extending as far north as the Gulf of California and as far south as the north coast of Peru, and measuring 92 mm in length and 60 mm in height. This sample was dated several times to assure greatest possible accuracy. The final count, made 9 December 1964, yielded, with corrections, a date equivalent to approximately A.D. 254 $\pm$ 80. This age was computed on the basis of the surface ocean water in the region concerned having an initial C^{14} concentration of approximately -1 percent (or being -80 years) with respect to 0.95 percent of the National Bureau of Standards' oxalic acid radiocarbon standard (*13*).

It is hoped that some of the skeletal material from the tomb will soon be subjected to radiocarbon analysis in order to obtain another check on the present computations made from seashell artifacts (*8*). Pending additional radiocarbon dating, however, it is suggested that the present results be tentatively accepted as valid and a date of approximately A.D. 250 be assigned to at least one phase, possibly a late phase, of the Jalisco-Nayarit-Colima deep shaft-and-chamber tomb complex, and therefore to the large, hollow, polychrome figurines of the Ameca-Zacoalco or Etzatlán-Magdalena (Jalisco) and Ixtlán (Nayarit) types. Although the radiocarbon dates given here were obtained from samples from a Jalisco tomb, the Ixtlán area may be inferentially included, both because of the similarity of tomb architecture and because several figurines of a typically Ixtlán style were among the burial furniture in the Etzatlán tomb.

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References and Notes

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2. F. Gamboa, *Masterworks of Mexican Art,* Los Angeles County Museum of Art, 32–63 (1963).
3. Dates obtained by the Radiocarbon Dating Laboratory, Univ. of California, Los Angeles. Numbers following the abbreviation UCLA indicate the number of the sample at the Radiocarbon Dating Laboratory.
4. R. Berger, G. J. Fergusson, W. F. Libby, *Radiocarbon Dates 4* (Univ. of California, Los Angeles, 1965).
5. J. C. Nuñez, "Tumba de el Arenal, Etzatlán, Jal.," in *Informes Inst. Nac. Antropol. Hist., Mexico* **3**, 1 (1955). A plan of the tomb may also be found in M. Covarrubias, *Indian Art of Mexico and Central America* (Knopf, New York, 1957), p. 89.
6. S. Long, Department of Anthropology, Univ. of California, Los Angeles, private communication (1964).
7. G. J. Fergusson, Radiocarbon Dating Laboratory, Univ. of California, Los Angeles, private communication (1963).
8. R. Berger, A. G. Horney, W. F. Libby, *Science* **144**, 999 (1964).
9. James McLean, Curator of Invertebrate Zoology, Los Angeles County Museum (1964).
10. A more detailed discussion of this problem will be published by the Los Angeles County Museum in its *Contributions to Science* series early in 1965.
11. The cooperation of Charles Rozaire, Curator of Archaeology, Los Angeles County Museum, in selecting and making sampling materials available for radiocarbon dating is gratefully acknowledged.
12. One shell was tentatively identified as *Strombus gracilior* Sowerby, native to the West Coast. However, a similar shell, *Strombus pugilis,* exists in the Caribbean. The condition of this artifact made specific identification impossible.
13. R. Berger, Radiocarbon Dating Laboratory, Univ. of California, Los Angeles, private communication (1964).

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Polypeptide Chains of Antibody: Effective Binding Sites Require Specificity in Combination

Abstract. *Separated chains from antibody of different rabbits do not always give effective binding sites although combination of the chains does occur. There is a specificity of combination such that only chains from the same (or perhaps a related) rabbit form effective binding sites. There appears to be preferential combination between those chains which yield effective sites.*

Separated heavy (H) and light (L) polypeptide chains from a preparation of reduced and alkylated specific antibody have little antigen-binding activity, but activity can be largely restored by mixing the chains (*1, 2*). Restoration of activity is associated with a physical combination of H- and L-chains that results in a unit similar to native antibody, as demonstrated by radioimmunoelectrophoresis and ultracentrifugation (*2*) or by passage through Sephadex columns (*3*). There is a concomitant reformation of the antigen-binding region. Disulfide bonds do not participate in the combination since the sulfhydryl groups are alkylated.

Physical combination of L- or H-chains from normal γ-globulin with the complementary chains from antibody γ-globulin resulted in hybrids possessing little antibody activity. Apparently the