# Chronology and Stratigraphy at La Quemada, Zacatecas, Mexico

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*La Quemada* (A.C. *500–900) is a key site for understanding the processes involved in fluctuations of the northern frontier of Mesoamerica. Archaeologists have constructed scenarios about its founders and political relationships in the absence of adequate information about dating. This paper summarizes the historical and theoretical issues that hinge on the dating of La Quemada, reports the stratigraphic contexts of 39 radiocarbon samples obtained in recent excavation, and provides quantitative and qualitative evaluation of the available chronometric data from the site and its satellites. These data allow the testing of growth models at several scales. La Quemada's growth occurred during the Epiclassic period, which was one of decline in the core area of central Mexico. This chronological information clarifies the challenge to archaeologists who might wish to explain the pattern of a growing periphery and declining core, and it also underscores the need for more data from satellite sites to understand the organization and development of the local system.*

## Introduction

La Quemada (FIG. 1), located in the Malpaso Valley of central Mexico, is one of several large settlements comprising the northern frontier of Mesoamerica. It is a ceremonial center made up of artificial terraces, platforms, staircases, causeways, ball courts, sunken patios, temples, and residential complexes, most of which are enclosed within a series of imposing cliffs and massive masonry walls (FIG. 2). The site overlooks the Malpaso Valley (FIG. 3), a locality dotted with villages that were connected to one another, as well as to La Quemada, by an ancient road system. Because of its visual dominance and physical connections to other settlements, as well as the fact that La Quemada is much larger than any other settlement in the valley, the other sites are assumed to have been political subordinates and are referred to in this paper as "outliers" or "satellites." Prehispanic occupants of the Malpaso Valley may have used the roads in ritual processions, footraces, or military activities that centered on La Quemada. Disarticulated human skeletons are a common occurrence at the site, probably as a result of regular sacrificial rites.

Humans were present in the northern Mesoamerican frontier by ca. 9500 B.C., as suggested by the finding of a Clovis projectile point in the Huichol region southwest of La Quemada (Weigand 1977). Yet sedentism began no earlier than A.C. 200–400, more than a millennium later than in the Mesoamerican heartland. Maximal incorporation into the Mesoamerican tradition probably occurred approximately A.C. 600–900 during the period sometimes called the Epiclassic (TABLE 1). Elaborate writing and calendrical systems such as those found farther south apparently did not develop in this region, but the presence of Mesoamerican ideology is expressed in elements of architecture, ceramic decorative techniques and iconography, sacrificial practices, and the ball game.

As one of the principal settlements in the frontier region, La Quemada offers an excellent vantage point from which to investigate the processes involved in the expansion and contraction of the frontier. Yet, though archaeologists have offered various interpretations of the site and its relationship to the wider region, they have conducted relatively little fieldwork at La Quemada. Working from surface data, archaeologists attributed the occupation of the site to such diverse groups as the Mexica (Batres 1903: 22–24; Clavigero 1979 [1787]: 112–117), Tarascans (Batres 1903: 40; Noguera 1930: 68–71), and Toltecs (Weigand 1977: 23–26, Weigand 1982: 91). A project directed by Pedro Armillas (Armillas 1964) in the early 1960s raised intriguing questions about environmental change and colonization from the south, but did not produce detailed descriptions of the excavated remains. The resulting handful of dates from virtually undescribed contexts raise provocative questions, but allow a range of interpretations of the dating of the site and, by extension, of the wider processes


Figure 1. Map of northern Mesoamerica and the American Southwest showing sites mentioned in text.

that determined the growth of the settlement. Confusing chronometric data, along with the absence of a ceramic typology that would permit cross-dating, have permitted radically divergent views of La Quemada's growth, decline, and sociopolitical significance to the wider Mesoamerican world.

Recent fieldwork conducted in collaboration with the Gobierno del Estado de Zacatecas and the Instituto Na-

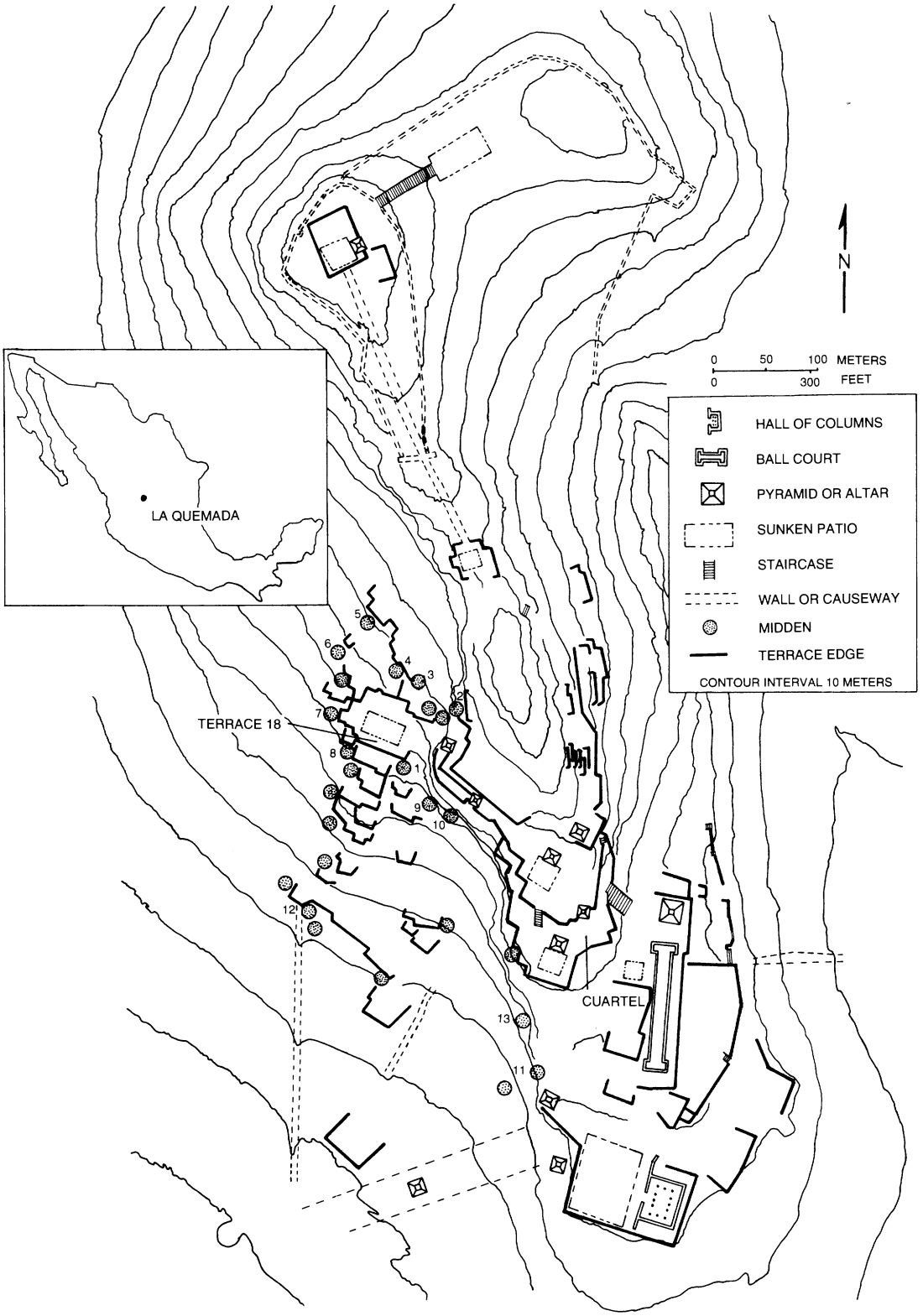



Figure 2. Site map of La Quemada showing terraces and middens. Contours after Plano Fotométrico de La Ciudadela La Quemada Versión Armillas-Weigand. Contour interval 10 m.

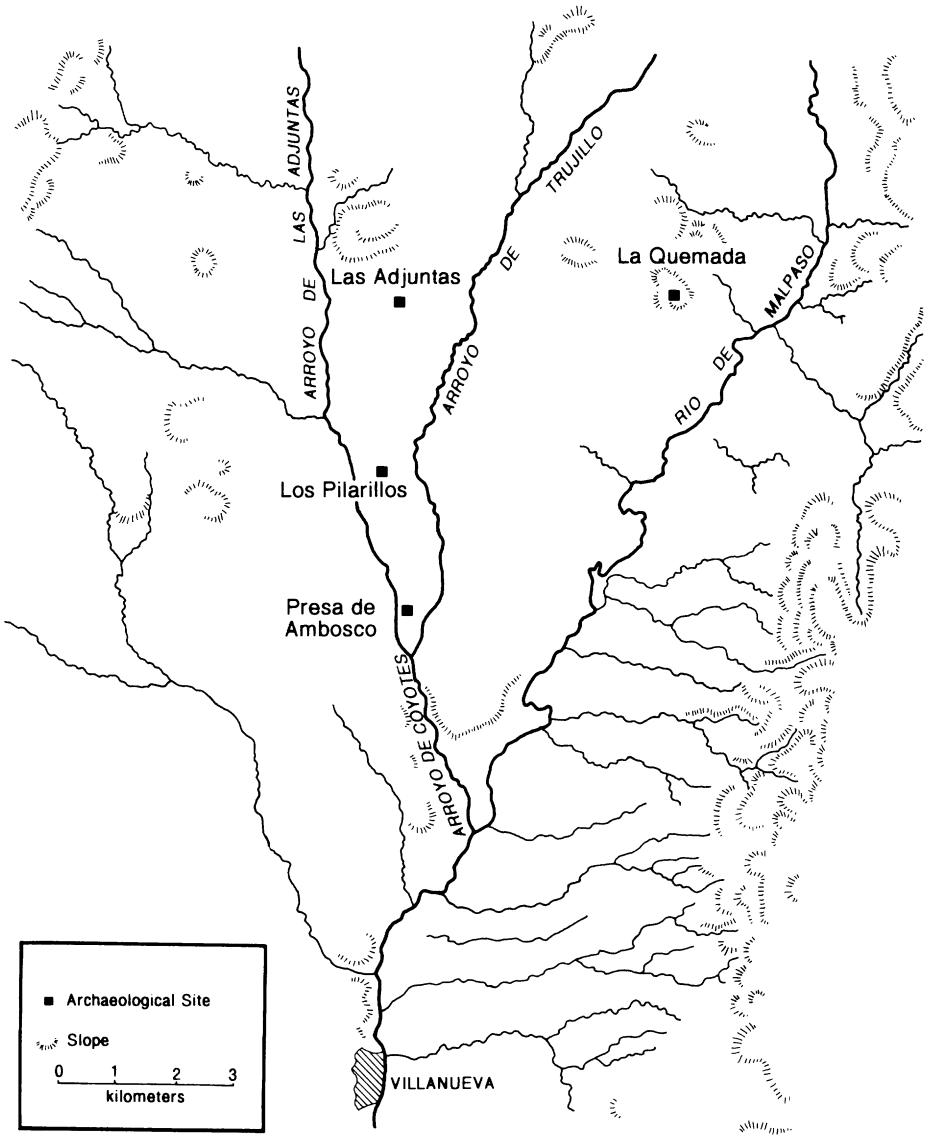



Figure 3. Map of Malpaso Valley showing location of La Quemada and the sattellite villages mentioned in text.

cional de Antropología e Historia (INAH) at La Quemada has resulted in much improved chronological resolution. This paper presents new radiocarbon determinations in the light of the issues and sampling decisions that led to their collection. Because the theoretical and historical implications of the dates are discussed in other papers (Nelson 1990, 1993), emphasis is given here to describing the contexts from which the dates were obtained and to accounting for why these particular samples were selected from among the several hundred available for laboratory analysis. Radiocarbon dating represents a significant investment of scientific resources as well as a set of judgments about the most strategic locations from which to collect data. For a variety of technical reasons discussed below, radiocarbon determinations must sometimes be rejected even though their collection and laboratory analysis are faultlessly performed. In documenting decisions about dates selected and rejected, the author hopes to provide readers with a basis to critically evaluate his conclusions.

Table 1. Chronological periods used in text.

| *Period* | *Dates A.C.* |
|---|---|
| Postclassic | 900–1519 |
| Epiclassic | 600–900 |
| Classic | 150–600 |

## Interpretive Issues

A major issue surrounding La Quemada's dating is its interpretation as an outpost of Mesoamerican empire. This proposition has taken several different forms since archaeologists began to study the site. The most recent, which still survives as the main textbook interpretation (Coe 1994: 146; Diehl 1983: 48–50, 154, 274; Weaver 1981: 381–383—but see Weaver 1993: 189–191), is Weigand's provocative assertion that La Quemada was a Toltec outpost (Weigand 1977: 23–26, Weigand 1982: 91). Weigand, Harbottle, and Sayres (1977) argue that La Quemada was founded during the Early Postclassic (A.C. 900–1100) as an intermediate station along a "turquoise trail" that led from Chaco Canyon in the American Southwest to Tula in central Mexico. This interpretation represents a significant shift from earlier readings of the site's chronology, which had suggested that it dated to the Late Postclassic period (A.C. 1100–1400).

Weigand's model was a reasonable derivation from the available chronological data, which consisted of a handful of radiocarbon dates, some of which were analyzed shortly after the advent of radiocarbon dating (Crane and Griffin 1958: 1100). It was further corroborated by the existence of a colonnaded hall, a trait commonly connected with Postclassic occupations in central Mexico. Recently archaeologists have begun to view the evidence from La Quemada as more supportive of a Classic period (i.e., pre-A.C. 900) alignment. This view is based on 1) the recognition that colonnaded halls are a Classic rather than Postclassic trait in NW Mexico (Holien and Pickering 1978); 2) a new understanding of ceramic cross-ties with the Chalchihuites sequence (Jiménez 1989: 12–20; Nelson 1990: 523–524; Trombold 1990: 316–318); 3) new dates from a satellite village (Trombold 1990: 313–316); and 4) re-evaluation of the descriptions of the specific contexts from which the initial radiocarbon samples were collected (Hers 1989: 42; Trombold 1990: 311).

The latter two scholars suggest that some of the dated material taken from the Cuartel area of La Quemada represents post-occupational reuse of the site as a shrine. Three of those samples were in fact collected not from excavation, but from burned material that James B. Griffin (personal communication, 1989) observed on the surface of the site. One of the samples, which dated to a.c. 1170 ± 200 (uncalibrated), consisted of "charcoal selected from a concentration of charred wood against a smoke-stained wall" (notes archived in the University of Michigan Memorial-Phoenix Project Laboratory). The fact that those early dates carry standard deviations of 200 years, and that there is no report on the Armillas excavations in the Cuartel area that would permit evaluation of context, still leaves much latitude for interpretation.

Assigning the occupation to the Classic period tends to trigger thoughts of Teotihuacan sponsorship; however, archaeologists who work in the Valley of Mexico now see Teotihuacan's regional influence diminishing significantly ca. A.C. 600 (e.g., García 1993: 216–218). Evidence from elsewhere in Mesoamerica indicates that most of Teotihuacan's presence abroad was felt considerably earlier, in the 400s and 500s (Millon 1988: 114–136; Coggins 1979; Culbert 1988: 135–152) At Matacapan, however, Santley (1989, 1994: 248, 261–263) infers extensive interaction with Teotihuacan, including a resident Teotihuacan population, from A.C. 300–800. Yet at that site the Teotihuacan presence is clearly marked by architecture, pottery styles, and figurines; such pronounced stylistic linkages are not present at La Quemada. There is little analogous support for Teotihuacan's involvement in the growth of La Quemada. Falling in an interval when Teotihuacan's influence in Mesoamerica was waning, the interregnum dating indeed poses problems for any suggestion that La Quemada was an outpost of Mesoamerican empire.

This historical alignment raises a theoretical issue as to why growth on the Mesoamerican periphery should occur in inverse proportion to that of the core. Hers (1989) explores the thesis that such growth was the product of a colonization by people from central Mexico, and that it also set the stage for a migration southward into what became the Toltec domain. Jiménez (1989) suggests that the growth was a product of small-scale peer-polity interaction; if so, La Quemada and its peers should have arisen simultaneously. Nelson (1990, 1993) suggests that the periphery might have been in a state of "structural underdevelopment," i.e., subjected to an extractive economic relationship that inhibited the accumulation of resources by the local population until it was liberated by the disintegration of the core. Recently gathered data on La Quemada's economy and iconography, however, fail to reveal either any resource worthy of long-distance exploitation or the presence of symbols indicating core dominance. Darling (1993: 251–252) and Trombold et al. (1993: 268) see little participation by far northern sites such as La Quemada in the obsidian exchange spheres that encompassed much of Mesoamerica. Trombold et al. (1993: 255–256), paralleling Jiménez (1992: 195), propose a distinction between inner and outer periphery, and suggest that core dominance extended only to the inner zone, excluding more distant polities such as La Quemada. Jiménez (1992: 192–196) and Darling (1993: 252) urge consideration of the role of local interaction in peripheral political development.

Chronology is crucial in weighing the various formulations that archaeologists propose. Accumulating evidence favors abandoning models of intersocietal hegemony, but the nature and degree of connectivity between the core and the periphery remain unclear. Ultimately the data may suggest that sites in the northern periphery did not participate in large-scale spheres of interaction because they did not exist when those spheres were active. Also, it may eventually be possible to conclude that the "collapse" of the core set up conditions for the propagation of small-scale local hegemonies. Such conclusions are only distant possibilities until the chronologies of peripheral sites are controlled.

The dating of La Quemada also has implications for understanding local community organization. Did La Quemada arise as the most successful among several villages competing for local power, or did it form by coalescence late in the Malpaso Valley's occupational history? Was it, as suggested above, used after abandonment as a shrine? These scenarios have different chronological implications, some of which can be tested by evaluating patterning among the radiocarbon determinations.

## Site Structure and Sampling Strategy

Spaces within the site of La Quemada (FIG. 2) can be stratified according to centrality and function. The *monumental core*, marked by a massive enclosing wall and natural cliffs, contains large structures such as the Hall of Columns and the Votive Pyramid. The *flanking areas* are made up of terraces with less grand but still substantial structures. In both areas, the sloping natural surfaces were transformed into architectural space by the construction of numerous terraces.

Deposits upon and around the terraces can be classified as belonging to *patio complexes*, which are arrangements of structures around sunken patios, or *middens*, consisting of deliberately discarded trash. The patio complex appears to be the fundamental residential unit. As a rule each patio complex occupies a whole terrace, but some terraces are dedicated to other more specialized structures such as ball courts. The distinction between core and flanking area may mark an important social dimension, although the existence of a number of internal causeways and grand staircases linking the flanking areas with the monumental core demonstrates a fundamental integrity among the social entities represented by the architecture.

To date 56 terraces, with an approximately equal number of patio complexes, have been identified within the site area of approximately 0.5 × 1.0 km. The terraces range from approximately 3 × 10 m in area and 1 m in height to 40 × 80 m in area and 7 m in height. A great deal of the area within the site is unterraced, either because of excessive slope or simply because it was left open. The majority of the architecture is concentrated in the southern end of the site.

Trash deposits accumulated in various places along the bases of terraces and natural cliffs. Surface reconnaissance thus far has detected 25 middens; a few more may exist beneath crumbled masonry at the bases of terraces. The middens range from thin scatters of artifacts 2 × 3 m in surface area to 2 m deep and 30 × 40 m in extent. The horizontal dimensions of the largest middens, however, are exaggerated by artifact displacement on the steep slopes.

In terms of patterns of trash deposition, it is significant that only two very large deposits—Middens 6 and 11—have been noted. Trash was not scattered widely nor often incorporated into architectural fill. Architectural areas apparently were swept frequently, as remarkably little trash is evident on the surface of the monumental core or in the excavated architectural areas. These patterns suggest that trash was carefully collected, possibly in keeping with beliefs about its polluting nature (Osborn 1979), and sometimes deposited in common dumps.

Decisions about where to excavate were based on the core-flank and patio complex-midden dichotomies as well as consideration of previous work. The latter, mostly undocumented and concentrated in the monumental core, is better characterized as clearing than excavation, but reveals a good deal about site structure. A number of radiocarbon dates were obtained from that work, although, as discussed below, their contexts are far from clear. The careful work currently being conducted by the Instituto Nacional de Antropología e Historia and the Gobierno de Zacatecas promises to provide details of deposition and dating in the core area.

The evident gaps in representation were in patio complexes in the flanking areas plus middens in both the core and flanking areas. Our excavations have concentrated on one large terrace on the western flank of the site and the sampling of 10 middens. The major effort has been directed at structures on the banquettes of Terrace 18. On the basis of its surface area of approximately 3200 sq m, Terrace 18 is the largest of the flanking terraces and the second largest in the site. The terrace is located along a causeway that must have comprised a significant entryway into the site; the causeway passes alongside a temple on Terrace 18, proceeds along the north side of its main patio, and then connects with a grand staircase that ascends to a small pyramid or altar in the monumental core. The terrace has a main sunken patio 20 × 35 m in area dominated by a small ball court with walls 11 m long and a floor width of 4 m. There is one clear temple structure, and four plat-

forms that apparently elevated other buildings, now destroyed, rise above the adjacent architecture. The east, south, and west banquettes are covered with a variety of structures, which are themselves arranged around five small patios. Nelson (1995) speculates that these smaller patios mark fundamental household units, perhaps the nuclear units of extended or polygynous families.

Within Terrace 18, potentially datable wood was found in a number of forms, not all of which are represented in the samples submitted for dating. A few samples of fuelwood were left in hearths after their last uses, though in general the hearths had been thoroughly cleaned. Other charred wood came from seeds, roof support posts, roof beams, and scattered charcoal of undetermined origin. Some of the charcoal lay in direct association with human skulls and long bones, and may represent skull racks (Hers 1989: 89–93; E. A. Kelley 1978: 114–117; Nelson, Darling, and Kice 1992: 306).

The sampled middens represent both the monumental core and the flanking areas. Although all lie outside the monumental core per se, several are located along the base of the natural cliff that serves as the boundary between the monumental core and the flanking areas. Such locations served as dumps for materials discarded from above, i.e., from patio complexes within the monumental core. They include two of the largest middens, both of which contain relatively large amounts of exotic and elaborate artifacts, and these locations make no sense as dumping locations for the inhabitants of nearby flanking terraces, who would have had to carry trash uphill in order to dump it there. Four of the 10 sampled middens represent the monumental core, and the remainder belong to the flanks.

The major source of charcoal recovered in the middens appears to be fuelwood discarded during the cleaning of hearths. Invariably the middens are located in places where people would have stepped to the edge of a precipice to discard trash. The gradual accumulation of trash in some middens produced charcoal-laden strata that appear to represent periods of relatively intensive and regular dumping. The very latest material in the middens with well-developed strata, however, appears to consist not of trash, but of building materials issuing from crumbling buildings. Roof beams and other building members may be included in some of this late material.

## The Dates in Their Contexts

In this section the individual dates are discussed in order to evaluate their representativeness and reliability. For each excavation context, the stratigraphy is discussed and the dates are examined to determine whether they make sense in view of independent chronological information. In some cases dates can be rejected, either because they are inordinately different from others in the same stratum, or because they are contradicted by more plausible dates from other strata. Information about each date is summarized in Table 2 in order to facilitate discussion of the context and chronology of the samples. The samples from Terrace 18 are discussed first, followed by those from the middens. The discussion is in depositional order of strata within contexts, and in chronometric order within strata. Most of the rejected dates are mentioned at the end of discussion of each context.

Three points of technical clarification are important to mention. First, the dates given in discussion are uncalibrated, and their calibrated ranges as computed by Stuiver and Becker's (1986) CALIB program may be found in the table. Uncalibrated dates are used in the following discussion because they are required as input for Kintigh's (1994) $^{14}C$ program, which assumes a normal distribution in order to construct the probability plots shown below. Second, the dates are also corrected for isotopic fractionation where that information is available. Unfortunately, the laboratory measurements necessary to correct for isotopic fractionation were not taken for all samples. While it is a fairly common practice to apply corrections to one sample based on measurements taken from another in the same context, such adjustments are not appropriate in this case because of the considerable variety of woods and wide range of resulting correction factors encountered among the measured samples. Third, the term "source" refers to the botanical and behavioral source of the samples and by implication to the probable age of the material at the time of use. For example, the source of one date might be a construction beam, while that of another might be a mesquite bean.

### *Terrace 18*

Building episodes at Terrace 18 can be distinguished at three levels of detail: 1) substructure expansion; 2) "arrangements" of structures constucted either immediately upon the substructure or following the razing of earlier structures but without change to the substructure; and 3) maintenance of existing structures and surfaces. Figure 4 is a schematic representation of the architectural remnants of these episodes as found in excavation. At the most general level, the terrace substructure was built in two major stages, the first in which the terrace reached about 80% of its current size, and the second when it was expanded vertically and horizontally to take on its current form. The structures that had been on top of the terrace were completely dismantled during the expansion, leaving only traces where the main patio had been and indications that

Table 2. Radiocarbon dates from SUNY Buffalo excavations 1988–1993.

| *Sample no.* | *Lab no.* | *Excavation area* | *Material* | *Stratigraphic position* | *$^{14}C$ age* | *$^{13}C/^{12}C$ ratio* | *$^{13}C$ adjusted age* | *Uncalibrated date (A.C.)* |
|---|---|---|---|---|---|---|---|---|
| 1 | B-44790 | Terrace 18 | Charred beam | On temple floor | 1260±50 | – | – | 690±50 |
| 2 | B-44791 | Terrace 18 | Charred beam | On temple floor | 1320±60 | – | – | 630±60 |
| 3 | B-44792 | Terrace 18 | Charred post in north post hole | Main roof support post of temple, installed as part of late expansion | 1210±50 | – | – | 740±50 |
| 4 | B-44793 | Terrace 18 | Charred post in south post hole | Main roof support post of temple | 1350±50 | – | – | 600±50 |
| 5 | B-44794 | Terrace 18 | Single piece of charcoal—portion of beam or skull rack or fuelwood? | Fill that accumulated in Patio B after occupation | 1640±60 | – | – | 310±60 |
| 6 | B-44795 | Midden 6 | Dispersed pieces of charcoal | Lowest of three occupational strata | 1270±60 | – | – | 680±60 |
| 7 | B-44796 | Midden 6 | Single piece of charcoal—firewood? | Lowest of three occupational strata, near bedrock | 1460±80 | – | – | 490±80 |
| 8 | B-44797 | Midden 11 | Charcoal concentration | Post-occupationally deposited material from core area of site above midden | 1320±60 | – | – | 630±60 |
| 9 | B-44798 | Midden 11 | Charcoal concentration | Post-occupationally deposited material from core area of site above midden | 1340±60 | – | – | 610±60 |
| 10 | B-44799 | Midden 11 | Charcoal concentration | Post-occupationally deposited material from core area of site above midden | 1660±120 | – | – | 290±120 |
| 11 | B-44800 | Midden 11 | Charcoal concentration | Post-occupationally deposited material from core area of site above midden | 1250±60 | – | – | 700±60 |
| 12 | B-62001* | Terrace 18 | Charcoal concentration | West Banquette, early Patio B, in construction fill deposited during renovation | 1320±60 | – | – | 630±60 |
| 13 | B-62002 | Terrace 18 | Charcoal concentration | West Banquette, later Patio B, associated with human crania and long bones | 1340±60 | –24.1 0/00 | 1350±60 | 600±60 |
| 14 | B-62003 | Terrace 18 | Dispersed pieces of charcoal | West Banquette, accumulated fill of later Patio B | 1220±60 | –24.7 0/00 | 1230±60 | 720±60 |
| 15 | B-62004 | Terrace 18 | Dispersed pieces of charcoal | West Banquette between Floors 2.2 and 2.3 | 1250±90 | –24.2 0/00 | 1260±90 | 690±90 |
| 16 | B-62005 | Terrace 18 | Charcoal concentration—firewood | North Banquette, late extramural hearth | 1120±60 | –24.0 0/00 | 1130±60 | 820±60 |
| 17 | B-62007 | Terrace 18 | Charcoal concentration | On or just above floor of ball court | 1280±60 | –24.8 0/00 | 1290±60 | 660±60 |
| 18 | B-62009 | Terrace 18 | Charcoal concentration | West Banquette, associated with human crania and long bones that fell along banquette walkway outside temple | 1450±80 | –25.0 0/00 | 1450±80 | 500±80 |
| 19 | B-62010 | Terrace 18 | Charcoal concentration | Main patio, in floor-preparation layer beneath earliest of 11 floors | 1280±120 | –25.6 0/00 | 1280±120 | 670±120 |
| 20 | B-62011 | Terrace 18 | Dispersed pieces of charcoal | West Banquette, on or just above latest floor of passageway | 1730±100 | –25.3 0/00 | 1720±100 | 230±100 |

the main patio floor had been replastered a number of times before the expansion took place. After the expansion the record becomes more detailed. A new complex of buildings was constructed to fit the expanded terrace; both the buildings and patio were periodically renovated in a series of maintenance episodes. At some point that entire complex of structures, except for the temple, was again destroyed, and rebuilt in a new arrangement. The temple stayed in its previous location; its northern wall was, however, shifted northward to increase the interior space by several square meters. This second arrangement was followed by a number of maintenance episodes involving replastering of floors and changes in the locations of a few individual walls.

Some examples of rearrangements and maintenance episodes suffice to give a sense of the evidence available about

Table 2. (cont.)

| *Sample no.* | *Lab no.* | *Excavation area* | *Material* | *Stratigraphic position* | *$^{14}C$ age* | *$^{13}C/^{12}C$ ratio* | *$^{13}C$ adjusted age* | *Uncalibrated date (A.C.)* |
|---|---|---|---|---|---|---|---|---|
| 21 | B-62012 | Terrace 18 | Single piece of charcoal—portion of beam or skull rack | East Banquette, lower platform, associated with human cranial and long bone fragments and structural remains, above walkway floor | 1100±70 | −24.5 0/00 | 1110±70 | 840±70 |
| 22 | B-62013 | Terrace 18 | Charcoal concentration | East Banquette, walkway of early interior patio | 1390±60 | −23.5 0/00 | 1420±60 | 530±60 |
| 23 | B-62016 | Midden 7 | Single piece of charcoal | Uppermost occuaptional stratum, associated with a Michilía sherd | 1490±90 | −24.9 0/00 | 1490±90 | 460±90 |
| 24 | B-62017 | Midden 7 | Charcoal concentration | Earliest occupational stratum, extends beneath western talud of Terrace 18 | 1310±60 | −25.1 0/00 | 1300±60 | 650±60 |
| 25 | B-62018 | Midden 7 | Charcoal concentration | Earliest occupational stratum, extends beneath western talud of Terrace 18 | 1340±50 | −25.1 0/00 | 1340±60 | 610±60 |
| 26 | B-62019 | Midden 11 | Charcoal concentration | Latest of three occupational strata | 1280±80 | −24.8 0/00 | 1290±90 | 660±90 |
| 27 | B-62020 | Midden 11 | Charcoal concentration | Latest of three occupational strata | 1060±80 | −19.4 0/00 | 1150±80 | 800±80 |
| 28 | B-62021 | Midden 11 | Charcoal concentration | Middle of three occupational strata | 1340±80 | −22.2 0/00 | 1340±80 | 610±80 |
| 29 | B-62023 | Midden 12 | Dispersed pieces of charcoal | Single undifferentiated occupational stratum | 134±1<br>Modern | –<br>– | –<br>– | 1816±1<br>Modern |
| 30 | B-62025 | Midden 15 | Dispersed pieces of charcoal | Single undifferentiated occupational stratum | 1180±70 | −23.7 0/00 | 1210±70 | 740±70 |
| 31 | B-66554 | Midden 11 | Charcoal concentration | Middle of three occupational strata | 1290±80 | −23.7 0/00 | 1310±80 | 640±80 |
| 32 | B-66555 | Midden 11 | Charcoal concentration | Earliest of three occupational strata | 1260±90 | −21.2 0/00 | 1320±90 | 630±90 |
| 33 | B-66556 | Midden 11 | Charcoal concentration | Earliest of three occupational strata | 1270±100 | −24.7 0/00 | 1280±100 | 670±100 |
| 34 | B-66557* | Midden 11 | Single piece of charcoal | Earliest of three occupational strata | 1340±60 | −24.7 0/00 | 1340±60 | 610±60 |
| 35 | B-66558 | Midden 11 | Charcoal concentration | Middle of three occupational strata | 1330±80 | −20.4 0/00 | 1410±80 | 540±80 |
| 36 | B-66559* | Midden 11 | Charcoal concentration | Middle of three occupational strata | 1550±60 | −23.1 0/00 | 1550±60 | 400±60 |
| 37 | B-77238 | Terrace 18 | Single piece of charcoal | Construction fill of early terrace beneath East Banquette | 1580±70 | −26.3 0/00 | 1560±70 | 390±70 |
| 38 | B-77240 | Terrace 18 | Charcoal concentration | Hearth resting on bedrock beneath terrace fill | 1430±80 | −26.0 0/00 | 1410±80 | 540±80 |
| 39 | B-77239* | Terrace 18 | Charred corn cob | Hearth resting on bedrock beneath terrace fill | 1110±50 | −13.5 0/00 | 1300±50 | 650±50 |

* Date obtained by AMS (accelerator mass spectrometry) method.

the construction sequence. On the East Banquette, the occupants arranged a number of structures around a single small sunken patio after the expansion of the terrace substructure. Later, all the structures were razed and rebuilt, and this arrangement was changed so that there were instead two small sunken patios surrounded by more structures. As another example, excavations in the SW corner of the main patio revealed a number of maintenance episodes. There, both original and expanded versions of the terrace were in evidence. Stratigraphy showed that the patio floor had been plastered four times before the expansion of the terrace, and thereafter was replastered seven times more.

The building episodes recognized in excavation could be grouped in a number of ways to define strata. Ultimately there is no utility in defining strata that are finer than the dating method can distinguish, and the limitations of radiocarbon dating are such that often it cannot even distinguish adjacent phases of occupation (Dean

1991). On the other hand, in the present context there is little independent evidence to suggest how much time might have elapsed between episodes; therefore it is preferable to err on the side of stratigraphic precision. The building sequence also has the property of becoming clearer through time, so that the later episodes are more easily recognized and more robustly represented with radiocarbon samples than the earlier ones.

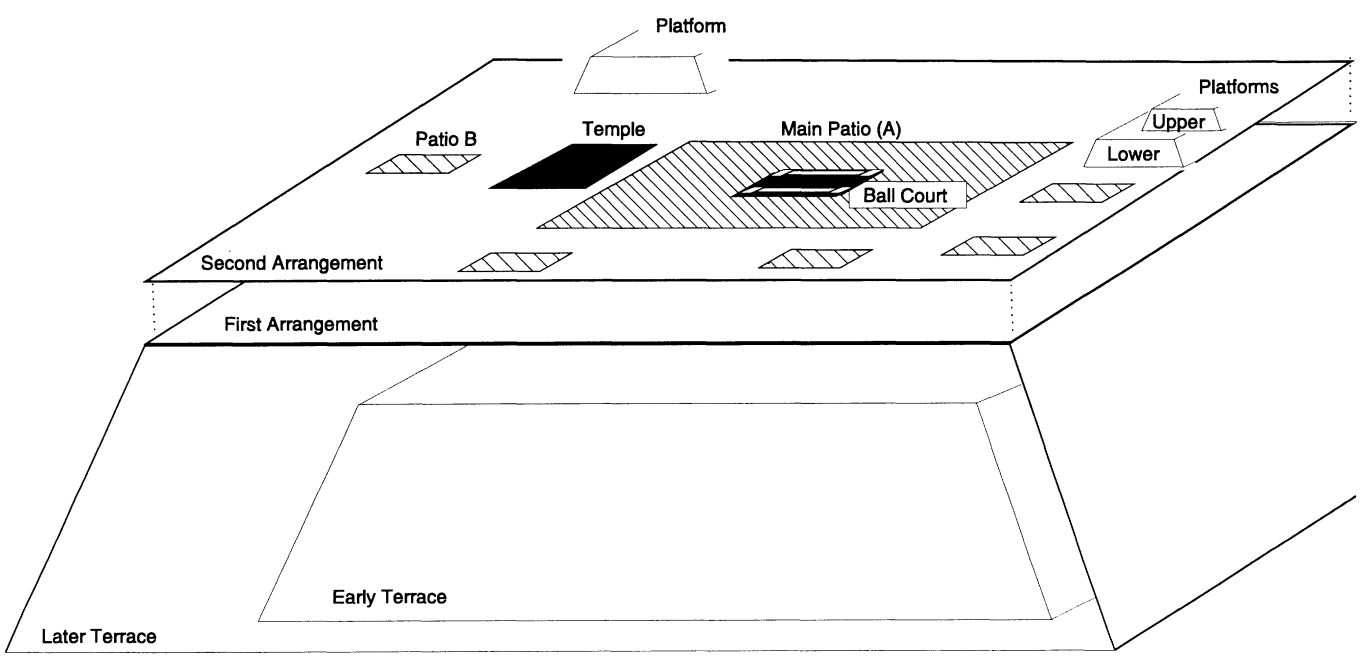
The major stratigraphic contexts within Terrace 18 are thus 1) the ground surface underlying the terrace; 2) the fill deposited in the early episode of terrace construction, which became encapsulated in the later phase; 3) architecture of the early terrace; 4) the fill deposited during the later expansion of the terrace substructure; 5) the first arrangement of structures after the expansion; 6) the second arrangement of structures after the expansion; 7) materials in use at the time of abandonment; and 8) post-occupational deposits. Within some of these strata are more subtle substrata, such as the replastering of floors. Also within each stratum may be materials that represent rather different phenomena from a chronometric standpoint, e.g., support posts versus seeds, the former potentially representing an "old wood problem" (Schiffer 1986), the latter more likely to reflect the actual time of occupation.

There are 19 dates from Terrace 18, including the ones from the closely associated Midden 7. The earliest stratum, the natural ground surface underlying the terrace, is represented by two dates, no. 38, a.c. 540 ± 80, and no. 39, a.c. 650 ± 50. Both dates are taken from charred material found in a hearth built on bedrock, the more circular of the two rock features in Figure 5. Both samples should stem from the same use-episode and should fix the date of construction of the terrace. Date no. 38 is from fuelwood, and no. 39 is from a charred corn cob. Because the hearth was intact and contained fuel remnants, this material probably was deposited immediately before the area was covered by construction of the terrace; otherwise, the charred material would have disintegrated and been washed away. It is conceivable that the hearth was actually used by the construction crew that built the terrace.

The second stratum, fill belonging to the early episode of terrace construction, is also represented by one radiocarbon sample, no. 37 (a.c. 390 ± 70). This date, which is corrected, comes from a single piece of charcoal embedded in the construction fill of the early terrace underlying the East Banquette. This date is unreasonably early in the light of date no. 38 and other evidence discussed below, unless there is a small version of the early terrace that has not been detected in excavation. Such a small early terrace was anticipated, and evidence of it was sought, but its existence could not be confirmed. Therefore, this date is rejected.

The third stratum, the architectural components belonging to the early terrace, is represented by two dates. Date no. 22, a.c. 530 ± 60, comes from a concentration of charcoal that probably derived from a single piece of wood. It was resting on the walkway floor of a small interior patio on the East Banquette, and perhaps was part of a beam or

Figure 4. Schematic map of strata in Terrace 18. View is to north. Hatching indicates sunken areas.

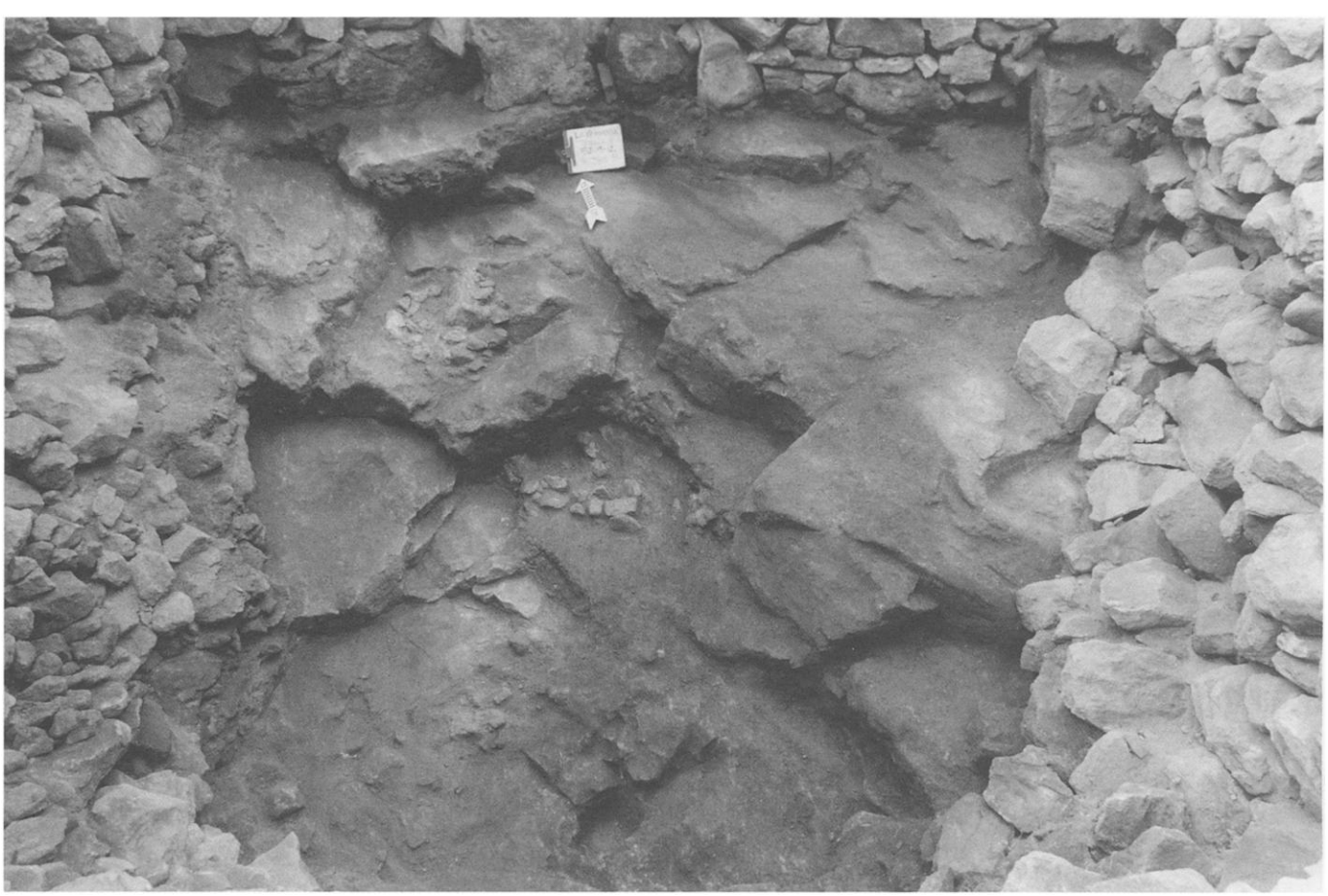


post that was razed during reconstruction. Date no. 19, a.c. 670 ± 120, comes from the SW corner of the main patio. The sample comes from bits of charcoal found in the underlayment, or floor preparation layer, of the earliest floor of the original patio. Although the source of the wood comprising this sample is unknown, the charcoal was concentrated rather than dispersed, and the relatively high negative $^{13}C/^{12}C$ ratio suggests that the wood belongs to a single species rather than a mix. The precision of the sample is among the lowest in the suite of dates, however, by virtue of its very wide sigma range.

Dates representing the early architecture are rare because, at least in the areas where deep excavations were conducted, the earliest buildings were almost totally dismantled. This situation is understandable as the builders were placing adobe buildings on top of a rock substructure, so that the outer layer of rock had to be very carefully selected, and was probably reused. Also, deep excavations were conducted only in the patio.

The fourth stratum, fill of the later terrace substructure, is not represented by any dates. The fifth stratum, the arrangement of structures created immediately after the expansion, is more clearly represented even though almost all of these buildings also were ultimately razed. All of the Stratum 5 dates come from the West Banquette. Date no. 4, a.c. 600 ± 50, comes from a main roof support post belonging to the temple. The temple was apparently the only building not completely demolished during the final rearrangement of structures. The location of the southern roof support post, from which date no. 4 was taken, did not change even though the building was partially dismantled and enlarged. Conceivably, therefore, the southern post belongs to the pre-rearrangement stage of construction. The dated material is charred wood from the standing post. It was not possible to determine whether the outer rings were represented, and the sample material could represent a mixture of inner and outer rings. The date has not been $^{13}C/^{12}C$-corrected. Date no. 12, a.c. 630 ± 60, was obtained from the fill placed and sealed in Patio B, the small sunken patio to the west of the temple, when it was reconstructed during the rearrangement of structures. This date, also not corrected, comes from a concentration of charcoal rather than dispersed pieces. Date no. 15, a.c. 690 ± 90, derives from scattered charcoal between the two earliest floors of a room to the west of the temple; it has been corrected. The source of the charcoal is

Figure 5. Bedrock hearths beneath Terrace 18, each about 50 cm in diameter.



unclear, but its deposition should relate to a fairly narrow period.

The sixth stratum, which includes structural materials relating to the second and final rearrangement of buildings after the terrace expansion, is represented by three dates. Dates no. 2 and no. 1, a.c. 630 ± 60 and a.c. 690 ± 50, are both uncorrected and are stratigraphically equivalent. They derive from charred timbers that were resting on the floor of the temple, and probably represent roof beams. These beams should date the last major repairs to the temple structure,[1] although they may have been borrowed from an earlier structure.

Date no. 3, a.c. 740 ± 50, uncorrected, comes from the northern roof post of the temple. It will be recalled that this post was relocated and possibly replaced when the temple was expanded northward. The southern post, discussed above in relation to the fourth stratum, dates to a.c. 600 ± 50. These uncorrected means of a.c. 600 and 740 bracket the construction activity that took place at the temple, although such an interpretation exceeds the allowable inferential limits. In any case, the dates are extremely important because their behavioral context is clear and the error ranges are as small as the technique allows.

Stratum 7, material in use at the time of abandonment, is represented by seven dates. This material is distinguished from that of Stratum 6 because of the possibility that significant time may have elapsed between construction of the last buildings and the actual end of the occupation. The kinds of materials that belong to this category are not main posts and roof beams, but smaller elements that may have been consumed more rapidly. An example of ideal material is fuelwood from an indoor hearth, but unfortunately all of the hearths had been thoroughly cleaned. Another such category of material, which was available but unfortunately was not given enough consideration when the samples were being selected, is the accidentally discarded seeds of annual plants such as corn and beans.

From among the samples that were submitted for radiocarbon analysis, the best representation of materials in use at the time of abandonment apparently comes from charcoal associated with deposits of human skeletal material. As noted by Pijoan and Mansilla (1990: 467), displays of skulls and long bones are a pervasive feature of La Quemada in general and Terrace 18 in particular, occurring inside the temple, in the main patio, in walkways, and in at least one small patio, Patio B. Almost invariably the bones are in some manner of disarray, resting in a pattern suggesting that they were suspended from walls, roofs, or racks, and the outdoor examples are all associated with charcoal. The charcoal may represent either skull racks or firewood that was ritually associated with the skeletal material.

The distribution of dates from such specimens, however, suggests that the wood associated with the skeletal material was kept around the patio complex for a very long time or was very old wood when it was cut. One such specimen is no. 18, a.c. 500 ± 80 (corrected), which comes from a charcoal concentration found among human bones along the eastern wall of the temple on the walkway of the western side of the main patio. Here the positioning of the skulls and long bones suggested that they may have been hung on the exterior wall of the temple. Date no. 13, a.c. 600 ± 60 (corrected), comes from a similar deposit lying inside Patio B. The skeletal material formed a rough row along the western edge of the patio and was resting partially in contact with the floor and patio wall and partially in accumulated fill. The impression was that the skeletal material had been suspended above the patio walkway or floor and had fallen along with whatever structure supported it. A later determination more consistent with the probable time of abandonment is date no. 21, a.c. 840 ± 70 (corrected), which comes from a single piece of charcoal associated with human cranial and long bone fragments. The skeletal material and charcoal were resting beneath the collapsed masonry wall of the upper platform, which apparently was the substructure for a building that overlooked Terrace 18. The original positioning of this material was unclear other than that it appeared to have been outside the building, probably near the edge of the platform.

Also belonging to Stratum 7 are two other samples from contexts that immediately precede the abandonment. The first was taken from a sample that lay in contact with an outdoor floor; unfortunately there were no samples in contact with interior floors except for the beams in the temple mentioned above. Sample no. 17, a.c. 660 ± 60 (corrected), was obtained from a charcoal concentration resting on the floor of the ball court. The source of this material is unclear; it could represent construction materials that came adrift in the decomposition of the structures, some small wooden apparatus associated with the ball court, or even a post-occupational fire within the ball court walls. The second sample potentially representing the peri-abandonment phase is no. 14, a.c. 720 ± 60 (corrected), which was obtained from dispersed pieces of

1. The Huichol of San Andrés Coahmiata re-roof their main temple every five years in a formally scheduled community activity with religious significance. In terms of structural renovations, the main purpose is to replace the thick straw thatch of the roof; as the thatch is entirely removed at these intervals weak beams are no doubt replaced as well. Therefore, if similar practices occurred at La Quemada, the dated beams may have been cut at almost any point in the life of the temple structure.

charcoal in the same layer of accumulated fill in the same patio.

The final date from Stratum 7 and one of the two latest determinations obtained from the terrace is no. 16, a.c. 820 ± 60 (corrected). The dated material, unquestionably firewood, was resting in an ephemeral extramural hearth about 4.5 m east of the platform overlooking the temple. This hearth is believed to have been constructed after that portion of the terrace, at least, fell into disuse; an adjacent extramural surface had ceased to be maintained by the time the hearth was constructed and had begun to accumulate water-borne sediments. This sample is considered the best indication of the moment of abandonment.

Stratum 8 is not represented by any dates, although it could reasonably be argued that date no. 16 was deposited post-occupationally. There was one stratigraphic context that clearly represented post-occupational reuse of the terrace; it consisted of a lightly packed surface, a cache of manos, and a hearth or small windbreak built in the ruins of the temple. Unfortunately, no charcoal was encountered among those intriguing features.

Two other dates from Terrace 18 are rejected because they are clearly contradicted by other dates and associated stratigraphic information. Date no. 20, a.c. 230 ± 100 (corrected), comes from dispersed pieces of charcoal on the floor of an exterior passageway on the West Banquette. This date is unacceptably early and is contradicted by nearby readings that are stratigraphically earlier and yet post-date this sample by centuries. For example, no. 20 contrasts radically with no. 15, which dates to a.c. 690 ± 90 and yet was sealed between two floors that underlie the one from which no. 20 was obtained. Date no. 5, a.c. 310 ± 60 (uncorrected), comes from a single piece of charcoal in the aeolian fill of Patio B. The fill accumulated in the patio after the ultimate renovation and presumably at the end of the occupation. This is another unacceptably early determination and like no. 20 discussed above, it accords poorly with material that was sealed beneath it in the same architectural unit—see date no. 12. Date no. 5 must be discarded; the best explanation for its earliness is that it represents the inner portion of a very old beam.

### *Midden 11*

The most intensively dated midden at La Quemada is Midden 11, one of the dumping locations for the monumental core located at the base of the natural cliff that separates the core from the western flank. A total of 13 dates were obtained from this context; two are rejected. The midden is undisturbed and was formed by gradual accretion; its profile (FIG. 6A) manifests a number of relatively clear soil zones, alternating light and dark, paralleling the rather steep slope. The dark layers are relatively charcoal-laden and artifact density is high throughout the deposit. These soil zones were not, however, clear during excavation, and so the excavation was done in very small provenience units, mostly 0.5 × 2.0 swaths, 0.15 m deep (FIG. 6B), which were later matched with the stratigraphy visible in profile. Radiocarbon samples were also point-provenienced within the excavation subunits. One of the criteria for selecting radiocarbon samples for submission was that they be associated clearly with one stratum or the other.

Midden 11 can be divided into four strata: early, middle, late, and post-occupational. The lowest 1 m of deposits, approximately, are occupational strata that could be divided in a number of ways; the early-middle-late designations are not intended to imply separate periods of site use. It does appear, however, that these zones were deposited in a highly orderly fashion. The higher and later post-occupational deposits, on the other hand, are more difficult to interpret in terms of deposition. They are considered post-occupational because the soil is substantially lighter, the artifact density lower, and the quantity of charcoal smaller than in the levels below. Also, they contain chunks of material that appear to be adobe, suggesting the decomposition of buildings immediately above. The implication of this stratigraphic interpretation is that while dates from the early, middle, and late strata can be considered potentially reliable chronometric indications, those from the post-occupational zone could represent almost any phase of occupation and are of interest only in terms of dating the site as a whole.

The earliest date from the early stratum is no. 34, a.c. 610 ± 60 (corrected), which comes from a single piece of charcoal. It is suspected that the source of this specimen, as well as all the rest from the occupational strata, is fuelwood. This midden location is a highly logical one for daily dumping, and the decision about where to place excavation units was made by going to the edge of the cliff above and tossing stones down to see where they would tend to fall. The high frequency and scattered distribution of charcoal in the midden is best explained by the dumping of domestic debris on a regular basis. The other dates from the early stratum are no. 32, a.c. 630 ± 90 (corrected), and no. 33, a.c. 670 ± 100 (corrected), both of which were obtained from charcoal concentrations that may or may not have derived from single pieces of wood.

The middle stratum is also represented by three dates. Date no. 35, a.c. 540 ± 80 (corrected), comes from a charcoal concentration which, based on its low negative $^{13}C/^{12}C$ ratio, probably represents a single species of wood and not a mix. The date represents a minor reversal,

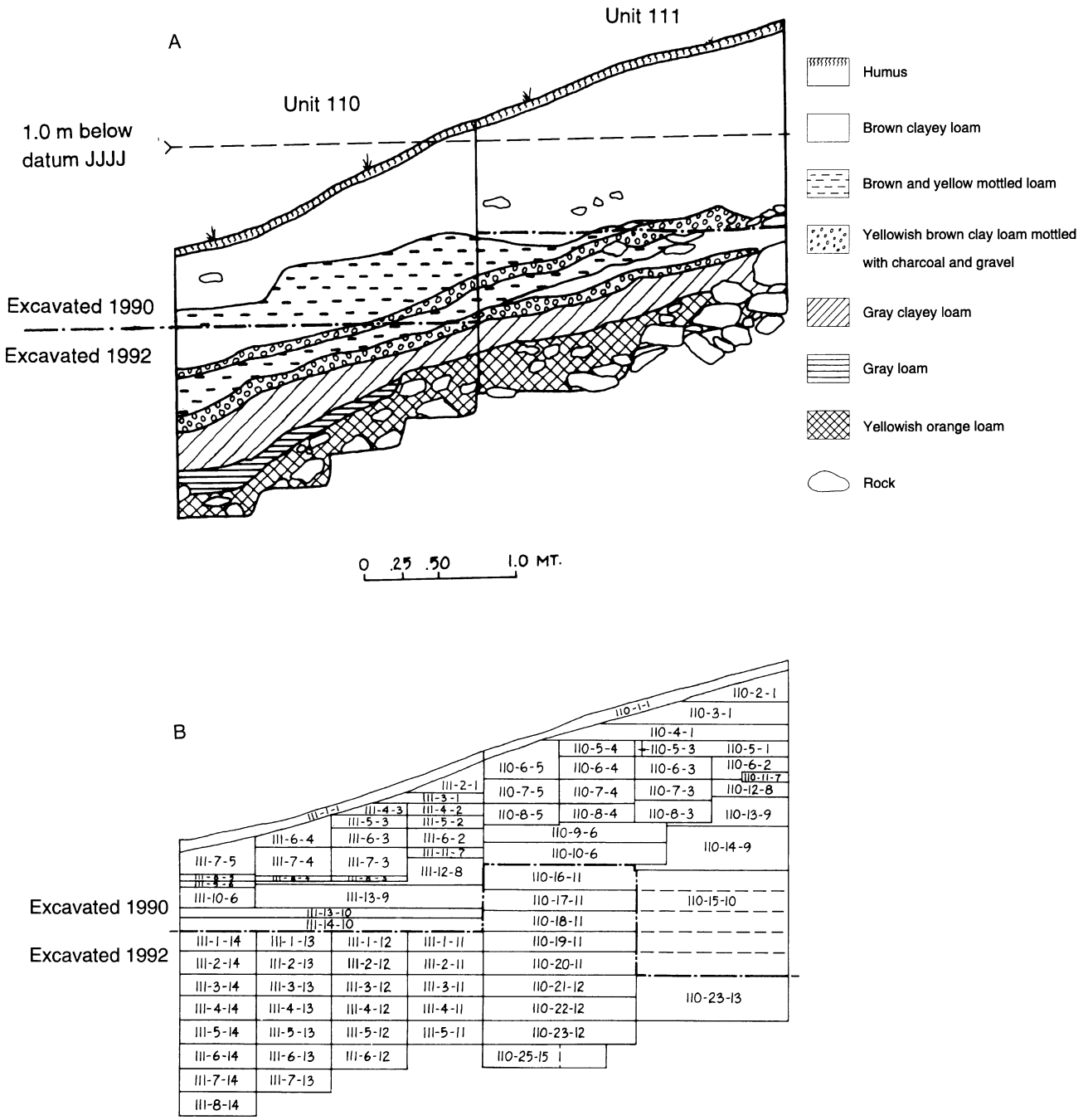



Figure 6. Profiles of Midden 11. A) Soil zones of varying charcoal content. B) Schematic of provenience units.

and its earliness relative to the rest of those from the occupational strata is probably attributable to sampling error. Date no. 28, a.c. 610 ± 80 (corrected) comes from a charcoal concentration, as does no. 31, a.c. 640 ± 80 (corrected).

The late occupational stratum of Midden 11 is delineated by two dates, both from charcoal concentrations. The determination for date no. 26 is a.c. 660 ± 90 (corrected), and that of no. 27 is a.c. 800 ± 80 (corrected).

The post-occupational stratum, as noted above, was not recognized as such until after excavation was done and a number of radiocarbon samples had been submitted; hence it is overrepresented. While dates from this stratum are not readily interpretable from the standpoint of mid-

den deposition, they are useful for considering the overall span of site occupation as well as that of the architectural units above from which they probably originated. All three dates are from charcoal concentrations rather than dispersed materials, and all are uncorrected. They are no. 9, a.c. 610 ± 60, no. 8, a.c. 630 ± 60, and no. 11, a.c. 700 ± 60. The source of these dates is believed to be construction materials from decomposing buildings on the terrace above the midden in the monumental core, although it is possible that they represent redeposited trash and hence possibly fuelwood.

Two dates from Midden 11 are rejected for lack of fit with the stratigraphic ordering of the other dates. Date no. 10, a.c. 290 ± 120 (uncorrected), comes from the post-occupational stratum. This sample consisted of a very small charcoal concentration that required extended counting time in the laboratory. Its standard deviation is the highest among those of recently submitted samples. If the determination is accurate it most likely represents the inner rings of a beam that was quite old when cut. Date no. 36, a.c. 400 ± 60 (corrected), comes from the middle stratum but cannot be accurate since there are five dates in the same stratum and the one below that are two to three centuries later. This date is also likely to be the product of old wood or a determination error.

### *Other Middens*

From the remaining nine middens, dates are available from Middens 6, 7, 12, and 15. One of these dates is rejected. These middens were less intensively dated and also were not dug in quite the same highly controlled fashion as Midden 11. For example, in Midden 6, from which two dates were obtained, the arbitrary levels were 1 × 2 m in area and 0.15 m deep instead of the finer-grained 0.5 × 2 × 0.15 m provenience units used in Midden 11. Most of the other middens were dug in sloping 15 cm levels in an attempt to capture the sloping stratigraphy, an effort that was partially successful.

Two dates were obtained from Midden 6. Date no. 7, a.c. 490 ± 90 (uncorrected), comes from a single piece of charcoal from the earliest of three occupational strata in the midden. While this date is significantly earlier than most others that have been obtained, and is particularly surprising in view of the peripheral position of the midden, there is little basis for rejecting it except that a considerably later date comes from the same stratum. That date is no. 6, a.c. 680 ± 80 (uncorrected). The context of these two samples appeared to be well sealed, but the material for the latter date was collected from dispersed bits of charcoal rather than from a single piece.

Three dates were obtained from Midden 7, which is associated with and partially covered by Terrace 18. These dates are particularly important because they represent materials discarded from the same residential and ceremonial contexts that were intensively excavated on Terrace 18. Like two of the other middens discussed above, this midden can be divided into early, middle, late, and post-occupational strata. Two of the dates come from the early stratum and one from the late stratum. Those from the early stratum belong to a deposit that extends beneath the western exterior wall of Terrace 18, apparently having accumulated there before the terrace expanded to its final size. These samples should therefore be relatively early and comparable to Stratum 2 or 3 from within the terrace itself (see discussion above). The dates, both taken from charcoal concentrations, are no. 25, a.c. 610 ± 60 (corrected) and no. 24, a.c. 650 ± 60 (corrected). The date from the late stratum of Midden 7 is no. 23, a.c. 460 ± 90 (corrected), which rather clearly represents a reversal, not only because it is contradicted by the aforementioned dates from the early stratum but because the date was taken from a piece of charcoal lying in association with a Michilía sherd from Chalchihuites, which should date ca. a.c. 750–900 (Kelley 1985). Date no. 23 is therefore rejected.

From Midden 12 came a radiocarbon sample that apparently represents a recent brush fire. The date is no. 29, a.c. 1816 ± 1 (corrected). This midden had a single, undifferentiated occupational stratum, and there appears to be little hope of obtaining a better determination from it.

The final date is taken from dispersed pieces of charcoal in Midden 15. The date is no. 30, a.c. 740 ± 70 (corrected), and represents the single occupational stratum in that midden, which is associated with one of the terraces below Terrace 18. If it is imagined that the string of terraces of which Terrace 18 is a part grew gradually downslope then the mean date of occupation for the terrace from which this date was obtained should be somewhat later than that of Terrace 18. Insofar as such matters can be judged from a single date, this sample seems to agree with that proposition.

## Quantitative and Qualitative Evaluation

Archaeologists tend to depict radiocarbon dates either as means or as ranges; neither representation is satisfactory. The radiocarbon mean is important because it points to the greatest probability of actual dating, yet misleading because there is a significant chance that the true date is some rather different value. The most widely adopted solution to this problem is to consider the date as a range bracketed by one or two standard deviations above and below the mean. While useful in calling attention to the breadth of possibilities, this solution is undesirable because

it implies that the occurrence of any date along the continuum is equally probable. In adopting this solution, the archaeologist loses information and accepts diminished analytical power.

Rather than treating radiocarbon dates as means or ranges, it is preferable to think of them as probability distributions. Before calibration, $^{14}C$ determinations represent samples drawn from normally distributed populations. One of the properties of the standard normal curve is that the area beneath it, which is 1, is equal to the probability that the parameter of interest occurs within the range encompassed by the curve's range. The area under the curve diminishes to zero with increasing distance from the mean. The probability that the parameter occurs within a specified interval is given by the area under the curve corresponding to that interval.

Kintigh (1994) resourcefully takes advantage of these properties in creating an algorithm that calculates the probabilities that a true date belongs to a series of intervals, the width of which is set by the analyst. Instead of characterizing the distribution in terms of the standard deviation, the archaeologist is able to suggest intervals that are easier to cognize, such as 10-, 25-, 50-, or 100-year intervals. Thus, for a single date, e.g., no. 4 from the south post of the temple on Terrace 18 which has a radiocarbon mean of a.c. 600 and standard deviation of 50 years, one can inquire as to the probabilities that the true date lies within the intervals a.c. 550–559, 560–569, 570–579, etc. The sum of the answers to these questions is a probability distribution that represents both the range of possible dates and the greatest likely age of the post.

It might appear that this method would smooth the picture of occupation, creating an illusion of continuity. In fact, it has less of that tendency than the standard approach, which forces the archaeologist to assume that each date represents either a moment of occupation or, more plausibly but still unacceptably, a span during which occupation was continuous and equally intense. Kintigh's probability-distribution approach strikes a balance, creating a picture of greatest occupational intensity around the most likely date, but acknowledging the outwardly diminishing probability of continuity. Using this method of representation, a gap of occupation is more likely to be correctly inferred than by visual examination of one- or two-sigma ranges. Similarly, it permits dates with different standard errors to be compared more realistically, portraying the less precise readings as flatter distributions.

A further advantage of this approach is that the probability distributions of different dates can be combined. This additive property, which is achieved by standardizing the distributions associated with individual dates and then summing the probabilities for each interval, allows the creation of an aggregated probability distribution that gives appropriate weight to each date and its respective precision. A date with a "large sigma" will be spread over a large number of intervals, with proportionally less weight given to each interval than would be contributed by a more precise date. Also, if one wishes to make the assumptions that the dated materials are a random sample of wooden objects discarded or abandoned in the dated context, and that such materials were deposited at a regular rate, then it is possible to quantitatively evaluate the overall distribution as if it represented an actual population of dates. By assuming, for example, that the outer 12.5% on each end of the distribution represents sampling error, one may ask what interval contains 75% of the "probabilistic dates" in the distribution, and obtain a reasonably accurate estimate of the span of occupation.

A disadvantage to this approach is that it cannot be applied to calibrated dates because they are not normally distributed. Also, calibration recognizes the problem of multiple intercepts between the curves representing radiocarbon and sidereal ages; the probability distribution representing calibrated ages would have to incorporate the resulting multimodality. Although there are no doubt curve-fitting solutions to these problems, the present study deals with them by creating probability distributions from uncalibrated dates and then judgmentally considering the effects of calibration. Given the amount of noise in the data, this line of reasoning probably produces adequately accurate answers to the chronological questions.

The data supplied by the probability distributions ultimately can be used to test growth models at four scales—macroregional, regional, community, and intrasite. At present, definitive conclusions can be reached only at the macroregional scale, yet at the finer scales there is improved resolution and the impetus for further inquiry. The specific questions that can be addressed are 1) whether the growth of La Quemada as a whole coincides with that of the Mesoamerican core; 2) whether La Quemada was coeval with other centers that constitute the archaeologist's "Mesoamerican frontier;" 3) whether La Quemada grew at the same time as its satellites; and 4) whether the various parts of the site grew simultaneously or according to an order that reflects expansion and contraction within the settlement itself.

The macroregional relationship of La Quemada's growth to that of the Mesoamerican core is now clear. La Quemada is an Epiclassic site in the truest sense of the word; its growth occurred within the Classic period but coincided with and followed upon the decline of Teotihuacan. The probability distribution in Figure 7 represents the

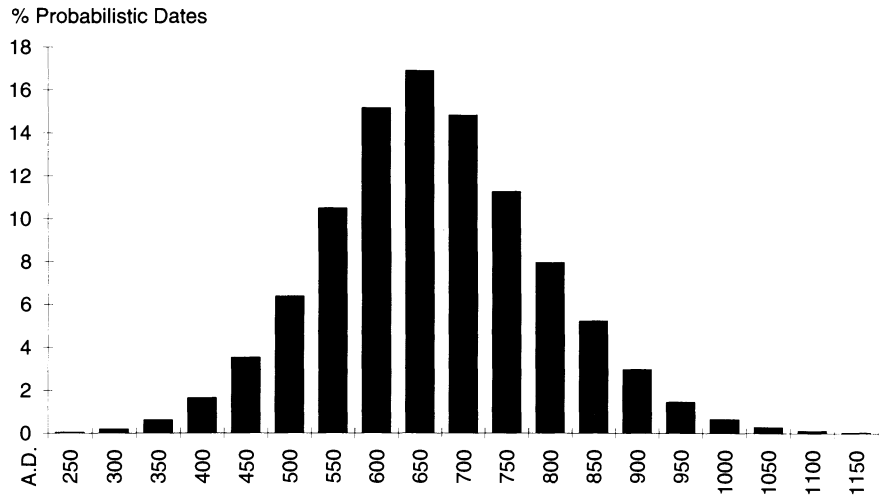



Figure 7. Probability distribution of dates from La Quemada and its satellites combined.

whole range of dated contexts from La Quemada and its satellites. It represents all dates that have been obtained, minus those rejected. The distribution includes the 38 dates from our excavations plus dates submitted earlier by other investigators (TABLE 3). These include three from Griffin's 1956 collection (Crane and Griffin 1958), nine from Armillas's 1963 season (notes from the University of Michigan Memorial-Phoenix Project Laboratory), and four from Trombold's 1986 excavations at Site MV 138 (Trombold 1990), minus those that archaeologists have rejected on stratigraphic grounds. The excluded dates are the five early ones from Terrace 18 and Midden 11 that are rejected on the basis of the above discussion, the one modern sample from Midden 12, the four dates from the Cuartel area that recently have been identified as post-occupational (Hers 1989: 42; Trombold 1990: 310–313), and one early date from the Cuartel that Trombold (1990: 313) regards as inexplicably early.

The peak of this distribution is at a.c. 650, and 75% of the probabilistic dates fall into intervals with midpoints between a.c. 550 and 800. There is no evidence of multimodality, although there is a slight suggestion, not statistically significant, of skewness toward the early end of the occupation. Even though approximately one-third (14) of the actual dates are from Terrace 18, the distribution should be quite different if the overall span of occupation

Table 3. Radiocarbon samples submitted by other investigators.

| *Sample no.* | *Lab no.* | *Site* | *Submitted by* | *$^{14}C$ age* | *$^{13}C/^{12}C$ ratio* | *$^{13}C$ adjusted age* | *Uncalibrated date (A.C.)* |
|---|---|---|---|---|---|---|---|
| 40 | M-430 | La Quemada | Griffin | 885±200 | – | – | 1065±200 |
| 41 | M-431 | La Quemada | Griffin | 775±200 | – | – | 1175±200 |
| 42 | M-432 | La Quemada | Griffin | 1205±200 | – | – | 745±200 |
| 43 | M-1651 | La Quemada | Armillas | 1230±120 | – | – | 720±120 |
| 44 | M-1652 | La Quemada | Armillas | 1540±120 | – | – | 410±120 |
| 45 | M-1653 | La Quemada | Armillas | 1230±120 | – | – | 720±120 |
| 46 | M-1654 | La Quemada | Armillas | 1080±120 | – | – | 870±120 |
| 47 | M-1655 | La Quemada | Armillas | 1180±120 | – | – | 770±120 |
| 48 | M-1656 | La Quemada | Armillas | 770±110 | – | – | 1180±110 |
| 49 | M-1658 | La Quemada | Armillas | 1020±120 | – | – | 930±120 |
| 50 | M-1659 | Presa de Ambosco | Armillas | 1100±120* | – | – | 850±120 |
| 51 | M-1660 | Presa de Ambosco | Armillas | 960±120 | 00-10.11† | 1190±110 | 730±110 |
| 52 | B-18194 | Las Adjuntas | Trombold | – | 00-10.11 | – | 620±70 |
| 53 | B-18195 | Las Adjuntas | Trombold | – | – | – | 750±100 |
| 54 | B-18196 | Las Adjuntas | Trombold | – | – | – | 780±70 |
| 55 | B-28036 | Las Adjuntas | Trombold | – | – | – | 500±60 |

* The University of Michigan archives contain a note about this sample stating: "The 1100±120 is correct. Published date at 950 is wrong. Should be A.D. 850. JBG [James B. Griffin]."
† Correction for $^{13}C/^{12}C$ ratio applied as suggested by Trombold 1990: 313.

were much unlike that of Terrace 18. The refined data set also includes six dates that are from the satellite sites of Presa de Ambosco and Las Adjuntas, and not from La Quemada itself. The justification for including these dates is that the road network implies a highly integrated set of sites that is best regarded as a single community. Also, the few dates from the outlying settlements fall in the interval defined by La Quemada's own occupation.

One concern in evaluating this overall distribution is that the monumental core, which makes up considerably more than half of the surface area of the site, is represented by dates from only two contexts—Midden 11 and the Cuartel—whereas the flanking areas are represented by Terrace 18 and a number of middens. Also, there are no dates taken directly from architectural contexts representing early strata in the monumental core; the core is represented only by dates from the "outer shell" of occupation in the Cuartel area and the sequence of deposits in Midden 11. Although the latter should represent the whole spectrum of dates, it would be comforting to have a broader sample. It is hoped that dates obtained from the work by the Gobierno de Zacatecas and INAH will address this gap.

More dates from deeper strata in the monumental core are not likely to change the inference about overall span of occupation very much, and almost certainly will not make it seem significantly later. The late dates from the Cuartel area are similar to the late-stratum dates from Terrace 18, though perhaps enough later to allow the suggestion that a remnant group made use of standing architecture in the core for a century or so after the main occupation faded. It is reasonable to think of Terrace 18 as representative of the apogee of La Quemada's growth and the Cuartel as its late end. If this inference is correct, the site may have been founded around a.c. 500 and occupied until around 900, with the peak of use occurring at ca. a.c. 600–750. However the data are viewed, there seems to be no support for a significant Postclassic occupation.

At the regional scale, the question is one of timing between La Quemada's growth and that of other centers. If a peer-polity model (Renfrew 1986) accounts for the growth of centers in northern Mexico (Jiménez 1992: 192–196; Minnis 1989: 301–305), then La Quemada should be contemporary with other regional centers. Alta Vista, the only other well-dated center in far northern Mesoamerica, appears to have a span of occupation that is similar to La Quemada's, ca. a.c. 450–900 (Aveni, Hartung, and Kelley 1982: 331–334; Kelley 1985). On the face of it this span would suggest support for a peer-polity model. On the basis of a detailed analysis of construction dates, however, Kelley (1985: 274) suggests that there are three periods of growth at Alta Vista, one in the late 400s and through the 500s, one in the late 600s to the late 700s, and a final one in the early to mid 800s. Only one of these periods matches La Quemada, which shows strong growth in the 600s and 700s. This pattern might imply that the growth episodes at the two centers were somewhat independent. On the other hand, Schiavitti (1995) argues that Kelley's early growth episode is illusory, and in the meantime 25 new, unpublished radiocarbon dates from Alta Vista remain to be factored into the evaluation (J. C. Kelley, personal communication, 1994). Important progress can therefore be expected on the issue of regional growth patterns in the near future.

At the community level, it is possible to ask whether La Quemada grew before, after, or during the growth of its spatial satellites. The high degree of connectivity between La Quemada and the other sites in the Malpaso Valley, as expressed in the road system, suggests contemporaneity, but that connectivity could mask a sequence of developments. La Quemada could have been founded considerably earlier or later than most of the surrounding communities, yet still have been connected to them by road at some point in the course of events.

Figure 8 gives the probability distribution for dates from La Quemada contrasted with those the from Presa de Ambosco (notes from the University of Michigan Memorial-Phoenix Project Laboratory) and Las Adjuntas (Trombold 1990) sites. The sample of dates from the satellite sites is far from adequate, especially since both sites belong to the cluster that Trombold (1991: 151) labels the "Pilarillos aggregate," one of three groups that surround La Quemada. Despite the potential biases, one can still ask whether these dates contradict the presumed contemporaneity of La Quemada and the smaller surrounding villages. The distribution centers on A.C. 750, and the removal of the satellites from the La Quemada distribution pushes its own apparent peak back to A.C. 650. If there were no questions about the representativeness of the samples, this pattern would imply a difference of timing. In view of the very limited representation of the small sites, however, it is better to conclude that the model of contemporaneity is challenged by these data but not refuted. Additional research is needed on the satellite population.

The intrasite scale is the smallest one at which questions of contemporaneity can be addressed; here the data are used to evaluate an expansion-contraction model. This model predicts that the founding population of the site occupied what eventually became the core, that the site grew outwards in various directions from that core over time, and then eventually shrank back into the core at the end of the occupation. Why should this have been the case? The core area is the most visible from the populated portions of the valley below, and it is clear that creating an

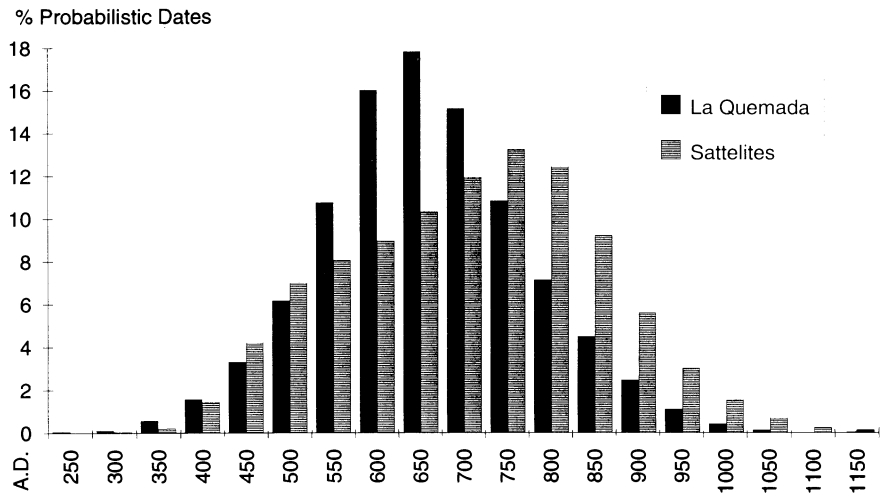



Figure 8. Probability distributions contrasting La Quemada with its satellites.

imposing monument was part of the occupants' design. The core is surrounded by cliffs and an expansive enclosing wall, and many terraces are outside of that enclosed area, suggesting that as the site grew, new terraces eventually had to spill outside the protected area. Finally, the greatest degree of architectural superposition appears to occur in the core, based on glimpses that can be gained from eroded areas.

The probability distributions of three areas of the site are given in Figure 9. The distribution for Terrace 18 (FIG. 9A) centers on A.C. 650 and appears to be a smooth unimodal curve. Seventy-five percent of the probabilistic dates fall within the intervals bounded by the midpoints of A.C. 550 and 800. All else being equal, the interval A.C. 600–649 would be considered the one during which occupational intensity was at its peak and the maximal number of datable specimens was generated. Depositional history, of course, is not that simple; datable materials generated at different times in the course of the occupation may have unequal probabilities of being selected. Materials deposited early in the occupation may be less likely to have been recovered than later materials because of the bias in excavation toward the latest arrangement of structures.

Nine of the 15 dates are from the late arrangement of structures. On the other hand, all or almost all of these dates are from structural members as opposed to fuelwood or other short-lived objects. With proper maintenance, structural beams and posts may last a number of centuries. They were probably recycled when buildings were razed and rebuilt, so that some of the dates from the latest arrangement of structures could in fact represent the earliest occupation. There is also the possibility that many of the latest beams were scavenged upon abandonment of this part of the site and reused elsewhere, reducing the representation of the latest occupation. Given these complexities it is impossible to know how representative the dates are, but it seems fair to conclude that each part of the occupation has some chance of being represented. The probability distribution, therefore, probably provides a roughly accurate depiction of dates.

Midden 11, the other intensively dated deposit, affords a different view of the occupational history of the site (FIG. 9B). Materials in this midden should contrast with those in Terrace 18 in their social contexts, their behavioral sources, and possibly in the span over which they were deposited. Materials in Midden 11 were discarded from above, within the monumental core of the site. Instead of consisting of construction materials, most of the dated specimens from Midden 11 probably represent fuelwood. There should be a close relationship between death of the specimen and its period of use, and the problem of recycling should be minimal.

If the site grew outward from a founding core, reached an apogee, and then shrank back into that core prior to abandonment, then Midden 11 should have a substantially longer span of use than Terrace 18. There should be significantly greater proportion of dates on the early and late ends of the spectrum, assuming that the differences in behavioral sources of dated wood do not distort the picture. If, on the other hand, growth of Terrace 18 was coeval with that of the core, then the span of dates as well as the form of the curve represented in Midden 11 and Terrace 18 should be very similar.

The probability distribution of dates from Midden 11 is strikingly like that of Terrace 18 and has exactly the same peak. Seventy-five percent of the probabilistic dates fall in

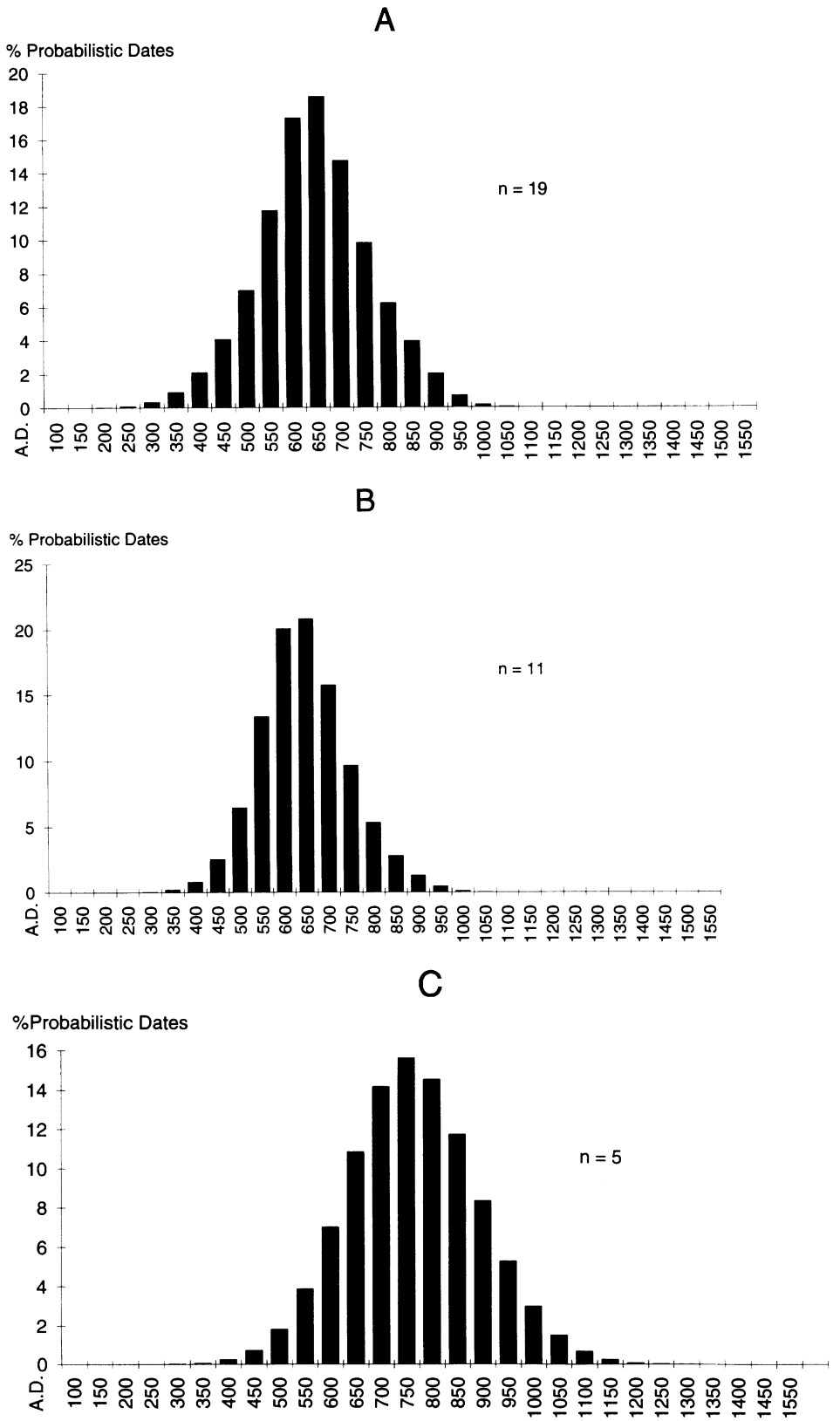



Figure 9. Probability distribution of dates from various parts of La Quemada. A) Terrace 18. B) Midden 11. C) The Cuartel Area.

intervals bounded by the midpoints of A.C. 550 and 750. This distribution suggests that the growth pattern at Terrace 18 was very similar to that in the monumental core. An alternative interpretation is that the areas of the monumental core that were "feeding" Midden 11 were somewhat marginal within the core itself, and thus the midden reflects only a part of the core's occupational history. Arguing against this alternative is the fact that Midden 11 is the largest and deepest midden known at La Quemada, which suggests that it probably was one of the longest and perhaps most widely used. Also, Midden 11 is located in a place that would have been conducive to trash deposition from above even when the nearby terraces had not yet been constructed. It is situated below the edge of a cliff adjacent to one of the flattest parts of the core. The comparison between Terrace 18 and Midden 11 seems to suggest, therefore, that the core and flank areas had quite similar occupational histories.

Adding weight to the expansion-contraction model is the probability distribution from the Cuartel area (FIG. 9C). The five acceptable dates from that portion of the site center on an interval that is a century later than the peak of occupation for Terrace 18. If any of the even later dates that have been rejected in fact pertain to the site's occupation and not to post-occupational visits, then this tendency would be much stronger. Also, it must be noted that the excavation sample only encompasses the latest phases of construction in the Cuartel area. With an excavation strategy like that used on Terrace 18, it is conceivable that one would recover materials dating not only to the period of Terrace 18's occupation, but to an earlier phase as well. Relying strictly upon the data available, however, the best interpretation seems to be that the early end of the expansion-contraction model cannot be tested with the radiocarbon dates, although other data make it seem reasonable, and that the late end of the model is confirmed.

The discussion thus far has dealt with uncalibrated dates in order to take advantage of some convenient properties of the normal curve. As noted above, this approach fails to account for the fact that radiocarbon years are not quite equal to sidereal years, and also ignores the problem of multiple intercepts between the radiocarbon and sidereal curves. To some extent these concerns are minimized by the fact that the entire chronology of Mesoamerica has been constructed on the basis of uncalibrated dates. The beginning date of A.C. 750 for the Alta Vista phase, for example, is uncalibrated. Considering the effects of calibration is important, however, for comparison of future determinations with these data, and can also help to refine current inferences. Particularly germane is consideration of the multiple-intercept problem.

Figure 10 is a chronologically ordered plot of individual, uncalibrated radiocarbon means against their one-sigma and two-sigma calibrated ranges as calculated by the CALIB program of Stuiver and Becker (1986). An important pattern is visible here: most of the uncalibrated radiocarbon means fall at the lower end of their one-sigma calibrated ranges. This implies that if an algorithm were developed to produce a probability distribution from the calibrated data (which are non-normal and in many cases multimodal), it would look very much like the one produced from the calibrated dates except that it would be somewhat flatter because of the multiple intercepts and would have a later mean, perhaps by about 78 years, which is the mean of the standard deviations in the sample. Thus the calibration problem is not a cause for alarm or confusion; it is addressed relatively easily by the imprecise but sufficiently accurate judgment that the "true" peak of the occupation is about 78 years later than the uncalibrated probability distributions suggest.

Another kind of refinement can be made by removing the dates that have wide standard deviations and multiple intercepts—although the effects of this latter selection must be considered carefully. Removing dates with multiple intercepts essentially involves eliminating representation of the periods when the calibration curve is jagged, meaning that a value on the axis of radiocarbon ages can match more than one point on the axis of sidereal years. If the sample of acceptable dates is reduced by eliminating all dates with standard deviations greater than 80 years and all dates with multiple intercepts, then 100% of the remaining calibrated intercepts fall within the interval A.C 600–750. This pattern seems to provide fairly strong confirmation of the inferences already made about the peak and span of La Quemada's occupation.

## Conclusion

The history of interpretation surrounding La Quemada provides a good example of the importance of detailed analysis of chronology. Wishing to make the most of available data, archaeologists may accept unfounded assumptions about dating that in turn affect their interpretations of broader issues. In the case of La Quemada, scenarios of conquest, colonization, and exploitation by distant peoples such as the Toltecs were plausible because the inadequate dating of the site. While many finer-grained chronological issues remain, the new data permit alignment of La Quemada's growth and decline with events and processes in the wider Mesoamerican world.

La Quemada probably was founded in the early A.C. 500s. Although a number of earlier dates have been discussed, virtually all are anomalous with respect to their

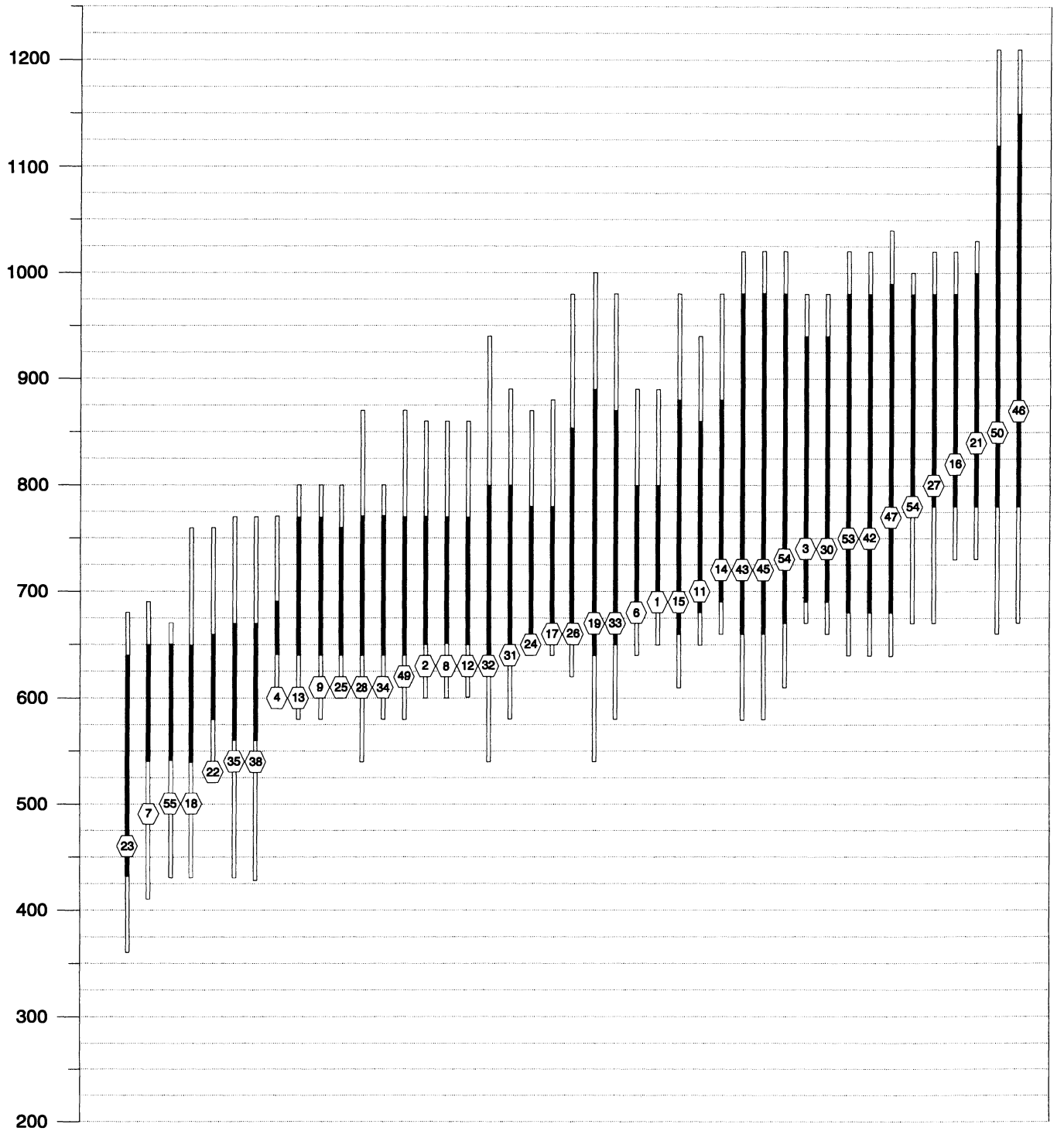



Figure 10. Chronologically ordered plot of uncalibrated radiocarbon means against their one-sigma and two-sigma calibrated ranges. Y-axis represents years A.C. Note: date no. 39, a.c. 650 ± 50, is not included in the plot.

stratigraphic contexts. The existence of material dating to the 4th or 5th centuries does not demonstrate that the site was occupied at those times since the dates could come from wood that was already old at the time of use. On the other hand, some of the early contexts at the site may be unrepresented because they are buried beneath later architecture. La Quemada grew into its main occupation from 600–750 and by the late 800s had shrunk back into its monumental core. Full abandonment, except for periodic visits, probably occurred in the early 900s. Archaeologists suggesting that dates from the 9th and 10th century represent post-occupational reuse of the site as a shrine appear to be on solid ground. Terrace 18 represents the apogee of the site's growth and probably spans most of its occupation. One of the main entrances to the western side of the site passes through Terrace 18, suggesting that Terrace 18 was integral to the site during the height of its development. There is little or no Postclassic occupation at La Quemada; despite some of its seemingly Postclassic traits such as the large colonnaded hall it cannot have been founded, and possibly was not even occupied, during that period.

The historical and processual implications of these findings are outlined in the introduction to this paper but are worth reiterating in the light of the above discussion. The appealing idea that La Quemada was a Toltec outpost established to facilitate the acquisition of turquoise from the American Southwest is unsupported. La Quemada's occupation was not contemporary with that of Tula Grande nor with that of Chaco Canyon, New Mexico, the proposed terminus of the turquoise trail. Also, the growth of La Quemada probably cannot be attributed to any other core state, since the growth of the site falls between the apogees of "mega-polities" in the Mesoamerican core region.

The notion that La Quemada was an outpost of empire, whether of Teotihuacan, the Toltecs, the Tarascans, or the Aztecs, should be abandoned in favor of more dynamic models of mutualism or autonomy. Peripheral populations were not simply reacting to processes in the core, but were constructing social power in accordance with their own local needs and resources. New local power structures developed within conditions created by core disintegration. La Quemada is only one of a number of peripheral polities that flourished at about the same time on the northern periphery of Mesoamerica (Cabrero 1989, 1991; Jiménez 1989; Trombold 1990). It is now clear that the growth of La Quemada occurred not in concert with that of the core, nor independently of it, but apparently in inverse proportion to it. One theoretical challenge before archaeologists of the region is to determine whether this cadence was coincidental, and if not, why polities on the periphery flourished while those in the core disintegrated.

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