Aztec period houses and terraces at Calixtlahuaca: The changing morphology of a Mesoamerican hilltop urban center

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Calixtlahuaca, a Middle–Late Postclassic site in the Toluca Valley of central Mexico, was occupied ca. A.D. 1100–1530. Our excavations reveal some of the processes involved in the creation, functions, and decay of a large hilltop urban center. At its height, the majority of the site's surface (264 ha) was covered with residential-agricultural terraces supported by a complex water management system. House construction techniques included the use of adobe brick, wattle-and-daub, and stone pavements. Our fieldwork contributes to a growing body of research on hilltop political capitals in Mesoamerica. Using a refined chronology, we illuminate the processes by which people constructed the residential zones of this ancient hilltop city.

Keywords: agricultural terraces, Aztec, hilltop centers, Postclassic, urbanism, Toluca Valley

Introduction

Recent excavations and surveys reveal an impressive variety in the forms and functions of ancient cities in Mesoamerica (Mastache *et al.* 2008; Sanders *et al.* 2003), leading to the recognition of hilltop political capitals as a recurring Mesoamerican urban form. The best studied examples of this form are Monte Albán and El Palmillo in Oaxaca, Xochicalco in central Mexico, and several Postclassic highland Maya cities. With the exception of Tlaxcallan (Fargher *et al.* 2011a), few of the Aztec period urban centers of central Mexico were built on hilltops (Smith 2008). The site discussed here, Calixtlahuaca, is unusual for the Aztec period in that it is a large city (264 ha) with abundant monumental architecture on the top and sides of a hill.

Ethnohistorical and art historical evidence indicate that the rulers of the Calixtlahuaca polity were powerful kings. Excavations in the early 20th century focused on the site's civic architecture including numerous temples and a large royal palace (García Payón 1936, 1979). Our project took a complementary approach by excavating houses and terraces, providing detailed documentation of the chronology and morphology of this hilltop political capital. Although the terracing of the hillsides required major investments of labor, we found little evidence that indicated the involvement of elites or political authorities in this work or in the construction of houses on the terraces. We believe that households or neighborhoods were responsible for the construction and operation of the physical urban infrastructure of terraces, drains, and houses. We suggest, however, that elites were relevant at ancient Calixtlahuaca. Indeed, both monumental architecture and a program of politically themed public art (Umberger 2007) provide ample evidence for their political and social prominence at the city.

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The Site of Calixtlahuaca

Calixtlahuaca is a Middle–Late Postclassic period (ca. A.D. 1100–1530) urban center whose remains are in the village of San Francisco Calixtlahuaca, Toluca, Mexico. It is located in the Toluca Valley, which is separated from the Basin of Mexico to its east by mountains (FIG. 1). The site is best known for the civic and religious buildings excavated and restored in the 1930s by José García Payón (1936), which include a large circular temple, a royal palace, and other temples and civic plazas.

The site covers most of the slopes and top of Cerro Tenismo, a remnant of an old volcanic caldera known as Sierra Morelos (FIG. 2). Tenismo rises from the surrounding alluvial plain at ca. 2650 to 2920 masl.

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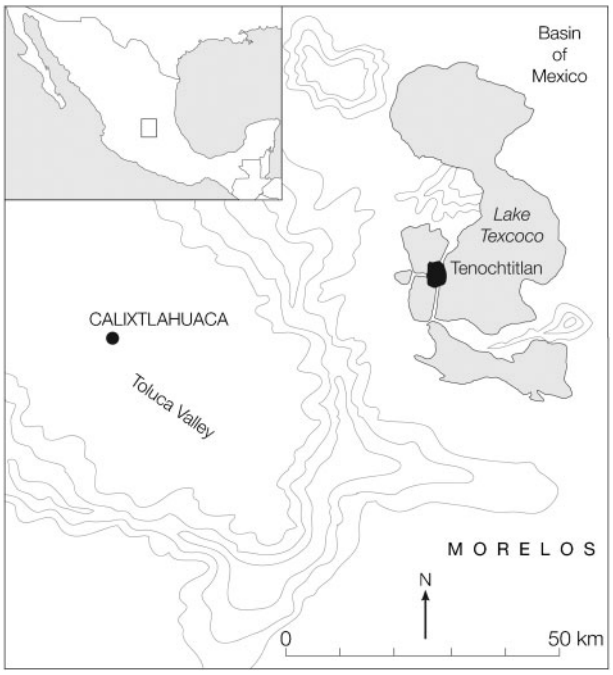

Figure 1 Location of Calixtlahuaca in central Mexico.

The site extends onto the plain and the slopes of a small adjacent hill, Cerro San Marcos. Most of the site is above the limit of 2700 masl that Sanders (1976) set for the Prehispanic cultivation of maize in the Basin of Mexico. However, in view of the higher precipitation in the Toluca Valley (ca. 800 mm per year) and the advantages of cold air drainage that the slopes offer with respect to the plain, modern farmers are able to grow maize, maguey, and other crops.

Ethnohistorical background

Few historical data exist for social conditions before the conquest of the Toluca Valley by the Aztec Empire around 1476 under the Mexica king Axayacatl. Home to speakers of the Nahuatl, Matlatzinca, Otomi, and Mazahua languages (García Castro 2000), the valley was a complex ethnic and political mosaic. The most powerful capital prior to Axayacatl's conquest was known as "Matlatzinco," and several lines of independent documentary evidence confirm that the archaeological site of Calixtlahuaca constitutes the remains of this capital (García Castro 1999: 56; Tomaszewski and Smith 2011).

According to native historical accounts, Axayacatl's conquests of Calixtlahuaca and other polities of the Toluca Valley around 1476 were motivated by the need to stop the aggressions of the Tarascan Empire to the west (Carrasco 1999). After conquest, the power and position of Calixtlahuaca/Matlatzinco were reduced and Tollocan (Toluca) was selected as the head town of the province. Groups of immigrants from the Basin of Mexico were sent to repopulate areas of the Toluca Valley, whose residents had fled or where resistance was encountered (Hernández Rodríguez 1950), and some natives were forcibly moved to new areas (García Castro 2004; Umberger 1996). One goal of our project was to establish a pre- and post-conquest chronology for Calixtlahuaca.

Previous fieldwork

José García Payón excavated at Calixtlahuaca between 1930 and 1938 and, as was common at that time, he concentrated his efforts on the site's monumental architecture. Structure 3—a large four-stage circular pyramid dedicated to the wind god Ehecatl—is the best known building. García Payón excavated other religious structures at the site, including Structure 4—a rectangular temple that yielded offerings of vessels with the likeness of the deity Tlaloc—and a cross-shaped building decorated with tenoned stone cones and skulls. He also excavated a large architectural complex on the plain at the base of the hill known as Structure 17. Although García Payón called this structure a *calmecac* (school), it is almost certainly a royal palace (Smith 2008: 115–119). His excavation of several smaller structures in a patio group (Group C in our nomenclature) revealed burials with rich offerings of ceramic vessels, bronze objects, greenstone jewelry, obsidian, rock crystal, and other items, giving rise to the name of *Panteón* (cemetery), by which the complex is known today. Similar burials with offerings were

Figure 2 View of Cerro Tenismo from the northwest. The entire hill was covered with terraces and houses. Horizontal lines of vegetation mark modern terrace risers.

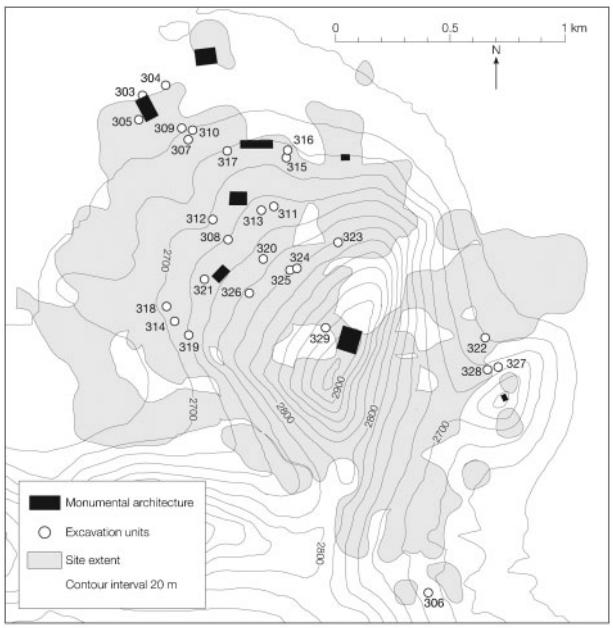

Figure 3 Extent of the Postclassic city of Calixtlahuaca showing the locations of the Arizona State University excavation units.

excavated in the plaza in front of Structure 3. Unfortunately, García Payón did not adequately publish the results of his fieldwork at Calixtlahuaca, apart from brief articles on ceramics and burials (García Payón 1941a, 1941b), and most of his notes and materials have been lost.

The Arizona State University project

Our project carried out two seasons of fieldwork at Calixtlahuaca beginning in 2006 with an intensive surface survey of the site. Using specially designed procedures to link GIS databases, digital orthophotos, and GPS devices (Tomaszewski 2006), the archaeological zone and surrounding areas were surveyed on foot. Survey teams recorded data on natural conditions and surface artifacts and made both systematic and opportunistic surface collections using standard 5×5 m units. All collected artifacts were classified and quantified. It was clear that occupation at the site extended far beyond the 120 ha of the Instituto Nacional de Antropología e Historia (INAH) archaeological zone (Smith *et al.* 2009), which covers the north face of Cerro Tenismo and includes all of the architecture excavated by García Payón. After completing the survey in 2007, we redefined the urban limits to encompass 264 ha (FIG. 3). The expanded site limits include the majority of Cerro Tenismo, a small neighboring hill, and limited amounts of the surrounding plain. During the second season of fieldwork in 2007, we excavated 27 areas, called units (TABLE 1; FIG. 3). Approximately half of the excavation units were dug to address geoarchaeological issues related to the use and modification of the hillside through terracing and other activities, while the other half targeted houses and deposits of domestic refuse.

Table 1 Excavation units; lot is another level of physical unit of excavation and provenience control.

					Phases†		
Unit	#Lots	Area excavated*	Goal of excavation	Contexts found	D	N	Y
303	54	18.0	Testing near royal palace	Fan and gully with artifacts	x	x	–
304	17	11.0	Testing near royal palace	Fan and gully with artifacts	–	x	–
305	42	8.0	Testing near royal palace	Alluvial fan with artifacts	x	x	–
306	13	10.0	Domestic deposits	Nothing	–	–	–
307	73	77.0	Domestic deposits	House and midden	x	x	x
308	30	14.0	Terraces and drains	House fragment, terrace, drain	–	x	x
309	73	84.0	Domestic deposits	House with exterior pavements	–	–	x
310	29	14.0	Domestic deposits	Midden	–	x	–
311	75	51.5	Terraces	House, midden, terrace	x	x	x
312	22	12.0	Terraces	Colluvium with artifacts	?	?	?
313	34	9.0	Drain	Gully filled with Postclassic refuse	x	x	–
314	32	52.0	Domestic deposits	Modern terrace	x	–	–
315	169	101.0	Domestic deposits	Burned house and pavement	x	–	–
316	133	91.8	Domestic deposits	House with exterior pavement	x	x	x
317	224	127.0	Domestic deposits	House, pavements, burial	–	–	x
318	9	47.0	Infilled gully	Gully with artifacts	–	–	–
319	54	12.8	Terraces	Terraces	x	–	–
320	102	48.0	Terraces and house	House floor, midden	x	x	–
321	81	42.2	Terraces	Terraces and burials	–	x	–
322	12	4.0	Test pit	Ancient terrace	–	–	x
323	120	36.5	Domestic deposits	Midden, burned house fragment	x	–	x
324	103	28.0	Terraces and house	Terraces, pavement, pit	x	x	x
325	7	3.5	Water control feature	Colluvium, wall debris	–	x	–
326	26	11.3	Terraces	Terraces, gully with artifacts	x	–	–
327	13	7.0	Terraces	Modern terraces	–	–	x
328	7	2.0	Terraces	Modern terraces	?	?	?
329	18	12.0	Terraces	Terraces, buried ditch	–	–	x

* Square meters.
† D (Dongu); N (Ninupi); Y (Yata).

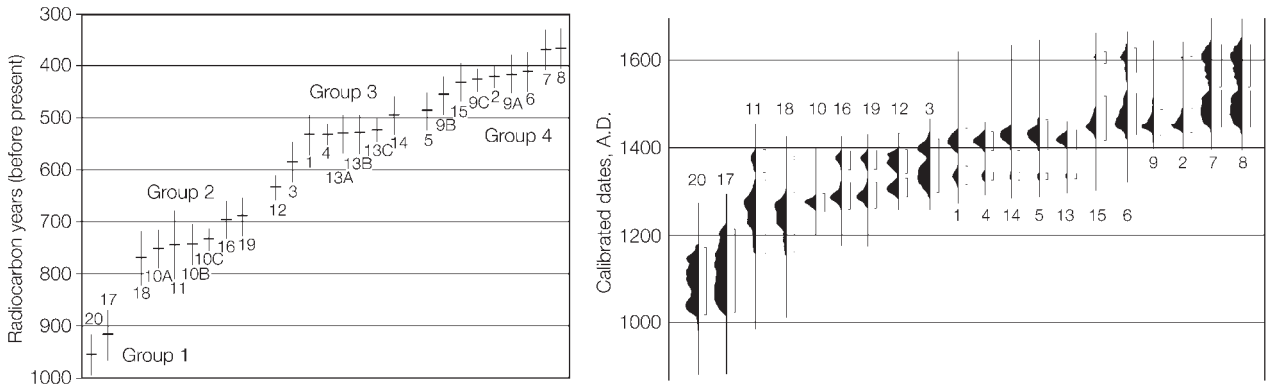

Figure 4 Twenty radiocarbon dates from Calixtlahuaca. A) Plot of uncalibrated radiocarbon ages; B) Calibrated ages (from Bronk Ramsey 2008).

Chronology

Calixtlahuaca was occupied during the Middle and Late Postclassic periods. García Payón proposed a start date for the site as early as the Classic period (A.D. 100–600), and the collection of materials from his project contains a number of Classic period ceramic vessels including some Xoo phase (A.D. 500–800) vessels probably imported from Oaxaca (Smith and Lind 2005). With a single exception, however, we recovered no evidence for occupation prior to the Middle Postclassic period. The exception is a small deposit of gully fill (in Unit 318) that contained some eroded sherds from Classic period vessels, which were most likely transported from a Classic period house or another deposit upslope. Formative (1500 B.C.–A.D. 200) and Classic period figurines are present in Postclassic middens, mixed in with Postclassic ceramics and artifacts; we attribute these to the collecting of old objects by the Postclassic inhabitants of the site. In addition to comparative ceramic data from other Toluca Valley sites (Tommasi de Magrelli 1978; Vargas Pacheco 1975), 20 radiocarbon dates (FIG. 4) support the conclusion that the occupation of Calixtlahuaca was limited to the Middle and Late Postclassic periods (Fowler 1996).

Huster and Smith carried out a seriation analysis of the ceramics from the excavations, the details of which will be presented elsewhere; here we summarize the main findings of that project. Using k-means cluster analysis on type frequencies in ceramic collections, we divided the collections into two clusters. The deposits in one cluster are consistently located stratigraphically above the deposits of the other cluster, while imported ceramics of known date suggest strongly that the two clusters correspond to the Middle and Late Postclassic periods, respectively. These periods are dated at Yautepec, Morelos, which has the best documented Aztec period chronology in central Mexico, to A.D. 1100–1300 and 1300–1520, respectively (Hare and Smith 1996). Further, we were able to subdivide the Late Postclassic cluster into two chronological phases based on stratigraphy. The resulting three ceramic phases are labeled Dongu (Middle Postclassic), Ninupi (early portion of the Late Postclassic), and Yata (late portion of the Late Postclassic). The final stage of the seriation analysis involved the classification of additional ceramic collections with regard to the three phase clusters using discriminant function analysis.

The uncalibrated radiocarbon ages of the 20 samples fall into four clusters that we define as Groups 1 to 4 (FIG. 4A). The contexts that yielded the carbon samples in Groups 2–4 are consistently assigned by the ceramic seriation and stratigraphy to the Dongu, Ninupi, and Yata phases, respectively. The two dates in Group 1, the earliest group, are anomalous both in their large sigma values and in their associated ceramic assemblages, which pertain to the Ninupi and Yata phases. The attribution of the Dongu phase to the Middle Postclassic seems secure, but the timing of the transition from Ninupi to Yata is still uncertain. We anticipate that the results of a second set of 36 additional radiocarbon dates will permit us to establish reliable dates for beginning and ending dates of all three phases. Those results will then be compared to the ethnohistorical chronology of the site and the Toluca Valley (Tomaszewski and Smith 2011). The dating of the terraces is less secure than that of the domestic deposits, due to the large scale redeposition of artifacts and charcoal in terrace fills and the often small number of ceramics they contain. We thus use the three-phase chronology only for our discussion of the house excavations.

Several lines of evidence suggest that the Yata phase occupation of Calixtlahuaca continued briefly into the Colonial period (A.D. 1521–1810). First, ceramic figurines that depict Spaniards in the uppermost levels of some Yata deposits demonstrate occupation after 1520. Second, the absence of any other markers of Colonial occupation (e.g., glazed ceramics, iron objects, European fauna) suggests that it was brief. Third, archival evidence reveals a poorly documented episode of *congregación* (forced relocation of indigenous peoples into central communities),

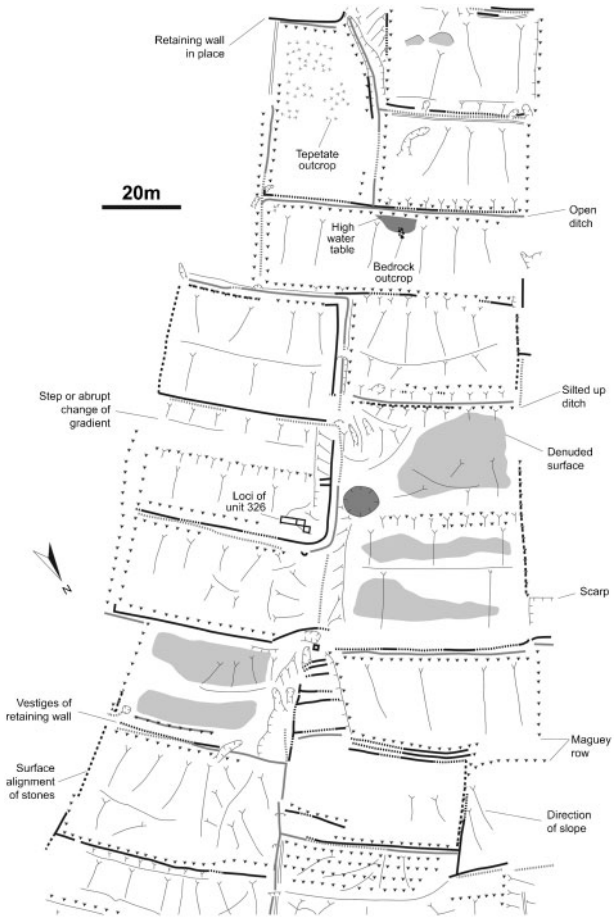

Figure 5 Agricultural surface morphology in the vicinity of Unit 326.

in which individuals from the Calixtlahuaca area were moved into Toluca some time between 1530 and 1560. Fourth, the village of San Francisco Calixtlahuaca was not founded until several decades after the Spanish conquest and shows little or no spatial continuity with the Yata phase occupation at Calixtlahuaca. This discontinuity has been beneficial for archaeological research, because—unlike most Aztec cities—the majority of the Postclassic occupation is not under a modern settlement.

Terraces

Cerro Tenismo is covered today by a patchwork of cultivated, fallowed, and grazed fields (FIG. 2). In some places cultivation is made impossible by outcrops of bedrock, while in others by the formation of badlands made up of erosional pedestals separated by a dense networks of gullies. Most of the hill is terraced or displays signs of having been terraced in the past. The lower north-facing slope is covered by dense modern settlement on terraces that are often cut with the aid of heavy earthmoving machinery. The middle and upper northern and northwestern slope is the area most intensively used for agriculture today. It contains the most sophisticated terracing (FIG. 5) and most of the monumental architecture of the Postclassic period.

Most fields in this part of the site can be classified as bench terraces (see Frederick and Krahtopoulou 2000; Whitmore and Turner 2001: 145–154) with gently sloping treads. The risers are walls built of unfaced field stones set in a mud mortar. The terraces generally follow the expected pattern of higher risers and narrower treads in steeper areas, which on Tenismo tend to be those at higher altitudes. Some terraces also have slope-parallel retaining walls along the sides, separating them from an adjacent tread that is markedly lower or from a slope-parallel path, drain, or gully. A ditch usually runs along the back of the tread, at the foot of the riser of the next higher terrace; the front is often planted in one or several rows of maguey plants. The ditches were not designed as field canals (Doolittle 1990: 15–17) because the spoil from digging one typically was thrown downslope, where it formed a low ridge, and was sometimes reinforced with stone. Water may normally seep down towards the planting surface, but after heavy rains, the ditches divert it away from the field, preventing uncontrolled flooding and gully initiation. One of these ditches may articulate at the edge of the tread with another ditch that runs along the side of the field parallel to the slope. The latter ditches are typically wider, deeper, and more continuous, passing by several fields. We refer to these ditches as drains in order to distinguish them from the slope-perpendicular ditches. Certain drain reaches are wide enough to be blocked by stone walls to create cross channel terraces, inserted between flights of bench terraces. In many places the drains stop abruptly at the corner of a field, and their prolongation is taken up by a wall, berm, or line of maguey plants. The regular alignment of such slope-parallel field boundaries suggests that in the past the drains were more continuous and that some degree of planning or coordination was involved in their layout.

Two such alignments are particularly striking because they traverse the entire site. We refer to them as the master drains. One leads from the summit towards Structure 4 and the cruciform structure, the other from the summit towards and beyond the Panteón. The fact that the large platform of the Panteón interrupts the course of the master drain suggests considerable antiquity in the layout of the latter. The master drains originally could have been paved, as indicated by some protrusions of flagstones along their courses, and contained between the side walls of contiguous terraces. As such, they would have efficiently channeled runoff when it rained as well as channeled traffic up and down the hill, obviating the need to climb terrace risers. The paving and the double purpose of the drains are described by García Payón (1981: fig. 11, 1979: 188–191, 303–310) and were mentioned to us by an elderly local resident. In their

present state, however, the drains hardly serve either purpose. In a few places along the courses of the master drains we observed partially destroyed and buried features that may have acted as plunge pools that took time to fill before they overflowed, thereby reducing the velocity of flow.

Simpler field morphologies dominate outside the central area of the site. There are treads that slope at a gradient just slightly less than that of the natural slope and are separated only by ditches and berms planted in maguey, an arrangement known in much of central Mexico as *metepantle* (West 1971; Wilken 1987: 105–113). Other fields are lined on all four sides by dry-laid stone walls (*tecorrales*). These walls do little to modify slope gradient and their main purpose seems to be to keep out livestock. Finally, there are also sectors of the hill that have a gradient equal to the natural one, but where the former presence of terracing is indicated by half-buried stone alignments, subtle breaks in slope gradient, or changes in the vigor of grass growth. Elsewhere, similar patterns point to the purposeful elimination of a former riser and the merging of two narrow treads into a single, wider, more inclined tread.

The obvious problem that this agricultural landscape poses for the study of Aztec urbanism is distinguishing the layout of the Postclassic city, in which the function of terraces was presumably both residential and agricultural (Evans 1985; Smith 2012: 182–185), and understanding the modifications that have accrued over over the half millennium since the city's abandonment. Terraces are inherently unstable landforms, and in those parts of the highlands where their maintenance was discontinued in the Colonial period, they have in most cases completely disintegrated (Borejsza 2006; Córdova and Parsons 1997; Fisher 2005). Therefore, the relatively good state of preservation at Calixtlahuaca is in itself an indication that they have been managed and modified to a significant degree since the Postclassic.

Terrace excavations

As surface observation could not completely disentangle the contributions of different generations of farmers, we implemented an excavation program that would uncover terraces, associated water management features, and the products of terrace degradation. We targeted places where observations of the modern ground surface and cuts revealed by recent gullying or construction activity led us to expect the preservation of long and complex stratigraphic sequences. We usually laid out trenches perpendicular to the features we targeted. Thus, trenches were slope-parallel on terrace treads and slope-perpendicular in the case of drains. Other relevant contexts were explored as opportunities arose in units originally opened to discover houses or certain artifact assemblages. In the end, terrace fills were excavated in practically all units (TABLE 1), with the exception of those situated at the very foot of the hill. Units at the lower elevations yielded information on how sediment delivery from Cerro Tenismo responded to changing land use. We were less fortunate in the case of the master drains, as landowners prevented access. Segments of the system that channeled runoff from the hill were nonetheless excavated in several units. Our dataset is the largest sample of stratigraphically explored terraces in Mexico.

Three excavations in the center of the site—Units 308, 311, and 321—produced a similar stratigraphic sequence, in which a natural soil profile was buried by two generations of wedge-shaped terrace fills (FIGS. 6, 7). The soil profile in question had developed in sandy yellowish sediments of pyroclastic origin. Though unconsolidated, some are indurated enough to merit the folk designation of *tepetate*, a subsoil horizon too hard to be plowed (Etchevers *et al.* 2003). Their upper parts have been modified by the accumulation of organic matter and illuviation of clay to such an extent that they have a texture of clay or silty clay and a bluish black color. They also have a strongly developed structure of prisms that swell and shrink with the alternation of wet and dry seasons. The colors, mottling patterns, and occasional slickensides displayed by these horizons point to seasonal saturation in water. We are certain that this soil profile predates the human occupation of the site because the attributes described take millennia to develop, and because it contains no artifacts, except for those that fall into the cracks that separate the prisms. The soil in question is very difficult to till even with the use of a plow because of the high clay content, and farmers say it is infertile.

The overlying terrace fills document the progressive modification of the natural soil. The fills become more sandy, more friable, and their color passes from bluish black, through gray, to yellowish brown. The structure becomes much less pronounced and takes on angular, then subangular blocky forms. These differences are most pronounced at the front of the terrace treads and least at the back where the fills pinch out and the clayey soil may appear at the modern ground surface. There is, in most places, a clear boundary between the two generations of terrace fills, pointing to a break in terrace use or a significant change in the techniques of their management. The older terrace fills contain a higher concentration of charcoal, sherds, and other artifacts, suggesting more regular additions of refuse. In Unit 321 they also contain vestiges of bedding that may indicate purposeful flooding of the tread in order to raise its surface and replenish nutrients. The cumulative result of terracing in all three units (308,

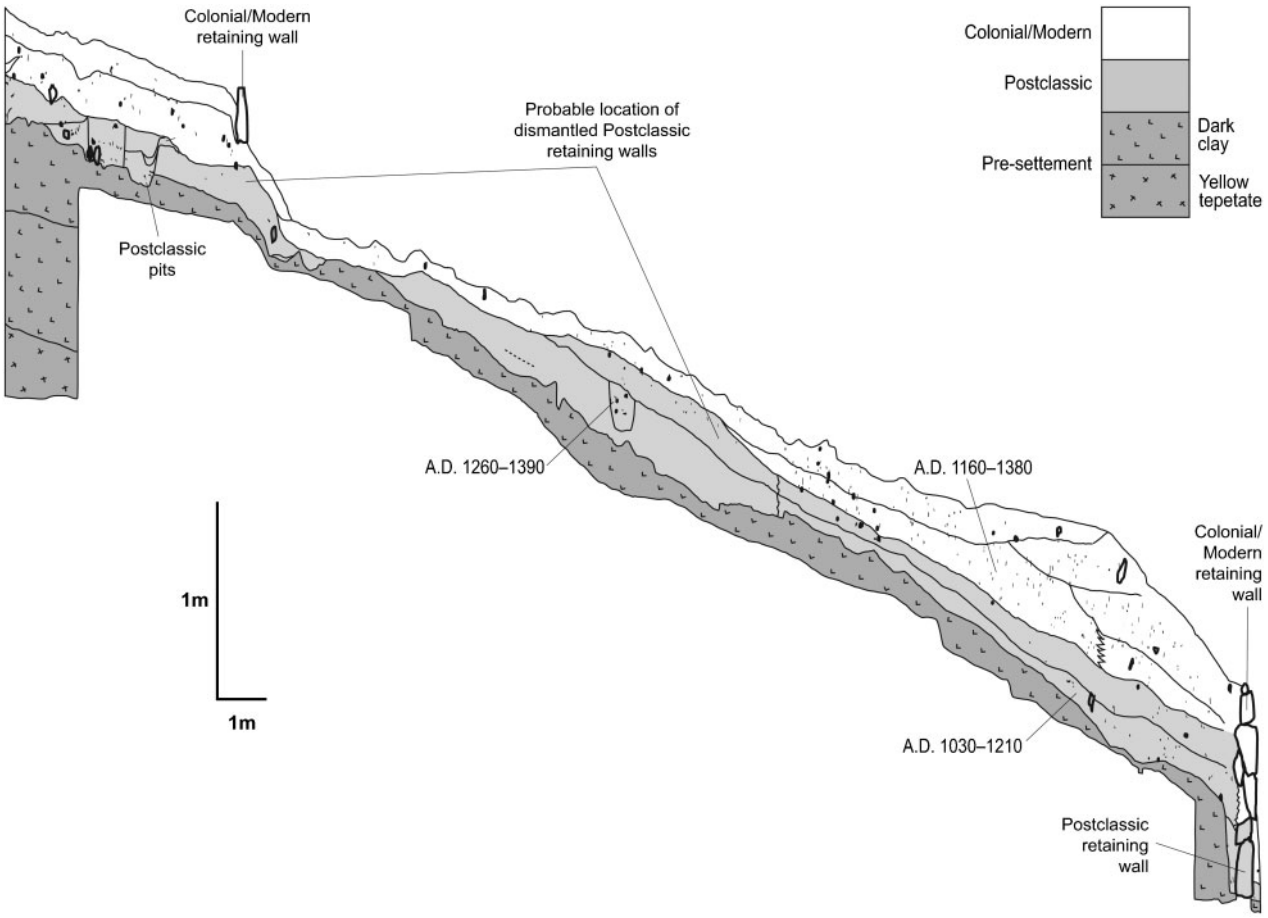

Figure 6 100N section of excavation Unit 321. Dates are radiocarbon ages calibrated at two sigma.

311, and 321) is a composite soil profile better suited for agriculture: the friable and sandy surface horizons are easy to till and allow the percolation of rainwater, which is then stored in the underlying clay-rich horizons where it can be tapped by the roots of the crop.

The geometry of the two generations of fills is also interesting. In each, the slope was cut into and the spoil was redeposited as terrace fill; but the introduction of extra fill from farther afield cannot be ruled out. In Units 311 and 321, the length of the stratigraphic sections was sufficient to reveal that, between one generation and the next, some risers were eliminated and the treads that they separated were merged (FIG. 7). We thus have stratigraphic confirmation of the process of merging treads that we had hypothesized from surface observations, and we have some prospects for dating the process. In Units 308 and 321, differences in stratigraphy between the center and the sides of the treads reveal that in the past they occupied, respectively, convex and concave sectors of the hillside. The latter required the addition of much larger volumes of fill in order to raise them to the level of the rest of the tread and to create a single bench terrace.

Higher up the hill, on a steeper slope, the clay-enriched horizons are absent in Units 320, 324, and 326, and the terrace fills rest directly on top of the natural substrate. It is possible that the clay-rich horizons never formed here, but it seems more likely that they were removed by natural or anthropogenic erosion prior to the Postclassic occupation of the site or by the cut-and-fill operations involved in constructing terraces. The stratigraphic sequences also record two stages of terrace construction separated by an erosional unconformity. The older terrace fills are present in the form of isolated remnants buried by colluvial deposits generated by terrace collapse and dissected by gullies. The younger generation of terraces was created after the gullies were backfilled and the colluvium was subjected to a second round of cut-and-fill terrace construction. In Units 320 and 324, Postclassic house foundations and floors were found, with associated ceramics dating to the Dongu phase. In both cases, they were situated at the back of the tread (the portion that is cut), rather than at the front (the portion that is filled). This is the preferred position for houses in terraced landscapes because the weight of the construction is borne by the compact natural substrate.

Units 329 and 319 were situated at the periphery of the site, the former near the summit of Cerro Tenismo and the latter on its western footslope (FIG. 3). They have in common a loamy, pale brown

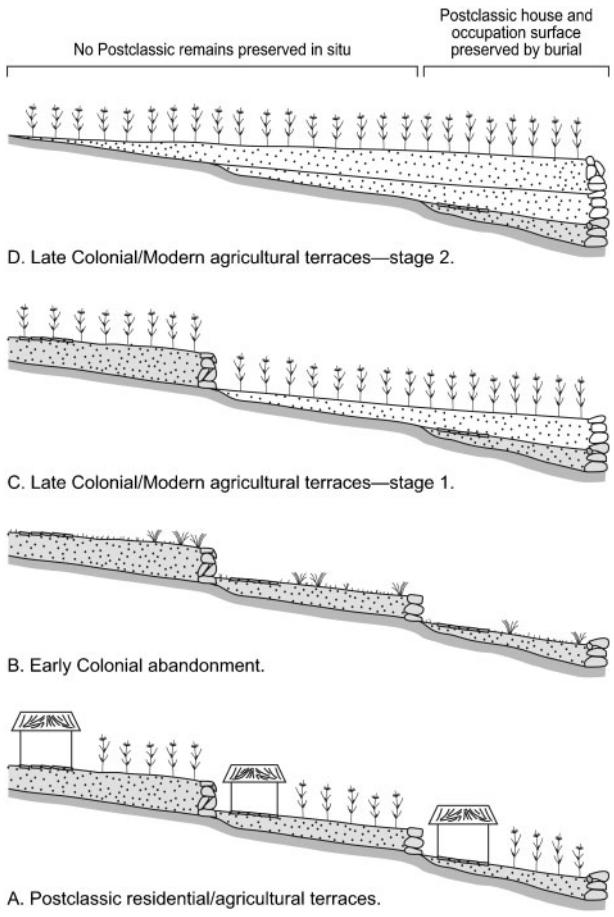

Figure 7 Schematic model of the process of merging terrace treads.

natural substrate that could have come from the weathering of bedrock, rather than that of unconsolidated pyroclastics. Outcrops of bedrock and detached fragments are particularly prominent in Unit 319. The building of terrace walls here had the beneficial side effect of clearing the treads of stones and boulders that hindered tillage. The terrace fills excavated in these units are texturally closer to the pre-terrace soils than those in the center of the site. They contain fewer artifacts and charcoal, testifying to lower amounts of refuse, perhaps owing to the prevalence of agricultural over residential use. There are two stages of terracing in Unit 329, but the attributes that set them apart are less pronounced than farther downslope. In Unit 319, there is only one stage. The walls are in an advanced state of decay and the modern ground surface has almost recovered the natural gradient.

The most recent terrace fills in Units 310, 313, 314, 321, 323, 324, and 326 bury and incorporate infilled, slope-parallel gullies that have almost no expression on the modern ground surface. In several cases they are aligned with the course of our master drains. They all contain Postclassic artifacts, often including those of the latest ceramic phases. In Unit 323, the gully fill contained an entire panel from the wall of a wattle-and-daub house, charred fiber of some sort, a broken pot from which charred beans had spilled, and other hints at rapid abandonment of a house and the rapid infilling of the gully. In Unit 313, a very deep infilled gully contained a concentration of artifacts comparable to a midden. Included were large unabraded sherds and stones that seemed too large to have been transported by the current in the gully and were more likely intentionally dumped architectural rubble from the demolition of some nearby structure. It is likely that the gully did indeed serve as a midden. Given its proximity to several monumental structures, demolition debris and other refuse were probably dumped here during the abandonment of the Postclassic settlement.

Other striking examples of landscape transformation come from Unit 318 and from Units 303 and 305 in the vicinity of the Postclassic palace. In Unit 318, the infilled channel of a stream today stands aloft in an erosional pedestal. A complete inversion of the natural topography has taken place. This inversion occurred within the timespan of human occupation since the channel contains Prehispanic artifacts throughout its 4 m depth. The palace stands on top of an alluvial fan at the terminus of another stream draining the slope of Tenismo. The fan became active again after the palace was abandoned. The swiftness of the burial of the palace, and the amount of sediment mobilized, can be grasped from García Payón's (1981: figs. 57, 63, 1979: 202–203) exposure of several preserved Postclassic adobe walls, some standing to the full height of the original first story. Gullies choked with Postclassic artifacts, uncovered in Unit 303, seem to have been distributaries of the fan that cut across the central courtyard of the palace.

Land use history

The absolute chronological framework for reconstructing the transformation of Calixtlahuaca's landscape is based on artifacts from excavated deposits, a limited suite of radiocarbon dates, and fragments of written and oral history. There is little indication of intensive farming or slope modification before the Dongu phase. Given the bipartite structure of several terrace fills, and the evidence for two stages of terrace construction that in several instances can be shown to be separated by a stage of severe gullying and colluvial transport of sediment, we are inclined to associate the first stage of terracing with the Middle to Late Postclassic occupation of the site. In several units the association is beyond any doubt, as the terrace fills support house foundations or are cut by graves and other pits of the Postclassic period. The few bricks, glazed sherds, glass, and iron artifacts that the younger terrace fills contain place them after the arrival of the Spanish. Their construction could have begun in the late 18th century when population in the

Toluca Valley began to rebound (Ouweneel 1991), or in the middle of the 19th century when the inhabitants of San Francisco Calixtlahuaca were dispossessed of land on the valley floor (García Payón 1979: 216). The intervening stage of terrace abandonment and decay probably began between 1520 and 1600 when the effects of epidemics and congregation efforts in the Toluca Valley took hold (García Castro 1999).

Our preliminary summary of local land use history is as follows. Middle Postclassic settlers encountered a hill of irregular topography with radially alternating concave and convex sectors. They placed walls and other obstacles across the concave (i.e., water-gathering) sectors, allowing the accumulation of sediment in cross-channel terraces. In the convex sectors, they created bench terraces by cut-and-fill techniques. Over time most concave sectors were raised to the same elevation as the convex sectors. As a result, rectangular bench terrace plots covered most of the slope, while surface runoff was confined to the narrow drains between them. Terraces in the center of the site supported public structures and private residences. The residences shared terrace treads with gardens in which domestic refuse was discarded. Terraces on the periphery of the site were devoted primarily to staple crops. Colonial depopulation and the relocation of settlement away from Cerro Tenismo resulted in the destruction of this mixed urban-rural landscape. Breached walls of neglected terraces and former drains concentrated runoff, initiating the development of gullies, which removed terrace fills and construction debris, channeling them towards the foot of the hill. The hill was probably turned over to grazing, which may have contributed to land degradation and prevented the regrowth of natural vegetation. When farmers began to reclaim the slopes in the 18th or 19th century, gullies were filled in, walls rebuilt, and new terraces superimposed on Prehispanic ones. Since animal and later tractor drawn plows required wider treads, older treads were often merged, resulting in a pattern of slope-perpendicular strips (FIG. 7). In each strip in situ remains of the Postclassic settlement were either obliterated or preserved by burial. The periphery of the site was left to grazing and there the damaged vestiges of the Postclassic settlement survive at the modern ground surface in a more random pattern. Without extensive excavation, the maze of stone walls visible on the slopes of Cerro Tenismo today cannot be used to reconstruct the layout of the house lots of Postclassic Matlatzinco.

Houses and Domestic Deposits

Approximately half of our excavations at the site targeted domestic structures. Six units contained houses that were completely excavated, and three others were partially excavated. The majority of the excavated houses contained components assigned to more than one chronological period. Excavation units were selected to provide a sample for different portions of the site, from the valley floor to the upper slopes of the hill. Specific excavation locations were selected based on a combination of landowner permissions, geomorphological probability of preserved remains, and the presence of visible architecture at the ground surface.

Dongu phase

Thirteen of the 27 excavation units encountered deposits dating to the Middle Postclassic Dongu phase (TABLE 1). These units are scattered over the entirety of the portion of the site sampled by excavation, except for the eastern settlement on Cerro San Marcos (FIG. 3), suggesting a rapid colonization of Cerro Tenismo. Portions of houses were encountered in Dongu phase deposits in five units (307, 315, 320, 323, and 324).

Unit 307 contained stratigraphic deposits from all three ceramic phases. This unit was excavated in a plowed field located between the palace and the circular temple. A trench placed on a low topographic rise encountered the remains of a partially destroyed house, a terrace wall, and several midden deposits (FIG. 8). The house appears to be a narrow structure of which only the central portion has survived. The southern (upslope) wall extends several meters to the east beyond the north-south wall, which was either an interior dividing wall or the eastern wall of the house. Several large square pavement stones along the north wall were likely part of an exterior pavement, most of which have eroded. The house probably had an earth floor. The remains of a terrace wall were located 5 m north of the house. A pit excavated into tepetate just south of the structure contained a very dense, stratified midden.

Occupation of this terrace began in the Dongu phase with the construction of the house, which was used continuously for the remainder of the Postclassic sequence. The lowest fill in the midden dates to the Ninupi phase; there are two Ninupi strata and two Yata strata. The upper Ninupi deposit was extremely dense with artifacts; the sherd density was 15,800 sherds per cu m. Unit 307 yielded 18 of the 38 pieces of copper/bronze recovered by the project, including one item from a Dongu phase level. The 10 metal items from Dongu phase deposits at Calixtlahuaca are the largest collection of Middle Postclassic bronze objects yet excavated in central Mexico.

A burned wattle-and-daub structure excavated in Unit 315 also dates to the Dongu phase. This excavation was initiated to test a small line of stones

Figure 8 Plan of the house in Unit 307.

located 200 m east of Structure 3, noted during the 2006 survey. The slope was actively eroding in this area, exposing the tepetate several meters downslope from the line of stones. Initial clearing revealed an amorphous layer of stones with several short segments of aligned stones both parallel and transverse

to the hillslope. The stones appear to have been transported from upslope, perhaps from features associated with the house in Unit 316 located immediately upslope from Unit 315 (FIG. 3). Excavation below the stones revealed a layer of burned daub fragments encompassing a 4×3 m area, which in turn rested on a layer of heated clay. These features represent the partially preserved floor of a burned wattle-and-daub house. Below these house remains we located a canal cut into tepetate running downhill to the east. The entire sequence in Unit 315 dates to the Dongu phase. The amorphous stone layer that covered these deposits contains ceramics from all three Postclassic phases, most likely eroded down from Unit 316.

Three other units yielded small portions of Postclassic houses associated with Dongu ceramics. Unit 320, excavated in an area of narrow modern terraces, revealed the poorly defined back wall of a Postclassic house built on a tread cut deep into the slope and a patch of a pumice surfaced floor. Most of the house was destroyed by erosion and buried by the second stage of terracing. Unit 323 was placed on a high terrace that had also been farmed in recent years. Three parts of the terrace were tested, resulting in the identification of two areas of Postclassic occupation. Excavation in the central zone encountered dense refuse deposits of the Dongu phase including a horizontal lens of burned refuse and debris, but without an associated structure. All of the ceramics from these deposits date to the Dongu phase. The deposits were subsequently buried, most likely in the Colonial period, by colluvium containing Yata ceramics. The eastern portion of Unit 324 contained an ancient gully or drain running perpendicularly across a modern field that exposed a cross section of three Postclassic terraces. The middle terrace included a Dongu phase pavement that covered a midden intruding into tepetate. The midden contained an unusually large deposit of mostly intact small ceramic vessels of the type we call "Crude unfinished." We cannot yet identify the function of these vessels; however, their size, finish, and shapes suggest that they may have been used in some kind of craft activity.

Ninupi phase

Eleven excavation units included deposits of the Ninupi phase and two others may have been occupied at this time. Two of the excavated houses—in Units 311 and 316—were built during the Ninupi phase in areas with prior Dongu occupations. Unit 311 was excavated in a modern field above a terrace wall where we suspected that modern terracing had buried (and preserved) Postclassic deposits. The field immediately downslope from this location contained dense concentrations of obsidian (documented in the 2006 survey), which we investigated to determine if obsidian tool production took place in this area. We did not obtain permission to excavate in the obsidian filled field, but secured permission to work on the terrace directly upslope (FIG. 3). The upslope (south) wall of the house in Unit 311 was well preserved and the quality of the masonry exceeded that of other domestic structures. The east and west walls were only partially preserved and the north (downslope) wall had been destroyed by erosion. Although the quantities of obsidian in this unit were high, the kinds of obsidian tools and debitage recovered did not differ greatly from those in other excavations. A piece of the "cloud wing" from a massive Templo Mayor-style brazier, provisionally interpreted as an offering, was recovered from terrace fill within the unit.

Unit 316 was excavated in a vacant lot immediately upslope from Unit 315. The landowner had used a bulldozer to level the property in preparation for house construction, revealing a portion of a Postclassic stone pavement. This turned out to be one of two exterior pavements associated with a house with a packed earth floor. Like Unit 309 (described below), the earth floor was covered with a layer of jumbled stones, probably from the collapsed wall foundations.

Most architecture in Unit 316 was built during the Ninupi phase. Occupation began, however, during the Dongu phase, as evidenced by poorly represented structures and terraces immediately to the north and a shallow pit with Dongu ceramics. The Ninupi occupation began with the construction of a structure or structures represented by several fragmentary walls under the southern pavement. These were evidently dismantled before the visible pavements were laid over fill that contained Ninupi phase ceramics. A patch of burned earth north of the house also dates to this phase, as does an extensive midden north of the visible architecture that covered the burned earth. These middens were then covered by Yata refuse.

Many other excavations encountered Ninupi deposits, but without associated domestic architecture. Three units close to the royal palace (303, 304, and 305) contained high densities of unabraded sherds from this phase. In Unit 303, immediately north and downslope from the palace, Ninupi sherds were recovered from what appeared to be a Colonial gully; the materials in its fill likely eroded from the palace, which supports the notion that the palace itself dates to the Ninupi phase.

Yata phase

Only 10 units yielded deposits securely dated to the Yata phase; two of these units, 309 and 317, contain houses. Unit 309 was located by testing a level area at the bottom of a large sloping field below Unit 307.

Figure 9 Photograph of the house in Unit 309, looking south (upslope).

Figure 10 Photograph of the architecture in Unit 317, looking east.

The house located in Unit 309 is a rectangular building with an earth floor and exterior pavements on two sides (FIG. 9). Three superimposed (exterior) stone pavements were found on the north side and a pavement on the east side was at least partially enclosed inside a room. These pavements were carefully constructed using large stones with flattened upper surfaces. Only the western house wall is fully preserved. The earth floor in the center of the house was covered with an irregular pile of stones and other construction debris, similar to Unit 316; these were removed prior to taking the photograph in Figure 9. The deposit of apparent architectural collapse included several stones carved with geometric and glyph-like designs. All of the construction phases in Unit 309 date to the Yata phase and demonstrate that frequent remodeling occurred over a relatively short time period. In Unit 309, like in Unit 307, we had only limited time to explore outside of the structure and did not find any dense midden deposits. Nevertheless, the unit did include two reconstructable, locally produced, imitation Aztec III Orangeware tripod bowls.

Unit 317 was placed to follow the edge of pavement visible at the ground surface near the site museum. This excavation revealed a series of stone features (FIG. 10), the northern (downslope) portions of which had been destroyed by erosion. A partial house structure was present in the center of the unit, associated with a low platform revealing two phases of construction. There are two additional unattached rooms or outbuildings with stone floors to the southwest of the main house. Several abutting pavements cover the area between the main house and the additional rooms. Part of the earth floor of the house showed traces of burning. Abundant fragments of burned daub were recovered from this unit. Although most of the daub was recovered from the overburden from upslope that had covered the features, a significant portion was recovered in levels associated with the architecture of Unit 317. It is likely that there was an additional small wattle-and-daub structure on the main platform, perhaps lacking a stone foundation. The identification of terrace risers above and below the group suggests that the architecture occupied the entire width of the terrace tread. The back of the terrace containing the architecture is heavily cut into the underlying tepetate, a smaller scale example of the technique used to create level areas for several of the monumental structures at the site.

Unit 317 dates exclusively to the Yata phase. The stone wall foundations included several fragments of sculpture reused as building stones. One burial was recovered on what would have been the terrace below the one that contains the house, but it cannot be associated definitively with the structure. Like most Yata phase occupations, the ceramics include a wide range of imported types from the Basin of Mexico, among them Aztec III Black-on-orange, Aztec III/IV, Aztec III spinning bowls, *comales* (distinctive shallow vessels used to toast tortillas), Guinda redware, globular *copas* (small cups), Texcoco molded censers, and Texcoco fabric marked salt vessels (Parsons 1966). One fragment of turquoise was found in the unit (the only such item in our excavations), but no copper items.

Several of the units described for the Dongu and/or Ninupi phases also contained Yata phase deposits. The houses described in Units 307 (Dongu construction) and 316 (Ninupi construction) continued to be used through the Yata phase. One interesting feature of several of the Yata deposits is the presence of ceramic figurines depicting Spaniards (with Spanish-style hats and clothing). Most of these figurines were recovered from Unit 307, and several from Unit 317, in the uppermost levels of the Yata phase. These deposits lacked other markers of Colonial occupation

such as iron objects, glazed ceramics, or cow and horse bones. The presence of these Spanish influenced figurines suggests that the Yata phase occupation of Calixtlahuaca continued after the Spanish conquest, probably for a short interval.

House form and construction

Six of the excavated houses (in Units 307, 309, 311, 315, 316, and 317) were sufficiently complete to make some inferences about house form and construction. Four had stone wall foundations that resemble the bases for adobe walls of Aztec period houses in Morelos (Smith 1992). Such walls are around 30 cm in width and consist of two parallel rows of stones laid several courses high. The two houses without wall foundations (in Units 315 and 316) contained large quantities of burned daub, most likely representing wattle-and-daub rather than masonry construction. One house (Unit 317) had both stone wall foundations and abundant burned daub concentrated in an area without walls, suggesting a combination of construction methods within the same house complex.

All houses apparently had earth interior floors, some covered with an irregular layer of pumice. Smaller rooms in Units 309 and 317 had paved stone floors. In contrast to the palace and temples excavated by García Payón, lime plaster was not identified on floors or walls of the excavated houses. Three houses were associated with extensive, well made, exterior stone pavements akin to those in the royal palace. Although the erosion of the downslope portion of most of the houses makes the identification of their overall layout difficult, most appear to have one large room with one or two smaller rooms either attached or freestanding.

Although similar in size to the small, one room, Aztec period houses of Morelos (Smith 1992; Smith *et al.* 1999), these six houses vary far more in form and materials than the Morelos examples. We recovered over 500 kg of burned daub, most of it from four houses: Unit 317 (376 kg), Unit 315 (90 kg), Unit 323 (61 kg), and Unit 316 (14 kg). Some of the daub bears impressions of maguey stalks. Three houses exhibited evidence of burning and destruction. The destroyed houses date to different phases and thus cannot be linked to a single event, such as the Aztec conquest or the abandonment of the site during the Colonial period. Unlike the Morelos houses, those excavated at Calixtlahuaca cannot be divided easily into elite and commoner residences based on size and form.

Discussion

A number of features of the terraces and houses at Calixtlahuaca are worth discussing. Methodologically, our excavations underscore the difficulty of reconstructing ancient settlement layouts from the modern layout of terrace walls and other field boundaries. Minimal agricultural activity between site abandonment and the present is often assumed by survey archaeologists, particularly if the abandonment coincided with the epidemics of the Colonial period. Although conditions obviously vary from site to site, we suspect that most hilltop centers have suffered significant damage from agricultural activities and geomorphic processes.

What little we can reconstruct of the terracing at Calixtlahuaca suggests a diffuse settlement boundary and a lack of neat separation between urban and rural spaces, long known to be characteristic of intensive agriculture cross culturally (Netting 1993), and of Postclassic central Mexico (Smith 2012: 189) and highland Oaxaca (e.g., Kowalewski *et al.* 2009) in particular. The sophisticated management of water flow down the terraced hillside at Calixtlahuaca has few parallels in Mesoamerica, though the drains require better dating. The amount of labor invested in the moving of stone and earth, and the modification of soil properties is far greater than has been documented at other Aztec settlements (Smith 2008).

How this labor was organized is difficult to ascertain from the available archaeological data. Modern farming practices are poor analogues for the Postclassic. Due to the prevalence of absentee landholders and a general lack of interest in agricultural pursuits, the few farmers active today liberally borrow stone from neighbors and show little concern for the state of the risers and drains beyond their own plots. At the height of the Postclassic occupation, when the hillside was covered with residences and public buildings, and when commoners presumably derived most of their livelihood from their terraced house lots, we would imagine the existence and strict enforcement of rules regarding the maintenance of risers and drains, both because of the threats posed to neighbors by stretches that fell into disuse and because of the importance of maintaining property boundaries (Stone 1994). Many modern plots are aligned on the master drains whose layout appears to be ancient. However, we do not interpret this as an indication of large scale planning or land allocation on the part of Calixtlahuaca's rulers. Comparative research shows that sophisticated hydraulic agricultural systems can develop gradually from minimally coordinated and incremental inputs by multiple generations of farmers (Billman 2002: 373–374; Pérez Rodríguez 2006: 3) and that preindustrial elites concentrate on extracting surpluses rather than on managing technical aspects of farming (Tilly 1985; Mann 1986).

Pérez Rodríguez (2006) commented on the possible role of social units (*siqui*) similar to the Aztec *calpolli* in organizing terrace farming and other economic

activities in the Mixteca, but found it challenging to identify them archaeologically. She focused instead on the household level and argued that, in keeping with Netting's (1993) descriptions of "smallholders" engaged in intensive agriculture, it was the stability of usufruct rights that motivated people to invest in the physical infrastructure around their houses. Archaeologically, such stability could be visible in the repeated rebuilding and expansion of the same house and a certain degree of affluence. The latter is presently being evaluated by artifact analyses. The former is not pronounced in the sample of houses we have excavated, but the fragmentary preservation of adobe and wattle-and-daub walls is a major issue. In several cases, the damage to houses from repeated cycles of terracing may have destroyed all but the earliest stages of construction.

The labor manifest in the terraces of Calixtlahuaca is in itself proof of agricultural intensification, especially if we stick to traditional economic definitions that gauge intensification by inputs rather than outputs (yields) per unit area (Boserup 1965; Brookfield 1972; Turner and Doolittle 1978). We are currently performing laboratory assays modeled on work on the fertility of terrace soils in the Andes and the American Southwest (Homburg and Sandor 2011; Sandor 1992) to address the subject of yields. We hypothesize that the site represented prime agricultural land suitable for growing maize and other demanding crops. This would set it apart from other terraced sites of the Aztec period (Borejsza *et al.* 2008; Córdova and Parsons 1997; Evans 1988; Smith and Price 1994), which were mostly rural backwaters founded on previously eroded and agro-ecologically marginal land often by socially marginalized groups such as the Otomi in the Basin of Mexico and Tlaxcala. The strong association of Aztec households with maguey exploitation, cloth production, and other craft activities (Evans 2005, 1990; Parsons 2010) independent of the quality of farmland may not hold true for Calixtlahuaca. We plan to compare geoarchaeological analyses with ceramic and lithic artifact studies to shed light on this issue.

In general, terraced sites that are also large urban centers may be a more direct analogue for Calixtlahuaca, particularly in terms of the value of land and the economic activities of its households. In central Mexico, the only comparable and contemporaneous center that has been explored with modern field techniques is Prehispanic Tlaxcallan, the name that Fargher and colleagues (2010, 2011a, 2011b) give to the remains spread over several hills on the outskirts of the Colonial city of Tlaxcala, including Tepeticpac and Ocotelulco. They consider all to be part of the same urban center, with nearby Tizatlan a contemporaneous and related, but spatially isolated "rural" seat of authority. One possible parallel with Calixtlahuaca is the dispersal and isolation of public spaces. Even though it does not display the typical Aztec palace plan, Tizatlan is reminiscent of Calixtlahuaca's royal palace in its position on the periphery of the city. The multiple small plazas of Tlaxcallan that Fargher and colleagues (2010, 2011a, 2011b) interpret as belonging to different residential wards, however, are not identifiable at Calixtlahuaca. Though covering more surface area than Calixtlahuaca, Tlaxcallan lacks comparable monumental architecture. Other currently studied centers with Postclassic terracing of comparable extent and sophistication are in the Mixteca Alta and include Cerro Jazmín (Pérez Rodríguez *et al.* 2011), Yucundaa (Spores and Robles García 2007), and Coixtlahuaca (Kowalewski *et al.* 2010). The concept of "agrarian urbanism," as employed by archaeologists working in the Mixteca Alta (Kowalewski *et al.* 2009: 346–349), may prove useful for interpreting Aztec centers such as Calixtlahuaca.

Calixtlahuaca also promises to bring new evidence to bear in the debate over the timing and causes of land degradation in Mexico (Endfield and O'Hara 1999; Fisher 2005; Hunter 2009). The episode of terrace destruction and gullying at the site is stratigraphically better constrained than in many other cases. The site-specific focus of our research allows us to relate the depositional environments directly with erosional features a little higher upslope. However, we defer any definitive statements on the subject of land degradation until more radiocarbon dates have been analyzed.

Although the site as a whole shows considerable continuity in its Postclassic occupation, locally there was much change and fluidity. Many house lots were abandoned and others occupied across the transitions between chronological phases, and in several cases, multiple stages of major architectural change occurred during an individual phase. Another interesting feature of Calixtlahuaca is the prevalence of wattle-and-daub construction. This type of construction dominated Formative period architecture throughout Mesoamerica (Flannery 1976). In later Prehispanic periods and the ethnographic record (Prieto 1994), however, it is more prevalent in the lowlands than in the highlands. We are unaware of other Postclassic sites in highland western Mesoamerica with a similar abundance of burned daub. There are few modern examples of wattle-and-daub houses in the Toluca Valley, which suggests a disjunction in the forms of peasant housing from the Late Postclassic period to the present. This situation contrasts with that in the Basin of Mexico and Morelos, where the dominant Aztec period house type—built of adobe bricks on a stone foundation—survived as the traditional rural house form into the 20th century.

Finally, Calixtlahuaca was built on a hilltop, yet defense and security do not seem to have been of primary concern. Preexisting settlement patterns in the valley or agricultural concerns may have been more important. The royal palace sits unprotected at the base of the hill and we did not locate any defensive walls or ditches, although the terraces themselves could have served a defensive purpose. We cannot yet say why the city was built on a hill, but our ongoing analyses of the data are revealing how the city was built and how the use of the hilltop changed through time.

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