Early Urban Planning, Spatial Strategies, and the Maya Gridded City of Nixtun-Ch’ich’, Petén, Guatemala

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Early Urban Planning, Spatial Strategies, and the Maya Gridded City of Nixtun-Ch’ich’, Petén, Guatemala

by Timothy W. Pugh and Prudence M. Rice

Street grids commonly reflect the administration of urban populations and attempts to enhance city life. Planned grids are not typical of ancient Mesoamerican and especially Maya settlements, yet recent research at Nixtun-Ch’ich’, Petén, Guatemala, has revealed a modular grid layout that is also diagrammatic. Excavations determined that the grid was constructed before 500 BC, making it the earliest currently known in Mesoamerica. Its construction accompanied the emergence of complex society in the Maya lowlands, and leaders would have used the grid to organize and control the newly urbanized population—as seen in other parts of the world. The planned city was also likely a form of governmental conceit and a proclamation of social order. At the same time, the grid and the settlement’s dense population enhanced social interaction, promoting communication, exchange, and interconnectivity. Nevertheless, urban grids do not appear to have spread to other parts of the Maya world.

Cities must be awesome. (Yoffee 2015a:546)

Cities emerged independently in numerous places throughout the world between 6,000 and 1,000 years ago (see Yoffee 2015a, 2015b). Despite this convergence of cultural developments, considerable disagreement exists about what constitutes a city, how cities arose, and the social implications of their nascence. They are frequently imagined as growing from earlier villages as centripetal forces attracted people to growing centers of prosperity and safety, a process that does not satisfactorily explain the emergence of some cities. Some ancient cities were rapidly constructed according to well-planned layouts, whereas others developed gradually through moderate, periodic planning. The lack of evidence for comprehensive planned layouts in the Maya lowlands of the Yucatán Peninsula (Mesoamerica) has contributed to characterization of its cities as spatially dispersed with only moderate planning.

The lowland Maya site of Nixtun-Ch’ich’ in northern Guatemala (Department of El Petén) is a gridded urban center established by 500 BC. This grid, which appears to have been invented or preplanned and then constructed, largely as a single unit and upon an earlier occupation, remodeled the existing natural and cultural landscape into a linear diagram. As far as is currently known, the grid is unique in the Maya lowlands. It demonstrates that varied strategies were applied to managing emergent centralization and social differentiation in the region.

Cities, States, and Planning

What does it mean to invent a city? As a concept, “city” notoriously resists definition (see Yoffee with Terrenato 2015:1–2), but the term generally refers to awe-inspiring settlements with intensified human interactions and specializations or functions that differ from those of the hinterlands (Bettencourt 2014; Cowgill 2004; M. L. Smith 2003b; Taylor 2012; Yoffee 2015a:546). They tend to attract population—because of increased opportunities, protection, and/or awesomeness. Increasing population in cities produces a sort of “social reactor” with a superlinear impact upon social networks, enhancing economic and social productivity (Bettencourt 2013:1441). Cities can emerge for varied reasons and at various velocities (M. L. Smith 2003a:11–12). Capital cities were occasionally “invented” to signify a new social organization (Yoffee 2005) or to locate a political center on neutral ground (Blanton 1976). New cities could also be built to solve inexorable problems of existing settlements. For example, if communication and social connectedness had been hindered in an existing settlement, a new one might be built to remedy the problem (Blanton and Fargher 2011:518). In addition, settlements could be founded to fulfill primarily military, colonial, economic, religious, or utopian purposes.

Cities are often conceptualized as indicators of “states,” but not all states have cities, and not all cities are in states (M. L. Smith 2003a:12–16). “States,” like “cities,” are multifaceted and no longer as clearly definable as once imagined. Political
systems that preceded states were equally erratic in their organization, and not all nascent complex societies result in state organization (Yoffee 2005:5–20). Substantial research has focused on defining the chiefdom/state boundary, but some now consider such compartmentalizing as limiting rather than furthering the understanding of the development of social complexity. Many argue for a shift away from an emphasis on what states "are" and toward asking what actors in these societies "do" (e.g., Yoffee 2005:20). Scholars have also recognized that states are distinguished by their administrative capabilities and power (Spencer 1990; Wright and Johnson 1975:271; Yoffee 2005:21–41).

Here, our focus is not on economic or military power but rather on subtle orchestrations of behavior. The most effective means to govern is not through force but by managing behavior through configuration, to “determine the conduct of individuals” (Foucault 1988b:18). Such rational strategies are applied by states to efficiently manage or control populations (Foucault 1991:87–104). These strategies have also been termed “structural power” (Wolf 1990:586–587). Our objective is not to undermine the importance of other forms of power, as we consider some of those as well. Instead, we present a case study that documents the invention and application of governing strategies in a Middle Preclassic Maya city.

Like Norman Yoffee, Michel Foucault (1988a:152) addressed practices associated with states, but he was not particularly interested in the contribution of “actors”: he believed that the state was not concerned with individuals other than those who enhanced or threatened it. The “state is inseparable from the set of practices by which the state actually became a way of governing, a way of doing things, and a way too of relating to government” (Foucault 2009:277). Such rational exercises in governance ultimately developed into stable and expandable systems of order known as “the state” (Foucault 1988r:150–151). Foucault (1991:96–103) referred to overlapping strategies focused upon rationally “conducting” a population for the good of the state as “governmentality,” which he believed crystallized in Europe after the Renaissance.

Although we do not presume that Middle Preclassic Maya social organization exhibits the elaborated governmentality of a modern nation-state, it did exhibit several governing strategies, and the concept of governmentality provides some useful considerations. First, the development and overlapping of governing strategies are crucial for the emergence of social complexity. Ancient peoples did think about and took steps to improve the well-being of the state, as clearly documented by infatuation with royal tombs, kings, and nobility as well as assumptions of a Nietzschean “will to power” and the fashionable urge to access agency have led to Machiavellian models of elite transcendence and motivations. Yet political elites in complex societies exercise power within the context of government—not out of whole cloth (Foucault 1991:91–96; Yoffee 2005:34). Third, scholars almost always describe the “physical city” or the “human city,” but they rarely bridge the two (Hillier 2005). In some respects, Foucault bridged this divide, as he was particularly interested in the creation of state power though the manipulation of space.

As part of his effort to understand what actors in complex societies do, Yoffee (2005:33) suggested that “social differentiation and political integration”—two critical aspects of complex societies—“are generated through various forms of power and the changing relations of power.” Political power comes in a variety of forms, and here our data lead us to be concerned with two of these: structural power and ideological power. Of central concern is power which was not overtly carved into monuments but subtly inscribed into the built environment. One such strategy implemented by some modern and ancient states is the planned gridded settlement (Kostof 1991:99, 215–218; Rose-Redwood 2006:59–94; Scott 1998). Such abstract planned spaces do not appear out of nowhere—they emerge from larger ideas of world and social order. Thus, they involve ideological components that both guide their development and make the built form meaningful to occupants.

Popular—and even some academic—imagineations suggest that the grid layout was invented once and then diffused worldwide (see Rose-Redwood 2008; Stanislawski 1946), but clearly grids evolved independently in both the Old and New Worlds. In the New World, urban grids seem to have developed independently in South America (Hyslop 1990:191–222), the southwestern United States (Van Dyke 2004:418–421), and central Mexico (Millon 1973). Although few archaeologists today would accept hyperdiffusionist scenarios, they might still hold some essentialist notions underlying a search for the grid’s origins: invariant functions and the perception of such gridded spaces as “legible, finished products” (Rose-Redwood 2008:55). Nonetheless, grids commonly organize—from Maya texts to Cartesian geometry to city plans.

**Gridded City Plans, Planning, and Power**

Orthogonal plans—those with a grid of lines intersecting at right angles—have long been considered the hallmark of urban planning, yet grids are not universal characteristics of cities and are not the only form of urban planning. Furthermore, not all orthogonal organization represents the same degree of planning. Michael Smith (2007:12–20) identifies kinds and “degrees of orthogonality,” which range from largely unplanned “semi-orthogonal urban blocks” formed by rectangular structures of roughly the same size built adjacent to one another (e.g., Çatal Höyük, Turkey) to highly planned “modular orthogonal” grids, which tend to have blocks of standard sizes formed by regularly spaced streets and avenues (e.g., Spanish-colonial towns in the Americas). “Integrated-orthogonal plans” represent an intermediate level, involving the alignment of buildings with other large constructions (e.g., Teotihuacan, Mexico).
Planning can go beyond the repetition of right angles or consistent city blocks, so that corridors and other constructions constitute a kind of diagram (Kostof 1991). The reasons for such extreme planning are many, but planners usually strive for a spatial ideal. However, residents commonly find such "diagrammatic" settlements too disciplined for a satisfying existence.

A grid’s most basic component, the straight line, is an indicator of human agency that contrasts with the natural landscape (Kostof 1991:95). Straight lines often intentionally signify culture as well as mastery over nature, as they "organize, simplify, and control" (Booth 2012:69, 161). A grid multiplies the organization and control of the straight line as it regiments a series of lines into a harmonious rhythm, extending the power of the line over a larger area. These layouts standardize space and make it easy to understand, organize, and use. In so doing, grids promote the intensification of internal social interaction as well as interactions with outsiders familiar with its uniformity. The convenience of the grid may encourage a population to embrace what is effectively a mechanism of their domination. Rulers, as outsiders on the inside, use legible gridded space to simplify and summarize the diversity of occupants; the grid allows for "effective intervention," whether to help or to restrain (Scott 1998:78). Rulers in ancient complex societies commonly used simplification as a means to make populations comprehensible (Yoffee 2005:91–94).

Grids have no single necessary function, but they effectively situate objects and individuals. They guide movement, provide orientation, and connect people with one another and with specific places. Central authorities frequently use gridded spaces as a form of social control and organization, concerns associated with increased population density and societal complexity. Thus, grids can be a form of infrastructural power: the ability to "penetrate civil society, and to implement logistical political decisions" (Mann 1984:189). Their governing qualities and partitioning within them were described as early as the fourth century BC by Aristotle: much of his Politics was concerned with governmentality. He also observed that, although grids may be good for organization and control, their legibility made the population more vulnerable to attack by outsiders (Aristotle 2013:42–43, 206; Mazza 2009:128). Grids and other segregating organizational practices are not just about space; rather, "the object of these divisions is to design the population within the urban form" (Kostof 1992:72). Hence, spatial divisions do not just reflect social divisions; they help create them (Foucault 1995:195–228; Hatton 1999:65–66). Such dominant spaces become the new "pre-existing" space—the given (Lefebvre 1991:165). The organization and its power become a part of the landscape. Yet, straight roads and grids overtly communicate that the urban landscape differs from the natural world.

Most urban grids are considered evidence of central/state control of city construction and symbols of state power (Kostof 1991:99, 215–218; M. E. Smith 2007:21). Grids are not inherently political, but planning is, although the power relations underlying politics and embedded in planning can vary. Spatial organization and governing are not necessarily connected, but grids are "amenable" to use as a political strategy (Grant 2001:237; Mazza 2009:134). It is no wonder, then, that they are tied to expansionist states (e.g., Hyslop 1990:191–222) and colonialism. For example, grids were legally required, per the 1573 Laws of the Indies, for Spanish-colonial towns and missions as part of efforts to establish Christian order, and they emulated Greek and Roman colonies (Crouch, Garr, and Mundigo 1982; Cummins 2002; Kostof 1991:102–116; Low 1995). In ancient China, a rigid grid was a means to control the population and to spatialize the social hierarchy (Wheatley 1971).

Grids might be constructed for defensive, social, or economic purposes, aesthetic qualities, or to facilitate efficient movement (Kostof 1991:99–102). The straight roads, linkages, public spaces, and legibility of grids enhance "urban movement economy" (Blanton and Faragher 2011:509–512). They form an "infrastructural network" enhancing interactions, thereby promoting economic exchange, information flow, and access to services (Bettencourt 2013).

The logical geometry of the grid can work its way into ideology. Orthogonality might represent a cultural or moral ideal and give evidence of progress or modernity. Grids can come to represent "the urban," communicating that built city space is qualitatively different (whether positive or negative) than that of the countryside (Kostof 1991:108). Sometimes the grid might represent equality, acting as a facade hiding social hierarchy. Over time, however, such a layout supporting equality can transform into one upholding hierarchy (Grant 2001:234–237).

In sum, the intended objectives of an orthogonal city plan can vary immensely. The grid’s multipurposiveness, efficiency, naturalization, and normalization parallel its general functions with Jeremy Bentham’s panopticon, infamized by Michel Foucault (1995) and an impeccable lattice to shape human behavior. The panopticon included individual cells surrounding a tower. Persons within the cells could be seen, but the watcher in the tower could not. In fact, the urban grid is a step up from the panopticon, as there is no tower; persons are automatically organized without the potential presence of a watcher—without surveillance. But it cannot be assumed that discipline is an essential function of the grid (Rose-Redwood 2008:55–56), although "discipline" is a broad concept. It does not refer simply to a naughty child in time-out or a soldier in boot camp; it also refers to efforts at self-improvement (Foucault 1988a:16–49). Just as individuals seek to improve themselves, a state improves itself through the "political technology of individuals"—knowing itself and refining itself (Foucault 1988a:146–162). Thus, if a grid is applied to a town for absolutely no reason, then it does not reflect discipline. Alternatively, if it were imposed to communicate that the occupants are “civilized”?modern, organize the population, encourage social interaction, facilitate land sale, or align the population with the cosmos, then these are all examples of discipline. While no universal rationality explains the construction of grids, these forms do have a strong tendency to organize populations and make them comprehensible. In many
cases, then, the gridded landscape might be considered an extension of the state.

**Imposed Grids and Architecture**

Large-scale planning is sometimes imposed upon settlements and can represent elite agency. Urban theorist Hilary Ballon (2012:211) remarked, "the grid has a dual nature: it is a conceptual idea with concrete form, a theory that can be found in practice." It is designed on paper or with models and then inscribed onto the landscape. The planning and imposition of a grid is a direct action upon urban form and raises the issue of who has the power to compel this formatting—particularly when a grid replaces a preexisting form of spatial organization. The application of a coordinating grid plan in an area lacking such a tradition marks a sharp contrast—it is a spatial paradigm shift. Its imposition requires the population to perceive and occupy the urban landscape in a new way. If the new city form drastically diverges from the images held by its dwellers, tensions can emerge (Rose-Redwood 2006:151). Thus, the reshaping of a city requires immense "symbolic capital" (Bourdieu 1984:97, 1989:19–24) underwriting the power and authority, and it also requires the physical means to direct the reorganization of space.

Major architectural transformations involve demolition as well as construction. The demolition of monuments is one means of symbolically attacking a society (Coward 2006; Lefebvre 1991:221; Makdisi 2010)—think of the events of 9/11—but what of the destruction and reordering of the entire built landscape? Such an event would have terminated place-based identities and restructured social memory, the social order, and spatial relations of production. Moreover, one can only imagine the message carried by the reordered space to nearby communities and elites. Nevertheless, such architeconic drama may have been commonplace in the creation of early cities and the establishment of a city’s legitimate domination of surrounding areas (Cowgill 2004:528).

Another aspect of agency involved in grid construction is resistance to its implementation. Internal resistance to centrally imposed reorganizations of space was evident during the implementation of Manhattan’s grid in 1811 (Ballon 2012:73) and in modern-day opposition to state-encouraged urban gentrification (Hackworth 2002:823–825). The potential strain between conventional organization and implementation of a new urban plan led some designers to meld the two (Rose-Redwood 2006:151).

Yet to imagine architectural planning and construction only as top-down strategies that are resisted from the bottom up seems overly simplistic. Urban planning, whether through layout, city walls, aqueducts, sports stadiums, or other elements, requires negotiations among administrative, mid-level, and grassroots agents (Reyerson 2000; York et al. 2011). Many decisions by elites are made to meet the needs of the collective rather than out of self-interest (Carballo 2012:4). Population density and urban grids enhance communication and connectivity (Bettencourt 2013; Blanton and Fargher 2011:507–517; Schlapfer et al. 2014). So, it is unlikely that grids were imposed solely to proclaim “behold my elite power” rather than to fulfill infrastructural needs and enliven the social interactions of the general population.

Builders in a particular society may strive to achieve a particular ideal form but, as with any stylistic expression, they work within a culturally acceptable range of variation (Glassie 1976:19–20). Such ideals or limits can be internalized through training (which may or may not be codified) or by simply dwelling within a community. In the latter, many if not most patterns are replicated without conscious consideration (e.g., habitus; Bourdieu 1977:87–95). Builders also have agency. In medieval France, for example, masons were the prime agents of city planning as well as of the design of fortifications, water control, and cathedrals. They also organized quarrying and transportation of building materials. Masonry guilds possessed a great deal of political power. Construction, engineering, and architecture were not centralized under state control until after 1607 (Wolfe 2009:111–152). Thus, one cannot assume that political elites masterminded urban planning, as traditional architectural knowledge and the agency of building specialists also play critical roles.

Once imposed, the grid becomes the new landscape. While planners design from afar, imagining their projects on paper or in clay (or on a computer screen), residents live within the city and directly interact with its concrete form (de Certeau 1984:91–110). The violence of its imposition can be forgotten over time as it becomes naturalized, and thus it would be inaccurate to “diametrically oppose abstract space with lived experience” (Rose-Redwood 2006:70). All occupants of a city have a unique vision of it related to their experiences within (Lynch 1960:46). Furthermore, occupants improvise and assign meanings to constructions—some collective and others individual (de Certeau 1984:97–105).

What is more, cities are sites of dynamic human activities; they are mutable and transform through time, although constructed of solid materials. If the aesthetic that produced the grid is weakened or supplanted, it will begin to experience a process of “deregulation” (Kostof 1991:48). The tension between the planned city and its occupants is constant, and as the rules of the former change or weaken, the place will transform according to the desires of dwellers—some of whom may create new rules (de Certeau 1984:200–203). Even in a modular orthogonal city, this deregulation can result in deviations as new paths are created, distinct blocks are melded, and spatial focus shifts as old focal points decline and new ones emerge. Thus, a well-planned city can become increasingly organic though time, or one sort of planning can be eclipsed by another spatial schema (Kostof 1991:48–51).

Imposing a design from the drawing board onto the landscape requires a great deal of power and/or consensus. The same is true of immortalizing the design or maintaining the regulation of the form over time.
Mesoamerican Cities

As elsewhere, identifying “states” in Mesoamerica is tricky (Chase, Chase, and Smith 2009). Key characteristics—cities, monumental architecture, social inequality, and large populations—have been identified in many Late Preclassic (400/300 BC–AD 200) lowland Maya regions and sites in northern Petén, such as the Mirador Basin (R. Hansen 2001:59–63), Tikal, and Cival (Estrada-Belli 2011:54–66; cf. Marcus 2003:81–85). Yet, these centers emerged during the Middle Preclassic period (ca. 800–400/300 BC; R. Hansen 2012:139–141). Our objective is not to discover a state, as such pigeonholing is not particularly productive, but instead to investigate the development of salient aspects of complex societies and cities: their governing strategies.

Typical Maya cities were not “compact, densely packed urban areas” (Guderjan 2007:67). With few exceptions, ancient Mesoamerican and Maya cities lacked gridded layouts, but this does not mean that they lacked planning or were not “urban” (Chase, Chase, and Haviland 1990; Estrada-Belli 2011:67–74; Joyce 2009; Marcus 1983). Significantly, population centers emerging in the Maya lowlands in the Middle Preclassic period already incorporated planning in the form of east-west orientations and standardized architectural assemblages known as E-groups and triadic groups (below). These groupings can be considered diagrammatic, but on a small scale. Cities frequently replicated the quadruplicite cosmological structuring of the Mesoamerican universe, with orientations to the cardinal directions and/or to celestial phenomena (Ashmore 1989, 1991; Ashmore and Sabloff 2002; Aveni 2001; Šprajc, Morales-Aguilar, and Hansen 2009; cf. M. E. Smith 2005). Some exhibit a cruciform plan, such as at Cival (Estrada-Belli 2011:71) and central Yaxhá in the southern Maya lowlands. Rare gridded layouts are found in Mesoamerica outside the Maya area at Teotihuacan (Millon 1973) and Aztec Tenochtitlan (Calnek 2003) in central highland Mexico.

Cities with modular grids are thus far unknown in the Maya lowlands. Maya cities commonly consist of multiple cores that comprise such standard components as pyramidal temples, low range structures (“palaces”), plaza groupings, ball courts, and reservoirs, formed by cardinally oriented structures in various arrangements and displaying monumental art programs (Becker 2003; Harrison 1999). These architectural cores may exhibit varying degrees of centralization or dispersion within a city, the dispersed assemblages often joined by causeways. Maya causeways enhanced social interaction and communication (D. Chase and A. Chase 2014; Shaw 2001; Stanton 2005), but they would not have been as effective a social reactor as a grid layout, for they would have had limited penetration into the community.

Little is known of Maya masons, but they may have emerged as specialists by the end of the Middle Preclassic period. At that point, limestone blocks had become larger, more skillfully produced, and standardized in size and form (R. Hansen 1998:71–105). Stucco production also became specialized (E. Hansen 2000:223). Increased variation in architecture during the Late Preclassic period has been attributed to the emergence of Maya kings, who wished to display their power by promoting “innovative technical practices” (E. Hansen 2000:224). But increased variation can also be caused by a lack of standardization, so the notion that elites promoted this seems speculative. Maya paramounts may have instigated constructions, but one cannot presume that they directed them or managed quarrying and transportation of materials.

The Central Petén Lakes Region and Nixtun-Ch’ich’

The gridded site of Nixtun-Ch’ich’ reveals centralized architectural planning during the Middle Preclassic period. Lying in the tropical forests of the southern Maya lowlands of northern Guatemala, Nixtun-Ch’ich’ sits on the western shore of Lake Petén Itzá, the largest in a chain of eight lakes formed along a fault line in the limestone karst at approximately 17°N latitude (fig. 1). Occupation of the Petén lakes region covers three millennia, from the Late Early Preclassic (~1100–800 BC) to the present. As in most of the Maya lowlands, the earliest evidence of ceramic-using groups appears around 1000 BC. Whether these populations were indigenous or recent migrants is a matter of debate and likely varied by region (Inomata et al. 2015:4273). During the Middle Preclassic period (800–300 BC), settlements in the lakes district increased in number and size (Rice 1976:445). Middle Preclassic constructions have been found at most large sites investigated in the region. In the eastern part of the lakes region, Yaxhá emerged as the dominant community, with subordinate minor centers such as Sacnab (Rice 1976:438–445), in a three-tiered settlement hierarchy.

Nixtun-Ch’ich’ in the west is strategically situated in a large livable space bounded to the north by the steep escarpment that forms the northern boundary of all the lakes’ watersheds, to the east by the Ensenada San Jerónimo, and to the south by a narrow western finger of Lake Petén Itzá. The site’s monumental constructions are concentrated on this mainland but also occupy the narrow Candelaria Peninsula extending nearly 1 km eastward into the lake. Elevations decrease from west to east and from center to north and south. Ephemerical streams of fresh water and alluvium brought by torrential rainy-season downpours are efficiently drained out of the city by the grid corridors.

Ceramics indicate that portions of this area—Mound ZZ1 on the tip of the Candelaria Peninsula—evidence occupation as early 1270–970 cal. BC (2σ), and occupation and construction continued through Preclassic, Classic, Postclassic, and Contact-Colonial times (Rice 2009). Radiocarbon dates from excavations in 2014–2015 revealed that excavated portions of the gridded core were constructed before 500 BC. Much, though not all, of the grid was maintained throughout the site’s occupational history (table 1). Thus, Nixtun-Ch’ich’ exhibits the earliest known gridded city plan in Mesoamerica and is contemporary with the Olmec center of LaVenta, Tabasco, Mexico.
Many excavations ended with leveled and unweathered bedrock, indicating that the original surface materials had been removed not long before construction. This echoes a common early lowland practice: at some sites the earliest occupational remains—some possibly even Archaic in date—were scraped away and plazas were created of leveled bedrock, with constructions beginning with placement of a dark clay footing (R. Hansen 1998:70; Inomata et al. 2013:467, 2015:4272; Lohse 2010:343).

The Urban Core

Nixtun-Ch’ich’ occupies an area of 2 km², its 1.02-km² urban core comprising approximately 55 large platforms. The site, long covered by secondary forest, is now occupied by a working cattle ranch and has largely been cleared for grazing, which facilitated cost-effective mapping with a Topcon total station. The earlier mapping effort, based on identification of building corners, incorporated too many field interpretations (Rice et al. 1997); therefore, to produce data with minimal subjectivity, 85,770 points were systematically measured at approximately 3-m intervals. North was set to true north using a compass and declination calculations from the National Centers for Environmental Information. The figures in this article were created using Surfer software, versions 9 and 11. Surveyed points were gridded using Kriging, which most closely replicates the observed landscape (fig. 2).

The cardinally oriented grid of Nixtun-Ch’ich’ is defined by seven north-south corridors (“Avenues” A through G) and six east-west corridors (First through Sixth “Streets”; figs. 2, 3). To call it “orthogonal” would be inaccurate and a simplification, because the site evinces a more complex trapezoidal grid. The recently mapped portion with a clearly visible gridded layout covers an area of 641,217 m² (64.1 ha), although the grid extends into unmapped areas on the Candelaria Peninsula to the east and possibly continues to the west as well. The grid-iron did not structure the landscape in all areas equally. It is most strongly embedded in the center and southeast of the site, but it gradually fades to the east and west. In the west, the streets deviate slightly from the core alignment, likely from deposition of alluvium and perhaps also from later constructions. The urban grid terminates rapidly to the north and west, indicating possible agricultural areas and clearly demarcating the city from the hinterland.

The corridors forming the grid partitioned the constructed areas of the site into distinct blocks, which we identified alphabetically beginning in the northwest and moving east and south. Thus, the northwesternmost construction area is block (or sector) A, and the extreme eastern tip of the Candelaria Peninsula is sector ZZ. Within these blocks, individual structures were designated numerically.

Most of the urban blocks include residential groups. These residential blocks range in size from less than 1,600 m² to approximately 14,000 m². Residences likewise range from small to large, although we are not currently certain of their chronologies. The site contains at least three long structures—possible palaces, again of unknown chronologies. Small residential groups are also scattered across the landscape outside the urban core. Thus, inequality is suggested in residential architecture as is a fairly sharp urban-hinterland divide. Furthermore, the city had a distinct ceremonial sector.

1. We currently lack permission to work on these areas, which have different landowners.
The Ceremonial Nucleus. The civic-ceremonial nucleus of Nixtun-Ch’ich’ (figs. 3, 4) and its grid blocks are trapezoid shaped (rather than strictly right-angled orthogonal) and occupy elevated ground in blocks Y, Z, AA, and BB. Architecture within this trapezoid includes an east-west linear arrangement of two well-known Preclassic forms, a triadic group and two possible E-groups, plus a large temple and a reservoir.

The nucleus is anchored on the east by a triadic group or structure (group BB), a variant of what has been called a “fractal-type” arrangement (Szymański 2014, fig. 1e). The group BB triadic consists of a two-tiered platform, the upper tier supporting three temples and with a stairway on its western side, that constitutes the highest elevation of the city. The large (247 × 174-m) basal platform supports several buildings and is accessed by stairways on all four sides.

Immediately west of the triadic group is a probable E-group (sector AA). A typical E-group has a four-stairway (radial) structure on the west centered on and across the plaza from a north-south elongated eastern platform (structure AA1). This platform normally supports three superstructures (see Aimers and

Table 1. Preclassic period radiocarbon dates of Nixtun-Ch’ich’

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<td>Sixth St, N4279/E4074, level 12</td>
<td>−25.7</td>
<td>2515 ± 37</td>
<td>796–522</td>
<td>Charcoal</td>
</tr>
<tr>
<td>AA107440*</td>
<td>Fourth St, N4064/E4391, level 14</td>
<td>−26</td>
<td>2532 ± 31</td>
<td>798–543</td>
<td>Charcoal</td>
</tr>
<tr>
<td>Beta 232953*</td>
<td>Str ZZ1, level 11</td>
<td>ND</td>
<td>2880 ± 40</td>
<td>1190–920</td>
<td>Charcoal</td>
</tr>
<tr>
<td>Beta 232952*</td>
<td>Str ZZ1, level AA</td>
<td>ND</td>
<td>2900 ± 40</td>
<td>1270–1010</td>
<td>Charcoal</td>
</tr>
</tbody>
</table>

Note. Ave: avenue; ND: no data; St: street; Str: structure.

* Rice 2009, tables 2 and 3.

5 Dates calibrated with Oxcal 4.2. The long date ranges result from a plateau in the calibration curve affecting most of our Middle Preclassic dates.
Rice 2006; A. Chase and D. Chase 1995), but these are not immediately evident on structure AA1. The pairing of triadic structures and E-groups, particularly with the triadic immediately east of the E-group, forms a distinctive planned urban core at numerous lowland sites (Estrada-Belli 2011:67; Flores Esquivel 2010; Szymański 2014). This template may date as early as the Middle Preclassic, although triadic groups are often thought to date to the Late Preclassic.

West of sector AA is sector Z. The western building of the sector AA E-group lies under structure Z2, which interrupts broad Avenue G, thus establishing Z2 as “the center” of the city. Structure Z1, the site’s second tallest building, stands opposite Z2 and rises 21 m above an associated plaza bounded by elongated structures Z3 and Z4 to the south and north, respectively, aligned with their bordering streets. Four low platforms, two flanking structure Z1 and two west of structure AA1, form a rectangle. Next in this central architectural core is group Y, a second E-group. The eastern elongated platform (structure Y1/1) is topped by three superstructures, and immediately to its east is a shallow *fosa* or depression, Reservoir Y (Rice and Pugh 2016). The western structure of the sector Y E-group is flanked by two low platforms similar to those flanking structure Z1. Three additional paired flanking structures are found in three groups farther west, adding to the bilateral symmetry of the urban core.

**Axial Alignments.** The east-west alignment of the largest buildings of the civic-ceremonial nucleus is continued westward beyond sector Y by another eight buildings and another reservoir, which still accumulates water during the rainy season. These fifteen structures and the two reservoirs are cleanly bisected by a line oriented 94°7 clockwise of true north, which forms the site’s central axis (fig. 3). We are uncertain about the reasons for the 4° declination, but it and the off-axis east-west streets forming the trapezoids may have been oriented to sunrise around the equinoxes: the vernal on March 22 and the autumnal on September 21. This is atypical of Maya sites, however, which are more commonly oriented to solstices (Aveni 2001:245–250).

Axes are special types of lines, as they do more than just dominate the landscape—they symbolize that domination and communicate power (Booth 2012:69). The central axis of Nixtun-Ch’ich’ differs from the corridors, as it emphasizes height and thus has a greater impact upon the viewscape—it draws attention to itself. Unlike the axis of Teotihuacan (the Avenue of the Dead), that of Nixtun-Ch’ich’ could not be easily traversed by humans, but they could walk almost parallel to it. Cosmologically, its ultimate end/beginning point was east/sunrise or the beginning of time; on the earthly plane, its terminus was group BB, the triadic group or a Middle Preclassic–period predecessor. Hence, as appreciated by its looming visual presence, the triadic group dominated the city’s landscape and was the foundation of spatial order.

**The Grid Corridors**

The Nixtun-Ch’ich’ grid corridors—the six east-west streets and seven main north-south avenues—cover at least 148,595 m².
(23%) of the urban core. Excavations to date reveal that these corridors were variously composed. A few areas were covered with well-fitted limestone slabs, and the earliest versions of some corridors appear to have been created by leveling bedrock. Most had plaster surfacing, which averaged 4 cm in thickness (in our excavated units), suggesting that approximately 5,944 m³ of plaster would have covered the confirmed corridors. The excavations also suggest that the fill event associated with the first grid construction included approximately 46,584.5 m³ of fill. The grid was a monumental construction.

The streets exhibit slightly varying orientations or azimuths (table 2), the variations coordinated in complex ways north and south of the central trapezoid. With respect to mean orientations, the nucleus is bounded by Third and Fourth Streets, with a mean of 93°57’. Second and Fifth Streets, on opposite sides of the trapezoid, together average 94°37’, and similarly opposed First and Sixth Streets average 94°10’. All mean orientations are close to the central axis (94°7’).

The street orientations can be characterized as “coordinated,” because Fifth and Sixth Streets north of the nucleus parallel central Third Street, while those farther south (First and Second Streets) parallel Fourth Street. As a result, the northern and southern grid blocks invert the trapezoidal form of the nucleus—their larger end is to the west, rather than the east. The alternating directions of the trapezoids create bilateral symmetry rather than the radial symmetry that would have been created by a series of trapezoids with the same orientation. A series of similarly oriented adjacent triangles would ultimately “join another at a single point” (Booth 2012:215). Thus, had they not been formed into an alternating trapezoidal grid, the streets would have formed a radial grid emphasizing a distant pivot point rather than the site axis. In brief, the site axis was emphasized through bilateral symmetry and the negation of a specific joining point. Such coordination would have required a high degree of planning and surveyor skill.

The north-south avenues also vary in orientation. The longest, Avenue F, is nearly perpendicular (4°11’) to the central axis, and its orientation seems intentional. The widest, Avenue G, divided into G1 (north) and G2 (south) by structure Z2 at the site center, probably constituted the city’s formal entrances. The angle (off north) of the avenues gradually increases as one moves from Avenue A to Avenue G, then gradually decreases thereafter. This pattern may be happenstance, but the undulation may mirror the curved lakeshore in this area.

In addition, the streets and avenues differ with regard to visibility. The streets gradually decline in elevation from west to east. Even in today’s landscape, distorted by eroded platforms, one can see quite a distance along the streets, their visi-
The east-to-west incline of Nixtun-Ch'ich' adds to their visual presence. It is overtly artifical and contrasts with the natural landscape even while the grid surface is currently buried by at least a meter of collapse and eroded soil. Avenues, by contrast, are often blocked by temples, and all are arced—rising to the center from north and south. Thus, one cannot contemplate great distances along the avenues because the elevated central axis interrupts the view. In general, uneven terrain, such as that of the avenues, breaks the line's continuity and diminishes its vitality (Booth 2012:73). It seems clear, then, that in comparison with the north-south avenues, the east-west streets were both better planned, as evidenced by their coordinated azimuths, and more accentuated at Nixtun-Ch'ich'.

One wonders about additional functions and perceptions of the trapezoid grid, given that it is more complex than an orthogonal grid. Diagonal lines help lessen perceptions of a "force of gravity" by extending lines and decreasing the incline of a slope (Booth 2012:202). The east-to-west incline of Nixtun-Ch'ich' might have been minimized through the use of diagonal lines.

The grid’s administrative technology would have been costly in the form of construction resources, such as plaster for filling the corridors’ spaces, but it had another cost. Nixtun-Ch'ich' appears to have been a "stone city," as opposed to a "green city" or "garden city." Green cities incorporate a large amount of "greenspace" (plants for food, industry, or shade) into their landscape (Graham 1999:191), and they are more typical of Maya settlements. Much of the greenspace of Maya cities lay between dispersed platforms and architectural complexes, but such was not the case at Nixtun-Ch'ich'. Nevertheless, one would expect that some greenspace existed in early patio groups within the grid.

To recapitulate, the Nixtun-Ch'ich' grid structured the city into trapezoidal and rectangular blocks formed by wide, paved corridors, most of which were straight. The diagrammatic pattern of roads and linearity of the central axis would have been visible only from above or in the eye of the planner. Such objectification is characteristic of layouts planned in miniature, whether on maps or with scale models (Scott 1998:57–58, 75), perhaps formed of clay or stone. Consequently, the grid clearly reveals itself as a mechanism of administrative centralization and enhanced legibility.

### Excavations

Recent excavations at Nixtun-Ch'ich' initially targeted Late Postclassic–Colonial-period communities in the southern portion of the site. As reported elsewhere (Pugh et al. 2016), these small communities settled on early platforms shaped by the grid. Excavation of test units (fig. 4) across the site to investigate the city’s chronology revealed that the deepest levels incorporated early pottery organized into two ceramic "complexes" (type-variety nomenclature): an early Chich complex, typically in levels over bedrock, dating to approximately 1200/1100–900/800 BC, and a later and overlying Nix complex (table 3; Rice and Salas Pol 2015; South 2016). The Nix complex falls into the broad and well-known lowland Middle Preclassic Manom ceramic "sphere," with numerous shared wares, types, varieties, and forms. The earlier Chich pottery is one of several pre-Manom or late Early Preclassic complexes of individualized content and fairly limited spatial extent in the southern lowlands (e.g., Cunil in western Belize and eastern Petén; Cheetham 2005). These early materials are still poorly known because of the difficulty of excavating to bedrock through the massive volume of overlying Late Preclassic–Classic period construction at most Maya sites.

#### Grid Corridor Excavations

Excavations in Avenue H2 (units N3828/E4213 and N3828/E4232; figs. 4, 5) revealed that the grid originated in the late Middle Preclassic period. Construction consisted of a thin fill layer incorporating Nix complex ceramics and plaster surfacing directly on leveled bedrock. The edge of the construction block to the east (platform LL) was found to be a Middle Preclassic

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2. One such maquette carved of calcite, probably Late Classic in date, was recovered in structure SD–54, the western radial structure of the Mundo Perdido E-group (Laporte 1997:343, fig. 11). Depicting 14 buildings, some with balustrade stairways, and a ball court, this maquette does not resemble any known group at Tikal.
 platform built on this surface (figs. 5, 6). The same may be true of platform KK on the western side of the corridor, but we did not excavate as deeply there. The edge of platform LL was constructed of coursed, cut-limestone ashlars, the top course projecting 11 cm from the rest of the wall to form a cornice. Similar cornices were observed at El Mirador, Tikal, and Uaxactun beginning at AD 250 (R. Hansen 1998:97). A Late Preclassic wall bordered the avenue, exterior and parallel to this earlier platform edge, revealing that the Middle Preclassic structure originally bounded the corridor and guided the orientation of the later constructions. The Late Preclassic platform wall was also composed of cut limestone, but the courses were not as regular as those of the Middle Preclassic wall.

The bedrock on each side of the Avenue H2 corridor is roughly level, but in the middle, it was cut and removed. In addition, along the edges of both eastern and western structural blocks, the Middle Preclassic surfacing and fill also had been cut into—at the same point as the cut into the bedrock. A 70-cm-deep cut on both sides of, and likely completely across, the corridor removed the floor, fill, and some bedrock. It appears that early Middle Preclassic (and any earlier) constructions were removed to access limestone for construction material: on both sides of the corridor, the bedrock exhibited rectangular cuts representing unfinished slabs. The Avenue H2 cuts were partially refilled with Late Preclassic material but not surfaced with plaster. Still later, the refilling was completed with debris incorporating Early Classic (AD 200–600) pottery, but the surface still remained unplastered. Late/Terminal Classic (AD 600–950) and Postclassic (AD 950/1000–1525) constructions were built upon both platforms, but these showed no signs of being accompanied by renovations or excavations into Avenue H2.

Additional evidence for Middle Preclassic grid construction came from seven other excavations. One unit (N3909/E3941) into Avenue F revealed that its latest plaster surface was likely Late Preclassic (Kax Chicanel ceramic complex), but just below this were two additional surfaces with construction fill dated by Nix (Mamom) pottery. Below the third floor and 85 cm of fill, we encountered a fourth floor. A radiocarbon assay (AA106285) associated with this floor indicated a date 406–335 and 330–204 BC (see table 1), which did not correspond with the Middle Preclassic ceramics in the same deposit and was anomalous.

Table 3. Early ceramic chronology at Nixtun-Ch’ich’

<table>
<thead>
<tr>
<th>Ceramic</th>
<th>Period</th>
<th>Years</th>
<th>Sphere</th>
<th>Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicanel</td>
<td>Late Preclassic</td>
<td>400/300 BC–AD 200</td>
<td>Kax</td>
<td></td>
</tr>
<tr>
<td>Mamom</td>
<td>Middle Preclassic</td>
<td>~800–400/300 BC</td>
<td>Nix</td>
<td></td>
</tr>
<tr>
<td>Pre-Mamom</td>
<td>Late Early Preclassic</td>
<td>~1100–800 BC</td>
<td>Chich</td>
<td></td>
</tr>
</tbody>
</table>

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Figure 5. Cross section of Avenue H2, Nixtun-Ch’ich’.
relative to the other dates. This sample was mammal bone, rather than charcoal, and its collagen may have been contaminated. Below this were still another two floors above leveled bedrock.

A second unit (N3935/E4023) examined the southern edge of structure Z5 as well as the southern edge of platform Z and the corridor (Third Street) to its south. This 1 × 5-m excavation revealed that structure Z5 was constructed in the Late Preclassic, but it rests upon a Middle Preclassic platform with a sequence of four recorded plaster surfaces. Below the last of these surfaces were pre-Mamom (Chich complex) materials in basal levels upon bedrock. Third Street had been partially filled by the Late Preclassic occupants with 1.3 m of fill. Below this fill was the street surfacing, dated by Mamom ceramics.

Another excavation into Third Street (N3885/E4523), but 502 m east of the first, was placed between platforms BB and MM (figs. 4, 7). The 1 × 4-m excavation, placed on the south side of the corridor and the northern edge of platform MM, also revealed the corridor had been largely filled in during Late Preclassic times and capped with a plaster surface (level 5). Beneath this surface and its 1.2-m-deep fill of large boulders, we encountered a Middle Preclassic floor—the corridor surface (level 8). Charcoal (AA106865) from the fill (level 9) found immediately beneath the floor gave calibrated dates between 755 and 416 BC (table 1). We excavated another 0.5 m of Nix/Mamom pottery-containing fill before we ended this excavation for safety reasons.

What is interesting about the Late Preclassic 1.2-m-deep filling of Third Street is that it, along with Fourth Street, is still the most visible of the corridors from the ground surface before excavation. One can still see several hundred meters down the corridor despite eroded mounds and occasional trees. Thus, the corridor must have been truly marked before being filled in. The latest Middle Preclassic floor in the eastern excavation into Third Street was 5.5 m lower than that found 502 m to the west, indicating a slope of 1.1%; thus, the decline apparent on the ground surface matches that of the last Nix/Mamom corridor surface. The unit into Avenue F at the corner of Third Street, mentioned above, revealed three Mamom floor constructions covered by a fill of large stones that were ultimately capped by a series of Late Preclassic floors. Although the fill event is dated by Mamom ceramic diagnostics, one wonders whether this event coincided with other nearby Late Preclassic filling of the grid corridor.

An excavation at the intersection of Third Street and Avenue G2 (N3920/E4136) revealed that the area had been too modified by Late Preclassic remodeling to be of use to our understanding of the early grid. However, 83 m to the south a large 3 × 4-m excavation unit (N3834/E4125) into Avenue G2 revealed how the corridor was modified after the Middle Preclassic period in this area. Multiple Middle Preclassic floors were exposed, but no massive Chicanel resurfacing as in Third Street was seen. Instead, the platform edges were gradually enlarged with low (<25 cm) extensions into the corridor. Some of the expansions include what appear to have been small plaster-lined drainage ditches.

The fact that Avenue G2 did not experience a massive fill event and that Avenue H2 was actually cut into during the Late Preclassic period suggests that the distinction between the center and the southern corridors was exaggerated during this period. We have not yet observed a similar modification to the north. These preliminary data suggest a major modification in the city drainage system during the Late Preclassic. It is possible that this change was necessary due to new large constructions in the ceremonial core—a point to be tested by future research.

In 2015, we tested Fourth Street with a 14-m-long excavation, of which the southern 8 m (N4070/E4391) are primarily discussed here (figs. 4, 8). The bedrock below Fourth Street seemed modified, but it was not leveled. Immediately upon bedrock was dark, sticky clay with Chich ceramic diagnostics (level 14). A radiocarbon assay on charcoal (AA107440) produced calibrated dates between 798 and 543 BC (table 1), possibly postdating the clay. A few meters to the north, in unit N4074/E4391, charcoal (AA107442) in fill between bedrock and the surface of Fourth Street produced calibrated dates of 768–486 BC. These dates (AA107440 and AA107442) correspond with those of charcoal (AA107489) from similar soil above bedrock and beneath the surface of Sixth Street (N4279/E4074), which yielded calibrated dates between 796 and 522 BC.
We believe these similar fill events represent the initial construction of the grid.

Above the sticky clay in N4070/E4391 was a ballast layer supporting a plaster floor (level 11). A fragment of charcoal (AA107441) embedded in the plaster produced a calibrated date of 771–540 BC (table 1). This floor was the original surface of Fourth Street. A wall in the south part of the excavation was o n c et h ee g eo ft h el a r g et r i c o m p l o c e x ( s t r u c t u r e B B 1 ). T h e f l o o r and the wall were later covered by a sloped platform edge or access point composed of fill (containing Nix ceramics) topped by a tightly fitted “stone mosaic pavement” (level 7) similar to those of Nakbe (R. Hansen 1998:60–61). The mosaic pavement was in turn covered with fill (with Late Preclassic ceramics) retained by a crude wall (level 5c).

Data from excavated Preclassic residences at Nixtun-Ch’ich’ will be presented in future publications. Yet one test unit (N3766/E4533) excavated into structure UU1, a Middle Preclassic dwelling at the corner of Avenue K and Second Street, is relevant here. The unit encountered two burials in separate pits—one adult and one child. Both were buried extended, supine, with heads to the north and bodies oriented within five degrees of true North; neither included pottery or other burial furniture. One might argue that these individual burials may have been aligned with house walls coordinated by the city grid or that they were consciously oriented toward the grid. We may never find an answer to that question, but in either case, the grid structured everyday life and death. These burials also differ from an apparent looted tomb salvaged at Nixtun-Ch’ich’ by the University of Pennsylvania in 1977. The burial contained several Middle Preclassic ceramic vessels and other objects (A. Chase 1983:1166–1167). Contrasting with the two burials from structure UU1, this burial suggests the possibility that, along with varied residential sizes, mortuary practices also communicated social differentiation in the community.

In sum, the grid corridors were established sometime before 500 BC with periodic modifications into the Late Preclassic.
period. These modifications narrowed the corridor widths. In some cases, the corridor levels were raised over time, and in others, the corridors were stripped.

The Sector Y E-Group Reservoir

Two 6-m² excavation blocks (N4014/E3905 and N4014/E3924) tested Reservoir Y immediately east of the Y1 E-group and west of structure Z1 (figs. 4, 9). A third block, excavated in 2016, is not discussed here. This reservoir or fossa, a 46-m-long (north-south) depression, 31 m wide and 2.5 m deep, is on the city's central axis, so the excavations were placed on the east and west slopes, directly over this axis. Excavations were stepped down at various features, and only a 1-m² square in the eastern unit (N4014/E3924) proceeded 6 m below datum before being terminated for safety reasons.

Two low terraced walls, possibly lining the late Middle Preclassic reservoir, were found in both the east and west excavation units under about a meter of collapsed material from buildings flanking the depression (structures Y1/1 and Y2/1). Abutting the lower of these walls was a 40-cm-deep midden that included sherds of the Nix (Mamom) ceramic complex and earlier material. The deposit also included a high frequency of fauna, freshwater snails (*Pomacea* and *Pachychilus*), obsidian blades and flakes, and chert flakes. Pottery represented many vessels that were wholly or partially reconstructible, indicating

Figure 8. Western profile of N4070/E4391, Nixtun-Ch’ich’.

Figure 9. Cross section of sector Y E-group reservoir, Nixtun-Ch’ich’. Ritual refuse is shaded black.
primary deposition. This rich deposit recalled the fills of early platforms ZZ1-sub-8 and sub-7, nearly 2 km to the east on the tip of the Candelaria Peninsula (Rice 2009).

At the same time, the Fosa Y pottery was also distinctly different in terms of types, forms, and decoration (Rice and Salas Pol 2015: fig. 10). The most abundant pottery represented types in the well-known Juventud (red-slipped) ceramic group. Because the slips are primarily orangey-red (Munsell hue 2.5YR), we identified new variants, including the monochrome Chapo variety. The Chapo orangey-red slips in this deposit and in ZZ1 were generally of excellent quality, thick, and lustrous. Vessels were typically large and forms included enormous, heavy, everted-rim platters or tamaleras (ca. 42–50 cm diameter), cuspidors, an unusual tub-like bote or deep palangana, “mushroom” vessels, and varied bowls, plates, and dishes. Decoration was primarily groove incising (fig. 10a–10d), unlike that in ZZ1-sub-8 and sub-7, which was primarily fluted and chamfered. Sherds of the Chunhinta (black-slipped) and Pital (cream-slipped) ceramic groups were present in the excavated deposit but in small quantities. In addition, these vessels were typically smaller-sized and in different forms than those of Juventud, and they exhibited little decoration. The deposit also included fragments of censers, a partially reconstructible black-slipped chocolatera in the form of a cacao pod (fig. 10c), a large Mars orange sherd with broken spout, and a partially reconstructible Boolay brown vessel, the latter two gadooned in the shape of a squash.

It is possible, though far from demonstrated, that the midden represents feasting refuse placed in the reservoir after some unknown kind(s) of ritual activity and, like the Mamom ritual deposit underlying structure ZZ1, calls attention to the importance of the construction process itself, which may have reenacted cosmic creation (see Swenson 2015:339). Given the completeness of many of the vessels in both locales, they appear to have been ritually broken immediately before or as part of deposition. The good preservation of the sherds indicates that the reservoir contained no water at the time of their deposition.

We continued the excavations below the midden deposit with hopes of striking the water table or evidence of an ancient pond bed. However, 1.6 m below the midden—4.9 m below datum in the eastern trench—we encountered what appeared to be pulverized limestone surfaces. A series of four floors totaled approximately 30 cm in thickness. These multiple plaster layers incorporated moderate quantities of slipped sherds of Mamom and pre-Mamom pottery. Together, the underlying fills and plaster surfaces represented a construction at least 1.5 m in height.

The lowest levels of the eastern (deeper) excavation unit consisted of four fill layers of different colors (yellow, gray, and brown) and textures (sandy to clayey); three were moist or very moist soils, indicating water retention. All yielded slipped ceramics of very good to excellent quality. The Juventud slips in the lowest levels were red or dark red-brown (Munsell hue 10R), distinct from the orange-red slips in upper levels and the midden deposit. Black slips were thick and glossy with little evidence of firing clouds; Pital Cream, present but in small amounts, had slips that were hard, thin, and varied from cream to gray and extremely fine paste. The pottery in general was thin walled and had simple decoration (Rice and Salas Pol 2015). These materials characterize the Early Eb or pre-Mamom Chich complex at the site. Both excavations in Reservoir Y were ended for safety reasons without encountering bedrock. Unfortunately, no samples suitable for radiocarbon dating were found in these levels.

Discussion

The Grid and Urban Planning

Excavations at Nixtun-Ch’ich’ have revealed late Early and Middle Preclassic occupation and construction, the latter characterized by the imposition of a unique gridded site plan over a

Figure 10. Middle Preclassic pottery from the Fosa Y midden. a–d, Large, orangey-red-slipped (Juventud ceramic group) platters with everted rims incised with vaguely piscine or crocodilian forms. a, c, and d are Tormenta groove incised; b is Guitarra incised. e, Semireconstructible black-slipped (Chunhinta ceramic group) Golondrina modeled chocolatera formed as a cacao pod lying on its side, showing the stem end. f, Juventud red. Chapo variety beaker-like form with flange and postslip-incised crossed bands. Rim has been broken off, and its form is unknown. g, Tormenta groove-incised (Juventud ceramic group) cuspidor.
The Maya Gridded City of Nixtun-Ch‘ich’

preexisting settlement. The city exhibits multiple indicators of directed urban planning: (1) One indicator is its modular grid plan, with streets coordinated by a central axis of 94°7’. Modularity is indicated by the streets and avenues forming discernible blocks. (2) Second, the line of at least 15 buildings and two reservoirs forming the central axis also indicates coordination as well as standardization—buildings aligned by an east-west axis are common Preclassic Maya arrangements (see Estrada-Belli 2011). (3) Third, the streets and avenues are relatively straight, with the exception of areas impacted by later constructions. We presume that the Maya builders surveyed with cords. (4) Fourth, two overlapping rectangles are suggested by parallel groupings of First, Second, and Fourth Streets and Third, Fifth, and Sixth Streets. Thus, the Middle Preclassic occupants of Nixtun-Ch‘ich’ used rectangles to control azimuths in settlement form, as did the Late Preclassic Maya at El Palmar, Guatemala (Doyle 2013). Somehow, they did so on slightly uneven terrain. (5) Fifth, the grid is diagrammatic, especially in its core, with alternately ordered repetition of angles and trapezoidal city blocks. (6) Moreover, familiar Middle Preclassic structural forms—E-groups and triadic groups, found at sites throughout eastern and central Petén and often paired in a civic-ceremonial template—were incorporated into the grid, further indicating standardization (M. E. Smith 2007).

The Middle Preclassic modular grid of Nixtun-Ch‘ich’ is not simply the only such layout to be defined at a pre-Columbian Maya site; its construction before 500 BC predates that of Teotihuacan, and it is currently the earliest known grid in Mesoamerica. It is not the earliest evidence of settlement planning, however, as elements such as the coordination of directionality and canonical structure templates are evident at varied contemporaneous sites. Maya city layouts often included roads (causeways) and occasionally “streets” (as at Yaxhá), but a diagrammatic urban grid is not known to have been adopted elsewhere. Thus, the founders of Nixtun-Ch‘ich’ were not building in vacuo. They inscribed typical Preclassic Maya architectural complexes—the east-west axis, two E-groups, a triadic group or its predecessor, reservoirs, causeways, and residential platforms—into a centrally organized diagram.

One must not drive a conceptual partition between architecture and lived space—ordered architecture likewise organizes aspects of daily life. We cannot reconstruct motivations, but it seems preposterous to imagine that planners at Nixtun-Ch‘ich’ did not realize that they were also organizing the lives of people in their community. The grid obviously guided constructions and peoples’ movements through space during Middle Preclassic and later times. The grid would have enhanced the legibility of the space and better connected its occupants. Thus, the city was certainly a “social reactor” and likely encouraged collective action. One wonders, therefore, whether more dispersed Maya cities reflect more selfish and autonomous behavior on the part of elites (see Blanton and Fargher 2011:508).

Even so, legibility can also be a governing strategy. Persons living within the grid were organized and more easily managed. Their motion was automatically guided by the choreographed landscape without the intervention of central coercion. Nixtun-Ch‘ich’, now a cattle ranch, continues to structure movement and construction, just as it did for the Terminal Classic and Postclassic occupants of the site. Movement is still strongly influenced by the urban landscape configuration established more than 2,500 years ago.

Movement and increased access were just two aspects of spatial organization that impacted social organization. The grid blocks differ in length and width, with the smallest bordering the south shoreline. Some differences in height and area were most likely related to the social inequalities within the city that were inscribed on the landscape (following Kostof 1992).

The gridiron was not simply negative space formed by the edges of platforms; it was a monumental construction in its own right and structured other architecture. Like the grid of ancient Greek cities (Mazza 2009), that of Nixtun-Ch‘ich’ not only partitioned the community but also propagated a particular aesthetic most explicitly communicated from the ceremonial center. The ceremonial nucleus—particularly structure Z2 and Avenue G—is unambiguously the formal center of the grid and most clearly divulges that centrality through monumental architecture, one of the most powerful forms of symbolic capital. The “monumentalization” of the grid around massive architecture in the site center promulgated it as the ideal spatial form.

The size of a planned area is an indicator of the degree of planning (M. E. Smith 2007:29–30). The grid at Nixtun-Ch‘ich’ is much smaller than that at Teotihuacan (Millon 1973), and in that sense, the latter would have required greater regulatory power over space. Yet the Nixtun-Ch‘ich’ grid is trapezoidal rather than rectangular; the trapezoid is conceptually more complex because it incorporates patterned variety rather than rectangular modules, which are easier to add to an existing layout. Thus, the complexity in the two sites’ planning is difficult to compare. It seems clear, however, that that of Teotihuacan required greater long-term control, since the city size expanded over time.

Nixtun-Ch‘ich’ had very little internal greenspace and must have had an extensive hinterland. We have no evidence that the site dominated other larger settlements during the Middle Preclassic. In the Late Preclassic period, a possible Nixtun-Ch‘ich’-style enclave was established at Tayasal and may represent political expansion into the area.

In later periods of occupation, there were some small modifications of the grid. During the Late Preclassic period, for example, the corridors in some areas were excavated for building materials and later filled but never replastered. In other areas, the corridor surfaces were renovated. Hence, the city likely had more green space at this time. Thus far, there has been little evidence of Early Classic (AD 200–600) occupation at Nixtun-Ch‘ich’ or of grid construction or maintenance in the Classic period. Substantial Late-to-Terminal Classic constructions tended to use existing platforms as foundations. An immense ball court in the north generally follows the grid orientation but appears to overlap two blocks. Minor grid modifications
are found in other groups near the ball court. Settlement plans last only as long as they are regulated, and at Nixtun-Ch’ich’, the Late/Terminal Classic modification of blocks at the ball court signals a late process of grid “deregulation” (Kostof 1991). Widespread abandonments, some partial and others total, at the end of the Late Preclassic in the southern lowlands (Estrada-Belli 2011:52; R. Hansen 1990) may have brought about the demise of the power structure that enforced the grid aesthetic.

Celestial Power and Patronage

The persistence of the Nixtun-Ch’ich’ grid through nearly two millennia of occupation can be at least partially attributed to the cosmological significance of its orientation, established by celestial alignments in the Middle Preclassic period. Its central ceremonial nucleus and adjacent residential areas, certainly displayed “a deliberate program of ritual intent” (Scott 1998:171). What was the basis of power—and what were the cosmopolitical strategies underlying the imposition of the Nixtun-Ch’ich’ grid?

An overt cult of personality, such as that of monumentalized divine kingship, was lacking at Middle Preclassic Nixtun-Ch’ich’, as it was at later Teotihuacan and the much earlier Harappan civilization. No images of rulers of the city have been found at the site. Besides inequality in residential space, the only evidence of elites thus far recovered is possible elite feasting. The ceramics in the sector Y E-group reservoir were finely made, elaborately decorated, and included imports. Feasting is one of the strategies through which elites “act” and construct power (Rosenswig 2007:2). If this were the case at Nixtun-Ch’ich’, the feasting vessels were ritually destroyed and deposited in the reservoir along the central axis—an overtly central space.

The Nixtun-Ch’ich’ planning resonates with later Maya expressions of power by emphasizing east-west cardinality and solar phenomena. Planners accomplished this feat by incorporating canonical architectural ensembles, E-groups and triadic groups. The earliest E-groups likely had some horizon-based astronomical functions, particularly vis-à-vis seasonal solar positions at zenith and solstice, but they are not literally “observatories,” particularly in their later, largely commemorative incarnations (Aimers and Rice 2006; Aveni, Dowd, and Vining 2003).

At the same time, the triangular arrangement of the three structures of triadic groups is generally thought by some Maya groups to represent the primordial three hearthstones, the center of the home. Three stars in the constellation known as Orion in Maya mythology, the stones of the celestial hearth of Creation, may also be symbolized by triadic temples (cf. Szymański 2014:147–148). During the Middle Preclassic period, these stars rose almost exactly due east after sunset in mid-November (Aveni, Dowd, and Vining 2003:173).

The east-west axis of 15 buildings and two reservoirs dominated the Nixtun-Ch’ich’ grid and tied it loosely to the solar equinox. This orientation dominates the site’s layout. The axis also directed stone, soil, and water placement and movement, signifying nature dominated and attuned to the path of the sun. Among the Classic-period Maya dynastic elites, supernatural patronage of rulership was clearly advertised on carved stelae and altars. One royal patron was the Sun God, K’inich Ajaw (k’in “sun, day”), and in many areas of the lowlands, rulers took on the name or title K’inich, variously translated as sun-faced/-facing or sun-eyed (Miller and Taube 1993:106). In the Middle Preclassic, however, political power and its patronage were generally less institutionalized and overtly communicated. Elites across the lowlands sought and experimented with novel ways to expand and proclaim such power as part of state formation (Freidel and Schele 1988; Inomata et al. 2013; Lucero 2003). The planning at Nixtun-Ch’ich’ seems a precocious manifestation of this pattern. The planners of its east-focused layout on the western edge of a vast lake formally materialized the earliest stages of this veneration. The city’s expression of power differed from later lowland forms by organizing a population in space, rather than by outright claims of divine aegis. The builders seem to have melded structural power with ideological power and, in the process, rationalized their urban space to be in accord with the cosmos.

Conclusions

Cities can exist without state-level organization (Cowgill 2004), but one wonders how the repatriation of hundreds (if not thousands) of people in a novel way occurred without the stability, administration, and symbolic capital afforded by institutional state apparatus and centralized power. The Maya lowlands have often been disregarded with respect to the development of social complexity in Mesoamerica, partly because of notions of an Olmec mother culture and partly from a “drunkard’s search” for complexity only where there are early written texts. If the grid of Nixtun-Ch’ich’ were founded in the Late Preclassic period, the city would likely be proclaimed the center of a state because of its configuration and size. However, because it was established before 500 BC, one must be cautious in this categorization, given that no other such echelon has been documented in this region at this early time. Aside from evidence of centralized planning and residential inequality (to be discussed elsewhere) at Nixtun-Ch’ich’, we have not yet identified other criteria on the state “checklist,” such as expansion or settlement hierarchies (Spencer and Redmond 2004:173–175). Nor have we noted ostentatious claims of royal legitimacy carved into monuments, but these are also absent from Teotihuacan.

Space in Nixtun-Ch’ich’ was far more regimented than in any other known Preclassic Maya settlement. The city demonstrates that complex grids can be imagined and constructed by people without previous traditions of urbanization or intricate planning. Like Poverty Point, Louisiana (Sassaman 2005:336), this layout seems to have been an invented tradition (following Hobsbawm 1983) that organized a large population in harmony with the cosmos. Associations with cosmos and myth add legitimacy to the form, its builders, and those charged with maintaining the city. Nixtun-Ch’ich’ may have been created to represent a newly formed polity, literally inscribed on the
landscape by clearing and cutting bedrock. This new layout required rethinking the population at large—making rational decisions about collective spatial organization. Thus, regardless of the ultimate motivations of the planners, the grid represents nascent “govern-mentality” (adapting Foucault 1991). Ultimately, the new tradition did not spread among Maya cities and was discarded. An urban grid was later reinvented at Teotihuacan.

A salient question concerns who, in the Middle Preclassic period, had the power to impose a grid upon a preexisting occupation at Nixtun-Ch’il’. Although we know little about Middle Preclassic sociopolitical organization in the Petén lakes region, the planning of this city seems to represent dominated space or space transformed through the vision and agency of powerful individuals (Lefebvre 1991). Diagrammatic plans are often reifications of “single-minded visions of some determined individual or institution about how the world should function” (Kostof 1991:162). Yet whether political elites, masons, or some other specialized group designed the grid, we are currently uncertain. The grid was planned and implemented in the absence of a fully elaborated glyphic script, unless a developed script existed on perishable materials now lost. Whether the designers imagined this landscape aesthetic or borrowed it from some unknown source is also unclear. Nevertheless, the diagrammatic gridded layout suggests a high degree of centralized management.

Diagrams were built on a small scale in earlier Mesoamerican ceremonial complexes and were vaguely represented on the larger scale by cardinally aligned buildings in earlier sites, but Nixtun-Ch’il’ exhibits a much more overt and choreographed diagram. Life in the city was likely similarly disciplined—it subtly organized the landscape and was naturalized, the “given.” This construction, likely applied top-down, imbued the landscape with power, but the power no longer flowed from above but rather from within—literally from the ground up. This power was manifest within the grid lattice in the form of organization, legibility, and constraint. Its creation was not simply a display of power, but the implementation of governing strategies affecting all occupants from the most humble to the highest elite. Elites could not walk through platform walls; therefore, they were in no way transcendent to its structuring. Nor was this complex to the hinter land. It was appropriately rationalized a living city into a form that facilitated and intensified social interaction and unquestionably differed from the hinterland. It was appropriately “awesome” (Yoffee 2015a:546).

Acknowledgments

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Comments

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The gridded city of Nixtun-Ch’il’ in the heartland of the ancient Maya area of Central America is significant on a number of levels. The early dating of the site, which Pugh and Rice place at 500 BC, makes it the earliest known expression of an orthogonally planned city in the New World. That this kind of city plan was attempted early in the Maya area—and, in fact, not subsequently replicated—suggests not only that the plan may not have originated in central Mexico but that it may not have been perceived to be well-suited for the social structure and agricultural practices of the Classic-period Maya. That the structural layout of the early monumental architecture at Nixtun-Ch’il’ differs from other early Maya sites also raises the possibility that the settlement may not have been completely Maya; instead, this gridded plan may have been created by or inspired by another population, such as the Mixe-Zoque, viewed by some as early migrants into the Belize Valley (Ball and Taschek 2003).

Gridded orthogonal plans do not characterize ancient Maya settlements and cities of the Classic period (AD 250–900). The emphasis on a concentrated arrangement of large special-function architecture set among gridded blocks of settlement at Nixtun-Ch’il’ contrasts with the more distributed settlement patterns found later in the Southern Maya lowlands. The site of Tayasal, located directly across Lake Petén Itzá east of Nixtun-Ch’il’, has central architectural groups in an east-west alignment, but this complex is neither as massive nor as concentrated as Nixtun-Ch’il’ (and also dates to the later Classic period); however, while Tayasal is not gridded, it does evince a possible north-south “street” that divides the site into two parts (A. Chase and D. Chase 2006:50, fig. 2). The only other site that shows resemblance to Nixtun-Ch’il’ in having a potentially gridded road system is Yaxha, Guatemala (Hellmuth 1972), where smaller east-west and north-south streets appear amid concentrated architectural complexes anchored by a dominant north-south causeway. Similar to Nixtun-Ch’il’, the eastern platform of one of Yaxha’s E-groups is located in the middle of this north-south road. While research has demonstrated that there is no one universal Maya city plan, Nixtun-Ch’il’ amplifies the variability that existed in ancient urban planning within Mesoamerica. While Late Classic Southern Maya lowland cities distributed their populations to incorporate agriculture within their settlement areas (A. Chase and D. Chase 2016a), the Nixtun-Ch’il’ gridded plan occurred at a time of lessened population pressure.
amid ready access to agricultural areas. Yet, the creation of an entirely anthropogenic landscape covered with public urban structures, settlement, and streets at Nixtun-Ch’ich’ is consistent with later practices undertaken by the Maya that not only rebuilt the central urban landscapes but also completely remodeled the wider environment that was covered with residential groups and agricultural fields (A. Chase and D. Chase 2016b).

The gridded plan at Nixtun-Ch’ich’ is much earlier than the one that occurs at Teotihuacan, Mexico. Pugh and Rice date this layout to the Maya Middle Preclassic period, noting that it existed before 500 BC. This dating rivals the temporal appearance of orthogonal cities in Europe (e.g., Castagnoli 1971; Hammond 1975:1303). Teotihuacan, north of modern day Mexico City, was seen as a unique development in Mesoamerican urbanism in having a gridded layout characterized by two major cross streets with a central market place on one side of the center and a ruler’s compound on the other. Approximately 2,000 square apartment compounds, housing corporate residential groups, conformed with an axial grid system. However, these apartment compounds came to dominate Teotihuacan only between AD 200 and 300 (Nichols 2016:15), and its major pyramids were completed between AD 150 and 225, meaning that the orthogonal city at Teotihuacan, with its substantially larger scale, is much later than the one at Nixtun-Ch’ich’.

The variation in city pattern that exists between Nixtun-Ch’ich’ and other Maya sites may signify non-Maya influence. Most Maya sites evince an initial architectural focus on a Maya E-group, a set of buildings aligned with the movements of the sun and believed to represent the first civic-religious public architecture in the Maya lowlands (e.g., Freidel et al. 2017). Pugh and Rice note that two E-groups exist at Nixtun-Ch’ich’. The E-group in quad AA is unusual in its long linear eastern platform, whereas the E-group in quad Y is more typical of these early complexes. The E-group in quad AA is the central architectural compound at the site; however, its eastern platform is unusually long and narrow. In conjunction with the concentrated architecture and gridded plan of Nixtun-Ch’ich’, this may suggest that the site was home to an amalgam of different populations that came into the Petén area at an early date. The earliest ritual deposits from other E-groups in the Maya lowlands resemble those found in the Gulf Coast region of Mexico (e.g., Inomata et al. 2013). Thus, it would be useful to excavate one or both E-groups at Nixtun-Ch’ich’ to determine whether they produce early deposits similar to those found at Cival (Estrada-Belli 2011) and Ceibal (Inomata et al. 2013). Likewise, stable isotope analysis of early skeletal remains would be useful in assessing origins.

Finally, given its unique gridded layout and the fact that the early Maya had to have known about this city, Nixtun-Ch’ich’ may have served as a special place in terms of Mesoamerican mythology relative to origin places. Given its position directly above a marshy side branch of Lake Petén Itzá, Nixtun-Ch’ich’ was perfectly positioned to have constituted one of the origin places for the Maya that is referenced in later hieroglyphic texts as “Tollan” or “Place of Cattails.” David Stuart (2000:466) noted that there were multiple Tollans but suggested that the original “Tollan” was Teotihuacan; however, Nixtun Chi’ich’ must surely be included in this class of sites. Additional archaeological work needs to be undertaken to clarify the role that Nixtun-Ch’ich’ may have played in the development of Maya civilization.

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Big Surprise

The authors have succeeded in situating the discovery of the great antiquity and gridded urban design of Nixtun-Ch’ich’ within a cogent review of relevant theoretical literature, at the most general level of Foucault’s notion of discipline, the middle level of Yoffee’s notion of cities as awesome (intrinsically monumental), and the more specifically Mesoamerican level of Smith’s conception of urban planning. The theme of “govern-mentality” raised in this review by such perspectives is a useful guide, as it pertains not only to the unique Middle Preclassic gridded settlement in question but more generally to how and why lowland Maya agrarian populations convened in centers as a first step to social complexity. As we are beginning to learn, many of the earliest ceremonial centers of the lowlands were founded around E-groups, solar commemorative places designed to witness the sun cycle through the year, named after the first-identified such group at the site of Uaxactun in Petén, Guatemala. Such time-bound places likely facilitated scheduling not only ceremonies but also many practical activities, like trade. In this respect, Nixtun-Ch’ich’ is normal, for it has such an E-group built into its grid. It has the other various kinds of pyramids and plazas as well. So the people who founded and maintained and lived in this town were certainly lowland Maya, as their artifacts also attest. Living before writing and public art, we will be hard pressed to get any answers from them as to why, in their own sense of things, they decided to create such a community. So the relatively abstract contemplation of the matter by the authors may be our best course.

The gridded town of Nixtun-Ch’ich’ is a good example of what Lewis Binford colloquially termed a “surprise” in archaeological patterning. It flies in the face of V. Gordon Childe’s lament (1950:9) that the lowland Maya case upset his list of universal criteria for the urban revolution. While he despaired of the Maya because of what he regarded as technological backwardness (e.g., no draft animals), he no doubt had in mind the lack of nucleated and orderly settlement—true cities. More recently, Michael Smith (2009:21), in his review of Childe’s model, today gently passes over this affection for the nucleated in his contemplation of Tikal as a city, emphasizing monumental civic architecture instead. Other theoretically inclined archaeologists,
like William Sanders and David Webster (1988), influenced by Childe, insisted that the Maya case lacked true cities and therefore represented a lesser level of government organization than highland Mexican sites like Teotihuacan, a presumption relevant to this article’s focus on power and authority. Even the massive, nucleated—if not orthogonal—Classic-period settlement of Chunchicmil in northwestern Yucatan (Magnoni et al. 2012) could not persuade skeptics that the Maya had cities and not just grandiose royal estates, even though it is far from clear whether the governments of that city were ever ruled by divine kings. J. E. S. Thompson, champion of the “empty ceremonial center” in his popular writing of the 1950s, resisted the urban nature of Tikal despite clear settlement pattern evidence of the urban scale of this place (Thompson 1971). The debate has subsided, and the lowland Maya are now identified, in general, as having “low density” urban settlements.

The unsettling reality of Nixtun-Ch’ich’ is that the lowland Maya did not have to have “low density” urbanism for some pressing set of environmental or geographically determinative reasons or because their tradition of governance was in some way lesser than that of those peoples who chose nucleated urban settlement (e.g., “chieftdom” vs. “state”). Even as a young Mayanist, I recognized that residential dispersal was a cultural and political decision and not an environmental necessity (Freidel 1981). We are all being reminded, to our sorrow and astonishment, that there is no direct path between environment and adaptation. What the discovery unequivocally demonstrates is that a group of lowland Maya chose to create and inhabit a gridded, nucleated town (city, if one prefers) at the very outset of sedentary settlement. They not only did so but also successfully continued to live that way for many centuries. In Karl Popper’s (1977) sense, this is a clear disconfirmation of the persistent notion that the Maya had to adapt to their subtropical forest environment by making and maintaining low-density urban settlements. No doubt there are many reasons why this was the way they generally founded and maintained settlements. But it can no longer be said that they had to.

The article by Pugh and Rice is a significant assessment of planning and incipient urbanization in the Maya lowlands that will foster much discussion. The article presents excellent empirical data based on years of investigations and solid interpretations regarding the processes of community formation at Nixtun-Ch’ich’.

In their article, Pugh and Rice stress that the dense nucleation and rectilinear organization of civic and residential structures at Nixtun-Ch’ich’ is dissimilar to other cities in the southern Maya lowlands, especially during the Middle Preclassic (800–400/300 BCE), which is when they propose that the gridded layout appeared. This distinction is the foundation for their argument that the organization of space directs the behavior of individuals, an assertion made by others as well (Gehl 1996; Hall 1966; Hillier and Hansen 1984; Lefebvre 1991; Whyte 1980).

According to Pugh and Rice, Nixtun-Ch’ich’ lacks green or garden spaces in the civic precinct, but it also lacks large plazas for the congregation of people to view public ceremonies. Although Pugh and Rice hypothesize that the ceramics recovered from the reservoir to the east of the main E-group represent a trash deposit from a feasting event, they do not identify large public gathering spaces in the layout. While the Nixtun-Ch’ich’ E-groups do provide gathering places, most E-groups measure only 50–60 m from east to west, which is not large. In contrast, Cival’s main civic plaza, constructed during the Middle Preclassic, measures approximately 500 m × 500 m (Estreda-Belli 2011:75) and would have accommodated a sizeable number of spectators for public performances. The Cival E-group and triadic acropolis sit on this plaza. Nixtun-Ch’ich’ may have had an expansive plaza at one time, which was filled in with civic architecture later in the history of the settlement. The lack of such a large gathering space throughout much of Nixtun-Ch’ich’’s history indicates that the civic life for the citizens may have been more controlled and less inclusive than that of more open city plans.

Pugh and Rice argue that the gridiron layout of Nixtun-Ch’ich’ was formed before 500 BCE. However, based on the excavations presented, a date before 500 BCE for a gridded layout is problematic. Although there is no doubt a substantial building event dating to before 500 BCE at Nixtun-Ch’ich’, this construction may have consisted of a large plaza. Expansive plazas were common building projects during the early Middle Preclassic, pre-Mamom era (1000–600 BCE). The continuation of the early plaster surfaces under adjoining platforms indicates that the extent of the first construction was greater than the area covered by the corridors. Moreover, the construction sequence described by Pugh and Rice, consisting of a dark, sticky clay matrix placed directly atop scraped bedrock and superimposed by ballast and a plaster layer, has been recorded in association with plaza building at El Mirador (R. Hansen 1998), Ceibal (Inomata et al. 2013, 2015), and Yaxnohcah (Peuramaki-Brown 2014). Initial plaza construction at these sites consistently dates to 900–700 BCE, based on ceramic identifications and radiocarbon dating, and these dates correspond well with the pre-500 BCE date that Pugh and Rice propose for the first constructions at Nixtun-Ch’ich’.

We also cannot rule out the possibility that the alignments in the corridors forming the grid grew by accretion, as platforms and structures were added and the settlement expanded. Nevertheless, it is clear that several of the platforms flanking the corridors in the southeast sector were constructed during the latter part of the Middle Preclassic (600–300 BCE) based on the presence of Juventud ceramics recovered in the fill and one carbon-14 date. Therefore, the standardized alignments that were followed throughout the history of Nixtun-Ch’ich’ were in place by 300 BCE at the latest.

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The article by Pugh and Rice is a significant assessment of planning and incipient urbanization in the Maya lowlands that will foster much discussion. The article presents excellent empirical data based on years of investigations and solid interpretations regarding the processes of community formation at Nixtun-Ch’ich’.
One of the most compelling arguments made by Pugh and Rice states that the layout of Nixtun-Ch’ich’ was the result of centralized planning. According to Jane Jacobs (1992), a centralized planning regime draws upon the “expert” knowledge of an individual or a small group to make decisions. Interestingly, specific geographic considerations may have heavily influenced the planning process. Nixtun-Ch’ich’ is located on a peninsula and circumscribed on three sides. Therefore, the settlement did not have the luxury of sprawl. Civic complexes and residential groups are packed into an area of 2 km². Its urban core contains 55 large platforms and covers only 1.02 km². This level of nucleation in such a small area is possible only if the layout is highly organized, and centralized planning would have been crucial to this process.

In the Maya lowlands, the transition from the Middle to the Late Preclassic (ca. 400–200 BCE) is the point at which centralized rulership and statecraft emerged. This time is also when unambiguous evidence for the appearance of corridors and a gridiron layout has been recovered. Therefore, I agree with Pugh and Rice that a standardized plan for Nixtun-Ch’ich’ was likely implemented by a small group of planners under a centralized authority.

The degree of nucleation seen at Nixtun-Ch’ich’ is in stark contrast to most “edgeless” Maya cities. These cities, characterized by clustered nucleation (Nalda 1989) or polycentric agglomeration (Dear, Schockman, and Hise 1996), may have resulted from decentralized planning (Jacobs 1992), which relies on “local” knowledge and integrates people from various social groups into the planning process.

Intriguingly, a gridded pattern also appears at Ujuxte on the Pacific Coast during the late Middle Preclassic, and Love (1999) suggests that Ujuxte, too, was centrally planned. The Nixtun-Ch’ich’ and Ujuxte examples, then, imply that gridiron layouts and central planning may be more widespread than previously suspected.

In sum, this is an important article that advances our understanding of early urban processes within the Maya lowlands. The development of a gridded layout with dense nucleation during the Middle Preclassic at Nixtun-Ch’ich’ demonstrates that, while there may have been shared concepts of spatial organization, Maya cities did not embody “cookie-cutter” designs. Instead, this study confirms that urban designs of prehispanic Maya cities were highly variable and contingent upon local geographic and historic contexts.

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Nixtun-Ch’ich’ is a fascinating site that will force us to rewrite the history of Maya urbanism. Who could have predicted that the earliest grid layout in Mesoamerica would be found at a Preclassic Maya center? Like Teotihuacan in central Mexico many centuries later, Nixtun-Ch’ich’ was evidently a failed experiment in orthogonal planning. While these two unique cities each thrived for several centuries, once they declined, their successors rejected orthogonal plans and returned to older planning principles. If archaeologists can explain the development of orthogonal planning at Nixtun-Ch’ich’—and its sociopolitical context and significance—this would be a major breakthrough in understanding early Maya cities.

Unfortunately, the theoretical and epistemological choices made by Pugh and Rice all but rule out achieving an adequate explanation for these questions about Nixtun-Ch’ich’. In fact, their paper is an exemplar of the kind of faulty argument I criticize elsewhere (M. E. Smith 2015). Here I focus on two components of this paper’s logical structure: the use of the social theory of Michel Foucault, and the lack of any attempt to determine whether the interpretations are correct.

Highly abstract theories and concepts—such as Foucault’s governmentality, power, and discipline—describe the operation of the world on a very general level. This kind of approach, termed “grand theory” by C. Wright Mills, is “so general that its practitioners cannot logically get down to observation. They never, as grand theorists, get down from the higher generalities to problems in their historical and structural contexts” (Mills 1959:33). This is a basic pillar of social science epistemology; grand theory is so abstract that it cannot explain individual cases or variation among cases (Abbott 2004:218; Ellen 2010; Mjøset 2001; M. E. Smith 2011). Foucauldian power and governmentality simply exist—presumably for all societies—so how can they explain change and variation?

In Abend’s (2008) classification of types of theory in sociology, Foucault’s concepts are examples of either theory type 3 (a statement about the meaning of social phenomena, an interpretation, a reading, or a way of making sense) or type 5 (a weltanschauung, an overall perspective from which one sees and interprets the world). What this means is that Foucault’s concepts—as used by Pugh and Rice—are of limited utility in explaining specific social phenomena, and their empirical adequacy cannot be tested. In the words of Fisher (2009:440), abstract theory like this “does not offer the tools needed to analyze the material remain on the ground.”

Pierre Bourdieu recognized this problem with Foucault’s work. As reported by Callewaert (2006:92), Bourdieu complained that “the philosophical method was used [by Foucault] for answering questions that are basically empirical sociological questions.” Foucault’s methods of both history and social science were faulty (Garland 1987). Indeed, his method of social analysis has been called “politically engaged journalism” (Vallois 2015). If one is interested in abstract, philosophical notions about the human condition, then the work of Foucault is full of insights. But if one is interested in a social-scientific explanation of the dynamics of cities, one has to look elsewhere for concepts and models.

In the social sciences, theory that is more grounded and testable is termed “middle-range theory” (Hedström and Udéhn 2009; Merton 1968:39–72; Sampson 2010). In Abend’s (2008) scheme, this corresponds to theory type 1 (a general proposition
about the relationship between two variables) and type 2 (an explanation of a particular social phenomenon). In this approach, explanation consists of identifying the causal mechanisms responsible for observed changes: “to explain a fact is to exhibit the mechanism that makes the system tick” (Bunge 2004:182).

To their credit, Pugh and Rice do not rely exclusively on Foucault’s concepts. Their theory discussion also draws on several more empirically grounded urban scholars, such as Spiro Kostof, Jill Grant, and Luis Bettencourt. But their theory section is phrased in a highly generalized fashion—cities are like this; grids imply that; states do this—that prevents specific propositions from being tested. One does not have to be a strict Popperian falsificationist to recognize that social science arguments are more convincing if expressed in a fashion that can be tested. In the words of Haber, “The fundamental question of all serious fields of scholarly inquiry [is]: How would you know if you are wrong?” (Haber 1999:312). Methodological works in social science routinely stress this aspect of argumentation (Abbott 2004:216; Bunge 2013:153; Gerrig 2007:74, 2012:30–31; Luker 2008:53; Ragain and Amoroso 2011:39).

If I were confronted with the puzzles of Nixtun-Ch’ich’ and asked to work with the collection of concepts and theories employed in this paper, here are a few propositions I might want to test: (1) Was the layout of the city “diagrammatic” or not? To me, a grid does not fit Kostof’s (1991) concept of a diagram layout, but one should be able to test the claim of diagrammatic design. (2) Was the polity responsible for creation of the grid an expansionist state? (3) Where would it fit on Blanton and Fargher’s (2008) scale of premodern collective governance? (4) To what extent was the grid starting to break down late in the life of the city? (5) Did any of the principal street or building orientations align with a specific measurable solar phenomenon? Instead of assuming a solar orientation, this can be tested (M. E. Smith 2003). As it stands, the reader has no idea whether the proffered interpretations are correct or not, in part because of the abstract nature of the theory and in part because there is no testing or explicit evaluation of alternatives.

I urge the authors to reconsider their epistemology and to look at some of the empirical theory available to archaeologists (Moore 1996; Rapoport 1990; M. E. Smith 2011). Foucault is fine for cultural studies, but anthropological archaeology in a social science vein requires more attention to concepts that can be clearly operationalized. Nixtun-Ch’ich’ is a particularly important early city for understanding ancient Mayan and Mesoamerican cities and polities. I am thankful to the authors for their fieldwork and reporting on the site, but I really think it deserves better theory and better epistemology.

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Pugh and Rice are to be congratulated for conveying to us some exciting features of this intriguing new find at the Maya site of Nixtun-Ch’ich’ in Guatemala. There is much to be celebrated here in this exploration of major topics such as the character of Maya urbanism, the role of planning in assessing the complexity of an ancient administration, and the effects of specific architectural forms on society and how the interactions among densely packed urban inhabitants played out.

The authors take on several important issues: for example, whether states and urbanism are coeval. They maintain that they are not, but I think that stance is more controversial than they suggest. The cases where cities supposedly exist without state-level integration, and vice-versa, are certainly cases we can argue about, and, of course, the Maya are one. One example: the authors state that “Ancient peoples did think about and took steps to improve the well-being of the state, as clearly documented by ‘nilometers’ in Egypt and census taking: monetary, measurement, and stylistic standardization; and urban planning in various early states.” All true, but aside from modest indicators of urban planning for the Maya, the Maya themselves really did none of those things. Hence the doubts about Maya statehood and the reasonable doubts about whether their centers were truly urban to many non-Mayanists. Maya centers are probably cities but clearly of a different sort—something one might designate as “hypo-urban.” Those kinds of low-density cities are not unique to the Maya, being found commonly in Africa and Southeast Asia.

So, we are here presented convincing evidence (through test excavations and carbon-14 samples) that the Maya had one case of a nonorthogonal grid plan in one early center. The “Achilles heel” of all this is, of course, the apparent total uniqueness of a grid plan appearing once. Accepting the demonstration of the early date of this feature, it seems that the Maya really are “the Greeks of the New World,” inasmuch as they have now demonstrated the application of the “Hippodamian” grid scheme at about the same time that Hippodamus of Miletus—if the historical figure truly did apply it to places such as the Peiraeus harbor in Athens—was at work in Greece. Given that Hippodamus’s dates are traditionally reported as spanning the 400s BCE and that he supposedly planned the Peiraeus anytime between 460 and 430 BCE, the Maya even have the best of him in being earlier. (Should the Greeks be called “The Maya of the Old World”?)

All levity aside, it really does not matter regarding the so-called Hippodamian plan. The Mesopotamians, Egyptians, Harappans, and Dynastic Chinese were all arguably applying the rectangular grid pattern before the Greeks (or the Maya). It is clearly the kind of feature that would occur to most humans contemplating the layout of a nucleated community into which they expected the movement of people to live their lives, without necessarily focusing on the issues of control or convenience or the cognitive reaction of humans to space crowded with streets and structures.

What does it mean that the Maya in Middle Preclassic times at Nixtun-Ch’ich’ went out of their way to construct a gridiron layout of their city, maintain it for a few centuries, then let it fade out and never repeat the process in another Maya city? Were the Maya being “ahead of their time” in some fashion?
How, if they did not make this kind of planning a pattern? No Maya center after this seems to have this feature of planning, which, we can mostly accept, is perhaps a feature that strongly illustrates a reasonably sophisticated approach to administration and urban planning. (Not that one necessarily has to have a grid plan to prove some level of urban planning, as the authors clearly set out in their overview of Maya practices.)

In most other urban civilizations of the ancient world, cities started out as unplanned and ungridded, and then subsequent cities of that culture were laid out on grids. Athens was an unplanned city, but its port was given a grid; the cities of Priene and Olynthus are the type-sites for Greek gridded and highly planned urban centers (and these provided the aura of equality that the authors correctly state can be a feature of a grid). Rome was an unplanned city; yet as the empire grew, especially in Europe, military camps set down on strict orthogonal grids, whose plottes were continued deep into the countryside, became the cores of later cities (promoting hierarchy, which the authors also correctly note as a possible attribute of a grid). So, in other urban civilizations, the evolution went from ungridded to gridded (organic to strictly planned), whereas the Maya, turning the pattern on its head, went from one early gridded example to none at all (planning to organic, with some planning of the location of ceremonial foci of those centers). The pattern simply seems odd, possibly prompting a shrugging of the shoulders and the reaction, “so?”

The problem here is that we are dealing with a sample of one. Very little can, in reality, ultimately be concluded from this apparent anomaly. Even one more Preclassic gridded Maya center would constitute some evidence that this grid was something other than a single complete surprise and that the Maya did indeed engage in a pattern that is commonly found in other early urban civilizations.

It just seems that Maya archaeology often has resonances with Greek and Roman archaeology in the cases where some research is performed against a background suffused with an aura of admiration and attribution of uniqueness and special treatment. After all, as Plato said, the Greeks were “the everlasting children of the mind.” Many classical archaeologists have moved beyond idolizing the Greeks and Romans. The Maya, as if they were the everlasting children of the K’uhul Ajaw, sometimes come across as so different from others and so unique that, if they happened to adopt a feature that we admire, it is emphasized that they did so earlier than any other people in Mesoamerica—maybe even earlier than anyone else in the whole world and in a way totally unlike anyone else—because they are the Maya and, therefore, special.

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Reply

We thank all of the commenters for their ideas, as they have allowed us to think more deeply about Nixtun-Ch’ich’. Much like Poverty Point in Louisiana, Nixtun-Ch’ich’ is anomalous relative to its time and place and, reviewers agree, suggests centralized planning on a scale that seems precocious for the Maya Middle Preclassic period.

Several of the commenters note that other early sites and cities have grid-like arrangements. Glenn Storey discusses the many Old World nucleated, gridded communities that existed well before Nixtun-Ch’ich’. In the Maya area, Arlen Chase mentions that parts of nearby Yaxha have dense settlement that seems to approach a grid-like form. And Kathryn Reese-Taylor reminds us of Michael Love’s (2016:286) claim that Uxulte (Pacific coast) was built on a “grid plan,” on the basis that all buildings had similar orientations. Uxulte certainly exhibits coordination, yet it is not a modular orthogonal grid, which requires a higher degree of planning (see M. E. Smith 2007:7–8). Orthogonal urban grids are not just coordinated buildings but include coordinated buildings within blocks, which are bordered by coordinated streets. Because streets tend to be straighter and intersections fewer and more regimented in urban grids, they require greater planning, and the resulting space is more legible. Centralized planning was not limited to the Middle Preclassic Maya world, as it is evident in the bilateral symmetry of La Venta (Reilly 2002:36)—a characteristic it shares with Nixtun-Ch’ich’. Yet the central axis of La Venta is oriented north to south, while that of Nixtun-Ch’ich’ was oriented east to west, a pattern typical of the Preclassic Maya in the eastern Southern Lowlands (Estrada-Belli 2011). The urban grid of Nixtun-Ch’ich’ exhibits great creativity, but that creativity occurs within a larger trend of social planning. The ingenuity is played out upon a typical east to west axis.

Reese-Taylor mentions the anomaly that there are no large spaces for people to gather—such as open plazas—at Nixtun-Ch’ich’ and points to the common occurrence of plazas at contemporaneous and earlier Maya sites. Yet the site does include a number of plazas, which would have provided space for ritual events and other gatherings. For example, the open area between the east and west buildings of the E-group adjacent to Reservoir Y is 3,100 m². Based on modern estimates of 1 person per m² in a loose crowd, 2 people per m² in a moderate crowd, and 4 people per m² in an extremely dense crowd (Jacobs 1967; see Still 2014 for visualizations), over 6,000 people could comfortably mass into the plaza for important events, although we expect that many events were not open to everyone. We believe that initial “grid” corridors were once much wider and may have resembled plazas more than corridors (Pugh 2016, 2017). We will test this issue with future excavations. Reese-Taylor also notes that Nixtun-Ch’ich’ might have expanded through accretion. One must keep in mind that the site plan illustrated is the site as it currently appears. Our test units have revealed evidence that the grid experienced several renovations. Nevertheless, we have not determined the initial city form. Diachronic variation in the grid form is another issue that we hope to investigate in future research. At present, the only accretion evident is the expansion of platforms into the corridors (Pugh 2016, 2017).
Rice largely agrees with Michael Smith’s advocacy of a positivist approach to archaeology, but Pugh does not. In her view of what this article tried to accomplish, Rice feels that the “highly generalized” discussion of theory was not intended to present testable hypotheses—yet. Rather, it was intended to outline the ideas about what cities and grids are currently thought to be by urban theorists, against which we can compare findings and expectations about Nixtun-Ch’ich’. We are still in the early stages of investigating this large site, and Smith—given his work with sites and states in central Mexico—wants to push us toward conclusions we are not yet ready to make (e.g., concerning “expansionist states” or “collective governance”).

Our article utilizes two aspects of Foucault’s work to help us understand the grid at Nixtun-Ch’ich’: (1) divisions in space organize city occupants and can be used as a form of population control; and (2) efforts of self study and improvement are aspects of government—particularly those of highly developed states. The first point is commonsensical, but if Smith would like hard data to support this “hypothesis,” he might look at the Google Earth image of Nixtun-Ch’ich’ and observe the cattle paths—many of which are structured by the topography and, therefore, the grid.

The second aspect of Foucault’s work is complicated by general misunderstandings of both surveillance and discipline, which are often falsely equated with powerful images such as the eye of Sauron in J. R. R. Tolkien’s *Lord of the Rings* and room 101 in George Orwell’s 1984, respectively. Foucault’s notions of discipline and punishment were far subtler. For example, if Pugh realizes that he requires more knowledge about Olmec constructions and does an immense amount of reading to fix the issue, then this is a real and observable example of both self-awareness (surveillance) and improvement (discipline). If agents of a state observed that walking on the right side of the sidewalk was more efficient (surveillance) and, during the 1970s, forced students at Signal Mountain Elementary School to conform to this practice (discipline), then Pugh will likely practice this behavior largely unconsciously and believe that it is the correct way to walk on the sidewalk (which, in many parts of the United States, it is). If agents of a state observe that a city’s traffic infrastructure is poor (surveillance), they may impose a grid to enhance the social reactor (discipline). Thus, the notion that the organization of space is a means of social improvement is not an example of high theory but would be better categorized as middle-level theory.

Pugh argues that the real reason that many materialists have problems with Foucault and attempt to attack his validity is that Foucault’s notion of power undermines that of materialists on a number of levels. First, structural power cannot be possessed, so it cannot be sought out by ambitious elites. Second, Foucault believed that power was not always repressive—it can be quite productive, thereby challenging Marx’s moral position on power. Third, and perhaps most annoying to materialists, structural power is not subservient to the economy (Choat 2010:114–118).

Smith’s notion that archaeological conclusions should be derived though hypothesis testing seems unevenly applied. Ironically, the most common materialist explanation of monumental constructions (and many other practices) is that they justify the position of elites in society. “Justifies” implies that the position of elites is satisfactorily internalized by the masses. In other words, the practices have a cognitive impact upon the populace, affecting legitimacy. When dealing with archaeological data, is this hypothesis really testable? Pugh has no problem with science or hypothesis testing and believes that Smith has done more than any recent archaeologist to further the study of architecture. The problem is that science is very limited in the study of some phenomena—particularly art. Architecture is an art, and studying it solely from a scientific perspective would hinder its understanding (Norberg-Schulz 1979:5).

We do not swallow Foucault’s theories hook, line, and sinker—in fact, we questioned some of Michel Foucault’s assumptions in the article. We mentioned that efforts of evaluation and state improvement efforts did not simply begin with the European Renaissance, but that many early states and pre-state organizations also did this on a large scale. The writings of Aristotle are, perhaps, the best example, but such efforts also occurred in Egypt and China. We also believe that the urban grid at Nixtun-Ch’ich’ was constructed to remedy many of the organizational challenges of early complexity.

Glenn Storey asks an important question that one should pose for all research: “So?” The urban grid at Nixtun-Ch’ich’ adds much to our knowledge of the Maya and of city planning in general. David Freidel, for example, recognizes that the dense settlement at Nixtun-Ch’ich’ challenges notions that the ancient Maya were forced live in dispersed settlements because of limits imposed by the tropical forest. They had the ability to do otherwise, but they generally chose the dispersed layout. Yet it is possible that Nixtun-Ch’ich’ was able to have a denser settlement because they had access to an efficient means of moving people and resources—canoe transportation on the lake.

Storey also questions the significance of a sample of one. Keep in mind that it is a sample of one city—a city that contained several thousand people—and that the grid was maintained, renovated, and probably expanded over several hundred years. In addition, this may not be the only urban grid in the Maya lowlands. It is very possible that ancient grids rest underneath later constructions in larger cities. The grid at Teotihuacan emerged while the grid of Nixtun-Ch’ich’ was still in use. “So,” in other words, this sample of one seems part of a larger trend of central planning in Mesoamerican urbanization.

Chase suggests that Nixtun-Ch’ich’ may have been a paradigmatic origin place generally known as *tollans* (“place of reeds”) in Mesoamerica. Rice (forthcoming) has suggested that possibility, more specifically raising the possibility that it is a place mentioned in the late indigenous histories as Chak’an Putun. Chak’an Putun may be the Postclassic Itza Maya equivalent of the central Mexican term *tollan*. 
Orthogonal grids were once considered the pinnacle of city planning, but this notion is ethnocentric (M. E. Smith 2007:3–4) and also somewhat ridiculous, because orthogonal grids are not overly complex forms. It is not surprising that they were independently invented in a number of areas. The Maya used grids to organize written texts, so the appearance of a grid in this area is not entirely astounding. Yet the seemingly precocious development of large-scale centralized planning is, as noted by Freidel, a surprise. However, it is certainly not the only example of Middle Preclassic city planning.

Smith, in contrast, argues that the planning does not seem diagrammatic. Diagrammatic cities are those that are “planned at one time as a precise diagram” (Kostof 1991:162). Diagrammatic layouts do not necessarily represent another phenomena. For example, sixteenth-century fortresses in the form of circles, squares, octagons, and so on were not necessarily composed to simply look like those shapes but were part of a larger trend in which practical geometry was applied to solve defense needs (see Wolfe 2009:144–145). We have presented data (table 2) attesting to the coordination of the streets at Nixtun-Ch’ich’, which we believe demonstrates that it is diagrammatic. Of particular note is that the angle bisectors of First and Sixth Streets, Second and Fifth Streets, and Third and Fourth Streets are parallel to each other as well as parallel with the central axis to within half of a degree. It is highly improbable that such precise bilateral symmetry could occur organically. These angles must have been carefully planned, surveyed, and regulated.

We currently know little about social organization at Nixtun-Ch’ich’ except that it involved large-scale feasting events. We have not uncovered large sculptures of “kings,” which is problematic because kingship is often used as a proxy for state-level political organization in the Maya lowlands. In sum, we do not believe that Nixtun-Ch’ich’ remotely resembles a chiefdom, but we feel that it is premature to suggest a state. Yet if it were a state, it takes a form different from that which emerged in other areas during the Late Preclassic period—particularly with respect to political iconography. The construction boom at Nixtun-Ch’ich’ continued into the Late Preclassic period, and we have not yet found images of rulers from that period either. Thus, nascent social complexity in the region may have experimented with a number of options. As a result, we must be careful about making broad general characterizations for the ancient Maya in either period, particularly the Middle Preclassic period.

—Timothy W. Pugh and Prudence M. Rice

References Cited


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