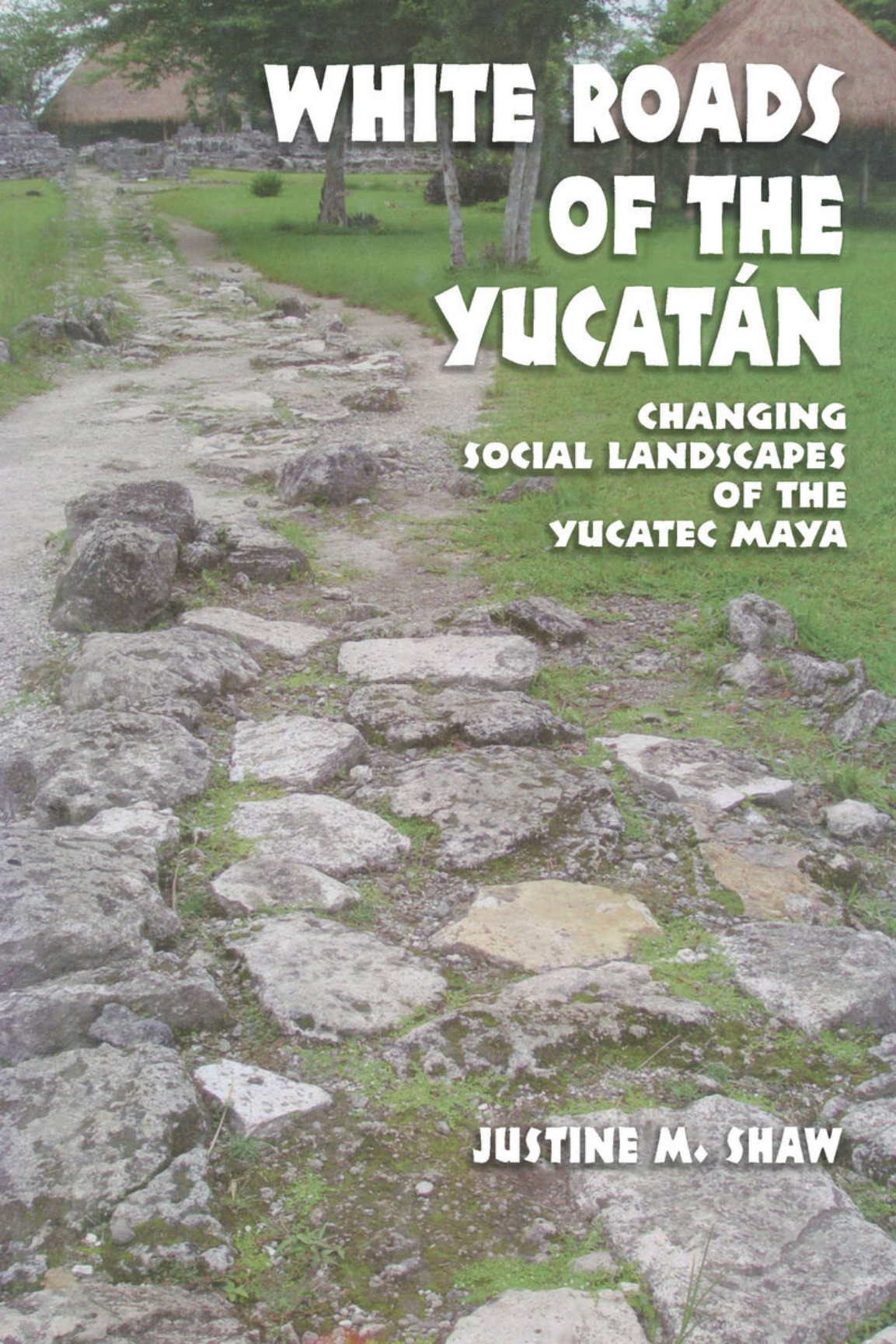
WHITE ROADS OF THE YUCATÁN
CHANGING SOCIAL LANDSCAPES OF THE YUCATEC MAYA
JUSTINE M. SHAW

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Justine M. Shaw

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Contents

List of Figures

Preface

The aim of this text is to present all available, well-documented examples of research on sacbeob within the Maya lowlands, as well as the more synthetic works that speak about the entire feature class. The goals of gathering this information together are twofold: to attempt to make statements concerning the nature and functions of sacbeob as a feature class, and to provide a context for the consideration of two recently documented road systems from the Cochuah region. The former was the original, primary intent of the text. With so many years of research, and so many cases available, it was initially hoped that making more profound, predictive statements about causeways with some statistical basis would be possible. However, after a systematic review of the actual data available, it became clear that finding variables that were consistently present for many roads (such as the dimensions, surrounding settlement, nearby cultural and natural features, construction techniques, date, and construction and/or use data) would be very difficult. Although this situation prevented a statistically meaningful analysis of the variables of interest, a review of the available descriptive materials has served to emphasize the tremendously variable nature of the features that archaeologists have termed "sacbeob," as well as to begin to elucidate potential patterns (discussed in chapters 4–8) that might be pursued in future investigations. The second goal, providing a comparative framework within which to consider the two new Cochuah road systems and their functions as elements of social integration, has been the focus of the concluding two chapters. This context is particularly critical because of the nature of the CRAS project (a small research project spread across numerous sites each season) and shifting local political conditions. Both of these factors have limited the degree to which the project has been able to concentrate on the individual road networks that are the focus of this book.

Note on the Use of Foreign Terms

Numerous foreign terms, both Maya and Spanish, have been utilized throughout this text. Short definitions for these terms have been in-

cluded within the text at the point each is first used. Where these brief definitions were considered to be inadequate or for terms used repeatedly throughout the text, longer definitions are provided in a glossary. The terms have not been translated to English, because for most there is no single word or short phrase with an equivalent meaning.

Acknowledgments

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I also would like to thank my colleagues from the United States, Canada, Sweden, and Mexico, including INAH–QR and INAH-Nacional, for helping us with our many seasons of research. Adriana Velazquez Morlet, director of INAH–Quintana Roo, has been incredibly helpful in helping us to continue our research in the Cochuah region. Dave Johnstone, my long-time research partner, has been instrumental in providing excellent ceramic analyses, helping me run our project, and forcing me to put our findings in context. Willie Folan, Ed Kurjak, Jennifer Mathews, and Sue McIntyre provided valuable feedback on drafts of the manuscript, and Allyson Carter, of the University of Arizona Press, has nurtured this project since its inception.

Sandra Bever has advised and assisted our project in obtaining local and national permission to work. I am also grateful to all of the students who have taken part in the Proyecto Arqueológico Yo'okop and Cochuah Regional Archaeological Survey, including Alberto Flores, Adam Kaeding, Maya Kashak, Pablo Huerta, Chris Lloyd, Veronica Miranda, Johan Normark, and Tatiana Young.

David McVeigh, my new David, I thank for helping me to realize that archaeology may not be the only thing in life that's important. My parents, Tom and Mary Lou Shaw, I thank for believing in me and supporting me as I continue to strive to attain my goals in life.

Finally, and most important, I would like to thank the people of Ichmul, Sacalaca, Saban, San Felipe, and Huay Max who graciously allow us to live and work in their *ejidos* during our summers. In addition to the crew members we are able to hire, we have received countless tips and continual assistance from individuals throughout the Cochuah region.

White Roads of the Yucatán

1

The Ancient Maya and Their Sacbeob

Through time, cultures have used a variety of methods to define themselves relative to others and integrate members of their society. Such strategies have included everything from religious cults (Lee and Zhu 2002; Malville and Malville 2001; Ringle et al. 1998) to gift giving (LeCount 1999) to specialized architecture (Adler 1989; Adler and Wilshusen 1990) to taxation (Morrison and Sinopoli 1992). When societies become larger and more diverse, through natural growth or immigration, social integration becomes particularly important if such groups are to function as a unit (Adler 1989; Adler and Wilshusen 1990; Johnson 1978, 1982, 1983; Rautman 2000).

Two ancient Maya sites, Ichmul and Yo'okop, faced with exponentially more inhabitants than ever before during a time of social and political turmoil, called upon road networks as a means to integrate their burgeoning, dispersed populations. These causeways were not new features for the Maya, having been utilized by many other sites in the Yucatán. However, an examination of these road systems, in the context of other examples from throughout the Maya lowlands, reveals why it was only at this particular time, never before or after, that the people of Ichmul and Yo'okop decided to invest enormous time and resources in the construction of such monumental architectural features.

Who Are the Maya?

Today, the term *Maya* has come to refer to a series of related languages spoken throughout highland and lowland regions of southern Mexico, Guatemala, Belize, and into Honduras, as well as the speakers of those languages and descendants of those who once spoke the

languages (Edmonson 1973; Hanks 1990; Tozzer 1974 [1921]). However, not all speakers of the various Mayan languages would necessarily be considered Maya people. The term is also used to refer to an ethnic group or groups, indigenous peoples within these regions; in this case, it is generally applied by outsiders, rather than by the Maya themselves (Gabbert 2004). In fact, Castañeda (1996) believes that the "Maya" culture has been invented by anthropologists, tourist-oriented businesses, politicians, and New Age spiritualists, as well as Maya peoples themselves.

In this work, the term *ancient Maya* does not assume such a shared ethnic identity, language, or status. Instead, it is used to refer to the occupants of the Yucatán Peninsula from around 500 BC until the time of the Spanish conquest. *Classic Maya* is used to refer to a narrower window of time, from around AD 250 until AD 850. Although neither term exclusively refers to the lowland Maya, this is its general implication in this work, which focuses on the raised roadways constructed mainly within the Maya lowlands.

What Are Sacbeob?

Throughout this text, the question of what a *sacbe* is, is addressed in terms of potentially variable construction styles, physical characteristics, functions, and potential meanings, with examples from the sites of Ichmul and Yo'okop (fig. 1) being discussed in greater detail. However, basic definitions of the term are reviewed here to provide a background for these more technical discussions and specific cases.

As a Yucatec Maya word, *sacbe* can be broken down into two morphemes, *sac* and *be*. The former is variably written as *sac*, *zac*, or *sak* and translated to English as "white," with "clean," "neat," "intensity," "fiction," and "artificial" sometimes given as secondary meanings. English equivalents for the latter term, *be* or *beh*, include "road" or "street," although "trail," "course," "destiny," "employment," "route," "transit," and "path" are also among its definitions (Barrera Vázquez 1941:76; Bevington 1995:114, 162; Heath de Zapata 1980:65, 118; Romero Conde 2000:13, 93). A translation of "white road" (or "camino blanco") is generally given for the entire word (Barrera Vázquez 1941:75; Bolles and Folan 2001:300).

Stuart (2006) provides evidence that the ancient Maya used this word. Inscriptions along the Cobá–Yaxuná causeway include a glyph

that reads "sakbih," the Ch'olan form of the Yucatecan word for "road." He also points out examples in the Dresden Codex associated with road imagery and from Copán's Hieroglyphic Stairway, indicating a widespread use of the term.

In this text, the spelling "sacbe" is used ("sacbeob" being the plural form in Yucatec Maya), not because it is necessarily the most correct in reflecting actual pronunciation but because, among Maya researchers, it is the most commonly used and recognized form of the word. To avoid extreme redundancy within the text, the terms *causeway*, *road*, *roadway*, and *raised road* have also been freely substituted.

As is discussed in chapter 4, the term *sacbe* refers to a linear feature composed of stone that may have once been paved with a *sascab* (powdered limestone) or plaster surface. Commonly, the base is formed of dry-laid boulders topped with progressively smaller cobbles, with gravel being applied to create a smooth base for the roadway. However, this is an inconsistent feature class, with material composition, height, width, and length varying considerably among the many examples included in this study.

The earliest sacbeob within the Maya lowlands may date to the latter part of the Middle Formative period (about 6/500 BC to 300 BC). By this time, village farmers had come to occupy most of the Maya lowlands, and a number of sites, such as Altar de Sacrificios and El Mirador, had grown large enough to construct public architecture. More examples of causeways are securely dated to the Late Formative (300 BC to AD 250), a time when El Mirador, Altar de Sacrificios, Seibal, Barton Ramie, Cerros, Uaxactún, Tikal, Becan, Dzibilchaltún, Yaxuná, Ichmul, Yo'okop, and many other Maya sites were able to make major investments in monumental architecture, including some roadways. The Early Classic (AD 250–550) and Late Classic (AD 550–850/900) saw the apogee of what most consider "Classic Maya civilization" at most centers in the southern lowlands. During these periods, in both the northern and southern lowlands, hundreds of sacbeob were built at sites that ranged from little more than small hamlets to extensive metropoli. Toward the end of the Late Classic, many sites in the southern lowlands were abandoned or left with greatly reduced populations as a result of processes that may be subsumed under the term *Maya collapse*. In the north, however, the Terminal Classic (AD 850/900–1100) was a peak period for many sites, with centers such as Chichén Itzá continuing to construct aspects of ancient Maya

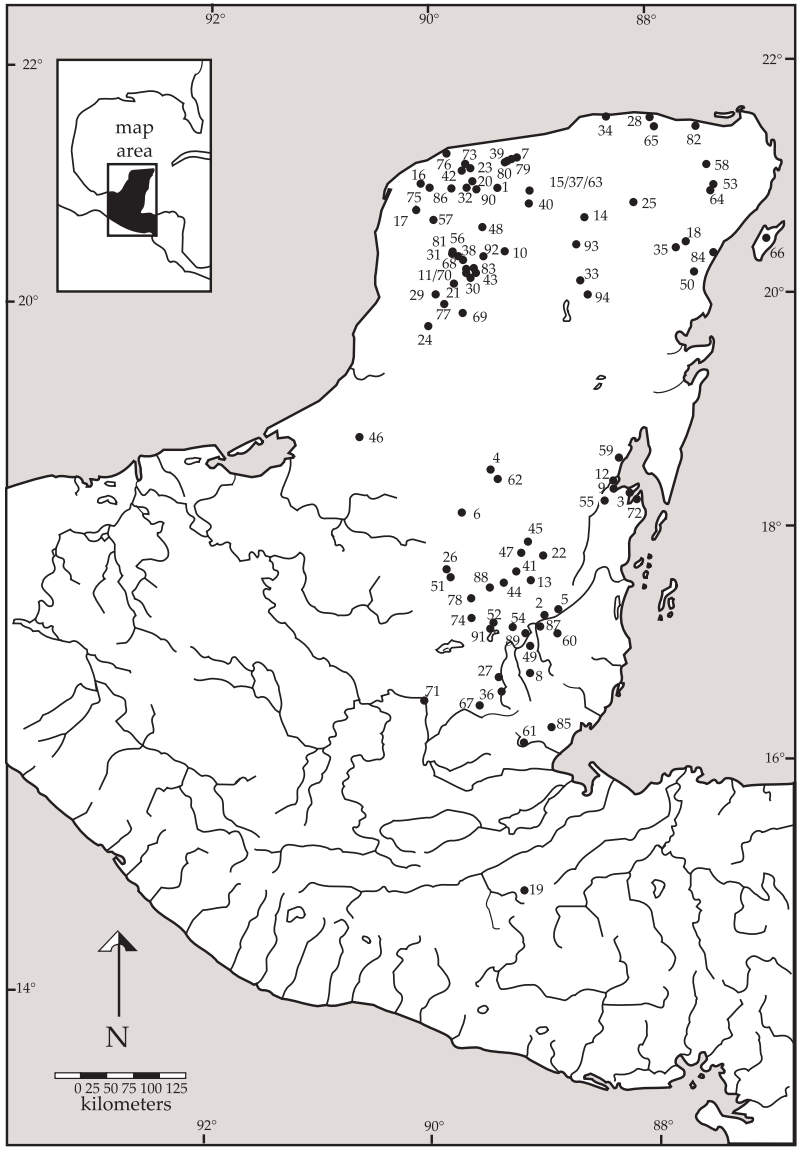

Figure 1. Map of sites with sacbeob. (Drawn by Justine M. Shaw)

Site	*Number*	*Site*	*Number*
Aké	1	Mayapán	48
Baking Pot	2	Minanha’	49
Bandera	3	Muyil	50
Becan	4	Nakbe	51
Big Laugh	5	Nakum	52
Calakmul	6	Naranjal	53
Cansahcab	7	Naranjo	54
Caracol	8	Nohmul	55
Cerros	9	Nohpat	56
Chacchob	10	Oxkintok	57
Chac II	11	Oxlakmul	58
Chan Chen	12	Oxtancah	59
Chan Chich	13	Pacbitun	60
Chichén Itzá	14	Pusilha	61
Chobenchen	15	Rio Bec	62
Chuh ku	16	Sahaltun	63
Chunchucmil	17	San Cosmé	64
Cobá	18	San Fernando	65
Copán	19	San Gérvasio	66
Cucá	20	San Luis Pueblito	67
Dolores	21	Sannacte	68
Dos Hombres	22	Santa Rosa Xtampak	69
Dzibilchaltún	23	Sayil	70
Edzná	24	Seibal	71
Ek Balam	25	Shipstern	72
El Mirador	26	Tamanché	73
El Rosario	27	Tikal	74
Emal	28	Tzemé	75
Halal	29	Tzikul	76
Huntichmul	30	Tzum	77
Hunto Chac	31	Uaxactún	78
Ichcantiho	32	Ucanha	79
Ichmul	33	Ucí	80
Isla Cerritos	34	Uxmal	81
Ixil	35	Vista Alegre	82
Ixkun	36	Xcanaheleb	83
Izamal	37	Xelha	84
Kabah	38	Xnaheb	85
Kancab	39	Xtobó	86
Kantunil	40	X-ual-canil	87
Kinal	41	Xultun	88
Komchen	42	Xunantunich	89
Labná	43	Yaxcopoil	90
La Honradez	44	Yaxha	91
La Milpa	45	Yaxhom	92
Las Ruinas	46	Yaxuná	93
Maax Na	47	Yo’okop	94

architecture, including sacbeob. Finally, the Postclassic (AD 1200–Spanish contact) saw the downfall of even these great northern cities. However, smaller settlements—such as Tulum, Xelha, San Gérvasio, and Muyil—continued to be built and occupied. At some of these, sacbe construction accompanied new temples and palaces, although on an admittedly smaller scale (Blanton et al. 1993; Coe 1994; Schele and Freidel 1990; Weaver 1993).

Prior Sacbe Studies

Many hundreds of researchers, crew members, and students have contributed to our current knowledge of sacbeob through their documentation of roadways at particular sites (see fig. 1 and the appendix). While each of these efforts has been important in helping to enlarge the available database of roadways, and many are brought up as examples in the following chapters, such research is not discussed in detail in this introductory chapter. Instead, studies that attempt to make statements about the feature class as a whole are reviewed here, with the aim of elucidating how and why the problems and questions raised in this volume have come to exist.

One of the first outsiders to specifically note the existence of roads within the Yucatán was Diego de Landa, who mentions "a very beautiful road" connecting Ichcantiho (Tiho), now the city of Mérida, to Izamal (Tozzer 1966 [1941]:109), as well as a causeway near Chichén Itzá's Cenote of Sacrifice (Tozzer 1966 [1941]:179–180). Forty-four years later, Bernardo de Lizana (1988 [1633]:56) also told of causeways to the four cardinal points used for pilgrimages. Describing Alonso Davila's journey through the Champoton area, Gonzalo Fernández de Oviedo y Valdés (1959: book 32, p. 243) reported "broad and level and well swept" roads. In the seventeenth century, Diego López de Cogolludo (1957) wrote of paved roads traversing the peninsula, like *caminos reales*. Similarly, nineteenth-century explorers, including John Lloyd Stephens (1963 [1843]) and Alice LePlongeon (1879), commented on the presence of raised stone roads at Maya sites. LePlongeon describes an "ancient causeway, carefully built of hewn stones, cemented with mortar" between Mérida and Izamal; at the time of her visit, it had already been largely destroyed to build a new public road. Stephens (1963 [1843]:2:232) was told of a road leading from Cobá toward Chichén Itzá, but he was not able to visit

the region himself. He also heard of a sacbe from Kabah to Uxmal, paved with white stone and used by messengers to carry letters (Stephens 1963 [1843]:1:259). Désiré Charnay (1887:308) wrote of four good roads leading from Izamal to Guatemala, Chiapas, and Tabasco, as well as a "cemented road from Iza[b]al to the sea facing the island of Cozumel." These roads allowed visitors from great distances to have access to the main temple at the site. Marshall Saville (1935) provides an excellent summary of these early commentaries, as well as the initial efforts to systematically study the ancient roadways.

During the first half of the twentieth century, largely thanks to the efforts of the Carnegie Institution of Washington, more systematic descriptions and considerations of sacbeob were produced. In 1926, Thomas Gann (1926:113–114) visited Cobá, writing about the causeway to the west. Gann noted the quarries located along the sides of the road, remarking on the tremendous labor investment that such a roadway would have demanded. J. Eric Thompson visited the same year, later publishing a more thorough description of sixteen of the site's sacbeob, including his prediction that Sacbe 1 terminated at Yaxuná (Thompson et al. 1932:18–27). Robert Bennett (1930) attempted to further explore this important causeway, traversing a small section and visiting the site of Yaxuná to locate its terminus. Bennett was able to observe components of the road's construction in greater detail, noting *cenotes* (limestone sinkholes in contact with the water table; see Brown 2006 for a discussion of these features), *chultunes* (underground storage chambers frequently lined with stucco), stelae, mounds, and other features along the road's path. Finally, in February 1933, Alfonso Villa Rojas (1934) traversed the entire length of the road, describing its features in detail and speculating about the meaning and functions of such features in general.

In the 1960s and 1970s, as more causeways were recorded throughout the Maya area, a larger number of synthetic works on Maya roads began to be produced. Among these are Antonio Bustillos Carillo's (1964) work, titled *El Sacbé de los Mayas*, which discusses sacbeob as a general feature class as well as details concerning the roads of Chichén Itzá, Dzibilchaltún, Cobá, Cobá–Yaxuná, Tulum, Aké, Cozumel Island, Ichcantiho, and Mayapán. Additionally, a rumored Uxmal–Nohcacab–Copán road was mentioned by Bustillos Carillo. Michael Romanov (1973) further explored the possibility of a causeway that reputedly runs from the area of Puerto Morelos westward

across the majority of the northern portion of the peninsula (subject to more recent studies by the Yalahau Project; Fedick et al. 1995; Mathews 1998). Although not all of Romanov's conclusions may be accepted by mainstream researchers, he does present interesting evidence not reported elsewhere, as well as an assessment of historic and modern processes that might impact, mask, or destroy sacbeob. Rubén Maldonado Cárdenas (1979a, 1979b) provided a thorough review of two well-documented long-distance roads in the north, those of Izamal–Aké and Ucí–Cansahcab. In addition to describing the roads, he explored their possible construction dates and political implications. Around this same time, Edward Kurjack (1977), using examples from the northern lowlands, set out his detailed analysis of the entire feature class, in terms of its contribution to the settlement patterns of Maya communities, ability to inform about territorial organization, and evolution of Maya states.

The following decade saw an increase in the number of individual roads documented, with more emphasis on sites with road networks and still more attention to the feature class itself. One of these site-based studies that has implications for the study of sacbeob as a whole was conducted by Antonio Benavides Castillo (1981). Examining the network of roads at Cobá, he provided the most thorough coverage of data on the system to date, as well as a commentary on the social implications of the causeways and their associated features. William Folan, Ellen Kintz, and Laraine Fletcher (1983) also produced their volume on Cobá at about this time, which includes a rare contribution on non-sacbe intersite linear features (Fletcher 1983). In addition to helping to clarify the definition of sacbe, the essay is one of the few that examines less obvious features that may have augmented the functions of, or potentially substituted for, causeways. While sacbeob had been reported at Postclassic sites (e.g., Pollock 1954, 1956), one of the first considerations of the feature class over an extensive area during the Postclassic was included in David Freidel and Jeremy Sabloff's (1984) study of Cozumel's settlement patterns. In addition to reviewing the form of the roadways, the authors focused on the function(s) of sacbeob during the Postclassic, which may have differed somewhat in emphasis from earlier examples. Another Mayanist concerned with the functions of causeways was José Diaz-Bolio, whose 1989 essay reviewed the topic using primarily colonial sources.

Since this time, more synthetic works have been produced and

still more examples of individual roads (e.g., Mathews 1998, 2000; Reid 1995) and sacbe systems (e.g., Chase and Chase 1987; Cobos 2003; Jaeger 1991; Suasnávar 1994) have come to light. One of the leading thinkers on the feature class as a whole has been Folan, whose career has included research at Cobá (1977a, 1977b, 1983a, 1983b) and Calakmul (Folan 1992b; Folan et al. 1995a, 1995b, 1995c, 2001a, 2001b), two sites with major road systems. This experience has allowed him to write on topics including the ways in which causeways provide insights into social, political, and economic relationships; the cosmological and astronomical significance of roadways; the ways in which language studies can inform researchers about road function and meaning; and the ties between sacbeob and water sources (Bolles and Folan 2001; Folan 1991, 1992a). Likewise, Maldonado Cárdenas (1995, 2006) has continued his examination of road systems, focusing on examples from northern Yucatán in an effort to elucidate sociopolitical meaning.

While there have been recent works focusing on ancient road systems in general (e.g., Trombold 1991), the most up-to-date comprehensive statement on sacbeob thus far is a special section in the journal *Ancient Mesoamerica* (fall 2001, vol. 12, no. 2), titled "Recent Research on Maya Causeways." Including new research on extensive road networks at Caracol (Chase and Chase 2001), Chichén Itzá (Cobos and Winemiller 2001), and Calakmul (Folan et al. 2001b), the collection also contains two synthetic articles on the feature class (Bolles and Folan 2001; Shaw 2001).

Research in the Cochuah Region

Since 2000, two previously unstudied sacbe systems have been documented at the sites of Ichmul and Yo'okop, situated within the Cochuah region (figs. 1 and 2). The contact-period Cochuah province was located in the east-central portion of the Yucatán Peninsula, between the provinces of Cupul (to the north), Sotuta and Maní (to the west), Uaymil (to the south), and Ecab (to the east). In terms of modern *pueblos*, the province extended to the south of Chunhunhub and Polyuc, to the east of Tepich, and to the north of Chikindzonot, as well as to the west of Lake Chichancanab (Flores Colin and Kaeding 2004:149, fig. 67; Roys 1957:135–136). Despite tremendous sociopolitical change through time, the integrity of the province as a

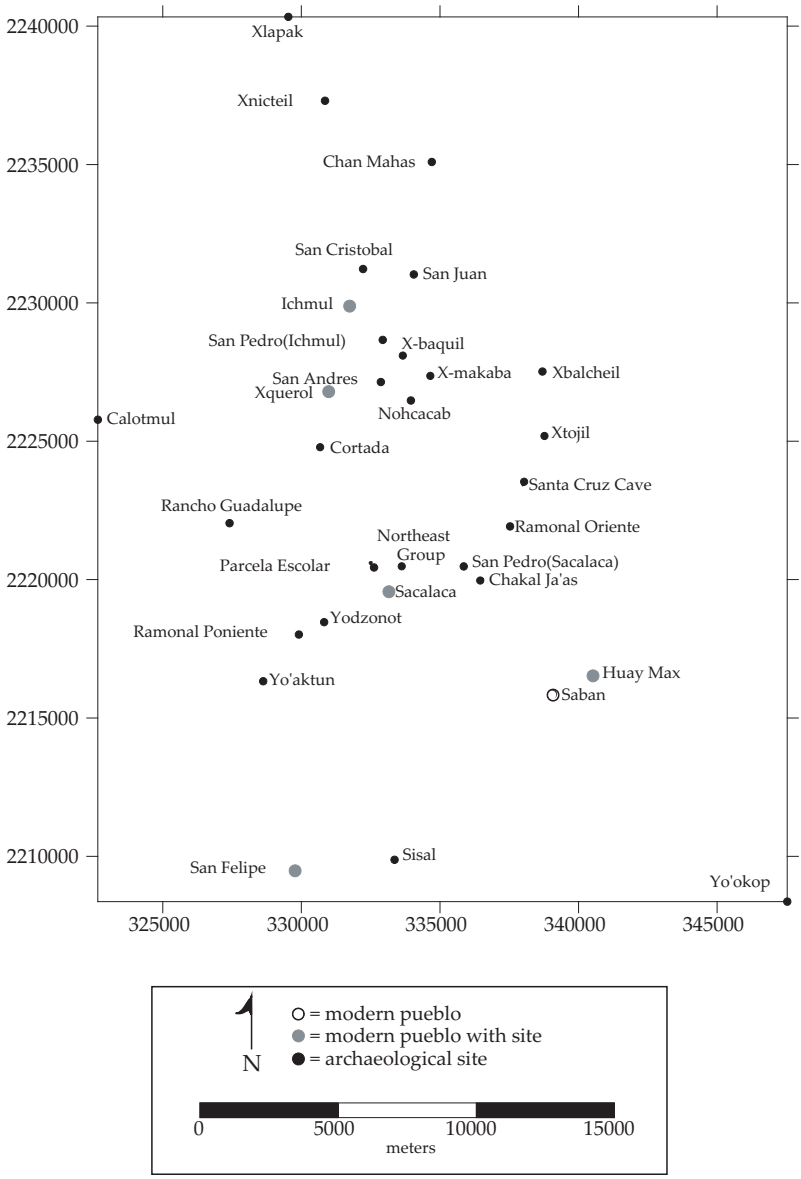

Figure 2. Cochuah Regional Archaeological Survey study area. (Drawn by Justine M. Shaw)

sociopolitical unit may have remained relatively stable (Marcus 1993; Roys 1957).

The Cochuah Regional Archaeological Survey (CRAS), known as the Proyecto Arqueológico Yo'okop during its first three seasons, has been conducting research in the Cochuah region from 2000 to the present (fig. 2). The project has begun the process of documenting and understanding the area's settlement patterns, which had not been studied in any systematic manner by a sustained archaeological program. On the basis of maps, surface collections, observations of surface remains, test pits, and structural excavations, it is now possible to provide descriptions and locations of many sites in the region, as well as a preliminary account of settlement shifts within the province (Johnstone and Shaw 2006; Shaw et al. 2000, 2001, 2002, 2003, 2004, 2005).

In the course of work at the two largest sites (Rank II sites according to the system defined by Velázquez Morlet et al. 1988) within the Cochuah region, Ichmul and Yo'okop (see fig. 1), two sacbe systems have been documented. Members of the CRAS project have begun to explore the characteristics, development, and potential purposes of these systems in an attempt to better understand not only roadways themselves but also sacbeob as a whole. The results of these efforts are detailed in chapters 2, 3, 9, and 10.

2

Ichmul and Its Sacbe System

Although Ichmul (figs. 2 and 3) was an important regional capital during Classic, Postclassic, colonial, and Caste War times, it had not been systematically documented, or even thoroughly examined, by anthropologists until relatively recently. This research, done by members of the CRAS project, has revealed major architecture from these time periods, including a five-member sacbe system.

Prior Research at Ichmul

In 1954, the site of Ichmul was visited by Gustav Stromsvik and Heinrich Berlin as part of their brief reconnaissance of the area east of Peto (Stromsvik et al. 1955:170–171). They remarked primarily upon its substantial ancient Maya and colonial constructions, noting architecture concentrated for a kilometer or more in each direction from the main square. On each of the main platforms and pyramids are fortifications that date to the Caste War of the mid-nineteenth century (Reed 2001).

At the time of Stromsvik and Berlin's visit, the ancient Maya constructions were already in poor condition, having been quarried for colonial, historic, and more recent constructions. In spite of this, a system of intact stepped-vaulted passages still existed that permitted the explorers to enter one of the largest mounds. Exposed masonry along the western edge of the ruins revealed a sequence of earlier constructions replaced by Puuc- or Chenes-style cut stones, as well as cruder Postclassic east coast–style masonry. A small sample of ceramics collected by Stromsvik and Berlin appeared to include "Puuc types," as well as potentially colonial types, Postclassic Mayapán redwares, and southern Classic types. Stromsvik, Pollock, and Berlin estimated—based on their observations of architectural and ceramic

styles—that the major period of occupation at Ichmul was the Late Classic. They did not locate the terminus of the Ichmul–Xquerol Sacbe at Ichmul, as the explorers did not note the existence of the raised road until halfway into the journey from Ichmul to Xquerol.

Initial Observations of Ichmul by the CRAS Project

The modern community of Ichmul, meaning "between mounds," is currently occupied by approximately two thousand people (Flores Colin and Normark 2004b). CRAS project members first made a brief informal visit to the site at the end of the 2003 season; the modern road between Xquerol and Ichmul had been closed for the majority of the summer so that it could be widened, regraded, and resurfaced using heavy machinery. This new construction, and earlier road-building activities, heavily impacted the ancient causeway connecting the two centers, with the snaking modern road cutting completely through the sacbe twice. Because of the project's permit from INAH, only approximately forty meters of the sacbe, that which lay in the state of Quintana Roo, could be mapped in 2003.

During this initial visit to Ichmul, project members observed the same features described by Stromsvik, Pollock, and Berlin. However, they noted that the growing modern occupation had caused further damage to the site, collapsing the previously described standing vault at only about ten meters into the structure. A side passage near this collapse could be followed for approximately five meters before more collapse blocked the corridor. The largest mounds at Ichmul were overgrown with relatively recent vegetation, although they were crossed by a number of paths. The edges of the mounds adjacent to the plaza formed the rear of *solares* (modern house lots), occupied by domesticated animals and used for refuse disposal. The current inhabitants were keeping much of the colonial architecture clear of vegetation, with recent repairs to roofs visible; no such efforts had been made to maintain or protect the more ancient architecture, which appeared to function primarily as a source of raw materials for construction. Although not authorized to collect any ceramic materials in 2003, project members were able to informally examine surface sherds. Unlike the observations of Stromsvik, Pollock, and Berlin, the ceramics identified by project ceramicist Dave Johnstone were largely Early Classic in date.

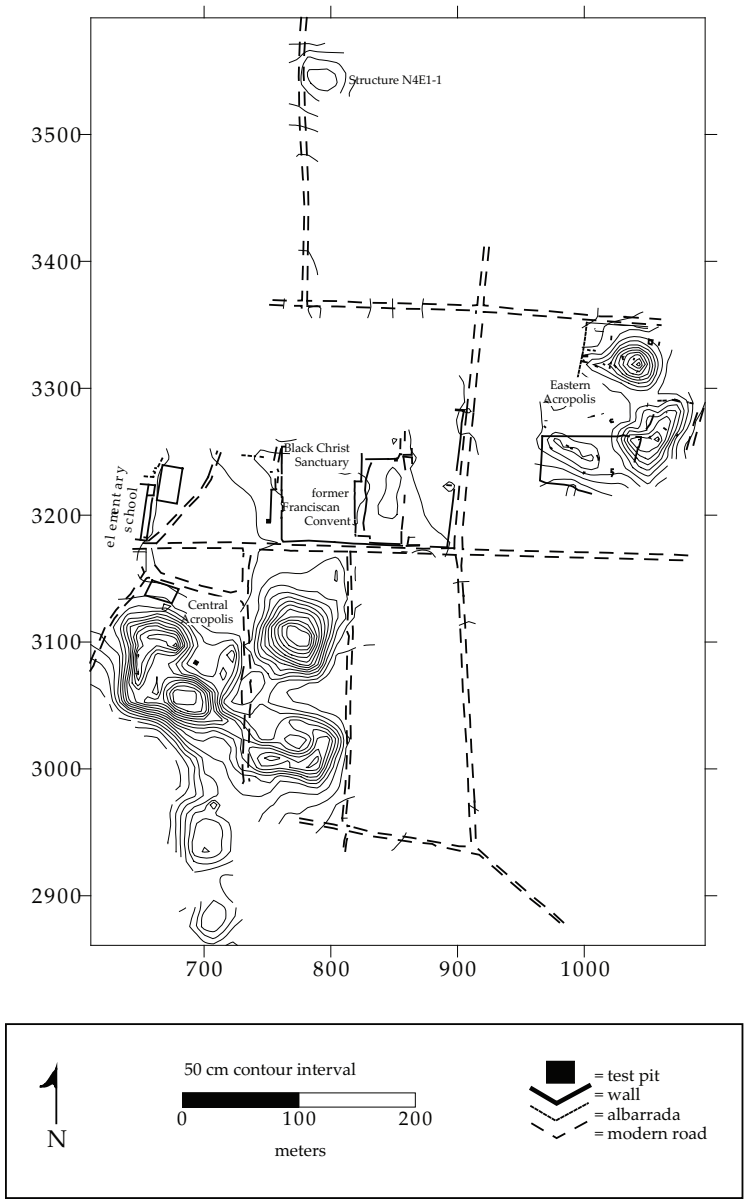

Figure 3. Plan map of Ichmul site core. (Drawn by Alberto Flores and Johan Normark)

CRAS Research during 2004 and 2005

Systematic study of Ichmul by the CRAS project began in 2004, when a portion of the survey's personnel and resources were devoted to an initial assessment of the site and its sacbe to Xquerol. The principal goal of this first formal research effort, conducted by Alberto Flores Colin and Johan Normark (2004a and 2004b) under the direction of Johnstone and me, was the accurate recording of the sacbe between the site of Xquerol and Ichmul. In addition, the area around the sacbe terminus at Ichmul was mapped and a test pit was excavated in the plaza in which the causeway appeared to terminate. Finally, when local consultants reported additional roadways, four more sacbeob were located. GPS coordinates were recorded along portions of the sacbe courses, and sketch maps were made of the sites at the termini of the roadways (Flores Colin and Normark 2004a and 2004b).

The following season, in 2005, one of the principal aims of the CRAS project was to more systematically record and date the construction of the various components of the Ichmul sacbe system, as well as to better understand the remnants of the site core. Because the portion of each road within the confines of the modern pueblo of Ichmul was badly damaged or nonexistent the project directors decided that dateable materials could best be obtained through excavations at the far termini of the sacbeob, as well as within two of the major raised plazas within the site core. Test pits measuring 2 $\times$ 2 meters were placed in the terminus plazas with the hope of obtaining sealed ceramic lots associated with the construction of the terminus sites and the causeways. In this way, the construction period(s) of the roadways and the chronological relationship between sacbe, Ichmul, and outlying site might be assessed. Additionally, the terminus sites were cleared of smaller vegetation and mapped using a total station to more accurately observe and record the quality and quantity of architecture present and its relationship to the sacbeob.

The General Layout and Occupational Sequence of the Classic Maya Site of Ichmul

Mapping in the site core has revealed the general layout of the major components of the ancient center of Ichmul, despite the impact of historic and recent occupations. The site proved to have a large central

acropolis with six plazas, two pyramidal structures, and several range structures, most of which were used as sources of raw material and building platforms for Caste War fortifications. The eastern portion of the acropolis was less of a focus during this conflict and therefore remains in somewhat better condition. The southern segment of the mapped area, which presumably contained the origin of the sacbe to Xquerol, includes a complicated series of low walls, plazas, platforms, and a wide ramp. The modern pueblo's main square proved to be laid out atop a raised plaza, the Great Plaza, with platforms on its eastern and western sides. The Eastern Acropolis and other scattered monumental constructions are interspersed between modern constructions.

Despite the scale of the ancient constructions, colonial and historic constructions remain visually dominant at present. Postcontact modifications began in 1571 with the founding of the Franciscan convent of San Bernardo de Sena Ichmul (Andrews 1991; Bretos 1992). The convent (as well as a colonial church) is currently located on the eastern side of the town's central plaza upon an artificial platform that was tested in 2005. To the north of this complex is the white church in which the Blister Black Christ ("El Santo Cristo de las Ampollas"), the object of a sixteenth-century cult, was located before being taken to Mérida (Caseres et al. 1998:3:356–357; Flores Colin 2006). Yet another church, L-shaped and currently overgrown, is situated on the north side of the plaza.

A water tower stands in the center of the northern plaza edge, replacing an old well present in photographs from twenty years ago (Artigas 1982). Colonial texts mention two cenotes at Ichmul (RHGY 1983:2:298), although project members have not located any, potentially because they have been capped by more recent constructions.

Two test pits carried out in 2005 have provided additional insights into the sequence of events that took place in the site core. The first of these excavations was located in the western part of the Central Acropolis's Plaza 2 (Flores Colin 2005). Its north side is open to the Great Plaza, although the two are currently divided by a modern solar. The unit contained significant Late Formative, Early Classic, and Terminal Classic occupations, with an apparent hiatus during the Late Classic and abandonment after the Terminal Classic.

The second test pit, located on a raised plaza upon which a monastery and unfinished church were built, revealed colonial and Terminal Classic deposits, with Late Formative and Early Classic materials

included as fill (Kaeding and Flores Colin 2005). The test pit was not excavated to bedrock, as is the project's general policy, because of time constraints at the end of the field season. However, the excavated levels revealed that the entire area now taken up by the modern pueblo's central square is actually an enormous raised plaza, visible in the site's topography. The church and monastery were erected on an additional raised platform that sits upon this main plaza. Ceramic evidence indicates that both platforms date to the Terminal Classic.

This second platform, now under the church and monastery, appears to have served a specialized funerary function, with portions of seven burials being located within the single 2 × 2 m unit. None contained any obvious burial goods, although there was an abundance of painted plaster fragments near Burial 2, a female with teeth that had been filed to points who appears to have died from a massive ear infection. Likewise, no tomb architecture was associated with any of the individuals, all of which had been placed in simple excavated holes or as part of flooring episodes. With one exception, which was in a flexed position, all were extended and supine at an east–west orientation, with heads to the east. Two of the seven were older than approximately 22 years of age; the rest of the individuals were between 1.5 and 17 years old (Johnstone and Shaw 2006). This relatively young average age likely represents a normal mortality profile for the Maya of the time (Johnstone, personal communication).

A series of postholes, several of which intruded from above the burials, indicates that some type of perishable structure(s) once capped the platform. The courses of three of the five sacbeob appear to have been laid out from the approximate area of this platform. However, they could not all have physically originated here, as preexisting monumental architecture would have blocked their paths.

The absence of colonial interments where more might have been expected and the unanticipated appearance of multiple Terminal Classic burials raise questions about activities in this portion of Ichmul. The enormous investment in monumental architecture ringing this zone, the effort to raise the Great Plaza and the platform upon which the Catholic religious complex was later built, and the area's apparent function as the symbolic center of the road network indicate the significance of this place during the Terminal Classic. A similar argument may be made for colonial Ichmul, although the paucity of artifacts and features dating to this period, outside the monumental

buildings atop the platform, raise questions about the manner in which the surrounding space was used.

These excavations and surface observations suggest that the core of the ancient settlement, like that of the modern pueblo, was the Great Plaza. The portion of the Great Plaza that is currently visible measures approximately 150 × 100 meters. The operation that was carried out in front of the churches on the plaza's eastern side revealed that dry core fill extended at least 1 meter below the modern plaza surface.

The western edge of the modern square is currently bounded by a school and basketball court. The former is built upon a raised area that appears to mirror that on the eastern side of the plaza (with the churches) in terms of its scale. This elevated area appears to be another Prehispanic platform upon the larger, elevated Great Plaza.

To the south-southwest of the Great Plaza is the Central Acropolis (fig. 4), which covers an area of 210 × 190 meters. The sidewalls of an abandoned modern toilet pit near the lowest terraces of one structure (S1E1-1) reveal a Terminal Classic Puuc-style wall with traces of stucco and red pigment. Some architecture remains intact at the summit of this largest mound, including a 2-meter-tall wall and a western entrance. The vaults of the uppermost level appear to have been filled in, possibly during the Postclassic. Two simple foundation braces violating the inner patio area are also likely from late in the history of the site's occupation. Substantial platforms, structures, and plazas continue to the south of the Central Acropolis, although these too have been heavily impacted by postcontact events, being recycled into *albarradas* (dry-laid stone walls) and Caste War fortifications.

Ichmul's Eastern Acropolis (fig. 5) includes six range structures and a pyramid arranged around an interior plaza. Located to the east, or rear, of the colonial church complex, it is currently divided into solares by albarradas. The summit of the mound rises approximately twelve meters above the level of the adjacent streets, which are built upon elevated cultural deposits. In comparison to the Central Acropolis, the plaza of the Eastern Acropolis is larger and more public. The dimensions, accessibility, and spatial relationships suggest that the Central Acropolis may have contained elite living quarters, while the Eastern Acropolis would have contained more public functions.

Several other structures and features visible within various modern solares have been noted or partially recorded. Approximately four

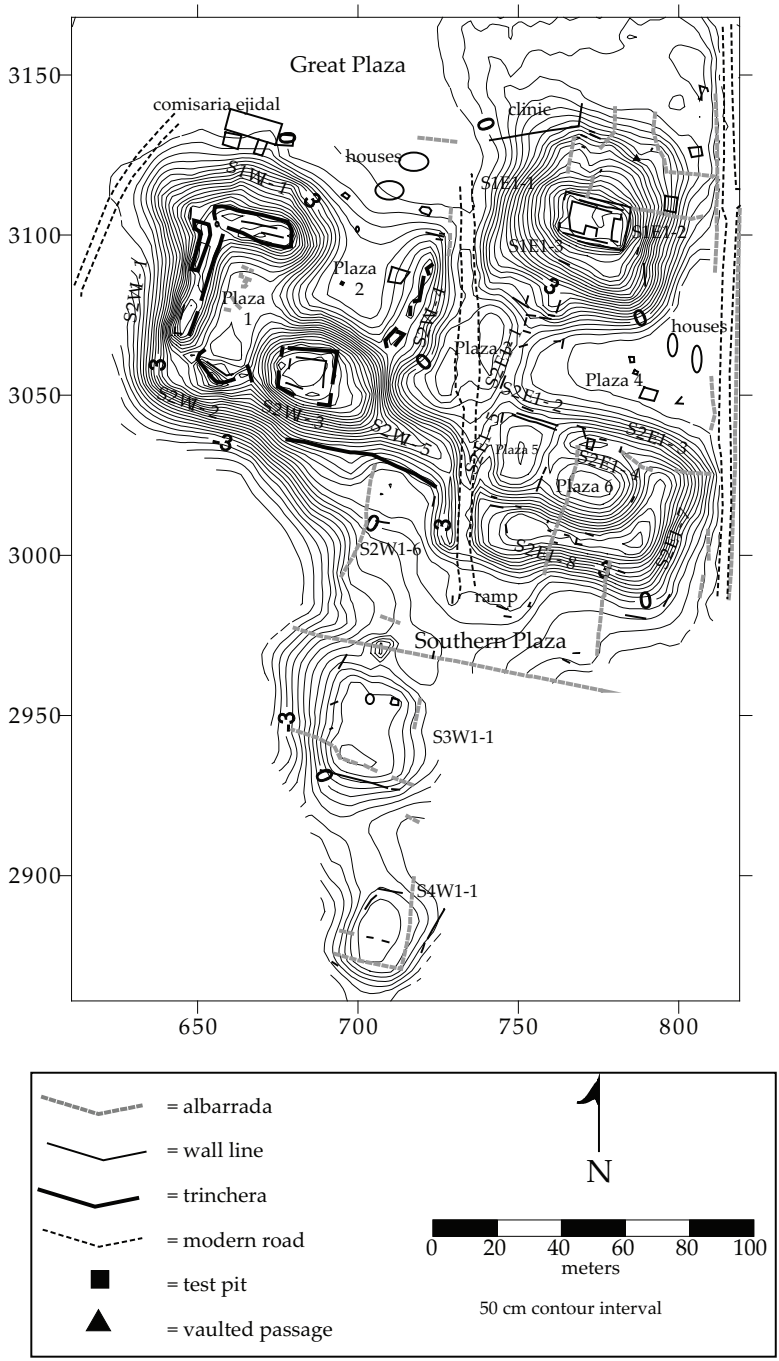

Figure 4. Ichmul's Central Acropolis. (Drawn by Alberto Flores and Johan Normark)

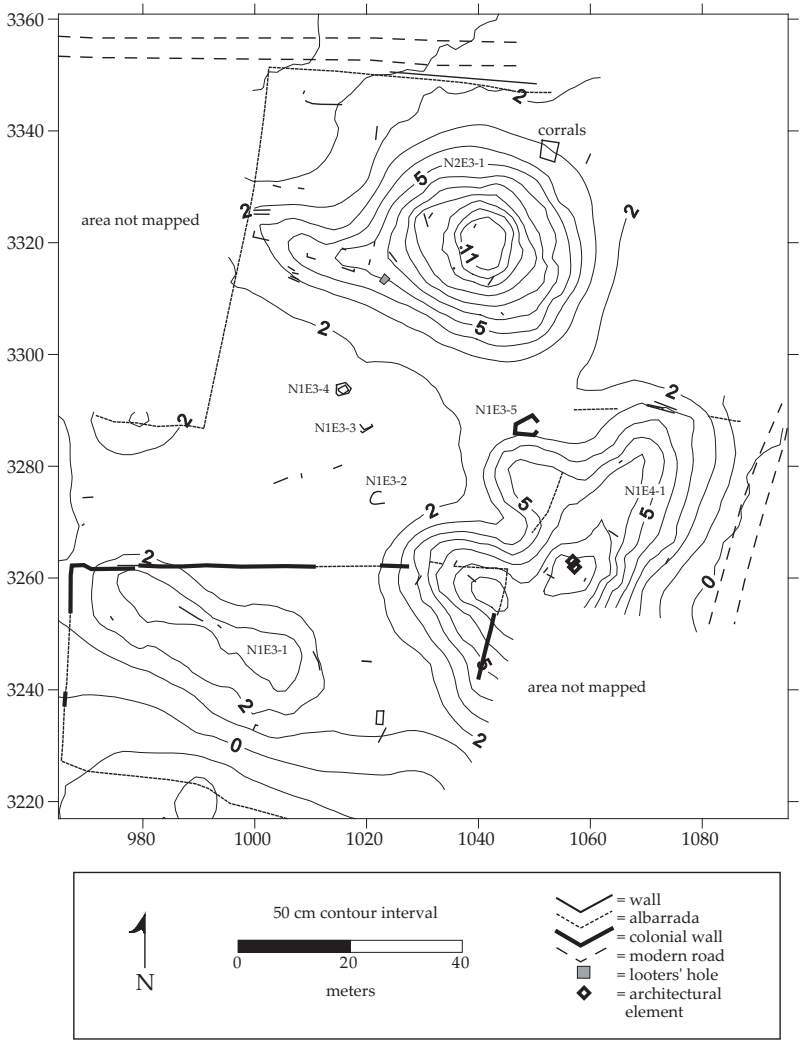

Figure 5. Ichmul's Eastern Acropolis. (Drawn by Alberto Flores and Johan Normark)

hundred meters north of the Great Plaza is Structure N4E1-1, an elevated region with some wall lines remaining on the surface. The majority of the structure(s) that once graced the mound appear to have been recycled into modern facilities; cut stones may be seen within the walls and steps of these buildings. Portions of two terraces are visible nearby.

Poxil, another locus of ancient activity on the periphery of the modern pueblo, was located approximately five hundred meters northwest of the Great Plaza. The area contains a range structure and possible steps upon a hill, as well as an associated altar built of megalithic stones (for a discussion of megalithic architecture in the Yucatán Peninsula see Mathews and Maldonado Cárdenas 2006) and the foundation for a perishable superstructure. Both Poxil and the Structure N4E1-1 area were mapped in 2005, whereas other ancient features within the pueblo have been only visited and briefly observed.

One such large, unmapped platform, provisionally named Structure 5, has also been located near the Central Acropolis, at the point where the sacbe from San Andres might have ended if its trajectory is traced farther from the point at which it may be first located within the pueblo today. Similarly, Structure 6, a long east–west range structure, has been noted in a solar to the north of the Eastern Acropolis. A third (and still-unexplored) feature of the site is a stone alignment near historic and abandoned portions of the road to Peto. If this comprises the remains of an ancient causeway, it would have made the radial plan of the road system more symmetrical; the alignment may be investigated in future seasons by graduating project members Alberto Flores Colin and Johan Normark.

Before further consideration of the settlement and sacbe system of Ichmul as a whole, it is essential to review some of what is known about Ichmul's hinterland, some of which became formally tied to the site core through the construction of a radial sacbe system during the Terminal Classic. Although earlier occupations existed throughout this zone, the argument can be made that symbolically and functionally the formalization of ties from core to periphery during the Terminal Classic would have fundamentally changed the manner in which the components were integrated.

The Components of Ichmul's Sacbe System

The Ichmul–San Andres Sacbe

The Ichmul–San Andres Sacbe is currently about 13 meters in width, 50 centimeters high on average, and 2.64 kilometers in length, although it may have originally been more than 3 kilometers long (fig. 6). As with the other members of Ichmul's road system, only its distant terminus can be accurately assessed, as its origin within Ichmul is

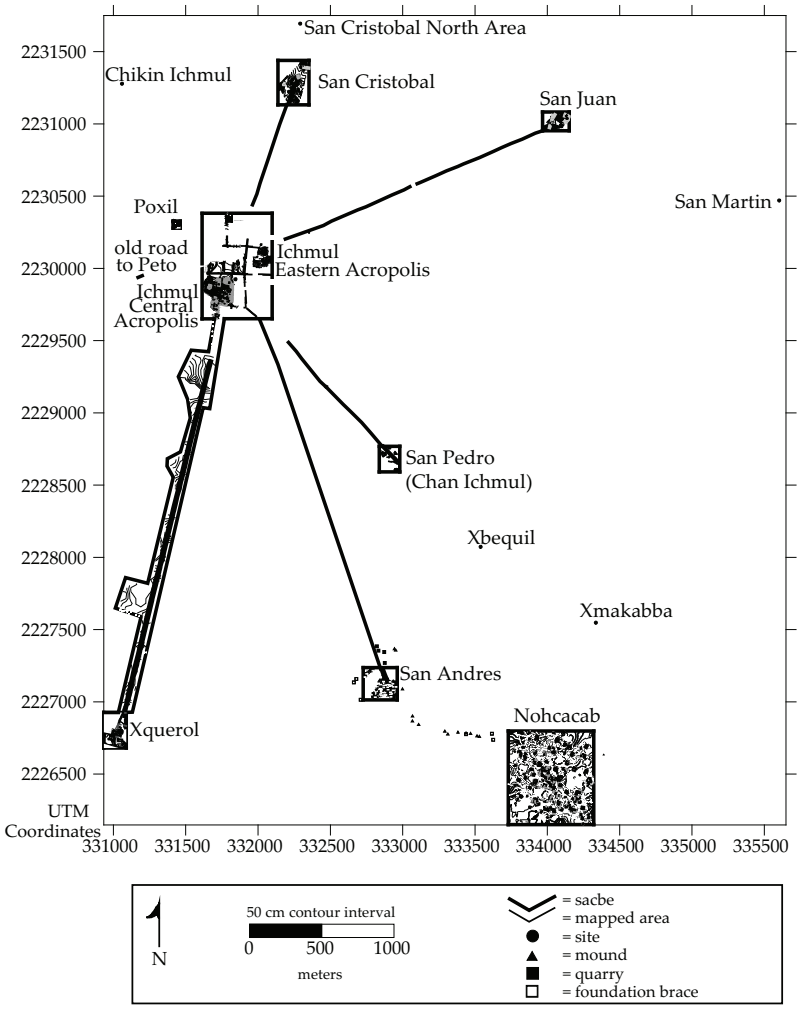

Figure 6. Ichmul sacbe system. (Drawn by Alberto Flores and Johan Normark)

obscured or obliterated by historic and recent development (Flores Colin and Normark 2005a).

Although unknown to the archaeological community prior to its initial documentation in 2004, the Ichmul–San Andres Sacbe has long been recognized by the local inhabitants of the area. Portions of the linear feature were also spotted on aerial photographs prior to

the 2004 season, when project members were assessing the spatial relationship between Ichmul and the site of Nohcacab (fig. 7). Originally thought to lead to Nohcacab (a conclusion based on its bearing of 162 degrees), the road actually stops at the site of San Andres. Further reconnaissance has shown that Nohcacab and San Andres could have been considered part of the same settlement, a zone of medium-density, primarily residential constructions set atop bedrock outcrops around deep soil deposits. Aerial photographs reveal a possible branch from this sacbe at about 1.6 kilometers from Ichmul; the shorter road leads to a restricted zone that, based on aerial photographs, appears to share the same geological characteristics as Nohcacab. These would have made the zone ideal for agriculture, potentially including specialized crops such as cacao and cotton.

Other features along the path of the main roadway to San Andres include a collapsed *sascabera* (sascab mine) that destroyed about sixty meters of sacbe (fig. 8). Flores Colin and Normark (2004a:81) also report that in cleared areas they were able to see what appeared to be construction boxes within the road; these boxes could potentially have been used to provide stability or divide work for corvée crews (see chap. 4).

The terminus architecture of the sacbe at San Andres is the most elaborate of all the outlier sites, including a small acropolis that supports a substantial five-meter-high platform containing further superstructures (fig. 9). The majority of the site's original architecture appears to have been oriented to the south. However, the sacbe to Ichmul connects to the northern edge of the acropolis, abutting the edge of the substructure at a roughly 45-degree angle. The unusual angle and the occurrence of the union between causeway and acropolis at a point that appeared to be "out back" with respect to the architectural focus of the site indicate that the roadway did not yet exist when most of the site's architecture was built.

Following the construction of the roadway, San Andres continued to be modified by further large-scale constructions. Upon clearing the raised plaza into which the sacbe arrives, excavators discovered wall lines, indicating that the plaza was extended northward to encompass a portion of what had originally been the road and its terminus. Additional structures were constructed on the corners and front of this expansion. Such structures may have served to control the flow of traffic and goods or may have been locations for the performance of rituals associated with the use of the feature. The older portion of the

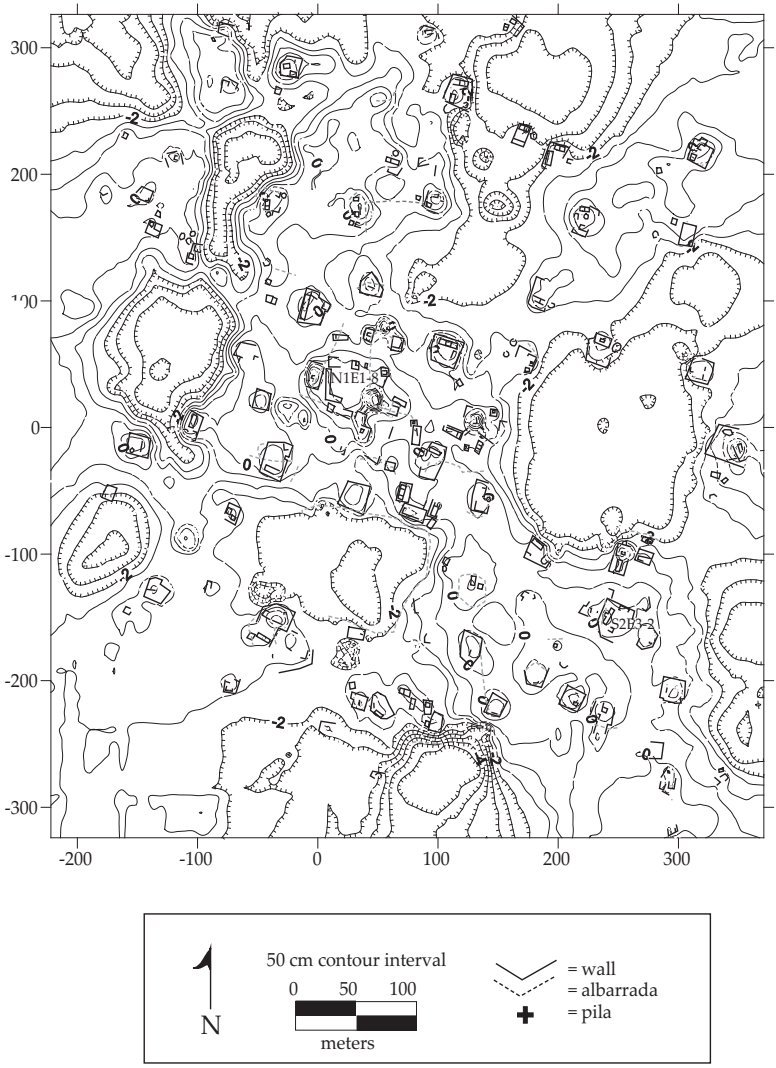

Figure 7. Plan map of Nohcacab. (Drawn by Dave Johnstone and Justine M. Shaw)

Figure 8. Photograph of *sascabera* collapse in the Ichmul–San Andres Sacbe. (Photo by Alberto Flores)

site was dominated by lower plazas and platforms with foundation braces, *metates* (grinding stones for maize processing), and walls, indicating a more domestic original emphasis for the zone. Postclassic shrines attest to continued use of the area following the period of most intense activity during the Terminal Classic.

Mapping in the immediate vicinity of the terminus revealed a series of other foundation braces to the northwest. Additionally, small quarries and other substantial unmapped platforms and foundation braces were noted along the eastern edge of the roadway.

Two test pits in plazas at the site indicate that, although occupation at the site began by the Late Formative, the sacbe was not in place until the Terminal Classic (Huerta Rodriguez 2005a, 2005b). Both excavations were placed in the newer, northern, portion of the site's main raised plaza. The first was placed at a point that was originally thought to be just beyond the road's terminus; later, after the extension of the plaza was understood, the excavation was discovered to be within the road. Two construction episodes were revealed in this

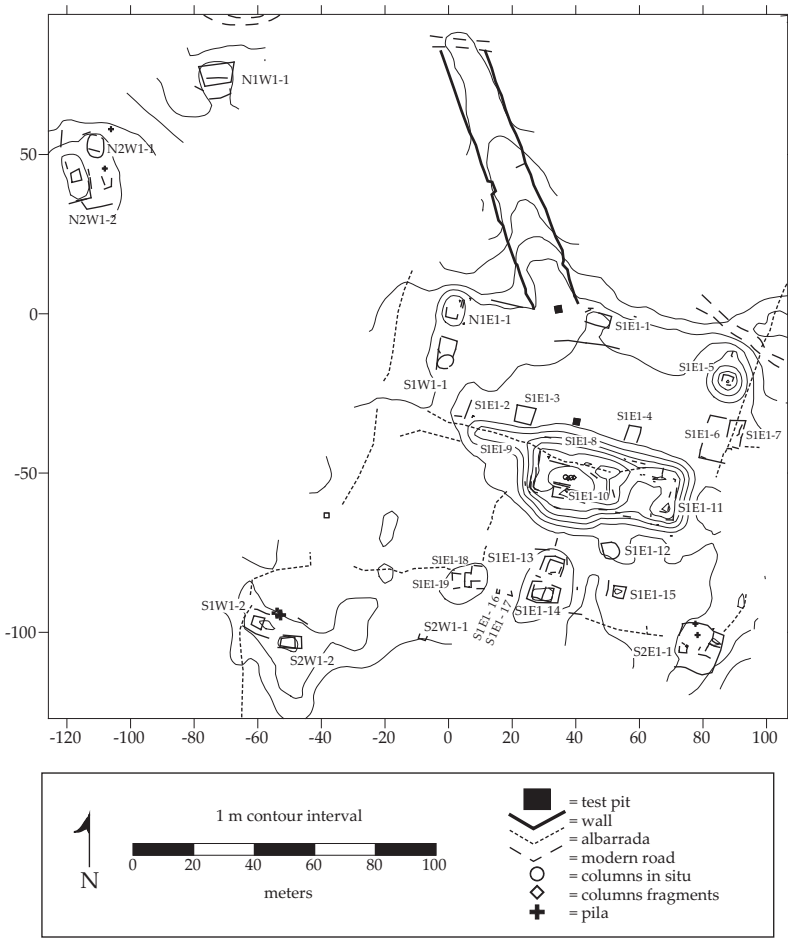

Figure 9. Plan map of San Andres site core. (Drawn by Alberto Flores and Johan Normark)

initial test pit. One phase predated the sacbe, leveling the bedrock and *chac luum*, while the second was a typical sacbe (or plaza) sequence of boulders, cobbles, and then gravel to raise the surface by an additional half meter. Although earlier materials were incorporated, both construction components clearly dated to the Terminal Classic.

The second excavation, directly to the north of the largest structure at the site, revealed a more complex set of activities in this

portion of the plaza. Three occupational surfaces and one preserved plaster floor were uncovered, with the level of the plaza being gradually raised through the Terminal Classic.

The evidence to date indicates that San Andres had been a relatively small, agriculturally oriented site with, at most, minor elites and a relatively dispersed pattern of domestic settlement that extended to the south from the zone with the largest architecture. Occupation began during the Late Formative, with the site core being largely abandoned during the Early Classic and Late Classic. The Terminal Classic was the period during which the greatest volume of construction activity took place, including the sacbe, site reorientation to the north, raised plaza construction, enlargement of this northern plaza, and construction of, or modifications to, the 3-meter-high range structure atop the principal platform. Although San Andres is the largest of the terminus sites, the inhabitants of the settlement are unlikely to have had the resources to independently construct the 2.6-kilometer-long causeway without assistance from Ichmul or other inhabitants of the greater region.

The Ichmul–San Cristobal Sacbe

At only about 5 meters in width and 910 meters in length (possibly up to 1.2 kilometers originally), this roadway is the smallest component of the Ichmul system. Its potential origin within Ichmul differs somewhat from the other roadways in that it seems to come from a point in the northwest corner of the central square of the modern pueblo (Flores Colin and Normark 2005b; see fig. 6). This zone is part of the Terminal Classic Great Plaza, although the original corners of this large raised platform are not known, having been covered, and obliterated, by more-recent settlement. Had the roadway originally crossed this plaza in some manner, it could not have originated at a point beyond the Central Acropolis, which existed prior to the construction of the road network.

The sacbe's distant terminus at San Cristobal includes a raised plaza upon a natural hill, with another mound and smaller structures to the north and southeast of the causeway (fig. 10). A six-meter-high pyramidal mound at the northern end of the raised platform is the largest structure in the immediate area. Another cluster of architecture, including a four-meter-tall range structure, was located to the north of the terminus platform. As at San Andres, the majority

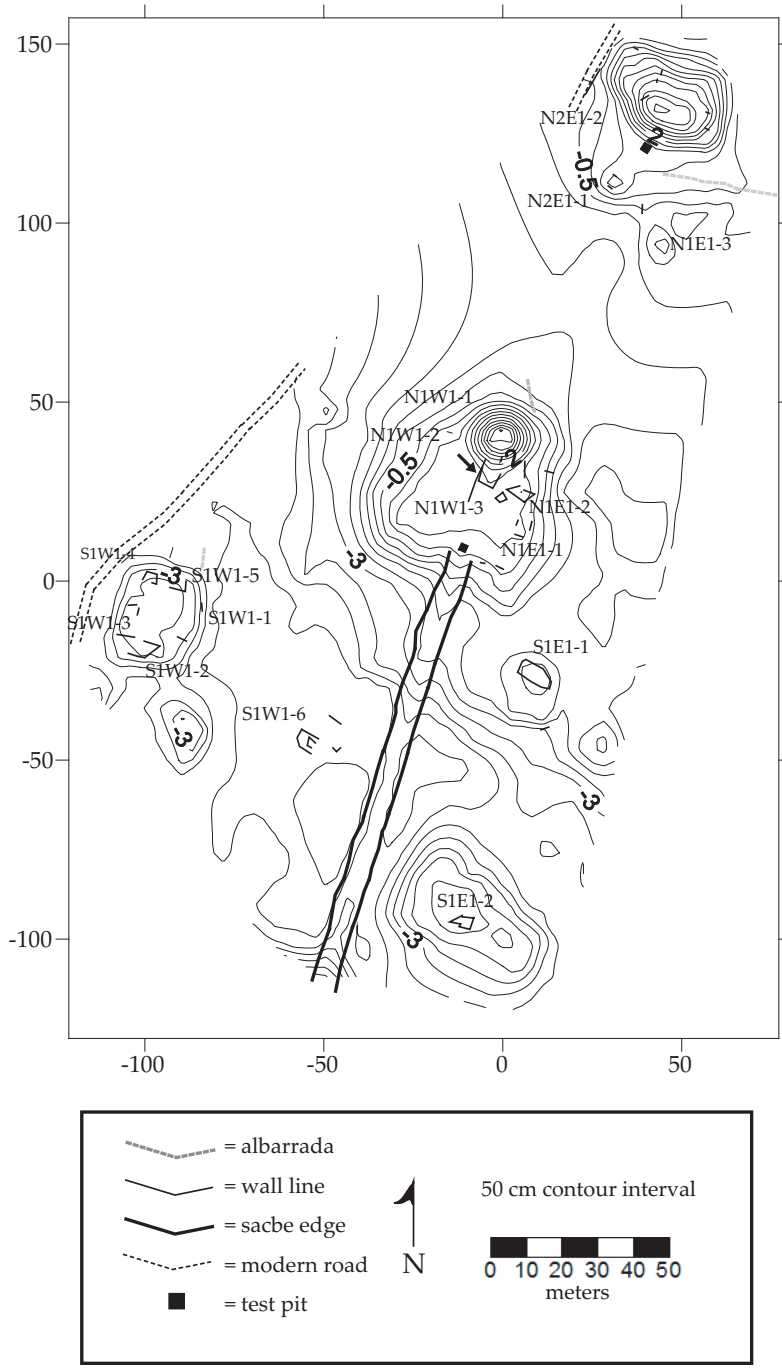

Figure 10. Plan map of San Cristobal site core. (Drawn by Alberto Flores and Johan Normark)

of the site's original large architecture was not oriented toward the sacbe terminus.

Two 2 × 2 m test pits were excavated at the site of San Cristobal in an effort to date this component of the road system, as well as to explore the temporal relationship between the northern portion of the site and the immediate terminus area (Huerta Rodriguez 2005c, 2005d). Unfortunately, the first excavation, at the point at which the sacbe met the raised terminus plaza, yielded few identifiable ceramics. It did indicate that the plaza was raised in a single Terminal Classic construction episode placed directly upon chac luum and bedrock; this earlier deposit contained a limited quantity of Late Formative ceramics that were not associated with any feature within the excavated area.

The second unit, at the base of the large structure to the north of the terminus area, was somewhat more informative. As with the first excavation, the construction effort dated to the Terminal Classic. However, ceramics were more abundant and varied, dating from as early as the Middle Formative, with evidence of very limited activity during the Late Formative, Early Classic, and Late Classic.

The original settlement in the area, including a series of structures in a modern *rancho* (used for raising cattle) to the northwest that were not recorded by the project, appears to have been oriented to the north. Unlike most other small sites in the survey area, which experienced a hiatus during the Early Classic and Late Classic, some settlement continued in the vicinity of the San Cristobal terminus through time. During the Terminal Classic, when the causeway arrived from Ichmul, some of the site's architecture was remodeled to emphasize this new direction, to the southwest. No obvious signs of Postclassic activity were noted at the site.

The Ichmul–San Juan Sacbe

The road to San Juan is similar in height and width to the Xquerol and San Andres sacbeob, at around 13 meters wide and 70 centimeters high. Presently, it exists for only 1.65 kilometers (although it may have been as long as 2.3 kilometers originally), becoming invisible as it enters the modern pueblo. Its trajectory indicates that it may have begun in the northeastern portion of the Eastern Acropolis of Ichmul. However, it does appear to have been laid out from the same point as the roads to San Andres and Xquerol (Flores Colin and Normark 2005c).

Numerous structures are present along the causeway's path, as are a large *haltun* (water-catchment basin), which may have originally been a quarry for building material, and several sascaberas. The modern road between Ichmul and Chikindzonot cuts directly through the Ichmul–San Juan Sacbe in one place, obliterating the sacbe for a distance of about forty meters on either side of the modern road.

The San Juan terminus includes a raised platform with a long range structure and scattered mounds (fig. 11). The original (Late Formative to Early Classic) orientation of the site was to the northeast, with a vaulted range structure at the rear of a platform that supports numerous small structures. Scattered foundation braces continue to the northeast, currently interrupted by the immediately adjacent modern road. Many of the surrounding structures have double wall lines indicative of a Terminal Classic construction style. A Postclassic shrine and scattered small structures in locations that would have disrupted the normal flow of traffic indicate an occupation following the periods in which most of the site's construction took place. A set of late defensive features was also documented in the area to the east of the largest structure and east-northeast of the smaller structures to its north.

The causeway enters the San Juan core from the southwest, striking the largest architecture off center and at an angle of 125 degrees. A plaza roughly 45 × 55 meters, raised just 1–2 meters above the surrounding terrain, separates the sacbe's terminus from the principal architecture at the site. This elevated plaza follows the same general orientation as the rest of the architecture at San Juan, indicating that it too may actually predate the causeway or may have been planned as part of a separate building program.

As at other termini, test pits were used to clarify temporal relationships within San Juan and between site and sacbe (Young 2005). The first was placed at the intersection of the road and the raised plaza, while the second was positioned in the plaza to the north of the largest structure. Ceramics from Operation 1 dated almost exclusively from the Terminal Classic, with minor indications of Late Formative and Early Classic occupations in the area. The second operation contained ceramics that indicated a primarily Terminal Classic occupation in the vicinity, with traces of a very minor Late Classic component.

Thus, as at other terminus sites, the sacbe was added to a site with significantly earlier, and more minor, occupations. Here, relatively

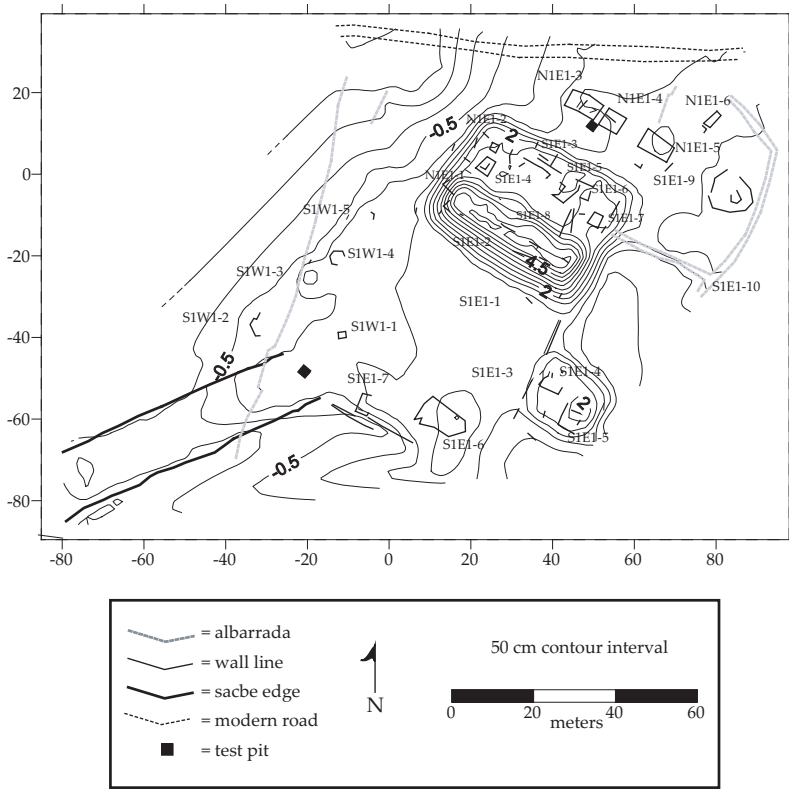

Figure 11. Plan map of San Juan site core. (Drawn by Alberto Flores and Johan Normark)

little effort was made to modify the existing structures and features in terms of their orientation. San Juan is unique among the terminus sites in terms of its potentially defensive enclosure.

The Ichmul–San Pedro (Chan Ichmul) Sacbe

Another of the smaller roads in the Ichmul system, the Ichmul–San Pedro (Chan Ichmul) Sacbe is similar in proportions to the San Cristobal feature at 6 meters in width and only 25 centimeters in height (Flores Colin and Normark 2005d). Its length (1,100 meters) is the second shortest at present, but it may have been close to 1.6 kilometers long in the past. It might have been a branch from the Ichmul–

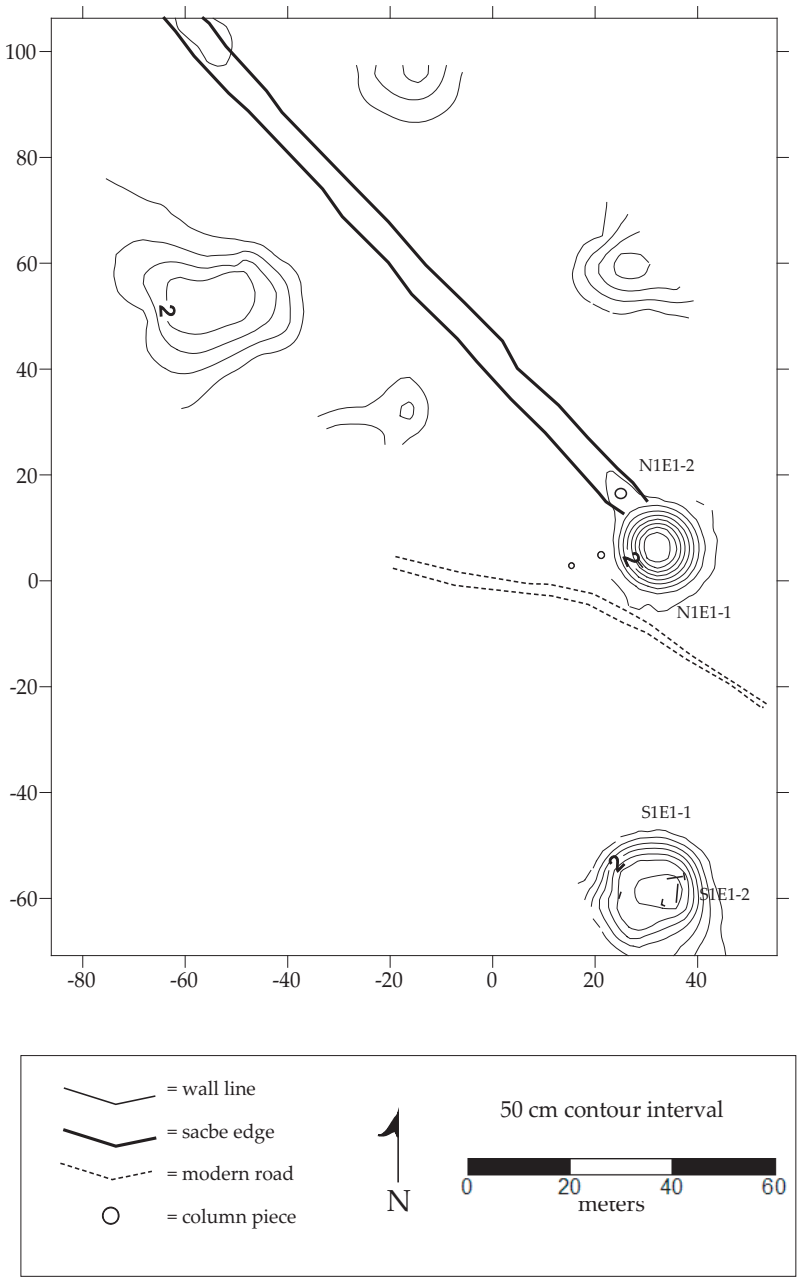

Figure 12. Plan map of San Pedro site core. (Drawn by Alberto Flores and Johan Normark)

San Andres Sacbe, unless an angle change occurred along its course. Alternately, the two may have originated from the same point (east of the Central Acropolis), or the smaller San Pedro roadway could be the older of the two, having been interrupted by the more substantial San Andres causeway.

A single five-meter-tall mound comprises the San Pedro terminus. The roadway widens slightly as it meets the mound; the center of this terminus is capped by a small foundation brace. Only one other significant mound has been located in the area, approximately forty meters south of the terminus; although a few smaller structures were visible in the immediate vicinity (fig. 12), determining the original orientation of the architecture at the site is difficult. Because of the lack of any constructed plaza at the site and time constraints at the end of the 2005 season, no test pit was excavated at San Pedro. However, based on the probable intersection of this sacbe with that from San Andres and the consistent dates of the other members of the road network, the argument may be made that this roadway also dates to the Terminal Classic.

The Ichmul–Xquerol Sacbe

This component of the sacbe system—13 meters wide and currently 2.5 kilometers long (once perhaps more than 3 kilometers long)—is the only road at Ichmul to thus far be accurately mapped using a total station (Flores Colin and Normark 2004a). Cut by the modern Ichmul–Xquerol road in two places and spanning the Yucatán–Quintana Roo border, it has been used for building material in *ejidos* (collective landholding units), as well as for the modern road (fig. 13). As a result, neither its origin nor its terminus is known for certain. The most probable terminus in Xquerol is a 9-meter-high mound found to the northeast of the central plaza (fig. 14), approximately 100 meters from the point at which the roadway is last visible today. Where the sacbe is evident as one leaves the formally defined solares of Xquerol, it possesses a 9-meter-long step on its eastern flank.

The pyramid that serves as the most likely terminus at Xquerol has been heavily impacted by four recent looters' holes. However, enough architecture remains intact to indicate that the structure's principal structure faced south, into the modern plaza, rather than northward toward the sacbe and Ichmul. A 2 × 2 m test pit excavated in 2003 revealed a ceramic sequence beginning in the Middle Formative and continuing through the Postclassic, with a noted drop in

Figure 13. Road cut into the Ichmul–Xquerol Sacbe. (Photo by Justine M. Shaw)

ceramic frequencies during the Early Classic and Late Classic. Thus, Xquerol, like other outlying sites in the Ichmul system, appears to have been a preexisting center that was joined to Ichmul during the Terminal Classic.

Leaving the modern pueblo of Xquerol and crossing the modern border into the state of Yucatán, the sacbe exhibits a relatively smooth grade achieved through variations in its height to compensate for a terrain that includes depressions and higher limestone outcrops. Also, 650 meters from its terminus in Xquerol, a set of steps or a possible terrace was seen along the western side of the roadway at a point where the feature was elevated nearly 2 meters above the ground level.

Within the site and pueblo of Ichmul, the sacbe runs directly along the western portion of the base of a 6-meter-tall mound (Structure S7W2-1), which is in extremely poor condition due to heavy looting. However, this is not the terminus, as the sacbe clearly continues its straight course for at least 30 more meters. At this point, it enters a zone of more concentrated historic and modern settlement

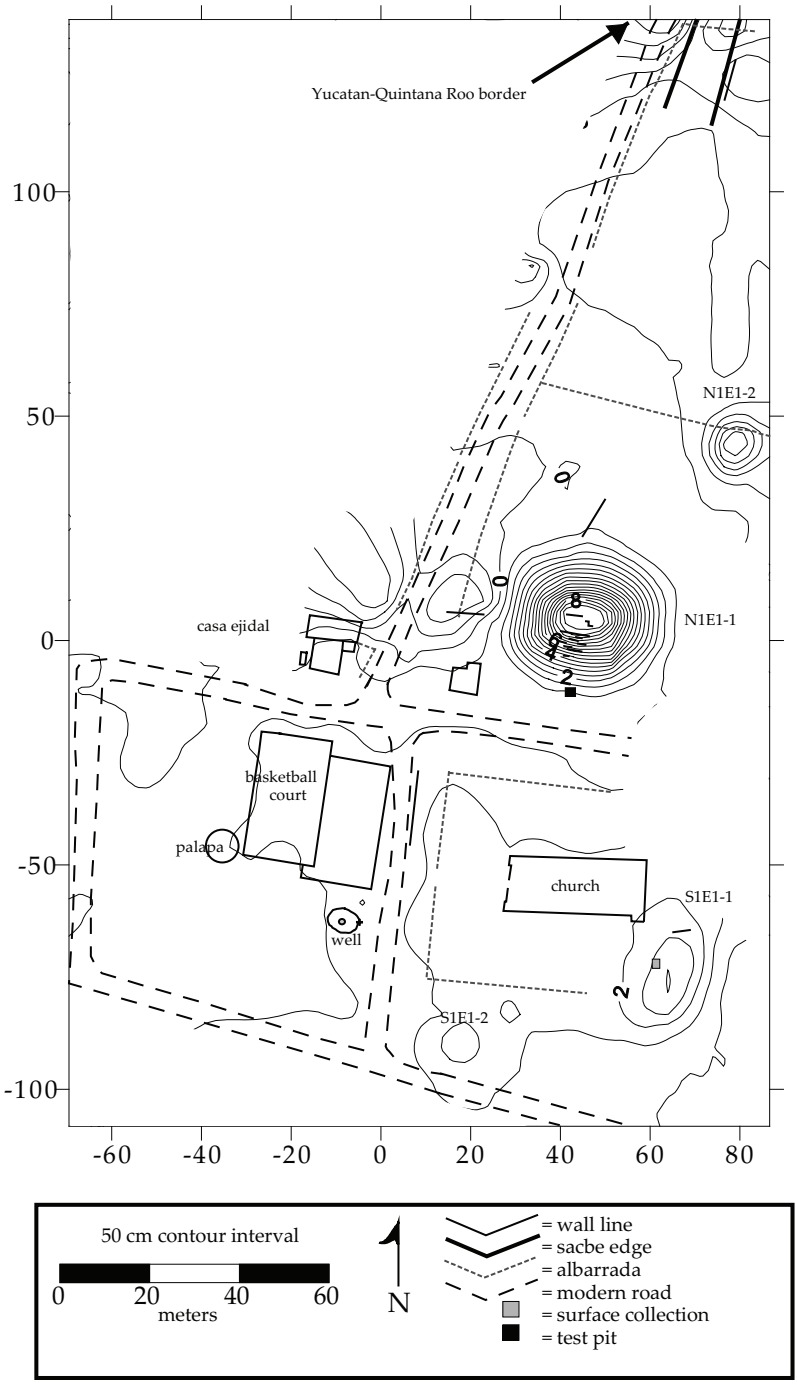

Figure 14. Plan map of Xquerol site core. (Drawn by Justine M. Shaw)

that is crossed by numerous albarradas, Caste War *trincheras* (fortifications), and domestic architecture. If the road did continue farther into the core of the site, it would have arrived at the southeastern flank of the Central Acropolis.

In 2004, a 2 × 2 m test pit was excavated by Flores Colin and Normark in the plaza area directly adjacent to the sacbe. Unfortunately, the operation failed to produce any sealed lots, such as materials from under a plaza floor. Ceramics within the four natural levels ranged from the Middle Formative through the Postclassic. A tentative Terminal Classic date was postulated based strictly on the frequency of ceramics from this period.

Other Sites in the Vicinity of Ichmul

The five sites joined to Ichmul by causeways are not by any means the only settlements in the vicinity. Working from information obtained from local consultants, the CRAS project has documented a number of other settlements in the vicinity (Flores Colin and Normark 2004b) and received reports of several other sites that have not yet been visited. Thus far, some of these sites have been recorded using only sketch maps, and only one has been test-pitted.

Calotmul

Stromsvik and Pollock (Stromsvik et al. 1955:169), who first reported upon ruins in the vicinity of the modern pueblo of Calotmul, noted the existence of four mounds. At least one of the mounds included Puuc-style masonry walls on what may have been earlier structures. Located on the modern road from Ichmul to Peto, Calotmul is ten kilometers west of the Great Plaza in Ichmul. Project members observed that Calotmul currently includes at least two pyramidal structures, each of which is over ten meters tall. Local residents state that more architecture and a cave with water and a passage exist. There are rock alignments adjacent to the historic road to Peto, as it leaves the pueblo of Ichmul, indicating that Calotmul may have also been a terminus site of the Ichmul road system.

Chanmahas

Near the road from Ichmul to Chikindzonot, the site of Chanmahas lies six kilometers northeast of Ichmul's Great Plaza. Chanmahas cur-

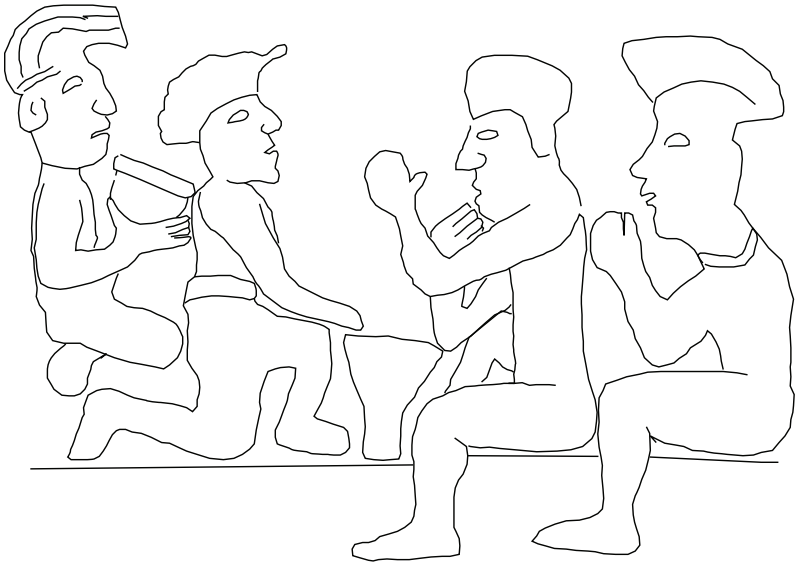

Figure 15. Xlapak Panel. (Drawn by Dave Johnstone)

rently consists of a small pyramid, pilas/metates, a well, and a stairway to a pool of water, as well as a cenote-cave. Three wooden crosses attest to modern ritual activity in the area.

Xlapak

Xlapak is located 10.5 kilometers north of the Great Plaza of Ichmul, along a small and rocky road. Structures at the site are arranged around a large plaza, with a 10-meter-tall platform and range structure serving as the most monumental architecture at the site. A substantial collapsed sascabera separates the pyramid from the remainder of the site. Megalithic and Puuc-style architectural elements attest to Early Classic and Terminal Classic occupations. A modern settlement is located a few hundred meters from the ancient site. Xlapak's *casa ejidal* (government building for the local collective landholding unit) includes a panel taken from the Prehispanic site; this panel shows two individuals sitting in the right portion of the pane, facing left (fig. 15). Two persons, holding various objects including a bowl, kneel in front of the seated individuals. All four wear headdresses. Local consultants report that a second panel now resides in

Yaxcaba, the capital of the *municipio* (government municipality similar to a county).

Xnicteil

Located en route to Xlapak, Xnicteil lies 7.3 kilometers north of Ichmul's Great Plaza. The Prehispanic structures that once composed the site have been heavily impacted by colonial and modern occupations; one platform was located near the modern road, while two mounds were detected in the pueblo.

Xbalche

Xbalche, also known as Xbalcheil, is located approximately eight kilometers from Ichmul. First visited by Alberto Flores Colin in 2004, the site was the subject of further investigations by Adam Kaeding (2005). This more recent effort was aimed at exploring the colonial component of the site, which had included a rancho. However, the investigation also revealed more details about the Prehispanic occupation.

Excavated near the site's only obvious colonial residential structure, a 2 × 2 m test pit revealed a Terminal Classic platform with a plaster floor. Late Formative and Early Classic ceramics included in the deposit indicate that Xbalche, like most sites in the study area, had occupations prior to more significant investments during the Terminal Classic. The date of the four small Prehispanic platforms currently visible at Xbalche is unknown.

Greater Ichmul's Idealized Plan

What is known of Ichmul and its surrounding territory (fig. 6) indicates that during the Terminal Classic the settlement pattern generally follows Hoyt's (1939) sector model, with differences in land use near the center of a city being maintained as the city expanded outward (Marcus 1983:200–202). Rather than forming simple continuous rings of relatively homogenous settlement radiating outward from the central high-status zone, natural features, cultural constructions, and earlier occupations conditioned the type of activities that took place in a given zone. The sacbeob, presence of better agricultural lands, and location of contemporaneous and preexisting hamlets appear to have resulted in zones with considerably greater settlement

densities and differential activity patterns than other areas equidistant from the core of Ichmul. The moderate-sized public architecture at and near the termini and the monumental causeways focused political, economic, and ritual activities along linear districts, while elsewhere terrain remained relatively open, potentially serving as agricultural land, hunting territory, or low-density buffer zones between polities.

Prior to the construction of the roadways, which essentially restructured the site plan by enlarging greater Ichmul beyond its core and immediate periphery, the sector model may not apply. Instead, our current knowledge suggests that a simpler concentric model (Marcus 1983:199–200; Park et al. 1925) may have applied to the site. Monumental architecture was concentrated in the core of the settlement, with a residential zone surrounding the center. Although the occupational loci that later became the terminus sites contained some constructions, with the exception of Xquerol these appear to have been almost exclusively domestic in nature. The earlier settlements were also several orders of magnitude smaller than their final incarnations, originally being not markedly different from other small hamlets dispersed across the countryside.

A Consideration of the Entire Sacbe System of Ichmul

Ichmul's road system is described as containing local and core outlier-intrasite components in that its roadways, at present, are all either less than one kilometer in length (local) or less than five kilometers in length (core-outlier) (Shaw 2001; see chap. 5). Ichmul is not known to possess intersite sacbeob over five kilometers in length, although its causeways are longer, on average, than Yo'okop's; the former possesses four roadways exceeding one kilometer in length (Flores Colin and Normark 2004a), while only one of Yo'okop's reaches more than a kilometer (Shaw et al. 2002; see chap. 3).

Unlike the sacbe system of Yo'okop, which appears to link groups of roughly equivalent status, the radial system of Ichmul—like that of Caracol (Chase and Chase 2001), Cobá (Benavides Castillo 1981), and Chichén Itzá (Cobos 2003)—involves a plan that is focused on one center. This hub is then linked to outlying sites by spokelike sacbeob. Although the Ichmul–San Andres road may have had branches, these

too are positioned to efficiently tie more locations to the center. The system does not display a concern with linking any of these outlying sites to each other.

Architectural and ceramic evidence from the terminus sites and Ichmul indicates that the system was established relatively late in the region's occupational history, after the general layout of each site had already been established. The outlying sites and center of Ichmul were occupied by the Middle and Late Formative and display strong occupations until at least the Early Classic, with a hiatus or population diminishment through the Late Classic. Following this, all terminus sites demonstrate strong Terminal Classic populations accompanying the construction of the road system and then moderate-to-no Postclassic usage.

Thus, Ichmul's system is undoubtedly hierarchical, with the Rank II (Velázquez Morlet et al. 1988) site of Ichmul being the origin (or terminus, depending on one's view) of each of the roads. The Rank IV sites at the end of the five major sacbeob could be considered to have been of secondary importance, and the smaller site on the potential branch of the Ichmul–San Andres Sacbe would be of tertiary importance. Presumably, during the Terminal Classic, any site not treated to a sacbe would have been considered by the leaders of Ichmul to be relatively unimportant or may have already served some other type of connection to another site.

Whether or not this scenario is accurate, however, depends in part on who administered, organized, and paid for the system. With Ichmul being the core of the system, and by far the largest site in its area, one may be able to assume that it was the political capital and drove the program of sacbe construction to integrate its hinterland. However, another possibility is that sites in the outlying zones could have chosen to build roads to link themselves to their capital, with costs being paid by the more remote terminus site and other occupations along its path. That the distant sites could have afforded the human and material resources required to build the substantial roadways (based strictly on the size of the terminus sites) seems unlikely. However, construction boxes visible in at least one of the roadways indicate that the work and costs may have been divided in some manner, possibly to include not only those living at the termini but also anyone along the path of each member of the system. The common origin of the roadways implies that Ichmul was involved on some

level with the coordination of the construction projects, although the road builders might have used monumental architecture in the core of Ichmul as an orienting guide without the benefit of extensive assistance from the main center.

Also of interest is the fact that there are actually two different types of roadways within what today appears to be a single system. The San Andres, San Juan, and Xquerol causeways are all of similar dimensions, maintaining a fairly consistent 13-meter width and 70- to 80-centimeter average height along their courses. The San Cristobal and San Pedro examples, however, are only 6 to 6.5 meters wide and 25 to 50 centimeters high on average. The San Pedro sacbe also could have crossed, or been crossed by, the road to San Andres, which itself may have a further branch. The three larger causeways all appear to be laid out from the same point on the eastern part of Ichmul's Great Plaza. The San Cristobal road may have originated to the west of this point, if it ever reached the Great Plaza, or even farther to the south, in the north-central portion of the Central Acropolis. If the San Pedro roadway did not serve as a branch of the San Andres sacbe, it too may have come from the Central Acropolis, although its origin would have been on the east side of the northeastern part of the acropolis.

One explanation for the two types of causeways may be that the smaller and larger roads differed in their functions, perhaps emphasizing practical functions in the former and ceremonial processions for the latter. However, it may also be that, with two potential sets of origins and two construction styles, what is now called one system may, in fact, be a palimpsest of at least two distinct building programs. Both phases appear to date to the Terminal Classic, based on ceramic materials associated with their distant termini. However, this single archaeological period spans approximately 250 years, which would have comprised many human generations and numerous leaders. It may be that the "system" is contemporaneous only in archaeological time.

If indeed the two components of the system were built at different times rather than as part of the same general program, as seems entirely possible, there is no decisive evidence indicating which of the two would be the earlier component. Based on the longer occupation span evidenced in the Central Acropolis, the argument may be made that the two roadways that appear to have originated from

this location would be the older examples. Their shorter lengths and smaller dimensions, resulting in a markedly smaller overall cubic volume than the more monumental sacbeob, are indicative of fewer resources being invested in their construction, a fact that does not particularly assist in their relative dating. The association of the three larger roadways with the Great Plaza and its eastern platform, both of which appear to be exclusively Terminal Classic in date, implies a massive, centralized construction program taking place at about the same time. This effort may have redefined the center of the site of Ichmul during the Terminal Classic or, at the very least, provided architectural definition to what was previously a largely open area adjacent to the monumental acropoli.

The most decisive evidence in determining the relative sequence of road-system components would be a detailed excavation of the point at which the San Pedro and San Andres sacbeob would join or cross. Unfortunately, their trajectories indicate that this would be directly in a zone obliterated by one of the modern roads within Ichmul. Other options involve using more-sensitive temporal indicators, possibly including radiocarbon dates, from contexts firmly associated with the causeways. While not impossible, this option would require more excavations and sealed contexts more likely to be associated with terminus plazas than with the sacbeob, which are currently characterized by porous gravel, cobbles, and boulders, making for extremely poor preservation of even ceramic materials, let alone organics.

Regardless of the timing of the two components, remembering that Ichmul's sacbe system was potentially not a single contemporaneous effort but instead was a set of at least two building programs changes the way in which the resulting system should be viewed. Like the sacbeob of Chichén Itzá and Cobá, which also experienced two major causeway-building episodes (Benavides Castillo 1981:176; Cobos 2003:226–260), the cumulative form of the entire system changed markedly through time. Viewed as a whole or in its component parts, Ichmul's system is clearly hierarchical, centered on the core of the site. However, instead of constituting a radial system, the causeways may have originally had a more linear configuration with one road to the north and one to the southeast (assuming the greater antiquity of the smaller roadways). The later tripartite addition may have been thought of as being part of a cruciform orientation for the site, as at

Ek Balam. Much more recently, at historic Chan Kom, the reality of the direction and count of roads did not necessarily have to match the ideal of a cruciform to invoke the cosmological model (Redfield and Villa Rojas 1962). The lack of a member to the west may relate to the particular cosmological references being called upon, the existence of some sort of political frontier in this direction, or differential preservation. Alternately, there may not have been a concern with a particular form for the system(s), with more practical economic, social, and political functions driving the expansion of the network.

A Summary of Ichmul and Its Terminal Classic Sacbeob

In sum, the sacbe system of Ichmul is composed of two sets of roadways, both of which were constructed during the 250-year-long time period commonly referred to as the Terminal Classic. This was an era when Ichmul, as well as every other documented Classic Maya site within the CRAS project's survey area, reached its peak in terms of population size and overall construction volume. Ichmul, like Yo'okop, appears to have been a regional capital of some sort, as indicated by the tremendous volume of construction involved in its site core and the causeways radiating from this zone.

Factors that gave Ichmul the advantage over other sites in the surrounding area at this particular time may have included the existence of previously constructed monumental architecture dating from earlier periods, which would have provided sanction and precedence for the dominance of the center. Additionally, the presence of attractive natural features, including water sources within its core and deeper-than-average soil in the surrounding countryside, may have provided an advantage. Charismatic leaders and the effects of ritual and belief systems should not be discounted as key elements either, particularly in light of the presence of unusual, concentrated burials contained within the platform on the eastern side of the Great Plaza. An innovative cult of some sort, analogous to that of the Black Christ in the sixteenth century (Caseres et al. 1998:3:356–357), may have attracted followers willing to commit substantial resources to ambitious building programs (see chaps. 9 and 10).

Unfortunately, the poor preservation within the site core, teamed with the fact that the Terminal Classic was the last major Prehispanic

occupation period and therefore the first to be removed for building material, leaves relatively little evidence readily available within Ichmul itself. The sacbe system, as a collection of giant artifacts, therefore serves as a unique set of evidence that may provide some insights into the role of Ichmul within the context of its hinterlands.

Clearly ranked, with Ichmul positioned as the paramount power, the five-member (possibly two-phase) system contains roadways that appear to have all been originally core-outlier intrasite in terms of their estimated length. Additional roads may have existed within the area now consumed by the modern pueblo. However, the state of the currently preserved road system implies a concern with integrating outlying centers that might not have otherwise been symbolically or functionally a part of Ichmul proper. The degree to which this was necessitated by competition with other regional political powers (such as Yo'okop) or driven by internal motivations (including ritual functions or the need to transport goods and people) is unknown. Managing these termini and the intervening terrain as part of a single social and political unit seems entirely possible given the quantity of architectural investments made during the Terminal Classic.

Several sites within this same zone were not graced with causeways, just as more-distant locations with substantial architecture were not attached to Ichmul. Choosing particular termini sites for inclusion in the network may have been done on the basis of voluntary selection, with elites and commoners at the more distant centers being related to those in Ichmul through kinship or other social ties (McAnany 1995). Even without such ties, potential terminus sites may have competed for the privilege of being integrated into the regional capital. Alternatively, Ichmul may have taken over the outliers in a less-than-voluntary manner, claiming the centers and marking its territory as a means to assert and maintain control of an expanding hegemony potentially threatened by Yo'okop, which was experiencing a similar population boom. Vestiges of a possibly Chichén Itzá–affiliated presence at the nearby site of Nohcacab imply that even more distant powers could also have loomed large. These and other factors are further discussed in chapters 9 and 10.

3

Yo'okop and Its Sacbe System

The site of Yo'okop consists of four major architectural groups (Groups A, B, C, and D) linked by three sacbeob. These four groups have significantly larger architecture (up to twenty-eight meters in height) at substantially higher densities than the remainder of the site. Between the major groups, moderate-sized mounds (five to six meters in height), platforms, *rejolladas* (depressions not in contact with the water table), and small residential structures are scattered. These lower-density, intergroup zones are believed to be where the majority of Yo'okop's population resided. Mapping has also revealed that where deep soils are found at an elevation close to the water table, there is an absence of architecture, resulting in a "garden city" plan (Smyth and Dore 1994:49) including zones of intensive agriculture between concentrations of architecture on higher elevations and bedrock outcrops (Johnstone 2002).

Initial Research at Yo'okop

Although no concentrated program of research had taken place at the site of Yo'okop (fig. 16) prior to 2000, several archaeologists had made extended visits to the area. The first to report the site, as "Okop" or "La Aguada," were Gregory Mason and Herbert Spinden (Mason 1926a, 1926b; Mason and Spinden 1927). Pausing at the site to water their mules at the *aguada* (large water-catchment basin), the explorers noticed the tallest structure at the site (Structure S4W1-1), reported by their guide to be a feature of natural origin. Upon climbing to the top of the "Castillo," they were in awe of the scale of the construction at the previously unreported site. "'God,' says Spinden at last, 'this by itself is worth the whole journey'" (Mason and Spinden 1927:301),

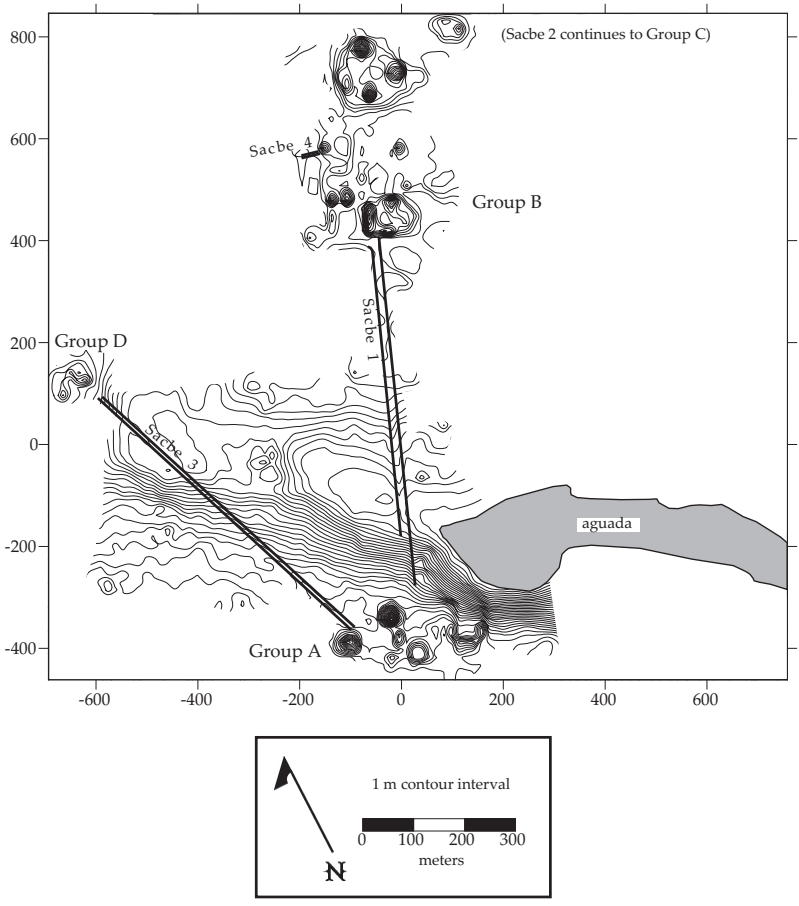

Figure 16. Plan map of Yo'okop. (Drawn by Justine M. Shaw)

prompting the explorers to spend the two days at "Okop" that they had previously allotted to Tabi.

On the basis of the style of the architecture observed in what came to be labeled Group A, they equated the site's occupation period to that of Labná, earlier than that of the east coast cities. However, in response to the relatively plain architecture observed in the group, Mason (1926a) declared that "[t]he place was not a center of art and learning, but a good, substantial city of industrialists, who took religion seriously and built heavy temples, wasting no time on flourishes and decoration and not believing in evolution. Briefly, good, sub-

stantial bourgeois fundamentalist Maya built Okop." The two also reported on a patio group (probably that composed of Structures S4E1-5, S4E2-9, and S4E2-1) to the southeast of the largest pyramid and a pyramid-temple with subterranean passages (Structure S4W2-1), which they speculated may have led to lower rooms.

In 1954, Gustav Stromsvik and H.E.D. Pollock (Stromsvik et al. 1955) visited the site for a single day. At that time, there was a small concentration of huts referred to as "Okop" located on the outskirts of what came to be referred to as Group B. Concentrating on the northern group (Group B), they noted the existence of three good-sized pyramids ranging from nine to fifteen meters in height, as well as several smaller mounds on a "large platform" to the north and south. They appear to have been referring to what became known as Group B's North Acropolis (Structure N8W1-1). Stromsvik and Pollock observed that the northern and eastern pyramids were capped by small, single-room structures with crude masonry that included Puuc-style stones; the size of the structures and the mixture of reused and crudely dressed architectural components typified the east coast architecture that they had seen at other sites.

Additionally, they extracted the remains of a stela (Stela 1) from a *ramon* tree and noted the existence of a southern group (Group A) joined to the northern mounds by a sacbe (Sacbe 1). Locals reported the existence of another causeway to the west (Sacbe 3), which was not located. While commenting on various Terminal Classic Puuc-style elements reused in Postclassic contexts, Stromsvik and Pollock estimated, based on the style of various stelae, that the major period of construction at Yo'okop was the Late Classic (Stromsvik et al. 1955).

Years later, when the closest village to Yo'okop, Dzoyola, requested a minister and physician from the Presbyterian Mission Station in Xocempich, Yucatán, pilot Jack Walker was able to observe the Castillo and the aguada from the air, with more structures becoming visible in future flights. In 1966, Walker and physician Reginald Wilson made a brief visit to the structures in Group A. Guided by an older Maya man, Marco Chan, the two were told that the site was referred to as Chac Luc by locals. They were also informed that more ruins could be found "down the sacbe" running to the north (Sacbe 1); near the end of the sacbe was said to be a stone with "El Rey" on it (Wilson 1972).

In 1969, Pilot Bill Clapp then located Groups A, B, and C, Sacbeob 1 and 2, three altars, and three stelae. This spurred Walker and Wilson

to return in 1972 with Maya assistants to make basic renderings of the main groups and take measurements of important structures and features. Although they conducted no excavations, this effort provided the most extensive description of the site published prior to 2000 (Wilson 1972, 1974). Reginald Wilson has continued to assist members of the PAY/CRAS project by providing photographs of elements that have subsequently been damaged or removed and detailed information concerning the state of the site at the time of his visits.

In 1998, as Dave Johnstone and I visited Yo'okop to assess its research potential, researchers from Mexico's Instituto Nacional de Antropología e Historia (INAH) conducted basic reconnaissance and surface collections at the site. The following year, INAH's Luis Alberto Martos López carried out excavations and restorations at the nearby Caste War site of the same name. Much of the core of the regional center of Yo'okop was mapped in 2000–2002 under the direction of Johnstone and me as the Proyecto Arqueológico Yo'okop (PAY), with eight test pits and one structure being excavated. Using these materials, as well as observations of the style of surface architecture and limited surface collections, my colleagues and I have been able to describe a general sequence of intrasite settlement alterations, with corresponding changes in ceramic affiliations. These shifts (Shaw 2005) include an occupation by at least the Middle Formative that continued through the Postclassic, although the zones in which architectural investments were made varied greatly through time.

Yo'okop Site Description

General Site Layout

Group A is the southernmost monumental component of Yo'okop (fig. 17). It is linked by Sacbe 1, which runs north from the north-central edge of Group A, to south-central Group B. Group B is further connected to Group C by Sacbe 2, which extends to the northeast. During its first season, the PAY located an additional group and associated causeway: Group D and Sacbe 3. Group D is connected by Sacbe 3 to the northwestern part of Group A. The monumental structures in Groups A and B, as well as many intervening constructions, share an alignment of 25 degrees east of magnetic north. Sacbe 1, however, is aligned to 20 degrees east of magnetic north.

The majority of the site is situated on essentially flat terrain,

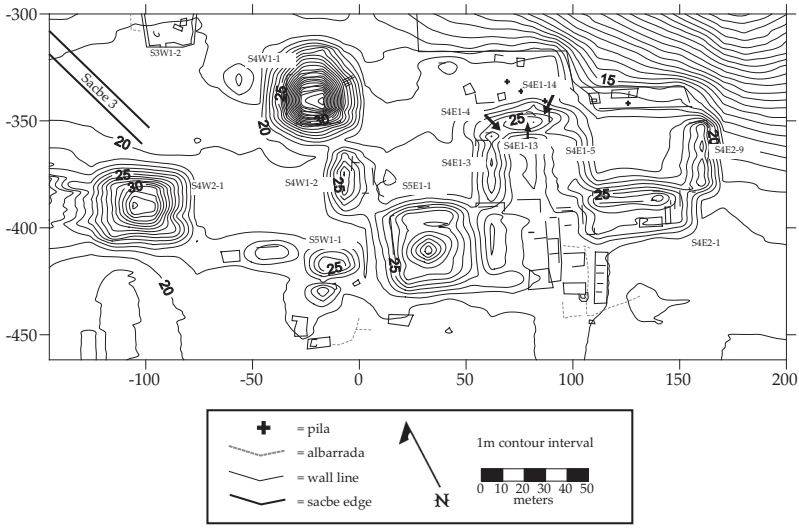

Figure 17. Yo'okop's Group A. (Drawn by Justine M. Shaw)

although Group A sits atop a sharp natural rise. The only major water source on or near the site is the aguada immediately to the east of Group A, at the base of the natural slope. A modern dirt road between Saban and Dzoyola cuts through Sacbeob 1 and 3, running east–west, one hundred meters north of Group A. Only footpaths connect the modern road to other portions of the site.

Group A

Group A measures roughly four hundred meters (east–west) by two hundred meters (north–south) and rises to between eighteen and forty-six meters above the site datum to the north of the modern road (figs. 16 and 17). As with the rest of the site, the majority of the structures in Group A are oriented 25 degrees east of north. The architectural style of many of Group A's structures suggests that they were originally built during the Early Classic, although substantial Late Classic constructions and modifications are also evident. Little Terminal Classic construction is evidenced in the group, even though ceramics dating to this time period were common in test pits. The area seems to have experienced a significant Postclassic resurgence. Although Formative ceramics are present at the site, Group A constructions dating to this time are either buried or architecturally indistinct.

Unlike the majority of sites in the north (Pollock 1965), Yo'okop's Group A displays a very formal architectural layout around plazas. While some of these plazas are large public spaces, others are more private with restricted access. Constructions that would have had perishable superstructures are located primarily around the periphery of Group A. Some of these smaller buildings are associated with contemporaneous albarradas.

The most prominent structure on Group A is Structure S4W1-1, also known as the Castillo, a twenty-eight-meter-tall construction that appears to be Late Classic and Postclassic in date. The base of Structure S4W1-1 measures approximately fifty-five meters at its maximal north–south width and forty-five meters at its maximal east–west width. An intact northwestern corner is curved, indicating that the structure may have been rounded in a manner similar to the Temple of the Magician at Uxmal (Sáenz 1972) or Cobá's recently reconstructed Xaybe (Shaw and Johnstone, personal observation).

Structure S4W2-1 is the second-tallest construction in Group A, measuring roughly forty-five meters on each side at its base and rising about fifteen meters. Two descending passages with intact vaults are present on the north and east faces. These lead to small square chambers that have been damaged by relatively recent looting. The visible surface of the building appears to date to the Postclassic. One indication that some type of construction was present at this locus prior to the Postclassic is that the structure was the terminus for Sacbe 3, which connects Groups A and D; the latter group appears to be primarily Terminal Classic in date, and the causeway, by extension, likely dates to this same period.

The Postclassic power of Yo'okop is also reflected in the presumed function of Structure S4W2-1. Comparisons to similar excavated structures from other sites (e.g., Freidel and Suhler 1999) suggest that the building served as an accession structure. Postclassic rulers of Yo'okop may have used the structure as part of the ceremony to take office. Although the two chambers do not connect with further interior constructions, they would have allowed leaders or other ceremonial participants to temporarily disappear from sight.

To the east of the two largest structures in Group A, Structure S5E1-1 is an unusual monumental construction, with a square, elevated platform base framed by higher room blocks along its top edges. Inside this square is a depression; rising from its center is a pyramid. The base of Structure S5E1-1 measures approximately 50 meters by

50 meters, while the top of the central pyramid reaches about eleven meters above the surrounding plaza.

As stated, diagnostically Terminal Classic constructions are largely absent in Group A. However, upon excavation, Structure S3E1-5 proved to be an approximately 7 × 7 m vaulted sweatbath with a U-shaped bench that was constructed at the start of the Terminal Classic period at the edge of the aguada, to the northeast of Group A (Shaw et al. n.d.). With its lower central passage and benches, Structure S3E1-5 is similar to the sweatbath Structure P-7 reported from Piedras Negras (Satterthwaite 1952), as well as Structure 9 at Cerén (McKee 2002; Sheets 1992:98).

The eastern portion of Group A is dominated by a series of substantial range structures located around formal plazas. Although few small structures were found within the monumental core of Group A, several clusters of small buildings were located on the fringes of the group. Of note is the north-central cluster, which appears to be consistent with small residences excavated at other sites. However, its location and restricted access using formal walls may indicate that it was perhaps a more administrative- or trade-oriented zone.

In addition to excavating the sweatbath structure on the edge of Group A, researchers placed three test pits in Group A plazas to provide a general idea of when the zone was occupied. The first of these explored a depression to the northwest of the Castillo that was thought to be a potential water-catchment feature. Although no evidence of any modification that might have achieved this end was detected, ceramics from within the unit demonstrated an occupation by the Late Formative, with Late Classic and Terminal Classic materials being most prevalent. A test pit excavated in the Structure S4E2-1 plaza, overlooking the dropoff to the aguada, demonstrated that the plaza was exclusively Terminal Classic in date, with only one flooring episode being detected in a relatively thin deposit directly overlying bedrock and chac luum. The third test pit was placed next to Structure S4W1-2, which contained Early Classic megalithic stairs. Late Formative and Early Classic materials were recovered, with most of the activity in the area dating to the Terminal Classic.

Group B

Group B (fig. 18), a concentration of monumental architecture over an area measuring 300 × 450 meters, is located approximately 718 meters north of Group A; Sacbe 1 connects the two groups. Sacbe 2

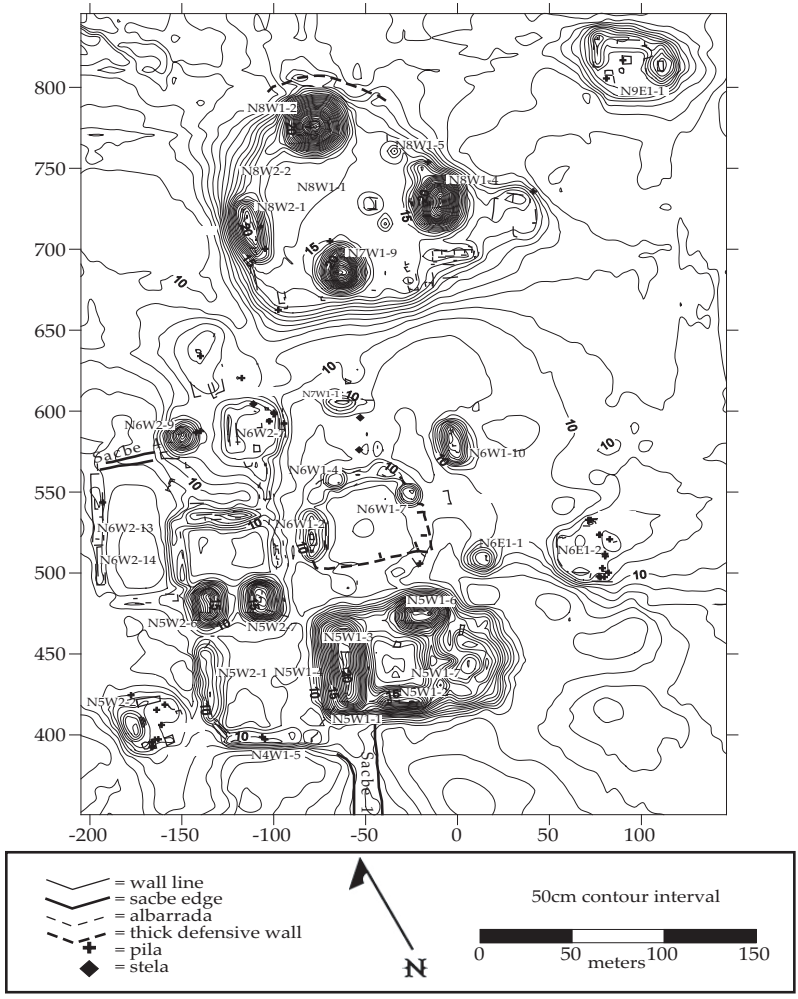

Figure 18. Yo'okop's Group B. (Drawn by Justine M. Shaw)

provides a link from Group B to Group C. The largest of the three groups thus far mapped in their entirety, Group B contains substantial pyramidal and range buildings, as well as two acropoli, a ballcourt, and three stelae. It is surrounded by scattered substantial constructions that have not yet been mapped.

During the 2000 season, researchers were able to record the terminus of Sacbe 1, one of Group B's main plazas, and smaller plazas to the east and west of this larger plaza. Sacbe 1, running from Group A, broadens as it reaches Group B. The northern end of the roadway is marked by the southern end of a long range structure on a larger platform (N5W1-1). The combined height of the platform and range structure raises Structure N5W1-3 to ten meters above the surrounding ground surface. This platform forms the Central Acropolis, as it continues eastward under the remainder of the large plaza and beneath a smaller adjacent plaza.

Forming the western edge of the large plaza (as well as the sacbe terminus), Structure N5W1-3 (fifty-five meters long by twenty meters wide) was capped by later additions, including a small foundation brace, and a Postclassic temple with a column on either side of its doorway and Puuc-style cut stones recycled from a Terminal Classic construction. The southern edge of the large plaza is marked by a smaller range structure, while the north is defined by a raised platform and pyramid (Structure N5W1-6) with a very small Postclassic shrine on its summit. To the east, Structure N5W1-7 delineates the end of the large plaza; it also forms the western edge of a smaller plaza.

To the west of the Sacbe 1 terminus, a substantial complex of fortifications was recorded, including albarradas, a stepped parapet, and a protected, L-shaped entrance. The stratigraphic relationships between the fortifications and the structures that they abut and cover suggest that they are relatively late in Yo'okop's occupation sequence, potentially dating to the latter Terminal Classic or Postclassic.

Additional fortifications were discovered in Group B in 2001. Besides the identification of an albarrada on Structure N5W2-7 that helped to further enclose the fortified plaza west of the Structure N5W1-1 Central Acropolis, two new walled zones were discovered. One new set of Group B fortifications was recorded to the north of the Central Acropolis. This plaza is enclosed by a series of albarradas and low walls that would have supported perishable palisades. As with the

more southern fortifications, the albarradas and palisade base were built relatively late in the site's occupational sequence, since they were placed over buildings but do not appear to have been dismantled.

A final fortification was constructed north of the Structure N8W1-1 Northern Acropolis. Curving just north of Structure N8W1-2, a substantial wall limits access to the acropolis. However, the ends of the wall do not meet any other constructions in a manner that would provide a sealed barrier. This indicates that the feature was never completed or that other portions were constructed of exclusively perishable materials.

To the west of the fortified Structure N5W2-1/N4W1-5 plaza, near Sacbe 1's northern terminus, lies a complex of smaller residential constructions on the Structure N5W2-2 platform. A similar arrangement was seen on the Structure N6E1-2 platform, which lies to the northeast of Group B's Central Acropolis. An additional residence platform example lies inside Group B proper, directly east of Sacbe 4 and Structure N6W2-9.

The identity of Group B's ballcourt (Structures N5W2-6 and N5W2-7 to the northwest of the Central Acropolis; see fig. 18) was confirmed in 2001 by the location of a partial ballcourt ring, although its identity was suspected based on its plan and Stela 2's depiction of a ballplayer. Both structures are capped by small Postclassic shrines. Interestingly, Reginald Wilson (personal communication) reports having seen a stone yoke in Group B during his 1972 visit to the site (Wilson 1974). This yoke has not been located in the course of this project's research, and local crew members do not remember the existence of such an artifact. However, glyph blocks are known to have been taken from Group A, so the removal of such a yoke is quite possible.

The larger of Group B's two acropoli, the Northern Acropolis (Structure N8W1-1), mimics the basic arrangement of the Central Acropolis on a larger scale. The largest range structure in the arrangement lies on the western side of the acropolis. The three other primary constructions on the Northern Acropolis are pyramidal buildings, and smaller foundation braces are scattered across the acropolis. Postclassic buildings top all four Classic constructions.

Three plaza test pits were excavated within Group B. The first, placed in the northern terminus of Sacbe 1, provided a Terminal Classic date for both the causeway and its amplification into an entrance

plaza utilizing two distinct flooring episodes with repair patches. Earlier finds in the pit included Early Classic postholes, with Late Formative and Middle Formative sherds at the base of the unit. The second 2 × 2 m excavation, in the Central Acropolis, located portions of two Late Formative masonry platforms and explored the main Late Classic 2.4-meter raising of the acropolis. The absence of Postclassic ceramics and the association of Terminal Classic sherds with only collapse debris indicate that this portion of the group may have fallen into disuse following the Late Classic (Johnstone 2001a). The final test pit for the group, located in the plaza at the foot of the largest, northernmost mound in the Northern Acropolis, exposed eleven flooring episodes, although time and safety constraints did not permit its continuation beyond the eleventh floor. Six of the floors dated to the Late Formative; three were laid down during the Early Classic; and the most recent surface was put down during the Postclassic.

Group C

Because of its distance from Group B and the rest of the site, Group C has never been formally mapped. However, information from Wilson (1974), local crew members, and a visit to the group by Chris Lloyd in 2002 provide some basic information about the area. Sacbe 2 begins to the north of Group B's core, running northeastward to Group C. According to Wilson (1974), it continues for 1.66 kilometers until it reaches Group C; Lloyd's GPS measurements indicate that the distance is much greater, approximately 1.8 kilometers. Numerous sascaberas are reported along the sides of the roadways. Clapp's aerial observations (Wilson 1974:12) spotted several individual mounds along the roadway.

Group C consists of only one pyramid. This structure, approximately fourteen meters high and of a "square-type," according to Wilson (1974), is located at the northeastern terminus of Sacbe 2.

Group D

Although Group D has long been known to local residents, the PAY first documented it in 2000. In 2001, Sacbe 3 and Group D were more accurately mapped using a total station. Additionally, two test pits were excavated in Group D plazas.

Group D is located approximately 670 meters northwest of Group A; Sacbe 3 connects the two areas. Local residents believe that a road

to Group B exists, although such a link was not found in *brechas* cut through a portion of the zone in 2002. The smallest of the three groups thus far mapped, Group D consists of approximately nineteen structures in a 100-square-meter zone. None of these structures attains more than 6 meters in height. Group D lacks a common orientation of any kind.

The southern portion of Group D rests on a constructed platform. This platform actually acts as a terrace, raising the lower southern portion of the group and nearly disappearing on the higher northern extreme. Foundation braces ring the principal structures in Group D, marking the edge of the group where it is otherwise not obvious. Several small sascaberas were located immediately to the north of the mapped zone.

Structure N2W7-3 is the highest building in Group D, at about six meters in height. Immediately to the south and west of Structure N2W7-3 are two connected range structures that form an angle of approximately 105 degrees. The connected plaza and its surrounding structures were built at a unique angle not shared by the group's larger structures or the remainder of the site. Several small Postclassic shrines cap many of the structures of Group D.

Thus, although small, Group D is interesting because it is unlike the other groups at Yo'okop in a number of ways. Group D lacks the large-scale structures that are known to characterize the other three groups. Although it is connected by a sacbe to the rest of the site, the group fails to conform to what appears to have been a very standard orientation of 25 degrees east of north that is shared by nearly all monumental constructions and many nonelite buildings within and outside the main architectural groups. The late date of Group D, indicated by Late Classic plaza floors capped by a robust Terminal Classic occupation and some Postclassic activity, suggests that the 25-degree east-of-north angle may be an early preference that was not continued in the later constructions at Yo'okop.

Sacbeob at Yo'okop

Yo'okop's Sacbe 1

Sacbe 1 was the first roadway at the site to be noted by outsiders, and later the first to be accurately mapped. Its eastern edge, including courses of cut stone forming the retaining wall, is fairly visible within

Group A, potentially because this edge must also serve as a terrace against the start of a more marked slope down to the aguada. The presumed western edge is adjacent to a series of undated small structures, which may actually have consumed a portion of the roadway during their construction or could have formed a more vaguely defined western side to the sacbe. Once the natural slope down to the north becomes marked, the sacbe is clearly demarcated on both edges and maintains an average elevation of around one meter above the surrounding terrain. At the base of this slope, the Early Classic Altar 1 was located atop the Terminal Classic causeway.

At a point just a few meters to the north of the altar, Sacbe 1 is currently bisected by a modern dirt road. The cut, approximately five meters wide, has done significant damage to the feature, with the intervening material being entirely removed and dispersed to augment the newer road. Following this destruction, the sacbe continues across relatively level terrain, elevated approximately fifty centimeters above the modern ground level, until it reaches Group B. Features of note along the road include a Postclassic altar placed on the sacbe, as well as another a few meters to the east on the ground surface. A collapsed sascabera has opened in the middle of the road as it nears Group B. Although this may have served as a mine for some of the construction material, it apparently predates the sacbe and must have originally had a natural or culturally constructed roof for the road to have been functional (see chap. 4).

Yo'okop's Sacbe 2

Sacbe 2 is the only roadway at the site that has yet to be accurately mapped. Chris Lloyd (2002) described it, based on his brief reconnaissance with a GPS, as being 639 meters longer than Wilson's earlier (1974) estimate of 1.16 kilometers, maintaining a fairly straight course of 22 to 23 degrees east of magnetic north. Because the road was not cleared, Lloyd was not able to locate the origin of Sacbe 2 at Group B. It appears to come directly from the north side of the North Acropolis (Structure N8W1-1), but this area was highly disturbed due to the building of substantial fortifications along the northern edge of the acropolis. Lloyd found that albarrada systems had further impacted the roadway along its southern third. Approximately halfway between Groups B and C, he describes an unusual vaulted passage through an elevated portion of the road (see chap. 4). No other

remarkable features were observed before the terminus at Group C, a solitary pyramid built upon a substantial platform.

Yo'okop's Sacbe 3

Dave Johnstone (2001b, 2002) was responsible for mapping Sacbe 3 and the residential zones on either side of its path. Running 690 meters north-northwest to south-southeast, the road connects Group A with Group D. Its height is quite variable (10 centimeters to 2 meters) because it maintains a constant grade over uneven terrain. Near Group A, outset stairs provide easy access to the roadway. They were built directly over a residential platform on the edge of Group A, indicating that the sacbe is not among the earliest constructions in the area.

The sacbe's retaining walls are composed of roughly shaped stones held together by mortar in some locations, with the lower courses being laid using large, thick stones set vertically and the upper containing smaller horizontal stones. Although the surface is largely eroded, small traces of plaster remain visible. The composition of the road can be more clearly examined in profile at the point where it is bisected by the modern dirt road. Along the causeway's course between the groups, Johnstone documented uneven concentrations of varied residential architecture, from simple foundation braces to vaulted structures. "Open" spaces were maintained through time in the areas with the deepest, moistest soil, which presumably would have been utilized for agriculture. As at Sayil (Smyth et al. 1995; Tourtellot and Sabloff 1989), soil type and geological features, rather than any attraction that a sacbe might have had, were the key considerations in locating domestic structures. The northern terminus of Sacbe 3 is at Group D, the second smallest of the site's four principal groups.

Yo'okop's Sacbe 4

Yo'okop's Sacbe 4, which never reached more than thirty meters, appears to be an unfinished roadway (Shaw et al. 2001). Approximately halfway along its length, two internal walls were built perpendicularly to the side, or retaining walls, of the road. They are spaced fifteen centimeters apart and cross the entire sacbe, connecting the retaining walls. The features are visible within the road's fill because it does not appear to have received a final coat of gravel and then sascab. Another unfinished road section lies at the eastern end of Sacbe 4. The west-

ern, more complete, portion of Sacbe 4 abuts a platform, but the causeway's eastern "terminus," a line of stones, stops approximately five meters before another platform at the same angle, which was constructed on the edge of a pyramidal structure (Shaw et al. 2001:figs. 5, 27, 29). The internal partitions of the causeway do not appear to provide structural support of any kind but clearly divide the road into segments, bolstering the hypothesis that separate labor parties of some form were used in its construction.

Other Sites in the Region

Numerous other ruins have been reported in the zone around Yo'okop, including one cluster of significant mounds (which surround a cenote) near the modern pueblo of X-cabil and a second site a few kilometers northwest of Group A. Johnstone and I visited the latter site in 1998 and observed substantial quantities of Late Formative sherds present on the surface. No water source is reported for the site. An ejido resident making a *milpa* (a slash-and-burn agricultural field) at another Formative site in the Saban ejido collected a bark-beater in excellent condition, which was photographed by Johnstone. While these loci are considered to be separate sites for reasons of distance alone, the relationship between these nearby communities and Yo'okop is not known.

In 2005, two other relatively nearby sites, San Felipe and Sisal, were recorded and tested by the CRAS project. Although significantly smaller than Yo'okop, they revealed patterning more similar to Yo'okop than any other sites in the survey area had possessed in terms of their occupation phases. Both sites began in the Middle Formative and continued through the Postclassic, without the Early Classic and Late Classic hiatus characterizing the rest of the survey area. Also, as at Yo'okop, the sites displayed elevated frequencies of southern tradewares. In future seasons, the project directors plan to focus on this dichotomy, with the hypothesis that it may represent the signature of the Petén Corridor, an inland trade route between the north and south (Harrison 1982:120–121).

A Generalized Model for Yo'okop

As described, the site of Yo'okop has a markedly different layout than that of Ichmul; however, its general plan is certainly not unique in

Mesoamerica or even within the Maya area. Utilizing ideas developed by Harris and Ullman (1945), Marcus (1983:202–206) writes that the multiple-nuclei model fits a number of Mesoamerican cities, including Altar de Sacrificios, Seibal, Tzum, and Uaxactún. Instead of being centered on a single "downtown," as at Ichmul, Yo'okop's groups each served as long-lasting foci for important economic, political, ritual, and social activities.

As Marcus (1983:204) states, these nuclei are "separate but equal" architectural clusters that are maintained through time with no single group ever emerging as the "center." Marcus questions the degree to which the nuclei duplicated functions or served the same segments of society. Present knowledge indicates that Yo'okop's groups possessed somewhat different functions (see chapter 10), with Groups A and D emphasizing elite residences and Groups B and C being dominated by architecture utilized for more ceremonial functions. Although not all of the groups appear to have been in use until the Late or Terminal Classic, the city never seems to have had one single core.

Basing her opinion on the fact that Maya regional capitals identified with emblem glyphs (Marcus 1976) seem to have a single major architectural complex at their hearts, Marcus (1983:206) argues that the multiple nuclei pattern is more characteristic of a secondary (or lower) level on the settlement hierarchy. Even though Yo'okop's Rank II classification (Velázquez Morlet et al. 1988) suggests that it would have been less important than Ichmul within the Cochuah region, Yo'okop's secondary status could have been emphasized because of its closer links to major alliance players in the southern lowlands. Johnstone (personal communication) believes that Yo'okop may have its own emblem glyph; more such glyphs are being recognized in the northern lowlands (Graña-Behrens 2006).

A Consideration of Yo'okop's Entire Sacbe System

Although only one causeway at Yo'okop, Sacbe 1, has been dated through excavation, the entire system could date to the Terminal Classic (Shaw 2005). Sacbe 2 is the least understood of the site's roads. The passageway under the road has a stepped vault that appears to date to the Early Classic, based on its architectural style (Lloyd 2002:23; Johnstone personal communication), but whether

the feature predates the sacbe or is an integral part of its construction remains unknown. Albarradas, probably colonial or more recent in date, were built over the road using the sacbe as a source for material. Based on this evidence, a Terminal Classic date is possible for Sacbe 2, but the feature could be as early as the Early Classic or as late as the Postclassic. Sacbe 3 appears to be Terminal Classic in that it connects Group A to Group D, whose principal occupation was during this period. Sacbe 4 was also probably built late in the site's history, given its unfinished condition.

The plan of Yo'okop's roads could be described in several different manners. When the traditional "site" is considered (Groups A, B, and D and the immediately surrounding area), the scheme appears to be rather radial (see chap. 6), emanating from Group A, which is the highest point in the surrounding landscape. However, when Sacbe 2 is included, the picture changes. This 1.8-kilometer extension of the system results in an appearance that is much more linear, like that of Sayil (Tourtellot and Sabloff 1994; Tourtellot et al. 1992). Sacbe 3 would then be a deviation from the lineal plan in form, but it is less anomalous in concept, as it still maintains the idea that relatively equivalent architectural groups are linked to each other. Although the current geography, topographic relief, and history of exploration have caused archaeologists to consider Group A to be the core of the site, thinking about multiple cores—varying in importance through time and each considered to be significant enough to connect into the road system—seems potentially more accurate.

Looked at another way, however, it may have been the site's only significant water source that was the target of the desire to connect to the zone around Group A. Group D is closer to Group B than it is to Group A; if a simple connection from Group D to another major group was the goal, a roadway ought to have linked Groups B and D. Instead, Group D is linked to the more distant Group A. Thus, rather than being a linear system with a "kink" in its end to Group D, Yo'okop's roadways may be a variant of a radial system.

4

The Sacbe Constructed

Using any single term such as *sacbe*, *causeway*, or *road* to describe this class of features belies the variability that exists in sacbe construction techniques and forms. These differences are particularly evident when examples from throughout the Maya area, not just Ichmul and Yo'okop, are considered. While the most obvious and most frequently recorded formal difference is that of length, variability in width, height, and composition also exist as the result of a number of construction techniques. Also, the roadways have been modified, added to, or designed in conjunction with assorted elements, which differ from place to place. Some of the distinctions between sacbeob are certainly the result of varied preservation and available building materials, while other aspects of diversity may relate to function (see chaps. 5 and 6). Before the factors that condition this variability may be understood, however, it is important to first explore the nature of sacbeob.

Construction Methods

According to ethnographic and archaeological sources (Folan 1977a:40; Redfield and Villa Rojas 1962:30), the path of a sacbe would initially have been laid out by positioning vertical posts in a straight line starting from an elevated point. In the case of the pueblo of Chan Kom (Redfield and Villa Rojas 1962:30), a tower reported to be fifty feet high was constructed to provide a view of the desired terminus for a roadway, the Castillo of Chichén Itzá. Following this, a brecha was to have been cut in the path of the intended road. Because many ancient Maya sacbeob were utilized to connect monumental architecture, it would have been relatively simple to stand on either of the termini and assess the progress of the road construction, as appears

to have been the case at Ichmul. Likewise, with some vegetation clearance, workers on the ground would have been able to see their architectural goal in the distance. Historically, a similar process was used to construct many of the main roads in the northern Yucatán, which run in straight lines between churches (personal observation).

The construction of a sacbe has been likened to the erection of a long, extended platform (Kurjack 1977:223; Kurjack and Garza Terrazona 1981:301). Following the layout of its course, the building of the sacbe generally started with the placement of dry-laid retaining walls, designed to contain the various elements of interior fill. These retaining walls might be composed of cut or uncut stones, with cut stones being more common in public spaces (Shaw et al. 2000, 2001, 2003). The fill included large, uncut boulders, grading to *chich* (cobbles and gravel) and sascab, which were mined from nearby locations (Folan 1977a:40, 1982, 1991:222; Villa Rojas 1934:193) (fig. 19). After placement of the sascab layer, water was added to make a firm surface. Lime plaster, in addition to sascab, provided an impermeable surface in some examples (Thompson 1928:40–44). The multiple sascab surfaces detected on some causeways suggest that the roadways were subject to frequent resurfacings. At Nakbe, Calzada Kan saw at least three construction episodes between the Middle and Late Formative (Suasnávar 1994:336); at Yaxuná, Sacbe 3 similarly included Late Formative, Early Classic, and Terminal Classic modifications (Johnstone 1994). At Cobá, a row of flat rocks was placed over a level of sascab to further elevate the sacbe in a line down its center (Folan 1977a:40, 1991:222). Whether this added feature was Prehispanic or of more recent origin, however, is unclear.

While many excavated and observed sacbeob fit the above description, there are numerous exceptions, generally based on the types of locally available building materials. At Calakmul, packed earth formed the interior of some sacbeob (Folan 1991:222), while tamped earth and oyster shell substituted in the Río San Pedro and San Pablo portions of Tabasco (Vargas Pacheco 1985:102). Carrasco Vargas (1993:201) also describes how the form of sacbeob varies within a particular roadway. The Uxmal–Nohpat–Kabah road is reduced to a scattering of stones, probably accompanied by vegetation clearing, in *bajos* (low lying, seasonally flooded) that are primarily soil. In zones where more stones are abundant, this same roadway becomes well elevated with ramps and stairs.

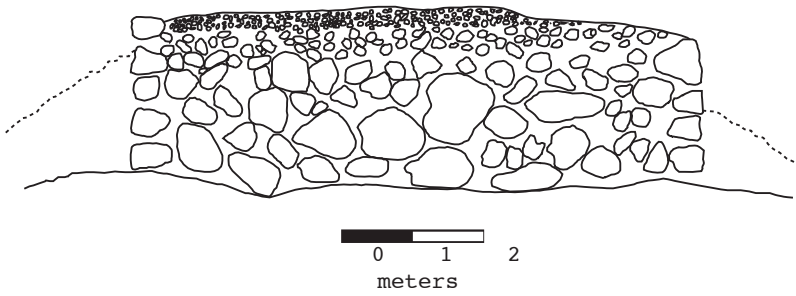

Figure 19. Cross section of Yo'okop's Sacbe 3. (Redrawn by Justine M. Shaw from original illustration by Dave Johnstone)

At Muyil, Witschey (1993:182–183) describes four different construction styles combining the basic elements described above. Muyil's Sacbe 2 consisted of a double line of unworked stones twenty-five to forty centimeters in diameter. Witschey believes that, although the area between these stones was near the level of the surrounding terrain, the interior of the roadway had originally been filled with packed earth, which subsequently eroded. Muyil's Sacbe 3 was made completely of unworked stone, which may have initially had chich and plaster on top. A third technique, exemplified in Sacbe 1, had upright slabs of uncut limestone forming retaining walls with additional large, unmodified slabs placed horizontally in the interior. These also would have been covered with chich and plaster. Finally, Muyil's Sacbe 5 and Sacbe 6 were built strictly as paved walks made of a single layer of unworked stones.

Cobos (2003:224) has found that two different systems were used to construct the sixty-nine causeways identified at Chichén Itzá. The first followed the most common type of building materials and methods, with the end result being an extended platform elevated above the surrounding terrain. The second, seen in Causeways 6, 15, 32, and 52, utilized one or two rows of small stones (forty to fifty centimeters or less) to line both sides of the roadway, with the interior filled with red soil.

Likewise, Freidel and Sabloff (1984:79) point out that the sacbeob of Cozumel vary in construction technique, sometimes lacking retaining walls and being built of layers of large slabs. According to Lish (1974:35, fig. 3), the causeway at the Belizean site of Big Laugh was

capped only with limestone cobbles, with a continuous row of uncut stones serving as a retaining wall on either edge; as these sidewalls extend well above the interior cobble layer and there is no evidence of a cap of any kind over the stones, it may be that the unusual roadway was never completed.

The building and maintenance of sacbeob are believed to have taken place using corvée labor crews (Folan 1977a:40), potentially similar to the historic *fagina* (compulsory labor) system of the Yucatán in which adult males made compulsory labor contributions to sacred and secular projects at the discretion of community leaders (Redfield 1941:176–180; Redfield and Villa Rojas 1962 [1934]:30; Villa Rojas 1945:75–76). Arguments for a corvée system are strengthened by evidence from unfinished causeways, which bear indications of division into segments that were completed as separate tasks (although these could have doubled as, or have instead been, construction pens for structural support). Cobá's unfinished Sacbe 26 is an excellent example of this situation, with only some sections of one stretch being completed. Incomplete spaces remain between the portions of completed roadbed (Bolles and Folan 2001:307, 309). Reid (1995:127) reports similar seven- and thirteen-meter breaks in the Naranjal–San Cosmé sacbe. Yo'okop's Sacbe 4 (see chap. 3) also appears to have been unfinished, and construction boxes are visible in portions of the Ichmul system (see chap. 2), providing additional evidence supporting this type of labor system.

Sacbe Courses

Most sacbeob, regardless of construction material, maintain a straight line with few, if any, angle changes. Following basic geometric principles, they seek to connect two points in the shortest distance, therefore using the least effort and cost, by maintaining a true course (this may also be related to symbolic functions; see chap. 7). The roads of Ichmul and Yo'okop all seem to follow these principles, without angle changes, although the former system appears to contain branches.

However, a number of sacbeob do not follow this prescription. One explanation may, of course, be human error. Another reason for angle adjustments may have been that the goals of the road construction included connecting multiple locations along a route. Finally, technical reasons may have occasionally called for shifts, as when large natural

or cultural obstacles, such as cenotes, rejolladas, bajos, or major constructed features were positioned in the prospective path.

Determining which of the three conditions was responsible for angle changes could be achieved by excavating locations at the angle changes in question. If significant occupations at these points predate the sacbe, their existence is likely to be a reason for the angle change. Equally, if the materials postdate the sacbe, potentially as a result of settlement attracted by the road itself, then the course may have been shifted by human error. Observation of substantial natural obstacles that predate the sacbe in association with an angle change, or dating of cultural deposits that appear to be responsible for an angle change to a time prior to the roadway, would indicate the third scenario of angle adjustment for avoidance purposes. At Calakmul, some roads change angles to circumvent bajos (Folan et al. 1995a:277), while others cut directly through these seasonally swampy areas (Folan et al. 1995b:313, 2001b:294–296).

Evidence from Ichmul (Flores Colin and Normark 2004a) and Yo'okop (Shaw et al. 2001) indicates that, even when features of moderate size lie in the projected path of a sacbe, every effort was made to maintain the same line, even to the point of covering earlier constructions. Sacbeob associated with both sites contain collapsed sascaberas and earlier structures in the middle of their courses. The features apparently predate the roadways and were covered by their construction. Rather than filling in the sascaberas, though, the cavities appear to have been roofed by perishable materials no longer present or by previously existing thin cap-rock layers that have collapsed (Flores Colin and Normark 2004a:88; Shaw et al. 2000:43). Cobos and Winemiller (2001:285) report similar surface collapses along the course of Causeway 15 at Chichén Itzá. At Mayapán, however, an angle change was apparently made to avoid a sizeable sinkhole (Pollock 1954:543).

The longest well-documented sacbe in the Maya area, connecting Cobá and Yaxuná, includes six direction changes, according to Villa Rojas' (1934:199–200, 206) survey. Although no excavations have taken place at these points, Villa Rojas believes that the Prehispanic settlements evidenced at each of the corresponding locales predate the sacbe, with the road's course having been altered slightly to connect multiple smaller sites in addition to the two major centers. Shaw (1997:30) found that, near Yaxuná, this sacbe's edge was curved gently around at least one apparently preexisting structure rather than

having been built over the structure, as was done in other cases along the same road. However, natural hillocks and depressions did not appear to have been avoided (Shaw 1998). The Cobá–Ixil Sacbe similarly exhibits course changes associated with architecture (Robles Castellanos 1976:34). Copán contains a sacbe in its center with a more gradual curve that connects multiple loci (Fash 1991:155). The Uxmal–Nohpat–Kabah roadway also exhibits a bend in its plan, thus connecting a number of sites (Carrasco Vargas 1993:fig. 1). Xunantunich's Sacbe I has a marked 90-degree-angle change from east to south, with another more minor jog slightly eastward before it arrives at its destination (LeCount et al. 2002:fig. 2).

Maldonado Cárdenas (1995:72) writes that angle changes in the Izamal–Aké Sacbe are the result of construction phases related to the size of Izamal's hegemony. The roadway was first extended to Kantunil, 15.5 kilometers to the south. Later, the feature was extended to Sitpach, tying into the preexisting Aké–Sitpach causeway.

Other settlements appear to have utilized branches, rather than angle changes, to directly connect more places with sacbeob. Examples of systems including branches include Calakmul (Folan et al. 2001b:296), Caracol (Chase and Chase 2001:274–275), Chichén Itzá (Cobos and Winemiller 2001:284–287), and possibly Ichmul (Flores Colin and Normark 2004a:81). Chase and Chase (2001:277) also describe smaller *vías* (relatively narrow, elevated walkways) connecting residential groups to causeways. Similar features are found at Copán, connecting the Sepulturas sacbe with residential compounds (Fash 1983:283; Willey et al. 1978).

Sacbe Dimensions

Although length is the most obvious and most frequently reported difference, carefully cleared and mapped causeways also reveal marked differences in height and width. Such differences may relate to function (see chap. 7), as well as the resources available at the time of the road's construction. At Calakmul, widths vary from 2.7 meters (Sacbe 13) to 15 meters (Sacbe 10), with heights ranging from about 30 centimeters (Sacbeob 13 and 14) to 1.5 meters (portions of Sacbe 3) (Folan et al. 2001b:294–297). Here, as at other sites, a single road's elevation varies along its path: Calakmul's sacbeob are elevated as they cross swampy land (Folan et al. 1995a:279), as is the Naranjal–San

Cosmé sacbe, which averages 1 meter in height (Reid 1995:124). The sacbeob of Cobá also vary, with widths from 1 meter (Sacbe 42) to 20 meters (Sacbe 9) and heights of 30 centimeters (Sacbeob 41 and 42) to 2.5 meters (portions of Sacbe 1 to Yaxuná, Sacbe 17 to Ixil, and Sacbe 24) (Benavides Castillo 1981:76–144, 148, cuadro 1; Folan 1977a:34; Folan and Stuart 1983:24–25; Villa Rojas 1934:201). Yo'okop's roadways that have been mapped in detail (Shaw et al. 2000:43, 2001:34; see chap. 3) and the larger three roadways of Ichmul (Flores Colin and Normark 2004a; see chap. 2) fall within the above ranges, while the sacbeob of Aké are generally lower and narrower than the average roadways at other sites (Roys and Shook 1966:45). The sacbeob of Caracol, which have been more thoroughly mapped than the roads at many other settlements, generally fall into three size ranges—2.5–4.5 meters, 5–8 meters, and 9–12 meters in width, with heights from ground level up to 3 meters—and the earth being removed to form a sunken sacbe in some cases (Chase and Chase 2001:273). Recent mapping efforts at Chichén Itzá (Cobos 2003:207–260) have revealed that whereas some causeways are so insubstantial that they have been covered in sections by relatively minimal accumulations of sediment (20 to 50 centimeters), others measure more than a meter in height. In general, the heights and widths of sacbeob tend to be fairly proportional, with higher roads being generally wider (and the converse, lower roads being generally narrower). A trait that most roadways share in terms of their height is that, with respect to the ground level, the elevation of the roadbed does vary. However, this is to maintain a fairly constant grade throughout the course of the road, with height above ground being less of a concern (fig. 20).

Accurate recording of the varying height, width, and composition of a given sacbe requires a significant investment of time and resources so that the feature can be thoroughly cleared and mapped for a substantial portion of its length. For this reason, these data are not available for the majority of the roadways in the Maya area. However, the length of a sacbe is much more likely to be recorded because this characteristic can be readily assessed for the average causeway running a straight course between two points. Cobá, noted for its extensive sacbe network, currently appears to possess roadways at both extremes of length (Sacbe 41 at six meters long and Sacbe 1 to Yaxuná at one hundred kilometers long; Benavides Castillo 1981:76–144, 148, cuadro 1). All other sacbeob currently recorded fall somewhere

Figure 20. Yo'okop's Sacbe 3. (Photo by Justine M. Shaw)

along a continuum between these extremes (Shaw 2001:265–267; see appendix), although Mathews and others (Fedick et al. 1995; Mathews 1998, 2000) have recently recorded portions of a potentially longer regional road system running from Ichcantiho (Mérida) to Puerto Morelos. Romanov (1973:69–77) similarly collected evidence of such a sacbe, and an earlier account by Bennett (1930) reviews ethnohistoric accounts concerning varying components of what might have been a three-hundred-kilometer roadway.

Features Associated with Sacbeob

Several cultural and natural features are associated with Maya causeways with some regularity. Some of these are a consequence of the need for construction and maintenance supplies along the road's course; others are features added to the road to enhance its functions; and a third set derives from the sacbe's ability to attract activity and settlement. Alternately, some features may have existed before the road and could be the reason for the sacbe's existence and given course.

Road Building and Maintenance

To ensure a supply of rock for the construction of the raised roadways and transportation of the material using minimal effort, quarries and sascaberas located quite close to the sacbe were often utilized. At Chichén Itzá (Cobos and Winemiller 2001:285, 289), Ichmul (Flores Colin and Normark 2004a:73, 84, 88), Yaxuná (Shaw 1997:31, 1998:121), El Naranjal (Reid 1995:122), and Yo'okop (Shaw et al. 2001:43), sascaberas and stone quarries are common along the course of causeways, as well as in other locations around the sites. Villa Rojas (1934:201–202) similarly reports the presence of both sascaberas and stone quarries, including unused cut stone, close to the Cobá–Yaxuná Sacbe. Folan (1978:80, 1982:150–163) states that at least seventy-nine sascaberas have been documented at Cobá, with many found in association with sacbeob. He describes both open-pit and tunneled sascab mines at the site (Folan 1978:80–82). Most of the large sascaberas at Cobá contain wells, which Folan believes would have supplied the miners, as well as nearby residences and gardens, with water. Scars left in mines that have not been used in historic or modern times suggest that hafted stone tools were used to mine sascab, while finer tools analogous to chisels and gouges were used for pillars and finer work (Folan 1978:83).

Approximately one-third of the distance from Yaxuná to Cobá, Villa Rojas (1934:199, 206; Bustillos Carillo 1964:16) located another more unusual type of feature potentially used for the building and maintenance of the road. What appears to be a solid stone roller, measuring four meters long and seventy centimeters in diameter and weighing an estimated five tons, was observed resting atop the sacbe. Today, the roller has been removed from this context; it resides in front of a business on the old road from Mérida to Uman (Dave Johnstone, personal communication). Although the roller might be an architectural element, such as a column from a structure, Villa Rojas does not mention a likely candidate in the vicinity. If the artifact is indeed a roller, then Villa Rojas may be correct in his assessment that this is consistent with a sascab surface (which would need to be compacted as a part of construction and resurfacing), rather than some type of lime plaster, mortar, or cement. However, these latter road surfaces might have required a sascab base, not meant to be exposed once the sacbe was finished. The rarity of the stone roller may be due to the fact that perishable materials, such as the trunk of a large tree, would have made a viable substitute for a stone roller.

Presumably, without beasts of burden, any kind of roller would have been pushed by human laborers, a substantial undertaking regardless of the material used for the roller.

Features Added to Sacbeob to Augment Their Function

Ramps, steps, pedestrian passageways, portal vaults, forks, and cross road features are present on some roads, presumably as means to augment sacbe functions. The latter two terms describe conditions in which two or more roads cross or join, termed a *xay be* (fork in the road) or *hol can be* (crossroads), which are related to the terms *hol can heleb* and *hol can lub* (resting place at the crossroads) according to Bolles and Folan (2001:306). These unions are not additional features in the sense of being a different feature class, as they actually refer to cases in which the courses of two or more roads intersected or became one. The sacbeob of Cobá include multiple examples of such junctions (Bolles and Folan 2001:306, figs. 2 and 7; Folan 1992a:338). Similarly, Cobos and Winemiller (2001:288–289, fig. 5) and Chase and Chase (1987, 2001:276–277, fig. 2; Chase et al. 1990) have revealed that Chichén Itzá's and Caracol's causeways contain many such branches and crossroads as a means to connect a multitude of terminal architectural groups, and even separate sites, with a more well-defined site core. Even sites with less-complex systems may contain branches, when connecting a second terminus area with the site core becomes important.

Ramps, steps, and pedestrian passageways are utilitarian features added to some roads, with the latter being, apparently, quite rare. Ramps have been noted as a part of the Cobá–Yaxuná Sacbe (Villa Rojas 1934:200), including one located at its Yaxuná terminus at an Early Classic residence (Shaw 1998), as well as in other non-Maya road systems of Mesoamerica (Hirth 1982:323). Interestingly, the Cobá–Ixil roadway, which has been described as a shorter version of the one to Yaxuná, duplicates many of the latter's features, including large and small ramps along the length of its twenty-kilometer course (Bolles and Folan 2001:301, 304; Folan 1977a; Robles Castellanos 1976:34, 37). At Cobá, four-way ramps are also used as part of crossroads features (Folan 1991:223, 1992a:336, 338), while for the Uxmal–Nohpat–Kabah roadway, ramps and stairs were used as a means to permit passage when the road's elevation changed markedly (Carrasco Vargas 1993:201). Steps have been found in association with the

Ichmul–Xquerol Sacbe, providing a means of entry along the road's edge (Shaw et al. 2003), as well as along portions of Dzibilchaltún's Sacbeob 2 and 5 (Uriarte Torres 2005). Witschey (1993:184) points out that at both Muyil and Cobá, arches were used to link two causeways. An arch is also found at the sacbe terminus at Kabah.

At Yo'okop, a more unusual feature of a vaulted passage was recorded under Sacbe 2 (Lloyd 2002:23, fig. 10). The feature appears to be a pedestrian passage permitting access between the zones on either side of the roadway at a point where the surface of the sacbe is quite high above the ground surface. Unfortunately, in the brief reconnaissance conducted, and without excavation, it was impossible to discern whether the passage was built as an integral part of Sacbe 2 or whether it had been a preexisting structure engulfed by the road. In addition to permitting individuals to pass between the two areas, the passage may be related to water management. Saville (1935:72) writes about seemingly similar passages on a road from Cobá to a site called Kucican to its south, saying that the sacbe possessed an elevation of six to seven meters in some places, which would have necessitated a means to cross its path. Such passages and extreme heights were not reported by later researchers in the course of mapping the site's road system, however.

At El Mirador, which receives a greater seasonal excess of water than Cobá or Yo'okop, there are breaks in four major causeways that appear to be designed to allow water to pass between higher and lower topography (Dahlin 1984; Scarborough 1993:31, 2003:113). To permit travel on the road surface, perishable bridges presumably would have crossed these breaks.

Finally, some sacbeob are associated with portal vaults, which may have served to emphasize the start or terminus of particular roadways. Cobos (2003:220–224, 244) describes several such features associated with causeways (Causeways 5, 11, 25, 26, and 61) at Chichén Itzá. Flagstone pavements have also been located in the vicinity of these portal vaults. The flagstone pavement areas, a Terminal Classic phenomenon, are further associated with termini at major stairways and gates (Causeways 12, 15, and 33).

Other Features Added after Sacbe Construction

A third category of elements associated with Maya roadways includes features that appear to have been erected following the construction

of the roadway. This class of features includes possible distance markers, inscribed stones, altars (features too small to be entered or round tablelike stones that were used for religious rituals, often involving burning copal in an *incensario* [incense burner] in the Postclassic; see Lorenzen 1999), shrines, adjacent structures, storage facilities, and defensive constructions. When roads are within urban centers, it may be difficult to discern whether or not a given feature's location is actually conditioned by the presence of a sacbe, or whether the element is present because of other construction or activity in the vicinity. However, a study of longer-distance roadways, farther from urban cores, clarifies that certain items were likely associated with sacbeob. Villa Rojas' (1934:197, 205) description of the Cobá–Yaxuná Sacbe includes *mojoneras* (distance markers or boundary stones) beginning at eight kilometers from Yaxuná, as one moves eastward. There was no way to directly date the stones, but Villa Rojas points out that, from at least the fifteenth century onward, the road served as an important boundary, dividing lands between the Cochuahes and Cupules and more recently the villages of Tekom and Dzitnup. Similarly, he makes an association between the sacbe and inscribed monuments, with monuments appearing at Kilometer 85 onward as he approached Cobá (Villa Rojas 1934:200, 206–207). Dzibilchaltún's roadways, too, are associated with stelae, on separate nearby platforms as well as on the causeways (Andrews and Andrews 1980:232–240). If these and other sacbeob were regularly utilized for transportation to and within the urban cores of Cobá, Dzibilchaltún, and other sites, inscribed monuments could be likened to billboards along the highway, which increase as one approaches a modern city in many Western countries.

Altars along or on top of sacbeob appear to fall into two categories: those built during a road's prime (when it would have been actively maintained and used by one or more sites) and those added at a later time. Such additions generally occurred sometime during the Postclassic, in the manner of the small altars and shrines that came to frequent many sites in the Maya lowlands after they had been largely abandoned (Andrews 1981; Shaw et al. 2001, 2003). When altars were placed directly on a roadway such that they would have impeded both maintenance and regular traffic, as seen in examples from Yaxuná (Shaw 1997:30; Suhler 1990:7) and Yo'okop (Shaw et al. 2000:fig. 5), they are in the latter category. Other altars that appear at a destination or along the road could be in either class; comparing the relative or absolute dates of the two features would be necessary to sort out

their chronological relationship. Witschey (1993:185) mentions an altar at Xelha that is present at Sacbe 3's terminus at an inlet—an example of an altar with an ambiguous relationship to a roadway. Finding altars in association with active roadways should not be terribly surprising, however, in light of statements (Piña Chan 1978:44; Tozzer 1966 [1941]:95, 107) that, historically, merchants were expected to burn copal by a roadside altar to Xaman Ek, their protector, and rites were carried out in honor of Ek Chuah, the god of merchants and travelers, before an individual went on a journey.

Quite a variety of structures can be found adjacent to Maya sacbeob (Villa Rojas 1934:206). Freidel and Sabloff (1984:79–84) note that on Cozumel Island there is a clear association between sacbeob and shrines (in this case, referring to small Postclassic temples generally large enough to be entered but small enough that one must crouch or hunch over to do so). The sacbe system of Cozumel, in fact, seems to have been established with the principal aim of connecting these locations. They would have been utilized for ritual processions, with intersite sacbeob being used as pilgrimage routes (see chap. 7). At other sites, where roads converge and along the course of long causeways, resting places may be found. The junction of Sacbe 8 and Sacbe 13 at Cobá contains a possible resting place, at present existing only as a large, flat stone, that could be called a *hol can heleb* and *hol can lub* (Bolles and Folan 2001:306). Villa Rojas (1934:205–206) describes isolated platforms along the Cobá–Yaxuná Sacbe, which he believes may have served as spots for rest and religious devotion. In addition to residences, the Cobá–Ixil road also has platforms along its course (Robles Castellanos 1976:35) that may have served similar purposes. Piña Chan (1978) notes that there were lodgings run by "innkeepers" along roads used by merchants.

Structures built along causeways, particularly when found in association with valuable resources or boundary areas, might have also served administrative functions. Chase and Chase (2001:277) write that, at Caracol, one reservoir along a causeway is guarded by two small buildings that could have served as check or control points. Along the Uxmal–Nohpat–Kabah roadway, grain storage features associated with concentrations of metates are found along the road (Carrasco Vargas 1993:204). At Dzibilchaltún, recent excavations have explored the structures associated with Sacbe 2 and Sacbe 5, finding that not only platforms but also several burials were placed

in direct association with the roadways (Coyoc Ramírez and Uriarte Torres 2003; Uriarte Torres 2005).

While road-based surveys (e.g., Robles Castellanos 1976; Villa Rojas 1934) may make it appear that causeways are lined with constructions at a much higher density than other parts of the site, this is not always the case. Sacbeob are potentially attractive features, but their function(s) may not have always encouraged settlement in their immediate vicinity if road access was restricted or privacy and security valued more than travel convenience. Also, dozens of other considerations (such as soil type; Smyth et al. 1995) conditioned where a residence might be constructed. At Yaxuná, a mapped transect along Sacbe 1 to Cobá did not yield higher architectural densities than similar transects to the north and south of the site, despite the fact that the Late Classic road existed during one of the more active building booms in the site's history, the Terminal Classic (Shaw 1997, 1998). Similar results were found along Yo'okop's internal Sacbe 1 and Sacbe 3 (Johnstone 2001a, 2002; Shaw et al. 2000), as well as along the roadways of Cobá (Kintz 1983:fig. 12.1). Likewise, Jaeger Liepens (1994:59), in her survey of the settlement zone around Caracol's Conchita Causeway, found that there was not "any clear relationship among the siting of groups with respect to the Conchita causeway."

Defensive features have been found in association with a number of roads in the Maya area. One of the primary reasons for this is that the body of the feature provides ample building material that can be readily removed from a dry-laid core and sidewalls. Therefore, the fortifications may not have any temporal relationship with the causeway and must be independently dated, a challenging proposition. The Cobá–Yaxuná Sacbe contains a series of ramparts between Kilometer 17 and Kilometer 97 (measured from Yaxuná to Cobá), some of which extend far past the width of the road (Villa Rojas 1934:198, 205). As this area involved active Caste War battles (Rugeley 1996), and similar fortifications are found at other Classic Maya sites that offer supplies of ready building material (Shaw et al. 2003, 2004), these ramparts may be relatively recent in date. Alternately, the region served repeatedly as a battleground in the past (Manahan et al. 1997), and the defenses could actually have been constructed during the time when Yaxuná, Yo'okop, Chichén Itzá, Cobá, and other nearby contemporaneous sites were still occupied. Defensive walls associated with

roadways at Aké (Dahlin 2000:290), Chunchucmil (Dahlin 2000:286–288; Dahlin and Ardren 2002:267), Cuca (Garza Terrazona and Kurjack 1980), and Ek Balam (Bey et al. 1997; Ringle et al. 2004) are contemporaneous with at least a portion of the occupation at each site. Rather than representing a sacbe-specific phenomenon, however, their presence is better understood as being conditioned by the presence of raw building materials (Dahlin 2000:287). Structures and features at these sites were similarly dismantled to permit the obtaining of stone rapidly, as occurred at Ichmul during the Caste War.

Preexisting Natural Features

Although there is a potentially infinite list of features that may predate the construction of a sacbe through an area, certain elements may have been important enough to the builders of a road to help influence the road's course. Structures, particularly when monumental in scale, and special natural features, such as water sources and caves, appear to have been sufficiently significant to direct or redirect the building of a roadway at some sites. As most sacbeob connect architectural groups, or even separate sites, these are not discussed here. Instead, the latter category of special natural features is addressed.

Numerous researchers have remarked upon the fact that causeways pass close to or terminate at water features. This is not terribly surprising, as there is a clear association between settlement and water sources (Kurjack 2004). Cuca's sacbe passes by a cenote that provided water for the inhabitants of the site (Garza Terrazona and Kurjack 1980); at Chichén Itzá, Causeway 1 leads to the Sacred Cenote (Cobos and Winemiller 2001:fig. 5). At T'isil, a road led from the outskirts of the site to the cenote at its core (Fedick and Mathews 2005), and at El Naranjal, a sacbe terminated at the edge of a wetland (Reid 1995:122). On Cozumel, at Aguada Grande, there are two sacbe segments that run through a seasonally flooded aguada (Freidel and Leventhal 1975:68–69, fig. 10; Freidel and Sabloff 1984:84). Rather than being isolated accidents, this association may be part of a deliberate pattern; Folan (1992a:341–343) writes that Ix Zacbeliz, the grandmother of the Maya deity associated with rain (Chac), is said to live on a white road. He reports that at Cobá, the internal sacbe system evidences a strong association between road and water source. Robles Castellanos (1976:34) and Villa Rojas (1934) similarly believe

that the two longest roadways from Cobá are associated with water sources. At Caracol, reservoirs are often situated on one side of a causeway (Chase and Chase 2001:277). This association is also seen at the small site of X-ual-canil, at which the Lahkin Sacbe and Zuhuy Ha reservoir are located in close proximity.

In addition to their possible symbolic meaning, the roads themselves may be a part of the water capture and storage system here and elsewhere (Scarborough 1993, 1998; see chap. 7). At Cobá (Folan 1991:222), culverts to permit the passage of water from one side of a causeway to another have been documented. In addition to its probable pedestrian function, the passage described at Yo'okop (Lloyd 2002) may have served this purpose. However, according to Bustillos Carillo (1964:15–16, 26), there was an intentional association between roads and water to ensure that travelers would not die from thirst during their journey. Most roads may not have been long enough to cause this eventuality, but travelers along any expanse of open road would have been glad of refreshment. Additionally, water would have been useful for maintaining the causeway surface.

In a few cases, sacbeob have been found to be directly associated with caves. The Western Belize Regional Cave Project has found that Aktun Nak Beh is connected to the core of the site of Cahal Uitz Na by a 780-meter causeway (Walker 2000). Interestingly, in addition to its terminus at Chichén Itzá's Sacred Cenote, Sacbe 1 also leads to the Castillo, which was recently found to have a cavernlike feature to its east (Desmond and Sauck 1997). Likewise, the site's Sacbe 15 is associated with the Cenote Xtoloc, which has a cave nearby, and Sacbe 4 passes near the Osario, from which a natural cave could be accessed (Skidmore 2004).

As is discussed in chapter 5, the myriad of natural and cultural features associated with sacbeob, as well as their variable composition, reflects not an absence of patterns but a complex web of interrelated function and meaning. Teasing significance from this requires a careful consideration of each of the components described here, as well as their larger archaeological and cultural contexts.

5

Types of Sacbeob

With any consideration of "types," the purpose of the system should be designated prior to the design and implementation of the typology. If the archaeologist's goal is strictly to devise a means of organizing variability for her or his own analytical purposes, then the only real consideration is whether or not the system is a useful tool suited to the purposes of the practitioner (Ford 1954); the categories of the system are "heuristic devices and nothing more" (Dunnell 1971:47). However, if the researcher intends to imply that the typology is in any way emic, there needs to be some manner in which to test the hypothesis that the types had some meaning for the culture to which they are being applied. If types had cultural meaning, then they would be discovered rather than created (Spaulding 1960). At the same time, of course, the archaeologist's choice of adopting such a typology should still be governed by its utility for a particular purpose.

In this study, an effort is made to explore both emic and etic classification systems. The aim in this examination is not to arrive at any sort of reality in terms of ancient Maya conceptions of their world. Instead, varied classification systems are investigated as a means of presenting diverse tools that may be helpful in teasing patterning out of the archaeological record, particularly with respect to the Cochuah region's sacbeob.

Intrasite and Intersite Sacbeob

The traditional, and most common, means of classifying roadways into types has been with reference to two basic categories: intrasite and intersite sacbeob. The former is generally used for causeways that travel a relatively short distance and remain within a zone of

moderately dense, continuous constructions that archaeologists have deemed a single site. In contrast, the latter class of features leaves this "site" and carries on through a zone of lower-density occupation to arrive at another "site," which is recognized by a resumption of nucleated, usually larger-scale, structures. In some cases, the implication is that intersite causeways connect centers that were politically distinct at one point in time. While the intersite/intrasite division is reasonably straightforward in concept, other typologies might better reflect the complexity of this highly variable feature class.

Types Based on Language

In an attempt to provide a more emic means of classifying Maya roadways, several researchers have explored a number of different road-related terms used by historic and modern Maya peoples. The idea behind such examinations is that, where different words exist, distinct mental categories have been created. Just as the English-language terms *highway*, *alley*, *avenue*, and *boulevard* can be substituted to give a more precise meaning than *road*, more-specific Maya terms indicate that *sacbe* may be only the general term archaeologists use for what the Maya saw as feature categories related to differences in form and function.

One of the first individuals to focus specifically on sacbe-associated Mayan language terms was Bustillos Carillo (1964:19), who describes five different types of sacbeob. Wide, primary roads cut into the forest for the extraction of building materials are termed *nohbé*. Lacking stone components so that heavy materials could be moved using rollers, such features would be nearly impossible to distinguish archaeologically. Local roads within a town are called *luluthbé*. *Bokol-bokbé* are roadways that contain stone and are therefore preferred during the rainy season. Short, straight roads are *tohbé*, and *colbé* refers to the winding footpaths used to reach the scattered milpas dispersed in the vicinity of Maya villages. Although applicable to recent constructions, the system does not take into account the types of roadways constructed in the past that often involved labor investment on a monumental scale to produce elevated causeways (see chap. 4).

Bolles and Folan (2001) have produced a very thorough review of historic documents that provides greater promise of applicability to the archaeological record. Although the sources that they utilized in

the study are not contemporaneous with the Classic Maya sacbeob that are the primary subject of this volume, they called upon a variety of resources, including contact-period dictionaries and accounts, that are less temporally distant than a system based strictly on modern Yucatec Maya. Their study includes some of the same terminology as that of Bustillos Carillo (1964). However, their sources provide somewhat different definitions that are potentially more similar to precontact meanings (Bolles and Folan 2001:table 1). *Noh be*, still literally translated as "big road," is also defined as *calzada* or *camino real* in their sources. The roadway said to once connect Ichcantiho (Mérida) with Izamal would be an example of such a sacbe. *Luluth be* or *luth be*, also present in Bustillos Carillo's work, is here designated to be a pathway that has not been cleaned of impediments, forcing the user to leap or trot.

A number of other roadway types reported by Bolles and Folan (2001) are not reported by Bustillos Carillo. *Chibal be*, a main road from which other smaller roads branch out, is one such type. Literally translating as "lineage road," it appears to have had kinship associations in terms of its construction or the locations that it connects (Folan 1975; Folan and Stuart 1977). A stone-filled sacbe, potentially for crossing wet terrain, is termed *buth*, *buth be*, or *buthbil be*. The road from Cobá to Ixil and some of the roads from Calakmul that lead through seasonal marshes are potentially examples of such a road. Another alternative to calzada, *be tun* is a more generic term meaning "stone road." Some further distinctions include *cochbaben be* ("wide road"), which may refer to the wide, yet relatively short, internal concourses at Dzibilchaltún, Tikal, and Caracol. *Haban be* ("bush road"), *thulthul be* ("narrow road"), *ek be* ("dark road," closed in by vegetation), and *chux be* ("narrow road") refer to more-minor roads that could have been raised stone paths or merely cleared brechas. Bolles and Folan (2001:304) point out that the term *zac be* became the single preferred term in the late nineteenth century, possibly by mere chance, and it should not be assumed to have ever served as a primary term used by the ancient Maya to refer to the feature class as a whole.

In general, the above types may be said to represent both formal and functional characteristics. As presently defined, they are not particularly specific with respect to construction method. A presence or absence of stone is noted, and width (rather than length) is generally described. Additionally, several categories that would leave little to no

archaeological trace are referred to by terms that indicate they are considered to be a type of road. Thus, while the above-mentioned, Mayan-language-based terms are potentially more likely to reflect an emic typology during the historic period, it would be difficult for archaeologists to utilize the categories with much certainty. For that matter, the research goals of many investigators might not coincide with the properties stressed in these labels.

Types Based on Form

One alternative that attempts to utilize data readily observable in the archaeological record is a typology based strictly on form, including the various outcomes of a given construction method. This includes the types of materials used in the construction and quantitative aspects, such as height and width. Focusing on these characteristics, one could examine a section of a sacbe and place it into a given type, in a manner analogous to the examination of a ceramic sherd with the aim of type-variety analysis (Smith et al. 1960).

However, two issues complicate such a potential scheme. The first is that present evidence does not support clear categories into which causeways can be divided based on their construction methods and resultant forms. As described in chapter 4, not only is the variability of all documented roadways relatively continuous, but individual examples may vary radically along their courses as terrain and raw materials change. Shorter, internal roads are potentially the most consistent, but as the distance covered increases, the features may morph from meters in height to being nearly indistinguishable from the surrounding terrain, with their constituent components similarly varying. While a system could be devised to classify the features only at a given portion of their courses, this might mean that a single road would have multiple identities. The utility of this sort of scheme for most purposes seems dubious.

A second challenge to an archaeologist attempting to gather and compare sacbeob data from sites at which she or he has not worked is that, while length is frequently recorded, the construction style of roadways is much less frequently noted and reported in any detail. Scattered, anecdotal information on a limited number of roadways makes a poor sample from which to extrapolate patterns and construct types.

A Tripartite Classification Using Length

In an effort to construct a classification system based on a large sample size of data from across the Maya lowlands, the author initially compiled a database of the lengths of 190 roadways (Shaw 2001). Although information on form and measurements of height and width were missing from most sources, length data were found to be readily available for many cases, either in print or on scaled maps. Augmented since this initial study, the data set now includes 293 sacbeob (for the references from which the data were derived, see appendix). The first study, plotting the frequency of given sets of length measurements, demonstrated a distribution that could be divided into three categories with "gaps" between them, or a noncontinuous distribution. As a result, three sacbe types were designated: "local intrasite" (less than one kilometer in length), "core-outlier intrasite" (one to five kilometers), and "intersite" (five kilometers or more). Similar patterning has been reported in smaller samples from individual sites. Benavides Castillo (1981:147–168) divides the sacbeob of Cobá into three primary categories (regional, zonal, and local) based on length and associated characteristics. Likewise, Folan and others (2001a, 2001b:293–294) have constructed a quadripartite system for the roadways of Calakmul: *regionales* (extending beyond the limits of the state), *estadales* (reaching the limits of the state), *urbanos* (connecting the site center with outlying groups), and *vecindarios* (linking areas within the site core).

However, when the new data are added to the author's original data set and the patterning is reexamined, the gaps are less evident and the distribution is more continuous (fig. 21). The continuity of the data is most obvious with the shortest roadways, which account for the bulk of the sample. The distribution of the longer sacbe lengths is still interrupted to some degree, but this is potentially attributable to a much smaller sample of roadways exceeding one kilometer in length.

While the less-pronounced, or potentially absent, reality of the three groups gives a potential cause to abandon the scheme as an emic classification system, the typology still has possible utility for archaeologists concerned with generating a tool for their own analytical uses, and it can be argued to relate to real-world conditions that may have had meaning for the builders and users of the roadways. For this reason, the tripartite system is discussed in detail here.

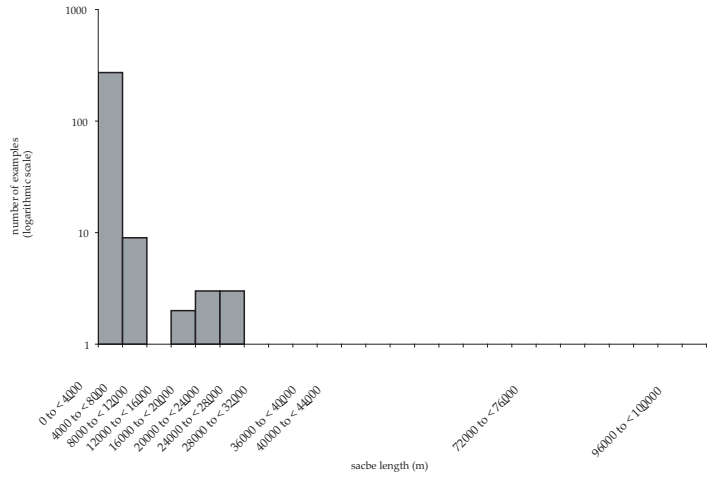

Figure 21. Sacbe lengths in sample. (Prepared by Justine M. Shaw)

Local Intrasite Sacbeob

By far the most frequent class in the sample (78 percent of 293; see appendix table 1), local intrasite sacbeob are less than one kilometer in length. Equivalent to Benavides Castillo's (1981) "local A" and "local B" types and Folan and others' (2001b:293–294) "urbanos" and "vecindarios" categories, these causeways remain within the denser urban core of Maya settlements. In terms of the various Mayan language categories explored by Bolles and Folan (2001; Folan et al. 2001b), they could include xay be (roads branching from primary roads), thulthul be (narrow roads), and cochbaben be (between the city center and sacred-secular groups). In some cases, they radiate from a core zone to groups on the periphery, while in other examples they tie more-equivalent architectural units.

Houk (1996:279) describes causeways of this type at the site of Copán, located within a one-kilometer radius of the site core. Fash (1983:283, 286) believes that this may be a deliberate phenomenon, an emic definition of the site core for the occupants of the site. As the sizes of various site cores vary, it seems reasonable to expect that, if roadways were used to define or service site cores, their lengths would

vary. The extreme clustering within my collected sample (see appendix) may relate to this function, as sites defined and linked their urban cores using the linear features. At the same time, the highly varied nature of sacbe system plans makes it unlikely that this was their only purpose (see chap. 6).

Kurjack (1977:225; Kurjack and Garza Terrazona 1981:301) writes that such shorter, internal sacbeob would have been the earliest type built, as exemplified by the roadways of Tamanché that are associated with Late Formative architecture. In his excavation of the ballcourt plaza at Yaxuná, Johnstone (1994) likewise found that the first two phases of the site's Sacbe 2, originally a 1.5-meter-wide stone pathway that was widened and raised into a more substantial 3.5-meter-wide road, date to the Late Formative. George Andrews (personal observation in Dunning 1992:109) has also noted that internal causeways in the Puuc area tend to connect Early Puuc structures and are therefore relatively early in the settlement history of the area. Additionally, the west end of Muyil's Sacbe 2 can be associated with the oldest area of the site (Witschey 1993:186). At the same time, other examples of short, internal causeways from Muyil (Witschey 1993:185–187), Yaxuná (Johnstone 2001c), Yo'okop (Shaw et al. 2001), Tzemé (Lawton 2003), and elsewhere appear to be relatively late in the history of each site. Unfortunately, most sacbeob have not been dated directly and, at best, have an age estimate based on their association with visible surface architecture, which may be iterations of earlier hidden buildings more directly associated with the roadway's construction. These short, internal roads are not necessarily from the early history of any given site or region, judging by associated features that have been securely dated. Instead, their presence may have been conditioned by other factors that are further explored in following chapters.

Core-Outlier Intrasite Sacbeob

Core-outlier intrasite sacbeob (see appendix table 2) have been separated from the traditional inter-/intra-site typology in an effort to differentiate roads that continue outside the denser urban core of sites without leaving what is potentially considered to be a single political and social unit. Extending from one to five kilometers in length, these roadways generally connect to outlying groups of architecture that may predate their construction. They leave the zone

of concentrated monumental and residential structures, often going through an area of lesser density before arriving at their destinations. Although determining the degree to which political and social unity reigned in this zone requires a much more extensive analysis of epigraphic and archaeological data, the investment in this permanent link and the relatively short distance between the termini indicate that such ties are likely, particularly during the time of the road's construction and active use.

Bolles and Folan's (2001) be tun and noh be, potentially comparable to caminos reales, are terms that could be used for roads in this category. In Folan and others' (2001b:293) typology for Calakmul, they can best be equated to estadales, which link the capital to the limits of the state. However, the non-Calakmul examples put forth by Folan and others (2001b) (Uxmal–Nohpat–Kabah and Aké–Izamal–Kantunil) make it clear that their estadal roads extend over a greater distance, and potentially between less closely affiliated centers, than is intended for the category of "core-outlier sacbeob." I believe that the areas linked by core-outlier sacbeob would have functioned in many ways as a single social unit, as opposed to politically affiliated sites that were not closely associated on a day-to-day level of interaction.

In my sample of 293 causeways, 41 of the roads (14 percent) would be classified as core-outlier sacbeob, making them the second most common type of causeway. Generally, these roads are less likely to be noticed by investigations focusing on the core of a site, as they may originate at the perimeter of the dense central site core (e.g., Yo'okop's Sacbe 2; see chap. 3). Increased use of remote sensing could guide efforts to discover these longer linear features, as has been done with some success at Calakmul (Folan et al. 1995a) and in the Cochuah region for Ichmul (see chap. 2). These types of roadways also tend to be associated with large-scale sites, significant centers within their respective regions, probably because of the enormous resource investment required to build and maintain such a monumental feature (see chap. 4).

Cobá's extensive sacbe system was among the first in the lowlands to be well documented (Benavides Castillo and Robles Castellanos 1975; Folan 1983a, 1983b). Containing at least seven "zonal" roadways that are between 1 and 5 kilometers in length, with an eighth example at 5.6 kilometers (Benavides Castillo 1981), the causeways emanate from several major architectural groups (Grupos Macanxoc,

Cobá, Nohoch Mul, and Chumucmul) in the core of the site, reaching out to more-distant groups that may have been distinct sites during certain times in their history.

Although the existence of some internal roadways at Chichén Itzá has been known for quite some time (Landa 1959:114), not until the 1990s did systematic documentation of the site's sacbe system begin. Cobos and Winemiller's (2001; Cobos 2003) efforts have added fifty-five new causeways to the previously reported fourteen, bringing the number of internal causeways (classified here as both "local intrasite" and "core-outlier intrasite") to sixty-nine. Based on data extracted from the current system map (Cobos and Winemiller 2001:fig. 5), four or five of these could be classified as core-outlier intrasite, traveling from 1 to 5 kilometers. When the causeways are examined in a functional sense, however, the number increases, because several members of the complex web act as single units rather than separately (for example, the connected Causeways 40, 14, and 48 together stretch approximately 2.15 kilometers). Cobos and Winemiller (2001:285–288; Cobos 2003) suggest that the system was constructed in two phases. The first, associated with the High Priest's Grave Group–Monjas Complex and the Southwest Group–Temples of the Three and Four Lintels, potentially dates to the ninth century. During the Terminal Classic, new roadways were added to connect the Great Terrace to other components of the site to tie together an area of at least 30 square kilometers.

Calakmul is another site with a complex road system that is beginning to be documented (Folan et al. 1995a, 1995b, 2001a, 2001b). Of the fifteen causeways that have been recorded, at least three are classified in the intermediate "core-outlier" category, with the total potentially increasing as more of the causeways are documented along their entire lengths. Although none has been directly dated, a probable connection to the site of El Mirador, important during the Formative, indicates that at least portions of the system may be quite early in date.

Research at Caracol (Chase and Chase 1987, 1989, 1996, 2001; Chase et al. 1990; Jaeger 1991) has revealed a total of thirty-six ground-truthed and three LANDSAT-detected causeways to date, eight of which would be "core-intrasite." Interestingly, Chase and Chase (2001:276) have noted that the causeways radiating from the core connect to two distinct rings of architectural groups. The first

terminate at groups located 2.7–3.0 kilometers from the epicenter, containing nonresidential monumental architecture that includes range structures. However, spur causeways connect elite residential groups to these roadways. Chase and Chase believe that these shorter core-outlier examples might have made excellent loci for exchange, in addition to reinforcing social ties. They point out that a second ring of roadways extends to locations 4.5–7.5 kilometers from the site core (thus including primarily "intrasite" sacbeob according to my classification system). These termini appear to represent originally distinct sites that later became incorporated into Caracol as the site grew.

Other core-outlier causeways from the sites of Ichmul and Yo'okop are reviewed in detail in chapters 2 and 3.

Intersite Sacbeob

The least numerically prevalent of the three types in the sample of 293 (23 sacbeob at five kilometers or longer; see appendix table 3), intersite sacbeob equate to Folan and others' (2001b; Bolles and Folan 2001) "regionales" or "chibal be" categories. They extend beyond the limits of the site, as defined archaeologically by significant settlement density dropoff. In the past, they may have continued beyond the boundaries of the state. Alternatively, such roads also may have served as a means of formally extending and maintaining these boundaries. Kurjack and Andrews (1976) have examined this phenomenon in the northern Yucatán, where they noted fortified sites (Cucá, Aké, and Muna) located approximately halfway between Mérida (Ichcantiho) and Izamal. In this same region, there are long sacbe complexes that appear to extend from one major center to a location halfway between this center and the next comparably sized site (Ucí–Cansahcab and Izamal–Aké). This political function is further explored in chapter 7.

In addition to the major centers with sacbe systems described in the previous section (Caracol, Chichén Itzá, Calakmul, and Cobá) and mentioned above (Ucí–Cansahcab and Izamal–Aké), examples include the famous Yaxuná–Cobá causeway (Shaw 1998; Shaw and Johnstone 2006; Villa Rojas 1934) and the Puuc-area Uxmal–Nohpat–Kabah connection. Likewise, the El Mirador–Tintal (Dahlin 1984), El Naranjal–San Cosmé (Mathews and Maldonado Cárdenas 2006:112; Reid 1995), and some San Gérvasio (Freidel and Sabloff 1984; Sierra Sosa 1994) causeways are long enough to be categorized as "intersite."

Fedick and Mathews (Fedick et al. 1995; Mathews 1998) have explored the possibility that a regional road may have once extended across the northern Yucatán. Such a road, potentially stretching from Puerto Morelos to Ichcantiho (Mérida), would have been over three hundred kilometers in length. Segments of the roadway have been documented on its eastern extreme, where the ancient sacbe appears to have been used as the base for historic rail lines (Mathews and Lizama Rogers 2005). On a 1959 map, Raisz (1959) included a "Maya Causeway" extending inland from Puerto Morelos for almost fifty kilometers. A geologist named Weidie (personal communication in Mathews and Lizama Rogers 2005:118) has also reported that local residents claimed that the tracks of the narrow-gauge railroad were built on an ancient road, potentially the same as that labeled on Raisz's map. Additional accounts from early chroniclers, such as Diego de Landa, Bernardo de Lizana, and Diego Lopez Cogolludo (Tozzer 1966 [1941]), eighteenth- and nineteenth-century travelers (Charnay 1887), and more-recent researchers (Paxton 2001; Romanov 1973) also give tantalizing accounts that indicate such a causeway may have once existed (see chap. 6 for a discussion of the problem of poor preservation and later cultural impacts on sacbeob). Because the reuse of older causeways as the basis of historic roads has been reported elsewhere (Ligorred Perramon 2001, 2005; Roys and Shook 1966), one might reasonably assume that preexisting, leveled stretches of ancient sacbeob may have been taken over for use as historic railways and roads.

The Application of a Typology

This consideration of a proposed tripartite typology, in conjunction with other emic and etic systems, is not meant to stipulate a single means of classification for all archaeologists and all sites. Sites and polities certainly varied in scale, so one site's four-kilometer-long "core-outlier" roadway may indeed have connected it to another polity, while that same distance would remain within the urban core of Chichén Itzá or Caracol. Instead, researchers attempting to look for patterning in the archaeological record with respect to sacbeob may need to use a classification system more complex than a simple intersite/intrasite division. Additionally, rather than just reporting lengths, providing detailed descriptions of the form and associations

of each causeway (as has been done in some cases) is required to truly begin to study patterning. Even if each researcher working at a site with multiple roadways were to produce a site-specific typology, this would allow a broader comparison, which could shed light on the functional questions raised in the latter half of this volume.

6

Sacbe System Variability

While many sites may have only one or two causeways (or none), there are a limited number of lowland Maya sites, including Ichmul and Yo'okop, that possess multiple roadways that together can be considered sacbe systems. These networks of roadways generally reflect the nature of the relationship between the various features they linked at the time each member was added. Some of these systems evolved over extended periods of time as more causeways were built and modified, while other sites invested in networks during what appears to be a single period of time, at least in archaeological terms. Following their construction, the systems were further modified as vegetation covered them and later peoples utilized the roadways as ready sources of raw material, as well as bases for their own roads and railways. The resultant forms that are visible today can be described as relatively linear systems, cruciform systems, radial systems, and dendritic systems.

A Consideration of Change through Time

Sacbeob are challenging features to directly date for several reasons. The first relates to their construction technique (see chap. 4) and, hence, their relatively poor preservation. Unless covered by later features, the thin sascab or plaster coating that once capped a sacbe readily breaks down, leaving any organic or ceramic materials that might have been encased within the roadway with little to no protection. Even in examples in which the contents of a roadway are protected in some manner, such long, linear features are unlikely to include substantial deposits of dateable materials. Additionally, governmental (INAH) restrictions in Mexico prohibit the direct excava-

tion of a causeway without the consolidation of a significant section of the feature, inhibiting the identification of dateable materials in a time- and cost-effective manner. Although numerous sacbeob have been directly dated despite these obstacles, many dates have only been estimated based on relative associations with other architecture.

Cultural Impacts

An examination of directly and indirectly dated sacbe systems from a number of sites emphasizes the importance of considering change through time. Relatively recent historic and modern activities have, of course, impacted the appearance of causeways. However, through the hundreds of years during which many ancient cities were occupied, those with power and resources also frequently chose to modify the infrastructure of their settlements.

Benavides Castillo (1981:176) has argued that the complex network of sacbeob at Cobá—one of the largest systems in the Maya area, with forty-five roads currently registered (Con 2002:38)—should more properly be considered as having at least two components: a Cobá Group system and a Nohoch Mul Group system. The former appears to be the older of the two, being associated with Late Formative ceramics recovered from 1974 and 1975 plaza excavations. This first set of road components is oriented in a cruciform, or cardinal direction, manner. The later Nohoch Mul system probably dates to the Late Classic, as indicated by ceramics from the plaza of origin. This date is consistent with ceramic materials from the far terminus of the system's Sacbe 1 at Yaxuná (Shaw 1998; Shaw and Johnstone 2006). Benavides Castillo believes that the Nohoch Mul network represents an expansion of Cobá's social, economic, and political system, with roads being added to meet the needs of the growing state. Thus, while the final form of the site's sacbe system could be described as radial (see below), this does not accurately reflect its original appearance.

Cobos and Winemiller (2001:285–288; Cobos 2003:226–260) postulate a similar two-stage evolution for the sacbeob of Chichén Itzá. The first of these phases, associated with the High Priest's Grave Group Monjas Complex and the Southwest Group—Temples of the Three and Four Lintels, dates to the Late Classic or beginning of the Terminal Classic period. The chronological placement of the earlier causeways has been based on ninth-century hieroglyphic texts in the area of the roads' origin, as well as Sotuta Complex wares associated

with the causeways themselves. Basing their opinion on their current data, Cobos and Winemiller believe that this early system connected architectural "beads on a string" (Tourtellot et al. 1992:94) in a manner similar to the system of Sayil. Cobos and Winemiller (2001:285–288; Cobos 2003:246–260) think that the roadways emanating from the Great Terrace area were added during the late Terminal Classic period. Architectural styles and Sotuta wares, as well as the absence of Thin Slate Ware and hieroglyphic inscriptions in the area, indicate that the system reached its greatest extent during this later period. The new series of sacbeob was necessitated, at least in part, by a shift in the center of the site.

When the principal occupation of any site ended, cultural modifications to its roadways did not necessarily cease. Several authors have commented on the historic reuse of roadways in Mesoamerica (e.g., Hirth 1982:322; Lee and Navarrete 1978). As part of their documentation of the site of Aké, which has been heavily impacted by the Hacienda Ruinas de Aké, Roys and Shook (1966:43) describe how sacbeob in the region were liberally mined to construct *tranvías*, or the narrow railways used to transport *henequen*. They further comment on a tranvía that utilized a preexisting sacbe to form its base. Bustillos Carillo (1964:76–80) and Romanov (1973) echo these findings, stating that causeways were used as the foundation for the Decauville lines, as well as for mule-train paths. With these kinds of development concentrated in the region of Mérida, it is not surprising that the Ichcantiho (Mérida)–Aké roadway reported by Landa (Tozzer 1966 [1941]:174) could be located only in segments during Roys and Shook's (1966:43) search. Ligorred Perramon (2005) believes that some of the principal streets in Mérida may still follow ancient sacbeob, as is the case in Izamal (Wagner 2000:169). Chichén Itzá's causeway leading south from the Monjas Group was also used as the base for a narrow-gauge rail system (Dave Johnstone, personal communication). As mentioned in chapter 5, recent investigations by Jennifer Mathews and others (Fedick et al. 1995; Mathews 1998; Mathews and Lizama Rogers 2005) of a possible regional sacbe across the northern lowlands have yielded further cases of causeway reuse for rail lines.

Natural Forces

Natural forces have also caused roadways to become damaged and obscured. In addition to bioturbation and the damaging effects of

vegetation growth and death cycles, water-level changes and sedimentation processes have been shown to impact and mask roadways. At Cobá, a sacbe was built across the quarry that later became Lake Macanxoc when the water level rose. A ramp and several walkways leading into Lake Cobá are also currently underwater; during the rainy season, ancient dikes are inundated (Folan et al. 1983a:455). Sea-level changes have also taken place, with several fluctuations ranging from approximately 1.5 meters below to 1.5 meters above current sea level occurring from the Early Formative through the Late Postclassic (Folan et al. 1983a:fig. 8). In addition to potentially conditioning a cyclical movement of populations (Folan et al. 1983a:461–462), such alterations may have inundated roadways adjacent to water features (see chap. 4). Sacbeob around Itzam Kanac, in the vicinity of the Río Candelaria, at Isla Cerritos, and at Vista Alegre are all now underwater because of sea-level changes (Andrews 1990; Andrews and Gallareta Negrón 1986; Andrews et al. 1988; Bolles and Folan 2001:306; Eaton and Ball 1978; Gallareta Negrón and Andrews 1988; Glover and Rissolo 2005).

Soil formation processes may also cover or modify roadways. In their recent research at Chichén Itzá, Cobos and Winemiller (2001:285, figs. 2 and 3) found that less-substantial causeways could be hidden by this process. Having heard reports of Causeways 8 and 14 disappearing into red soil, they decided to excavate twenty to fifty centimeters of materials from the projected path of such problematic roads. This enabled them to register more than twenty otherwise masked roads at the site. Witschey (1993:187–189) reports that, at Muyil, soil formation processes caused shoreline changes, necessitating the construction of further sacbe sections. A Classic causeway appears to have extended to the edge of a karstic shelf at Muyil, but by the Postclassic, the lagoon had silted up sufficiently to require further constructions to cross the swampy terrain and reach the new lagoon edge farther to the east.

Thus, both natural and cultural forces may impact the appearance of, or even mask, portions of an individual roadway, as well as entire components of a sacbe system. Rather than assume that the current configuration at a site reflects the reality in the past, researchers need to carefully study the evolution of the network.

Sacbe System Types

The current appearance of a given system or an assessment of what the system was like at a given time in the past permits the classification of sacbe systems into a number of categories (Cobos and Winemiller 2001:283–284). One purpose of such an exercise is to better understand the sociopolitical system, as expressed in architectural relationships, at the time of the roads' construction (Kurjack and Garza Terrazona 1981:300–301). Additionally, the way in which a set of causeways are arranged may provide insights into past belief systems (Dunning 1992:109, 143–149).

Linear Sacbe Systems

Sayil is one of the best-known Maya sites with a linear sacbe system (Dunning 1992; Sabloff and Tourtellot 1991; Smyth and Dore 1992). The north–south roadway connects the Great Palace, Mirador, Double Court, Big Hill, Ball Court, and South Palace complexes, passing through a vaulted portal between the Mirador and Great Palace complexes (fig. 22). Likened to "beads on a string" (Tourtellot et al. 1992:94), the system joins major architectural groups and a possible marketplace with four roadways—or what could also be considered one sacbe broken in three places. Labná exhibits a simplified version of this linear arrangement, with a causeway connecting its tallest pyramid to a three-story palace (Kurjack and Garza Terrazona 1981:301). Likewise, Tamanché uses north–south roadways to link its central group to two smaller complexes. Tzum also possesses a linear system (Von Euw 1977). As discussed in chapter 3, Yo'okop's system might be classified in this manner. Although the final appearance of Chichén Itzá's early network was more complex, Cobos and Winemiller (2001:286–287) describe it as linear, with the site center and architectural groups arranged along causeways.

Linear sacbe systems are unlike the other types of networks that are discussed, as they do not indicate a clear hierarchy in their stipulation of a center. Instead, when they tie together groups of similar scale, linear road systems may be interpreted as implying a relatively equal relationship between the various loci being connected. At the same time, functional variability among the linked units may be evident. Tourtellot (in Dunning 1992:109) has suggested that, at Sayil, the various nodes along the north–south road may have served as ritual

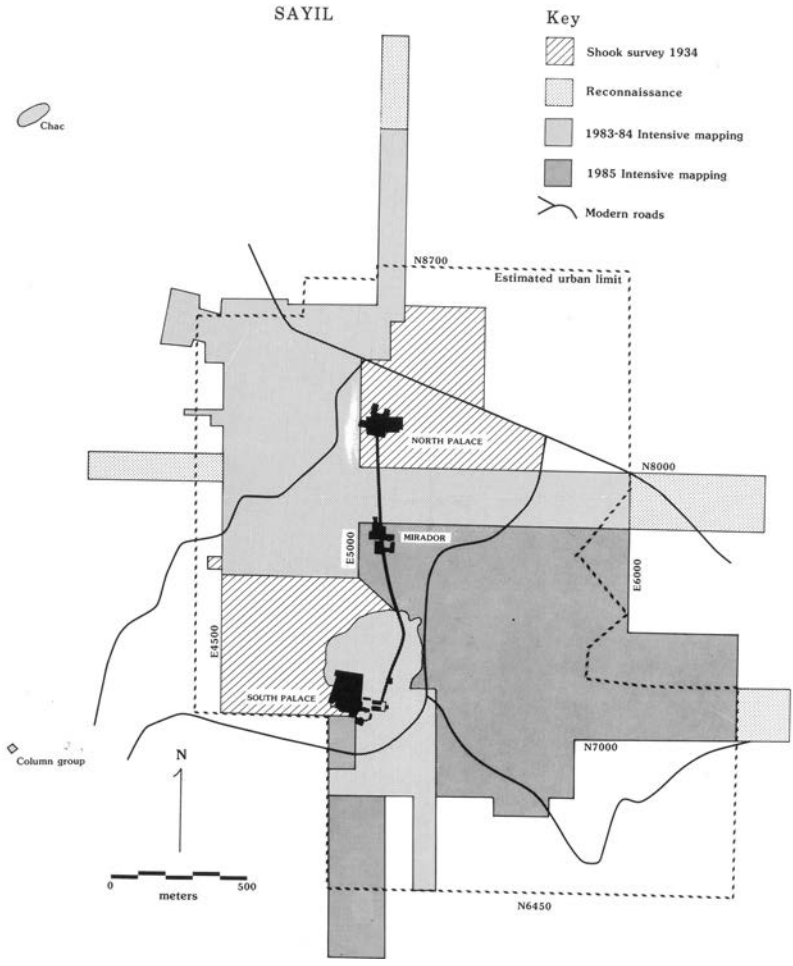

Figure 22. Map of investigations at Sayil, showing linear system of sacbeob. (From Sabloff and Tourtellot 1991)

stops along a procession way from the royal residence to the southern complex including the site's ballcourt, which was aligned in a manner that would have allowed it to serve as a device for marking twenty-day *uinal* periods (Aveni and Hartung 1986). On a larger scale, some inter-site sacbe systems, such as the Uxmal–Nohpat–Kabah connections, could be viewed as a larger version of this general plan (Dunning 1992).

Cruciform Sacbe Systems

Numerous Maya sites display a cruciform sacbe system, with roads radiating in four directions from a central location. This type of arrangement references a number of concepts central to Prehispanic belief systems in Mesoamerica (see chap. 7), including a quincunx or quadripartite concept (Freidel et al. 1993; Mathews and Garber 2004). The pattern may be described as the former when one includes the central point of origin or *axis mundi* in addition to the four extensions, while the latter term emphasizes the termini. Quadripartite motifs are symbolic of cyclical completion and may relate more to positions relative to the path of the sun than to our Western concept of cardinal directions (Coggins 1980; Milbrath 1999:70–74). Likewise, the world tree, with its main trunk and two primary branches, has been likened to this form in ancient and postcontact Maya cosmologies (Dunning 1992:137; Freidel et al. 1993).

Although there has obviously been a tremendous amount of culture change from the ancient Maya to the present, some of the basic tenets related to this concept have endured. Ethnographically, these concepts have appeared in the layout of Maya settlements and milpas from Highland Chiapas (Vogt 1990 [1970]:17–18) and Guatemala (Watanabe 1992:64–69, fig. 5) to the northern Yucatán (Faust 1998:127–133; Freidel et al. 1993:165–170; Redfield and Villa Rojas 1962 [1934]:114–115). The four corners, related to the "sky bearers" or *babatunob*, as well as the *chakob* or rain deities (Freidel et al. 1993), may be spatially designated by physical roads, crosses, altars, or prominent features on the landscape. Landa (in Tozzer 1966 [1941]:135–140) noted that, at the time of Spanish contact, Yucatecan towns had entrances at each of the cardinal directions. The Dresden Codex, a Late Postclassic document, lays out deities with respect to world directions; the Madrid Codex also contains directionally oriented, froglike creatures that can be associated with Chak (Paxton 2001:63–93, 101–107). Coe (1965) and others (Stomper 2001:207–209) have proposed that this resulted in a community composed of four quarters.

Focusing on the use of sacbeob in making these spatial designations, one can find a number of examples that mirror this imagery. The Late Postclassic site of San Gérvasio on Cozumel Island provides an example of a quincunx-ordered settlement (Freidel and Sabloff 1984; Freidel et al. 1993:161–162). Likewise, Classic Maya sites including Cobá (Benavides Castillo 1981; Benavides Castillo and Robles

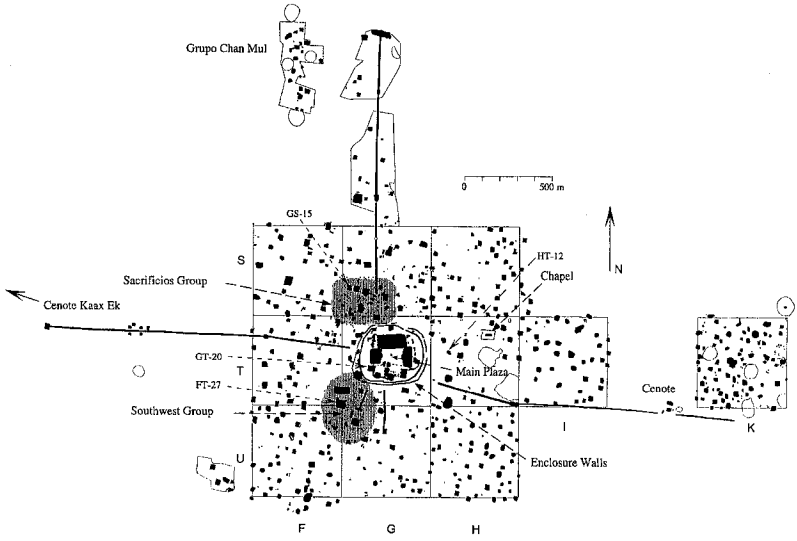

Figure 23. Plan map of Ek Balam, showing cruciform system of sacbeob. (From Bey et al. 1997)

Castellanos 1975; Folan 1977b; Gallareta Negrón 1981), Dzibilchaltún (Andrews and Andrews 1980), Ek Balam (Bey et al. 1997, 1998; fig. 23), Izamal (Lincoln 1980), El Naranjal (Reid 1995; Taube 1995), Seibal (Tourtellot 1988; Willey 1990), T'isil (Fedick and Mathews 2005; Fedick and Taube 1995; Mathews and Garber 2004), Xtobó (Anderson 2003), and Yaxhom (Dunning 1988, 1992) evidence this type of arrangement. Stuart (2006:2) writes that Copán's Hieroglyphic Stairway refers to four roads even though the site contains only two causeways, possibly indicating an idealized cosmological scheme; a reference at Caracol to four paths of the sun may connect to this same idea. "It is the idea of proper spatial order and its recognizable materialization that counts, not the precision of its rendering" (Ashmore 2002:43).

The cores of the various cruciform-plan sacbe systems that have been described are formed either by architecture of some sort (generally monumental in scale) or by cenotes. Architecture-centric configurations appear to be the most common. As discussed above, at Cobá the earlier version of the site's road system, centered on the Cobá

Group, appears to have had a cruciform shape (Benavides Castillo 1981), although this became obscured through time as more roads were added to give the site a more asterisk-like appearance (Dunning 1992:143). Ek Balam's site plan includes three core-outlier roadways (over one kilometer long) to the north, east, and west, with two shorter extensions of the system to the south and southwest (Ringle et al. 2004). Connecting to outlying smaller architectural groups, the system is centered on the massive site core, as is the system at Izamal (Lincoln 1980; Maldonado Cárdenas 1979a, 1979b, 1990). The Xtobó system is centered on a plaza that includes a ballcourt (Anderson 2003). At Seibal, a relatively open, low area with medium-sized architecture is connected by roadways to higher-elevation groups to the south, west, and east. The most massive constructions at the site lie at the eastern and western termini of the system (Tourtellot 1988). The central depression from which the roads originate may have represented the underworld component contained in some notions of directionality (Dunning 1992:fig. 7.2). The hub of Yaxhom's sacbe system is formed by its Nohoch Cep Group, from which four roadways radiate. Causeways exit to the west (probably to Contreras), to the main Yaxhom Group to the north, to the south to Nucuchtunich, and to the southeast to Cooperativa A (also known as Xucmil Castillo) (Dunning 1992:180–187). Because the Nohoch Cep Group lacks chultunes and metates common elsewhere in the site, a more civic-ceremonial function is suggested for the sacbeob's origin point. At El Naranjal and T'isil (Fedick and Mathews 2005; Fedick and Taube 1995; Mathews and Garber 2004), the pattern is less complete. Moderate-sized constructions mark the core of El Naranjal's system, but at T'isil, the center is formed by a cenote. In northwestern Yucatán, at Dzibilchaltún, an east–west sacbe links an E Group solar observatory with the site's central point, a large cenote (Dunning 1992:144; Kurjack 1974). Less-substantial roadways radiate to the north and south of this axis mundi. As Freidel, Schele, and Parker (1993:131) explain, "Centering the world is thus a way of re-creating a spatial order that focuses the spiritual forces of the supernatural within the material forms of the human world, rendering these forces accessible to human need. Because centering the world requires movement to, from, and around the designated center point, the processional route humans use to define the center is as important as the center itself" (Freidel et al. 1993:131).

While the various functional implications of these arrangements are discussed in chapter 7, the dominant and repetitive nature of this type of layout—found in everything from caches to houses to settlement systems (Mathews and Garber 2004)—undercuts the argument that Maya causeways with such an arrangement were strictly "transportation architecture" (cf. Hirth 1982). Instead, Maya civic planners were able to combine the core values of their cultural systems with more mundane needs to provide a complex of features meaningful on a number of levels.

Radial/Solar Sacbe Systems

Like cruciform road systems, solar or radial sacbe arrangements stress a single core from which causeways originate (Cobos and Winemiller 2001:284). However, instead of only four primary sacbeob coming from this center at relatively regular angles, more such features at a variety of angles characterize a radial or solar system. The two terms to label this pattern are used interchangeably here.

One of the most famous examples of a solar system is that of Cobá (fig. 24) in its final form (Benavides Castillo 1981; Folan 1977b, 1983a, 1983b), which links peripheral groups to the site core. Not counting the two longest roadways in Cobá's system (to Ixil and Yaxuná), twenty-three square kilometers are associated with the site by these ties (Kurjack and Garza Terrazona 1981:302).

Recent evidence suggests that Ichcantiho (Mérida) may have had a radial system of sacbeob (Ligorred Perramon 2001, 2005), with at least some of the principal streets departing downtown Mérida having replaced ancient roadways. Although most of the system has been masked or destroyed by historic and modern development, a portion of one roadway leading to the site of Xoclán, on the western fringe of the city, still remains. Ligorred Perramon plans future excavations to explore the existence of other components of the system.

Dendritic Sacbe Systems

A dendritic sacbe arrangement involves architectural groups concentrated in concentric rings around the site core, with roadways being used to link elements at each distance to the site core (Cobos and Winemiller 2001:284). Such a system appears quite similar to a solar/radial arrangement if only the causeways are examined, because of the hierarchical origin at the center of the site. However, a closer

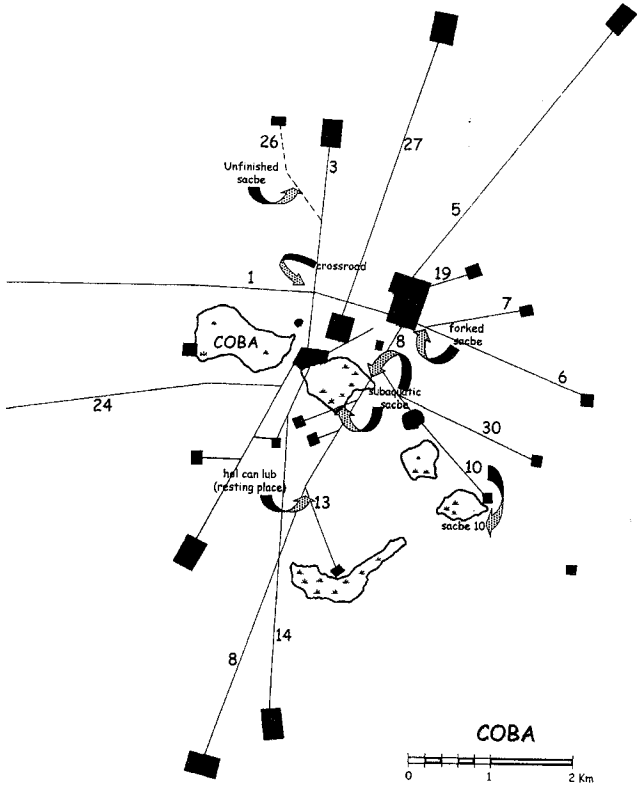

Figure 24. Plan map of Cobá, showing radial system of sacbeob. (From Folan et al. 2001b)

inspection of the distances the roads travel and the clustered distribution of more significant architecture at each "ring" reveals that there is a difference.

Caracol (fig. 25) is one of the best examples of such an arrangement, with causeways radiating from the site's epicentral plaza to specialized plaza groups (Chase and Chase 2001:276–277). Upon leaving the site core (see chap. 5), sacbeob lead to one of two distinct rings at a distance of 2.7–3.0 kilometers and 4.5–7.5 (or up to 9.5) kilometers. Whereas the former appear to have been excellent locations for local exchange, also serving administrative and social functions, the latter termini include formerly distinct sites engulfed by the growth of Caracol.

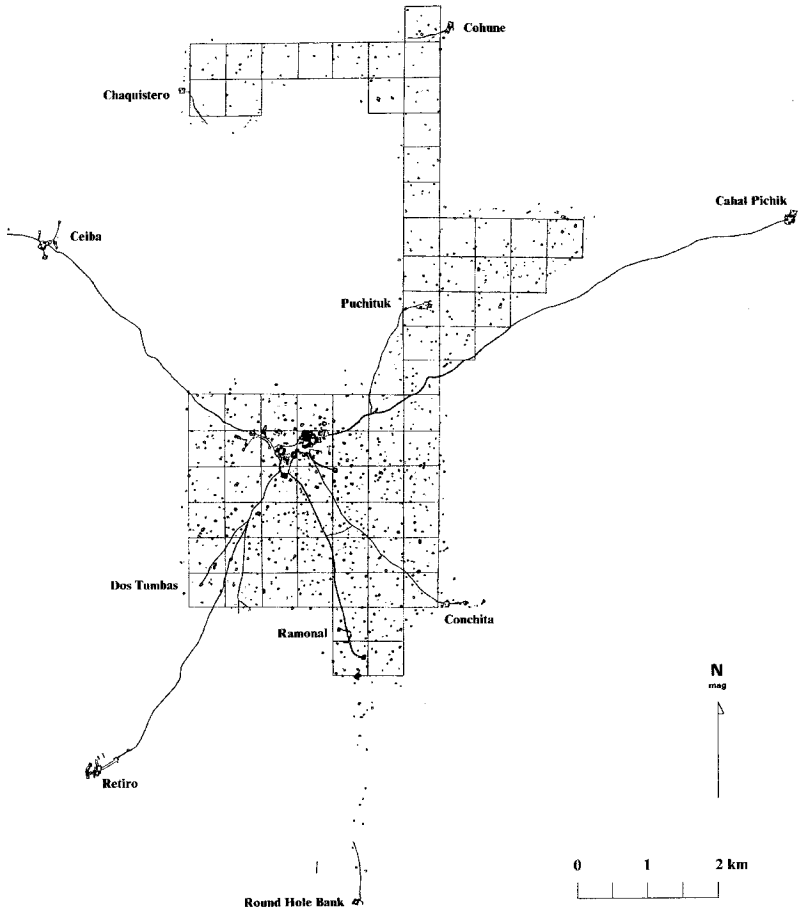

Figure 25. Plan map of Caracol, showing dendritic system of sacbeob. (From Chase and Chase 2001)

Cobos and Winemiller (2001:288, 289) argue that, in its final form, the Chichén Itzá sacbe system (fig. 26) was similarly dendritic, with concentrically distributed architectural groups linked to a well-defined site core of the Great Terrace. The most common type of terminus arrangement included a temple, altar, and a gallery-patio structure.

The newly discovered roadways of Ichmul may provide another example of a dendritic sacbe system when the final form of the network is considered (see chaps. 2, 9, and 10). This system, built in two

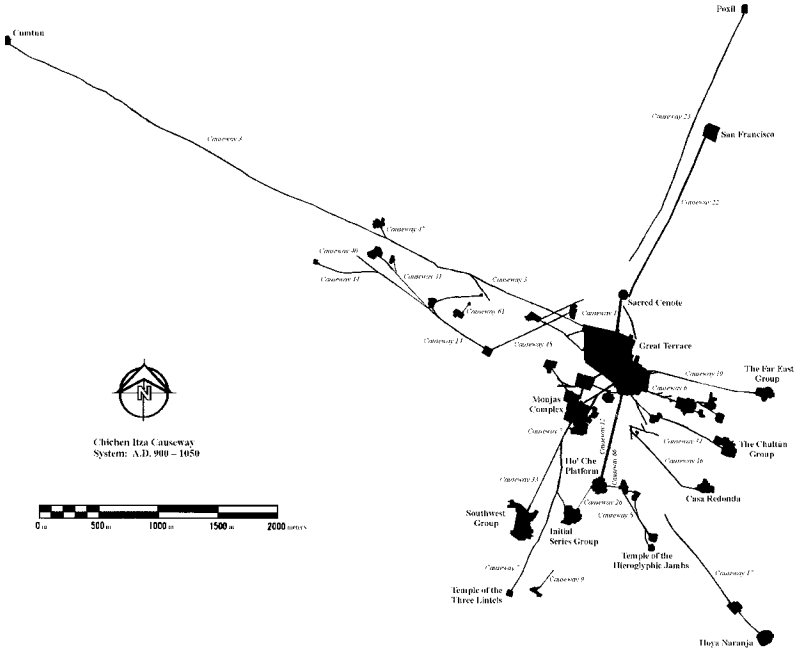

Figure 26. Plan map of Chichén Itzá, showing dendritic system of sacbeob. (From Cobos and Winemiller 2001)

stages during the Terminal Classic, connected Ichmul to a series of preexisting sites that may have been valued for their agricultural production, as well as other factors.

Other sites currently labeled as "radial" or "solar" could potentially be reclassified as "dendritic" upon further study of their sacbe arrangements and architectural associations with roadways.

The Significance of a Particular Type of Sacbe System

The four basic types of Maya road systems described here can be generally thought of as being either hierarchical (as illustrated by the cruciform, radial/solar, and dendritic models) or nonhierarchical (exemplified by linear systems). Linear systems tend to be used in sites composed of relatively equivalent architectural groupings, without a

single definable, concentrated core area. The existence of what appear to be multiple, potentially equally important loci may be the result of shifting emphases through time or the contemporaneous use of functionally distinct areas. In either scenario, political and economic power and control are distributed across the landscape, which indicates a more-dispersed or shifting authority.

More-hierarchical versions of a system are utilized when a single core is evident. Such systems generally are associated with a more-concentrated political and/or economic power, with the aim of connecting outlier with core (and vice versa), not outlier with outlier. During the construction and active use of the system, the general hierarchical structure of this political scheme would have remained relatively consistent, although the individual(s) in charge would have certainly changed through time.

7

Functions of Sacbeob

The most obvious practical function of any road is that of transportation, to facilitate the movement of people, goods, and ideas across space. As "transportation architecture" (Hirth 1982), roadways in the Maya area, as elsewhere in Mesoamerica, provided an elevated pathway for traversing wet, overgrown, crowded, or otherwise difficult terrain. They provided a means to move salt, fish, cloth, wood, obsidian, shell, agricultural products, and a variety of other goods in a terrain that was otherwise difficult to negotiate (Bustillos Carillo 1964:23; Diaz-Bolio 1989:6, 8, 13). At the same time, it cannot be assumed that practical access was the only motivator for the significant investments made in constructing and maintaining sacbeob. Political, social, hydraulic, ritual, military, and symbolic functions also need to be considered as important, or perhaps even primary, purposes of Maya causeways. While one or more factors may have weighed in as being more significant for any given road at a particular site, the unique nature and meaning of sacbeob allowed them to serve as a type of infrastructure that could have simultaneously met a variety of needs (Velázquez Morlet et al. 1988:84–89).

Functions of Practical Access and Transportation

As Hassig (1991:18) states, although religious and social purposes may have been motivations to build roadways, economic (and political —see following section in this chapter) functions are potentially some of the primary motivations for road construction in the New World. Also, due to the long time span and tremendous cultural changes that have taken place since Maya sacbeob were constructed, the practical,

materialist functions of the roadways are perhaps the most straightforward of their functions to explore. These include moving humans and goods, as well as the ideas communicated by the people, from one place to another location in a region lacking beasts of burden (Maldonado Cárdenas 1979a:24). Although shorter roadways would have been useful in maintaining clear, passable areas through congested core zones, the function of practical transport would have increased proportionally with length (Shaw 2001) as well as with the challenges provided by the surrounding terrain. Even relatively diminutive examples could have been vital through zones with regular flooding or in uncleared or special-purpose sectors that could not otherwise be readily traversed.

One of the primary types of evidence that support the practical-transport facet of sacbe functions is the natural and cultural features that the roadways connect. According to Folan (1991:224), sacbeob "represent a twenty-four-hour, twelve-month-a-year communication network" whose functions included "the transportation of goods and services from near and far thereby providing a near-perfect element to any forest-bound communication network." While Folan also stresses the political and symbolic implications of the roadways that are discussed later in this chapter, he points out the practical functions of observable features associated with roadways at Cobá, such as ramps (some of which are referred to as *aduanas*), cenotes, and aguadas (Folan 1977a:34–35). At Muyil and Xelha (Witschey 1993:185), sacbeob are also used to connect settlements to lagoons. As sea level changed, there is evidence that the sacbe was extended to permit continued pedestrian crossing of the mucky terrain along the shore.

Chunchucmil's eleven-member sacbe system, augmented by two- to four-meter-wide *callejuelas* ("alleys") formed by adjacent albarradas, allowed access to public spaces that could have hosted market exchange (Dahlin 2000:285; Dahlin and Ardren 2002). Unlike the central plazas at other sites that also contain elaborate, ceremonial architecture, the mundane function of practical access and transport between residential groups and civic spaces seems to be the primary motivator for the construction of the causeways at the site. Other sites may have had marketplaces (e.g., Sayil [Tourtellot et al. 1992] and Seibal [Tourtellot 1988:292]), but Chunchucmil's role as both a gateway city and a marketplace for local goods resulted in economic functions being highlighted in site planning to a greater degree there than

elsewhere. Rather than exhibiting focal pyramid or palace complexes, the core of Chunchucmil is indicated by the convergence of sacbeob and callejuelas, the clustering of patio quadrangles, moderately large architecture, and enclosure within a hastily built defensive barricade. Dahlin and Ardren (2002:270) argue that the site would have been a market-oriented corporate state (versus a redistributive theater state), which is consistent with a road system aimed at ease of commerce rather than ritual procession. Many of the roadways at similar "corridor sites" (Dunning and Andrews 1994), including a twenty-five-kilometer-long sacbe connecting San Fernando to its port of Emal and the recently documented road connecting the north coast site of Vista Alegre to an inland "Templo Perdido" (Glover and Rissolo 2005), might also have been constructed for primarily economic purposes.

Braswell (2000) and Cobos and Winemiller (2001:289) have suggested that Chichén Itzá may have had a market system that was administered on some level by the government during the Late and Terminal Classic periods. The distributions of obsidian, settlement, and limestone quarries suggest that a looser, decentralized government is associated with the first phase of sacbe construction at the site; this is consistent with hieroglyphic evidence from Chichén Itzá (Krochock 1988, 1995). A more hierarchical, centrally governed community was responsible for the second phase of causeways, which are contemporaneous with the construction of the Great Terrace, a new settlement core, and the late system of causeways linking architectural groups containing temples. If these scenarios are correct, the earlier set of sacbeob may have been designed to serve more strictly practical functions, including access and transportation of goods and people, while the latter may have melded these with a further emphasis on the political and ritual functions of the central government of a site with a clearly defined core.

Robles Castellanos (1976:39–40) argues that the Cobá–Yaxuná Sacbe served as a long-distance commercial route, allowing the northwestern part of the peninsula to more easily connect to Cobá, with its access to Petén goods and political powers; however, this is not consistent with a paucity of such goods in the archaeological record at Yaxuná (Johnstone 2001c). Robles Castellanos (1976) believes that the layout of Cobá during the time the road was constructed, the Late Classic (Shaw 1998), resembled that of a potentially market-related meeting place with large, open spaces. He also argues that the Cobá–Ixil Sacbe had primarily economic functions. Ixil may have served the

role of a secondary central place, controlling dispersed farmers in the surrounding vicinity. The more concentrated population in "urban" Cobá would have specialized in secondary production activities and would have been dependent on imported agricultural goods. An analogous situation may have taken place on a somewhat smaller scale at the regional center of Ichmul, with its outlying agricultural center(s) connected by sacbeob (see chap. 2; Shaw et al. 2004).

Chase and Chase (2001:277–279) have also stressed the economic and practical transport functions of Caracol's sacbe system. These causeways, narrower than roadways more clearly associated with ritual processions and dendritic in arrangement, seem designed to channel the site's population to open plazas surrounded by low range structures. In contrast to what has been found at other sites, no ritual paraphernalia is associated with any of the special-function causeway termini at Caracol. Although vías provided direct road access for select households, the connection of domestic groups to each other or to distribution centers does not appear to have been the primary purpose of the roadways. Instead, administrative and market locations are indicated for termini, with the system as a whole geared toward managing the flow of goods through the epicenter and termini as part of a centrally administered economy in which economic production took place primarily in outlying residential groups with differing specializations. The construction of causeways for moving these goods was also necessitated by the basic geography and geology of the site, which has agricultural terraces and a karst topography that would have significantly inhibited passage without causeways, in the same manner that the thorny scrub forest of the north makes passage difficult without cleared paths.

Although these examples emphasize or imply the existence of market systems, the movement of goods and labor does not necessarily need to be associated with a market economy. Indeed, tribute or tax systems would equally require the movement of people and materials into and out of a zone of central control (e.g., Carballal Staedtler and Flores Hernández 2006).

Political Functions of Sacbeob

The political functions of Maya causeways may certainly overlap with the economic associations described above (Hassig 1991:18; see Trombold 1976 for a discussion of these overlapping functions for

roadways at the non-Maya site of La Quemada, Zacatecas). Indeed, Chase and Chase (2001:279) include both as administrative functions in their discussion of models of causeway function, and Kristan-Graham (2001:351) points out how political relationships may "provide economic sustenance" in the form of tribute. Such economic sustenance might also be supplied in the form of access to markets and consumers.

Despite the close linkage between the economic and the political, the two have been separated here to emphasize that some roadways may serve primarily to exert power, control, or ownership of territory, with economic, ritual, social, and other functions being less important. Just as the settlement patterns of any site as a whole may suggest the nature and extent of political control (Dunning and Andrews 1994; see chap. 6), the political implications of any given causeway are likely to increase with the distance covered. As such, intersite sacbeob and core-outlier intrasite sacbeob are the most likely to have significant political implications. At the same time, Kurjack (1994:308) reminds us that political relationships between components of a single site may also be indicated in the scale, connections, and quality of the architecture in two or more parts of a settlement.

Boundary Maintenance

Kurjack (1977:225–227) has argued that regional sacbeob were built as a means of maintaining influence over an extensive territory, today appearing as fossilized skeletons permanently registering the relationship between the connected sites. He notes that the Izamal–Aké roadway extends approximately half the distance to Mérida (Ichcantiho), a center that would have rivaled Izamal in size. Extending the causeway reinforced Izamal's integration of its regional territory, as did the fortification of sites in the vicinity of this proposed border (Kurjack and Andrews 1976:319). A boundary maintenance function is also suggested for the Ucí–Cansahcab Sacbe, which extends half of the distance from Ucí to Dzilam, a site of similar size (Kurjack and Andrews 1976:323; Maldonado Cárdenas 1995:72). New evidence from archaeological work in Mérida implies that Ichcantiho may have mirrored this strategy, with roads radiating from its core to outlying sites including Xoclán (Ligorred Perramon 2005). At Yaxuná, the arrival of the roadway from Cobá, which would have required three-quarters of a million cubic meters of rock, made a clear declara-

tion of Cobá's mastery over an extensive domain (Schele and Freidel 1990:353). New temples and palaces were built around the sacbe terminus plaza at Yaxuná, with earlier structures being partially dismantled in the process, so that the site would be oriented toward Cobá.

In addition to serving as a signal to other polities in the region, the use of sacbeob provided a means of demonstrating political power and control to the populace at large. Written records displayed on public monuments, even when accompanied by representational scenes, may not have been well understood by commoners. However, indicating power through monumental constructions, including causeways, would have made a much more universally understood statement of a close relationship, alliance, or territorial possession (Carrasco Vargas 1993:211; Folan 1992b:163).

Solidifying Political Control

The process of building these major causeways could have also served to unify workers and establish a collective identity that would further the establishment of the territory as a single polity, in a manner analogous to pyramid building in ancient Egypt. Johnson (1989:375–377) has observed that elite control of labor for monumental constructions, as well as more-functional public works, would have been particularly important in New World societies, which lacked beasts of burden. With many such projects being labor intensive, requiring minimal skill in many stages, and being capable of being constructed in stages, they provided ideal "labor sinks" for elites to regularize demands for human workers and justify them on ideological grounds. Sacbeob, with practical and symbolic functions, would have been perfect projects for elites seeking to integrate and manage a population.

The historically documented Yucatec Maya concepts of *fagina* and *guardia* provide a more recent example of the use of labor to solidify political control, while providing a further means of social integration. The institution of fagina involved compulsory contributions by adult males at the discretion of community leaders. Anyone who refused to take part was punished or, if he continued to decline to participate, potentially forced to leave the community. In Chan Kom, fagina duties included, among other things, road building. Guardia required adult, but not elderly, men to serve one to two weeks at the seat of the local government. Duties involved carrying messages,

making arrests, and otherwise assisting the *comisario* (elected official in charge of the ejido). In the region of X-cacal, this institution came to be more important than that of fagina (Redfield 1941:176–179; Redfield and Villa Rojas 1962 [1934]:30; Villa Rojas 1945:75–76). Similar systems may have been utilized to build and then maintain ancient Maya causeways, as implied by the construction divisions discussed in chapter 4.

Referencing Other Polities

Ashmore and Sabloff (2000:20–21, 2002:203) write that, in addition to concepts of cosmic order, a significant source of ancient Maya civic spatial order is the enhancement of the "aura" of a place by constructing it to resemble more-established sites. Such mimicry is seen in American Colonial architecture, which incorporated components of European and Mediterranean cultures, as well as in the use of *talud-tablero* components at Mesoamerican sites far removed spatially and temporally from Teotihuacán. Potentially less important communities might have imitated the types of features present at their model sites, including sacbeob, and may also have borrowed entire site plans, particularly with respect to the layout of core areas.

Examples of such resemblances include Tenam Rosario, which mimics part of Yaxchilán and Tikal, with components of what Montmollin (1989, 1995) and Ashmore (1991) call a "Petén template." This template includes a strongly marked north–south axis; southern units with terrestrial or underworld associations and northern units with celestial associations; and a ballcourt between the northern and southern, and the eastern and western components. Frequently, causeways are used to emphasize links between these important elements (Ashmore 1989:274, 1991:200). Interestingly, within the region of the Grijalva River valley, there are smaller sites that mimic Tenam Rosario (Montmollin 1988a, 1995:128).

Ashmore (1998) believes that both Naranjo and Xunantunich may have been modeled on the core area of the massive site of Calakmul (Folan 1992b; Folan et al. 1995b, 1995c, 2001a). The younger, smaller sites sought to resemble the much larger and long-established capital allied with Naranjo (Martin and Grube 2000). Although Ashmore initially felt that the mimicry could have been used to signal Xunantunich's independence from Naranjo, she also recognizes that Naranjo remained quite powerful at the time of Xunantunich's major

building program (Late Classic), and the former may have had some sort of subordinate relationship (LeCount et al. 2002:43). Interestingly, this similitude was not extended to include Calakmul's heavy emphasis on causeways, although Xunantunich does have two local intrasite sacbeob within its core (LeCount et al. 2002:fig. 2). Iannone (2005:31) believes that the site of Minanha' may also attempt to emulate the plan of Calakmul, or possibly Tikal, on a much smaller scale, although its core includes only one roadway. Another site modeled on early capitals is Seibal, which utilized a strong east–west axis defined at the Formative powers of El Mirador and Nakbe (Ashmore and Sabloff 2002:209).

Quirigua's layout has been likened to that of Copán (Fash and Stuart 1991:148). This emulation, however, appears to be a deliberate effort by Quirigua's ruler Cauac Sky to surpass his previous rulers from Copán (Fash 1991:150–151). At Copán, a sacbe ends at the eastern entrance to the site core, while at Quirigua a port on the Motagua River substitutes in this same vicinity. Cauac Sky's Great Plaza was larger than that of Copán and contained taller stelae, larger zoomorphic altars, and more-massive temples. Ashmore (1991:281) further describes how the non-Maya sites of Gualjoquito and Los Naranjos established Copán-like layouts (north–south axis, functional dualism, and a ballcourt) during the Formative and Early Classic.

During the Late Classic in the Three Rivers region, Dos Hombres' site plan is similar to that of La Milpa (Houk 1996, 2003:55) and Chan Chich imitates La Honradez (Houk 2003:60). Houk hypothesizes that voluntary mimicry, as a means for rulers at the smaller sites to link themselves to more powerful sites, could explain the resemblances. However, he also offers the alternative explanation that the minor sites could have had a colony-like relationship with larger powers. In either case, political dictates would have been primary factors influencing site layout at the minor centers.

In the Puuc area, the sites of Labná and Sayil provide yet another instance of the layout of a minor site (Labná) mimicking that of a larger power (Sayil). Although carried out on a much smaller scale at the former, both sites include a northern palace connected by a sacbe to a set of compounds. Likewise, Uxmal and Kabah, joined by a sacbe, share architectural similarities (Dunning 1992; Maldonado Cárdenas 1995). The site of Teya, near Mérida, may be another site inspired by this model (Kurjack and Garza Terrazona 1981:301).

Kurjack and Garza Terrazona (1981:301–302) believe that other sites in the northwestern portion of Yucatán emulated the northwestern site of Dzibilchaltún. Although significantly smaller in scale, Tamanché also uses three major causeways extending from a central group.

During the Postclassic, the east coast sites of Xelha and Muyil also shared similar sacbe systems, with a major local intrasite sacbe connecting two significant architectural groups within each of the site cores. Likewise, each utilizes a road connecting a major architectural group to the water (the Xelha inlet and the lagoon at Muyil). It is not clear which was earlier, although there are indications that portions of Muyil's system may be Classic rather than Postclassic (Witschey 1993:185–186).

Thus, at many sites throughout the northern and southern Maya lowlands, there were obvious efforts to emulate centers perceived as either being more powerful at the time of the building program or possessing historical significance of some kind. In doing so, a given site not only demonstrated its own importance; it may have also been engaging in a competition with its neighbors with regards to monumental architecture (see Kurjack 2003 for a discussion of palaces serving this same function). As large-scale features that underscored the linkage between various elements, sacbe arrangements were among the key elements included in these programs of emulation and competition. In addition to expressing personal political power and the overall wealth of a community, these agendas sought to demonstrate real, or desired, affiliations with the sovereigns and sites responsible for executing the original models (Ashmore 1989:273, 283, 1992:174). Although certainly not all aspects of site planning were politically determined, political strategies must be considered as a significant component in most explanations of settlement ordering.

At the same time, it would be overly simplistic to assume that, even if political considerations were paramount in site planning, models might be easily found for most sites. In addition to changes made to meet the demands of the local topography and potentially variable budgets, most Maya sites, viewed as ruins today, are palimpsests of multiple, layered building programs and uses involving construction and destruction over long periods of time (Ashmore 2002:44; Dunning et al. 1999).

The Termination of Political Relationships

Just as the presence of a sacbe may represent the extension of political power or social alliance, cutting or destroying roadways can signal the disruption of such an association (Kristan-Graham 2001:352). Krochock (1995) describes a road abruptly ending before it reaches the platform where Chichén Itzá's Temple of the Hieroglyphic Jambs and Structure 6E1 are located. She suggests that the causeway may have been ritually terminated at the same time that masonry was added to seal off inscriptions related to the founding of Chichén Itzá.

Social Functions of Sacbeob

Cross-culturally, roadways and other architectural elements have been used to enhance social integration within and among communities. In their analysis of the role of Anasazi kivas, Adler and Wilshusen (Adler 1989; Adler and Wilshusen 1990) utilized the work of Johnson (1978, 1982, 1983) in conjunction with a database of twenty-eight ethnographically documented societies to examine the factors that condition the presence and scale of integrative facilities. Johnson has proposed that all human groups have organizational challenges resulting from the stresses of controlling information and making decisions; he uses the term *scalar stress* to refer to decision-making difficulty increasing exponentially with group size, noting that as groups get larger, the size of the basal unit increases. Therefore, according to Adler (1989:41), as the size of the basal units increases, the size of integrative facilities also becomes greater. He further observes that high-level integrative facilities (meant to be used by an entire community) are not only more common among larger groups but also more monumental in scale and the functions that take place in them include fewer nonritual activities. Rappaport (1979) and Turner (1969) have proposed that rituals are efficient means of disseminating information to large numbers of people using "liturgical order" (Rappaport 1979:192) to streamline the messages being encoded. Thus, larger groups not only are likely to have larger integrative facilities but also are probably going to do more ritual activities in those facilities. In addition to the activities carried out in and around the feature serving to integrate the community, the process of building the facility would also increase group cohesion (Adler and Wilshusen 1990:141).

Although Adler and Wilshusen (Adler 1989; Adler and Wilshusen 1990) focused primarily on structures, other researchers have described how features other than buildings may have similar integrative functions. Rautman (2000), based on excavations at Kite Pueblo in New Mexico, describes the construction, maintenance, and enlargement of the site's central plaza as providing a public context for individual and group activities that would have been an important factor in establishing and maintaining a community identity. During a fifteenth-century period of immigration and population aggregation, the use of multistory room blocks and the addition of additional plazas provided a compromise that allowed new arrivals to retain some of their prior community organization while being integrated into the growing pueblo. In this same region of the world, at Chaco Canyon, a road network was used to link more than one hundred communities that came together as part of periodic festivals and pilgrimages (Malville and Malville 2001). Although such occasions may have provided leaders with the opportunity to display their wealth and power, the larger Chaco Canyon area may also have become culturally integrated without administrative or political control, through the act of walking together to the regional center, as well as taking part in rituals.

In the Maya area, it seems quite reasonable to hypothesize that the construction, maintenance, and use of sacbeob would have similarly served to integrate social units of varying scales, from related kin groups to entire settlements to multiple communities. Kurjack (2003) writes that settlement maps may be interpreted as interaction diagrams of the social organization of a community. As such, the existence of a stone roadway connecting two or more architectural complexes clearly signals a strong relationship between the inhabitants of the two locales. Additionally, such a causeway would also facilitate the maintenance of such a relationship through enhancing communication flows and "channeling interactions" between the two units (Kurjack 1977:224, 1994:309). Although this type of connection would probably include the other functions discussed elsewhere in this chapter, separate social functions for roadways can also be identified, to some degree. Following Kurjack (1994), Kristan-Graham (2001:351) suggests that an examination of roads and their connections allows them "to be read as organizational charts of social structure." As such, they may indicate kin and corporate alliances between distinct sites, as well as between social groups within a community.

In addition to kin-based units, such social groups might have even been based on unifying factors such as common geographical origin or occupation. Krochock (1988) describes how, at Chichén Itzá, Causeway 7 linked the Temples of the One, Three, and Four Lintels, the Temple of the Initial Series, and the Monjas. Hieroglyphic inscriptions at each of these locales treat related subjects, although clearly each complex was the residence of a different extended family. Cobos (2003:245, 259) reports that this sacbe and some of its associated structures (Temples of the Three and Four Lintels) were built during the early Sotuta phase, when the Monjas Complex functioned as the site's center.

At Caracol, both sacbeob and vías connected certain residences to specific architectural groups, reinforcing social ties between particular social units (Chase and Chase 2001:276). Some palaces appear to have been purposefully bypassed, whereas others were connected during the process of Late Classic causeway constructions at the site. Tzum (Von Euw 1977) and Sayil (Sabloff and Tourtellot 1991; Tourtellot and Sabloff 1994) also display examples of elite residential groups directly integrated into the site core through causeways.

Functions of social integration and relationship maintenance would have also characterized roadways linking spatially discrete sites that may or may not have been politically independent at the time of the road construction. Calakmul's Sacbe 5, to El Mirador, connects two sites thirty-eight kilometers apart and may continue from El Mirador to Tintal (Folan et al. 2001b:294). However, the road has not been ground-truthed, and very little is known epigraphically of Formative Calakmul (Folan et al. 1995b:325; Marcus 2004:16–17), hindering speculation about social ties between the centers. In other cases, such as Cobá's roadway to Yaxuná (Shaw 1998; Villa Rojas 1934) and Ixil (Folan 1977a), the power relationship is clearer, yet the degree to which the enhanced communication network provided by the sacbeob affected everyday social relationships is not known. Caracol's more distant ring of causeway termini was added only after urban sprawl had engulfed the formally distinct settlements (Chase and Chase 2001:276).

Water-Management Functions

As sacbeob are not uncommonly associated with water features of varying kinds, it is reasonable to consider that roads may have been

utilized as a part of a site's overall water-management system (Ashmore 2002:41; Scarborough 1993). Bolles and Folan (2001:304) write that buth be, or stone-filled roads, are particularly associated with crossing wet terrain. Examples at Cobá include the road to Ixil, which crosses a marsh, and Sacbe 10 that links Laguna Zacal Puuc and Yax Laguna (Bolles and Folan 2001; Folan and Stuart 1983:65–66). Calakmul also includes a number of causeways that traverse its fifty-six aguadas (Folan 1992b; Folan et al. 2001b). The El Mirador causeways, elevated slightly above the water table, served as accessways into bajos (Dunning et al. 2006:89; Scarborough 1993:29–31).

However, merely using causeways to cross such obstacles does not necessarily imply a function in water management. Scarborough's work (1983, 1991b, 1992, 1993, 1998, 2003; Scarborough et al. 1994) has included some of the most directed efforts to investigate the ways in which various types of site configurations, including sacbeob, helped to manage water at a number of sites. At El Mirador, gaps in the four of the six major causeways appear to have been designed to permit the flow of water through the causeway system. Some roads at the site are positioned to impound and divert water to select locations, acting as dams or dikes (Dahlin 1984; Dahlin et al. 1980:41, 45, 47–48, 2006:89; Scarborough 1993:31, 2003:51–52). At Cerros, a sacbe was constructed by quarrying material from adjacent low-lying areas, creating reservoirs. The presence of the roadway through this zone divided the area into two water sources, in addition to connecting a residential zone to the ballcourt (Scarborough 1983:727, 1993:38). These examples indicate that, by the Late Formative, sacbeob had already taken on hydraulic functions.

During Classic times, some Maya roads continued to include water-management functions. Tikal's extensive core utilized a variety of types of architecture, including causeways, to direct and store water (Scarborough 1993:44–47, 1998:139–145). Dependent on the collection of seasonal rainfall to sustain its population, Tikal's monumental architecture formed a series of six major impervious catchment areas (Harrison 1993:84). Scarborough describes the system as "convex" (versus the "concave" systems typical of Formative sites) in that its core area was elevated above the remainder of the site. Other examples of sacbeob with potential water-management functions include X-ual-canil, where Schwake (2000:98) has found that the Lahkin Sacbe is also associated with drainage features leading to agricultural

fields below the site, and El Pilar (Ford 2001:17–18), whose Brian and Murphy Causeway contains breaks, like those at El Mirador, that permit the flow of water where major drainage channels cross the roadway. Outside the Maya area, causeways were used during the Postclassic to control the salinity and distribution of plants and animals in the Mexico–Texcoco lakes (Carballal Staedtler and Flores Hernández 2006:164–167).

Rituals and Sacbeob

As discussed earlier in this chapter, roadways would have served to socially integrate various populations through their construction and use. Adler and Wilshusen (Adler 1989; Adler and Wilshusen 1990) point out that these integrative functions would have been likely to include rituals when used by larger populations. Although at some settlements the sacred or ritual nature of causeways appears to have been downplayed, evidence from many other sites indicates that roadways played an important part in Maya rituals (Bustillos Carillo 1964:25–26, 35; Diaz-Bolio 1989:11). Although the symbolism behind the selection of roadways for such purposes is discussed later in this chapter, arguments and evidence that one of the primary functions of sacbeob was for use in rituals are reviewed here. Such ceremonies could be called religious in Western terms, but this does not mean that they would not, or could not, also have had clear political, economic, and social purposes.

Postconquest observers have reported that the principal function of causeways was to serve as pathways for ceremonial processions and pilgrimages among related nobility (Schele and Freidel 1990:498). Landa (in Villa Rojas 1934:189; Tozzer 1966 [1941]:146) was the first to point out the existence of roads in the Maya area and separately mentioned processional routes within settlements. Cogolludo commented that Maya roads were like caminos reales, guiding travelers to Cozumel to fulfill their vows (Tozzer 1966 [1941]:109). Lizana (1988 [1633]:56) remarked on their function as being related to offering alms and making pilgrimages, as well as visiting "oracles at Itzamut-ul and Tiab-ul." In reference to the Cobá–Yaxuná Sacbe, Molina Solis (in Villa Rojas 1934:207–208) says that the journey along an intersite road was a "true religious pilgrimage," with pilgrims burning copal incense at temples along the route.

On Late Postclassic Cozumel Island, sacbeob were used to connect main temples and colonnades to household shrines (Freidel and Sabloff 1984; Freidel et al. 1993:162). Freidel and Sabloff (1984:82) believe that roadways within sites would have hosted processions, while intersite roads functioned as pilgrimage routes.

Relying on information from excavations in Mayapán's principal sacbe and its terminus groups, Pollock (1954, 1956) postulates that the roadway served to connect an elite domestic unit (Structures R-95 to R-99), or palace, to a domestic-ceremonial group (Z-50). The function of the road appears to have been ceremonial, potentially a procession path for the occupants of the group formed by Structures R-95 to R-99, although it certainly would have had social and perhaps political implications as well. Pollock believes that the connection between the two groups was completed relatively late in Mayapán's main occupation; this occupation is now dated to have begun around AD 1050/1100, with major constructions continuing until around AD 1350–1400 (Milbrath and Peraza Lope 2003:21–24; Peraza Lope et al. 2006).

Kristan-Graham (2001:352–354) writes that travel along the causeways of Chichén Itzá would have brought together political, social, and cosmological referents. "The populace moving along the roadway paralleled the way the universe worked, equating the immutable order of the cosmos with the natural social order" (Kristan-Graham 2001:353). Although such processions may have related to the calendrical symbolism noted in Chichén Itzá's architecture by Aveni and others (2004), ritual processions on the site's sacbeob might have also paralleled historic migrations, like those detailed in the Books of the Chilam Balam (Roys 1967) and the Popol Vuh (Tedlock 1985).

Still other Classic Maya sites exhibit what appear to be internal procession ways. Tourtellot (1988) has suggested that Sayil's internal causeway connects a number of functionally distinct locations, serving as a ritual procession path from the ruling family's residence to an architectural group including the ballcourt. The ballcourt was aligned in a manner that physically recorded the Maya solar calendar (Aveni and Hartung 1986:39), and this alignment was replicated in later structures at the site. The road system of Ek Balam may have also been utilized for procession ways, as the five sacbeob terminate in complexes of elite architecture that generally included temple assemblages (Ringle et al. 2004:497). The Late Classic construction of the

Lahkin Sacbe at X-ual-canil (Schwake 2000:98–99) is also associated with the construction of a ballcourt at the site. Additionally, a possible "reviewing stand" (Structure 14C) along the course of the causeway provided a platform from which processions might have been viewed.

With the exception of short causeways to permit movement across its defensive ditches (Haviland 2003:134–137), Tikal's causeways also appear to have bound primarily ritual loci together (Carr and Hazard 1961; Chase and Chase 2001:279). Terminating at special-function groups containing temples, the roads at Tikal were built to permit the passage of large numbers of pedestrians at a single time. In contrast to the network at Caracol, Tikal's sacbe system was not designed to integrate outlying settlements or the site as a whole. Instead, it was ideal for specialized ritual processions between ceremonially significant groups in the core area, with constructions and refurbishments being carried out as part of major plaza refurbishments (Jones 2003:212–213).

Change through Time

The case for ritual sacbe functions is evident at a number of sites. Yet despite the clear emphasis on ritual functions for roadways at Cozumel, Freidel and Sabloff (1984:82–83) admit that the purpose of causeways may have changed through time. Many Classic Maya sites would have used their roadways for practical transport, as well as the water-management, political, and social purposes already addressed. During the Postclassic, sea transport was utilized to a greater degree than previously (Sabloff and Rathje 1975), potentially decreasing the roads' function of practical transport. At many Maya sites, analogous functional shifts are seen for a number of different feature classes, probably including roads. What had been elite domestic, temple, and administrative structures became capped with small shrines. With many formerly important sites being visited only by pilgrims and having little-to-no resident population, roadways at these interior sites, if used at all, may have also become procession ways, as evidenced archaeologically through the presence of features such as altars, associated directly with causeways at Yaxuná, Yo'okop, and other sites. At the same time, Postclassic coastal sites such as Xelha and Muyil (Witschey 1993) show that sacbeob continued to be used for other purposes.

Symbolic Meanings and Functions

As already discussed, one of the more obvious symbolic functions of causeways was to serve as a physical reminder of the political, economic, and social relationships between the human groups associated with different spatial locations at a given time. In addition to the practical advantages of roadway use for such a connection, causeways may have been selected for this use because of the complex cosmological meanings associated with them.

Astronomical Alignments

One of the ways in which such symbolism is most visible is in the physical position and orientation of the roadways. Folan (1991:226–227) states that, like other types of monumental architecture (see Aveni 1980; Aveni et al. 2004; Fuson 1969), some sacbeob may have been laid out in alignment with significant astronomical bodies. According to Folan, Cobá's Sacbe 6, from the Ixmoja Temple to Chan Mul, appears to align with the rise of Sirius. Additionally, the angle created by Sacbe 5's link between the Ixmoja Temple and Telcox may be directed toward Canopus. The Ixmoja Temple's connection to Manaachi (Sacbe 19) could align with the Pleiades, as well as the summer solstice sunrise and winter solstice sunset. Sacbe 7, from Ixmoja to Kanakax, and Sacbe 30, to Pakchen, may also align with the Pleiades, moonrise minimums, and moonset minimums. Finally, Sacbe 10 to Yax Laguna may align with the first-magnitude star in Cygnus.

Dunning (1992:147–148) writes that the Uxmal–Nohpat–Kabah road system is part of a geomantic alignment that recreated the celestial serpent on the landscape. A southernmost Venus alignment between the Governor's Palace at Uxmal and a pyramid at the site of Cehtzuc is also part of these astronomical references. When this alignment is continued to the west, it bisects a gap in the area's hills. Venus symbolism and celestial serpents also feature prominently on the facade of the House of the Governor and the east and west buildings of the Monjas quadrangle (Lamb 1980).

The Kušansum Concept and Mythological Roads

Sacbeob have been further related to the *kušansum* concept of the Yucatec Maya, frequently pictured as twisted cords, which provided an

axis mundi for their model of space (Miller 1974). As with other architectural models of cosmological concepts (see Ashmore 1991:201), the sky road—associated with the Milky Way or the movements of planets along the ecliptic (Freidel et al. 1993:76–78)—is also believed to have a terrestrial counterpart. This is a quadripartite system of roads starting from a center at Chichén Itzá and continuing to Cobá and Tulum, as well as Uxmal (Paxton 2001:126–127). According to Folan's (Bolles and Folan 2001:300–301; Folan 1992a:340; Folan and Stuart 1983:38) consultants from Cobá, such a road, constructed by the Itzá king Macehualo, connected Tulum, Cobá, Zaci (Valladolid), and then Ichcantiho (Mérida). Folan's consultants report another kunsansum between Dzibilchaltún and Izamal, which also connects Ix Chel (and the Cenote Xlacah at Dzibilchaltún) with the Virgin of Guadalupe at Izamal (Folan 1992a:343). Elsewhere, Folan (1991:224–225) reports that local tradition in Cobá also includes a land-level sacbe between Cobá and the Cenote Sagrado at Chichén Itzá, and between the Cenote Sagrado and Mexico City. He believes that this road may relate to an underground passage between the Cenote Sagrado and the Cenote Xtoloc, running under the Temple of Kukulcan. According to Folan, this may be further associated with the Hero Twins route in Xibalba. "[H]alving the cord, stretching the cord in the sky, on the earth, the four sides, the four corners" is mentioned in the Popol Vuh as part of the ritual to complete the emergence of all the sky-earth (Tedlock 1985:72). Miller (1974:172) likens the connection to a human umbilical cord, cut to sever mother from infant or, in this case, natural from supernatural.

Tozzer (1978 [1907]:153) collected an early-twentieth-century story describing the kušansum as a large rope through which blood flowed. This connection, which had served to send food to ancient rulers living in the structures, had been cut and vanished forever. The kušansum was in use when dwarfs, said to be responsible for the construction of the peninsula's ruins, inhabited the region. They were subsequently turned to stone, visible at many sites today (Thompson 1970:341; Tozzer 1978 [1907]). Folan's (1992a:340; Bolles and Folan 2001:300–301) consultants from Cobá report that the celestial road, wide enough for use by an army with horses, was cut by the Mexican army as an act of war.

Such mythological subterranean passageways are not uncommon in modern Yucatec Maya folklore. Individuals living near sites within

the CRAS research area frequently report the existence of such connections between a number of sites with mounds over five to six meters in height and Maya sites currently receiving public attention, such as Cobá, Chichén Itzá, and Tulum. Bolles and Folan (2001:301) write about modern Maya beliefs in connections between Acanmul and Uxmal, and Copán and Quirigua. When Villa Rojas (1934) conducted his 1933 survey of the Cobá–Yaxuná Sacbe, the area around the site of Cobá was not inhabited, yet the residents of the region believed that people still dwelled underground at the site, living in the same manner as its ancient inhabitants. Roys and Shook (1966:44–45) relate another story about a Maya roadway, told by laborers employed to work at Aké. In ancient times, according to the legend, the kings of Aké and Izamal were cousins. So that tortillas might be delivered from the kitchen of the king of Aké to Izamal, a road was built to link the two cities.

Considering Functions of Sacbeob

The potential, and actual, functions of Maya roadways are thus quite variable. They transported observable, physical cargo and may have also served to direct or contain the course of water. At the same time, they allowed the flow of less tangible concepts, such as political power, social relationships, and mythological forces. The purpose(s) and function(s) of a given sacbe would have likely varied though its use life and according to the viewpoint of the individual observer. Therefore, no causeway should be said to have exclusively one function; however, the examples reviewed in this chapter indicate that, in some cases, one may reasonably speak of a roadway being more or less suited to, or likely to have been used for, a particular purpose.

8

Explaining Sacbe Presence and Absence

Having reviewed the possible functions that Maya sacbeob had, one should not have difficulty in imagining why many sites included one or more raised roads as a part of their site plans. The various types of causeways seem to have simultaneously served practical and symbolic functions that would be difficult to fulfill with any other single class of features. Yet despite the seemingly obvious advantages of such roadways, they are not present at every Maya site. A number of potential variables and alternatives may be explored in an attempt to explain the presence and absence of sacbeob.

Potentially Significant Variables

Spatial Patterning

One of the first ways to begin searching for patterning with respect to the presence or absence of causeways is to look for the existence of nonrandom spatial distribution. If a zone with a greater or lesser number of roadways is detected, this could relate to factors such as geographic or geological conditions, (sub)cultural differences, local political factors, economic exchange, or any number of circumstances that might vary from zone to zone.

Maldonado Cárdenas (1995:70, 86–89) wrote that large sites with extensive sacbe systems were a northern, regional phenomenon, most developed at Cobá. A review of the sites in this sample does show clusters of sites with sacbeob, such as in the Puuc area and the northern lowlands, as well as in northeastern Belize and in parts of the Petén. However, I believe that these concentrations do not necessarily reflect the actual sacbe distributions in the past. Instead of revealing past reality, the concentrations most closely relate to the zones that

have been subject to study in recent decades because of historical, political, economic, and logistical considerations and conditions. This is not to completely deny any potential for spatial patterning—indeed, models based on the emulation of important sites or a greater need for raised roads under certain natural conditions would predict a nonrandom distribution—but rather to admit that the current sample cannot pretend to be unbiased in the creation of apparent spatial distributions. A more important consideration, even if one ignores the bias in the current sample, is that there is no clear evidence to argue that sacbeob are more likely to be found in a relatively wet versus dry climate, in northern versus southern zones, in association with any particular vegetation or soil class, or in any specific topographical setting.

Temporal Patterning

Another simple explanation for some sites having sacbeob while others do not is that sacbeob were a phenomenon specific to a limited period of time. Unfortunately, many roadways remain undated because of the difficulty in associating them with sealed, excavated contexts or dateable materials, as well as a focus on excavating other types of features at most sites. However, causeways that have been subject to some sort of chronological assessment do not appear to fall into, or avoid, any single time period. The sample gathered in this research (see appendix) includes roadways dated from as early as the Middle Formative to as late as the Late Postclassic.

Kurjack (1977:225) believes that the earliest roads in the Maya area would have been of a shorter distance and less elaborate type, built within settlements, rather than between them. He cites the internal roads of Tamanché as examples of Late Formative roadways, with the two short Olmec causeways at San Lorenzo also being consistent with this hypothesis (Cyphers and Zurita-Noguera 2006:40). In the Maya area, Yaxuná (Johnstone 2001c) and Komchen (Ringle 1985:114–115) also include early internal causeways. Certainly, the relatively late examples of the impressive hundred-kilometer Cobá–Yaxuná Sacbe (Shaw 1998; Shaw and Johnstone 2006; Villa Rojas 1934), the extensive Late Classic Caracol system (Chase and Chase 2001), the newly documented Chichén Itzá causeways (Cobos 2003; Cobos and Winemiller 2001), and the road networks of Yo'okop and Ichmul (see chaps. 2 and 3) are consistent with this hypothesis. How-

ever, the undated Sacbe 5 that Folan and others (2001b) believe went to the Formative power of El Mirador, thirty-eight kilometers distant, could be a major challenge to any possible pattern, as might other early, extensive roadways, such as the El Mirador–Nakbe causeway, which has been associated with Chicanel ceramics (Suasnávar 1994:337).

At this point, with so few sacbeob having been accurately dated, it is difficult to make secure statements about trends or patterns through time. If any temporal patterning is present, it may relate to the stage at which a particular site was prosperous enough to afford road construction and had specific needs that could have been met by a sacbe or sacbeob. What is evident is that Maya road construction was clearly not limited to just one time period, just as it was also not restricted to solely one zone.

Site Size

The size of a given site also cannot necessarily predict whether or not it will possess one or more roadways. My sample includes what may have originally been independent, small sites being tied to regional capitals using sacbeob, such as in the systems at Caracol (Chase and Chase 2001:276) and Ichmul (see chap. 2). There are also small sites with more-ambiguous political affiliations, such as Chuh' kú (Robles Castellanos and Andrews 2001:fig. 10), and secondary centers, such as Pusilha (Braswell et al. 2004b:fig. 3), that contain internal causeways. As with any other category of monumental architecture, minor sites do not appear to have built the longest, largest sacbeob without some assistance from, or at least relationship with, a more significant center. However, the largest, most powerful Maya sites did not all make major investments in roads—at least, not as major infrastructural components (such as at Copán; Fash 1983, 1991; Willey et al. 1978)—just as not all major sites were heavily invested in other types of architectural features such as ballcourts, range structures, temples, or sweatbaths.

Rather than a particular physical size being the criterion for road construction, it may be more meaningful to look at the relative growth of the site; sites faced with growing populations may have felt more of a need to use roadways for integrative and other functions. Marked population increases may have also been necessary to provide the resources needed to build a causeway.

Why Were Sacbeob Built? A Combination of Factors

Thus, as with most other questions worth investigating, it is most likely that a decision to build, use, and maintain a sacbe at any given place and time was likely the result of considering, perhaps consciously and unconsciously, a number of different factors. Which site(s) or ruler(s) might it be advantageous to emulate? What aspects of another entity needed to be re-created at the given site? How might a certain cosmological tie be created? What might the cost of such a venture be? Who would pay these costs? Where and how might a roadway help to fulfill the transportation needs of a given zone? What might the presence of a causeway signal politically? What supernatural and practical advantages might be gained or maintained? Was the site growing through immigration or natural population increase? How dispersed was the population considered to be part of the site? If the existence and course of our modern roadways can entail balancing the needs of everything from governmental budgets to political favors to environmental impacts to the concerns of native peoples, it is little wonder that the presence or absence of ancient Maya sacbeob cannot be predicted in any simple fashion.

At the same time, if causeways can be said to have had so many marvelous possible symbolic and practical functions, why were they not used at all sites? Altar de Sacrificios, Culubá, Kohunlich, Palenque, Piedras Negras, Yaxchilán, and a host of other sites in the north and south with monumental architecture did not build roadways. This situation may potentially be explained in a simple manner: first, there were disadvantages, such as the cost of building and maintenance; and second, there were alternatives that could fulfill some of the critical functions.

Substitutes for Sacbeob

It seems impossible to think of any other single feature that might truly take the place of a Maya sacbe, fulfilling all of its potential functions. However, other types of features could have provided adequate substitutes to fulfill one or more given functions. Although, of course, less archaeologically tangible programs of propaganda, threats, ideology, or promises might have been utilized to achieve these ends, the potential of observable physical features, including plazas or court-

yards, walls, water-management features, structures, brechas, and other features are reviewed here.

Brechas and Other Cleared Pathways

As Bolles and Folan (2001) point out, based on linguistic evidence, a sacbe is only one of the types of "be" utilized by the colonial, and presumably ancient, Maya. The degree to which the Classic Maya saw these various roads and paths as separate feature classes is certainly debatable, but cleared (versus constructed) passageways obviously leave a much less visible archaeological signature than sacbeob do. This does not mean, however, that such pathways were unimportant to the occupants of the region.

In the modern Spanish of the Yucatán, the term *brecha* tends to be used for a recently cleared, generally straight pathway between two points. *Camino* ("road") refers to a pathway that is clearly defined and can be traversed, although the term might be applied by the Maya to anything from a narrow, winding dirt-and-bedrock trail only passable on foot to a paved highway. Examples on the smaller end of the spectrum are used to connect Maya pueblos with distant milpas, beehives, livestock pens, water sources, and other settlements located away from modern roads. Such footpaths may see as much traffic as some of the paved roads within the region, even though they have not received any support from a governmental source and were created on an ad hoc basis. In some cases, footpaths are widened to allow truck passage, then perhaps formally defined by stones, and sometimes eventually paved. At other times, the paths are abandoned when the needs of the community or group change.

In the past, such footpaths may certainly have formed the basis of what developed into a sacbe route. However, it seems logical that, as is the case today, the majority of such features would never have been formally defined despite their critical contribution to a given settlement's infrastructure. If reasonably straight and clear, there seems to be little economic incentive to invest in further clearing, quarrying, and stonework to convert a serviceable footpath into a sacbe. Without mechanized conveyances or beasts of burden, the need to pave and widen a trail would have been less pressing. In areas not plagued by regular flooding, such a substitution or conversion probably took place only when a feature with additional political, social, ritual, or symbolic functions was required.

Plazas and Courtyards

As Kurjack and Garza Terrazona (1981:302) note, there are clearly Maya site plans with two or more architectural clusters that lack uniting causeways. Within the cores of sites, and in other densely settled areas, plazas and courtyards may have also taken the place of causeways, in that they allowed for the movement of people and goods through a given congested zone. At the same time, an open plaza area may have served the symbolic function of uniting the structures, and associated human occupants, around its periphery. Furthermore, in the same way that a raised road might provide the space for a ritual procession to take place, a large courtyard would supply an area in which a public or private ceremony could be carried out. Freidel, Schele, and Parker (1993:139) point out that in Classic Maya texts, the word *nab* stands for both plazas and large bodies of water. Sunken courtyards may have represented pools of water that served as portals to the Otherworld that could be shared by the surrounding structures. Of course, most sites with sacbeob also contain plazas of some sort, indicating that one was not able to entirely take the place of the other.

Dunning (1992:111–114, 1994:24) defines his "Nohpat/Yakalxiu Plan" as one in which the major structures within a site's core are arranged around a series of contiguous and semicontiguous courtyards. These open areas served to unite elite residential and civic/ceremonial constructions and activities within the site center. In the Santa Elena and Bolonchen districts of the Puuc region, sites with this type of plan include ballcourts, stelae platforms, altars, and elite residential compounds, as well as large platforms and pyramidal structures. Smaller sites may include only one central plaza, while larger sites utilize multiple plazas that are either contiguous or share a connecting architectural link. Likewise, the "typical" Yucatecan colonial town had civic, religious, and elite residential structures surrounding a central plaza, with commoners living in a larger surrounding ring (Tozzer 1966 [1941]). The use of plazas to allow public access to important core areas is certainly not a northern phenomenon; Lubaantún (Hammond 1972) and Dzibanché (Nalda and Campaña 1998) are among the many settlements in which open spaces unite the components of the site center.

Similar smaller-scale, open areas bounded by ordinary dwellings are also observable at many Maya sites. Although they would have

required the initial and continued removal of vegetation and cultural refuse, these zones (largely created by not building in a given area), would have been quite low cost. Indeed, beyond cleaning, the main "cost" associated with maintaining such a plaza might be seen in terms of loss of prime real estate.

Walls

At some Maya sites, walls have been used to create passageways that may have taken on some of the functions of sacbeob, as well as to limit access or direct the flow of movement within a given zone. As delineated, rather than constructed, space, they provided passage through congested or limited-access areas with much less material investment than an actual elevated and leveled roadway might have required. Other sites' wall examples do not create such formal passageways but may have mimicked some functions of causeways in their ability to direct or limit flow between certain spaces.

The site of Chunchucmil provides excellent examples of walls being used to direct pedestrian circulation. Although the site has eleven known sacbeob, it also has two- to four-meter-wide callejuelas formed by albarradas. Sacbe 1 connects to one such callejuela, which extends for at least another kilometer. Albarradas are used to separate residential from public areas. Together, the callejuelas and causeways provide a "transportation matrix" allowing ready access to and from residential groups, civic/ceremonial groups, and other specialized zones (Dahlin 2000:284–287; Hutson et al. 2006).

Nalda (1989:17–21, fig. 10) describes analogous linear features in southern Quintana Roo. Some walls simply functioned to define habitation and agricultural units, equivalent to today's solares and smaller milpas (or Fletcher's [1983:94–97] Linear Feature Types I and II walls at Cobá). Other linear features helped to trap and retain soil, preventing erosion, including those reported by Ruppert and Denison (1943:13, 50) near Calakmul and Oxpemul and by Wauchope (1934:133–136) for Uaxactún. Still other walls reported by Nalda were wider, lower and straighter, used to connect different sites as well as structures within sites. Nalda refers to these as sacbeob but implies that they are narrower than average causeways. He believes that some may have functioned as elevated walkways, perhaps used for ceremonial processions. Thomas (1981) also describes linear features that may be terraces or elevated walkways at Becan.

Fletcher (1983:92–93, 97) includes double-faced linear features wide enough to have served as walkways in her study of linear features at Cobá. She found that some walkways were associated with important natural features, such as water and sascab, as well as architectural features. Some double-faced examples were associated with resources but not visible architecture, while others led from architecture to an open area. She postulates that these may have been for defensive purposes. Additionally, she reports single-faced walls that connected directly to sacbeob, potentially to inhibit movement or limit access.

At many sites, walls served not only as potential defensive features but also as "material delimitations" of elite or special-purpose zones from ordinary domestic sectors, as Barrera Rubio (1981:73) believes Uxmal's wall would have done. San Pedro Sacalaca, located in the CRAS study area, contains what may be a similar feature on a much smaller scale. Here, a wall that was originally one meter high and eighty centimeters wide connects two elite residential platforms. With dimensions making it a bit too high and narrow to have functioned as an actual walkway, it seems to have served to divide two areas spatially, although no further encircling features completely enclosed the bisected areas (Shaw et al. 2004). In addition to its more obviously defensive walls, Yo'okop also contains lower walls that divided or enclosed space in some manner. Potentially analogous linear features have been reported from Cozumel (Rathje and Sabloff 1975:78; Sabloff et al. 1974:404–406; Sanders 1955:196), Las Ruinas (Andrews 1943), and Uaxactún (Wauchope 1934), among other sites.

Structures and Other Features

A final major category of potential sacbe substitutes includes the construction of a structure of some type to fulfill some of the functions that might otherwise have been realized by the construction of a sacbe. While certainly not a no-cost option, constructing an outlying group or administrative structure in a given location (rather than paving the entire linear distance between that point and the site center) might have been a lower-cost alternative. In addition to emphasizing political ownership or social affiliation, such a building would have practical functions that no roadway would, as a locus for administrative, religious, economic, political, and social activities. As discussed in chapter 3, the site of Yo'okop appears to have used the strategy of multiple, distinct major architectural groups, rather than

just one site core, for most of its occupation before connecting these loci with roadways in the Terminal Classic.

The site of Nakum displays an interesting use of structures in a manner similar to walls. On the northern extension of the site center, long connected sets of range structures are used to divide space and create what would have functionally acted as a roadway (Tozzer 1913:plates 32 and 33), similar to the vías at Chacchoben (personal observation). The structures funnel traffic into a limited space, the Great Plaza, and prevent easy egress for some distance to the north.

Similarly, investing in water-management infrastructure in areas away from the site core may have served an integrative function. The site of Edzná—with its extensive system of canals to drain, collect, store, and distribute water—provides an excellent example of such a program (Andrews 1984; Benavides Castillo 1997; Matheny 1978). As Benavides Castillo (1997:126, 127) points out, the centralized construction of this network would have not only allowed for more intensive agricultural production but also strengthened the government. This governmental power would have resulted not just from an appreciation for the infrastructure but also an increasing dependence on the existence of the facilities that permitted such production. Edzná does include one internal roadway, but it seems to have been constructed more as an afterthought, butted against existing architecture, rather than as part of any major program equal to that of the water-management features. According to Matheny (1978:199–201), the hydraulic system's several canals and aguadas were built during the Late Formative period as part of the original city plan, their alignments radiating from the center of the settlement in a manner similar to the roads of Cobá.

Cautions in Explaining Sacbe Presence and Absence

Rather than presenting definitive data or hypotheses attempting to explain the presence or absence of Maya sacbeob, this chapter largely serves as a suggestive and cautionary tale. Instead of facilitating the exploration of factors that might be conditioning the construction of roadways, our current knowledge base best permits a discussion of issues to consider as future researchers may attempt to arrive at such an investigation.

The first major issue is related to the fact that many Maya sites had extremely long occupations. Rather than asking simple questions such as "Why did site X build a road?" researchers should more appropriately ask, "At the time that the road was built, used, and maintained, what factors may have conditioned this investment?" "Why wasn't it built earlier or later?" and "Why wasn't it maintained after a given time?" or even "Why was it reused during a later period?" Such questions require, minimally, an ability to date a given road to a certain time period. Ideally, a more fine-grained dating technique, as well as an understanding of the political, social, and natural climate and the belief system peculiar to the people of that place and time, would be required to begin to test potential predictive hypotheses. Chapters 9 and 10 address these questions for the sites of Ichmul and Yo'okop and their Terminal Classic road systems.

The second major issue is that, although archaeologists may call a certain class of highly variable, raised stone roadways "sacbeob," there is no way to know what, if anything, this category meant in the past for the ancient Maya. Ethnographic and ethnohistoric evidence indicates that more-recent Maya peoples used a variety of terms for what they see as distinct types of features. For some questions this may be irrelevant, but for others it is not. Any consideration of the entirety of a site's transportation network should not focus exclusively on the more-obvious raised stone causeways; it should take into account other, less visible, connections between loci, be these social, physical, political, or cosmological (see Normark 2004a and 2004b).

A final potential issue is a tendency to see all Maya sites as similar, if not the same, culturally. However, the formal and functional variability revealed in the pan-Maya portion of this study (chaps. 4–7; see appendix) is consistent with a situation of considerable cultural diversity. As with the term *sacbe*, the term *Maya* has a certain meaning for us today even though most anthropologists recognize tremendous cultural, and natural, diversity within the Maya area at present. Some cultural diversity, be it more or less, certainly existed in the past; this would have resulted in beliefs and practices that would have differed from region to region, if not from site to site. Our assumptions that "the Maya" believed X or practiced Y may be true for particular sites or areas but may not necessarily hold up throughout the region that today is considered to be associated with the ancient Maya.

9

Sacbeob as a Terminal Classic Phenomenon in the Cochuah Region

As discussed, causeways were constructed in the Maya area as early as the Middle Formative and as recently as the Postclassic. In the Cochuah region, the major settlements of Ichmul and Yo'okop were occupied throughout this time span, although each constructed causeways only during the Terminal Classic. Unlike other sites whose road systems were developed over extensive periods of time, such as Chichén Itzá (Cobos 2003) and Cobá (Robles Castellanos 1990), there is no evidence that the Terminal Classic causeways of Ichmul and Yo'okop are modifications of features from earlier periods. Instead, they each appear to have been built entirely from scratch—having been made, used, and maintained only during the Terminal Classic, with the possible exception of minor ritual activities by small groups of later people.

The temporally restricted nature of the phenomenon raises a number of critical questions relevant not only to the Cochuah region but also for researchers at other sites. We might reasonably ask not only why the two regional capitals chose to build roadways but also why the sacbeob were built only during the Terminal Classic. What was unique about the Terminal Classic? What conditions prevailed during this time period, and apparently not earlier or later, that permitted or encouraged the enormous investment in building monumental roads?

An effort to explore possible answers to these questions should consider factors that may be unique to the region, as well as conditions that prevailed over a larger area. Ichmul and Yo'okop are certainly not the only sites to have constructed roadways during the

Terminal Classic. Many other sites also built roadways during this period, while others may have utilized different strategies to respond to what may have been pan-Yucatecan conditions, as well as site-specific circumstances.

A General Chronology for the CRAS Region

As the CRAS project began to establish a chronology for sites within the Cochuah region, an interesting pattern of settlement pattern shifts was recognized. Based on Dave Johnstone's ceramic analyses and architectural styles observed through mapping and excavation (Shaw et al. 2000, 2001, 2002, 2003, 2004, 2005; Johnstone and Shaw 2006), this pattern involved many sites being established by the Late Formative, with settlement concentrating at the major centers of Ichmul and Yo'okop during the Early Classic. During the Terminal Classic, the population of the region increased markedly, becoming dispersed to every site recorded to date (see fig. 2).

The earliest occupations thus far detected in the CRAS study area date to the Middle Formative (ca. 600/500–300 BC). Ceramically, the documented Middle Formative sites in the region possess many of the types present in the Komchen sphere, although they lack a strong Achiotes component.

The area investigated by the CRAS survey experienced a dramatic increase in the number and size of sites occupied during the Late Formative (300 BC–AD 250), the second most populated period of Prehispanic occupation within the region. During the Late Formative, the region can be included in the Chicanel ceramic sphere, dominated by Sierra Group ceramics. There is evidence of plaza constructions and public architecture at the largest centers, with all of what eventually became the medium- and large-sized sites being occupied during this period. All of the settlements with caves evidence use.

In contrast, during the Early Classic (AD 250–550), most of the sites within the Cochuah region evidence little to no population. However, some settlements in the center of the survey area, such as Sacalaca, Nohcacab, San Andres, and Xbalcheil/Xbalche, seem to have maintained very small resident occupations for a portion of this period. Ichmul and Yo'okop, which thrived during the Early Classic, appear to have absorbed populations from their immediate vicinities. Interestingly, the only two relatively minor sites to floresce during

this time were San Felipe and Sisal, in the western portion of the current CRAS study area.

Although extremely small populations have been detected at several of the sites that had Early Classic occupations, the Late Classic (AD 550–850) represents the period of lowest occupation levels for the CRAS study area after the Middle Formative. Only Yo'okop appears to have contained a sizeable resident population during this period; the regional capital seems to have been able to maintain its ties to the Petén region based on the prevalence of tradewares, such as Saxche Orange Polychrome.

The Terminal Classic (AD 850–1100) exhibits an abrupt reversal of the earlier Classic depopulation of the region, with a significant occupation evidenced at every site in the survey area during this period. Ichmul and Yo'okop both experienced booms in the building of public and domestic architecture, including the construction of the two sacbe systems. However, the population was not simply nucleated at these two centers; the marked growth of Ichmul and Yo'okop coincided with a widely distributed, dense population throughout the region. During this period, many of these other sites also invested in monumental architecture, such as the acropoli at Sacalaca and Yo'aktun and substantial platforms and pyramidal structures at the termini of Ichmul's road system. Ceramically, sites within the region can be included in the Western Cehpech ceramic sphere.

The Postclassic (AD 1100–Spanish contact) appears to represent a significant depopulation, with minor ritual architecture at some sites. To date, Yo'okop displays the most activity during the Postclassic, with numerous temples, altars, plaza resurfacing, and a possible accession structure having been constructed. Ichmul, known to have been occupied during Postclassic times (Farriss 1984:149), has thus far evidenced virtually no Postclassic ceramics, indicating that the Postclassic occupation may have been spatially distinct from the Classic, historic, and modern settlement (Kaeding and Flores Colin 2005:44). The vast majority of the Postclassic ceramics that have been recovered within the survey area have been Chen Mul incensario fragments associated with small ritual architecture that had been built reusing components of earlier constructions.

Thus, the construction of sacbeob at Ichmul and Yo'okop clearly correlates with a significant population reorganization within the region. When smaller numbers of people lived within the area or when

large populations were spatially concentrated, road systems were not built or maintained. Only when a dispersed pattern for a sizeable population prevailed were the sacbe systems constructed and actively used. This correlation (as well as other associated panpeninsular events) is explored in the following sections to explain the need for roadways at this time.

Political Changes in the Maya Area

The nature of Maya political entities during Classic times has been the subject of debate for a number of years. While some (Adams 1986; Marcus 1976) argue for larger "regional states" on the basis of the presence of "foreign" emblem glyphs, others (Mathews 1991) reject a hierarchical relationship between sites, resulting in a greater number of political units of correspondingly smaller area. Subsequent decipherments have suggested hierarchical relationships between "possessed" lords and sites. This has led to the hypothesis that many Maya cities were organized into "superstates" on the basis of marriage and alliance networks that persisted for many centuries (Martin and Grube 1995). These hierarchical relationships shifted through time, particularly during the Late Classic, as conflicts between various sites escalated (Houston 1993).

Recent research (e.g., Andrews and Robles Castellanos 1985) has shown that Maya warfare and alliance systems extended over large distances. A Petén Corridor (Harrison 1982:120–121) of sites located near bajos and built in the architectural style of the Petén seems to have extended from the southern lowlands north toward Cobá. This culturo-geographic complex went through Kohunlich and Dzibanché in southern Quintana Roo, possibly reaching Cobá (Schele and Mathews 1998), which would have meant that it extended directly through at least a portion of the Cochuah survey area.

By the Terminal Classic, it has been argued, not only had the long-distance alliances dominated by Tikal and Calakmul broken down, but the system of holy lords or kings, known as K'ul Ajaw, ruling Maya capitals had ended. Demarest (2004:109) believes that kingdoms had transformed into political systems "with significantly different political, economic, and ideological strategies." Other researchers (Carmean et al. 2004:429; Schele and Mathews 1998:259) have argued that divine kingship continued at some northern sites (such as Sayil

and Uxmal), possibly as a continuation of older lineages from the south, while other centers (including Chichén Itzá, Xcalumkin, and Mayapán) experimented with a joint or *multepal* style of organization (Carmean et al. 2004:437; Schele and Freidel 1990:359–364) that may or may not have had southern antecedents (Marcus 1993).

The Terminal Classic period, the most critical time for this study, has been the focus of a number of overviews by Maya archaeologists (Culbert 1973; Rice et al. 2001; Sabloff and Andrews 1986). Views on this period have varied from ones characterized by collapse to those emphasizing transition (Marcus 1993). Hypotheses advanced to explain this period have likewise ranged from relatively simple monocausal to complex systems models. What is clear is that there are important differences in the timing and nature of this period between the southern Maya lowlands and the northern Maya lowlands. At the same time that northern sites (including those in the CRAS study area) experienced a cultural florescence, many southern sites were already abandoned. The Cochuah region does not seem to have ever been a "core" area (as defined by Austen 1978; Rowlands 1987; Santley and Alexander 1992; Schortman and Urban 1994) before, during, or after this transition, judging by the relative size of the sites in the survey area, the very limited textual references, and the flow of trade goods. Rather, the Terminal Classic seems to have marked a transition from a primarily southern core to a northern one.

Epigraphic Evidence of Affiliations

Recent decipherments of Maya texts have shed some light on the nature of the transition, including the founding of new dynasties, the creation of new forms of governance with new political offices and titles, and the sacking of cities (Graña-Behrens 2006; Johnston 1985; Kowalski 1985; Schele and Freidel 1990). Unfortunately, Yo'okop has a very fragmentary written history that pertains only to earlier time periods, and to date, no monuments have been located at Ichmul. Apparently, the residents of Yo'okop ceased to commemorate political events with monuments such as stelae, altars, or hieroglyphic stairs by the Terminal Classic. While troubling in its absence of direct data, the cessation of public writing at Yo'okop was a significant departure for a site that appears to have had a tradition of monument erection.

At Yo'okop, glyphs from earlier periods that have been deciphered show a strong relationship between Yo'okop and the Petén region

during the Early Classic and Late Classic (Wren and Nygard 2005). One glyph block depicts the term *K'awil*, incorporated by some Maya kings as part of their names. A second glyph block denotes the title *Kalomte*, or *Chakte*, associated with rulers at southern lowland sites such as Tikal and Copán (Harrison 1999:79; Stuart et al. 1989). Another glyph block may refer to Calakmul's Ruler 17 (Martin 1997:861), also known as "Sky Witness," indicating that the confederacy between Calakmul and Cobá may have impacted Yo'okop around the same time as Caracol's defeat of Tikal, in AD 562 (Martin and Grube 1995, 2000:17; Schele and Freidel 1990). While these glyphs imply a relationship to the southern lowlands, particularly Calakmul, they do not denote the nature of that relationship. The Kalomte title is superior to that of *Ahaw* (or "lord") and signifies a larger political entity than the city (Harrison 1999; Stuart et al. 1989). Given the relative size of Yo'okop and the existence of Tikal and Calakmul, Yo'okop is unlikely to have been the dominant site in the relationship.

Considering its size and the presence of a significant resident population during the Early Classic, Ichmul might be expected to have also played a part in alliance-based politics between southern and northern powers. However, no epigraphic or iconographic evidence has been discovered to date at the site, possibly because of historic and modern destruction at the site or a political program that did not invoke the use of such monuments. Based on the lack of large temples, ballcourts, and stelae at Ichmul, the latter scenario seems likely.

Architectural Evidence of Affiliation

There were also significant architectural changes that coincide with the Late Classic to Terminal Classic transition. Four architectural styles were present in the northern lowlands during the Late Classic. The first, Petén-style architecture, consists in part of plain, load-bearing walls of roughly quarried stone, slab-corbelled vaults, and plain battered terraces with rounded corners. This style has been noted at Cobá (Thompson et al. 1932:108) and in the Petén Corridor (Harrison 1982:120–121). The Central Yucatán style (Potter 1977) includes corbelled vaults whose stones have either rounded or beveled faces, walls composed of a combination of semi-load-bearing and cut-veneer stone, and terraces with recessed panels. The western portion of the Yucatán is architecturally typified by a third style, the Early Puuc style, with corbelled slab vaults, cut semi-load-bearing veneer stones with chinking, and a lime mortar and *mamposteria* (irregular,

uncut stone) core (Pollock 1980). Finally, the northwestern plains had an architectural style composed of load-bearing masonry set in mud mortar, with slab-corbelled vaults. The upper facades were slightly battered with inset panels (Andrews and Andrews 1980).

Distinguishing constructions of this period, and the architectural style characteristic of particular regions, is difficult in the absence of excavation, because of poor preservation and obscuring overburden. At a minimum, Yo'okop has some Late Classic buildings that demonstrate Petén-style architecture. Structure S4W1-1 possessed rounded terraces, like Cobá's recently excavated "Xaybe" (personal observation). Yo'okop's ballcourt likewise shares the proportions of Cobá's courts. The only structure at Yo'okop excavated in its totality to date, Structure S3E1-5, a possible sweatbath, has some architectural elements that may be considered to be Early Puuc. These architectural styles were replaced in the Terminal Classic by Classic Puuc architecture over the majority of the peninsula with the exception of the east coast, where Petén-style architecture persisted, and the region near Chichén Itzá, where a modified Puuc style was used. Thin, well-cut veneer stones without chinking that face a concrete rubble core characterize both Puuc and modified Puuc styles. The vaults were faced with beveled veneer stones tenoned into the building core. Some contain carved-stone decorative elements including spools and colonnettes. At Yo'okop, Terminal Classic architecture is typified by the Puuc style, with a good example of developed Puuc architecture on the edge of Group B's North Acropolis and numerous reused Puuc-style stones and sculptural elements being visible in Postclassic architecture. Significantly, specialized vault stones are absent, indicating that the architecture may be somewhat transitional. Although very few intact Terminal Classic elements have been located at Ichmul, Puuc-style architecture also appears to have been utilized there during this time period.

Ceramic Evidence of Affiliation

An additional means of assessing the affiliation of sites is through the types of ceramics present at a given time. Ideally, lithic materials should be sourced to be compared to, or contrasted with, ceramic artifacts through time (e.g., Braswell et al. 2004a). Unfortunately, the lithic sample for the entire CRAS study area is quite small (Lloyd 2006), rendering any potential patterning relatively meaningless. Therefore, hypotheses about the affiliation of Yo'okop and other sites in the CRAS study area have been based largely on Johnstone's

ceramic analyses (Shaw et al. 2000, 2001, 2002, 2003, 2004, 2005; Johnstone and Shaw 2006).

Ceramically, Yo'okop had a rich variety of types, of both local and distant manufacture. The strong presence of Petén polychromes through the Late Classic underscores Yo'okop's importance as a node in a north–south inland trade route during this period that correlates with the Petén Corridor. The collapse of this route in the Terminal Classic and replacement of imported polychromes with northern ceramic tradewares belonging to the Sotuta, Eastern Cehpech, and Western Cehpech spheres (Ball 1979; Bey et al. 1992; Johnstone 1998; Robles Castellanos and Andrews 1986) was likely related to the overall collapse of the southern Maya centers as well as the coincident increase in political and economic wealth of sites in the northern lowlands. As former trade routes broke down and portions of the south became dominated by siege and fortification warfare (Demarest 2004), new trade patterns dominated by northern sites, including Chichén Itzá, prevailed, particularly with respect to smaller, portable items (McKillop 2002:13) and goods reserved for the elite class (Braswell et al. 2004a:180–185, 191; Masson and Mock 2004). Maritime routes became more important than ever before (Masson and Mock 2004; McKillop and Healy 1989), and many important trade goods would have originated in the north (Andrews 1983; Chase and Chase 1982; McKillop 2002:176).

Although the ceramic sample from Ichmul is even smaller than that from Yo'okop, some statements can be made about the site's general ceramic affiliations through time (Johnstone 2005). Like Yo'okop, Ichmul has relatively high frequencies of tradewares from the Petén region and Belize during the Early Classic. The Late Classic is less well defined, due to the nature of the contexts excavated thus far. The Terminal Classic, however, is much better represented; types from the Chum and Muna groups are dominant, with the Thin Slate Wares seen at Nohcacab, San Felipe, and Yo'okop being notably absent at Ichmul. These preliminary ceramic data indicate that Ichmul did not maintain its long-distance southern ties into the Terminal Classic.

Refugee Populations

Another new factor that may have resulted from the fall of Maya kingdoms in the southern lowlands is an influx of refugees, or at least relocated persons, coming from the south. Most of the massive popu-

lation reduction in portions of the southern lowlands, to less than 10 percent of earlier levels (Braswell et al. 2004a; Demarest 2004), may have been the result of endemic warfare (O'Mansky and Dunning 2004), food shortages, and lower reproductive rates in times of severe stress over several generations. However, as Webster (2002:207) states, through time Maya people appear to have "voted with their feet," demonstrating a "flexibility of attachment" to place and polity. It seems reasonable to think that some individuals could have successfully escaped the trouble in the south and come to northern sites, including those in the Cochuah region, which thrived at the same time that southern dynasties were losing their political power (Marcus 1993). Johnstone (2006) has argued that the Terminal Classic increase in ceramic counts at each excavated site in the Cochuah region is so massive that some population influx from outside the area must account for the demographic transformation (fig. 27). Demarest (2004:119–121) points out that migrants fleeing regional wars can help stimulate political systems in their arrival areas, providing a new, subordinate group of laborers. He points to evidence of western Petén–influenced architecture and ceramics in the Puuc zone and in central Yucatán at this time.

With the possible exception of a minor potentially Chichén Itzá–affiliated occupation at the site of Nohcacab (Shaw and Johnstone 2006), no clearly "foreign" presence has been detected in the Cochuah region to date, in terms of architecture or ceramics. There is no "Mundo Perdido"–style (Valdés Gomez 1983) distinct concentration of foreign occupation at any site, large or small. However, refugees would be unlikely to have taken breakable or heavy items, such as ceramics, in any rapid, relatively disorganized flight. Additionally, by the time refugees began arriving in the Cochuah region, the tendency, if anything, was for ceramics from portions of the southern lowlands to resemble those of northern Yucatán (Masson 1997; Mock 1994). More-subtle differences, including burial practices that are more likely to be conservative, would be expected to reveal any such population; however, because of the research methods of the CRAS project (utilizing plaza test pits to uncover sealed deposits with minimal architectural impact), burials have not normally been uncovered. Nevertheless, the fortifications seen at several Cochuah-area sites, as Demarest (2004:121) points out for other northern examples (Chacchob, Cuca, Dzonot Aké, Ek Balam, Uxmal, and Yaxuná), are similar

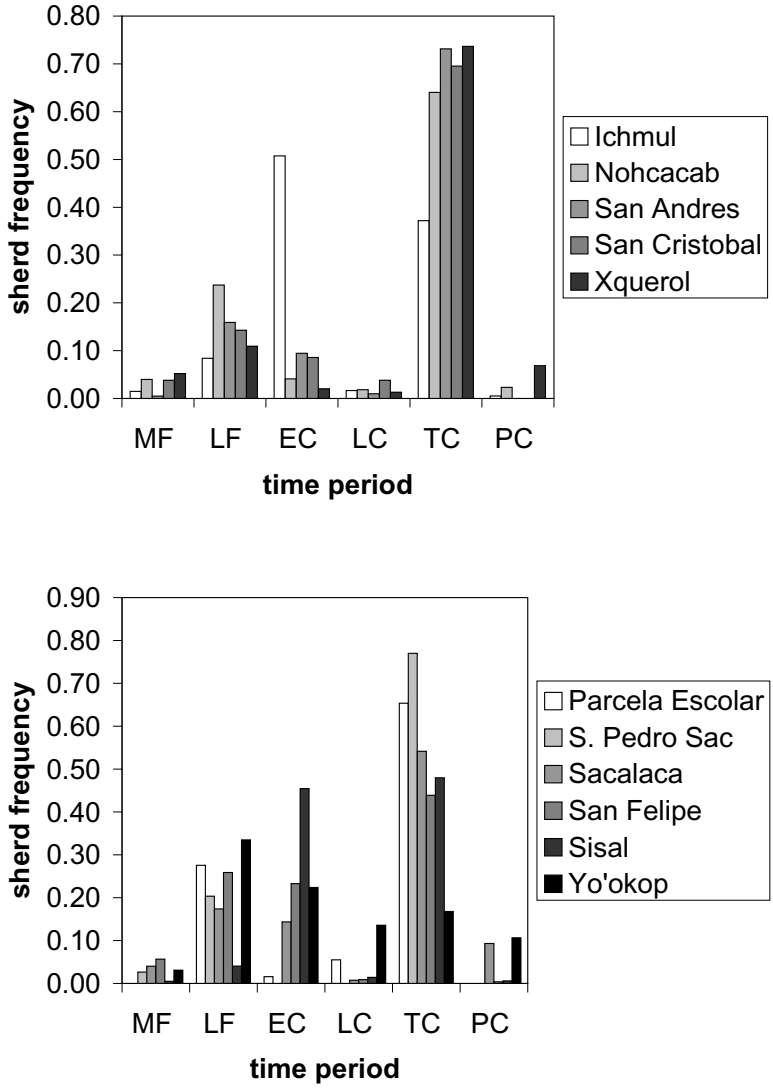

Figure 27. Frequencies of sherds by site and time period. MF = Middle Formative; LF = Late Formative; EC = Early Classic; LC = Late Classic; TC = Terminal Classic; PC = Postclassic. (Adapted by Justine M. Shaw from a graph by Dave Johnstone)

to those seen in the Petexbatun region in the late eighth and early ninth centuries. If refugees left a variety of southern sites, coming to the Cochuah region in relatively small, disorganized groups over several generations and becoming rapidly assimilated into the dynamic, growing settlements of the time, they may not be readily detectable as a distinct population.

With no clear evidence either way, it can only be said that if refugee populations were partly responsible for the demographic shift, they would have provided further impetus for the use of a variety of integrative strategies. Populations not only were larger and more dispersed than they had been before but may have also become more diverse. Additionally, migrants would have provided a new pool of laborers eager to be incorporated into stable economic and political units; such individuals would have provided an ideal workforce for causeway construction at the centers of Ichmul and Yo'okop.

Climate Change during the Terminal Classic

An additional factor that may have conditioned a move away from the concentrated centers favored during the Early Classic and Late Classic is a significant climatic event that has been detected in sequences derived from throughout the Maya area. Researchers investigating the Cochuah region are fortunate to have a local climatic sequence from Lake Chichancanab (Hodell et al. 1995), located just twenty kilometers from Yo'okop. These data, much more detailed than previous explorations of the lake's record (Covich 1970; Covich and Stuiver 1974), demonstrate unambiguous evidence for climatic drying between AD 800 and 1000. This evidence is consistent with data from Punta Laguna, located approximately twenty kilometers north of Cobá (Curtis et al. 1996), Cenote San José Chulchacá in northwestern Yucatán (Leyden et al. 1996; Whitmore et al. 1996), Lake Cobá and Lake Sayaucil (Leyden et al. 1998; Whitmore et al. 1996), and Lake Miragoane, Haiti (Hodell et al. 1991). The episode, the driest of the past eight thousand years, may be at least partially responsible for the decline of the Classic Maya in the central lowlands (Gill 2000; Lowe 1985; Shaw 2003).

Curtis and others (1996) point out that a period of extreme aridity between AD 800–900 does coincide with the southern collapse. They believe that, although the north is drier, the south would have

been more severely affected by any decrease in rainfall because the south has a water table much farther below the ground surface and a greater dependence on surface-water reservoirs. Northern sites would have had continued access to water through most cenotes and several lakes, as well as water storage features including aguadas, chultunes, and haltunes.

Gunn, Adams, and Folan and others (Folan et al. 1983a; Gunn and Adams 1981; Gunn and Folan 1995) have stated that the collapse may have been caused by ninth-century climate shifts "that failed to provide sufficient moisture for needed horticultural production" (Folan et al. 1983a:467) as globally colder temperatures reduced rainfall in the Maya area. At the same time, this made the northern coast more desirable for salt production as new merchants took over trade routes that had been dominated by southern powers (Andrews 1983; McKillop 2002). Coastal salt production was also aided by receding global sea levels through the ninth century that remained low until the sixteenth century (Dahlin et al. 2005).

Messenger (1990) introduces a new interpretation of climatic data, based on Sanchez and Kutzbach's (1974) study of weather during the 1960s. Between AD 800 and 1000, climate became unstable and a global warming trend began (Messenger 1990:36), which Messenger believes actually increased rainfall by about 10 percent in much of the northern and north-central Maya area. At this same time, parts of highland Chiapas and Guatemala would have received approximately 10 percent less precipitation. This may have upset regional interdependence as the "have-nots" in dry regions crossed a critical threshold enabling them to support increasingly large populations and participate in the regional economy and politics in ways never before possible.

I have recently brought a new element into these climate-related explanations for the collapse: deforestation leading to anthropogenic climate change (Shaw 2003). Studies of modern deforestation (Ghuman and Lal 1987a, 1987b; Laurance 1998; Shukla et al. 1990; Walker et al. 1995) have shown that when trees are removed, the local climate becomes warmer and drier. The removal of forest from large expanses of land (accompanied by the maintenance of short vegetation or bare earth) raises temperatures and decreases evapotranspiration. The high populations documented for many Maya sites (e.g., Culbert et al. 1990; Haviland 1969), use of swidden agriculture, and reliance on

wood as a fuel in lime production and daily cooking would have meant that many Maya site cores and supporting zones would have been largely free of trees. This deforestation is well documented in pollen profiles (Binford et al. 1987; Curtis et al. 1998; Rice 1996). Although there is evidence for a general drying trend during Late to Terminal Classic times, I argue that some sites suffered more than others, because of culturally induced microclimatic changes, differences in agricultural techniques, and the availability of alternative subsistence strategies.

Regardless of the degree to which the drought brought about the Maya "collapse" in the south, one might reasonably assume that, by its apogee, it would have affected the daily lives of the agriculturalists who resided in the CRAS survey area, as well as the elites who depended on their surplus. The Terminal Classic population dispersal is argued to have resulted, at least in part, from efforts by either a centralized authority (see Montmollin 1988b) or individual households to increase the number of water sources that were utilized during this critical time. A similar pattern is seen in the population that remained in and around Calakmul, with sites that had water sources being favored (Braswell et al. 2004a:188–189).

Although Ichmul, believed to once have had cenotes in its core, and Yo'okop, with a substantial aguada, continued to support substantial populations during the Terminal Classic, they may not have had enough water to provide for the largest occupation ever present in the region, particularly if measures such as pot irrigation were used to grow sufficient food (Dahlin et al. 2005). Moving to other sites with water sources and investing in water catchment and storage features in favorable locations could have been necessary for survival during this challenging period. Dispersal may have also aided dry-weather agriculture, with households locating themselves near deeper, lower pockets of soil that would have remained somewhat moister.

The Role of Sacbeob in the Cochuah Region during the Terminal Classic

It is clear that at the time of the Late Classic to Terminal Classic transition, populations in the Cochuah area appear to have been more dispersed than ever before, possibly as a response to the major drought during this time (Hodell et al. 1995, 2001), as well as a decrease in

conflict relative to the southern lowlands (Rautman 2000 describes population aggregation as a typical response to hostility and the threat of warfare). If the drought itself was the prime mover, any residential sites with Terminal Classic residential occupations should have reliable water sources and major investments in water storage and conservation features. This does not appear to have always been the case in the CRAS study area; however, the largest sites in the region with Terminal Classic occupations do have such water features, and more-subtle water features have been uncovered at settlements at which the project has been able to invest more time in detailed recording and excavations.

Likewise, the settlement changes may have been a response to the collapse of sites in the south, which would have meant the loss of southern allies, the disruption of trade patterns, and potentially an influx of refugees seeking to escape endemic warfare (Demarest et al. 1997). The political ramifications of losing southern allies might have included the regional capitals reaching out to northern powers, as well as adopting new strategies to integrate their populations and assert or display their power.

As discussed in chapter 7, following the research of Adler and Wilshusen (Adler 1989; Adler and Wilshusen 1990) and Johnson (1978, 1982, 1983), when sites grew markedly during the Terminal Classic in the Cochuah region, new integration strategies would have been needed for the attraction, retention, and management of burgeoning and more-dispersed populations. Sacbeob are suggested as one of the possible integration strategies used by local elites that would have been initiated during the Terminal Classic. These constructions would have provided physical and symbolic ties between the linked groups (Shaw 2001) and may have been analogous to constructions at Copán following the death of the ruler 18 Rabbit, which sought to "manipulate traditional political and ideological systems within a changing world" (Stomper 2001:225). Far from being "passive arenas or stage sets," the roadways and their associated constructions would have "played tangibly active roles in constant creation and shaping of Maya life" (Brady and Ashmore 1999:126), being intentionally designed and constructed as "clearly defined" landscapes, in the terminology of Knapp and Ashmore (1999:9).

Although sacbeob are certainly not limited to the Terminal Classic, during this time of change they would have been used to pro-

vide an integrative mechanism in a manner never before seen in the Cochuah region. Such devices were necessitated by populations that appear to have been larger than ever before, more dispersed than they had been since the Late Formative, and potentially more culturally diverse as a result of new arrivals from outside the region and changes to the institution of rulership. My colleagues and I have argued elsewhere that sacbeob were not the only strategy used (see Shaw et al. n.d.), but causeways in the Cochuah region appear to have been a popular option for the regional capitals of Ichmul and Yo'okop. Even though the leaders of the two sites may not have had much of a choice about whether or not to use integrative mechanisms to hold together their polities, their selection of causeways as one means of dealing with this new situation was potentially governed by the popularity of the features at Cobá, which had been a regional power through Classic times, and Chichén Itzá, the newer capital to the north (Ashmore 1989, 1991, 1992; Ashmore and Sabloff 2002; Houk 2003), both of which may have served as models for the larger sites within the Cochuah region. Unlike some other potential integrative mechanisms, such as those recently reviewed by Ringle and others (Ringle 2004; Ringle et al. 1998) for Chichén Itzá, causeways would have served political, social, economic, transportation, religious, and even water-management functions simultaneously.

A New Definition of Community

Utilizing sacbeob and other integrative strategies, the rulers of Ichmul and Yo'okop sought to construct a new definition of community during the Terminal Classic through the manipulation of their "clearly defined" landscapes (Knapp and Ashmore 1999). Prior to the construction of causeways, the residents of Ichmul and Yo'okop had resided in relatively dense architectural groupings. For the sites to continue to function as single communities following the Terminal Classic dispersal and marked population growth, integrative strategies would have been needed. Investing in building monumental architecture in peripheral zones, as well as physical connections to those outlying groups (regardless of the manner in which the costs were divided), was one obvious visual and functional way to connect occupations scattered across a broad swath of countryside.

Ringle and others (2004:508–510) describe an analogous situa-

tion at the site of Ek Balam, where they believe that sacbeob, as well as enclosure walls and formal complexes of civic architecture, were part of a program to formalize the relationship between center and periphery. Although not yet thoroughly dated, at least some of the construction episodes may have taken place during the Terminal Classic.

Power Dispersal

As evidenced at Copán (Fash 1991:175–179; Fash et al. 2004; Schele and Freidel 1990), Tikal (Valdés Gomez and Fahsen 2004:141–142), and other sites, rulers seeking to gain or maintain the support of other elites may choose to disperse their power to some degree using various forms of "social currency" (Reents-Budet 1994). LeCount (1999) suggests that at Terminal Classic Xunantunich, local elites attempted to build consensus and establish links to subgroups within the community by giving luxury items, including polychrome ceramics, down through the social hierarchy. In the past, such goods had been used as ostentatious displays by rival elites attempting to consolidate internal subgroup support while creating external images to display to non–group members. When the entire political system was threatened, the use of "social currency" moved beyond the dispersal of specialized trade goods to include acts that decentralized political power to some degree. At Copán, this took the form of hieroglyphic benches in four elite residential compounds in the eastern half of the valley (Fash et al. 2004:261), while at Tikal and Uaxactún the strategy of "democratization" included nonruling nobles erecting their own monuments as early as the Early Classic (Valdés Gomez and Fahsen 2004:142). By the late ninth century AD, rulers of Ixlú and Jimbal had begun to use the Tikal emblem glyph (Valdés Gomez and Fahsen 2004:151).

Power dispersal in the CRAS study area is particularly evident in the newly constructed architecture within the Ichmul sacbe system. As discussed in chapter 2, the roadways connected to locales that had prior occupations. However, in each case, these prior occupations appear to have been quite small and almost exclusively domestic. During the Terminal Classic (in addition to roads being used to link the termini with Ichmul), temples, elevated plazas, and elite residences appear for the first time at the terminus sites. One explanation for this pattern is that elites may have moved from the site center of Ichmul to reside in these distant locations as part of the dispersal. Alternately, individuals or lineages already associated with these pe-

ripheral sites may have been subsidized or rewarded for their loyalty to the greater Ichmul polity. At a time when subsistence goods would have been relatively more valuable, those who controlled the outlying agricultural communities would have had more power than ever before and, with this, the ability to demand more for their support and allegiance. A similar situation may have taken place at Yo'okop's distant Group C.

Attracting Community Members

Ichmul and Yo'okop may have utilized sacbeob as part of a strategy to not only permit easy access to the traditional site cores but also provide attractions to the center. One way in which this may have been done is through changes in ritual, shifting from an emphasis on what had been exclusive rituals into more inclusive practices. This change is consistent with Adler and Wilshusen's (1990) cross-cultural study, which shows that as the size of a given community increases, social integrative features of a more monumental scale tend to be constructed. Additionally, these features tend to be constructed for ritual purposes, as rituals "create a context in which a great deal of information can be disseminated efficiently to large numbers of participants" (Adler 1989:41; Rappaport 1979; Turner 1974).

Such a shift in ritual practice is evidenced in the cores of Ichmul and Yo'okop, with the construction of large public plazas accompanying causeways at each site; these replaced the temple-pyramids and restricted-access elite plazas on acropoli more characteristic of earlier times. In many ways, this change also represented a dispersal of power, as the general public was able to access, or possibly even take part in, ritual performances in a way uncommon in the past.

Evidence for this transformation is clearest at Ichmul (figs. 3 and 4), where a series of Terminal Classic constructions radically changed the site core. The two smaller sacbeob led to the Central Acropolis, which appears to have served as a fairly traditional, restricted-access, elite ritual space. Following these, however, the elevated Great Plaza and its associated platforms on the east and west sides were built. The eastern example is known to have been added in a separate construction event, placed atop the original surface of the Great Plaza. The three larger (and probably later) causeways, which point toward the northeastern side of the Great Plaza, were likely part of this same building program. Although intervening features would have blocked

the actual paths of the roadways, they symbolically, and to some degree functionally, funneled the passage of residents from outlying settlements into the new, open, more public center of Ichmul.

The majority of the events that took place in this plaza remain a mystery. Evidence does support one particular focus for the rituals, however. As discussed in chapter 2, an excavation into the eastern raised platform, atop the Great Plaza, revealed portions of seven different burials. Plaza burials, rather than internment beneath a structure, are not unheard of in the north, being evidenced in the core of Dzibilchaltún (Folan 1969:436, 458–459) and the Mirador Group (Andrews and Andrews 1980:36). However, such a concentration of individuals at Ichmul indicates a decidedly specialized focus for at least this portion of the space.

Rather than indicating merely a convenient funerary location, this behavior pattern is likely to represent a modification of the long-standing Maya practice of ancestor veneration. Rituals related to the reverence of human remains have been used to express lineage membership, as well as to venerate local leaders. Instead of including all deceased individuals, this generally involves a process of selectivity, with people of positions of respect within the household or community receiving greater attention (McAnany 1995:29). Although the house is the home of one's ancestors, ancestors in public places are traditionally officeholders, who are believed to hold authority in the spirit world (Bunzel 1952:270; McAnany 1995:49).

Buikstra and Charles (1999) utilize Morris's (1991) critique in their examination of sacred landscapes of the ancient North American midcontinent, contrasting "mortuary ritual" with "ancestor cult." The former includes rites of passage that distinguish the deceased from the living that might be carried out for most, if not all, members of a society. However, "ancestor cult" is reserved for rituals that continue to provide access to the deceased in the afterworld, with the ancestors continuing to have an influence on the lives of their descendents. McAnany's (1995) depiction of the Maya "living with the ancestors" would belong to this latter category of ritual behavior.

In most Classic Maya cities, public funerary rituals might have included the interment, or subsequent removal and veneration, of royal individuals (McAnany 1995:51). In Terminal Classic Ichmul, however, the presence of what appear to be numerous commoners buried in this public location indicates that this pattern changed. In

the same way as power was dispersed through the extension of sacbeob, people were drawn inward and tied to the site core through the installation and elevation of their ancestors in acts formerly reserved for elites. Potentially emulating a southern Maya pattern of ancestral shrines on the eastern side of plaza groups (Welsh 1988) and placing important ancestors at the core of sites (McAnany 1995:52–53), Ichmul chose to innovate by making the plaza burial location inclusive, so that the common people experienced a direct connection to their recently interred ancestors buried in the site core. Manipulating cults of exclusion and inclusion as a means to emphasize or deemphasize power inequalities is a strategy not unique to the Maya area (see Buikstra and Charles 1999:220–221). Religion, particularly tied to the treatment of one's ancestors, can provide a powerful means of social integration and political manipulation (Lee and Zhu 2002).

As with Becker's (1971) study of burials from shrines at Tikal, both males and females appear to have been viable ancestors at Terminal Classic Ichmul. Although one of the individuals had filed teeth that may have been a marker of special status, no individual was accompanied by any grave goods that left traces in the archaeological record. The interments were not in tombs. The emphasis appears to have been on linking ancestors with a place: in this case, the center of Ichmul. As with the roadways that physically connected the newly dispersed community, this spiritual tie was used to "create a genealogy of place that links descendants to that land" (McAnany 1995:65), a cosmological tie to accompany the visible, material sacbeob.

At Yo'okop, there is some evidence that Terminal Classic ritual and economic activities were focused on the site's aguada. Immediately adjacent to this water feature, a vaulted stone sweatbath was built near the beginning of the Terminal Classic (Shaw et al. 2002). Around this same time, the adjacent portion of the edge of the water feature was edged with cut stones. Additionally, a major plaza was constructed in front of the palace that sat on a terrace above the aguada (Shaw et al. 2001). As the largest water feature between Lake Chichancanab and the lakes of Cobá, the aguada would have been critical for the site's residents during this particularly dry period. Wren and others (n.d.) have argued that Yo'okop displayed an emphasis on water-related cosmology throughout its occupation, noting evidence that includes iconography on carved monuments and the arrangements, locations, and view sheds of particular structures.

Why the Terminal Classic?

The Terminal Classic appears to have included a unique confluence of circumstances not present in prior or later time periods that conditioned the need for sacbeob at the largest sites in the Cochuah region. Prior to, and following, the Terminal Classic, populations in the CRAS study area appear to have been too small to either necessitate or afford investment in this type of massive infrastructure. Only during the Terminal Classic did populations become both large and dispersed, necessitating some sort of integrative mechanisms.

The choice of roadways as a means of defining newly created, extensive communities probably relates to the multitude of functions that such roads are able to simultaneously perform. As described in chapter 7, the causeways would have not only provided a practical means to readily transport agricultural products and citizens to the cores of Ichmul and Yo'okop but also served a variety of other functions. The sacbeob made obvious physical statements about the power and extent of the regional capitals, which were negotiating a new political environment. Making these declarations to external powers would have been important; moreover, in redefining the nature of community, it would have been significant to demonstrate to the occupants of the dispersed settlements of greater Ichmul and Yo'okop that they were physically encompassed within the realm of each of the sites. In terms of social functions, the roadways may have linked kin groups and other social units that found the need to scatter across a broader landscape. The actual construction of the sacbeob would have strengthened both these social and political units, as work crews united to complete the enormous construction projects.

Water-management functions, more critical than ever during the Terminal Classic, may have also been a part of the decision to build roadways at the two sites. Although water management does not appear to have been a primary outcome of the construction episodes, the excavations in the Cochuah region (as in other areas) that were made to mine material for the roadways do appear to have served as catchment basins in some cases. Additionally, the paved surfaces helped to deflect and direct rainfall as the roads passed through the prime agricultural lands along their courses.

Finally, ritual and cosmologically symbolic functions were potentially prime considerations in formalizing the connections between

core and periphery at the two sites through causeways. Particularly at Ichmul, which appears to have had some sort of burial-related complex in its Terminal Classic center, one might readily imagine that processions may have taken place for funerary and other ritual events. If Yo'okop had similar processions, they might have had a more water-related emphasis, as this sacbe system appears to have directed traffic toward Group A, which is associated with the aguada.

None of these imperatives was entirely new; the northern Yucatán has always been a relatively dry setting, leaders of regional centers would have continually needed integrative strategies and a way to make political statements to establish and preserve their power, and the common people would have needed some sort of arteries to move their goods and maintain social connections. Only during the Terminal Classic were these needs exacerbated by an extremely large and dispersed population, with leaders attempting to redefine their communities under new political circumstances. Only during the Terminal Classic were sacbeob built in the Cochuah region.

10

Explaining Sacbe System Variability in the Cochuah Region

Both Ichmul and Yo'okop constructed road systems during the same time period, the Terminal Classic, potentially in response to a similar set of local and regional conditions (see chap. 9). However, an examination of the sacbe networks constructed at the centers reveals two markedly different plans. As described in chapters 2 and 3, the form of each of the systems—generally linear in the case of Yo'okop versus dendritic or radial for Ichmul—would have been partly a result of the preexisting site plans. Yo'okop's multiple-nucleus (Harris and Ullman 1945; Marcus 1983) "core" was dispersed between at least two of the four architectural groups at the site. Although the relative importance of each area varied through time (Shaw 2005), during the Terminal Classic all four appear to have been occupied and worthy of the effort of structural interconnection. As discussed, however, whether this was a linear connection of relative equals or a moderately hierarchical linkage to Group A remains undetermined. The portion of Ichmul that remains suggests that it, in contrast to Yo'okop, appears to have had a single site core. During the Terminal Classic, Ichmul was centered on a large, elevated public plaza adjacent to monumental architecture established during earlier time periods. When its roads were in use, the general plan of the site appears to have followed the sector model (Hoyt 1939; Marcus 1983). Ichmul's sacbe system was obviously hierarchical, with each of the five terminus sites linked to portions of the site core near the Great Plaza and no links between any of the secondary components of the network.

While both centers might be considered by Marcus (1983) to be relatively unplanned in terms of their layouts, this does not mean

that the two sites merely grew organically, without consideration for aspects of the natural and cultural environment. Not only the straight courses of the sacbeob but also the position of particular site components display a concern for the natural terrain, water and good soil locations, cosmology, and politics, among other things. As the two sites are located in relatively close proximity to each other, at about twenty-seven kilometers apart, within the same basic geographic zone, it is particularly interesting to consider the factors that may have conditioned markedly different site plans and, in turn, varied sacbe systems. Houk (1996:54–56), following Carlson (1981, 1982) and Aveni and Hartung (1986), has outlined eight categories of factors that could account for a given settlement plan, including topography, climate, cosmology, astronomy, magnetism and geomancy, functional considerations (factors relating to economics, water management, and defensive features), sociopolitical ideology, and chance or randomness. As Houk states, each factor would not have been equally important; topography, cosmology, and sociopolitical ideology likely played a larger role in influencing site plans. Here, these same basic factors are considered, although distributed among slightly different categories.

Natural Setting

Ichmul and Yo'okop can be said to share the same general environment, that of west-central Quintana Roo, part of the Yucatán Peninsula, a flat, low-lying Cenozoic marine limestone platform that projects northward into the Caribbean Sea and Gulf of Mexico. The northern portion of the peninsula, including the Cochuah region, is a pitted karst plain (West 1964). With the exception of the Puuc hills to the west, the terrain in the north is flat (Covich 1970; Ward and Wilson 1985).

The north also has a number of unique geological features. Aguadas (intermittent or permanent ponds) are present throughout the northern plain (West 1964); one is located near Group A at Yo'okop. These features are both culturally and naturally created and are frequently stone and clay lined when of human origin (Dahlin 1986; Shattuck 1933). Constructed aguadas were, and are, frequently placed in and around rejolladas (Siemens 1979). Some aguadas would have been created naturally as cenotes filled with sediment and organic

debris (Tamayo and West 1964). For either type of aguada to have been used for drinking water, regular cleaning and maintenance would have been required (Faust 1998). Located beyond the ring of northern cenotes, no such sinkholes are present at Yo'okop; the closest examples are approximately fifteen kilometers from the site, near the modern pueblo of X-cabil and on the outskirts of Sacalaca (see fig. 2). As discussed in chapter 2, Ichmul may in the past have had one or more cenotes, which have subsequently been covered by colonial and historic constructions. Additionally, underground cavities at Yo'okop, Ichmul, and most other sites in the survey area have been excavated for centuries to obtain sascab, a nearly pure carbonate material for construction (Wilson 1980). In some cases, these mines and the quarries for limestone would have held water.

As might be expected, soils within the peninsula are highly variable according to the topography, rainfall, age of the soil, organisms within and on top of the soil, parent material, and organic materials (Dunning 1991). In much of the north, this soil cover is extremely thin, with bedrock comprising up to 50 percent of the surface (Ringle 1985; Wilson 1980). However, the Cochuah region (translating as "our bread food" or, literally, the "well-fed province that has never found itself in need" [Flores Colin and Kaeding 2004; Relación de Tihosuco y Chikindzonot, in RHGY 1983:2:198]) is noted for deeper soils relative to many other parts of the north. Soils of the state of Yucatán, northern Campeche, and northern Quintana Roo are generally described as Laterization-process soils, while those to the south are Rendzina and Glei soils (Stevens 1964). The laterization found in the north occurs as conditions of fluctuating groundwater levels result in reduction of iron and loss of silica (Limbrey 1975).

Modern climatic variations in the Yucatán are generally moderate, although the northeastern corner of the peninsula does lie on a hurricane track through which passes nearly every storm impacting the northern Caribbean coast (Contreras Arias 1958; Ward and Wilson 1976). This brings damaging storms to the Cochuah area once or twice each decade. The northern part of the peninsula possesses a Tropical Monsoon (Am) climate, with very heavy rainfall only in the summer, while the southern portion is designated Tropical Rainy (Af) with at least sixty millimeters of rainfall in the driest month (Wilson 1980).

Despite these general similarities, the two sites' settings are rela-

tively disparate, within the limits of the region. As described in chapter 2, Ichmul, likely supplied with drinking water through cenotes and smaller water storage features, is situated on a fairly flat zone, although some of its sacbe terminus sites are near unusual concentrations of hillocks around deep soil depressions. Yo'okop (see chap. 3), in contrast, has an atypical amount of topographic relief for the north, with Group A situated on an escarpment that slopes sharply down to recharge the site's aguada near the base of the group. While the soil in each of the four main architectural groups at Yo'okop tends to be thinner, with the natural bedrock outcrops providing stable bases for larger architecture, the center of the site, its zone of deepest soil, is largely devoid of constructions (Johnstone 2002).

The close proximity of water and deep soil in the center of Yo'okop has resulted in a pattern of architectural groups that ring these critical resources. Not until Sacbe 1 and Sacbe 3 were built during the Terminal Classic did any monumental features encroach on this central zone. However, at Ichmul, a dense single core appears to have been maintained through time, centered on the area in which cenotes are believed to have been, with dispersed residences (and eventually hamlets and towns) located in the prime agricultural terrain in its hinterlands. Again, monumental architectural investments were lacking in these farming areas until the construction of the road network.

The nature of these arrangements, particularly the manner in which surface water was available, meant that as conditions became significantly drier by the Terminal Classic, the relative sensitivity of each center to climate change would have varied. Yo'okop's aguada, when properly maintained, would have provided year-round access to water for drinking and pot irrigation adjacent to prime agricultural lands; as a result, it appears to have been relatively hyposensitive to the climate change documented in nearly Lake Chichancanab (Hodell et al. 1995; see chap. 9). Despite the extreme aridity peaking about AD 900, Yo'okop sustained a continuous population that actively traded and interacted on an extraregional basis throughout Classic times and into the Postclassic. Ichmul and the sites in its hinterland appear to have been relatively hypersensitive to the climate change, with the smaller sites being entirely abandoned by the Late Classic and Ichmul demonstrating little Late Classic occupation to date. This difference may, among other things, relate to the relative distance from water source to farmland at each site, as well as

extraregional political connections. Each major center could have supplied residents with drinking water during dry periods, but Ichmul's inability to consistently produce food in the immediate vicinity of the site core would have made sustaining a viable population in its center more challenging.

As climatic conditions ameliorated somewhat after AD 900, and dispersed populations throughout the region grew, the sacbe systems installed by each of the two sites came to reflect the nature of the site cores. Dispersed communities, whose original locations were conditioned by resource distributions, became physically linked by the roads. Rather than establishing new settlement patterns, the causeways served to physically illustrate previously established ties and configurations. The two phases to this process that may exist at Ichmul, and possibly at Yo'okop, emphasize that the installation of roadways was not a brief event; it instead appears to be part of the process of site transformation that took place throughout this period as new strategies were used to integrate the populaces of the two centers.

Sociopolitical Factors

As stated in chapter 7, one of the important functions of Maya sacbeob was to reference, establish, and maintain sociopolitical ties. This would have included bonds between groups within the site, other entities in the same region, and even important powers located elsewhere. In the case of more spatially distant references, the roads need not have physically reached between the two sites; emulation of a particular arrangement or plan could have symbolized a real or desired link between two centers.

In an examination of the sociopolitical relationships between the units linked by the Cochuah causeway systems, only a discussion of hypothetical relationships between origin and terminus locations is possible at present. The system of Ichmul appears to have been decidedly hierarchical, concerned only with linking Ichmul to the termini, but not the termini to each other. However, this does not necessarily imply that Ichmul was in such a position of power that it was able to entirely dominate its subjects either socially or politically. The human labor, natural resources, and territory of the terminus sites may have permitted the smaller settlements to dictate, or at least influence,

relationships between Ichmul and themselves. The unique conditions present during the Terminal Classic (see chap. 9) may have meant that Ichmul found itself using causeways in order to display its ties to the smaller sites as a means of catering to or placating the settlements on its periphery as much as to fulfill the other needs of the inhabitants of the core. In at least two cases, Terminal Classic occupations were established at terminus sites prior to the arrival of the causeways.

With Yo'okop, the nature of the sociopolitical units tied by roadways is less clear. Groups A and B, the largest architectural concentrations at the site, appear to have alternated through time as foci for monumental constructions. Group D, not settled until the Late Classic, was a largely Terminal Classic construction, and the date of Group C is not known, although it, too, was presumably occupied during the Terminal Classic. Group A contains a Terminal Classic large raised plaza and enormous range structure on the natural rise overlooking the aguada (see chap. 3), which may have been the residence of at least one ruler during this period. However, other analogous candidate structures exist elsewhere in the site, making it far from clear which group, if any, was dominant in intrasite social or political interactions. The greater quantity of nondomestic monumental architecture in Group B in comparison to Group A, the single pyramidal structure at Group C, and the largely domestic nature of Group D may indicate functional, not hierarchical, differences between the groups. If this is the case, Yo'okop's roads might be thought of in a manner similar to those at Sayil (Dunning 1992; Sabloff and Tourtellot 1991; Smyth and Dore 1992), with each group being used for particular distinct functions in a manner that did not involve ranking any given group as primary, a relationship that is characteristic of multiple-nucleus sites (Marcus 1983:202–206). Alternately, because only Group A had a year-round water source, the occupants of that portion of the site may have wielded a disproportionate amount of intrasite sociopolitical power, with the causeway system reflecting a desire on the part of the other groups' residents to tie themselves to those controlling this critical resource (if, indeed, commanding the extensive feature was possible).

Although Ichmul and Yo'okop are the largest, and presumably most powerful, sites within the portion of the Cochuah region surveyed to date, they are likely to have been influenced by social and political entities outside the area. Ashmore (1989, 1991, 1992, 2002;

Ashmore and Sabloff 2002; Houk 1996:71–75; see chap. 7) has described how some sites appear to emulate particular centers in their layout, including the use of sacbeob. The desire of the elites initiating such projects may have been to affiliate themselves with particular rulers, long-standing powers, potential ancestors, or current political leaders. At sites with fragmentary or absent written records, such as Ichmul and Yo'okop, the study of civic plans may provide important clues about the cities' political histories (Ashmore 2002:49).

Ashmore's Petén template, including elements of Coggins' (1967) earlier model (with palace groups at the south end of the site and a ballcourt to the north of the palace groups), may have been at least partially responsible for inspiring Yo'okop's general plan. Another similarity between the Petén model and the plan of Yo'okop is the placement of the elite residences on a rise, composed of both constructed and natural elements, associated with an aguada or reservoir. Although no single site is given as the original inspiration for the plan, Ashmore believes that it was developed by elites in the northeastern Petén, a zone with which Yo'okop appears to have regularly traded as part of the Petén trade corridor (Harrison 1982:120–121). This layout, with key elements distributed on the two main groups flanking the zone of deepest soils at the core of the site, was established long before the construction of Yo'okop's causeways; the prominence of the components of the site plan called for Groups A and B, among others, to be linked when investments were made in roadways.

In looking to models that may have directly inspired the addition of roadways to the architectural repertoire of Yo'okop, one might best be served by northern examples, because most southern powers had faded by the time the Cochuah roads were built. As mentioned earlier, Sayil's "beads on a string" (Tourtellot et al. 1992:94) does provide an example of an analogous plan, including its road network. Yo'okop has some Puuc-style architecture and ceramics from the Puuc area, indicating some degree of interaction and emulation. However, a site with a very similar layout need not have necessarily been the inspiration for the causeways, if the more general concept of roadways linking important preexisting groups, rather than a whole new site plan, was the borrowed concept.

Ichmul likewise could have been inspired by contemporaneous northern powers, in addition to a need to tie together its newly dispersed populace. Unlike at Yo'okop, the construction of the Ichmul

road network produced a more radical change in the appearance and shape of the site, if one considers the entire zone connected to have been a single polity. The importance of the selected termini relative to other settlement concentrations in the periphery may have, of course, largely determined the form of the network. However, northern sites with analogous plans, such as Cobá (Benavides Castillo 1981), Chichén Itzá (Cobos 2003), or Ichcantiho (Ligorred Perramon 2001, 2005), could have inspired the larger concept of site extension through road building or even the more specific plan itself. As a dendritic system built in two distinct programs, Ichmul's system is quite similar to that of the former two sites, whose networks of causeways grew in at least two stages.

Belief-Based Factors

The inspiration for the layout of Ichmul and Yo'okop may also lie in belief-based factors (see Fox 1994; Hyslop 1990). Of course, such influences cannot be considered to be entirely distinct from more mundane sociopolitical and practical factors. At the same time, as Ashmore (2002:35) states, "those who commissioned ancient Maya civic construction drew on an array of shared beliefs about the proper arrangement and constitution of the human habitat . . . they materialized a cosmically sanctified authority by creating and acting within appropriately formed buildings and spaces." As with other motivations, patterning and similarities to other Maya and Mesoamerican sites yield only potential explanations for particular arrangements.

The site plan of Yo'okop, which appears to be based on the Petén template (Ashmore 1989, 1991, 1992), most readily lends itself to interpretation founded on belief-based principles. This is partly true because of its repetition of a well-known pattern; also, more-conclusive statements can be made about Yo'okop than about Ichmul because of the former's superior preservation. Although the general layout of the center with respect to the causeways is known from Ichmul, only the most monumental architecture within the core is sufficiently intact to be recorded today (see chap. 2).

As mentioned with respect to sociopolitical factors, the plan of Yo'okop's roads was largely determined by the location of preexisting groups. In addition to reflecting practical concerns about the position of natural features, the arrangement of particular functional areas

does appear to have been modeled on Ashmore's Petén template. Besides the social and political advantages of such a reference, utilizing this site plan "creates a symbolic map of the culture's world view" (Houk 1996:72), with rulers occupying cosmologically empowered locations in the private residential compounds at the southern end of the site, the north end being used for public rituals, and the intermediate ballcourt representing a passage to the Underworld. Tying these zones together with roadways may have not only allowed for ritual processions between the zones but also symbolized the ruler's connection to critical access points.

Yo'okop is a somewhat unusual site in that a concern with directionality is seen not only in the location and orientation of monumental public constructions but also in the wall lines of the residences of commoners. As discussed in chapter 3, throughout much of the site's history, the orientation of all scales of architecture was 25 degrees east of magnetic north. The reason behind this particular angle is not known, although astronomy, magnetism, and geomancy could provide possible explanations. According to Aveni (1980:237–238), an orientation of approximately 17 degrees is common to sites influenced by central Mexico, while Chichén Itzá's Castillo, Temple of the Warriors, and Upper Platform of the Caracol share a 21 to 23 degree orientation. The late date of these constructions means that they cannot be the inspiration for Yo'okop's long-standing orientation, although the two northern sites could have shared a common influence. No similar concern with orientation is known from Ichmul, although the erasure of nearly all wall lines from the surface could have obliterated even the most obvious and consistent alignment.

Ichmul and Yo'okop within Their Hierarchies

As Marcus (1983:208–211) points out, it is important to consider any particular city within its hierarchy, based on not just commercial or economic hierarchies but also relationships reflecting political, administrative, ritual, and religious status. While both sites have been referred to as "regional capitals" within the Cochuah region, this does not necessarily mean that their relative ranking in any one of the above areas would have been equal. Instead, their functions, emphases, and ties to extraregional powers may have meant that, with respect to a given type of hierarchy, one site may have been considered

to be more important than the other. These distinctions would have influenced the form of the settlements as a whole, as well as the nature of each site's sacbe system.

Each city would have had administrative, economic, political, and religious functions to some degree. However, the two appear to have had differing functional emphases, particularly during the period in which their road systems were built and used. As discussed in chapter 9, Ichmul may have distinguished itself as a ritual center at this time, manipulating ancestor-veneration concepts as a means of tying together a dispersed populace. Yo'okop, too, was certainly not without temples and other cosmologically important spaces, potentially emphasizing water-related rituals throughout its history (Wren and Nygard 2005). However, when compared in a hierarchical fashion, Ichmul's innovative revitalization of traditional concepts, in comparison to Yo'okop's relatively greater tendency to continue established practices and concepts, may have made the former a relatively more important site in terms of the regional ritual hierarchy during the Terminal Classic.

In contrast, through time, Yo'okop appears to have maintained a generally more "international" outlook, with more imported ceramics and external architectural references than have thus far come to light at Ichmul. Yo'okop's Late Classic occupation is also substantially more robust than that thus far detected at Ichmul, although both sites were important during the Early Classic. Although the degree to which Yo'okop was a "market center" (Marcus 1983:210) at any given time is not known, its long-standing differential access to imported goods, its rich agricultural lands, and its constant water supply may have given the city an economic advantage. At the same time, the use of causeways to extend Ichmul's domain into its more agriculturally focused hinterlands could have reversed this economic disparity.

In terms of the administrative hierarchy within the region, it is much more possible to start to make statements about Ichmul's position relative to other sites in its vicinity, in that physical connections exist between the large center and considerably smaller hamlets and towns. Yo'okop's relationship to nearby sites is not known, due to both a lack of causeways and an inability for the CRAS project to study nearby sites at present. For these reasons, the two have, thus far, been considered to be fairly equivalent regional capitals, located approximately twenty-seven kilometers apart with the secondary site

of Sacalaca bisecting the intervening terrain in a manner consistent with central place theory (Christaller 1933; Young 2006). The sites' relative importance in this area, and in other potential hierarchies, can only be guessed, with Yo'okop's written record implying that it may have been more significant outside the Cochuah area. In addition, one should remember that ranking cities in any way may be a largely Western concept, with particular inhabitants perhaps being more concerned with their ruler's leadership and the amount of tribute, labor, and allegiance owed in return (Marcus 1983:208).

Final Considerations of System and Site Variability

As with other questions raised in this work, explaining the differences between the road systems of Ichmul and Yo'okop is not an act of answering simple questions. Instead, both the sites were constructed and evolved through time in response to a myriad of internal and external influences and pressures that preceded, and were contemporaneous with, the settlements. Preexisting concerns such as natural resources, site plans, and cosmological programs became conflated with a new set of pressures during the Terminal Classic. Rulers at each center successfully negotiated these turbulent times, calling upon sacbeob as one of many means of integrating their large, dispersed polities. The use of these causeways, as well as other strategies, was innovative in the sense that neither site had experimented with this type of monumental construction at an earlier date. However, the use of roadways was a very traditional concept tied to mainstream Maya beliefs, practices, and priorities. Although both sites declined by or during the Postclassic, the approaches taken by the elites guiding the two centers permitted the cities to flourish for several hundred years longer than the southern polities that had dominated much of the peninsula during Classic times. It may be said that they redefined the nature of "community" to some degree, although in doing so, they called upon many of the same integrative concepts that had long been present in the Maya area.

Profound as these changes may have been for Ichmul and Yo'okop, this does not imply that the ways in which the roadways of the Cochuah region were utilized holds true for the remainder of the Maya area. Although these functions certainly could have been similar to

their use at some other sites, each set of individuals involved in building, maintaining, and using roadways at other sites is likely to have seen potential and actual sacbeob differently in terms of their functions and meaning. The enormous variability reviewed throughout this volume suggests that the Cochuah cases represent just a portion, only two examples, of a much wider set of practices and beliefs that would have differed through time and space. Such variability would have been at least as much as, if not greater than, the more obvious physical variation that is visible in the archaeological record. The lesson from this is not that Ichmul and Yo'okop are meaningless for other researchers. Instead, just as the ancient inhabitants of Maya sites may not have envisioned all of the "sacbeob" defined by archaeologists as the same type of object, it is wrong to oversimplify the past by looking for all "causeways" to have had the same purposes or meanings. Certainly, some of the larger concepts reviewed here may have been carried through at many sites, but a true understanding of the roads of any given site requires not only a study of the general, quite varied, feature class; in addition, an examination of the context in which a particular sacbe or sacbe system was planned, constructed, and utilized is needed to begin to understand any single example.

Appendix

Sites with Sacbeob by Type

Lengths have not been included, because many of the numbers used in these analyses were measured from maps rather than provided by the researchers. These estimates may differ from actual lengths by several meters, depending on the scale of the map and the manner of representation. Although these minor disparities were not considered significant for the purposes of examining overall length patterning, I do not wish to present these data in numeric form within the tables, giving the appearance that they are all actual field measurements.

Table 1 Sites with Local Intrasite Sacbeob

Site	Sources
Aké	Roys and Shook 1966
Baking Pot	Willey et al. 1965
Bandera	Sidrys 1983
Becan	Thomas 1981
Calakmul	Folan et al. 2001a, 2001b
Caracol	Chase and Chase 1987, 1989, 1996, 2001; Chase et al. 1990; Jaeger 1991
Cerros	Scarborough 1983, 1991a
Chac II	Smyth 2003; Smyth et al. 1998
Chacchob	Webster 1979
Chan Chen	Sidrys 1983
Chan Chich	Houk 2003
Chichén Itzá	Cobos 2003; Cobos and Winemiller 2001; Lincoln 1987, 1991; Piña Chan 1980
Chobenchen	Burgos Villanueva et al. 2004
Chuh ku	Robles Castellanos and Andrews 2001
Chunchucmil	Garza Terrazona and Kurjack 1980; Kurjack and Garza Terrazona 1981
Cobá	Benavides Castillo 1981; Benavides Castillo and Robles Castellanos 1975; Folan 1977b; Gallareta Negrón 1981

Table 1 continued

Site	Sources
Copán	Fash 1983, 1991; Willey et al. 1978
Cuca	Webster 1979
Dolores	Dunning 1992
Dos Hombres	Houk 2003
Dzibilchaltún	E. Andrews 1981; Andrews and Andrews 1980; Kurjack 1974; Stuart et al. 1979; Uriarte Torres 2004
Edzna	G. Andrews 1984; Benavides Castillo 1997
Ek Balam	Bey et al. 1997, 1998
Halal	Pollock 1980
La Honradez	Von Euw and Graham 1984
Huntichmul	Dunning 1992; Dunning and Kowalski 1994
Hunto Chac	Prem and Dunning 2004
Ichcantiho	Ligorred Perramon 2001, 2005
Ichmul	Shaw et al. 2004
Isla Cerritos	Gallareta Negrón and Andrews 1988
Ixkun	Maudslay 1899
Izamal	Lincoln 1980; Maldonado Cárdenas 1979a, 1979b, 1990
Kabah	G. Andrews 1975; Pollock 1980
Kancab	Maldonado Cárdenas 1995
Kinal	Graham 1967; Scarborough et al. 1994
Komchen	Ringle 1985
Labná	Gallareta Negrón et al. 1991; Pollock 1980
Maax Na	King and Shaw 2003
Mayapán	G. Andrews 1975; Pollock 1954, 1956
La Milpa	Tourtellot et al. 2003
Minanha'	Iannone 2005
El Mirador	Dahlin 1984; Graham 1967; Matheny 1980, 1986a, 1986b
Nakbe	Hansen 2000; Suasnávar 1994
Nakum	Hellmuth 1976
Naranjal	Reid 1995; Taube 1995
Naranjo	Morley 1938; Von Euw 1975
Nohmul	Hammond 1985; Hammond et al. 1988
Nuevo Leon	Velázquez Morlet et al. 1988
Oxkintok	G. Andrews 1975; Pollock 1980
Oxlakmul	Muller 1959
Oxtancah	Muller 1959
Pacbitun	Healy 1990

Table 1 continued

Site	Sources
Pusilha	Braswell et al. 2004b
Rancho Dolores	Dunning 1992
Río Bec	Adams 1981
El Rosario	Laporte et al. 1999
Las Ruinas	Muller 1960
Sahaltun	Burgos Villanueva et al. 2004
San Gérvasio	Freidel and Sabloff 1984; Gregory 1975; Sierra Sosa 1994
San Luis Pueblito	Laporte et al. 1997
Sannacte	Dunning 1992
Santa Rosa Xtampak	Adams 1981
Sayil	Sabloff and Tourtellot 1991; Smyth and Dore 1992; Tourtellot et al. 1988
Seibal	Tourtellot 1988; Willey 1990
Shipstern	Sidrys 1983
Tamanché	Kurjack 1977; Kurjack and Garza Terrazona 1981
Tikal	Haviland 1970
Tzemé	Robles Castellanos and Andrews 2000
Tzikul	Robles Castellanos and Andrews 2003
Tzum	Adams 1981; Von Euw 1977
Uaxactún	Ricketson and Ricketson 1937; Smith 1950
Ucanha	Maldonado Cárdenas 1995
Ucí	Maldonado Cárdenas 1995
Uxmal	Carrasco Vargas 1993
Vista Alegre	Glover and Rissolo 2005
X-ual-canil	Schwake 2000
Xcanaheleb	Dunning 1992; Dunning and Kowalski 1994
Xelha	Witschey 1993
Xnaheb	Dunham 1990
Xtobó	Anderson 2003
Xultun	Morley 1938; Von Euw and Graham 1978
Xunantunich	LeCount et al. 2002
Yaxcopoil	Garza Terrazona and Kurjack 1980
Yaxha	Hellmuth 1976
Yaxhom	Dunning 1988 and 1992
Yaxuná	Shaw 1998
Yo'okop	Shaw et al. 2000; Stromsvik et al. 1955; Wilson 1974

Table 2 Sites with Core-Outlier Intrasite Sacbeob

Site	Sources
Big Laugh	Lish 1974
Calakmul	Folan et al. 2001a, 2001b
Caracol	Chase and Chase 1987, 1989, 1996, 2001; Chase et al. 1990; Jaeger 1991
Chichén Itzá	Cobos 2003; Cobos and Winemiller 2001; Lincoln 1987, 1991; Piña Chan 1980
Cobá	Benavides Castillo 1981; Brasdefer 1984; Gallareta Negrón 1981
Dzibilchaltún	E. Andrews 1981; E. Andrews and E. W. Andrews 1980; Kurjack 1974; Stuart et al. 1979
Ek Balam	Bey et al. 1997, 1998
Ichmul	Shaw et al. 2004
Izamal	Lincoln 1980; Maldonado Cárdenas 1990
El Mirador	Matheny 1980, 1986a, 1986b
Muyil	Witschey 1993
Naranjal–San Cosmé	Mathews 1998; Reid 1995; Taube 1995
Oxkintok	G. Andrews 1975; Pollock 1980
San Gérvasio	Gregory 1975; Sierra Sosa 1994
Sayil–Chac	Smyth et al. 1998
Tikal	Carr and Hazard 1961
Ucí	Maldonado Cárdenas 1995
Vista Alegre	Glover and Rissolo 2005
Xelha	Sanders 1955
Yo'okop	Shaw et al. 2002

Table 3 Sites with Intersite Sacbeob

Site	Sources
Aké–Izamal	Lincoln 1980; Maldonado Cárdenas 1979a, 1979b, 1990; Roys and Shook 1966
Calakmul	Folan et al. 2001a, 2001b
Calakmul–El Mirador	Folan et al. 2001b
Caracol	Chase and Chase 1987, 1989, 1996, 2001; Chase et al. 1990; Jaeger 1991
Chichén Itzá	Cobos 2003; Cobos and Winemiller 2001
Cobá–Ixil	Benavides Castillo 1981; Folan 1977a; Gallareta Negrón 1981; Robles Castellanos 1976
Cobá–Yaxuná	Benavides Castillo 1981; Villa Rojas 1934
Izamal–Kantunil	Lincoln 1980; Maldonado Cárdenas 1979a, 1979b, 1990; Roys and Shook 1966
Kabah–Nohpat–Uxmal–(?) Oxkintok	Barrera Rubio 1981; Dunning and Kowalski 1994; Garza Terrazona and Kurjack 1980; Maldonado Cárdenas 1979a, 1979b
El Mirador	Dahlin 1984
El Mirador–Nakbe	Matheny 1980, 1986a and 1986b; Suasnávar 1994
San Fernando–Emal	Dahlin and Ardren 2002
San Gérvasio	Sierra Sosa 1994
Tiho–Izamal (?)	Roys and Shook 1966; Tozzer 1966 [1941]
Ucí Kancab–Ukana–Cansahcab	Garza and Kurjack 1980; Maldonado Cárdenas 1979a, 1979b, 1995

Glossary

aduana. A facility used to control the flow of access into or out of an area. Today it commonly refers to a customs control facility.
aguada. A natural and/or cultural freshwater catchment basin filled by runoff rather than direct contact with the water table. Many were lined, cleaned, and used for drinking water.
albarrada. A dry-laid stone wall built of boulder-to-cobble-sized rocks typical of colonial, historic, and modern times; used as long-term fences to demarcate property boundaries and contain livestock.
axis mundi. The center of the world for a particular belief system.
babatun. "Sky bearers" who held up the four corners of the world in Classic Maya cosmology.
bajo. A natural depression that may become seasonally inundated.
brecha. A path cut through vegetation; when used by archaeologists for mapping, these are generally straight sight lines.
callejuela. Alleys formed by walls or other constructions.
calzada. An avenue, generally wider and involving more construction investment than the average road.
camino real. Royal road.
casa ejidal. The primary, if not only, government building of a collective landholding unit (ejido); the internal rooms are generally used for storage, office space, and small meetings of local officials, while the exterior, often with a roofed porch, is used as the assembly point for meetings of ejido members.
cenote. A sinkhole in karstic topography that is in contact with the freshwater table; fresh water, along with small organisms, enters the sinkhole through the porous limestone underlying the Yucatán Peninsula; the formation of many such features is thought to relate to the Chicxulub meteor impact event (see Brown 2006 for a thorough discussion of this feature type).
chac luum. Red soil that is common to much of the northern Yucatán; in many areas, this is the deposit that directly overlies bedrock; in deeply stratified deposits, the presence of chac luum indicates that relatively little sediment remains to be excavated, and the remains associated with the chac luum are therefore likely to be among the earliest in a given locale.
Chak (also Chac). The rain deity known as Tlaloc in central Mexico; depicted with "goggle eyes."
chich. Small cobbles and gravel that are generally placed between larger cobbles and *sascab* in creating a floor, platform, or sacbe.
chultun. A cavity excavated and/or constructed that is generally lined with plaster and used to store water or foodstuffs.

comisario. The leading elected official in an ejido.
ejido. A collective landowning unit created after the Mexican revolution; although recent legislation (1992 modification to Article 27 of Mexico's constitution) has allowed many ejidos to be dissolved, they are still the primary form of land tenure in the Cochuah region.
fagina. Compulsory labor system of the Yucatán, in which adult males were required to contribute to sacred and secular community projects.
guardia. Literally translated as "guarding," in Quintana Roo the term is particularly associated with those who guarded the Talking Cross.
haltun. A small water-catchment basin of natural and/or cultural origin.
incensario. Incense burners particularly common to Postclassic Maya rituals, these include basic chalice forms, as well as very ornate modeled deities and other anthropomorphic figures.
in situ. A term used by archaeologists to refer to materials that are still in the context in which their last users deposited them, also called "primary context."
mamposteria. A type of masonry that includes irregular, uncut stones held together by mortar; this was generally used for surfaces meant to be covered by plaster or cut stones.
mano. A hand-held stone used for grinding corn in a *metate* or similar basin.
metate. A stone basin used for grinding corn and other materials using a *mano*; generally created from a hard stone and associated with domestic activities. The modern Maya in the Cochuah region refer to these as *pilas*, or storage devices, because their depressions capture and store rainwater.
milpa. Maya agricultural field created through swidden, or slash-and-burn, farming and containing corn, as well as other crops that might include beans, squash, and chiles.
mojoneras. Distance markers or boundary stones associated with some sacbeob.
multepal. Term used at the time of the Spanish conquest for a system of rule by a council thought to characterize Chichén Itzá, Mayapán, and a limited number of other sites (see Schele and Freidel 1990:361–364).
municipio. A governmental unit roughly equivalent to a U.S. county; a municipio may contain a number of ejidos and/or pueblos, is generally based at the largest town in the region, and reports to the state government.
pila. Although the term literally translates as "storage device" and may be used by modern Yucatec Maya to refer to items as diverse as batteries and water storage chambers, it is used here (and by the modern Yucatec Maya) to refer to metates; the modern Maya in the Cochuah region have noted that metates at archaeological sites collect rainwater and, not being aware of their prior grinding function, believe them to be small water-catchment basins used in the past.
pueblo. A village or town; the term is also used more generally to refer to the

place considered to be one's home and therefore potentially applies to anything from a large city to a lone house.

rancho. Literally translating as "ranch," the term is generally used to refer to a plot of land on which cattle are kept, although the amount of land and number of head of livestock may be quite limited; in some instances, the term is used to differentiate privately owned land from ejido land, regardless of the functions that take place on the land.

rejollada. A natural depression in karstic terrain; although small portions of some features may collect water during the rainy season, rejolladas are not in direct contact with the water table as cenotes are; they contain deeper soils than are present elsewhere and are commonly used to grow specialized crops.

sacbe. Translated as "white road," the term is usually applied to Maya roads built of stone that are elevated above the surrounding terrain; as discussed in this work, their dimensions and form may be highly variable, however.

sascab. Powdered limestone that is mined from softer, "decayed" deposits present throughout the Yucatán; commonly forming the top layer of floors, platforms, and roads, it may be packed into a relatively hard surface using water and pressure.

sascabera. A mine from which *sascab* is removed; these may be surface mines, mines within natural cave features, or artificial caves created through mining.

solar. A house lot in a Maya community generally demarcated by albarradas or other wall forms; may contain several structures, including houses for extended family members, a separate kitchen, a corncrib, a storage shed, and animal pens, as well as fruit trees and other high-maintenance plants.

talud-tablero. Architectural components associated with Teotihuacán that are formed by a sloping (talud) element and a tabular or inset panel element perpendicular to the ground (tablero).

tranvías. Narrow-gauge railway systems used to transport *henequen* in the northern Yucatán.

trinchera. Although the term literally translates as "trench," the Yucatec Maya use the term for any type of fortification, including walls enclosing an area; in the Cochuah region, these are the remains of Caste War conflicts.

uinal. A 20-day period of the Classic Maya calendar.

vía. A relatively narrow raised walkway connecting architectural groups that is roughly equivalent to the sidewalk, although its functions, whether for everyday or specialized ritual functions (or a mixture of both), are unknown.

References Cited

Adams, R.E.W.

1981 Settlement Patterns of the Central Yucatan and Southern Campeche Region. In *Lowland Maya Settlement Patterns*, edited by Wendy Ashmore, pp. 211–257. University of New Mexico Press, Albuquerque.

1986 The Maya City of Rio Azul. *National Geographic Magazine* 169 (4): 420–451.

Adams, R.E.W., and Richard C. Jones

1981 Spatial Patterns and Regional Growth among Classic Maya Cities. *American Antiquity* 46 (2): 301–322.

Adler, Michael A.

1989 Ranked Facilities and Social Integration in Nonranked Societies. In *The Architecture of Social Integration in Prehistoric Pueblos*, edited by William D. Lipe and Michelle Hegmon, pp. 35–47. Occasional Papers of the Crow Canyon Archaeological Center no. 1. Cortez, CO.

Adler, Michael A., and Richard H. Wilshusen

1990 Large-Scale Integrative Facilities in Tribal Societies: Cross-Cultural and Southwestern U.S. Examples. *World Archaeology* 22 (2): 133–146.

Anderson, David

2003 El Asentamiento Preclásico en la Región Noroeste de Yucatán. In *Proyecto Costa Maya: Reconocimiento Arqueológico en el Noroeste de Yucatán, Mexico. Reporte Interino, Temporada 2002: Reconocimiento Arqueológico de la Esquina Noroeste de la Peninsula de Yucatan y Primeras Aproximaciones a los Temas de Investigación*, edited by Fernando Robles Castellanos and Anthony Andrews, pp. 46–61. Centro INAH Yucatán, Instituto Nacional de Antropología e Historia and the National Geographic Society.

Andrews, Anthony

1983 *Maya Salt Production and Trade*. University of Arizona Press, Tucson.

1990 The Role of Trading Ports in Maya Civilization. In *Vision and Revision in Maya Studies*, edited by Flora S. Clancy and Peter D. Harrison, pp. 159–167. University of New Mexico Press, Albuquerque.

1991 Rural Chapels and Churches of Early Colonial Yucatán and Belize: An Archaeological Perspective. In *Columbian Consequences*, vol. 3,

The Spanish Borderlands in Pan-American Perspective, edited by David H. Thomas, pp. 355–374. Smithsonian Institution Press, Washington, DC.

Andrews, Anthony, and Tomás Gallareta Negrón

1986 The Isla Cerritos Archaeological Project, Yucatan, Mexico. *Mexicon* 8 (3): 44–48.

Andrews, Anthony P., Tomás Gallareta Negrón, Fernando Robles Castellanos, Rafael Cobos Palma, and Pura Cervera Rivero

1988 Isla Cerritos: An Itzá Trading Port on the North Coast of Yucatán, Mexico. *National Geographic Research* 4:196–207.

Andrews, Anthony P., and Fernando Robles Castellanos

1985 Chichén Itzá and Cobá: An Itza-Maya Standoff in Early Postclassic Yucatán. In *The Lowland Maya Postclassic*, edited by Arlen F. Chase and Prudence M. Rice, pp. 62–72. University of Texas Press, Austin.

Andrews, E. Wyllys, IV

1942 *Yucatán: Architecture.* Carnegie Institution of Washington Year Book no. 41, 1941–42. Washington, DC.

1943 *The Archaeology of Southwestern Campeche.* Carnegie Institution of Washington, Contributions to American Anthropology and History no. 40. Washington, DC.

Andrews, E. Wyllys, IV, and E. W. Andrews V

1980 *Excavations at Dzibilchaltun, Yucatan, Mexico*. Middle American Research Institute Publication 48. Tulane University, New Orleans.

Andrews, E. Wyllys, V

1981 Dzibilchaltun. In *Supplement to Handbook of Middle American Indians*, vol. 1, edited by Jeremy A. Sabloff, pp. 313–341. University of Texas Press, Austin.

Andrews, George F.

1975 *Maya Cities: Placemaking and Urbanization*. University of Oklahoma Press, Norman.

1984 *Edzna, Campeche, Mexico: Settlement Patterns and Monumental Architecture*. Foundation for Latin American Anthropological Research, Culver City, CA.

Artigas, Hernández Juan B.

1982 *Capillas Abiertas Aisladas de México*. Universidad Nacional Autónoma de México, Mexico City.

Ashmore, Wendy

1989 Construction and Cosmology: Politics and Ideology in Lowland Maya Settlement Patterns. In *Word and Image in Maya Culture: Explorations in Language, Writing, and Representation*, edited by William F. Hanks and Don S. Rice, pp. 272–286. University of Utah Press, Salt Lake City.

1991 Site-Planning Principles and Concepts of Directionality among the Ancient Maya. *Latin American Antiquity* 2 (3): 199–226.

1992 Deciphering Maya Architectural Plans. In *New Theories on the Ancient Maya*, edited by Elin C. Danien and Robert J. Sharer, pp. 173–184. University Museum Monograph 77. University Museum, University of Pennsylvania, Philadelphia.

1998 Monumentos Políticos: Sitios, Asentamiento, y Paisaje por Xunantunich, Belice. In *Anatomia de Una Civilización: Aproximaciones Interdisciplinarias a la Cultura Maya*, edited by Andres Ciudad Ruiz, Yolanda Fernández Marquinez, José Miguel García Campillo, Ma. Josefa Iglesias Ponce de León, Alfonso Lacadena García-Gallo, and Luis T. Sanz Castro, pp. 161–183. Publication no. 4. Sociedad Española de Estudios Mayas, Madrid.

2002 The Idea of a Maya Town. In *Structure and Meaning in Human Settlements*, edited by Tony Atkin and Joseph Rykwert, pp. 35–50. University of Pennsylvania Museum, Philadelphia.

Ashmore, Wendy, and Jeremy A. Sabloff

2000 El Orden del Espacio en los Planes Cívicos Mayas. In *Arquitectura e Ideología de los Antiguos Mayas: Memoria de la Segunda Mesa Redonda de Palenque*, edited by Silvia Trejo, pp. 15–33. Instituto Nacional de Antropología e Historia and Consejo Nacional Para la Cultura y las Artes, Mexico City.

2002 Spatial Orders in Maya Civic Plans. *Latin American Antiquity* 13 (2): 201–215.

Austen, Ralph A.

1978 African Commerce without Europeans: The Development Impact of International Trade in the Pre-modern Era. *Kenya Historical Review* 6:1–21.

Aveni, Anthony

1980 *Skywatchers of Ancient Mexico*. University of Texas Press, Austin.

Aveni, Anthony, and H. Hartung

1986 Maya City Planning and the Calendar. *Transactions of the American Philosophical Society* 76 (7): 1–73.

Aveni, Anthony, Susan Milbrath, and Carlos Peraza Lope

2004 Chichén Itzá's Legacy in the Astronomically Oriented Architecture of Mayapan. *Res* 45:123–144.

Ball, Joseph

1979 Ceramics, Culture History, and the Puuc Tradition: Some Alternative Possibilies. In *The Puuc: New Perspectives*, edited by Lawrence Mills, pp. 18–35. Scholarly Studies in the Liberal Arts, Publication 1. Central College, Pella, IA.

Barrera Rubio, Alfredo

1981 Patron de Asentamiento del Area de Uxmal, Yucatán, México. *Me-*

moria del Congreso Interno 1979, pp. 71–82. Instituto Nacional de Antropología e Historia, Mexico City.

Barrera Vázquez, Alfredo

1941 La Significación de los Morfemas Zac (Sak) y Chiic en los Nombres Sacbe y Sacchic (Sensontle). In *Los Mayas Antiguos: Monografías de Arqueología, Etnografía y Lingüística Mayas, Publicadas con Motivo del Centenario de la Exploración de Yucatán por John L. Stephens y Frederick Catherwood en los Anos 1841–42*, edited by César Lizardi Ramos, pp. 75–80. Fondo de Cultura Economica, Mexico City.

Becker, Marshall J.

1971 *The Identification of a Second Plaza Plan at Tikal, Guatemala, and Its Implications for Ancient Maya Social Complexity*. Ph.D. dissertation, Department of Anthropology, University of Pennsylvania.

Benavides Castillo, Antonio

1981 *Los Caminos de Cobá y sus Implicaciones Sociales*. Instituto Nacional de Antropología e Historia, Centro Regional del Sureste, Coleccion Cientifica, Mexico City.

1997 *Edzná: Una Ciudad Prehispánica de Campeche*. Instituto Nacional de Antropología e Historia, Mexico City.

Benavides Castillo, Antonio, and Fernando Robles Castellanos

1975 Coba: Sus Sacbeob y Dzib Mul. *INAH Boletin* [Instituto Nacional de Antropología e Historia] epoca 2 (15): 55–58.

Bennett, Robert R.

1930 The Ancient Maya Causeway in Yucatan. *Indian Notes* 7:347–407.

Bevington, Gary

1995 *Maya for Travelers and Students: A Guide to Language and Culture in Yucatan*. University of Texas Press, Austin.

Bey, George, III, Tara M. Bond, William M. Ringle, Craig A. Hanson, Charles W. Houck, and Carlos Peraza Lope

1998 The Ceramic Chronology of Ek Balam, Yucatan, Mexico. *Ancient Mesoamerica* 9:101–120.

Bey, George, III, Craig A. Hanson, and William M. Ringle

1997 Classic to Postclassic at Ek Balam, Yucatan: Architectural and Ceramic Evidence for Defining the Transition. *Latin American Antiquity* 8 (3): 237–254.

Bey, George J., Carlos Peraza Lope, and William Ringle

1992 Comparative Analysis of Late Classic Period Ceramic Complexes of the Northern Maya Lowlands. *Ceramica de Cultura Maya* 16:11–17.

Binford, Michael, Mark Brenner, Thomas Whitmore, Antonia Higuera-Gundy, and E. S. Deevey

1987 Ecosystems, Paleoecology, and Human Disturbance in Subtropical and Tropical America. *Quaternary Science Reviews* 6:115–128.

Blanton, Richard E., Stephen A. Kowalewski, Gary Feinman, and Jill Appel
1993 *Ancient Mesoamerica: A Comparison of Change in Three Regions*. Cambridge University Press, New York.

Bolles, David, and William J. Folan
2001 An Analysis of Roads Listed in the Colonial Dictionaries and Their Relevance to Pre-Hispanic Linear Features in the Yucatan Peninsula. *Ancient Mesoamerica* 12 (2): 299–314.

Brady, James E., and Wendy Ashmore
1999 Mountains, Caves, Water: Ideational Landscapes of the Ancient Maya. In *Archaeologies of Landscape: Contemporary Perspectives*, edited by Wendy Ashmore and A. Bernard Knapp, pp. 124–145. Blackwell Publishers, Malden, MA.

Brasdefer, Fernando C. de
1984 La Extension de Cobá: Una Contribución al Patron de Asentamiento. In *Investigaciones Recientes en el Area Maya, XVII Mesa Redonda*, pp. 63–74. Sociedad Mexicana de Antropología, San Cristobal de las Casas, Chiapas.

Braswell, Geoffrey E.
2000 The Emergence of Market Economies in the Ancient Maya World: Obsidian Exchange in Terminal Classic Yucatan, Mexico. Paper presented at the 65th Annual Meeting of the Society for American Archaeology, Philadelphia.

Braswell, Geoffrey E., Joel D. Gunn, María del Rosario Domínguez Carrasco, William J. Folan, Laraine A. Fletcher, Abel Morales López, and Michael D. Glascock
2004a Defining the Terminal Classic at Calakmul, Campeche. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 162–194. University of Colorado Press, Boulder.

Braswell, Geoffrey E., Christian M. Prager, Cassandra R. Bill, Sonja A. Schwake, and Jennifer B. Braswell
2004b The Rise of Secondary States in the Southeastern Periphery of the Maya World. *Ancient Mesoamerica* 15 (2): 219–233.

Bretos, Miguel A.
1992 Ichmul: El Santo Cristo de las Ampollas. In *Iglesias de Yucatán*, pp. 141–146. Editorial Dante, Mexico City.

Brown, Clifford T.
2006 Water Sources at Mayapan, Yucatán, Mexico. In *Precolumbian Water Management: Ideology, Ritual, and Power*, edited by Lisa J. Lucero and Barbara W. Fash, pp. 171–185. University of Arizona Press, Tucson.

Buikstra, Jane E., and Douglas K. Charles
1999 Centering the Ancestors: Cemeteries, Mounds, and Sacred Land-

scapes of the Ancient North American Midcontinent. In *Archaeologies of Landscape: Contemporary Perspectives*, edited by Wendy Ashmore and A. Bernard Knapp, pp. 201–228. Blackwell Publishers, Malden, MA.

Bunzel, Ruth

1952 *Chichicastenango: A Guatemalan Village*. American Ethnological Society 22. University of Washington Press, Seattle.

Burgos Villanueva, Rafael, Miguel Covarrubias Reyna, and Jose Estrada Faisal

2004 Estudios Sobre la Periferia de Izamal, Yucatán. *Los Investigadores de la Cultura Maya* 12 (1): 249–256.

Bustillos Carillo, Antonio

1964 *El Sacbé de los Mayas*. Costa-Amic Mesones, Mexico City.

Carballal Staedtler, Margarita, and María Flores Hernández

2006 Hydraulic Features of the Mexico-Texcoco Lakes during the Postclassic Period. In *Precolumbian Water Management: Ideology, Ritual, and Power*, edited by Lisa J. Lucero and Barbara W. Fash, pp. 155–170. University of Arizona Press, Tucson.

Carlson, John B.

1981 A Geomantic Model for the Interpretation of Mesoamerican Sites: An Essay in Cross-Cultural Comparison. In *Mesoamerican Sites and World-Views*, edited by Elizabeth P. Benson, pp. 143–211. Dumbarton Oaks Research Library and Collections, Washington, DC.

1982 The Structure of Mayapan: A Major Post-Classic Maya Site in Northern Yucatan. *Lateinamerika Studien* 10:43–62.

Carmean, Kelli, Nicholas Dunning, and Jeff Karl Kowalski

2004 High Times in the Hill Country: A Perspective from the Terminal Classic Puuc Region. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 424–449. University of Colorado Press, Boulder.

Carr, Robert F., and James E. Hazard

1961 *Tikal Report No. 11: Map of the Ruins of Tikal, El Peten, Guatemala.* University Museum, University of Pennsylvania, Philadelphia.

Carrasco Vargas, Ramón

1993 Formacion Sociopolitica en el Puuc: El Sacbe Uxmal–Nohpat–Kabah. In *Perspectivas Antropologicas en el Mundo Maya*, edited by Ma. Josefa Iglesias Ponce de Leon and Francesa Ligorred Perramon, pp. 199–212. Publicaciones de la Sociedad Espanola de Estudios Mayas no. 2. Girona, Spain.

Caseres, Raúl E., Juan Duch Cotell, Roger Camos Mungía, Gary Francisco, and López Cervantes

1998 *Yucatán en el Tiempo: Enciclopedia Alfabética*. Cares, Mexico.

Castañeda, Quetzil E.
1996 *In the Museum of Maya Culture: Touring Chichén Itzá*. University of Minnesota Press, Minneapolis.

Charnay, Désiré
1887 *The Ancient Cities of the New World: Being Voyages and Explorations in Mexico and Central America from 1857–1882*. Harper and Brothers, New York.

Chase, Arlen F., and Diane Z. Chase
1982 Yucatec Influence in Terminal Classic Northern Belize. *American Antiquity* 47 (3): 596–614.
1987 *Investigations at the Classic Maya City of Caracol, Belize, 1985–1987*. Pre-Columbian Art Research Institute Monograph 3. San Francisco.
1989 The Investigation of Classic Period Maya Warfare at Caracol, Belice. *Mayab* 5:5–18.
1996 More than Kin and King. *Current Anthropology* 37 (5): 803–810.
2001 Ancient Maya Causeways and Site Organization at Caracol, Belize. *Ancient Mesoamerica* 12 (2): 273–281.

Chase, Diane Z., Arlen F. Chase, and William A. Haviland
1990 The Classic Maya City: Reconsidering the "Mesoamerican Urban Tradition." *American Anthropologist* 92 (2): 499–506.

Christaller, Walter
1933 *Die zentralen Orte in Deuschland*. Jena: Gustav Fischer. Translated (in part) by Charlisle W. Baskin, as *Central Places in Southern Germany*. Prentice Hall, 1966.

Cobos, Rafael
2003 *The Settlement Patterns of Chichén Itzá, Yucatan, Mexico*. Ph.D. dissertation, Department of Anthropology, Tulane University, New Orleans.

Cobos, Rafael, and Terance L. Winemiller
2001 The Late and Terminal Classic-Period Causeway Systems of Chichen Itza, Yucatan, Mexico. *Ancient Mesoamerica* 12 (2): 283–292.

Coe, Michael D.
1965 A Model of Ancient Community Structure in the Maya Lowlands. *Southwestern Journal of Anthropology* 21:97–114.
1994 *Mexico: From the Olmecs to the Aztecs*. 4th edition. Thames and Hudson, New York.

Coggins, Clemency
1967 Palaces and the Planning of Ceremonial Centers in the Maya Lowlands. Manuscript on file, Tozzer Library, Peabody Museum, Harvard University, Cambridge, MA.
1980 The Shape of Time: Some Political Implications of a Four-Part Figure. *American Antiquity* 45 (4): 727–738.

Cogolludo, Diego López de
1957 *Historia de Yucatán*. 5th edition. Editorial Academia Literaria, Mexico City.

Con, Maria Jose
2002 Cobá: Entre Caminos y Lagos. *Arqueologia Mexicana* 9 (54): 34–41.

Contreras Arias, Alfonso
1958 Bosquejo Climatologio. In *Los Recursos Naturales del Sureste y Su Aprovechamiento*, vol. 2, edited by Enrique Beltran, pp. 93–158. Instituto Mexicano de Recursos Naturales Renovables, Mexico City.

Covich, Alan P.
1970 *Stability of Molluscan Communities: A Paleolimnologic Study of Environmental Disturbance in the Yucatan Peninsula*. Ph.D. dissertation, Yale University. University Microfilms, Ann Arbor, MI.

Covich, Alan, and M. Stuiver
1974 Changes in Oxygen 18 as a Measure of Long-term Fluctuations in Tropical Lake Levels and Molluscan Populations. *Limnology and Oceanography* 19:682–691.

Coyoc Ramírez, Mario A., and Alejandro J. Uriarte Torres
2003 Contextos Arquitectonicos y Funerarios Asociados a Los Sacbeob 2 y 5 de Dzibilchaltun, Yucatan. *Investigadores de Mesoamérica* 4:96–106.

Culbert, T. Patrick
1973 *The Classic Maya Collapse*. Albuquerque: University of New Mexico Press.

Culbert, T. Patrick, Laura J. Kosakowsky, Robert E. Fry, and William Haviland
1990 The Population of Tikal, Guatemala. In *Precolumbian Population History in the Maya Lowlands*, edited by T. Patrick Culbert and Don S. Rice, pp. 103–121. Albuquerque: University of New Mexico Press.

Curtis, Jason, Mark Brenner, David A. Hodell, Richard A. Balser, Gerald A. Islebe, and Henry Hooghiemstra
1998 A Multi-Proxy Study of Holocene Environmental Change in the Maya Lowlands of Peten, Guatemala. *Journal of Paleolimnology* 19:139–159.

Curtis, Jason, David A. Hodell, and Mark Brenner
1996 Climate Variability on the Yucatán Peninsula (Mexico) during the Past 3500 Years, and Implications for Maya Cultural Evolution. *Quaternary Research* 46:37–47.

Cyphers, Ann, and Judith Zurita-Noguera
2006 A Land That Tastes of Water. In *Precolumbian Water Management: Ideology, Ritual, and Power*, edited by Lisa J. Lucero and Barbara W. Fash, pp. 33–50. University of Arizona Press, Tucson.

Dahlin, Bruce
1984 A Colossus in Guatemala: The Preclassic Maya City of El Mirador. *Archaeology* 37 (5): 18–25.
1986 *Reconstructing Ancient Maya Adaptive Patterns on the Northern Plains of Yucatan, Mexico: 1986 Interim Report*. Howard University, Washington, DC.
2000 The Barricade and Abandonment of Chunchucmil: Implications for Northern Maya Warfare. *Latin American Antiquity* 11 (3): 283–298.

Dahlin, Bruce, and Traci Ardren
2002 Modes of Exchange and Regional Patterns: Chunchucmil, Yucatan. In *Ancient Maya Political Economies*, edited by Marilyn A. Masson and David A. Freidel, pp. 249–284. Altamira Press, Walnut Creek, CA.

Dahlin, Bruce H., Timothy Beach, Sheryl Luzzadder-Beach, David Hixson, Scott Hudson, Aline Magnoni, Eugenia Mansell, and Daniel E. Mazeau
2005 Reconstructing Agricultural Self-Sufficiency at Chunchucmil, Yucatan, Mexico. *Ancient Mesoamerica* 16 (2): 229–247.

Dahlin, Bruce, John E. Foss, and Mary Elizabeth Chambers
1980 Project Acalches: Reconstructing the Natural and Cultural History of a Seasonal Swamp at El Mirador, Guatemala; Preliminary Results. In *El Mirador, Peten, Guatemala: An Interim Report*, edited by Ray T. Matheny, pp. 37–57. Papers of the New World Archaeological Foundation no. 45. Brigham Young University, Provo, UT.

Demarest, Arthur A.
2004 After the Maelstrom: Collapse of the Classic Maya Kingdoms and the Terminal Classic in the Western Peten. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 102–124. University of Colorado Press, Boulder.

Demarest, Arthur A., Matt O'Mansky, Claudia Wolley, Dirk Van Tuerenhout, Takeshi Inomata, Joel Palka, and Héctor Escobeda
1997 Classic Maya Defensive Systems and Warfare in the Petexbatun Region: Archaeological Evidence and Interpretations. *Ancient Mesoamerica* 8 (2): 229–253.

Desmond, Lawrence G., and William A. Sauck
1997 Yucatan Ground Penetrating Radar Project 1997: Chichén Itzá. Additional GPR Surveys at Balankanche, Izamal, and Dzibilchaltun. Report submitted to Joaquin García Barcena, presidente del Consejo de Arqueologia, Instituto Nacional de Antropología e Historia, October 20, 1997. http://maya.csuhayw ard.edu/archaeo planet/LgdPage/GPR97SumRpt.htm.

Diaz-Bolio, José
1989 *El Sacbé*. Area Maya, Mérida, Mexico.

Dunham, Peter S.
1990 *Coming Apart at the Seams: The Classic Development and Demise of Maya Civilization (A Segmentary View from Xnaheb, Belize)*. Ph.D. dissertation, Department of Anthropology, State University of New York at Albany.

Dunnell, Robert
1971 *Systematics in Prehistory*. Free Press, New York.

Dunning, Nicholas P.
1988 The Yaxhom Conurbation. *Mexicon* 10:16–19.
1991 Soils and Settlement in the Sayil Valley: A Preliminary Assessment. In *The Ancient Maya City of Sayil: The Mapping of a Puuc Region Center*, edited by Jeremy A. Sabloff and Gair Tourtellot, pp. 20–26. Middle American Research Institute Publication 60. Tulane University, New Orleans.
1992 *Lord of the Hills: Ancient Maya Settlement in the Puuc Region, Yucatán, Mexico*. Monographs in World Archaeology no. 15. Prehistory Press, Madison, WI.
1994 Puuc Ecology and Settlement Patterns. In *Hidden among the Hills: Maya Archaeology of the Northwest Yucatan Peninsula*, edited by Hanns J. Prem, pp. 1–43. Von Flemming, Möckmühl, Germany.

Dunning, Nicholas P., and George F. Andrews
1994 Ancient Maya Architecture and Urbanism at Siho and the Western Puuc Region, Mexico. *Mexicon* 16:53–61.

Dunning, Nicholas P., Timothy Beach, and Sheryl Luzzadder-Beach
2006 Environmental Variability among Bajos in the Southern Maya Lowlands and Its Implications for Ancient Maya Civilization and Archaeology. In *Precolumbian Water Management: Ideology, Ritual, and Power*, edited by Lisa J. Lucero and Barbara W. Fash, pp. 81–99. University of Arizona Press, Tucson.

Dunning, Nicholas P., and Jeff Karl Kowalski
1994 Lord of the Hills: Classic Maya Settlement Patterns and Political Iconography in the Puuc Region, Mexico. *Ancient Mesoamerica* 5:63–95.

Dunning, Nicholas, Vernon Scarborough, Fred Valdez Jr., Sheryl Luzzadder-Beach, Timothy Beach, and John G. Jones
1999 Temple Mountains, Sacred Lakes, and Fertile Fields: Ancient Maya Landscapes in Northwestern Belize. *Antiquity* 73 (281): 650–660.

Eaton, Jack D., and Joseph W. Ball
1978 *Studies in the Archaeology of Coastal Yucatan and Campeche, Mexico*. Middle American Research Institute no. 46. Tulane University, New Orleans.

Edmonson, Munro S. (editor)
1973 *Meaning in Mayan Languages: Ethnolinguistic Studies*. Mouton, The Hague, Paris.

Farriss, Nancy M.
1984 *Maya Society under Colonial Rule*. Princeton University Press, Princeton, NJ.

Fash, William
1983 Deducing Social Organization from Classic Maya Settlement Patterns: A Case Study from the Copan Valley. In *Civilization in the Ancient Americas: Essays in Honor of Gordon R. Willey*, edited by Richard M. Leventhal and Alan Kolata, pp. 261–288. University of New Mexico Press and Peabody Museum of Archaeology and Ethnology, Cambridge, MA.
1991 *Scribes, Warriors and Kings: The City of Copán and the Ancient Maya*. Thames and Hudson, New York.

Fash, William L., E. Wyllys Andrews, and T. Kam Manahan
2004 Political Decentralization, Dynastic Collapse, and the Early Postclassic in the Urban Center of Copán, Honduras. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 260–287. University of Colorado Press, Boulder.

Fash, William L., and David Stuart
1991 Dynastic History and Cultural Evolution at Copán, Honduras. In *Classic Maya Political History*, edited by T. Patrick Culbert, pp. 147–179. Cambridge University Press, Cambridge.

Faust, Betty Bernice
1998 *Mexican Rural Development and the Plumed Serpent*. Bergin and Garvey, Westport, CT.

Fedick, Scott, and Jennifer Mathews
2005 The Yalahau Regional Human Ecology Project: An Introduction and Summary of Recent Research. In *Quintana Roo Archaeology*, edited by Justine M. Shaw and Jennifer Mathews, pp. 33–50. University of Arizona Press, Tucson.

Fedick, Scott, Dawn M. Reid, and Jennifer Mathews
1995 Preliminary Evidence for the Existence of a Regional Sacbe across the Northern Maya Lowlands. In *The View from Yalahau: 1993 Archaeological Investigations in Northern Quintana Roo, Mexico*, edited by Scott L. Fedick and Karl A. Taube, pp. 129–137. University of California–Riverside.

Fedick, Scott, and Karl Taube
1995 The Yalahau Regional Human Ecology Project: Research Orientation and Overview of 1993 Investigations. In *The View from Yalahau: 1993 Archaeological Investigations in Northern Quintana Roo, Mexico*, edited by Scott L. Fedick and Karl A. Taube, pp. 1–21. University of California–Riverside.

Fletcher, Laraine A.
1983 Linear Features in Zone I: Description and Classification. In *Coba:*

A Classic Maya Metropolis, edited by William J. Folan, Ellen R. Kintz, and Laraine A. Fletcher, pp. 89–102. Academic Press, New York.

Flores Colin, Alberto

2005 Ichmul Operation 2. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 25–30. College of the Redwoods, Eureka, CA.

2006 The Christ of Ichmul: Religious Syncretism with a New Faith. Paper presented at the Fourth International Conference of Hierarchy and Power in the History of Civilizations, Moscow, June 15, 2006.

Flores Colin, Alberto, and Adam Kaeding

2004 Forgotten Churches of the Cochuah Province. In *Final Report of the Cochuah Regional Archaeological Survey's 2004 Field Season*, edited by Justine M. Shaw, pp. 147–184. College of the Redwoods, Eureka, CA.

Flores Colin, Alberto, and Johan Normark

2004a All Roads Lead to Ichmul: Sacbeob in the Ichmul Region. In *Final Report of the Cochuah Regional Archaeological Survey's 2004 Field Season*, edited by Justine M. Shaw, pp. 72–94. College of the Redwoods, Eureka, CA.

2004b Ichmul and Its Surroundings. In *Final Report of the Cochuah Regional Archaeological Survey's 2004 Field Season*, edited by Justine M. Shaw, pp. 55–71. College of the Redwoods, Eureka, CA.

2005a The San Andres Terminus Area. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 45–51. College of the Redwoods, Eureka, CA.

2005b The San Cristobal Terminus Area. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 61–64. College of the Redwoods, Eureka, CA.

2005c The San Juan Terminus Area. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 71–74. College of the Redwoods, Eureka, CA.

2005d The San Pedro (Chan Ichmul) Terminus Area. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 79–81. College of the Redwoods, Eureka, CA.

2005e The Central Portion of Ichmul. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 7–24. College of the Redwoods, Eureka, CA.

Folan, William J.

1969 Dzibilchaltun, Yucatán, Mexico: Structures 384, 385, and 386, a Preliminary Interpretation. *American Antiquity* 34 (4): 434–461.

1975 Coba Archaeological Mapping Project, Interim Report No. 2. *Bo-*

letin de la Escuela de Ciencias Antropologicas de la Universidad de Yucatan 4:29–51.

1977a El Sacbé Coba–Ixil: Un Camino Maya del Pasado. *Nueva Antropología* 2 (6): 30–42.

1977b Informe Interino Número 2. *Boletin de la Escuela de Ciencias Antropologicas de la Universidad de Yucatan* 4 (22–23): 20–51.

1978 Coba, Quintana Roo, Mexico: An Analysis of a Prehispanic and Contemporary Source of Sascab. *American Antiquity* 43 (1): 79–85.

1982 Mining and Quarrying Techniques of the Lowland Maya. *Anthropology* 6 (1–2): 149–174.

1983a The Ruins of Cobá. In *Cobá: A Classic Maya Metropolis*, edited by William Folan, Ellen R. Kintz, and Laraine A. Fletcher, pp. 65–87. Academic Press, New York.

1983b Urban Organization and Social Structure of Cobá. In *Cobá: A Classic Maya Metropolis*, edited by William Folan, Ellen R. Kintz, and Laraine A. Fletcher, pp. 49–63. Academic Press, New York.

1991 Sacbes of the Northern Maya. In *Ancient Road Networks and Settlement Hierarchies in the New World*, edited by Charles D. Trombold, pp. 222–229. Cambridge University Press, Cambridge.

1992a Sacbes y Fuentes Hidraúlicas de los Antiquos Mayas. In *Antropología Mesoamericana: Homenaje a Alfonso Villa Rojas*, edited by Víctor Manuel Esponda Jimeno, Sophia Pincemin Deliberos, and Mauricio Rosas Kifuri, pp. 335–359. Gobierno del Estado de Chiapas, Talleres Gráficos del Estado, Tuxtla Gutiérrez, Chiapas, Mexico.

1992b Calakmul, Campeche: A Centralized Urban Administrative Center in the Northern Petén. *World Archaeology* 24 (2): 158–168.

Folan, William J., Laraine A. Fletcher, Jacinto May Hau, and Lynda Florey Folan

2001a *Las Ruinas de Calakmul, Campeche, México: Un Lugar Central y su Paisaje Cultural*. Universidad Autónoma de Campeche, Centro de Investigaciones Históricas y Sociales, Campeche.

Folan, William J., Joel D. Gunn, Jack Eaton, and Robert Patch

1983a Paleoclimatological Patterning in Southern Mesoamerica. *Journal of Field Archaeology* 10:453–468.

Folan, William J., Ellen R. Kintz, and Laraine A. Fletcher

1983b *Coba: A Classic Maya Metropolis*. Academic Press, New York.

Folan, William J., Joyce Marcus, and W. Frank Miller

1995a Verification of a Maya Settlement Model through Remote Sensing. *Cambridge Archaeological Journal* 5 (2): 277–301.

Folan, William J., Joyce Marcus, Sophia Pincemin, María del Rosario Domínguez Carrasco, Laraine Fletcher, and Abel Morales López

1995b Calakmul: New Data from an Ancient Maya Capital in Campeche, Mexico. *Latin American Antiquity* 6 (4): 310–334.

Folan, William J., Joyce Marcus, Sophia Pincemin, and Laraine Fletcher

1995c Calakmul: New Data from an Ancient Maya Capital in Campeche, Mexico. *Latin American Antiquity* 6 (4): 310–334.

Folan, William J., Jacinto May Hau, Joyce Marcus, W. Frank Miller, and Raymundo Golzález Heredia

2001b Los Caminos de Calakmul, Campeche. *Ancient Mesoamerica* 12 (2): 293–298.

Folan, William J., and George E. Stuart

1977 Interim Report No. 1. *Boletin de la Escuela de Ciencias Antropologicas de la Universidad de Yucatan* 4 (22–23): 20–28.

1983 El Proyecto Cartográfico Arqueológico de Cobá, Q. Roo: Informes Interinos Numeros 1, 2, y 3. *Boletin de la Escuela de Ciencias Antropológicas* 4 (22–23): 14–70.

Ford, Anabel

2001 *Influence of Ancient Maya Settlement in the Contemporary Maya Forest: Investigating Maya Land Use at El Pilar*. Submitted to the Belice Department of Archaeology. Mesoamerican Research Center, University of California–Santa Barbara.

Ford, James A.

1954 The Type Concept Revisited. In *Man's Imprint from the Past*, edited by James Deetz, pp. 58–72. Little Brown, Boston.

Fox, John W.

1994 Political Cosmology among the Quiche Maya. In *Factional Competition and Political Development in the New World*, edited by Elizabeth M. Brumfiel and John W. Fox, pp. 158–170. Cambridge University Press, Cambridge.

Freidel, David, and Richard Leventhal

1975 The Settlement Survey. In *Changing Pre-Columbian Commercial Systems: Cozumel, Mexico*, edited by Jeremy A. Sabloff and William L. Rathje, pp. 60–76. Harvard University, Cambridge, MA.

Freidel, David, and Jeremy A. Sabloff

1984 *Cozumel: Late Maya Settlement Patterns*. Academic Press, New York.

Freidel, David, Linda Schele, and Joy Parker

1993 *Maya Cosmos: Three Thousand Years on the Shaman's Path*. William Morrow, New York.

Freidel, David, and Charles Suhler

1999 The Path of Life. In *Mesoamerican Architecture as a Cultural Symbol*, edited by Jeff Karl Kowalski, pp. 250–273. Oxford University Press, Oxford.

Fry, Robert E.

1987 The Ceramic Sequence of South-Central Quintana Roo, Mexico. In *Maya Ceramics: Papers from the 1985 Maya Ceramic Conference, Part 1*, edited by Prudence Rice and Robert Sharer, pp. 111–122.

BAR International Series 345 (i). British Archaeological Reports, Oxford.

Fuson, Robert H.
1969 The Orientation of Mayan Ceremonial Centers. *Annals of the Association of American Geographers* 59 (3): 494–511.

Gabbert, Wolfgang
2004 *Becoming Maya: Ethnicity and Social Inequality in Yucatán since 1500*. University of Arizona Press, Tucson.

Gallareta Negrón, Tomás
1981 Proyecto Cobá: Extensión y Análysis Preliminar del Asentamiento Prehispánico. *Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán* 9 (50): 60–76.

Gallareta Negrón, Tomás, and Anthony P. Andrews
1988 El Proyecto Arqueológico Isla Cerritos, Yucatán, México. *Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán* 15 (89): 3–16.

Gallareta Negrón, Tomás, José Huchim Herrera, Carlos Peraza Lope, Carlos Pérez Alvarez, Lourdes Toscano Hernández
1991 Planeamientos y Resumen de los Trabajos de Campo del Proyecto Arqueologico Labna, Temporada 1991. Report on file, Centro INAH Yucatan.

Gann, Thomas
1926 *Ancient Cities and Modern Tribes: Exploration and Adventure in Maya Lands*. Charles Scribner's Sons, New York.

Garza Terrazona de González, Silva, and Edward B. Kurjack
1980 *Atlas Arqueológico del Estado de Yucatán*. Instituto Nacional de Antropología e Historia, Mexico City.

Ghuman, B. S., and Rattan Lal
1987a Effects of Deforestation on Soil Properties and Microclimate of a High Rain Forest in Southern Nigeria. In *The Geophysiology of Amazonia: Vegetation and Climate Interactions*, edited by Robert E. Dickinson, pp. 225–244. John Wiley and Sons, New York.
1987b Effects of Partial Forest Clearing on Microclimate in a Humid Tropical Forest. *Agricultural and Forest Meteorology* 40:17–29.

Gill, Richardson B.
2000 *The Great Maya Droughts*. University of New Mexico Press, Albuquerque.

Glover, Jeffrey B., and Dominique Rissolo
2005 El Puerto Maya Vista Alegre: Un Estudio Preliminar del Comercio Maya Antiguo en la Costa Norte de Quintana Roo. Paper presented at the Segundo Congreso Internacional de Cultura Maya, Mérida, Yucatán, March 16, 2005.

Graham, Ian
1967 *Archaeological Explorations in El Peten, Guatemala*. Middle American Research Institute, Publication 33. Tulane University, New Orleans.

Graña-Behrens, Daniel
2006 Emblem Glyphs and Political Organization in Northwestern Yucatan in the Classic Period (AD 300–1000). *Ancient Mesoamerica* 17 (1): 105–123.

Gregory, David A.
1975 San Gervasio. In *A Study of Changing Pre-Columbian Commercial Systems*, edited by Jeremy A. Sabloff and William L. Rathje, pp. 88–106. Harvard University, Cambridge, MA.

Gunn, Joel, and Richard E. W. Adams
1981 Climatic Change, Culture, and Civilization in North America. *World Archaeology* 13 (1): 87–100.

Gunn, Joel, and William J. Folan
1995 Three Rivers: Interregional Global Climate Response Surface for the Southwestern Maya Lowlands (Candelaria, Usumacina, and Champotón Watersheds). Paper prepared for the 1995 Campechano Conference.

Hammond, Norman
1972 The Planning of a Maya Ceremonial Center. *New World Archaeology: Theoretical and Cultural Transformations*. Readings from *Scientific American*. W. H. Freeman and Company, San Francisco.
1985 *Nohmul: A Prehistoric Maya Community in Belize, Excavations 1973–1983*. BAR International Series 250 (I). British Archaeological Reports, Oxford.

Hammond, Norman, Laura J. Kosakowsky, K. Anne Pyburn, John R. Rose, J. C. Staneko, Sara Donaghey, C. M. Clark, Mark Horton, Colleen Gleason, Deborah Muyskens, and Thomas Addyman
1988 The Evolution of an Ancient Maya City: Nohmul. *National Geographic Research* 4 (4): 474–495.

Hanks, William F.
1990 *Referential Practice: Language and Lived Space among the Maya*. University of Chicago Press, Chicago.

Hansen, Richard D.
2000 Ideología y Arquitectura: Poder y Dinámicas Culturales de los Mayas del Periodo Preclásico en las Tierras Bajas. In *Arquitectura e Ideología de los Antiguos Mayas: Memoria de la Segunda Mesa Redonda de Palenque*, edited by Silvia Trejo, pp. 71–108. Instituto Nacional de Antropología e Historia and Consejo Nacional Para la Cultura y las Artes, Mexico City.

Harris, Chauncy, and Edward Ullman
1945 The Nature of Cities. *Annals of the Academy of Political and Social Science* 242:7–17.

Harrison, Peter
1979 The Lobil Postclassic Phase in the Southern Interior of the Yucatán Peninsula. In *Maya Archaeology and Ethnohistory*, edited by N. Hammond and G. R. Willey, pp. 189–207. University of Texas Press, Austin.
1982 Subsistence and Society in Eastern Yucatán. In *Maya Subsistence: Studies in Memory of Dennis E. Puleston,* edited by Kent V. Flannery, pp. 119–130. Academic Press, New York.
1993 Aspects of Water Management in the Southern Lowlands. In *Economic Aspects of Water Management in the Prehispanic New World*, edited by Vernon Scarborough and Barry Isaac, pp. 71–120. JAI Press, Greenwich, CT.
1999 *The Lords of Tikal: Rulers of an Ancient Maya City*. Thames and Hudson, London.

Hassig, Ross
1991 Roads, Routes, and Ties That Bind. In *Ancient Road Networks and Settlement Hierarchies in the New World*, edited by Charles D. Trombold, pp. 17–27. Cambridge University Press, Cambridge.

Haviland, William A.
1969 A New Population Estimate for Tikal, Guatemala. *American Antiquity* 34 (4): 429–433.
1970 Tikal, Guatemala, and Mesoamerican Urbanism. *World Archaeology* 2 (2): 186–198.
2003 Settlement, Society, and Demography at Tikal. In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by Jeremy A. Sabloff, pp. 111–142. School of American Research Advanced Seminar Series. School of American Research Press, Santa Fe, NM.

Healy, Paul F.
1990 Excavations at Pacbitun, Belize: Preliminary Report on the 1986 and 1987 Investigations. *Journal of Field Archaeology* 17 (3): 247–262.

Heath de Zapata, Dorothy Andrews
1980 *Vocabulario de Mayathan: Mayan Dictionary*. Mérida, Yucatán.

Hellmuth, Nicholas M.
1976 *Maya Archaeology: Travel Guide, Guatemala, Honduras, El Salvador*. Foundation for Latin American Anthropological Research, Guatemala City, Guatemala.

Hirth, Kenneth
1982 Transportation Architecture at Xochicalco, Morelos, Mexico. *Current Anthropology* 23 (3): 322–324.

Hodell, David, Mark Brenner, Jason Curtis, and Thomas Guilderson
2001 Solar Forcing of Drought Frequency in the Maya Lowlands. *Science* 292:1367–1370.

Hodell, David, Jason H. Curtis, and Mark Brenner
1995 Possible Role of Climate in the Collapse of the Classic Maya Civilization. *Nature* 375 (1): 391–394.

Hodell, David, Jason H. Curtis, Glenn A. Jones, Antonia Higuera-Gundy, Mark Brenner, Michael W. Binford, and Kathleen T. Dorsey
1991 Reconstruction of Caribbean Climate Change over the Past 10,500 Years. *Nature* 352:790–793.

Hohmann-Vogrin, Annegrete
2000 El Espacio Estructurado y la Vision del Mundo. In *Arquitectura e Ideología de los Antiguos Mayas: Memoria de la Segunda Mesa Redonda de Palenque*, edited by Silvia Trejo, pp. 35–54. Instituto Nacional de Antropología e Historia and Consejo Nacional Para la Cultura y las Artes, Mexico City.

Houk, Brett A.
1996 *The Archaeology of Site Planning: An Example from the Maya Site of Dos Hombres, Belize*. Ph.D. dissertation, University of Texas, Austin. University Microfilms International, Ann Arbor, MI.
2003 Ties That Bind: Site Planning in the Three Rivers Region. In *Heterarchy, Political Economy, and the Ancient Maya*, edited by Vernon L. Scarborough, Fred Valdez Jr., and Nicholas Dunning, pp. 52–63. University of Arizona Press, Tucson.

Houston, Stephen
1993 *Hieroglyphs and History at Dos Pilas: Dynastic Politics of the Classic Maya*. University of Texas Press, Austin.

Hoyt, Homer
1939 *The Structure and Growth of Residential Neighborhoods in American Cities*. Federal Housing Administration, Washington, DC.

Huerta Rodriguez, J. Pablo
2005a San Andres Operation 1. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 53–55. College of the Redwoods, Eureka, CA.
2005b San Andres Operation 2. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 56–60. College of the Redwoods, Eureka, CA.
2005c San Cristobal Operation 1. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 65–67. College of the Redwoods, Eureka, CA.
2005d San Cristobal Operation 2. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 68–70. College of the Redwoods, Eureka, CA.

Hutson, Scott R., Aline Magnoni, Daniel E. Mazeau, and Travis W. Stanton
2006 The Archaeology of Urban Houselots at Chunchucmil, Yucatán. In *Lifeways in the Northern Maya Lowlands: New Approaches to Archaeology in the Yucatán Peninsula*, edited by Jennifer P. Mathews and Bethany A. Morrison, pp. 77–92. University of Arizona Press, Tucson.

Hyslop, John
1990 *Inka Settlement Planning*. University of Texas Press, Austin.

Iannone, Gyles
2005 The Rise and Fall of an Ancient Maya Petty Royal Court. *Latin American Antiquity* 16 (1): 26–44.

Jaeger (Liepens), Susan Elizabeth
1991 *Settlement Pattern Research at Caracol, Belize: The Social Organization in a Classic Period Maya Site*. Ph.D. dissertation, Department of Anthropology, Southern Methodist University, Dallas.
1994 The Conchita Causeway Settlement Subprogram. In *Studies in the Archaeology of Caracol, Belize*, edited by Diane Z. Chase and Arlen F. Chase, pp. 47–63. Pre-Columbian Art Research Institute Monograph 7. San Francisco.

Johnson, Gregory A.
1978 Information and the Development of Decision-Making Organizations. In *Social Archaeology: Beyond Subsistence and Dating*, edited by Charles L. Redman, pp. 87–112. Academic Press, New York.
1982 Organizational Structure and Scalar Stress. In *Theory and Explanation in Archaeology: The Southampton Conference*, edited by Colin Renfrew, Michael Rowlands, and Barbara Segraves, pp. 389–421. Academic Press, New York.
1983 Decision-Making and Pastoral Nomad Group Size. *Human Ecology* 11 (2): 175–199.
1989 Dynamics of Southwestern Prehistory: Far Outside, Looking In. In *Dynamics of Southwest Prehistory*, edited by Linda S. Cordell and George J. Gumerman, pp. 371–389. Smithsonian Institution Press, Washington, DC.

Johnston, Kevin
1985 Maya Dynastic Territorial Expansion: Glyphic Evidence from Classic Centers of the Pasion River, Guatemala. In *The Fifth Palenque Round Table*, edited by V. M. Fields, pp. 49–56. Precolumbian Art Research Institute, San Francisco.

Johnstone, Dave
1994 Excavations within the Ballcourt Plaza. In *The Selz Foundation Yaxuna Project: Final Report of the 1993 Field Season*, edited by Charles Suhler and David Freidel, pp. 62–69. Southern Methodist University, Dallas.

1998 Yaxuna Ceramics: Chronological and Spatial Relationships. Paper presented at the 63rd Society for American Archaeology Meetings, Seattle.

2001a Operations 1 and 2. In *Final Report of the Selz Foundation's Proyecto Arqueológico Yo'okop 2001 Field Season: Excavations and Continued Mapping*, edited by Justine M. Shaw, pp. 36–44. College of the Redwoods, Eureka, CA.

2001b Sacbe 3. In *Final Report of the Selz Foundation's Proyecto Arqueológico Yo'okop 2001 Field Season: Excavations and Continued Mapping*, edited by Justine M. Shaw, pp. 34–35. College of the Redwoods, Eureka, CA.

2001c *The Ceramics of Yaxuná, Yucatán*. Ph.D. dissertation, Southern Methodist University, Dallas.

2002 Residential Mapping in the Site Center. In *Final Report of the Proyecto Arqueológico Yo'okop's 2002 Field Season*, edited by Justine M. Shaw, pp. 7–11. College of the Redwoods, Eureka, CA.

2005 Ceramic Summary from the 2005 Cochuah Regional Archaeological Survey. In *Final Report of the Proyecto Arqueológico Yo'okop's 2005 Field Season*, edited by Justine M. Shaw, pp. 179–227. College of the Redwoods, Eureka, CA.

2006 Settlement Dynamics in the Cochuah Region of the Yucatan Peninsula. Paper presented at the 71st Annual Meeting of the Society for American Archaeology, San Juan, Puerto Rico, April 28, 2006.

Johnstone, Dave, and Justine Shaw (editors)

2006 *Final Report of the Cochuah Regional Archaeological Survey's 2006 Analysis Season*. College of the Redwoods, Eureka, CA.

Jones, Christopher

2003 The Tikal Renaissance and the East Plaza Ball Court. In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by Jeremy A. Sabloff, pp. 207–225. School of American Research Advanced Seminar Series. School of American Research Press, Santa Fe, NM.

Kaeding, Adam

2005 Xbalche. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 130–143. College of the Redwoods, Eureka, CA.

Kaeding, Adam, and Albert G. Flores Colin

2005 Ichmul Operation 3. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 31–44. College of the Redwoods, Eureka, CA.

King, Eleanor M., and Leslie C. Shaw

2003 A Heterarchical Approach to Site Variability. In *Heterarchy, Political Economy, and the Ancient Maya*, edited by Vernon L. Scarborough, Fred Valdez Jr., and Nicholas Dunning, pp. 64–76. University of Arizona Press, Tucson.

Kintz, Ellen R.
1983 Neighborhoods and Wards in a Classic Maya Metropolis. In *Coba: A Classic Maya Metropolis*, edited by William J. Folan, Ellen R. Kintz, and Laraine A. Fletcher, pp. 179–190. Academic Press, New York.

Knapp, A. Bernard, and Wendy Ashmore
1999 Archaeological Landscapes: Constructed, Conceptualized, Ideational. In *Archaeologies of Landscape: Contemporary Perspectives*, edited by Wendy Ashmore and A. Bernard Knapp, pp. 1–30. Blackwell Publishers, Malden, MA.

Kowalski, Jeff Karl
1985 Lords of the Northern Maya: Dynastic History in the Inscriptions of Uxmal and Chichén Itzá. *Expedition* 27 (3): 50–60.

Kristan-Graham, Cynthia
2001 A Sense of Place at Chichén Itzá. In *Landscape and Power in Ancient Mesoamerica*, edited by Rex Koontz, Kathryn Reese-Taylor, and Annabeth Headrick, pp. 317–369. Westview Press, Boulder, CO.

Krochock, Ruth
1988 *The Hieroglyphic Inscriptions and Iconography of the Temple of the Four Lintels and Related Monuments, Chichén Itzá, Yucatan, Mexico*. MA thesis, University of Texas–Austin.
1995 Cross-Correlation of Epigraphic and Archaeological Data at Chichén Itzá. Paper presented at the 60th Annual Meeting of the Society for American Archaeology, Minneapolis.

Kurjack, Edward B.
1974 *Prehistoric Lowland Maya Community and Social Organization: A Case Study at Dzibilchaltún, Yucatan, Mexico*. Middle American Research Institute Publication 38. Tulane University, New Orleans.
1977 Sacbeob: Parentesco y Desarrollo del Estado Maya. *XV Mesa Redonda*, vol. 1, *Mesoamérica y Areas Circunvecinas*, pp. 217–230. Sociedad Mexicana de Antropología, Guanajuanto.
1994 Political Geography of the Yucatecan Hill Country. In *Hidden among the Hills: Maya Archaeology of the Northwest Yucatán Peninsula*, edited by Hanns J. Prem, pp. 308–315. Von Flemming, Möckmühl, Germany.
2003 Palace and Society in the Northern Maya Lowlands. In *Maya Palaces and Elite Residences*, edited by Joyce Christie, pp. 274–290. University of Texas Press, Austin.
2004 Geología y los patrones de asentamiento en la peninsula de Yucatán. *Los Investigadores de la Cultura Maya* 12 (1): 225–233.

Kurjack, Edward B., and E. Wyllys Andrews V
1976 Early Boundary Maintenance in Northwest Yucatan, Mexico. *American Antiquity* 41 (3): 318–325.

Kurjack, Edward B., and Silva Garza Terrazona de González
1981 Pre-Columbian Community Form and Distribution in the Northern Maya Area. In *Lowland Maya Settlement Patterns*, edited by Wendy Ashmore, pp. 287–309. University of New Mexico Press, Albuquerque.

Lamb, Weldon
1980 The Sun, the Moon, and Venus at Uxmal. *American Antiquity* 45:79–86.

Landa, Diego de
1959 *Relación de las Cosas de Yucatán*. Editorial Porrúa, Mexico City.

Laporte, Juan Pedro, Oswaldo Gómez, and Lilian A. Corzo
1999 La Cuenca Media del Río Mopan, Petén, Guatemala: Su Desarrollo Arqueológico. *Mexicon* 21:33–39.

Laporte, Juan Pedro, Paulino Morales, and W. Mariana Valdizón
1997 San Luis Pueblito: Un Sitio Mayor al Oeste de Dolores, Petén. *Mexicon* 19:47–51.

Laurance, William F.
1998 A Crisis in the Making: Responses of Amazonian Forests to Land Use and Climate Change. *Trends in Ecology and Evolution* 13 (10): 411–415.

Lawton, Crorey
2003 Tzemé y El Clásico Tardío/Terminal en la Región Noroeste de Yucatán. In *Proyecto Costa Maya: Reconocimiento Arqueológico en el Noroeste de Yucatán, Mexico. Reporte Interino, Temporada 2002: Reconocimiento Arqueológico de la Esquina Noroeste de la Peninsula de Yucatan y Primeras Aproximaciones a los Temas de Investigación*, edited by Fernando Robles Castellanos and Anthony Andrews, pp. 88–95. Centro INAH Yucatán, Instituto Nacional de Antropología e Historia, and National Geographic Society.

LeCount, Lisa J.
1999 Polychrome Pottery and Political Strategies in Late and Terminal Classic Lowland Maya Society. *Latin American Antiquity* 10 (3): 239–258.

LeCount, Lisa, Jason Yaeger, Richard M. Leventhal, and Wendy Ashmore
2002 Dating the Rise and Fall of Xunantunich, Belice. *Ancient Mesoamerica* 13 (1): 41–63.

Lee, Thomas, and Carlos Navarrete
1978 *Mesoamerican Communication Routes and Cultural Contacts*. Papers of the New World Archaeological Foundation 40. Brigham Young University, Provo, UT.

Lee, Yun Kuen, and Naicheng Zhu
2002 Social Integration of Religion and Ritual in Prehistoric China. *Antiquity* 76:715–723.

LePlongeon, Alice
1879 Notes on Yucatan. *Proceedings of the American Antiquarian Society*, p. 80. Worcester, MA.

Leyden, Barbara W., Mark Brenner, and Bruce H. Dahlin
1996 A Record of Long- and Short-Term Climatic Variation from Northwest Yucatán: Cenote San José Chulchacá. In *The Managed Mosaic: Ancient Maya Agriculture and Resource Use*, edited by Scott L. Fedick, pp. 30–49. University of Utah Press, Salt Lake City.
1998 Cultural and Climatic History of Cobá, a Lowland Maya City in Quintana Roo, Mexico. *Quaternary Research* 49:111–122.

Ligorred Perramon, Josep
2001 Urbanismo e Identidad. *Ichcanzihó, Los Nacidos de la Serpiente: Desarrollo Urbano y Gestión Patrimonial* 8:2–3.
2005 T'hó: Una Ciudad Maya Antigua bajo Una Ciudad Maya Moderna, Mérida. Paper presented at the Segundo Congreso Internacional de Cultura Maya in Mérida, Yucatán, March 15, 2005.

Limbrey, Susan
1975 *Soil Science and Archaeology*. Academic Press, New York.

Lincoln, Charles
1980 A Preliminary Assessment of Izamal, Yucatán, Mexico. BA honors thesis, Department of Anthropology, Tulane University, New Orleans.
1987 Primera Temporada del Proyecto Arqueologico Chichén Itzá: Resultados del Trabajo de Campo y Laboratorio, 1983–1985, con un Esayo Exploratorio sobre el Patron de Asentamiento del Sitio. *Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán* 15 (86): 3–43.
1991 *Ethnicity and Social Organization at Chichén Itzá, Yucatan, México*. Ph.D. dissertation, Harvard University, Cambridge, MA. University Microfilms International, Ann Arbor, MI.

Lish, Lawrence R.
1974 The Big Laugh Sacbe, British Honduras. *Katunob* 8 (4): 35–40.

Lizana, Bernardo de
1988 [1633] *Historia de Yucatan*. Edición Félix Jiménez Villaba. Historia 16, Madrid.

Lloyd, Christopher
2002 Locality and Observations of Group C and Sacbe 2. In *Final Report of the Proyecto Arqueológico Yo'okop's 2002 Field Season*, edited by Justine M. Shaw, pp. 21–27. College of the Redwoods, Eureka, CA.
2006 Statistical Analyses of Lithics from the Cochuah Region. Paper presented at the 71st Annual Meeting of the Society for American Archaeology, San Juan, Puerto Rico, April 28, 2006.

Lorenzen, Karl James
1999 New Discoveries at Tumben-Naranjál: Late Postclassic Reuse and the Ritual Recycling of Cultural Geography. *Mexicon* 21:98–107.

Lowe, John W. G.
1985 *The Dynamics of Apocalypse: A Systems Simulation of the Classic Maya Collapse*. University of New Mexico Press, Albuquerque.

Maldonado Cárdenas, Rubén
1979a Los Sacbeob de Izamal–Ake y Uci–Cansahcab en el Noroeste de Yucatan. *Antropología e Historia, Boletin del INAH, México* 3 (27): 23–29.
1979b Izamal–Aké, Cansahcab–Ucí, Sistemas Prehispánicos del Norte de Yucatán. *Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán* 6 (36): 33–44.
1990 Izamal, Sitio Hegemonico del Norte de Yucatán en la Epoca Clasica. In *La Epoca Clasica: Nuevos Hallazgos, Nuevas Ideas*, edited by Amalia Cardo de Mendez, pp. 483–493. Instituto Nacional de Antropológia e Historia Litograf, Mexico City.
1995 Los Sistemas de Caminos del Norte de Yucatán. In *Seis Ensayos Sobre Antiguos Patrones de Asentamiento en el Área Maya*, edited by Ernesto Vargas Pacheco, pp. 68–92. Instituto de Investigaciones Antropológicas, Universidad Autónoma de México, Mexico City.
2006 Los Caminos Prehispánicos de Yucatán. *Arqueología Mexicana* 14 (81): 43–47.

Malville, J. McKim, and Nancy J. Malville
2001 Pilgrimage and Periodic Festivals as Processes of Social Integration in Chaco Canyon. *Kiva* 66 (3): 327–344.

Manahan, Kam, James Ambrosino, and Traci Ardren
1997 The Last Stand: Defensive Constructions at Yaxuná, Yucatan. Paper presented at the 62nd Annual Meeting of the Society for American Archaeology, Nashville.

Marcus, Joyce
1976 *Emblem and State in the Classic Maya Lowlands: An Epigraphic Approach to Territorial Organization*. Dumbarton Oaks, Washington, DC.
1983 On the Nature of the Mesoamerican City. In *Prehistoric Settlement Patterns*, edited by Evon Z. Vogt and Richard M. Leventhal, pp. 195–242. University of New Mexico Press, Albuquerque.
1993 Ancient Maya Political Organization. In *Lowland Maya Civilization in the Eighth Century AD*, edited by Jeremy A. Sabloff and John S. Henderson, pp. 111–183. Dumbarton Oaks Research Library and Collection, Washington, DC.
2004 Calakmul y Su Papel en el Origen del Estado Maya. *Los Investigadores de la Cultural Maya* 12 (1): 14–30.

Martin, Simon
1997 The Painted King List: A Commentary on Codex-Style Dynastic Vases. In *The Maya Vase Book, a Corpus of Rollout Photographs of Maya Vases by Justin Kerr*, vol. 5, pp. 846–867. Kerr Associates, New York.

Martin, Simon, and Nikolai Grube
1995 Maya Superstates. *Archaeology* 48 (6): 41–46.
2000 *Chronicle of Maya Kings and Queens: Deciphering the Dynasties of the Ancient Maya*. Thames and Hudson, New York.

Mason, Gregory
1926a Ruins of Maya City Found in the Jungle. *New York Times*, March 24, 1926.
1926b Mayas Flourished along the Coast. *New York Times*, March 25, 1926.

Mason, Gregory, and Herbert Spinden
1927 *Silver Cities of Yucatan*. G. P. Putnam's Sons, New York.

Masson, Marilyn A.
1997 Cultural Transformation at the Maya Postclassic Community of Laguna de On, Belize. *Latin American Antiquity* 8 (4): 293–316.

Masson, Marilyn A., and Shirley Boteler Mock
2004 Ceramics and Settlement Patterns at Terminal Classic-Period Lagoon Sites in Northeastern Belize. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 367–401. University of Colorado Press, Boulder.

Matheny, Ray T.
1978 Northern Maya Lowland Water-Control Systems. In *Pre-Hispanic Maya Agriculture*, edited by Peter D. Harrison and B. L. Turner II, pp. 185–210. University of New Mexico Press, Albuquerque.
1980 *El Mirador, Peten, Guatemala: An Interim Report*. Papers of the New World Archaeological Foundation no. 45. Brigham Young University, Provo, Utah.
1986a Investigations at El Mirador, Petén, Guatemala. *National Geographic Research* 2 (3): 332–353.
1986b Early States in the Maya Lowlands during the Late Preclassic Period: Edzna and El Mirador. In *City States of the Maya: Art and Architecture*, edited by Elizabeth Benson, pp. 1–44. Rocky Mountain Institute for Pre-Columbian Studies, Denver.

Mathews, Jennifer
1998 *The Ties That Bind: Late Preclassic and Early Classic Interaction Spheres of the Ancient Maya in Northern Yucatan*. Ph.D. dissertation, Anthropology Department, University of California–Riverside.
2000 *The Long and Winding Road: Regional Sacbe, Yucatan Peninsula, Mex-*

ico. Report prepared for the Foundation for the Advancement of Mesoamerican Studies, Crystal River, Florida. http://www.famsi.org/reports/98027/index.html.

Mathews, Jennifer, and James F. Garber
2004 Models of Cosmic Order: Physical Expressions of Sacred Space among the Ancient Maya. *Ancient Mesoamerica* 15 (1): 49–59.

Mathews, Jennifer, and Lilia Lizama Rogers
2005 Jungle Rails: A Historic Narrow-Gauge Railway. In *Quintana Roo Archaeology*, edited by Justine M. Shaw and Jennifer Mathews, pp. 112–124. University of Arizona Press, Tucson.

Mathews, Jennifer, and Rubén Maldonado Cárdenas
2006 Late Formative and Early Classic Interaction Spheres Reflected in the Megalithic Style. In *Lifeways in the Northern Maya Lowlands: New Approaches to Archaeology in the Yucatán Peninsula*, edited by Jennifer P. Mathews and Bethany A. Morrison, pp. 95–118. University of Arizona Press, Tucson.

Mathews, Peter
1991 Classic Maya Emblem Glyphs. In *Classic Maya Political History: Hieroglyphic and Archaeological Evidence*, edited by T. Patrick Culbert, pp. 19–29. Cambridge University Press, New York.

Maudslay, Alfred
1899 *A Glimpse at Guatemala*. London.

McAnany, Patricia
1995 *Living with the Ancestors: Kinship and Kingship in Ancient Maya Society*. University of Texas Press, Austin.

McKee, Brian R.
2002 Structure 9: A Precolumbian Sweat Bath at Cerén. In *Before the Volcano Erupted: The Ancient Cerén Village in Central America*, edited by Payson Sheets, pp. 89–96. University of Texas Press, Austin.

McKillop, Heather
2002 *Salt: White Gold of the Ancient Maya*. University Press of Florida, Gainesville.

McKillop, Heather, and Paul F. Healy (editors)
1989 *Coastal Maya Trade*. Occasional Papers in Archaeology. Trent University, Peterborough, Ontario, Canada.

Messenger, Lewis
1990 Ancient Winds of Change: Climatic Settings and Prehistoric Social Complexity in Mesoamerica. *Ancient Mesoamerica* 1:21–40.

Milbrath, Susan
1999 *Star Gods of the Maya: Astronomy in Art, Folklore, and Calendars*. University of Texas Press, Austin.

Milbrath, Susan, and Carlos Peraza Lope
2003 Revisiting Mayapan: Mexico's Last Maya Capital. *Ancient Mesoamerica* 14 (1): 1–46.

Miller, Arthur G.
1974 The Iconography of the Painting in the Temple of the Diving God, Tulum, Quintana Roo, Mexico: The Twisted Cords. In *Mesoamerican Archaeology: New Approaches*, edited by Norman Hammond, pp. 167–186. University of Texas Press, Austin.

Mock, Shirley B.
1994 Yucatecan Presence in Northern Belize as Seen in the Postclassic Ceramics at Colhá. In *Continuing Archaeology at Colhá, Belize*, edited by T. R. Hester, H. J. Shafer, and J. D. Eaton, pp. 233–244. Studies in Archaeology no. 15. Texas Archaeological Research Laboratory, University of Texas, Austin.

Montmollin, Oliver de
1988a Tenam Rosario: A Political Microcosm. *American Antiquity* 53 (2): 351–370.
1988b Scales of Settlement Study for Complex Societies: Analytical Issues from the Classic Maya Area. *Journal of Field Archaeology* 15 (2): 151–168.
1989 *Archaeology of Political Structure: Settlement Analysis in a Classic Maya Polity*. Cambridge University Press, Cambridge.
1995 *Settlement and Politics in Three Classic Maya Polities*. Monographs in World Archaeology no. 24. Prehistory Press, Madison, WI.

Morley, Sylvanus G.
1938 *The Inscriptions of Peten*. Carnegie Institution of Washington, Publication 437. 5 vols. Washington, DC.

Morris, Ian
1991 The Archaeology of the Ancestors: The Saxe/Goldstein Hypothesis Revisited. *Cambridge Archaeological Journal* 1:147–169.

Morrison, Kathleen D., and Carla M. Sinopoli
1992 Economic Diversity and Social Integration in a Pre-colonial Indian Empire. *World Archaeology* 23 (3): 335–352.

Muller, Florencia
1959 *Atlas Arqueologico de la Republica Mexicana: Quintana Roo (1)*. Instituto Nacional de Antropología e Historia, Mexico City.
1960 *Atlas Arqueologico de la Republica Mexicana: Campeche (2)*. Instituto Nacional de Antropología e Historia, Mexico City.

Nalda, Enrique
1989 Reflexiones Sobre El Patron de Asentamiento Prehispánico en el Sur de Quintana Roo. *Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán* 17 (97): 3–27.

Nalda, Enrique, and Luz Evelia Campaña
1998 Dzibanché: Una Alternativa de Interpretación del Patrón de Asentamiento del Sur de Quintana Roo. In *Modelos de Entidades Políticas Mayas: Primer Seminario de Mesa Redonda de Palenque*, edited

by Silvia Trejo, pp. 35–55. Sociedad Mexicana de Antropología, San Cristobal de las Casas, Chiapas.

Normark, Johan

2003 Operation 1 at Xquerol. In *Final Report of the Cochuah Regional Archaeological Survey's 2003 Field Season*, edited by Justine M. Shaw, pp. 18–21. College of the Redwoods, Eureka, CA.

2004a *Caught Somewhere in Time: Polyagentive Archaeology in the Maya Lowlands*. Licentiate thesis, Goteborg University, Sweden.

2004b Sakbihs and Polyagency: The Architectural Causes of Human Behaviour in the Cochuah Region, Quintana Roo, Mexico. *Current Swedish Archaeology* 12:141–168.

O'Mansky, Matt, and Nicholas P. Dunning

2004 Settlement and Late Classic Political Disintegration in the Petexbatun Region, Guatemala. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 83–101. University of Colorado Press, Boulder.

Oviedo y Valdés, G. Fernando de

1959 *Historia General y Natural de los Indios*. Ediciones Atlas, Madrid.

Park, Robert E., Ernest W. Burgess, and R. D. McKenzie

1925 *The City*. University of Chicago Press, Chicago.

Paxton, Meredith

2001 *The Cosmos of the Yucatec Maya: Cycles and Steps from the Madrid Codex*. University of New Mexico Press, Albuquerque.

Peraza Lope, Carlos, Marilyn A. Masson, Timothy S. Hove, and Pedro Candelario Delgadokú

2006 The Chronology of Mayapan: New Radiocarbon Evidence. *Ancient Mesoamerica* 17 (2): 153–175.

Piña Chan, Roman

1978 Commerce in the Yucatan Peninsula: The Conquest and Colonial Period. In *Mesoamerican Communication Routes and Cultural Contacts*, edited by Thomas A. Lee Jr. and Carlos Navarette, pp. 37–48. New World Archaeological Foundation, Brigham Young University, Provo, UT.

1980 *Chichén Itzá: La Ciudad de los Brujos del Agua*. Fondo de Cultura Economica, Mexico City.

Pollock, H.E.D.

1954 The Southern Terminus of the Principal Sacbe at Mayapan—Group Z-50. *Current Reports, Carnegie Institution of Washington, Department of Archaeology* 37:529–549. Washington, DC.

1956 The Northern Terminus of the Principal Sacbe at Mayapan. *Current Reports, Carnegie Institution of Washington, Department of Archaeology* 15 (2): 1–14. Washington, DC.

1965 Architecture of the Maya Lowlands. In *Handbook of Middle American Indians*, vol. 2, *Archaeology of Southern Mesoamerica*, edited by Gordon R. Willey, pp. 378–440. University of Texas Press, Austin.

1980 *The Puuc: An Architectural Survey of the Hill Country of Yucatan and Northern Campeche, Mexico*. Memoirs of the Peabody Museum vol. 19. Peabody Museum of Archaeology and Ethnology, Cambridge, MA.

Potter, David F.

1977 *Maya Architecture of the Central Yucatán Peninsula, Mexico*. M.A.R.I. Publication 44. Tulane University, New Orleans.

Prem, Hanns J., and Nicholas P. Dunning

2004 Investigations at Hunto Chac, Yucatan. *Mexicon* 26 (2): 26–36.

Raisz, Edwin

1959 Landforms of Mexico. Map prepared for the Geography Branch of the Office of Naval Research, Cambridge, MA.

Rappaport, Roy A.

1979 *Ecology, Meaning, and Religion*. North Atlantic Books, Richmond, CA.

Rathje, William, and Jeremy Sabloff

1975 *Changing Precolumbian Commercial Systems*. Monographs of the Peabody Museum no. 3. Harvard University, Cambridge, MA.

Rautman, Alison E.

2000 Population Aggregation, Community Organization, and Plaza-Oriented Pueblos in the American Southwest. *Journal of Field Archaeology* 27 (3): 271–283.

Redfield, Robert

1941 *The Folk Culture of the Yucatan*. University of Chicago Press, Chicago.

Redfield, Robert, and Alfonso Villa Rojas

1962 *Chan Kom: A Maya Village*. University of Chicago Press, Chicago. [1934]

Reed, Nelson

2001 *The Caste War of Yucatan*. Stanford University Press, Stanford, CA.

Reents-Budet, Dorie

1994 *Painting the Maya Universe: Royal Ceramics of the Classic Period*. Duke University Press, Durham, NC.

Reid, Dawn M.

1995 Inter- and Intra-Site Sacbeob of the Naranjal Area. In *The View from Yalahau: 1993 Archaeological Investigations in Northern Quintana Roo, Mexico*, edited by Scott L. Fedick and Karl A. Taube, pp. 121–128. University of California, Riverside.

RHGY

1983 *Relaciones Histórico Geográficas de la Gobernación de Yucatán*. 2 vols.

Edited by Mercedes de la Garza. Universidad Autónoma de México, Mexico.

Rice, Don S.
1996 Paleolimnological Analysis in the Central Petén, Guatemala. In *The Managed Mosaic: Ancient Maya Agriculture and Resource Use*, edited by Scott L. Fedick, pp. 193–206. University of Utah Press, Salt Lake City.

Rice, Donald, Prudence M. Rice, and Arthur Demarest
2001 *The Terminal Classic in the Maya Lowlands: New Views of the End of the Classic Period in the Maya Lowlands*. Westview Press, Boulder, CO.

Ricketson, Oliver G., Jr., and Edith B. Ricketson
1937 *Uaxactun, Guatemala: Group E, 1926–1931*. Carnegie Institution of Washington, Publication 477. Washington, DC.

Ringle, William
1985 *The Settlement Patterns of Komchen, Yucatan, Mexico*. Ph.D. dissertation, Tulane University, New Orleans. UMI Dissertation Information Service, Ann Arbor, MI.
2004 On the Political Organization of Chichen Itza. *Ancient Mesoamerica* 15 (2): 167–218.

Ringle, William, George J. Bey III, Tara Bond Freeman, Craig A. Hanson, Charles W. Houck, and J. Gregory Smith
2004 The Decline of the East: The Classic to Postclassic Transition at Ek Balam, Yucatán. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 485–516. University of Colorado Press, Boulder.

Ringle, William, Tomás Gallareta Negrón, and George Bey
1998 The Return of Quetzalcoatl: Evidence for the Spread of a World Religion during the Epiclassic Period. *Ancient Mesoamerica* 9 (2): 183–232.

Robles Castellanos, Fernando
1976 Ixil, Centro Agrícola de Cobá. *Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán* 4 (27): 13–43.
1990 *La Secuencia Cerámica de Región de Cobá, Quintana Roo*. Colección Científica no. 184. Instituto Nacional de Antropología e Historia, Mexico City.

Robles Castellanos, Fernando, and Anthony P. Andrews
1986 A Review and Synthesis of Recent Postclassic Archaeology in Northern Yucatán. In *Late Lowland Maya Civilization: Classic to Postclassic*, edited by Jeremy A. Sabloff and E. Wyllys Andrews V, pp. 53–97. University of New Mexico Press, Albuquerque.
2000 *Proyecto Costa-Interior entre los Mayas de Yucatan. Reporte Interino, Temporada 2000: Reconocimiento Arqueológico de la Esquina Noroeste*

de la Peninsula de Yucatan. Centro INAH Yucatán, Instituto Nacional de Antropología e Historia, National Geographic Society, University of South Florida, and New College of Florida.

2001 *Proyecto Costa Maya: La Interacción Costa-Interior entre los Mayas de Yucatán. Reporte Interino, Temporada 2001: Reconocimiento Arqueológico de la Esquina Noroeste de la Peninsula de Yucatan*. Centro INAH Yucatán, Instituto Nacional de Antropología e Historia, National Geographic Society, and New College of Florida.

2003 *Proyecto Costa Maya: Reconocimiento Arqueológico en el Noroeste de Yucatán, Mexico. Reporte Interino, Temporada 2002: Reconocimiento Arqueológico de la Esquina Noroeste de la Peninsula de Yucatan y Primeras Aproximaciones a los Temas de Investigación*. Centro INAH Yucatán, Instituto Nacional de Antropología e Historia, and National Geographic Society.

Romanov, Michael Alexander

1973 *Yucatec Roads and the Orientation of the Maya World*. Ph.D. dissertation, University of Oregon. UMI Dissertation Information Service, Ann Arbor, MI.

Romero Conde, Paulino

2000 *Vocabulario Inglés-Maya-Español*. Compañía Editorial de la Peninsula, S.A. de C.V., Mérida, Yucatán.

Rowlands, Michael

1987 Centre and Periphery: A Review of the Concept. In *Centre and Periphery in the Ancient World*, edited by Michael Rowlands, Mogens Larsen, and Kristian Kristiansen, pp. 1–11. Cambridge University Press, Cambridge.

Roys, Lawrence, and Edwin M. Shook

1966 Preliminary Report on the Ruins of Ake, Yucatan. *Memoirs of the Society for American Archaeology No. 20*, 31 (3): 1–54.

Roys, Ralph

1957 *Political Geography of the Yucatecan Maya*. Carnegie Institution of Washington, Washington, DC.

1967 *The Chilam Balam of Chumayel*. University of Oklahoma Press, Norman.

Rugeley, Terry

1996 *Yucatan's Maya Peasantry and the Origins of the Caste War*. University of Texas Press, Austin.

Ruppert, Karl, and John Hopkins Denison

1943 *Archaeological Reconnaissance in Campeche, Quintana Roo, and Peten*. Carnegie Institution of Washington Publication 543. Washington, DC.

Sabloff, Jeremy, and E. Wyllys Andrews V (editors)

1986 *Late Lowland Maya Civilization: Classic to Postclassic*. University of New Mexico Press, Albuquerque.

Sabloff, Jeremy A., and William L. Rathje
1975 Cozumel's Place in Yucatecan Culture History. In *Changing Pre-Columbian Commercial Systems: Cozumel, Mexico*, edited by Jeremy A. Sabloff and William L. Rathje, pp. 21–28. Harvard University, Cambridge, MA.

Sabloff, Jeremy A., William L. Rathje, David A. Freidel, Judith G. Connor, and Paula L. W. Sabloff
1974 Trade and Power in Postclassic Yucatan: Initial Observations. In *Mesoamerican Archaeology: New Approaches*, edited by Norman Hammond, pp. 397–416. University of Texas Press, Austin.

Sabloff, Jeremy A., and Gair Tourtellot
1991 *The Ancient Maya City of Sayil: The Mapping of a Puuc Region Center*. Middle American Research Institute Publication 60. Tulane University, New Orleans.

Sáenz, César A.
1972 Exploraciones y Restauraciones en Uxmal (1970–1971). *INAH Boletin* [Instituto Nacional de Antropología e Historia] epoca 2 (2): 31–40.

Sanchez, W. A., and J. E. Kutzbach
1974 Climate of the American Tropics and Subtropics in the 1960s and Possible Comparisons with Climatic Variations of the Last Millennium. *Quaternary Research* 4:128–135.

Sanders, William T.
1955 *An Archaeological Reconnaissance of Northern Quintana Roo*. Carnegie Institute of Washington, Current Reports no. 24. Washington, DC.

Santley, Robert S., and Rani T. Alexander
1992 The Political Economy of Core-Periphery Systems. In *Resources, Power, and Interregional Interaction*, edited by Edward M. Schortman and Patricia A. Urban, pp. 23–49. Plenum Press, New York.

Satterthwaite, Lindon
1952 *Piedras Negras Archaeology: Architecture*, part 6, *Sweathouses*. University Museum, Philadelphia.

Saville, Marshall
1935 The Ancient Maya Causeways of Yucatan. *Antiquity* 9:67–73.

Scarborough, Vernon L.
1983 A Preclassic Maya Water System. *American Antiquity* 48 (4): 720–744.
1991a *Archaeology at Cerros, Belize, Central America*, vol. 3, *The Settlement System in a Late Preclassic Maya Community*. Series editor, David Freidel. Southern Methodist University Press, Dallas.
1991b Water Management Adaptations in Nonindustrial Complex Societies: An Archaeological Perspective. In *Archaeological Method*

and Theory, vol. 3, edited by Michael B. Schiffer, pp. 101–154. University of Arizona Press, Tucson.

1992 Flow of Power: Water Reservoirs Controlled the Rise and Fall of the Ancient Maya. *Sciences* March/April: 38–43.

1993 Water Management in the Southern Maya Lowlands: An Accretive Model for the Engineered Landscape. In *Economic Aspects of Water Management in the Prehispanic New World*, edited by Vernon Scarborough and Barry Isaac, pp. 17–69. JAI Press, Greenwich, CT.

1998 Ecology and Ritual: Water Management and the Maya. *Latin American Antiquity* 9 (2): 135–159.

2003 *The Flow of Power: Ancient Water Systems and Landscapes*. School of American Research Press, Santa Fe, NM.

Scarborough, Vernon, Robert P. Connolly, and Steven P. Ross

1994 The Pre-Hispanic Maya Reservoir System at Kinal, Peten, Guatemala. *Ancient Mesoamerica* 5:97–106.

Schele, Linda, and David Freidel

1990 *A Forest of Kings: The Untold Story of the Ancient Maya*. William Morrow, New York.

Schele, Linda, and Peter Mathews

1998 *The Code of Kings: The Language of Seven Sacred Maya Temples and Tombs*. Scribner's, New York.

Schortman, Edward M., and Patricia A. Urban

1994 Living on the Edge: Core/Periphery Relations in Ancient Southeastern Mesoamerica. *Current Anthropology* 35 (4): 401–430.

Schwake, Sonia A.

2000 *On the Road: Excavations along the Maya Sacbe at X-Ual-Canil, Cayo District, Belize*. MA thesis, Trent University, Peterborough, Ontario, Canada.

Shattuck, George C.

1933 General and Miscellaneous Information about Yucatan. In *The Peninsula of Yucatan*, edited by G. Shattuck, pp. 5–27. Carnegie Institution of Washington, Washington, DC.

Shaw, Justine M.

1997 Community Settlement Pattern Study during the 1996 Field Season. In *The Selz Foundation Yaxuná Project: Final Report of the 1996 Field Season*, edited by Justine M. Shaw and David Freidel, pp. 29–33. Southern Methodist University, Dallas.

1998 *The Community Settlement Patterns and Residential Architecture of Yaxuná, Yucatan, Mexico from AD 600–1400*. Ph.D. dissertation, Southern Methodist University, Dallas. UMI Dissertation Information Service, Ann Arbor, MI.

2001 Maya Sacbeob: Form and Function. *Ancient Mesoamerica* 12 (2): 261–272.

2003 Climate Change and Deforestation: Implications for the Maya Collapse. *Ancient Mesoamerica* 14 (1): 157–167.

2005 The Late to Terminal Classic Settlement Shifts at Yo'okop. In *Quintana Roo Archaeology*, edited by Justine M. Shaw and Jennifer Mathews, pp. 144–157. University of Arizona Press, Tucson.

Shaw, Justine (editor), with contributions by Sandra Bever, Alberto G. Flores Colin, Dave Johnstone, Adam Kaeding, Christopher Lloyd, Veronica Miranda, Johan Normark, Justine M. Shaw, and Tatiana Young

2004 *Final Report of the Cochuah Regional Archaeological Survey's 2004 Field Season*. College of the Redwoods, Eureka, CA.

Shaw, Justine (editor), with contributions by Alberto G. Flores Colin, Jorge Pablo Huerta Rodriguez, Dave Johnstone, Adam Kaeding, Christopher Lloyd, Johan Normark, Justine M. Shaw, and Tatiana Young

2005 *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*. College of the Redwoods, Eureka, CA.

Shaw, Justine M., George Bey, and Dave Johnstone

n.d. Terminal Classic Sweatbaths in Northern Yucatan. Submitted to *Latin American Antiquity* in September 2004 for publication consideration.

Shaw, Justine, and Dave Johnstone

2005 El Papel de la Arquitectura Postmonumental en el Norte de Yucatán. *Los Investigadores de la Cultura Maya* [Universidad Autónoma de Campeche] 14 (1): 267–278.

2006 Classic Politics in the Northern Maya Lowlands. In *Lifeways in the Northern Maya Lowlands: New Approaches to Archaeology in the Yucatán Peninsula*, edited by Jennifer P. Mathews and Bethany A. Morrison, pp. 142–154. University of Arizona Press, Tucson.

Shaw, Justine (editor), with contributions by Dave Johnstone, Sandra Bever, Ben Goger, Annie Hanks, Tara Holman, Maya Kashak, Christopher Lloyd, Justine M. Shaw, and Veronica Miranda

2002 *Final Report of the Proyecto Arqueológico Yo'okop's 2002 Field Season*. College of the Redwoods, Eureka, CA.

Shaw, Justine (editor), with contributions by Dave Johnstone, Alberto G. Flores Colin, Christopher Lloyd, Veronica Miranda, Justine M. Shaw, and Johan Normark

2003 *Final Report of the Cochuah Regional Archaeological Survey's 2003 Field Season*. College of the Redwoods, Eureka, CA.

Shaw, Justine M. (editor), with contributions by Dave Johnstone, Maya Kashak, Ruth Krochock, Travis Nygard, Justine M. Shaw, and Linnea Wren

2001 *Final Report of the Selz Foundation's Proyecto Arqueológico Yo'okop 2001 Field Season: Excavations and Continued Mapping*. College of the Redwoods, Eureka, CA.

Shaw, Justine, Dave Johnstone, and Ruth Krochock
2000 *Final Report of the 2000 Yo'okop Field Season: Initial Mapping and Surface Collections*. College of the Redwoods, Eureka, CA.

Sheets, Payson
1992 *The Ceren Site: A Prehistoric Village Buried by Volcanic Ash in Central America*. Harcourt Brace, Fort Worth.

Shukla, J., C. Noble, and P. Sellers
1990 Amazonian Deforestation and Climate Change. *Science* 247:1322–1325.

Sidrys, Raymond
1983 *Archaeological Excavations in Northern Belize, Central America*. Monograph 17. Institute of Archaeology, University of California, Los Angeles.

Siemens, Alfred
1979 Possible Karstic Constraints on Prehispanic Mayan Land Use and Transportation in the Southern Lowlands. In *Actes du XLII Congrès International des Amèricanistes, Congrès du Centenaire*, vol. 8, pp. 373–388. Paris.

Sierra Sosa, Thelma Noemí
1994 *Contribución al Estudio de los Asentamientos de San Gervasio, Isla de Cozumel*. Serie Arqueología, Colección Cientifica, Instituto Nacional de Antropología e Historia, Mexico City.

Skidmore, Joel
2004 Recent Archaeological Work at Chichen Itza. http://www.mesoweb.com/chichen/features/work/02.html.

Smith, A. Ledyard
1950 *Uaxactun, Guatemala: Excavations of 1931–1937*. Carnegie Institution of Washington, Publication 588. Washington, DC.

Smith, Robert E., Gordon R. Willey, and James C. Gifford
1960 The Type Variety Concept as a Basis for the Analysis of Maya Pottery. *American Antiquity* 25 (3): 330–340.

Smyth, Michael P.
2003 Early Maya Urbanism in the Puuc Region: Archaeological Research at Chac II (1995–2000). In *Escondido en la Selva*, edited by Hanns J. Prem, pp. 97–118. Bonn University and the Instituto Nacional de Antropología e Historia, Mexico City.

Smyth, Michael P., and Christopher D. Dore
1992 Large-Scale Archaeological Methods at Sayil, Yucatan, Mexico: Investigating Community Organization at a Prehispanic Maya Center. *Latin American Antiquity* 3 (1): 3–21.
1994 Maya Urbanism. *National Geographic Research and Exploration* 10 (1): 38–55.

Smyth, Michael P, Christopher D. Dore, and Nicholas P. Dunning
1995 Interpreting Prehistoric Settlement Patterns: Lessons from the

Maya Center of Sayil, Yucatan. *Journal of Field Archaeology* 22 (3): 321–347.

Smyth, Michael, Josep Ligorred Perramon, David Ortegón Zapata, and Pat Farrell

1998 An Early Classic Center in the Puuc Region: New Data from Chac II, Yucatan, Mexico. *Ancient Mesoamerica* 9:233–257.

Spaulding, Albert C.

1960 The Dimensions of Archaeology. In *Essays in the Science of Culture in Honor of Leslie White*, edited by Gertrude E. Dole and Robert L. Carniero, pp. 437–456. Thomas Y. Crowell, New York.

Stephens, John Lloyd

1963 *Incidents of Travel in Yucatan*, 2 vols. Dover Publications, New York. [1843]

Stevens, Rayfred L.

1964 The Soils of Middle America and Their Relation to Indian Peoples and Cultures. In *Handbook of Middle American Indians*, vol. 1, *Natural Environment and Early Cultures*, edited by R. C. West, pp. 265–315. University of Texas Press, Austin.

Stomper, Jeffrey

2001 A Model for Late Classic Community Structure at Copán, Honduras. In *Landscape and Power in Ancient Mesoamerica*, edited by Rex Koontz, Kathryn Reese-Taylor, and Annabeth Headrick, pp. 197–229. Westview Press, Boulder, CO.

Stromsvik, Gustav, H.E.D. Pollock, and Heinrich Berlin

1955 Exploration in Quintana Roo. In *Current Reports, Carnegie Institution of Washington, Department of Archaeology no. 23*, pp. 169–178. Washington, DC.

Stuart, David

2006 The Inscribed Markers of the Coba–Yaxuna Causeway and the Glyph for *Sakbih*. www.mesoweb.com/stuart/notes/Sacbe.pdf.

Stuart, David, Nikolai Grube, and Linda Schele

1989 *A Substitution Set for the "Ma Cuch/Batab" Title*. Copán Note 58. Copán Acropolis Archaeological Project and Instituto Hondureño de Antropología e Historia, Copán.

Stuart, George E., John C. Scheffler, Edward B. Kurjack, and John W. Cottier

1979 *Map of the Ruins of Dzibilchaltun, Yucatan, Mexico*. Middle American Research Institute Publication 47. Tulane University, New Orleans.

Suasnávar, José S.

1994 Las Calzadas de Nakbe. In *VII Simposio de Investigaciones Arqueologicas en Guatemala 1993, Museo Nacional de Arqueologia y Etnologia*, edited by Juan Pedro Laporte and Héctor L. Escobedo, pp. 335–348. Ministerio de Cultural y Deportes, Instituto de Antropología e Historia, Asociacion Tikal, Guatemala.

Suhler, Charles
1990 Description of the 1989 Excavations. In *Yaxuná Archaeological Survey: A Report of the 1989 Field Season and Final Report of Phase One*, edited by Charles Suhler, pp. 7–11. Southern Methodist University, Dallas.

Tamayo, Jorge, and Robert C. West
1964 The Hydrography of Middle America. In *Handbook of Middle American Indians*, vol. 1, *Natural Environment and Early Cultures*, edited by R. C. West, pp. 84–121. University of Texas Press, Austin.

Taube, Karl A.
1994 The Iconography of Toltec Period Chichen Itza. In *Hidden among the Hills: Maya Archaeology of the Northwest Yucatan Peninsula*, edited by Hanns J. Prem, pp. 212–246. First Maler Symposium, Bonn 1989. Acta Mesoamericana vol. 7. Von Flemming, Möckmühl, Germany.
1995 The Monumental Architecture of the Yalahau Region and the Megalithic Style of the Northern Maya Lowlands. In *The View from Yalahau: 1993 Archaeological Investigations in Northern Quintana Roo, México*, edited by Scott L. Fedick and Karl A. Taube, pp. 23–58. Latin American Studies Program, Field Report Series no. 2. University of California, Riverside.

Tedlock, Dennis
1985 *Popol Vuh: The Definitive Edition of the Mayan Book of the Dawn of Life and the Glories of Gods and Kings*. Simon and Schuster, New York.

Thomas, Prentice M.
1981 *Prehistoric Maya Settlement Patterns at Becan, Campeche, Mexico*. Middle American Research Institute Publication 45. Tulane University, New Orleans.

Thompson, J. Eric S.
1928 The Causeways of the Cobá District, Eastern Yucatan. *Proceedings of the 23rd International Congress of Americanists*, pp. 181–184. New York.
1970 *Maya History and Religion*. University of Oklahoma Press, Norman.

Thompson, J. Eric S., H.E.D. Pollock, and J. Charlot
1932 *A Preliminary Study of the Ruins of Cobá, Quintana Roo, Mexico*. Carnegie Institution of Washington Publication 424. Washington, DC.

Tourtellot, Gair
1988 *Excavations at Seibal, Department of Peten, Guatemala: Peripheral Survey and Excavation, Settlement and Community Patterns*. Memoirs of the Peabody Museum of Archaeology and Ethnology, vol. 16. Harvard University Press, Cambridge, MA.

Tourtellot, Gair, Francisco Estrada Belli, John J. Rose, and Norman Hammond
2003 Late Classic Maya Heterarchy, Hierarchy, and Landscape at La Milpa, Belize. In *Heterarchy, Political Economy, and the Ancient Maya*, edited by Vernon L. Scarborough, Fred Valdez Jr., and Nicholas Dunning, pp. 37–51. University of Arizona Press, Tucson.

Tourtellot, Gair, and Jeremy A. Sabloff
1989 Approaches to Household and Community Structure at Sayil, Yucatan. In *Households and Communities: Proceedings of the Twenty-first Annual Conference of the Archaeological Association of the University of Calgary*, edited by Scott MacEachern, David J. W. Archer, and Richard D. Garvin, pp. 363–370. University of Calgary Archaeological Association, Calgary.
1994 Community Structure at Sayil: A Case Study of Puuc Settlement. In *Hidden among the Hills: Maya Archaeology of the Northwest Yucatan Peninsula*, edited by Hanns J. Prem, pp. 71–91. Von Flemming, Möckmühl, Germany.

Tourtellot, Gair, Jeremy A. Sabloff, and Kelli Carmean
1992 "Will the Real Elite Please Stand Up?" An Archaeological Assessment of Maya Elite Behavior in the Terminal Classic Period. In *Mesoamerican Elites: An Archaeological Assessment*, edited by Diane Z. Chase and Arlen F. Chase, pp. 80–98. University of Oklahoma Press, Norman.

Tourtellot, Gair, Jeremy A. Sabloff, Michael P. Smyth, L. Val Whitley, Stanley L. Walling, Tomás Gallareta Negrón, Carlos Peraza Alvarez, George F. Andrews, and Nicholas P. Dunning
1988 Mapping Community Settlement Patterns at Sayil, Yucatan, Mexico: The 1985 Season. *Journal of New World Archaeology* 7 (2–3): 1–24.

Tozzer, Alfred M.
1913 *A Preliminary Study of the Ruins of Nakum Guatemala: A Report of the Peabody Museum Expedition, 1909–1910*. Memoirs of the Peabody Museum of American Archaeology and Ethnology, vol. 5, no. 3. Harvard University, Cambridge, MA.
1966 [1941] *Landa's Relación de las Cosas de Yucatán: A Translation*. Papers of the Peabody Museum of American Archaeology and Ethnology. Harvard University, Cambridge, MA. Reprint by Kraus Reprint Corporation, New York.
1974 [1921] *A Maya Grammar, with Bibliography and Appraisement of the Works Noted*. Papers of the Peabody Museum of American Archaeology and Ethnology, vol. 9. Harvard University, Cambridge, MA. Reprint by Kraus Reprint Corporation, New York.

1978 [1907] *A Comparative Study of the Mayas and the Lacandones*. Report of the Fellow in American Archaeology 1902–1905, Archaeological Institute of America. Macmillan Company, New York. Reprint by AMS Press, New York.

Trombold, Charles Dickson

1976 Spatial Distribution, Functional Hierarchies, and Patterns of Interaction in Prehistoric Communities around La Quemada, Zacatecas, México. In *Archaeological Frontiers: Papers on New World High Cultures in Honor of J. Charles Kelley*, edited by Robert B. Pickering, pp. 149–180. University Museum Studies 4. Southern Illinois University, Carbondale.

1991 (editor) *Ancient Road Networks and Settlement Hierarchies in the New World*. Cambridge University Press, Cambridge.

Turner, Victor

1969 *The Ritual Process: Structure and Anti-structure*. Aldine Publishing, Chicago.

1974 *Dramas, Fields, and Metaphors: Symbolic Action in Human Society*. Cornell University Press, Ithaca, NY.

Uriarte Torres, Alejandro J.

2004 El Preclásico en Dzibilchaltún: Perspectiva del Sacbe 2. *Los Investigadores de la Cultura Maya* 12 (11): 349–363.

2005 Aproximación al Estudio de la Funcionalidad del Sistema de Caminos de Dzibilchaltún: Estructuras Asociadas a los Sacbeob 2 y 5. Paper presented at the Segundo Congreso Internacional de Cultura Maya, Mérida, Yucatán, March 15, 2005.

Valdés Gomez, Juan Antonio

1983 Etude de Groupes d'Habitations du Centre Cérémonial Maya du "Mundo Perdido," Tikal, Guatemala. Ph.D. dissertation, University of Paris, Sorbonne.

Valdés Gomez, Juan Antonio, and Federico Fahsen

2004 Disaster in Sight: The Terminal Classic at Tikal and Uaxactun. In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by Arthur A. Demarest, Prudence M. Rice, and Don S. Rice, pp. 140–161. University of Colorado Press, Boulder.

Vargas Pacheco, Ernesto

1985 Arqueología e Historia de los Mayas en Tabasco. In *Olmecas y Mayas en Tabasco: Cinco Acercamientos*, edited by Lorenzo Ochoa. Gobierno del Estado de Tabasco, Villahermosa, Mexico.

Velázquez Morlet, Adriana, Edmundo López de la Rosa, Maria del Pilar Casado López, and Margarita Gaxiola

1988 *Zonas Arqueológicas de Yucatán*. Instituto Nacional de Antropología e Historia, Mexico City.

Villa Rojas, Alfonso
1934 *The Yaxuná–Cobá Causeway*. Contributions to American Archaeology, vol. 2, no. 9. Carnegie Institution of Washington, Washington, DC.
1945 *The Maya of East Central Quintana Roo*. Carnegie Institution of Washington Publication 559. Lord Baltimore Press, Baltimore, MD.

Vogt, Evon
1990 [1970] *The Zinacantecos of Mexico: A Modern Maya Way of Life*. Case Studies in Cultural Anthropology. Holt, Rinehart, and Winston, New York.

Von Euw, Eric
1975 Naranjo. In *Corpus of Maya Hieroglyphic Inscriptions*, vol. 2, part 1. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA.
1977 Tzum. In *Corpus of Maya Hieroglyphic Inscriptions*, vol. 4, part 1. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA.

Von Euw, Eric, and Ian Graham
1977 La Honradez. In *Corpus of Maya Hieroglyphic Inscriptions*, vol. 5, part 2. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA.
1978 Xultun. In *Corpus of Maya Hieroglyphic Inscriptions*, vol. 5, part 1. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA.
1984 *Xultun, La Honradez, Uaxactun*. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA.

Wagner, Eugenio Logan
2000 El Espacio Abierto Como Herramienta de Conversión: El Caso de Izamal. In *Arquitectura e Ideología de los Antiguos Mayas: Memoria de la Segunda Mesa Redonda de Palenque*, edited by Silvia Trejo, pp. 159–175. Instituto Nacional de Antropología e Historia and Consejo Nacional Para la Cultura y las Artes, Mexico City.

Walker, Amélie
2000 *Maya Cave Sites of West-Central Belize*. Belize Valley Archaeological Reconnaissance, Western Belize Regional Cave Project. http://www.archaeology.org/online/features/belize/nakbeh.html.

Walker, G. K., Y. C. Sud, and R. Atlas
1995 Impact of the Ongoing Amazonian Deforestation on Local Precipitation: A GCM Simulation Study. *Bulletin of the American Meteorological Association* 76 (3): 346–361.

Ward, William C., and James Lee Wilson
1976 General Aspects of the Northeastern Coast of the Yucatan Penin-

sula. In *Carbonate Rocks and Hydrogeology of the Yucatan Peninsula, Mexico*, edited by A. E. Weidie and W. C. Ward, pp. 35–44. New Orleans Geological Society, New Orleans.

1985 Geology of Yucatan Platform. In *Geology and Hydrogeology of the Yucatan and Quaternary Geology of the Northeastern Yucatan Peninsula*, edited by W. C. Ward, A. E. Weidie, and W. Back, pp. 1–19. New Orleans Geological Society, New Orleans.

Watanabe, John M.

1992 *Maya Saints and Souls in a Changing World*. University of Texas Press, Austin.

Wauchope, Robert

1934 *House Mounds of Uaxactun, Guatemala*. Carnegie Institution of Washington, Publication 436, Contribution 7. Washington, DC.

Weaver, Muriel Porter

1993 *The Aztecs, Maya, and Their Predecessors: Archaeology of Mesoamerica*. 3rd edition. Academic Press, San Diego, CA.

Webster, David

1979 *Cuca, Chacchob, Dzonot Ake: Three Walled Northern Maya Centers*. Occasional Papers in Anthropology no. 11. Department of Anthropology, Pennsylvania State University, University Park.

2002 *The Fall of the Ancient Maya: Solving the Mystery of the Maya Collapse*. Thames and Hudson, London.

Welsh, W.B.M.

1988 *An Analysis of Classic Lowland Maya Burials*. BAR International Series 409. British Archaeological Reports, Oxford.

Wernecke, D. Clarke

1993 *The BRASS/El Pilar Program, Interpretations of Architecture at El Pilar: Results of the 1993 Field Season*. http://marc.ucsb.edu/elpilar/fieldreports/1993report/1993—report.html.

West, Robert C.

1964 Surface Configuration and Associated Geology of Middle America. In *Handbook of Middle American Indians*, vol. 1, *Natural Environment and Early Cultures*, edited by R. C. West, pp. 33–83. University of Texas Press, Austin.

Whitmore, Thomas J., Mark Brenner, Jason Curtis, Bruce Dahlin, and Barbara Leyden

1996 Holocene Climatic and Human Influences on Lakes of the Yucatán Peninsula, Mexico: An Interdisciplinary, Paleolimnological Approach. *Holocene* 6 (3): 273–287.

Willey, Gordon R.

1990 General Summary and Conclusions. In *Excavations at Seibal, Department of Peten, Guatemala*, no. 4, edited by John A. Graham, Gair Tourtellot III, Mary Pohl, and Gordon R. Willey. Peabody

Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA.

Willey, Gordon R., W. Bullard, J. Glass, and J. C. Gifford
1965 *Prehistoric Maya Settlements in the Belize Valley*. Papers of the Peabody Museum 54. Harvard University, Cambridge, MA.

Willey, Gordon R., Richard M. Leventhal, and William Fash
1978 Maya Settlement in the Copan Valley. *Archaeology* 31:32–43.

Wilson, Eugene
1980 Physical Geography of the Yucatan Peninsula. In *Yucatan: A World Apart*, edited by E. H. Moseley and E. D. Terry, pp. 5–39. University of Alabama Press, Tuscaloosa.

Wilson, Reginald
1972 Investigations at Okop, Quintana Roo. *Katunob* 8 (1): 78–85.
1974 Okop: Antigua Ciudad Maya de Artesanos. *INAH Boletín* [Instituto Nacional de Antropología e Historia] epoca 2 (9): 3–14.

Witschey, Walter Robert Thurmond
1993 *The Archaeology of Muyil, Quintana Roo, Mexico: A Maya Site on the East Coast of the Yucatan Peninsula*. Ph.D. dissertation, Tulane University, New Orleans.

Wren, Linnea, and Travis Nygard
2005 Witnessed at Yo'okop: Images and Texts of Rulers in a Watery Realm. In *Quintana Roo Archaeology*, edited by Justine M. Shaw and Jennifer Mathews, pp. 166–180. University of Arizona Press, Tucson.

Wren, Linnea, Travis Nygard, Justine M. Shaw, and Dave Johnstone
n.d. The Shifting Spatial Nexus of an Urban Maya Landscape: A Case Study of Yo'okop, Quintana Roo, Mexico. In *The Social Construction of Space in Ancient America: Exploring Sacred, Ritual, Celestial, and Earthly Landscapes and Architecture*, edited by Cynthia Kristan-Graham and Laura Amrheim. Mesoamerican Worlds. University of Colorado Press, Boulder. Forthcoming.

Young, Tatiana
2005 San Juan Operations 1 and 2. In *Final Report of the Cochuah Regional Archaeological Survey's 2005 Field Season*, edited by Justine M. Shaw, pp. 75–78. College of the Redwoods, Eureka, CA.
2006 Hierarchical Structure of the Settlement Pattern in the Ejido of Sacalaca, Quintana Roo. Paper presented at the Fourth International Conference of Hierarchy and Power in the History of Civilizations, Moscow, June 14, 2006.

Index

About the Author

Justine Shaw received a BA (from the University of Arizona) and an MA and PhD (from Southern Methodist University) in anthropology, with a specialization in Maya archaeology. She has conducted archaeological fieldwork with the University of Arizona's Garbage Project and in New Mexico at Pot Creek Pueblo, as well as on the Yaxuna Project in Yucatán, Mexico, from 1994 to 1997. She is currently co-director of the Cochuah Regional Archaeological Survey in Quintana Roo, Mexico. Her recent publications include *Quintana Roo Archaeology* (with co-editor Jennifer Mathews); "Maya Sacbeob: Form and Function" and "Climate Change and Deforestation: Implications for the Maya Collapse" in *Ancient Mesoamerica*; "The Lowland Maya Civilization: Historical Consciousness and Environment" (with David Freidel) in *The Way the Wind Blows: Climate, History, and Human Action*; and "The Late Classic at Yaxuná, Yucatán, Mexico" (with Dave Johnstone) in the journal *Mexicon*. Her research interests include road systems, settlement patterns, and the Late and Terminal Classic periods. She is a professor at the College of the Redwoods in northern California, where she teaches courses in anthropology, and is an associate in anthropology at Humboldt State University.