Chapter 4

Osteology of the El Diablo Complex: Burial 9 and Associated Caches

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2015 In *Temple of the Night Sun: A Royal Tomb at El Diablo, Guatemala*, by Stephen Houston, Sarah Newman, Edwin Román, and Thomas Garrison, pp. 180-207. Precolumbia Mesoweb Press, San Francisco.

This chapter provides an overview of the osteological analysis of the Burial 9 tomb and its associated cache deposits. As will be detailed below, the tomb contained the remains of seven individuals: the primary occupant (adult) and the sacrificed remains of six children. At the time of the recovery, the human remains from the tomb were found commingled. Remains of an adult were scattered across the length of the tomb (Figure 4.2). The remains of the six children were found more or less in clusters, each associated with one of six lip-to-lip cache vessels (Figure 4.3). In some cases the children's remains were contained within the vessel. In others, they were found partially spilled from the vessel, owing to both the original placement of the bodies (described below) and wall collapse that had disturbed some materials on the tomb floor.

Outside of the tomb, a series of caches consisting of eleven lip-to-lip vessels and one single bowl have been found that can be stratigraphically associated with the interment (eight paired vessels and the unpaired bowl recovered in the 2010 field season and three pairs of lip-to-lip vessels from 2012). Two of those caches contained complete, articulated child skeletons. Eight of the caches contained manual phalanges and teeth. One of the vessel pairs (Caches 1C and 1D) may have contained human remains, though none were identified during laboratory analysis. The project excavated the contents of all cache vessels in the field.

Figure 4.1. Caches 4 and 5 arranged around the stone altar outside the tomb. Photo: Arturo Godoy.

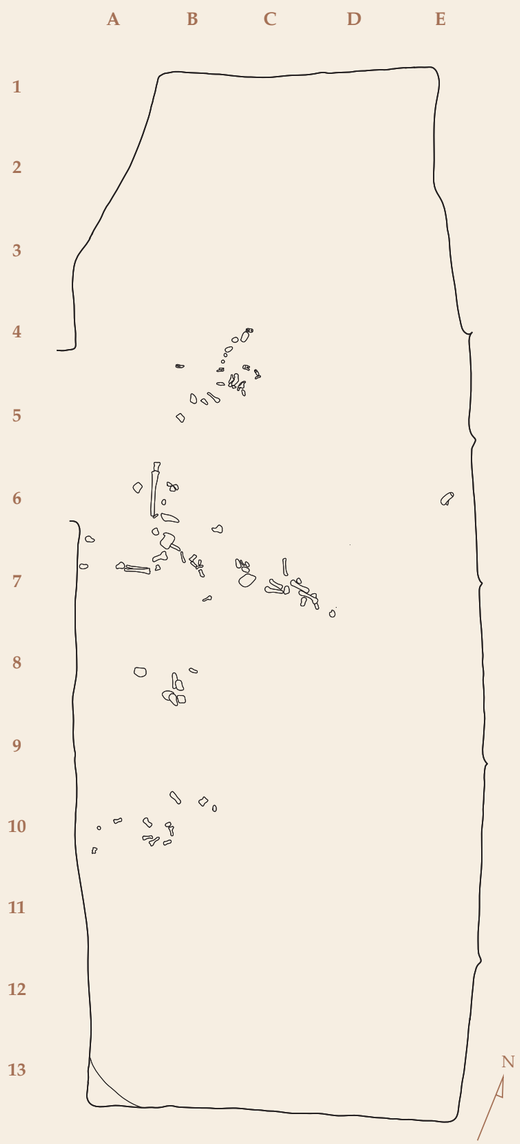

Figure 4.2. Remains of the single adult individual found within Burial 9, scattered along the length of the tomb. Drawing: Stephen Houston.

Methodology

As explained in Chapter 1, the interior of the tomb was gridded by excavators into 25 x 25 cm sectors; each north-south column (lengthwise across the tomb) was given a letter designation (A through F), and each east-west row (across the breadth of the tomb) received a number designation (1–12). Each bone fragment was assigned a unique number by sector (e.g., Bone 4 of Sector A7), drawn and labeled on the burial plan, and individually packaged after recovery. In the case of two of the cache vessels that contained human remains, the entire contents were stabilized underneath a layer of cyclododecane wax, which Scherer and Houston later excavated in the project laboratory. Chelsea Garrett Ellis and Sarah Newman assisted greatly, helping with lab analysis of human remains from the 2010 and 2012 field seasons, respectively.

The skeletal elements from the cache deposits located outside of the tomb are generally well preserved. However, the remains from inside the tomb are quite fragmentary and fragile. In the laboratory Scherer and Ellis unpacked each skeletal element and carefully brushed the remains to remove any adhering dirt (careful not to disturb traces of red pigment or other cultural material). In light of the fragility of the remains and the presence of pigment, no element from the caches or the tomb was washed with water. We treated each element with a dilute solution of Paraloid B-72 to conserve the remains. After consolidation was complete, we reconstructed the fragmentary bones using concentrated B-72 as an adhesive.

Having reconstructed the tomb remains, Scherer worked with Houston to locate each skeletal element on the field drawing. The location of fragments, coupled with each bone's size and associated age, made it possible to attribute fragments to a particular skeleton and thus to discern and assemble the seven individuals located within the tomb. With each element attributed to an individual, Scherer was able to work with Houston's field drawing to establish: (1) the original position of the bodies and their level of completeness (whole bodies versus isolated body parts); (2) the displacement of some elements during the process of natural decomposition; and (3) the final disturbance of some remains as a result of the collapse of the bier and falling stone from the tomb's walls. Analysis indicates a total of seven individuals within the tomb: a single adult individual (Skeleton A) and the remains of six subadult individuals (Skeletons B through G). Each skeletal fragment was assigned to one of the seven individuals. The original bone identification numbers (example, Bone 4 from Sector A7) were maintained, however, so as not to lose information about original context. After analysis, each element was re-packaged and labeled with both its field identification (e.g., Bone 4 from Sector A7) and its corresponding laboratory identification (e.g., Skeleton A, right hamate).

After reconstructing the skeletons, Scherer conducted a standard bioarchaeological analysis of the remains. Each individual was studied to determine age at death (Baker et al. 2005; Smith 1991; Ubelaker 1999), cultural body modification (Romero Molina 1986; Tiesler Blos 1998), antemortem pathology (Buikstra and Ubelaker 1994; Ortner 2002), perimortem pathology (Buikstra and Ubelaker 1994; Ortner 2002), postmortem damage (Schmidt and Symes 2008), dental metrics (Buikstra and Ubelaker 1994), and dental non-metrics (Turner et al. 1991). The adult individual was too incomplete to establish stature and sex beyond basic observations of robusticity. Sex cannot be reliably determined for subadult skeletal remains without ancient DNA (aDNA) analysis. The poor preservation of the remains also frustrated any wish to undertake dietary and migratory stable isotope analyses. In the case of migratory isotopes, there was no archaeological or epigraphic evidence to suggest the primary tomb occupant or the sacrificed children originated outside the Central Peten (the point at which migratory isotopes demonstrate variability). Moreover, ancient DNA analysis has yet to prove reliable in the Maya area because of the poor preservation of remains (Iglesias et al. 2001). As noted, nuclear aDNA would be useful for the determination of sex, but any analysis was unlikely to yield results. Mitochondrial DNA is more reliable in situations of poor preservation, yet it is only useful for tracing the matriline. Refinements in stable isotope research or aDNA analysis may facilitate future testing, assuming that there is a research question significant enough to warrant the destruction of such fragile yet important human remains.

El Diablo Caches

To date, ten caches have been found in excavations within Str. F8-1 of the El Diablo Complex. Caches 1 and 9 each include two pairs of lip-to-lip bowls and Cache 8 featured only a single, unpaired vessel, but the seven remaining caches each consisted of a single pair of lip-to-lip bowls containing various human remains. The ten caches therefore contained a total of 23 individual vessels. As noted earlier in this volume, analysis of the stratigraphy indicates that all of these caches are associated with the events immediately before or after the construction of the Diablo tomb and the interment of its primary occupant. Most of the caches contained isolated skeletal elements (adult manual phalanges and permanent teeth). However, two caches housed the nearly complete skeletons of children.

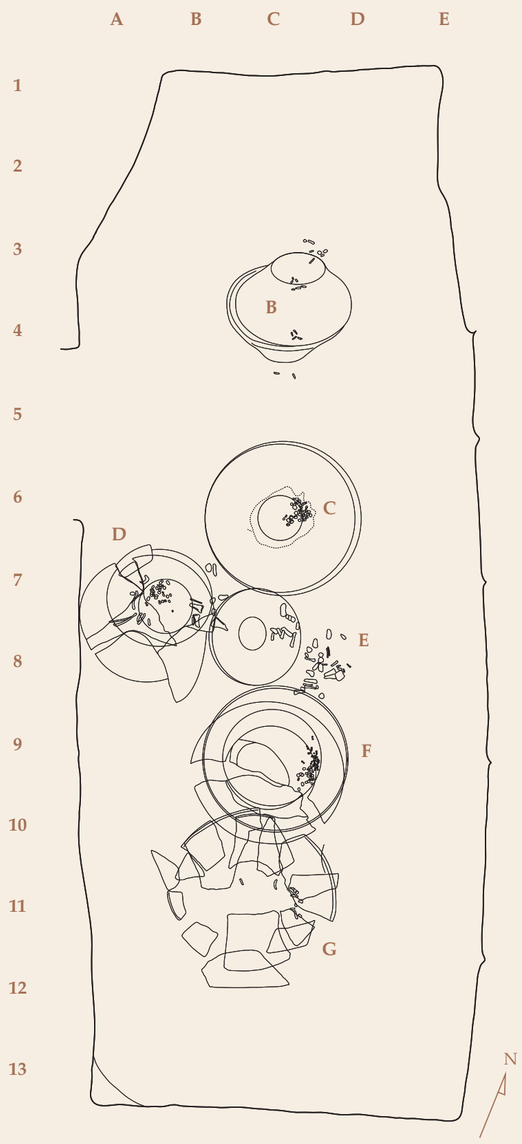

Figure 4.3. Remains of the six children found within Burial 9, each associated with a pair of cache vessels. Drawing: Stephen Houston.

Figure 4.4. Distal manual phalanx from Cache 1A/1B (dorsal view). Photo: Andrew Scherer.

Figure 4.5. Proximal, intermediate, and distal manual phalanges from Cache 2. Photo: Andrew Scherer.

Cache 1 (EZ 5B-23-2)

Cache 1 consisted of two pairs of lip-to-lip vessels. The upper pair (Cache Vessels 1A and 1B) contained a single adult distal manual phalanx (Figure 4.4). There was no evidence of trauma or pathology. No human remains were found in the lower pair of vessels (Caches 1C and 1D).

Cache 2 (EZ 5B-23-3)

Human remains from Cache 2 consist of three adult manual phalanges: a proximal phalanx, an intermediate phalanx, and a distal phalanx (Figure 4.5). The phalanges are all likely from the same individual and presumably represent a single finger. No cutmarks or other pathology were observed.

Cache 3/Burial 6 (EZ 5B-28-9)

Cache 3/Burial 6 contained the remains of a two- to four-year-old child placed within a lip-to-lip vessel cache (Figure 4.6). Age estimation was based on dental development. Because the skeleton is nearly complete, the excavators co-designated the deposit Burial 6. The bones are well preserved but fragmentary. To judge from the position of the skeletal elements at the time of recovery, the child was in a supine position, although the arrangement of the limbs is less clear. The bones of the skull had collapsed over the thorax, making it likely that the child's head was resting on the vertical wall of the vessel. Many of the elements exhibit thermal exposure. What follows is a summary of the skeleton with details on its pattern of thermal exposure.

The skull is partially complete. The frontal bone and the bones of the face are largely destroyed by exposure to heat. The frontal consists primarily of a fragment of the right squama along the coronal suture. The five other frontal fragments are severely blackened, warped, and shrunken. A mostly complete left zygomatic is present. The parietals are largely complete and well preserved. A right temporal is represented by the mastoid process and a significant portion of the squama, including a portion of the bone along the external auditory meatus. The petrous portion is missing. Other small cranial fragments are present. Some are clearly fragments of the vault, and some may include the otherwise missing occipital. Almost all demonstrate heat exposure similar to that noted above. The majority of the mandible is present, in two fragments.

The post-cranial skeleton includes fragments of both humeri, an unsided radius, an unsided ulna, both scapulae, the distal half of the right clavicle, the left femur (both epiphyses, metaphyses, and the lateral aspect of the diaphysis), the left tibia (length of diaphysis, including both metaphyses, but missing the entire anterior aspect of the bone), the right femur (length of diaphysis including the proximal metaphysis and a fragment of the distal metaphysis; anterio-medial aspect of the femur is fractured and missing), the right tibia (length of diaphysis is complete, including the distal metaphysis; entire anterior aspect of bone is missing), fragments of both fibulae, fragments of both ilia, the right ischium, fragments of at least nine left ribs and eight right ribs, the neural arches from all of the cervical vertebrae, neural arch fragments and bodies from at least ten thoracic vertebrae, neural arch and body fragments from at least two lumbar vertebrae, the superior two segments of the sacrum, the manubrium and body of the sternum, four metacarpal fragments, and two metatarsal fragments.

Figure 4.6. Child's skeleton from Cache 3/Burial 6. Photo: Andrew Scherer.

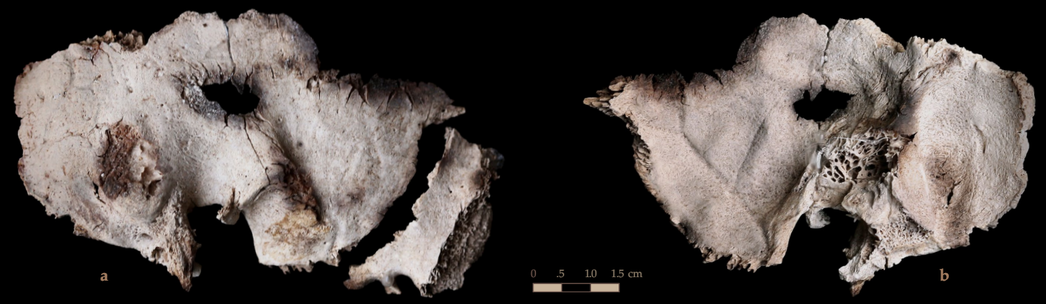

Figure 4.7. Right temporal from Cache 3/Burial 6: (a) ectocranial view with right greater wing of the sphenoid; (b) endocranial view. Note ectrocranial and endocranial thermal discoloration, particularly at the large perforation superior to the external auditory meatus. Also note endocranial and endocranial discoloration at small crack posterior to the mastoid process. Photos: Andrew Scherer.

Cultural Modification

The cranium was modified to produce the tabular oblique form. The deciduous teeth are not modified.

Pathology

There was no observable antemortem pathology. There are two perimortem defects of the right temporal bone. The first perforation is located superior to the external auditory meatus (Figure 4.7). The second is a fracture posterior to the mastoid process. Both exhibit ectocranial and endocranial discoloration, indicating these fractures were present at the time of heat exposure and are not the result of later postmortem

damage. These fractures may have been caused by blows to the child's head and thus relate to the cause of death. Alternatively, they may have formed as a result of the thermal exposure and thus do not relate to the cause of death. Unfortunately, it is impossible to determine which scenario is correct, particularly since the manner of child sacrifice among the Maya remains poorly understood. Because of the typically poor skeletal preservation at Maya sites, it is unclear if most child sacrifice involved violent trauma or more subtle acts such as suffocation or poison (Houston and Scherer 2010).

Thermal Exposure and Body Position

The majority of the skeleton demonstrates exposure to significant heat that occurred while the body was still in a cadaverous (fleshed) state. The body was not, however, cremated. Rather, the thermal alteration is consistent with brief exposure to flame in only isolated areas; the flame or heat was sufficient to burn away part of the soft tissue and affect the underlying bone. Much of the thermal alteration consists of brown discoloration of the bone coupled with some surficial cracking due to rapid loss of moisture. In some cases, the exposure to heat blackened the bone. However, no bones exhibit the effects of calcination—the glassy texture that results from the complete or near-complete loss of moisture and organic content from prolonged exposure to very high temperatures (Syms et al. 2008). Quite likely, the source of heat was smoldering copal or a similarly slow-burning substance.

Overall, the dorsal surface of the skeleton demonstrates greater evidence of thermal alteration—particularly color change—relative to the ventral surface. The first and second cervical neural arches are discolored brown-black on their dorsal aspects. The remaining cervical arches display only very light brown discoloration at the spinous processes. All of the thoracic neural arches show brown-to-black discoloration. The thoracic bodies are unaffected. Of the lumbar vertebrae, one of the neural arch fragments has brown discoloration of its dorsal aspect. Neither of the two sacral segments exhibits thermal discoloration, though the neural arches are absent. However, the left ilium presents significant brown discoloration and longitudinal fracturing on both of its aspects. The right ilium has fracturing of its dorsal aspect and brown discoloration of its internal aspect. The right ischium reveals brown discoloration and longitudinal fracturing of all of its surfaces. Ribs three through ten all show brown discoloration of their vertebral ends and along much of their inferior margins. The floating ribs are dark brown in coloration on all of their aspects. The elements of the sternum are, however, unaffected. The distal edge of the right clavicle manifests dark brown discoloration. The dorsal aspect of the left scapula is discolored brown. The right scapula is only represented by fragments near the acromion process and the coracoid process; neither are thermally altered. From the pattern of thermal alteration of the thorax, it is clear that the body was resting upon a heat source that burned through the soft tissue of the back. Extensive blackening of the interior basin of the cache vessel supports this hypothesis.

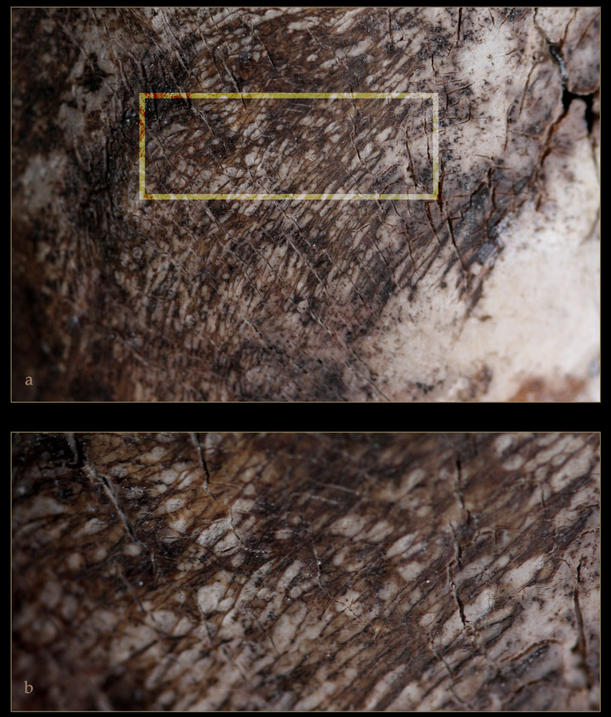

Figure 4.8. Close-up of ectocranium of right parietal from Cache 3/Burial 6: (a) parietal boss; (b) extreme close-up. Visible in both photos are blackened areas of localized burning, longitudinal cracks from thermal alteration, and adhering brown material and black striae that may be thermally altered soft tissue of the scalp and hair (respectively) fused to the ectocranium. Photos: Andrew Scherer.

The pattern of thermal exposure for the limbs is more complex. Fracture margins of both humerus diaphyses demonstrate brown discoloration. There is no discoloration of the unsided radius fragment, though a longitudinal fracture suggests exposure to significant heat. The unsided ulna fragment exhibits brown discoloration and longitudinal cracking. All of the metacarpal fragments are discolored brown and fractured. Thus, the shoulders were clearly exposed to the heat as were the upper arms. Parts of the lower arms appear to have escaped significant thermal alteration, though the hands were affected. Unfortunately, it is impossible to reconstruct the original position of the arms and hands from available evidence.

As for the legs, the left femur displays a dark brown discoloration, particularly on its dorsal aspect. Much of the medial aspect of the bone is fractured away, and the fracture margins show discoloration. Both metaphyses of the left femur are particularly discolored. Though less complete, the right femur is similarly affected. Both the left and right tibiae are fractured anteriorly and display brown discoloration along the fracture margins. The dorsal aspects of the tibiae are, however, unaffected. Fragments of both fibulae show brown discoloration. Both metatarsal fragments demonstrate brown discoloration and fracturing. To reconstruct the thermal alteration of the legs, it is relevant to consider their arrangement at the time of discovery. Field photographs show that the tibia and fibula were still articulated at the time of recovery and stratigraphically positioned somewhere underneath the left femur, not far from an ulna (unsided). This would suggest a flexed position, most likely with the lower legs tucked someplace under the body. The pattern of thermal alteration of the bone corroborates this hypothesis. From the destruction of the femora it would appear that the greatest source of heat was between the thighs. The anterior surfaces of the tibia must have been tucked in such a manner as to be in close proximity to the heat within the vessel.

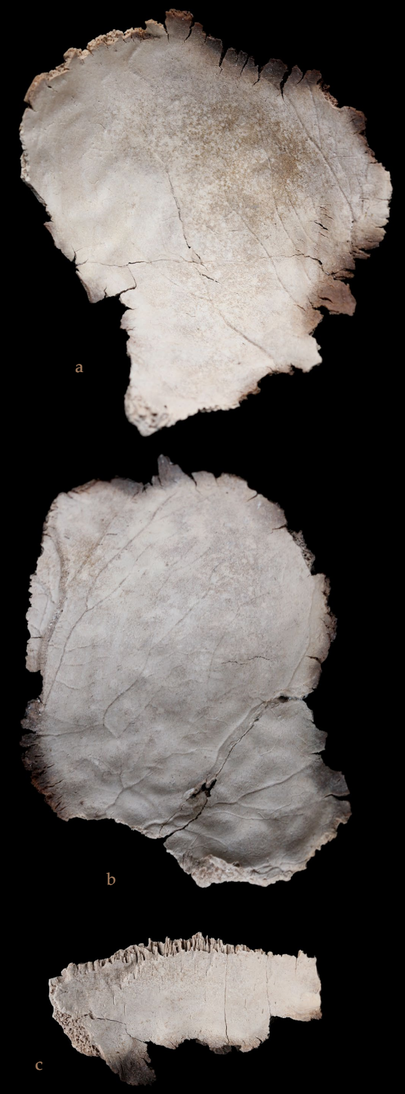

Figure 4.9. Endocranium of the child from Cache 3/Burial 6: (a) left parietal; (b) right parietal; (c) fragment of frontal along the coronal suture. Note that the thermal discoloration is isolated to the fracture margins and is much less significant than with the ectocranium as shown in Figure 4.7. Photos: Andrew Scherer.

Considering that the cranial elements and teeth were found scattered atop the rest of the skeletal remains, it is likely the child was in a reclining position within the vessel, legs folded under the body; the head was propped against the wall of the vessel interior, such that when decomposition occurred the cranial vault fell forward onto the rest of the body. Notably the occipital is completely destroyed, presumably because the back of the head rested on or near the burning material. The destruction of this bone was further facilitated by the lack of soft tissue on the back of the head relative to other dorsal surfaces of the body.

The parietals, however, show only moderate effects of thermal alteration. Both parietals demonstrate areas of brown and black discoloration of the ectocranial surface. Blackening is most apparent on their posterior aspects, and much of the bone along the lambdoidal suture is missing, corresponding to the destruction of the posterior cranium. The posterior ectocranial surfaces also exhibit surficial fractures, the result of shrinkage of the outer table of the skull during heat exposure. The ectocranial surfaces of both parietals also display adhering brown material near the coronal suture. The right parietal demonstrates adhering black striae anterior to the parietal boss (Figure 4.8). This attached substance may be the child's soft tissue of the scalp and hair. The endocranial surfaces of the frontal and parietals have thermal alteration only along the fractured edges near the coronal and lambdoidal sutures (Figure 4.9). The lack of endocranial thermal alteration indicates that the skull remained articulated throughout much of the burning process. That, combined with the minimal alteration of the ectocranial surfaces of the cranium, indicates that the head, as with the rest of the body, was fleshed when thermal exposure began.

In contrast to the parietals but like the occipital, the bones of the face were largely destroyed in the burning process. The few facial fragments that remain are blackened, warped, and shrunken. As with the occipital, the loss of much of the facial skeleton likely reflects direct exposure to flame or a smoldering substance. Of the facial fragments present, all visible surfaces are discolored indicating destruction of not only the soft tissue of the face but also the underlying skeletal architecture. A large squamosal fragment of the frontal bone, including a portion that preserves the coronal suture, is less affected, indicating diminished thermal exposure superior to the face. Indeed, the lack of thermal alteration of the parietals (despite the thin overlying soft tissue) confirms that the extreme heat affecting the face was localized. Quite likely, the burning or smoldering substance was placed directly onto the lower forehead, eyes, and nose of the child. It is possible that the child was dressed with a mask that

Figure 4.10. Intermediate and distal manual phalanges from Cache 4. Photo: Andrew Scherer.

subsequently combusted, leading to the localized burn pattern.

It is notable that the mandible is less affected by thermal alteration. The mandible is discolored brown-black along the inferior surface and is significantly fragmented. The facial and lingual aspects of the mandible show only isolated areas of brown discoloration. The left ascending ramus is, however, very dark brown. Thus, the lower jaw, despite its proximity to the face, appears to have escaped much of the heat, as did the chest of the child (recall the sternum and proximal clavicle were unaffected). Despite the fact that the maxilla was never recovered, the upper and lower jaws remained largely intact during the burning process as evidenced by the thermal alteration of the teeth. In the case of the permanent dentition, which was still in the alveolus at the time of the heat exposure, there is only slight browning of the dentine of a few teeth. The deciduous teeth are, however, mottled brown and black as a result of their more direct exposure to heat.

The right temporal bone is for the

Figure 4.11. Tooth (LI_1) and manual phalanges from Cache 5. Photo: Andrew Scherer.

Figure 4.12. Close-up of the proximal manual phalanx from Cache 5. A cutmark is located on the dorsal surface of the proximal end. Photo: Andrew Scherer.

Figure 4.13. Intermediate and distal manual phalanges from Cache 6. A third fragmentary phalanx is not shown. Photo: Andrew Scherer.

most part unaffected by heat exposure. The notable exception is the discoloration around the fracture defects, including the squamosal fracture site above the external auditory meatus and the fracture posterior to the mastoid suture, noted earlier. Other isolated areas of discoloration include the mastoid process and a location superior to the temporomandibular joint. There is also an isolated area of blackening superior to the broken (postmortem) petrous portion of the endocranium. A second area of thermal discoloration is visible on the endocranial surface adjacent to the fracture site. The endocranial discoloration may be due to flame entering the large defect superior to the auditory meatus and through the smaller fracture posterior to the mastoid process. The lack of diffuse thermal exposure to the endocranial surface of the temporal indicates the skull was still largely intact. As noted previously, this pattern suggests the fractures are perimortem, either associated with the death of the child or the subsequent exposure to heat.

As a final note, it is worth revisiting the disposition of the vessels when the excavators found the cache. The lower vessel was cracked, creating a gap between the rims of the upper and lower vessels. This gap corresponds to the "foot end" of the cache. The opposing end was intact and the rims of the vessels were in contact. It is likely that the crack in the vessel and the gap opened between the base and the lid date to the original deposition of the vessel and were created (presumably unintentionally) as a result of the extra space needed to accommodate the legs of the child. The head of the child must have separated from the body prior to its internment in light of the limited space.

Cache 4 (EZ-5B-28-14)

Human remains from Cache 4 consist of an intermediate and a distal manual phalanx (Figure 4.10). The size of the phalanges and their articulation indicate they are from a single finger of the same adult individual. Sex is indeterminate. No cutmarks or any other form of pathology were observed.

Cache 5 (EZ 5B-28-18)

Skeletal elements recovered from Cache 5 include six adult phalanges of the hand and a single tooth (LI_1) (Figure 4.11). The incisor is fully developed, indicating that it is from an individual older than 9–10 years. Further, the presence of substantial lingual calculus indicates the tooth is quite likely from an adult. Dental wear is minimal, and there is no artificial modification.

The phalanges include a proximal phalanx, three intermediate manual phalanges (one of which was broken post-mortem), and two distal hand phalanges. All of the phalanges appear to be from the same individual based on general size and articulation. It is impossible to know whether the phalanges and the incisor come from the same individual.

The phalanges do not exhibit antemortem pathology. However, a small cut occurs on the dorsal aspect of the proximal end of the proximal phalanx (Figure 4.12). The cut is fine and shallow, and the color within the cut is the same as that of the surrounding bone. There are no signs of healing. The cut is almost certainly associated with the removal of the finger from either a living person or a recently deceased individual. The fineness of the cut suggests it was likely made by an obsidian implement, though microscopic analysis is needed to confirm that hypothesis. None of the other elements demonstrate cutmarks.

Cache 6 (EZ 5B-28-19)

Human remains from Cache 6 consist of three adult manual phalanges: an intermediate phalanx, a distal phalanx, and fragments of an unknown phalanx (Figure 4.13). The two complete phalanges articulate and appear to be from the same finger of a single individual. Because of fragmentation in the third phalanx, it is impossible to determine if it is from the same finger/individual. No antemortem pathology was observed. The intermediate and distal phalanges are discolored consistent with heat exposure. Further, both phalanges exhibit a blackened substance on their surfaces that presumably consists of a smoldering material (copal?) that adhered to the bone.

Cache 7 (EZ 5B-28-16)

Cache 7 contained a single mandibular incisor. Laboratory analysis is still pending, and a full identification and photograph are not yet available.

Cache 8 (EZ 5B-28-20)

Cache 8 contained two intermediate adult manual phalanges (Figure 4.14). No antemortem pathology or trauma was observed. Their size suggests they could be from the same individual.

Figure 4.14. Intermediate manual phalanges from Cache 8. Damage to the proximal and distal ends of the larger phalanx may be perimortem or postmortem. Photo: Andrew Scherer.

Figure 4.15. Proximal and distal pedal phalanges and left mandibular second incisor from Vessels 9A and 9B of Cache 9. Photo: Andrew Scherer.

Figure 4.16. Dorsal surface of proximal pedal phalanx with cutmarks from Vessels 9A and 9B of Cache 9. Photo: Andrew Scherer.

Figure 4.17. Intermediate manual phalanx and a left mandibular central incisor from Vessels 9C and 9D of Cache 9. Photo: Andrew Scherer.

Cache 9 (EZ 19A-10-2)

Of the two pairs of vessels forming Cache 9, the first pair excavated (Cache Vessels 9A and 9B) contained two pedal phalanges and a tooth (Figure 4.15). The phalanges are an intermediate and a distal pedal phalanx, presumably from the same toe of an adult individual. The intermediate phalanx demonstrates two light cuts across the dorsal surface (Figure 4.16). Damage around the proximal articular surface may also relate to removal of the toe. The tooth is a left second mandibular incisor, with its enamel covered in dental calculus, suggesting it is from an adult.

The second pair of vessels included in the cache (Cache Vessel 9C and 9D) contained an adult intermediate manual phalanx and a left mandibular central incisor (Figure 4.17). The phalanx exhibits damage to its distal end, which may have occurred during removal of the finger. The moderate buildup of calculus on the lingual aspect of the tooth suggests that it is also from an adult. The root of the incisor is remarkably well preserved, showing little to no organic degradation. The lack of decay can be attributed to protection by a white matrix that filled the vessel and would suggest that this tooth was removed from a living person (as opposed to recovered from a mortuary deposit) prior to its deposition in the cache.

Cache 10/Burial 15

Cache 10/Burial 15 is a deposit of two lip-to-lip vessels that contained the remains of a mostly complete, well-preserved infant skeleton (Figure 4.18). The child was deposited in a prone position, the cranial end of the body "pointing" to the west. The arms were flexed at the individual's sides, wrists oriented to the west. The legs were flexed at the knees such that the distal ends of the lower legs rested near the pelvis. The skull was found atop the pelvis. Judging by the position of the mandible, the head was resting on its basilar surface, face looking to the southwest. However, the skull rolled back such that the cranium was found with the face looking slightly upward and the maxillae had spilled forward from the cranium. The positioning of the cranium makes it unlikely that the skull rolled from its point of articulation with the cervical vertebrae; rather, it was placed as a severed head over the lower back of the infant.

The skull is complete but fragmentary and is represented by the frontal bone, divided at the metopic suture, a left parietal, a fragmentary right parietal, a heavily fragmented occipital, largely complete temporal bones, the sphenoid, both zygomatics, the ethmoid, highly fragmented maxillae and palatines, and a very fragmentary mandible. All deciduous teeth are present and unerupted, as is the tip of a permanent canine.

The post-cranial skeleton is complete, missing only parts of the neural arches of the vertebrae, five ribs, six manual phalanges, 22 pedal phalanges, two metacarpals, and two metatarsals. Sixteen epiphyses, tarsals, and other small bones are present but unidentifiable.

Sex and Age

Sex is indeterminate. The infant was four- to eight-months-old at the time of death based on dental development.

Other Observations

Much of the skull demonstrates coalescing porosity and much of the cranium's cortical bone is either poorly formed or non-existent. The poor ossification of the cranium suggests the child was suffering from a serious infectious or metabolic disease at the time of death.

The frontal bone demonstrates flattening of its superior aspect, consistent with cranial modification. Unfortunately, the parietals and occipital are too fragmentary to determine the particular form of the modified skull.

The left parietal exhibits a series of cutmarks. The longest begins just posterior to the coronal suture and continues posteriorly towards the lambdoidal suture and is 46.6 mm long. Inferior to the longest defect is a cut that measures 9.6 mm. Superior to the long cut, also near the coronal suture, is a 4.4 mm cut.

Aspects of the cranium show evidence for thermal alteration. Much of the surface of the frontal bone demonstrates brown discoloration, whereas the corresponding endocranial surface is unaffected. The left parietal exhibits brown discoloration along the coronal suture and also at the parietal boss. The endocranial surface also is light brown. A fragment near the bregma demonstrates longitudinal splitting. Fragments of the right parietal show light brown coloration on their ectocranial surfaces only. The highly fragmented occipital is discolored to a light brown on both ectocranial and endocranial surfaces. The left temporal bone exhibits brown discoloration with longitudinal cracking near the occipital-mastoid suture. The right temporal bone is discolored to a light brown on the ectocranial surface. The zygomatics are largely unaffected, with some brown discoloration of their posterior aspects. The maxilla is largely destroyed. The heavily fragmented mandible shows focal areas of dark brown discoloration. The incisors are mottled white-brown and dark brown, whereas the posterior teeth are dark brown to black, the difference in coloration reflecting the lower enamel content of the posterior teeth (due to their later development).

Small black accretions are evident on much of the cranium but are especially concentrated on the squama of the frontal bone, an anterior fragment of the right parietal (the ectocranial surface), on both the ectocranial and endocranial surfaces of the left parietal, and the endocranial surface of the left temporal. The frontal was found with a substantial amount of an unknown black substance adhering to its ectocranial surface.

Although thermal alteration is evident on much of the post-cranial skeleton, it is most significant in the area of the os coxae and proximal femora. Both os coxae are discolored brown and are longitudinally cracked, especially on their ventral surfaces. Both femora show localized areas of brown discoloration and longitudinal cracking of the proximal thirds of the diaphyses, particularly on the ventral aspects. The neural arches of the lumbar vertebrae are discolored brown and are especially fragmentary relative to the other neural arches. The two tibiae and fibulae also show brown discoloration, with some longitudinal cracking on the tibiae. The bones of the right arm are discolored light brown whereas only the left radius shows similar discoloration. Some ribs demonstrated localized brown discoloration. In general, the feet are more discolored than the hands. Both scapulae are discolored light brown.

Figure 4.18. Infant skeleton from Cache 10/Burial 15. Photo: Andrew Scherer.

The general pattern of thermal alteration suggests that the source of heat was located closest to the pelvis and had its greatest effect on the lower back, upper legs, and the head that was situated atop the lower back. However, the substance adhering to the anterior aspect of the skull may indicate that burning material was placed directly on the head or that a combustible material, such as a mask, was placed over the face and caught fire.

Synthesis

The caches associated with the Diablo tomb can be categorized into two groups. The first consists of child sacrifices: Cache 3/Burial 6 and Cache 10/Burial 15. The second includes the remains of adults as either phalanges (manual and pedal) or anterior teeth. The cutmarks on the phalanges from Caches 5 and 9 indicate that these elements were severed from either a living person or a fleshed corpse. Presumably, the other fingers were similarly extracted from fleshed bodies, as opposed to being recovered from dry skeletons. In a similar fashion, the consistent selection of mandibular incisors indicates that these teeth were not randomly pulled from a dry skull, but rather were likely evulsed from a fleshed (and probably living) head due to their ease of access. The remarkable preservation of the tooth in Cache 9 confirms this. Notably, fingers, toes, and mandibular incisors are all parts of the human body that can be extracted from the living with much blood loss and dramatic effect, but with little risk of death. It is unknown, however, whether these offerings were made by compliant mourners within the community at El Zotz or were forced on unwilling victims. The slicing of captives' fingers in Room 1 of the Bonampak murals certainly comes to mind. Yet if these body parts were removed from tortured captives, it seems unusual that no element found in the Diablo caches is from a part of the body whose removal would have been particularly debilitating or would have required significant dismemberment: posterior teeth, thumbs, entire hands or feet, etc.

Figure 4.19. Anterior teeth, Skeleton A, Burial 9. RM^3 and LP_3 are also present but not shown. Photo: Andrew Scherer.

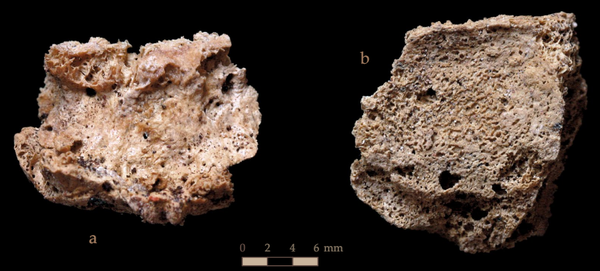

Figure 4.20. Arthritis of the vertebrae of Skeleton A, Burial 9: (a) lower cervical or upper thoracic vertebra, anterior view; (b) upper thoracic vertebra, superior view. Photos: Andrew Scherer.

Of the adult remains, at least two or more individuals are represented by the phalanges. The nine intermediate manual phalanges are the most duplicated element. A normal human body has eight intermediate phalanges—one for each finger, except for the thumbs. More likely, each intermediate phalanx represents a single finger cut from a different individual, though this proposition cannot be substantiated osteologically.

Burial 9 (EZ 5B-29-1)
Skeleton A

Skeleton A consists of the fragmentary and largely incomplete remains of the only adult in the tomb. The only cranial remains attributable to Skeleton A are fragments of the mandible and a partially complete dentition (Figure 4.19). Teeth consist of LI^2, LP^3, RP^3, LM^1, RM^3, LC_1, and LP_3. The post-cranial skeleton includes the body of the hyoid, proximal fragments of the right radius and ulna, a small diaphyseal fragment of the right femur, a possible fragment of the left femur, portions of the right hand (capitates, hamate, scaphoid, pisiform, first metacarpal, second metacarpal, fourth metacarpal, fifth metacarpal, three proximal phalanges, one intermediate phalanx, one distal phalanx), portions of the left hand (trapezium, scaphoid, third metacarpal, an unidentifiable metacarpal, two proximal phalanges, one intermediate phalanx), fragments of the right scapula (portion of glenoid fossa, acromion process, small body fragment), fragments of the left innominate (including the acetabulum, but lacking the pubis and the greater sciatic notch), fragments of most of the cervical vertebrae (including a complete axis), fragments of the upper thoracic vertebrae, at least one rib fragment, the right patella, elements of the feet (the right third metatarsal, four proximal phalanges, a sesamoid bone), and roughly 200 or more tiny unidentifiable bone fragments.

Sex

Probable male. Unfortunately, no diagnostic elements of the pelvis or cranium are present for sex determination. The radius and ulna are relatively large and robust and the ulnar tuberosity is notably rugged. The bones of the hand, particularly the phalanges, are large.

Age

Adult (> 35 years). All epiphyses are fused with no observable line of union. The teeth are fully developed with slight to moderate dental wear. The presence of vertebral arthritis, arthritis of the glenoid fossa, and arthritis of the pedal phalanges (see below) suggests the individual was at least 35 years old, if not older, at the time of death.

Antemortem Pathology

Aside from the atlas, the only vertebral bodies present are a partially preserved thoracic body and the anterior aspect of a lower cervical or upper thoracic body (Figure 4.20). Both demonstrate osteoarthritis. The anterior body fragment demonstrates moderate osteophyte development (Figure 4.20a). The thoracic body fragment shows osteophyte development on the anterior margin, porosity of the superior and inferior surfaces (Figure 4.20b), and slight compression of the body.

Figure 4.21. Porosity and osteophyte development on an inferior fragment of the glenoid fossa of the right scapula, Skeleton A, Burial 9. Photo: Andrew Scherer.

Figure 4.22. Proximal view of the proximal phalanges of the right foot, Skeleton A, Burial 9. Note the osteophyte development (arrows) on the central two phalanges. All damage is postmortem. Photo: Andrew Scherer.

A fragment of the glenoid fossa of the scapula (inferior, ventral) has porosity of its surface and osteophytic lipping around its margins (Figure 4.21). Osteophytes circumscribe the entire visible fossa and much of the surface displays fine porosity.

The pedal phalanges also exhibit arthritis. An intermediate and distal phalanx of the right foot are fused, while the proximal aspect of the intermediate phalanx reveals moderate osteophyte development. Two of the four observable proximal phalanges of the right foot present osteophytes on their lateral aspects (Figure 4.22).

Of the few observable long bone surfaces, there was no evidence for antemortem pathology.

Body Modification

The cranium is too incomplete to determine if it was modified. Of the few observable teeth, the anterior maxillary teeth have inlays (see Figure 4.19). Two jade inlays were placed in the labial surface of LI^2 in an unusual arrangement. The inlay closest to the incisal

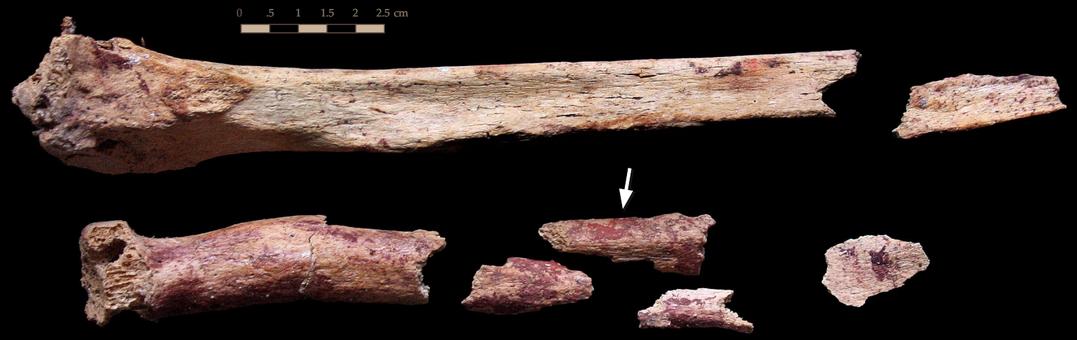

Figure 4.23. Right ulna and radius, Skeleton A, Burial 9. Both bones demonstrate areas of dark red pigmentation (specular hematite). One of the radius fragments also exhibits an area of bright red pigment (cinnabar, indicated by an arrow). Photo: Andrew Scherer.

Figure 4.24. Dorsal view of the right hand, Skeleton A, Burial 9. Traces of red pigment are visible on many of the elements. Photo: Andrew Scherer.

edge is loose at present. LP^3 and RP^3 both have single pyrite inlays. The remaining maxillary teeth (all posterior) are unmodified. None of the mandibular teeth were modified.

Red Pigment

A number of skeletal elements have red pigment on their surfaces. In contrast to the children's skeletons, which demonstrate only flecks of red pigment, Skeleton A exhibits thick deposits. The heaviest amount of pigment is on the surfaces of the bones of the right arm, especially the radius but also the ulna (Figure 4.23), the proximal fourth metacarpal, a proximal phalanx, the proximal and distal phalanges of the first digit (Figure 4.24), the capitate (Figure 4.25), and the acromion process and body fragment of the right scapula. Other bones that show traces of red pigment are the right femur diaphysis, the left third metacarpal, a proximal and intermediate phalanx of the left hand, as well as some of the unidentifiable fragments.

As is true of most cases in which red pigment was applied to the Maya dead, the pigment appears to have been applied to the skin while the body was still intact. After decomposition of any garments, skin, and underlying soft tissue, the pigment disseminated to the bone below. As can be best observed on the right capitate (Figure 4.25), there appear to have been two layers of pigment. First, a layer of red specular hematite was applied. The

Figure 4.25. Close-up of the right capitate, Skeleton A, Burial 9. Dark red pigment (specular hematite) overlain by bright red pigment (cinnabar). Photo: Andrew Scherer.

specular hematite appears as a dark red coating that is visible on the majority of the bone surfaces, particularly the right radius (see Figure 4.23). The specular inclusions are still visible within the pigment adhering to the bone. Presumably, the specular hematite was applied as a viscous liquid that then dried. The color matches cubes of the same substance that were recovered as offerings within the tomb. Presumably these blocks or cakes were put into solution and then painted on the body. The pigment overlaying the specular hematite is cinnabar. Unlike the hematite, the cinnabar is powdery and does not adhere as well as specular hematite, leaving much less cinnabar on the bone.

Because of the incompleteness of the skeleton it is difficult to reconstruct which parts of the body were painted and which were not. Of the hand bones, the pigmentation seems concentrated on the dorsal surfaces (the back of the hand). Otherwise, not enough of the skeleton survives to determine if the body was painted on one side or on all of its surfaces. Following decomposition of the body and collapse of the funerary bier (see below), both the specular hematite and cinnabar spread to artifacts, as well as some of the subadult remains that were in the vicinity of Skeleton A. Unlike Skeleton A, none of the subadult skeletons (Skeletons B–G) appear to have been directly painted with red specular hematite. Many do, however, show flecks of red cinnabar. It is unlikely that the cinnabar was applied directly to the subadults, but rather spread to the remains following decomposition of Skeleton A and subsequent disintegration of the contents of the tomb. Some of the tomb objects may also have been painted with specular hematite or cinnabar, or cinnabar may have been scattered throughout the tomb after the grave goods were arranged within.

Original Position of the Body

The remains of Skeleton A were recovered in columns A–D and rows 1–10 (see Figure 4.2). The cervical vertebrae were excavated in the laboratory by Houston and Scherer and were located underneath the large shell necklace near the north end of the tomb. The teeth were also recovered from this same area. The right radius and ulna were articulated and located near the obsidian blade found along the western wall of the tomb. The bones of the right hand were located just to the south in Sectors A7 and B7. Elements of the left hand were recovered from Sector C7. The left hand occurred near the remains of the left pelvis. A fragment of the right femur appeared south of the right hand in Sector B8, relatively near the right patella in Sector A8. Finally, the remains of the feet were found in Sectors A10, B9, and B10. From this arrangement it is clear that, despite the significant degree of fragmentation, the body was found in general anatomical position. The decedent was interred in a supine extended position, hands either at the sides or placed over the pelvis. The head was oriented to the north and the feet to the south.

Final Observations

There were no cutmarks or any other evidence of perimortem trauma or postmortem modification visible on the skeletal remains. There is no evidence of heat exposure for any of the elements associated with Skeleton A.

Also found among the skeletal remains was a brown clayey substance. Some of the fragments have a thin layer of stucco on one side and red pigment on the other. One possibility is that this substance was spread over the body of the deceased, suggested by impressions of bone in the material noted by Houston. The red pigment is presumably the cinnabar and specular hematite that was painted over the body. The function of the substance is not clear but may have served to protect the body and diminish the smell of decomposition as the tomb was prepared. A similar substance was labeled as "grey clay" in Pendergast's (1982a:67-68) analysis of Altun Ha Tomb B-4/7. The analysts of that tomb could not conclude whether the clay was a substance placed in the deposit or the result of decomposition of organic materials, especially cloth.

Some of the skeletal elements have flecks of brownish-black substance on

Figure 4.27. Right frontal, Skeleton B, Burial 9. Brown-black discoloration and cracking from heat exposure. Photo: Andrew Scherer.

their surfaces, similar to that noted for the phalanges in Cache 6. This adhering substance is most apparent on the proximal articular surfaces of one of the proximal foot phalanges illustrated in Figure 4.22 (second from the left). Considering that it is located at a point of articulation, it must have adhered to the bones after decomposition.

Skeleton B

Skeleton B consists of a largely incomplete and fragmentary infant skeleton (Figure 4.26). The cranium is represented only by a single fragment of the superciliary arch of the right frontal bone (Figure 4.27). The dentition includes rm^1, lm^2, rm^2, ri_1, li_2, ri_2, rm_2, LI^1, RI^1, LI^2, RI^2, LC^1, RC^1, LM^1, RM^1, LI_1, RI_1, LI_2, RC_1, LM_1, and RM_1. Fragments of additional teeth are present. The post-cranial skeleton consists of the third right metatarsal, two unidentifiable metatarsal diaphyses, four proximal pedal phalanges, three distal pedal phalanges, two probable tarsal fragments, and 21 miscellaneous unidentifiable fragments (the majority of which are long bone fragments).

Figure 4.26. Skeleton B, Burial 9. Photo: Andrew Scherer.

Sex and Age

Sex is indeterminate. Age is estimated at 1.5 to 2.5 years according to dental development (Smith 1991; Ubelaker 1999). The epiphyses of the metatarsals are unfused and absent.

Other Observations

None of the teeth from Skeleton B are artificially modified, which is to be expected from the young age of the individual. The skeleton is too incomplete to detect antemortem pathology.

The right frontal fragment was thermally altered (see Figure 4.27). A localized area of the orbit near the zygomatic arch shows a small area of blackening (6.0 mm) along the fractured edge. The discoloration permeates slightly into the underlying trabecular bone. There is some linear cracking associated with the burned area. The brown-black coloration of the burned area coupled with the lack of significant subperiosteal discoloration indicates that the exposure to heat was relatively brief and localized. The lack of burning along the fractured edge indicates that the post-mortem fracture of the cranium occurred sometime after the burning event. This in turn indicates the strong likelihood that the individual was still fleshed at the time of exposure to heat.

There is no evidence pertaining to the cause of death.

Figure 4.28. Dentition, Skeleton C, Burial 9. Photo: Andrew Scherer.

Original Body Position

The dental remains and some post-cranial remains were encountered within Vessel 2 (Sector C4). The bones of the feet and additional fragments were found spilling out of that vessel, into Sector C3. Originally, the entire body lay within the vessel. At some point in time after decomposition of the soft tissue, Vessel 2's base and lid (2A and 2B) were disturbed by collapse from the tomb's walls, spilling part of their contents onto the tomb floor. As a result, the original positioning of the body is uncertain. However, in light of the presence of cranial, post-cranial, and dental remains it is quite probable that the child was originally interred as a complete, fleshed body and that subsequent decomposition within the tomb accounts for the incomplete nature of the skeleton.

Skeleton C

Skeleton C is represented only by the dentition (Figure 4.28). There are no skeletal remains. The teeth include li^2, ri^2, lc^1, rm^1, lm^2, rm^2, ri_2, lc_1, rm_1, lm_1, rm_2, LI^1, RI^1, LI^2, RI^2, LC^1, RC^1, LP^3, RP^3, LP^4, RP^3, LM^1, RM^1, RM^2, LI_1, RI_1, LI_2, RI_2, LC_1, RC_1, LP_3, RP_3, LP_4, RP_4, LM_1, RM_1, and RM_2. Fragments of other teeth are present. The roots and dentin of the deciduous teeth are not present; these teeth are represented only by thin enamel shells.

Age and Sex

Sex is indeterminate. Using Ubelaker's (1999) standards, I estimate the age at 3–5 years. Based on Smith's (1991) standards, age at death was 4 to 4.5 years. Thus, a final age at death estimate is 4–5 years.

Other Observations

None of the teeth are artificially modified. No enamel hypoplasia or other pathology was observed, though full enamel formation was not complete for most of the permanent dentition and the deciduous teeth are generally quite fragmentary.

Original Body Position

Skeleton C was located within the lip-to-lip pair of Vessel 11. The inferior vessel (11B) was lifted in the field and its contents were excavated in the laboratory by Houston and Scherer. Photographic comparisons of the vessel in situ and during excavation indicate very little shifting of vessel contents between the field and laboratory. Surprisingly, the dentition was still largely in correct anatomical position, despite the complete degradation of the alveolus. The teeth were generally located with the left maxillary and mandibular teeth towards the north and the right teeth to the south. The maxillary teeth were situated slightly east of the mandibular dentition. To judge from the arrangement of the teeth, the dentition was deposited as an intact maxilla and mandible. Further, the general position of the teeth suggests the mandible and maxilla were articulated, most likely as part of a complete skull. In light of the complete lack of skeletal material, however, it is most likely that only an isolated skull was placed within the vessel, with no post-cranial skeleton. The position of the dental remains suggests that the skull was placed to rest either on the inferior surface of the mandible or face down into the bowl. The positioning of the teeth indicates that a skull positioned on its posterior surface (looking up) or on its side is highly unlikely. It cannot be determined if the skull was deposited as a dry skull or as a fleshed, severed head.

The teeth demonstrate exposure to heat (see Figure 4.28). The exposed deciduous teeth show a greater degree of discoloration relative to the unerupted

Figure 4.29. Skeleton D, Burial 9. Photo: Andrew Scherer.

permanent teeth, suggesting that all of the teeth were still in associated alveoli at the time of heat exposure. There is no evidence for direct, prolonged exposure to fire, suggesting the individual may have been fleshed at the time of burning. Unlike Vessel 16B (associated with Skeleton F, described below), Vessel 11B shows no obvious evidence of exposure to fire; the sediment inside the vessel was black and ashy, somewhat similar to but not as extensive as the ash within Vessel 16B. Thus it is probable, though not certain, that the burning event happened within the vessel. Alternatively, the burning may have occurred outside of the vessel with the contents (including Skeleton C) added afterward.

Skeleton D

The skeleton is fragmentary and largely incomplete (Figure 4.29). Remains of the skull include two associated fragments of an unsideable parietal (Figure 4.30) and a partially complete dentition, including lm^2, rm^2, li_1, li_2, ri_2, lc_1, lm_1, rm_1, lm_2, rm_2, LI^1, RI^1, LI^2, LI^2, LC^1, RC^1, LM^1, RM^1, LI_1, RI_1, LI_2, RI_2, LC_1, RC_1, LM_1, and RM_1. The post-cranial skeleton includes a right clavicle; five left rib fragments (including the first rib); the head of an unsideable humerus (plausibly a right based on its in situ association with the right clavicle); the head, distal epiphysis, and diaphyseal fragments of the right femur; a single unidentifiable metacarpal; and additional unidentifiable fragments.

Age and Sex

Sex is indeterminate. Age at death is estimated as 2 to 4 years based on dental development (Smith 1991; Ubelaker 1999). The femoral head, distal femoral epiphysis, proximal epiphysis of the humerus, and epiphyses of the unidentifiable metacarpal are all unfused.

Other Observations

There is no evidence for antemortem pathology. The cranium is too incomplete to observe for cranial modification. None of the teeth are artificially modified.

The parietal fragments demonstrate thermal alteration along their fracture edges (Figure 4.30a). There is brown discoloration coupled with cracking perpendicular to the broken edge. The smaller of the two fragments is also discolored on the endocranial surface, suggesting the skull may have been fragmented at the time of heat exposure. Among the post-cranial remains, a single unidentifiable fragment is discolored in a manner consistent with heat exposure.

Figure 4.30. Parietal fragments, Skeleton D, Burial 9: (a) both fragments, demonstrating approximate articulation and burned edges, indicated by red arrows; (b) close-up of inferior fragment showing probable cut mark (yellow arrow), irregular linear defect (white arrow), and flecks of cinnabar; (c) close-up of superior fragment with irregular linear defects indicated by white arrows. Photos: Andrew Scherer.

The parietal fragments also demonstrate a series of linear defects that may be cutmarks. A *probable* cut (3.75 mm long) and a *possible* cutmark are located along the smaller of the two fragments (Figure 4.30b). Two *possible* cutmarks are situated parallel to one another on the larger of the two fragments, 4.55 and 2.78 mm in length and ending at the fracture margin (Figure 4.30c). Overall, the defects shown in Figure 4.30b are more likely to be human-made with a cutting implement, whereas the defects visible in Figure 4.30c may simply result from postmortem damage.

It is difficult to interpret the fracture pattern of the parietal fragments because of the overall incompleteness of the skull. Some of the fracturing likely relates to burning, par-

Figure 4.31. Skeleton E, Burial 9. Photo: Andrew Scherer.

ticularly along the edge that demonstrates thermal alteration. The semicircular fracture defect along the inferior edge of the larger of the two fragments may relate either to the burning event or to skull trauma (recall Cache 3/Burial 6).

Traces of cinnabar are located on the parietal fragments and are most apparent on the smaller of the two cranial fragments (Figure 4.30b).

Two deciduous mandibular incisors (ri_1 and ri_2) and two permanent mandibular incisors (LI_1 and RI_2) are fused (see Figure 4.29).

Original Body Position

Skeleton D was associated with the fragmented remains of lip-to-lip Vessel 12. The cranial fragments, ribs, and right clavicle were encountered in anatomical position, indicating that the individual was deposited as a complete body. The body was originally placed within the bottom vessel (12B). According to the orientation of the right clavicle and ribs, the body lay supine with the head towards the northwest. The vessel assemblage was lifted from the field with its contents still in situ and then excavated in the laboratory by Houston and Scherer. Unfortunately, the vessel assemblage was already disturbed in antiquity (presumably by rock fall from wall collapse), and the original position of the teeth was too disturbed to determine precise positioning of the skull.

During laboratory excavation of the contents of Vessel 12B, four shell micro-beads (similar to those recovered from Vessel 16A/16B) and two green micro-beads of unknown material were recovered.

Skeleton E

Skeleton E is a partially complete, fragmentary skeleton (Figure 4.31). The skull consists of fragments of the cranial vault, the left zygomatic, the right maxilla, the mandible, and a partially complete dentition including, ri^1, lc^1, rc^1, lm^1, rm^1, lm^2, rm^2, li_1, ri_1, li_2, ri_2, lm_1, rm_1, lm_2, rm_2, RI^1, LM^1, RM^1, LI_1, LI_2, LM_1, and RM_1. The post-cranial skeleton includes the proximal epiphyses and distal end of the right humerus, fragments of the left radius and ulna, the diaphysis and distal epiphysis of the left femur, and the distal epiphysis of the right femur. Also included are the proximal epiphysis of the left tibia, the proximal epiphysis and diaphyseal fragments of the right tibia, a portion of each fibula diaphysis, an unfused sternal body, portions of both clavicles, unfused coracoid processes for both scapulae, a fragment of the right scapula body, the left scapular notch, fragments of at least five ribs including the left first rib and a nearly complete left rib, fragments of at least two cervical vertebra arches, fragments of at least three thoracic vertebra arches, one cervical vertebra body, one

Figure 4.32. Right zygomatic, right maxilla, and right and left mandible fragments, Skeleton E, Burial 9. Photo: Andrew Scherer.

Figure 4.33. Left femoral diaphysis demonstrating heat exposure, Skeleton E, Burial 9. Photo: Andrew Scherer.

thoracic vertebra body, three lumbar vertebra bodies, the upper two sacral bodies, fragments of the first sacral arch, fragments of both ilia, all of the metacarpals of the left hand, one unidentifiable metacarpal of the right hand, three proximal hand phalanges, three intermediate hand phalanges, three distal hand phalanges, both tali, a fragment of the left calcaneus, two unidentifiable metatarsal fragments, five proximal foot phalanges, one intermediate foot phalanx, and the distal phalanx of the first pedal digit. There are also an estimated 200 or more delicate, tiny fragments that likely represent the majority of the skeleton not noted in the inventory above.

Sex and Age

Sex is indeterminate. Age at death is estimated at 1 to 2 years on the basis of dental development (Smith 1991; Ubelaker 1999). The two halves of the neural arches of the cervical vertebrae are fused. However, the bodies of the cervical, thoracic, and lumbar vertebrae are all unfused to the neural arches.

Other Observations

There was no evidence of antemortem pathology. The cranium is too fragmentary to determine if it was artificially modified. None of the teeth were artificially modified.

There is evidence of thermal alteration on numerous elements of Skeleton E. Fragments of the cranial vault, including a fragment of the left superciliary arch, are discolored brown. The right zygomatic demonstrates brown discoloration and significant longitudinal fracturing (Figure 4.32). There are a few areas of significant blackening consistent with localized areas of burning—perhaps as flecks of burning substance adhering to the right cheek of the individual. The right maxilla and the mandible show significant areas of brown discoloration and longitudinal fracturing, especially on the anterior aspects, but also on posterior aspects of the mandible. The teeth are slightly discolored brown, generally less so than the other skeletons. The exposed deciduous teeth demonstrate a greater degree of discoloration, whereas the permanent teeth that were in the crypt are generally unaffected by thermal exposure. A left first rib and left thoracic arch show significant brown discoloration and some longitudinal fracturing. The left femur is significantly discolored brown with some blackening distally (Figure 4.33). The bone is warped and longitudinally fractured. Fragments of the right tibia and the right fibula display significant brown discoloration, warping, and longitudinal fracturing.

Figure 4.34. Skeleton F, Burial 9. Photo: Andrew Scherer.

Although it is difficult to reconstruct the precise pattern of burning, the most significantly affected areas were the face, thorax, and legs. Other elements, notably the bones of the arms that are present, are unaffected. The pattern suggests proximity to significant heat, but not complete immolation of the body. The burning in the vessel suggests that a combusted object was placed into the vessel with the child.

Flecks of red cinnabar are visible on two cranial elements and the right zygomatic. As with the other subadult individuals, it is highly unlikely that cinnabar was applied to the body; rather, the pigment probably fell from Skeleton A above.

Original Body Position

The remains of Skeleton E are associated with Vessel 13. Unlike the other paired cache vessels, which were placed lip-to-lip, 13A was stacked inside of 13B. Human remains were found within 13A (the upper vessel) and none were recovered from 13B. Human remains were also found both south and north-northeast of the vessels. When archaeologists entered the tomb they found the Vessel 13 assemblage tilted to the north, such that the northern rim of 13B rested on the floor of the tomb. This was probably not the original position of the vessel assemblage but the result of tomb collapse.

Because of rock fall and the disturbance of the vessel, the remains of Skeleton E were in general disarray. The remains located south of the vessel include the distal epiphyses of both femora, the proximal epiphyses of the tibia, fragments of both tibial diaphyses, and both fibula diaphyses. The fragments that spilled out of the vessel to the north include the cranium, teeth, ribs, the sternal body, the right humerus, left radius, fragments of the scapulae, and other unidentifiable fragments. Within the vessel were fragments of both ilia, the sacrum, lower vertebral bodies, lower vertebral arches, the left ulna, the left hand, metatarsals, pedal phalanges, cranial fragments, and other unidentifiable fragments. Within the vessel, the remains of the arm were highest, followed by the pelvis (ilia and sacrum), and finally, the remains of the feet underneath.

Despite the disturbance of the skeletal remains, it is possible to reconstruct the original body position. The child was placed in the vessel, lying supine, with the head to the north. The position of the arms and hands is difficult to discern, but considering that radius fragments were found with the majority of the cranium and pelvis, spilled outside of the vessel, we suspect the arms were placed crossed over the chest, not extended at the individual's sides. The knees (distal femoral epiphyses, proximal tibia epiphyses, and fibula fragments) were found outside the other side of the vessel, yet the remains of the feet were found below the pelvis inside the vessel. This suggests that the child was placed in the vessel with the knees extending out of the bowl; the feet, tucked below the buttocks, were possibly in cross-legged position.

Judging by the burning patterns on the skeletal elements, it appears that there were at least two concentrations of burned objects within the vessel, one located in the vicinity of the child's pelvis and legs (perhaps on the lap of the child) and a second located close to the head (perhaps placed on the face; see Cache 3/Burial 6).

Skeleton F

Skeleton F consists of only dental remains, found within the lip-to-lip bowls of Vessel 16 (Figure 4.34). The teeth present are li^1, ri^1, li^2, ri^2, lm^2, lm_2, rm_2, LI^1, RI^1, LI^2, RI^2, LC^1, RC, LP^3, RP^3, LP^4, RP^4, LM^1, RM^1, LM^2, RM^2, LI_1, RI_1, LI_2, RI_2, LC_1, RC_1, LP_3, RP_3, LP_4, LM_1, and RM_1. Additional tooth fragments representing many of the remaining deciduous teeth are present.

Sex and Age

Sex is indeterminate. Age is estimated at 4 to 5 years according to measures of dental development (Smith 1991; Ubelaker 1999).

Other Observations

None of the teeth are artificially modified. Both deciduous incisors have small defects along the incisal edge. The lack of wear indicates that these fractures occurred perimortem or postmortem.

Original Body Position

Prior to removal from the tomb, the contents of Vessel 16B were encased in cyclododecane wax, allowing the vessel to be excavated in a controlled environment. The orientation of the vessel was noted in the field so that it would be possible to reconstruct the orientation of materials within the vessel in the laboratory. Houston and Scherer sublimated the cyclododecane and excavated the vessel contents in the project laboratory. We found that the vessel was filled with a black silty-ash substance, likely the remains of burned organic material within the vessel, including the remains of the individual represented by Skeleton F. Resting atop this layer of ash were fragments of Skeleton A as well as large green stucco fragments, a few of which showed red paint. Also recovered from within the vessel were flecks of specular hematite, cinnabar, textile fragments, possible wood fragments, and a small quartz spall.

The teeth of Skeleton F were located in the north-northeast edge of the base of the vessel. The teeth were mixed within the ash layer and partially below the stucco fragments. The teeth were generally arranged anatomically, with the left teeth located in the northern aspect of the vessel and the right dentition continuing to the east. The maxillary teeth were largely found north of the mandibular teeth and as a group were shifted slightly to the east. The lack of skeletal elements, along with the presence of a complete and articulated dentition, echoes the arrangement of Skeleton C.

As with Skeleton C, the teeth are all that remains of what was once either an isolated head or skull. The discoloration of the dentition is consistent with exposure to heat. The exposed deciduous teeth demonstrate a greater degree of discoloration relative to the unerupted permanent teeth, suggesting that all teeth were still in the associated alveoli (no longer present) at the time of heat exposure. Given the evidence for burning apparent on the vessel itself, the remains of Skeleton F were doubtless exposed to heat within the vessel. Since there is no evidence for direct, prolonged exposure to fire, it is likely that the Skeleton F cranium was fleshed at the time of burning. In other words, Skeleton F was likely placed in the vessel as a fleshed, severed head that was exposed to heat shortly thereafter.

The teeth were found resting atop a shell necklace consisting of 400 micro-beads. When the beads were removed during laboratory excavation, they were strung on a single thread, measuring 75 cm in length (see Figure 3.84, page 170). Some of the beads were still articulated, clearly forming part of a necklace or set of necklaces. There are generally two kinds of beads: one type is 3–4 mm wide and 2 mm thick, while the other is more irregularly shaped and about 1–2 mm in

Figure 4.35. Skeleton G, Burial 9. Photo: Andrew Scherer.

width. Many of the beads show burning. The vessel itself is scorched on its interior walls, though the interior base is unaffected, suggesting the base was lined with a material that resisted the flames or smoldering. The exterior of the vessel is also unaffected.

Skeleton G

Skeleton G is a partially complete, fragmented skeleton (Figure 4.35). The cranial remains consist of a single fragment of the right zygomatic and a mostly complete dentition, including li^1, ri^1, li^2, ri^2, lc^1, rc^1, lm^1, rm^1, lm^2, rm^2, li_2, ri_2, lc_1, rc, lm_1, rm_1 ,lm_2, rm_2, LM^1, RM^1, LM_1, and RM_1. The post-cranial skeleton includes a fragment of the diaphysis of the left humerus, the left radius and ulna, the right clavicle, the left and right femoral diaphyses, the right tibial diaphysis and proximal epiphysis, a fragment of an unsided fibula diaphysis, the manubrium and two body segments of the sternum, fragments of both scapular bodies, the unfused coracoid process of the left scapula, fragments of at least two cervical vertebra arches, fragments of at least two thoracic vertebra arches, six lower vertebral bodies (thoracic or lumbar), large fragments of seven ribs (including both first ribs) and at least 20 additional rib fragments, fragments of five metacarpals, five proximal manual phalanges, six intermediate manual phalanges, two distal phalanges, one unidentifiable metacarpal diaphysis, and roughly 100 other various tiny post-cranial skeleton fragments.

Sex and Age

Sex is indeterminate. Age at death is estimated to be 8 to 16 months from dental development (Smith 1991; Ubelaker 1999). The coracoid processes of the scapulae are unfused, as are all observable vertebral bodies to the neural arches. The sternal body segments and the manubrium are also unfused.

Other Observations

No antemortem pathology was observed. The cranium is largely absent,

Figure 4.36. Vertebral bodies, Skeleton G, Burial 9. Photo: Andrew Scherer.

Figure 4.37. Right zygomatic fragment, Skeleton G, Burial 9. Photo: Andrew Scherer.

and it is impossible to observe whether the skull was modified. None of the teeth are artificially modified. There is no evidence of trauma.

The majority of the skeletal elements have small flecks of cinnabar on their surfaces. These elements include the right clavicle, a right cervical vertebra arch, at least five rib fragments (including the left first rib fragment), both the radius and ulna, nine of the phalanges, the manubrium, and four vertebral bodies (Figure 4.36). The only parts of the skeleton that do not have red flecks of paint are the bones of the legs. Presumably the red pigmentation fell into the broken remnants of Vessel 23 following the collapse of the Skeleton A's funerary bier. Importantly, the red pigmentation on the vertebral bodies is on the superior or inferior aspects of the body and thus could not have been applied to a fleshed body, confirming that the pigmentation was intrusive from above.

Some elements of the skeleton also reveal exposure to heat. The most significantly affected is a fragment of the right portion of the frontal bone (Figure 4.37), which is discolored to dark brown, with patches of blackening and longitudinal cracking quite similar to the zygomatic of Skeleton E. Both likely represent intentional burning of the face or perhaps specifically of the eyes. The deciduous teeth are slightly browned as a result of heat exposure. Of the post-cranial skeleton, the left humerus is lightly browned. The left femur is discolored brown and shows longitudinal cracking and some warping. The right tibia displays a focal area of brown discoloration on the proximal third (laterally) and some warping and cracking. The fibula fragment presents some brown discoloration. There is blackening of one of the lower vertebral bodies (see Figure 4.36).

As a result of the incompleteness of the skeleton, it is difficult to reconstruct the nature of the heat exposure. Nonetheless, the overall pattern is similar to that of Skeleton E with focal areas of heat exposure to the face and legs.

Original Position of the Body

Skeleton G was located among the broken remains of the lip-to-lip pair of bowls making up Vessel 23. Only a few of the elements of Skeleton G were documented in situ. Because of time constraints, the majority of the remains

Table 4.1. Osteological Summary of Burial 9

Skeleton	Sex	Age	Postcranial Skeleton?	Hematite	Cinnabar	Heat Exposure
A	Probable male	> 35 years	Yes	Yes	Yes	No
B	Indeterminate	1.5–2.5 years	Yes	No	No	Yes
C	Indeterminate	4–5 years	No	No	No	Yes
D	Indeterminate	2–4 years	Yes	No	Yes	Yes
E	Indeterminate	1–2 years	Yes	No	Yes	Yes
F	Indeterminate	4–5 years	No	No	No	Yes
G	Indeterminate	0.75–1.25 years	Yes	No	Yes	Yes

were removed by the archaeologists without photography or drawing. Even prior to excavation, however, the remains were badly disturbed as a result of the destruction of the Vessel 23 assemblage by tomb collapse. This makes the original position of the skeleton difficult to discern. The majority of the remains were recovered from two large sherds in Sectors B11 and C11. Notably, the teeth were located in Sector C11, while the majority of the other remains occurred in B11, suggesting the head was oriented to the north. The archaeologists report that the bones were scattered over a large enough area that, much like other burials, the body was at least partially extended.

Synthesis

Burial 9 contained the remains of seven individuals, a probable adult male and six children of indeterminate sex, all of whom died by the age of five or earlier (Table 4.1). Each of the children was placed in a lip-to-lip cache assemblage. The primary occupant was presumably laid out in a supine position on a bier made of wood. Unfortunately, because of poor preservation and the fragmentary nature of the skeleton, the only conclusion that can be drawn from the osteological analysis is that the remains derive from a probable male, of middle to old age. The body was covered in at least one layer of specular hematite, followed by another of red cinnabar. However, in light of the materials recovered throughout the tomb, it is clear that the painting of the body was only a small component of a much more elaborate preparation of the corpse. There is no indication of the cause of death of the primary tomb occupant.

As for the six other individuals, it is clear that these children were sacrificed as part of the funerary rites for the primary tomb occupant. Although only Skeleton D demonstrates *possible* cutmarks (on the skull), a lack of cutmarks is typical of juvenile sacrificial remains from Classic Maya tombs elsewhere in the southern lowlands—presumably because these individuals were killed with minimal violence, but also because of poor skeletal preservation. The overlapping age of these individuals further indicates that they likely did not die of natural causes, but were intentionally selected because of their young age. Notably, the two oldest individuals (4–5 years) are represented only by teeth—all that remained, probably, of what were once severed heads. Their lack of bodies may simply be a practicality, in that an intact five-year-old would not fit inside of a vessel, yet the full significance of these paired severed heads remains to be discerned. Moreover, the very young age of these child sacrifices is in marked contrast to the "typical" pattern at other Maya sites, where the sacrificed youths tend to be older, around 8–12 years of age (Houston and Scherer 2010:182).

Over the course of the osteological analysis, we identified heat exposure among the remains of each of the children. In all cases, it appears that the children lay within their vessels (in two instances as heads only) and some sort of burning material was also placed within the vessel assemblage. This pattern echoes that observed for Cache 3/Burial 6 and Cache 10/Burial 15, which were deposited outside of the tomb. Another commonality is that none of the remains are calcined and instead demonstrate only discoloration and some surficial cracking. This is consistent with bodies that are briefly exposed to flame or smoldering material such that the flesh is burned and bone is exposed in only isolated locations. In other words, these children were not immolated with the intent to cremate their bodies. A further consistency is that Cache 3/Burial 6, Skeleton E, and Skeleton G all demonstrate heat exposure that targeted the face and lower body. Facial burning hints that these children may have been wearing masks, perhaps a composite of wood and other combustible materials. Such a pattern would explain why this part of the skeleton demonstrates greater thermal alteration. There is a blackened substance attached to the bones of both Skeleton E and Skeleton G that may be carbonized copal or some other resinous material burned within the vessels.

Finally, red pigment was noted on some skeletal elements from nearly all

of the individuals. Red specular hematite was applied directly to the body of Skeleton A, presumably as a viscous paint. With the decomposition of the body, the hematite appears to have transferred to the bone where it still adheres quite well. None of the skeletal remains of the children demonstrate traces of specular hematite. In the case of Skeleton A, a layer of red cinnabar was applied over the hematite. Unlike the hematite, the cinnabar is quite loose and can easily be brushed off the bone. Cinnabar was detected on the remains of Skeletons D, E, and G and also within the vessel that contained Skeleton F. In addition to the primary occupant's body, many of the tomb objects were also covered in cinnabar. However, in the case of the children's skeletons, the cinnabar is present only in trace amounts and appears to have fallen onto the remains following the collapse of the funerary bier that held Skeleton A.

The sacrifice of children and the offering of adult body parts at El Diablo is an example of a widespread Classic Maya tradition of corporal offerings as part of royal mortuary rites and postmortem acts of veneration. However, the young age of the child sacrifices at El Zotz is significant. In a sample of twenty-two elite tombs with mortuary sacrifices from Kaminaljuyu, Tikal, Piedras Negras, and Palenque, three of the victims were infants (0–2 years), seven were children (2–10 years), 34 were adolescents (10–18 years), and ten were adults. Of the three infants in this sample, each was found in a different tomb. El Zotz Burial 9 is rare, if not unique, in that it contained the bodies of multiple infants.

In the Central Peten, the practice of youth sacrifice was most widespread during the Late Preclassic and Early Classic periods. At El Zotz, Burial 1, an Early Classic tomb that was ransacked by looters, contained fragments of both an adult individual and a child aged 5–9 years. At Tikal, a series of Late Preclassic and Early Classic tombs produced infant and child sacrifices, including Burials 10, 48, 160, 162, and 167 (Coe 1990). Burial 10, the probable tomb of Yax Nuun Ahiin I, contained the remains of at least nine human sacrifices, eight of which ranged in age from 5–6 years to adolescence (ca. 15 years old) and the ninth seems to have been an adult (Wright 2005). At Tikal, only the Late Preclassic Burial 167 and Early Classic Burial 162 contained infants, both apparently placed within bowls. A child from Burial 160 (paired with an adolescent) reportedly demonstrated thermal exposure similar to El Zotz Burial 9 (Lori Wright, personal communication, 2013).

At the start of the Late Classic period, the practice of child sacrifice declined in the Central Peten. Following over a century of royal mortuary rites involving the sacrifice of youths at Tikal, around the end of the sixth century, Animal Skull (Burial 195) was entombed alone. All subsequent royal tombs were void of sacrificial remains. If youths were still sacrificed as part of royal mortuary ritual at Tikal, their remains have not been found by archaeologists. At El Peru, Burial 39 contained the remains of an approximately seven-year-old child, placed atop a series of ceramic dishes, head oriented to the south in opposition to the orientation of the primary occupant (Rich 2011:276). Dating to the first half of the seventh century, the El Peru tomb presents one of the latest examples of child mortuary sacrifice in the central Peten. Outside of the Central Peten, child and adolescent sacrifice persisted throughout the Classic period, as at Palenque and Piedras Negras, for example (Cucina and Tiesler 2006; Escobedo 2004).

The placement of anterior teeth and hand phalanges in lidded cache vessels has been documented throughout the Central Peten and western Belize, though it is not a practice found throughout the Maya lowlands, suggesting a regionally circumscribed ritual tradition (Chase and Chase 1998; Cheetham 2004; Taschek and Ball 1999). Diane Chase and Arlen Chase note that deposits of phalanges and teeth at Caracol span the Late Preclassic through Late Classic periods and were placed primarily in lightly fired bowls, apparently crafted for the express purpose of caching human remains (Chase and Chase 2011:10; Chase and Chase 1998:319). They also report that, by the Late Classic period, bowls with finger bones and teeth were located in both elite and non-elite contexts at Caracol and are associated primarily with eastern structures that house human interments (Chase and Chase 2004:141). At Cahal Pech, David Cheetham reports a deposit of 200 small bowls that contained 225 proximal, intermediate, and distal manual phalanges associated with an entombed stela (Cheetham 2004:137). At the base of the stela, 36 permanent mandibular incisors were deposited.

The general absence of visible trauma on the Cahal Pech remains led David Cheetham (2004:137) to suggest that the phalanges and teeth must have been collected from burials and other deposits of already skeletonized remains. Although a cut was found on one of the El Zotz phalanges, if the fingers were cut from fleshed bodies it is unlikely they were removed by careful cutting but were more likely chopped off with an axe, large knife, or some other heavy stone implement. The removal of fingers by machete in a modern forensic case documented by John Verano (personal communication, 2013) resulted in angular fragmentation of the proximal and intermediate phalanges similar to patterns of fragmentation noted on three of the El Zotz phalanges (see Figure 4.5). Furthermore, these caches consistently contain only anterior teeth (never posterior) and are strongly biased towards phalanges of the hand. The phalanges of the foot (with cutmarks) from Cache 9 are an exception. Either the Maya had superior anatomical knowledge and specifically selected these elements from within the grave, or, more likely, these corporal elements were extracted from fleshed bodies, presumably living people. Mandibular incisors are among the easiest teeth to evulse and the least likely to impair masticatory function if missing. Of any body part, fingers and toes are among the few that may be cut off without seriously impairing a person, especially if some fingers are left intact. At Tikal, Cache 14D contained 39 phalanges, of which all but two were distal (Coe 1990:2:493). A preference for fingertips (not the bases of the finger) is further evidence that these were body parts cut from living people.

References

Abbott, Tucker
1996 *Seashells of North America: A Guide to Field Identification*. St. Martin's Press, New York.

Adams, Richard E. W.
1971 *The Ceramics of Altar de Sacrificios*. Papers 63(1). Peabody Museum of Archaeology and Ethnology, Cambridge.
1999 *Río Azul: An Ancient Maya City*. University of Oklahoma Press, Norman.

Aldenderfer, Mark
1991 Functional Evidence for Lapidary and Carpentry Craft Specialties in the Late Classic of the Central Peten Lakes Region. *Ancient Mesoamerica* 2(2):205-214.

Aldenderfer, Mark, Larry Kimball, and April Sievert
1989 Microwear Analysis in the Maya Lowlands: The Use of Functional Data in a Complex-Society Setting. *Journal of Field Archaeology* 16:47-60.

Anders, Ferdinand, Maarten Jansen, and G. Aurora Pérez Jiménez
1992 *Origen e historia de los reyes mixtecos. Libro explicativo del llamado Códice Vindobonensis*. Fondo de Cultura Económica, Mexico.

Aoyama, Kazuo
1989 Estudio experimental de las huellas de uso sobre material lítico de obsidiana y sílex. *Mesoamérica* 17:185-214.
1995 Microwear Analysis in the Southeast Maya Lowlands: Two Case Studies at Copán, Honduras. *Latin American Antiquity* 6(2):129-144.
1999 *Ancient Maya State, Urbanism, Exchange, and Craft Specialization: Chipped Stone Evidence from the Copán Valley and the La Entrada Region, Honduras*. Memoirs in Latin American Archaeology 12. University of Pittsburgh, Pittsburgh.
2001 Ritos de plebeyos mayas en la Cueva Gordon no. 3 de Copán (Honduras) durante el Período Clásico: análisis de las microhuellas de uso sobre la lítica menor de obsidiana. *Mayab* 14:5-16.
2004 El intercambio, producción y función de los artefactos de obsidiana del período formativo temprano en la costa del Pacífico de Guatemala: un estudio diacrónico y análisis de las microhuellas de uso sobre la lítica de obsidiana del complejo San Jerónimo, Escuintla, Guatemala. *U Tz'ib* 3(7):14-34.
2005 Classic Maya Warfare and Weapons: Spear, Dart and Arrow Points of Aguateca and Copan. *Ancient Mesoamerica* 16(2):291-304.
2007 Elite Artists and Craft Producers in Classic Maya Society: Lithic Evidence from Aguateca, Guatemala. *Latin American Antiquity* 18(1):3-26.
2008 Preclassic and Classic Maya Obsidian Exchange, Artistic and Craft Production, and Weapons in the Aguateca Region and Seibal, Guatemala. *Mexicon* 30(4):78-86.
2009 *Elite Craft Producers, Artists, and Warriors at Aguateca: Lithic Analysis*. Monographs of the Aguateca Archaeological Project First Phase, 2. University of Utah Press, Salt Lake City.

Aulie, H. Wilbur, and Evelyn W. de Aulie
1998 *Diccionario ch'ol de Tumbalá, Chiapas, con variaciones dialectales de Tila y Sabanilla*. Instituto Lingüístico de Verano, Mexico.

Baez, Miguel
2009 Stèle en pierre taillée. In *Teotihuacan: Cité des Dieux*, edited by Felipe Gómez Solís, p. 439. Somogy Editions D'Art, Paris.

Baker, Brenda J., Tosha L. Dupras, and Matthew W. Tocheri
2005 *The Osteology of Infants and Children*. Texas A&M University Press, College Station.

Ball, Joseph W.
1977 *The Archaeological Ceramics of Becan, Campeche, Mexico*. Publication 43. Middle American Research Institute, Tulane University, New Orleans.

Batta, Erasmo, Carlos Argáez, Josefina Mansilla, Carmen Pijoan, and Pedro Bosch
2013 On Yellow and Red Pigmented Bones Found in Mayan Burials of Jaina. *Journal of Archaeological Science* 40(1):712-722.

Baudez, Claude-François
1994 *Maya Sculpture of Copán: The Iconography*. University of Oklahoma Press, Norman.

Becquelin, Pierre, and Claude F. Baudez
1982 *Tonina, une cité maya du Chiapas (Mexique)*, t. 2. Mission Archéologique et Ethnologique Française au Mexique, Etudes Mésoaméricaines 6(2). Centre d'Études Mexicaines et Centraméricaines, Mexico.

Bell, Ellen Elizabeth
2007 Early Classic Ritual Deposits within the Copan Acropolis: The Material Foundations of Political Power at a Classic Period Maya Center. Ph.D. dissertation, Department of Anthropology, University of Pennsylvania, Philadelphia.

Bell, Ellen E., Robert J. Sharer, David W. Sedat, Marcello A. Canuto, and Lynn A. Grant
2000 The Margarita Tomb at Copan, Honduras: A Research Update. *Expedition* 42(3):21-25.

Bell, Ellen E., Robert J. Sharer, Loa P. Traxler, David W. Sedat, Christine W. Carrelli, and Lynn Grant
2004 Tombs and Burials in the Early Classic Acropolis at Copan. In *Understanding Early Classic Copan*, edited by Ellen E. Bell, Marcello A. Canuto, and Robert J. Sharer, pp. 131-157. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Berjonneau, Gerald, Emile Deletaille, and Jean-Louis Sonnery
1985 *Rediscovered Masterpieces of Mesoamerica: Mexico-Guatemala-Honduras*. Editions Arts 135, Boulogne.

Binski, Paul
1996 *Medieval Death: Ritual and Representation*. Cornell University Press, Ithaca.

Blainey, Marc G.
1997 Surfaces and Beyond: The Political, Ideological, and Economic Significance of Ancient Maya Iron-Ore Mirrors. M.A. thesis, Department of Anthropology, Trent University, Peterborough.

Bloch, Maurice, and Jonathan Parry
1982 Introduction: Death and the Regeneration of Life. In *Death and the Regeneration of Life*, edited by Maurice Bloch and Jonathan Parry, pp. 1-44. Cambridge University Press, Cambridge.

Blom, Frans, and Oliver La Farge
1926 *Tribes and Temples: A Record of the Expedition to Middle America Conducted by the Tulane University of Louisiana in 1925*, v. 1. Tulane University, New Orleans.

Boone, Elizabeth H.
2000 *Stories in Red and Black: Pictorial Histories of the Aztecs and Mixtecs*. University of Texas Press, Austin.
2007 The House of the Eagle. In *Cave, City, and Eagle's Nest: An Interpretive Journey through the Mapa de Cuauhtinchan No. 2*, edited by David Carrasco and Scott Sessions, pp. 27-48. University of New Mexico Press, Albuquerque.

Bosecker, Klaus
1997 Bioleaching: Metal Solubilization by Microorganisms. *FEMS Microbiology Reviews* 20(3-4):591-604.

Boyle, Alan
2013 Inside a Maya Pyramid, Mysterious Carvings Hint at Superpower Struggle. *NBC News*: www.nbcnews.com/science/inside-maya-pyramid-mysterious-carvings-hint-superpower-struggle-6C10861128.

Brady, James E., and Dominique Rissolo
2006 A Reappraisal of Ancient Maya Cave Mining. *Journal of Anthropological Research* 62(4):471-490.

Braswell, Geoffrey E.
2003 Dating Early Classic Interaction Between Kaminaljuyu and Central Mexico. In *The Maya and Teotihuacan: Reinterpreting Early Classic Interaction*, edited by Geoffrey E. Braswell, pp. 81-104. University of Texas Press, Austin.

Breedlove, Dennis E., and Robert M. Laughlin
2000 *The Flowering of Man: A Tzotzil Botany of Zinacantán*. Abridged ed. Smithsonian Institution Press, Washington, D.C.

Buikstra, Jane E., and Douglas H. Ubelaker
1994 *Standards for Data Collection from Human Skeletal Remains*. Research Series 44. Arkansas Archeological Survey, Fayetteville.

Callaghan, Michael G.
2009 Technologies of Power: Ritual Economy and Ceramic Production in the Terminal Preclassic Period Holmul Region, Guatemala. Ph.D. dissertation, Department of Anthropology, Vanderbilt University, Nashville.

Campaña, Luz Evelia, and Sylvian Boucher
2002 Nuevas imágenes de Becán, Campeche. *Arqueología Mexicana* 10(56):64-69.

Carter, Benjamin P.
2011 *Spondylus* in South American Prehistory. In *Spondylus in Prehistory: New Data and Approaches. Contributions to the Archaeology of Shell Technologies*, edited by Fotis Ifantidis and Marianna Nikolaidou, pp. 63-89. BAR International Series 2216. British Archaeological Reports, Oxford.

Carter, Nicholas P., Rony E. Piedrasanta, Stephen D. Houston, and Zachary Hruby
2012 Signs of Supplication: Two Mosaic Earflare Plaques from El Zotz, Guatemala. *Antiquity* 86(333), Project Gallery: http://antiquity.ac.uk/projgall/carter333/.

Chase, Arlen F., and Diane Z. Chase
1987 *Investigations at the Classic Maya City of Caracol Belize: 1985-1987*. Pre-Columbian Art Research Institute, San Francisco.
2011 Heterogeneity in Residential Group Composition: Continued Investigation in and near Caracol's Epicenter: Caracol Archaeological Project Investigations for 2011. Report submitted to the Belize Institute of Archaeology, Belize.

Chase, Arlen F., Diane Z. Chase, Elayne Zorn, and Wendy Teeter
2008 Textiles and the Maya Archaeological Record. *Ancient Mesoamerica* 19(1):127-142.

Chase, Diane Z., and Arlen F. Chase
1998 The Archaeological Context of Caches, Burials, and Other Ritual Activities for the Classic Period (as Reflected at Caracol, Belize). In *Function and Meaning in Classic Maya Architecture*, edited by Stephen D. Houston, pp. 299-332. Dumbarton Oaks, Washington, D.C.
2004 Archaeological Perspectives on Classic Maya Social Organization from Caracol, Belize. *Ancient Mesoamerica* 15(1):139-147.

Cheetham, David T.
2004 The Role of "Terminus Groups" in Lowland Maya Site Planning: An Example from Cahal Pech. In *The Ancient Maya of the Belize Valley: Half a Century of Archaeological Research*, edited by James F. Garber, pp. 125-148. University Press of Florida, Gainesville.

Chinchilla Mazariegos, Oswaldo
2013 Tecum, the Fallen Sun: Mesoamerican Cosmogony and the Spanish Conquest of Guatemala. *Ethnohistory* 60(4):693-719.

Codex Magliabechiano
2013 Electronic document, www.famsi.org/research/graz/magliabechiano/index.html.

Coe, Michael D.
1977 Supernatural Patrons of Maya Scribes and Artists. In *Social Process in Maya Prehistory: Studies in Honour of Sir Eric Thompson*, edited by Norman Hammond, pp. 327-346. Academic Press, London.

Coe, William R.
1990 *Excavations in the Great Plaza, North Terrace, and North Acropolis of Tikal*. 5 vols. Tikal Report 14. University Museum, University of Pennsylvania, Philadelphia.

Coggins, Clemency C.
1988 Classic Maya Metaphors of Death and Life. *RES: Anthropology and Aesthetics* 16:64-84.

Cucina, Andrea, and Vera Tiesler
2006 The Companions of Janaab' Pakal and the "Red Queen" from Palenque, Chiapas: Meanings of Human Companion Sacrifice in Classic Maya Society. In *Janaab' Pakal of Palenque: Reconstructing the Life and Death of a Maya Ruler*, edited by Vera Tiesler and Andrea Cucina, pp. 102-125. University of Arizona Press, Tucson.

Cuevas García, Martha
2007 *Los incensarios efigie de Palenque. Deidades y rituales mayas*. Universidad Nacional Autónoma de México; Instituto Nacional de Antropología e Historia, Mexico.

Culbert, T. Patrick
1993 *The Ceramics of Tikal: Vessels from the Burials, Caches, and Problematical Deposits*. Tikal Report 25, Part A. University Museum, University of Pennsylvania, Philadelphia.

Czapiewska, Ewa, Thomas Garrison, Edwin Román, and Stephen Houston
2014 La cerámica de los grupos de élite: análisis de los restos hallados en El Zotz, Petén, Guatemala. In *XXVII Simposio de Investigaciones Arqueológicas en Guatemala, 2013*, edited by Bárbara Arroyo, Luis Méndez Salinas, and Andrea Rojas, v. 1, pp. 283-296. Ministerio de Cultura y Deportes; Instituto de Antropología e Historia; Asociación Tikal, Guatemala.

Danien, Elin C.
2002 *Guide to the Mesoamerican Gallery at the University of Pennsylvania Museum of Archaeology and Anthropology*. University Museum, University of Pennsylvania, Philadelphia.

Díaz Balsera, Viviana
2008 Celebrating the Rise of a New Sun: The Tlaxcalans Conquer Jerusalem in 1539. *Estudios de Cultura Nahuatl* 39:311-330.

Doyle, James A.
2012 Regroup on "E-Groups": Monumentality and Early Centers in the Middle Preclassic Maya Lowlands. *Latin American Antiquity* 23(4):355-379.
2013 The First Maya "Collapse": The End of the Preclassic Period at El Palmar, Peten, Guatemala. Ph.D. dissertation, Department of Anthropology, Brown University, Providence.

Eberl, Markus
2005 *Muerte, entierro y ascención. Ritos funerarios entre los antiguos mayas*. Universidad Autónoma de Yucatán, Merida.

Emery, Kitty, and Kazuo Aoyama
2007 Bone, Shell, and Lithic Evidence for Crafting in Elite Maya Households at Aguateca, Guatemala. *Ancient Mesoamerica* 18(1):69-89.

Escobedo, Héctor L.
2004 Tales from the Crypt: The Burial Place of Ruler 4, Piedras Negras. In *Courtly Art of the Ancient Maya*, edited by Mary Miller and Simon Martin, pp. 277-280. Thames and Hudson, New York.

Estrada Reynoso, José Luis
2009 Extrémité supérieure de marqueur, fragment. In *Teotihuacan: Cité des Dieux*, edited by Felipe Gómez Solís, p. 246. Somogy Editions D'Art, Paris.

Fash, William L., Jr.
1989 The Sculptural Façade of Structure 9N-82: Content, Form, and Significance. In *The House of the Bacabs, Copan, Honduras*, edited by David Webster, pp. 41-72. Studies in Pre-Columbian Art and Archaeology 29. Dumbarton Oaks, Washington, D.C.

Filloy Nadal, Laura, and Sofía Martínez del Campo Lanz
2010 El rostro eterno de K'inich Janaab' Pakal: la máscara funeraria. In *Misterios de un rostro maya. La mascara funeraria de K'inich Janaab' Pakal de Palenque*, edited by Laura Filloy Nadal, pp. 108-129. Instituto Nacional de Antropología e Historia, Mexico.

Fitzsimmons, James L.
2009 *Death and the Classic Maya Kings*. University of Texas Press, Austin.

Foias, Antonia E.
1996 Changing Ceramic Production and Exchange Systems and the Classic Maya Collapse in the Petexbatun Region. Ph.D. dissertation, Department of Anthropology, Vanderbilt University, Nashville.

Folan, William J., Joyce Marcus, Sophia Pincemin, María del Rosario Domínguez Carrasco, Laraine Fletcher, and Abel Morales López
1995 Calakmul: New Data from an Ancient Maya Capital in Campeche, Mexico. *Latin American Antiquity* 6(4):310-334.

Forsyth, Donald W.
1989 *The Ceramics of El Mirador, Petén, Guatemala*. El Mirador Series, Part 4. Papers 63. New World Archaeological Foundation, Brigham Young University, Provo.

Furst, Jill L.
1978 *Codex Vindobonensis Mexicanus I: A Commentary*. Institute of Mesoamerican Studies Publication 4. State University of New York, Albany.

Garrison, Thomas, and Fernando Beltrán
2011 Investigaciones en Bejucal. In Proyecto Arqueológico "El Zotz," informe no. 5, temporada 2010, edited by Jose Luis Garrido López, Stephen Houston, and Edwin Román, pp. 293-319. Report submitted to the Dirección General del Patrimonio Cultural y Natural de Guatemala.

Garrison, Thomas, Jose Luis Garrido, Octavio Axpuac, Alexander Smith, Timothy Beach, Sheryl Luzzadder-Beach, and Fernando Beltrán
2011 Programa de investigaciones regionales (mapeo y excavaciones). In Proyecto Arqueológico "El Zotz," informe no. 5, temporada 2010, edited by Jose Luis Garrido López, Stephen Houston, and Edwin Román, pp. 321-386. Report submitted to the Dirección General del Patrimonio Cultural y Natural de Guatemala.

Gifford, James C.
1960 The Type-Variety Method of Ceramic Classification as an Indicator of Cultural Phenomena. *American Antiquity* 25(3):341-347.

Goodall, Rosemary A., Jay Hall, Rene Viel, F. Ricardo Agurcia, Howell G. M. Edwards, and Peter M. Fredericks
2006 Raman Microscopic Investigation of Paint Samples from the Rosalila Building, Copan, Honduras. *Journal of Raman Spectroscopy* 37(10):1072-1077.

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

Greene, Merle, Robert L. Rands, and John A. Graham
1972 *Maya Sculpture from the Southern Lowlands, Highlands and Pacific Piedmont, Guatemala, Mexico, Honduras*. Lederer, Street and Zeus, Berkeley, CA.

Gutiérrez Castillo, Yeny Myshell, Stephen Houston, Edwin Román, Thomas Garrison, Sarah Newman, and Catherine Magee
2013 Entre conchas y océanos: analizando los artefactos malacológicos procedentes del Entierro 9 de El Zotz, Petén, Guatemala. In *XXVI Simposio de Investigaciones Arqueológicas en Guatemala, 2012*, edited by Bárbara Arroyo and Luis Méndez Salinas, v. 2, pp. 597-609. Ministerio de Cultura y Deportes; Instituto de Antropología e Historia; Asociación Tikal, Guatemala.

Hall, Grant D.
1985 Results of Tomb Investigations at Río Azul, Season of 1984. Report submitted to Richard E. W. Adams for *Río Azul Reports, No. 2*, July 1985.
1989 Realm of Death: Royal Mortuary Customs and Polity Interaction in the Classic Maya Lowlands. Ph.D. dissertation, Department of Anthropology, Harvard University, Cambridge.

Hamman, Byron
2002 The Social Life of Pre-Sunrise Things: Indigenous Mesoamerican Archaeology. *Current Anthropology* 43(3):351-382.

Hammond, Norman
1984 Holmul and Nohmul: A Comparison and Assessment of Two Maya Lowland Protoclassic Sites. *Ceramica de Cultura Maya* 13:1-17.

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

Hansford, Geoff S., and Tomás Vargas
2001 Chemical and Electrochemical Basis of Bioleaching Processes. *Hydrometallurgy* 59(2):135-145.

Harrison-Buck, Eleanor, Patricia A. McAnany, and Rebecca Storey
2007 Empowered and Disempowered During the Late to Terminal Classic Transition: Maya Burial and Termination Rituals in the Sibun Valley, Belize. In *New Perspectives on Human Sacrifice and Ritual Body Treatments in Ancient Maya Society*, edited by Vera Tiesler and Andrea Cucina, pp. 74-101. Springer, New York.

Hellmuth, Nicholas
1987 *Monster und Menschen in der Maya-Kunst: Eine Ikonographie der alten Religionen Mexikos und Guatemalas*. Academische Druk- u. Verlagsanstalt, Graz.

Henderson, Lucia R.
2013 Bodies Politic, Bodies in Stone: Imagery of the Human and the Divine in the Sculpture of Late Preclassic Kaminaljuyú, Guatemala. Ph.D. dissertation, Department of Art and Art History, University of Texas at Austin.

Houk, Brett A., Hubert R. Robichaux, and Fred Valdez, Jr.
2010 An Early Royal Maya Tomb from Chan Chich, Belize. *Ancient Mesoamerica* 21(2):229-248.

Houston, Stephen D.
1996 Symbolic Sweatbaths of the Maya: Architectural Meaning in the Cross Group at Palenque, Mexico. *Latin American Antiquity* 7(2):132-151.
2008 In the Shadow of a Giant. *Mesoweb*: www.mesoweb.com/zotz/articles/Shadow-of-a-Giant.pdf.
2012 Diadems in the Rough. *Maya Decipherment*: decipherment.wordpress.com/2012/10/06/diadems-in-the-rough/.

Houston, Stephen D., and Andrew K. Scherer
2010 La ofrenda máxima: el sacrificio humano en la parte central del área maya. In *El sacrificio humano en la tradición religiosa mesoamericana*, edited by Leonardo López Luján and Guilhem Olivier, pp. 169-193. Instituto Nacional de Antropología e Historia; Universidad Nacional Autónoma de México, Mexico.

Houston, Stephen, and David Stuart
1996 Of Gods, Glyphs, and Kings: Divinity and Rulership among the Classic Maya. *Antiquity* 70(268):289-312.

Houston, Stephen, and Karl Taube
2000 An Archaeology of the Senses: Perception and Cultural Expression in Ancient Mesoamerica. *Cambridge Archaeological Journal* 10(2):261-294.

Houston, Stephen, Edwin Román, and Thomas Garrison
2013 The Temple of the Night Sun: Configuring Kinship at El Diablo, Guatemala. Paper presented at The Maya Meetings, University of Texas at Austin.

Houston, Stephen, David Stuart, and Karl Taube
2006 *The Memory of Bones: Body, Being, and Experience among the Classic Maya*. University of Texas Press, Austin.

Houston, Stephen, Claudia Brittenham, Cassandra Mesick, Alexandre Tokovinine, and Christina Warinner
2009 *Veiled Brightness: A History of Ancient Maya Color*. University of Texas Press, Austin.

Houston, Stephen, Héctor Escobedo, Andrew Scherer, Mark Child, and James Fitzsimmons
2003 Classic Maya Death at Piedras Negras, Guatemala. In *Antropología de la eternidad: la muerte en la cultura maya*, edited by Andrés Ciudad Ruiz, Mario Humberto Ruz Sosa, and María Josefa Iglesias Ponce de León, pp. 113-143. Sociedad Española de Estudios Mayas, Madrid.

Huntington, Richard, and Peter Metcalf
1979 *Celebrations of Death: The Anthropology of Mortuary Ritual*. Cambridge University Press, Cambridge.

Iglesias, María Josefa, Andrés Ciudad, Eduardo Arroyo, Jesús Adánez, and Sara Álvarez
2001 Aplicaciones de la antropología molecular a la arqueología maya: el caso de Tikal. In *XIV Simposio de Investigaciones Arqueológicas en Guatemala, 2000*, edited by Juan Pedro Laporte, Ana Claudia de Suasnávar, and Bárbara Arroyo, v. 2, pp. 1069-1088. Ministerio de Cultura y Deportes; Instituto de Antropología e Historia; Asociación Tikal, Guatemala.

Jansen, Maarten
1997 La serpiente emplumada y el amanecer de la historia. In *Códices, caciques y comunidades*, edited by Maarten Jansen and Luis Reyes García, pp. 11-63. Cuadernos de Historia Latinoamericana 5. Asociación de Historiadores Latinoamericanistas Europeos, Ridderkerk.

Jones, Christopher, and Linton Satterthwaite
1982 *The Monuments and Inscriptions of Tikal: The Carved Monuments*. Tikal Report 33, Part A. University Museum, University of Pennsylvania, Philadelphia.

Joyce, Rosemary A., and John S. Henderson
2007 From Feasting to Cuisine: Implications of Archaeological Research in an Early Honduran Village. *American Anthropologist* 109(4):642-653.

Keeley, Lawrence H.
1980 *Experimental Determination of Stone Tool Uses: A Microwear Analysis*. University of Chicago Press, Chicago.

Keen, Myra
1971 *Sea Shells of Tropical West America: Marine Mollusks from Baja California to Peru*. 2nd ed. Stanford University Press, Stanford.

Kidder, Alfred Vincent, Jesse David Jennings, Edwin M. Shook
1946 *Excavations at Kaminaljuyu, Guatemala*. Publication 561. Carnegie Institute of Washington, Washington, D.C.

Kovacevich, Brigitte
2006 Reconstructing Classic Maya Economic Systems: Production and Exchange at Cancuen, Guatemala. Ph.D. dissertation, Department of Anthropology, Vanderbilt University, Nashville.
2011 The Organization of Jade Production at Cancuen, Guatemala. In *The Technology of Maya Civilization: Political Economy and Beyond in Lithic Studies*, edited by Zachary X. Hruby, Geoffrey E. Braswell, and Oswaldo Chinchilla Mazariegos, pp. 149-161. Equinox Publishing, London.

Kovacevich, Brigitte, and Zachary Hruby
2005 Towards an Understanding of the Value of Jade in Two Lowland Classic Maya City Centers, Cancuen and Piedras Negras. Paper presented at the 70th Annual Meeting of the Society for American Archaeology, Salt Lake City.

Krejci, Estella, and T. Patrick Culbert
1995 Preclassic and Classic Burials and Caches in the Maya Lowlands. In *The Emergence of Lowland Maya Civilization: The Transition from Preclassic to Early Classic*, edited by Nikolai Grube, pp. 103-116. Acta Mesoamerica 8. Verlag Anton Saurwein, Möckmühl.

Lacadena, Alfonso
2004 The Glyphic Corpus from Ek' Balam, Yucatán, México. Report submitted to the Foundation for the Advancement of Mesoamerican Studies, Inc. Available: www.famsi.org/reports/01057/01057LacadenaGarciaGallo01.pdf.

Laporte, Juan Pedro
1989 Alternativas del clásico temprano en la relación Tikal-Teotihuacán: Grupo 6C-XVI, Tikal, Petén, Guatemala. Ph.D. dissertation, Universidad Nacional Autónoma de México, Mexico.
2005 Exploración y restauración en la Plataforma Este de Mundo Perdido, Tikal (Estructuras 5D-83 a 5D-89). In *XVIII Simposio de Investigaciones Arqueológicas en Guatemala, 2004*, edited by Juan Pedro Laporte, Bárbara Arroyo, and Héctor E. Mejía, v. 1, pp. 153-200. Ministerio de Cultura y Deportes; Instituto de Antropología e Historia; Asociación Tikal; Foundation for the Advancement of Mesoamerican Studies, Guatemala.

Laporte, Juan Pedro, and Vilma Fialko
1987 La cerámica del Clásico Temprano desde Mundo Perdido, Tikal: una reevaluación. In *Maya Ceramics: Papers from the 1985 Maya Ceramics Conference*, edited by Prudence M. Rice and Robert J. Sharer, pp. 123-181. BAR International Series 345. British Archaeological Reports, Oxford.
1995 Un reencuentro con Mundo Perdido, Tikal. *Ancient Mesoamerica* 6(1):58-62.

LeCount, Lisa J.
2001 Like Water for Chocolate: Feasting and Political Ritual Among the Late Classic Maya at Xunantunich, Belize. *American Anthropologist* 103(4):935-953.

Lewenstein, Suzanne M.
1987 *Stone Tool Use at Cerros*. University of Texas Press, Austin.
1991 Woodworking Tools at Cerros. In *Maya Stone Tools: Selected Papers from the Second Maya Lithic Conference*, edited by Thomas R. Hester and Harry J. Shafer, pp. 239-249. Prehistory Press, Madison.

López Castro, Hermenegildo F., and Ethelia Ruiz Medrano
2010 *Tutu Ñuu Oko. Libro del pueblo veinte. Relatos de la tradición oral mixteca de Pinotepa Nacional, Oaxaca*. Instituto Nacional de Lenguas Indígenas, Mexico.

Loten, H. Stanley
2003 The North Acropolis: Monumentality, Function, and Architectural Development. In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by Jeremy A. Sabloff, pp. 227-252. School of American Research Press, Santa Fe.

Lothrop, Joy Mahler
1992 Textiles. In *Artifacts from the Cenote of Sacrifice, Chichen Itza, Yucatan*, edited by Clemency Chase Coggins, pp. 33-90. Memoirs 10(3). Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge.

Love, Bruce
1989 Yucatec Sacred Breads through Time. In *Word and Image in Maya Culture: Explorations in Language, Writing, and Representation*, edited by William F. Hanks and Don S. Rice, pp. 336-350. University of Utah Press, Salt Lake City.

Lucero, Lisa J.
2003 The Politics of Ritual: The Emergence of Classic Maya Rulers. *Current Anthropology* 44(4):523-558.

Marcus, Joyce, and Kent V. Flannery
2000 Ancient Zapotec Ritual and Religion: An Application of the Direct Historical Approach. In *The Ancient Civilizations of Mesoamerica: A Reader*, edited by Michael E. Smith and Marilyn A. Masson, pp. 400-421. Blackwell, Malden, MA.

Martin, Simon
2003 In Line of the Founder: A View of Dynastic Politics at Tikal. In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited Jeremy A. Sabloff, pp. 3-45. School of American Research Press, Santa Fe.

Martin, Simon, and Nikolai Grube
2008 *Chronicle of the Maya Kings and Queens: Deciphering the Dynasties of the Ancient Maya*. 2nd ed. Thames and Hudson, London.

Martin-Sanchez, Pedro M., Santiago Sanchez-Cortes, Eduardo Lopez-Tobar, Valme Jurado, Fabiola Bastian, Claude Alabouvette, and Cesareo Saiz-Jimenez
2012 The Nature of Black Stains in Lascaux Cave, France, as Revealed by Surface-Enhanced Raman Spectroscopy. *Journal of Raman Spectroscopy* 43(3):464-467.

Mathema, Vivek Bhakta, Balkrishna Chand Thakuri, and Mika Sillanpää
2011 Bacterial Mer Operon-Mediated Detoxification of Mercurial Compounds: A Short Review. *Archives of Microbiology* 193(12):837-844.

Mathews, Peter
1975 The Lintels of Structure 12, Yaxchilan, Chiapas. Paper presented at the Annual Conference of the Northeastern Anthropological Association, Wesleyan University, Middletown.

Matthews, Robert W., and Jorge M. González
2004 Nesting Biology of *Zeta argillaceum* (Hymenoptera: Vespidae: Eumeninae) in Southern Florida, U.S. *Florida Entomologist* 87:37-40. Available: www.bioone.org/doi/full/10.1653/0015-4040%282004%29087%5B0037%3ANBOZAH%5D2.0.CO%3B2.

Maudslay, Alfred P.
1889-1902 *Archaeology*. 5 vols. Appendix to *Biologia Centrali-Americana; or, Contributions to the Knowledge of the Fauna and Flora of Mexico and Central America*. R. H. Porter and Dulau, London.

Maynard, David F., and Frances F. Berdan
2010 El adhesivo y el material de reparación de la mascara. In *Misterios de un rostro maya. La máscara funeraria de K'inich Janaab' Pakal de Palenque*, edited by Laura Filloy Nadal, pp. 154-161. Instituto Nacional de Antropología e Historia, Mexico.

McAnany, Patricia A.
1995 *Living with the Ancestors: Kinship and Kingship in Ancient Maya Society*. University of Texas Press, Austin.
1998 Ancestors and the Classic Maya Built Environment. In *Function and Meaning in Classic Maya Architecture*, edited by Stephen D. Houston, pp. 271-298. Dumbarton Oaks, Washington, D.C.

McNeil, Cameron L.
2010 Death and Chocolate: The Significance of Cacao Offerings in Ancient Maya Tombs and Caches at Copan, Honduras. In *Pre-Columbian Foodways: Interdisciplinary Approaches to Food, Culture, and Markets in Ancient Mesoamerica*, edited by John E. Staller and Michael Carrasco, pp. 293-314. Springer, New York.

Merwin, Raymond E., and George C. Vaillant
1932 *The Ruins of Holmul, Guatemala*. Memoirs 3(2). Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge.

Miho Museum
2011 Tetrapod Vessel with Dog on Lid. *Miho Museum*: http://miho.jp/booth/html/artcon/00004354e.htm.

Miller, Mary, and Claudia Brittenham
2013 *The Spectacle of the Late Maya Court: Reflections on the Murals of Bonampak*. University of Texas Press, Austin.

Moholy-Nagy, Hattula, with William R. Coe
2008 *The Artifacts of Tikal: Ornamental and Ceremonial Artifacts and Unworked Material*. Tikal Report 27, Part A. Monograph 127. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Nascimento, Andréa M. A., and Edmar Chartone-Souza
2003 Operon Mer: Bacterial Resistance to Mercury and Potential for Bioremediation of Contaminated Environments. *Genetics and Molecular Research* 2(1):92-101.

Nuland, Sherwin B.
1994 *How We Die: Reflections on Life's Final Chapter*. Random House, New York.

Orrego Corzo, Miguel
2000 Informe sobre las investigaciones arqueológicas en el conjunto A-3, temporadas 1986-87, Río Azul, Municipio de Melchor de Mencos, Petén, Guatemala. In *Río Azul Reports, No. 5: The 1987 Season*, edited by Richard E. W. Adams, pp. 54-107. University of Texas at San Antonio, San Antonio.

Ortner, Donald J.
2002 *Identification of Pathological Conditions in Human Skeletal Remains*. 2nd ed. Academic Press, London.

Orton, Clive, Paul Tyers, and Alan Vince
1993 *Pottery in Archaeology*. Cambridge University Press, Cambridge.

Parsons, Elsie Clew
1933 Some Aztec and Pueblo Parallels. *American Anthropologist* 35(4):611-631.

Pereira, Grégory, and Dominique Michelet
2004 Gobernantes mayas en lechos de muerte: el caso de Balamkú, un patron funerario del Clásico Temprano. In *Culto funerario en la sociedad maya. Memoria de la Cuarta Mesa Redonda de Palenque*, edited by Rafael Cobos, pp. 333-368. Instituto Nacional de Antropología e Historia, Mexico.

Pendergast, David M.
1969 *Altun Ha, British Honduras (Belize): The Sun God's Tomb*. Art and Archaeology Occasional Papers 16. Royal Ontario Museum, Toronto.
1982a *Excavations at Altun Ha, Belize, 1964-1970*, v. 2. Royal Ontario Museum, Toronto.
1982b Ancient Maya Mercury. *Science* 217(4559):533-535.

Pillsbury, Joanne
1996 The Thorny Oyster and the Origins of Empire: Implications of Recently Uncovered *Spondylus* Imagery from Chan Chan, Peru. *Latin American Antiquity* 7(4):313-340.

Pires-Ferreira, Jane Wheeler
1978 Shell Exchange Networks in Formative Mesoamerica. In *Cultural Continuity in Mesoamerica*, edited by David L. Browman, pp. 79-100. Mouton Publishers, Chicago.

Pincemin, Sophia, Joyce Marcus, Lynda Florey Folan, William J. Folan, María del Rosario Domínguez Carrasco, and Abel Morales López
1998 Extending the Calakmul Dynasty Back in Time: A New Stela from a Maya Capital in Campeche, Mexico. *Latin American Antiquity* 9(4):310-327.

Plesters, Joyce
1956 Cross-sections and Chemical Analysis of Paint Samples. *Conservation* 2(3):110-157.

Pohl, John M. D.
2005 The Arroyo Group Lintel Painting at Mitla, Oaxaca. In *Painted Books and Indigenous Knowledge in Mesoamerica: Manuscript Studies in Honor of Mary Elizabeth Smith*, edited by Elizabeth H. Boone, pp. 109-127. Publication 69. Middle American Research Institute, Tulane University, New Orleans.

Pohl, Mary D.
1983 Maya Ritual Faunas: Vertebrate Remains from Burials, Caches, Caves, and Cenotes in the Maya Lowlands. In *Civilization in the Ancient Americas: Essays in Honor of Gordon R. Willey*, edited by Richard M. Leventhal and Alan L. Kolata, pp. 55-103. Peabody Museum of Archaeology and Ethnology, Harvard University; University of New Mexico Press, Albuquerque.

Powis, Terry G., Fred Valdez, Jr., Thomas R. Hester, W. Jeffrey Hurst, and Stanley M. Tarka, Jr.
2002 Spouted Vessels and Cacao Use among the Preclassic Maya. *Latin American Antiquity* 13(1):85-106.

Pring, Duncan C.
2000 *The Protoclassic in the Maya Lowlands*. BAR International Series 908. British Archaeological Reports, Oxford.

Redfield, Robert, and Alfonso Villa Rojas
1934 *Chan Kom: A Maya Village*. Publication 448. Carnegie Institution of Washington, Washington, D.C.

Rich, Michelle E.
2011 Ritual, Royalty, and Classic Period Politics: The Archaeology of the Mirador Group at El Perú-Waka', Petén, Guatemala. Ph.D. dissertation, Department of Anthropology, Southern Methodist University, Dallas.

Ricketson, Oliver G., Jr., and Edith B. Ricketson
1937 *Uaxactun, Guatemala: Group E, 1926-1931*. Publication 477. Carnegie Institution of Washington, Washington, D.C.

Riese, Berthold
1984 Hel Hieroglyphs. In *Phoneticism in Mayan Hieroglyphic Writing*, edited by John S. Justeson and Lyle Campbell, pp. 263-286. Institute for Mesoamerican Studies Publication 9. State University of New York at Albany.

Robertson, John, Stephen Houston, Marc Zender, and David Stuart
2007 *Universals and the Logic of the Material Implication: A Case Study from Maya Hieroglyphic Writing*. Research Reports on Ancient Maya Writing 62. Electronic document, http://repositories.lib.utexas.edu/handle/2152/17706.

Robertson, Merle G.
1991 *The Sculpture of Palenque, Volume IV: The Cross Group, the North Group, the Olvidado, and Other Pieces*. Princeton University Press, Princeton.

Rochette, Erick T.
2009 The Late Classic Organization of Jade Artifact Production in the Middle Motagua Valley, Zacapa, Guatemala. Ph.D. dissertation, Department of Anthropology, Pennsylvania State University, University Park.

Román Ramírez, Edwin
2011 Living the Sacred Landscape: The Process of Abandonment of the Early Classic Maya Group of El Diablo at El Zotz, Peten, Guatemala. M.A. thesis, Department of Latin American Studies, University of Texas at Austin.

Román, Edwin, Heather Hurst, Karl Taube, David Stuart, and William Saturno
2006 Nuevos hallazgos arquitectónicos y pictóricos en la Pirámide Las Pinturas, San Bartolo, Petén. In *XIX Simposio de Investigaciones Arqueológicas en Guatemala, 2005*, edited by Juan Pedro Laporte, Bárbara Arroyo, and Héctor E. Mejía, v. 2, pp. 571-578. Ministerio de Cultura y Deportes; Instituto de Antropología e Historia; Asociación Tikal; Fundación Arqueológica del Nuevo Mundo, Guatemala.
2009 Estructuras ceremoniales del periodo Preclásico: Ixim, un ejemplo de ello. In *XXII Simposio de Investigaciones Arqueológicas en Guatemala, 2008*, edited by Juan Pedro Laporte, Bárbara Arroyo, and Héctor E. Mejía, v. 2, pp. 1253-1265. Ministerio de Cultura y Deportes; Instituto de Antropología e Historia; Asociación Tikal, Guatemala.

Román, Edwin, and Sarah Newman
2011 Excavaciones en el Grupo El Diablo (Operación 5). In Proyecto Arqueológico "El Zotz," informe no. 5, temporada 2010, edited by Jose Luis Garrido López, Stephen Houston, and Edwin Román, pp. 117-162. Report submitted to the Dirección General del Patrimonio Cultural y Natural de Guatemala.

Romero Molina, Javier
1986 *Catálogo de la colección de dientes mutilados prehispánicos, IV parte*. Colección Fuentes. Instituto Nacional de Antropología e Historia, Mexico.

Ruz Lhuillier, Alberto
1968 *Costumbres funerarias de los antiguos mayas*. Universidad Nacional Autónoma de México, Mexico.

Sahagún, Bernardino de
1950-1982 *Florentine Codex: General History of the Things of New Spain. Translated from the Aztec into English, with Notes and Illustrations by Arthur J. O. Anderson and Charles E. Dibble*. 12 vols. School of American Research Press; University of Utah, Santa Fe.

Saturno, William, Karl A. Taube, and David Stuart
2005 *The Murals of San Bartolo, El Petén, Guatemala, Part I: The North Wall*. Ancient America 7. Center for Ancient American Studies, Barnardsville, NC.

Saunders, Nicholas J.
1988 Anthropological Reflections on Archaeological Mirrors. In *Recent Studies in Pre-Columbian Archaeology*, edited by Nicholas J. Saunders and Olivier de Montmollin, pp. 1-39. BAR International Series 421. British Archaeological Reports, Oxford.

Sax, Margaret, Nigel D. Meeks, and Dominque Collon
2000 The Introduction of the Lapidary Engraving Wheel in Mesopotamia. *Antiquity* 74(284):380-387.

Schele, Linda
1992 The Founders of Lineages at Copan and Other Maya Sites. *Ancient Mesoamerica* 3(1):135-144.

Schele, Linda, and Mary Ellen Miller
1986 *The Blood of Kings: Dynasty and Ritual in Maya Art*. Braziller; Kimbell Art Museum, Fort Worth.

Scott, David A., M. Newman, M. Schilling, M. Derrick, and H. P. Khanjian
1996 Blood as a Binding Medium in a Chumash Indian Pigment Cake. *Archaeometry* 38(1):103-112.

Schmidt, Christopher W., and Steven A. Symes, eds.
2008 *The Analysis of Burned Human Remains*. Academic Press, Oxford.

Sempowski, Martha L., and Michael W. Spence
1994 *Mortuary Practices and Skeletal Remains at Teotihuacan*. Urbanization at Teotihuacan, Mexico 3. University of Utah Press, Salt Lake City.

Sharer, Robert J., David W. Sedat, Loa P. Traxler, Julia C. Miller, and Ellen E. Bell
2005 Early Classic Royal Power in Copan: The Origins and Development of the Acropolis (ca. A.D. 250-600). In *Copán: The History of an Ancient Maya Kingdom*, edited by E. Wyllys Andrews, and William L. Fash, pp. 139-199. School of American Research Press, Santa Fe.

Sievert, April K.
1990 Postclassic Maya Ritual Behavior: Regional Microwear Analysis of Stone Tools from Ceremonial Contexts. In *The Interpretative Possibilities of Microwear Studies*, edited by Bo Gräslund, Helena Knutsson, Kjel Knutsson, and Jaqueline Taffinder, pp. 147-158. AUN 14. Societas Archaeologica Upsaliensis, Uppsala.
1992 *Maya Ceremonial Specialization: Lithic Tools from the Sacred Cenote at Chichén Itzá, Yucatán*. Prehistory Press, Madison.

Smith, Alfred Ledyard
1950 *Uaxactun, Guatemala: Excavations of 1931-1937*. Publication 588. Carnegie Institute of Washington, Washington, D.C.

Smith, B. Holly
1991 Standards of Human Tooth Formation and Dental Age Assessment. In *Advances in Dental Anthropology*, edited by Mark A. Kelley and Clark S. Larsen, pp. 143-168. Wiley, New York. Available: http://deepblue.lib.umich.edu/handle/2027.42/90867.

Smith, Robert E.
1955 *Ceramic Sequence at Uaxactun, Guatemala*. 2 vols. Publication 20. Middle American Research Institute, Tulane University, New Orleans.

Smith, Robert E., and James C. Gifford
1966 Maya Ceramic Varieties, Types, and Wares at Uaxactun: Supplement to "Ceramic Sequence at Uaxactun, Guatemala." Preprint of *Middle American Research Records* 3:125-174. Publication 28. Middle American Research Institute, Tulane University, New Orleans.

Stemp, William J.
2001 *Chipped Stone Tool Use in the Maya Coastal Economies of Marco Gonzalez and San Pedro, Ambergris Caye, Belize*. BAR International Series 935. British Archaeological Reports, Oxford.
2004 Maya Coastal Subsistence and Craft-Production at San Pedro, Ambergris Caye, Belize: The Lithic Use-Wear Evidence. *Lithic Technology* 29(1):33-73.

Stemp, William J., Christophe G. B. Helmke, and Jaime J. Awe
2010 Evidence for Maya Household Subsistence and Domestic Activities: Use-Wear Analysis of the Chipped Chert Assemblage from Pook's Hill, Belize. *Journal of Field Archaeology* 35(2):217-234.

Stuart, David
1988 Blood Symbolism in Maya Iconography. In *Maya Iconography*, edited by Elizabeth P. Benson and Gillett G. Griffin, pp. 175-221. Princeton University Press, Princeton.
2006 *Sourcebook for the 30th Maya Meetings, March 14-19, 2006*. Mesoamerican Center; Department of Art and Art History, University of Texas, Austin.
2007 Old Notes on the Possible ITZAM Sign. *Maya Decipherment*: decipherment.wordpress.com/2007/09/29/old-notes-on-the-possible-itzam-sign.
2010 Shining Stones: Observations on the Ritual Meaning of Early Maya Stelae. In *The Place of Stone Monuments: Context, Use, and Meaning in Mesoamerica's Preclassic Transition*, edited by Julia Guernsey, John E. Clark, and Barbara Arroyo, pp. 283-340. Dumbarton Oaks, Washington, D.C.

Stuart, David, and George Stuart
2008 *Palenque: Eternal City of the Maya*. Thames and Hudson, New York.

Suzuki, Isamu
2001 Microbial Leaching of Metals from Sulfide Minerals. *Biotechnology Advances* 19(2):119-132.

Syms, Steven A., Christopher W. Rainwater, Erin N. Chapman, Desina Rachael Gipson, and Andrea L. Piper
2008 Patterned Thermal Destruction of Human Remains in a Forensic Setting. In *The Analysis of Burned Human Remains*, edited by Christopher W. Schmidt and Steven A. Symes, pp. 15-54. Academic Press, London.

Taschek, Jennifer T., and Joseph W. Ball
1999 Las Ruinas de Arenal: Preliminary Report on a Subregional Major Center in the Western Belize Valley (1991-1992 Excavations). *Ancient Mesoamerica* 10(2):215-235.

Taube, Karl A.
1988 A Study of Classic Maya Scaffold Sacrifice. In *Maya Iconography*, edited by Elizabeth P. Benson and Gillett G. Griffin, pp. 331-351. Princeton University Press, Princeton.
1989 The Maize Tamale in Classic Maya Diet, Epigraphy, and Art. *American Antiquity* 54(1):31-51.
1993a *Aztec and Maya Myths*. University of Texas Press, Austin.
1993b The Iconography of Mirrors at Teotihuacan. In *Art, Ideology, and the City of Teotihuacan*, edited by Janet C. Berlo, pp. 169-204. Dumbarton Oaks, Washington, D.C.
1998 The Jade Hearth: Centrality, Rulership, and the Classic Maya Temple. In *Function and Meaning in Classic Maya Architecture*, edited by Stephen D. Houston, pp. 427-478. Dumbarton Oaks, Washington, D.C.
2000 *The Writing System of Ancient Teotihuacan*. Ancient America 1. Center for Ancient American Studies, Barnardsville, NC.
2003a Ancient and Contemporary Maya Conceptions about Field and Forest. In *The Lowland Maya Area: Three Millennia at the Human-Wildland Interface*, edited by Arturo Gómez-Pompa, Michael F. Allen, Scott L. Fedick, and Juan J. Jiménez-Osornio, pp. 461-492. Food Products Press, New York.
2003b Maws of Heaven and Hell: The Symbolism of the Centipede and Serpent in Classic Maya Religion. In *Antropología de la eternidad: la muerte en la cultura maya*, edited by Andrés Ciudad Ruiz, Mario Humberto Ruz Sosa, and María Josefa Iglesias Ponce de León, pp. 405-442. Sociedad Española de Estudios Mayas, Madrid.
2004a Structure 10L-16 and Its Early Classic Antecedents: Fire and the Evocation and Resurrection of K'inich Yax K'uk' Mo'. In *Understanding Early Classic Copan*, edited by Ellen E. Bell, Marcello A. Canuto, and Robert J. Sharer, pp. 265-295. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.
2004b Flower Mountain: Concepts of Life, Beauty and Paradise among the Classic Maya. *Res: Anthropology and Aesthetics* 45:69-98.
2005 The Symbolism of Jade in Classic Maya Religion. *Ancient Mesoamerica* 16(1):23-50.
2010 Where Earth and Sky Meet: The Sea in Ancient and Contemporary Maya Cosmology. In *Fiery Pool: The Maya and the Mythic Sea*, edited by Daniel Finamore and Stephen D. Houston, pp. 202-219. Peabody Essex Museum; Yale University Press, New Haven.
2011 Iconographie du monde maya ancien. In *Maya de l'aube au crépuscule: Collections nationales du Guatemala*, pp. 50-57. Musée du quai Branly, Paris.
2013 The Classic Maya Temple: Centrality, Cosmology and Sacred Geography in Ancient Mesoamerica. In *Heaven on Earth: Temples, Ritual and Cosmic Symbolism in the Ancient World*, edited by Deena Ragavan, pp. 89-125. Oriental Institute, University of Chicago.

Taube, Karl, and Stephen Houston
2010 Lidded Bowl with the Iguana-Jaguar Eviscerating Humans. In *Fiery Pool: The Maya and the Mythic Sea*, edited by Daniel Finamore and Stephen D. Houston, pp. 250-253. Peabody Essex Museum; Yale University Press, New Haven.

Taube, Karl A., and Reiko Ishihara-Brito
2012 From Stone to Jewel. In *Ancient Maya Art at Dumbarton Oaks*, edited by Joanne Pillsbury, Miriam Doutriaux, Reiko Ishihara-Brito, and Alexandre Tokovinine, pp. 134-153. Dumbarton Oaks, Washington, D.C.

Taube, Karl, William Saturno, David Stuart, and Heather Hurst
2010 *The Murals of San Bartolo, El Petén, Guatemala, Part 2: The West Wall*. Ancient America 10. Boundary End Archaeology Research Center, Barnardsville, NC.

Than, Ker
2013 Giant Maya Carvings Found in Guatemala. *National Geographic Daily News*: news.nationalgeographic.com/news/2013/08/pictures/130807-maya-frieze-discovered-holmul-guatemala-archaeology.

Tiesler Blos, Vera
1998 *La costumbre de la deformación cefálica entre los antiguos mayas. Aspectos morfológicos y culturales*. Instituto Nacional de Antropología e Historia, Mexico.

Turner, Christy G., II, C. R. Nichol, and G. Richard Scott
1991 Scoring Procedures for Key Morphological Traits of the Permanent Dentition: The Arizona State University Dental Anthropology System. In *Advances in Dental Anthropology*, edited by Mark A. Kelley and Clark S. Larsen, pp. 13-31. Wiley, New York.

Ubelaker, Douglas H.
1999 *Human Skeletal Remains: Excavation, Analysis, and Interpretation*. 3rd ed. Taraxacum, Washington, D.C.

Valdés, Juan Antonio
2005 El Grupo A: nacimiento y ocaso de la Plaza Este. In *El periodo Clásico Temprano en Uaxactún, Guatemala*, edited by Juan Antonio Valdés, pp. 27-68. Instituto de Investigaciones Antropológicas y Arqueológicas, Universidad de San Carlos, Guatemala.

Valdés, Juan Antonio, and Federico Fahsen
1995 The Reigning Dynasty of Uaxactun during the Early Classic: The Rulers and the Ruled. *Ancient Mesoamerica* 6(2):197-220.

Valdés, Juan Antonio, Federico Fahsen, and Gaspar Muñoz Cosme
1997 *Estela 40 de Tikal. Hallazgo y lectura*. Instituto de Antropología e Historia de Guatemala, Guatemala.

Vasanthakumar, Archana, Alice DeAraujo, Joy Mazurek, Michael Schilling, and Ralph Mitchell
2013 Microbiological Survey for Analysis of the Brown Spots on the Walls of the Tomb of King Tutankhamun. *International Biodeterioration & Biodegradation* 79:56-63.

Vaughan, Patrick
1985 *Use-Wear Analysis of Flaked Stone Tools*. University of Arizona Press, Tucson.

Vázquez de Agredos Pascual, María Luisa
2007 Los colores y las técnicas de la pintura mural maya. *Proceedings of the Anales del Museo de América* 15:55-66.

Von Winning, Hasso
1987 *La iconografía de Teotihuacán. Los dioses y los signos*. Universidad Nacional Autónoma de México, Mexico.

Walsh, Jane MacLaren
2008 The Dumbarton Oaks Tlazolteotl: Looking Beneath the Surface. *Journal de la Société des Américanistes* 94(1):7-43. Available: http://jsa.revues.org/8623.

Wagner-Döbler, Irene
2003 Pilot Plant for Bioremediation of Mercury-Containing Industrial Wastewater. *Applied Microbiology and Biotechnology* 62(2-3):124-133.

Watanabe, John M.
1992 *Maya Saints and Souls in a Changing World*. University of Texas Press, Austin.

Welsh, W. Bruce M.
1988 *An Analysis of Classic Lowland Maya Burials*. BAR International Series 409. British Archaeological Reports, Oxford.

Wisdom, Charles
1950 Materials on the Chorti Language. Microfilm Collection of Manuscripts on Middle American Cultural Anthropology 28. University of Chicago Library, Chicago. Available: www.utexas.edu/courses/stross/chorti/.

Wright, Lori E.
2005 In Search of Yax Nuun Ayiin I: Revisiting the Tikal Project's Burial 10. *Ancient Mesoamerica* 16(1):89-100.

Wright, Lori E., Juan Antonio Valdés, James H. Burton, T. Douglas Price, and Henry P. Schwarcz
2010 The Children of Kaminaljuyu: Isotopic Insight into Diet and Long Distance Interaction in Mesoamerica. *Journal of Anthropological Archaeology* 29(2):155-178.

Yadeun, Juan
1993 *Toniná*. El Equilibrista, Mexico.