Photo: Ken Garrett.

Photo: Ricardo Agurcia F.

Monograph 2

PROTECTING SACRED SPACE

Rosalila's Eccentric Chert Cache at Copan and Eccentrics among the Classic Maya

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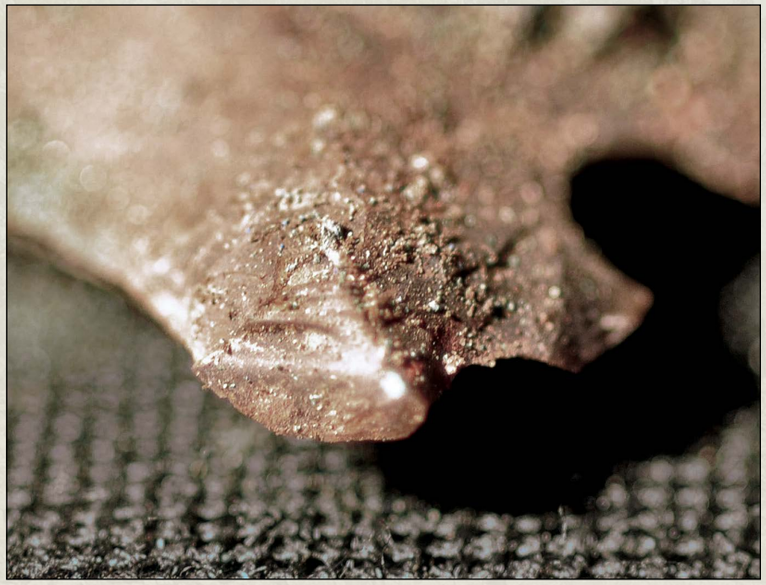

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Contents

Figure 1. Artifact 90-7, an eccentric from the Rosalila cache. Photo: Ken Garrett.

Introduction

"Eccentric flints" have been the focus of research among Maya scholars for close to a century. Unfortunately, most elaborate eccentrics in museums and private collections were looted and thus are lacking in information about their archaeological context and dating. Furthermore, most have been washed and have lost a great deal of information regarding their use, deposition, and surface treatment, including painting and wrapping. Therefore most remain as intricately elaborate, enigmatic artifacts, with their meaning, iconography, and objectives of manufacture and placement forever hidden from scholarship.

This study focuses on a cache of nine eccentrics and three bifaces placed within the Rosalila structure at Copan, Honduras, and excavated by Ricardo Agurcia Fasquelle in 1990 (Figure 1). In late 2011, Payson Sheets visited Agurcia Fasquelle at his laboratory and they reviewed the cache and agreed upon the need for a more detailed study and publication of the cache and its contents. As plans for this project evolved over the next months, it became evident that the eccentrics were also complex representations of Maya art and that the incorporation of a scholar with extensive experience in Mesoamerican iconography would greatly enrich this study. Both agreed that Karl Taube was the ideal candidate for this avenue of research, and he was invited to join. With Karl's addition, a better-rounded multidisciplinary team came into being to focus on the who, when, where, what, and why of this exceptional deposit. Significant contributions to understanding the eccentrics and other elements of the cache were also made by a number of other experts. They include Randolph J. Widmer, Linda Brown, Kitty Emery, and Irv Quitmyer in faunal analysis; Margaret Ordoñez and Harriet Beaubien in textile analysis; Sean Ulm in shell identification and dating; and Alexandre Tokovinine in 3D scanning. Taking advantage of the tightly controlled excavation data available for this cache, it was hoped that a thorough study of its context, physical attributes, and symbolism would lead to a better understanding of the use and meaning not just of this cache specifically, but of many other complex eccentrics in the Maya area.

In the preparation of this publication, each researcher has accepted primary responsibilities for different sections: Agurcia Fasquelle documenting the context of Copan and its acropolis, the Rosalila structure, and the cache; Karl Taube providing the interpretive iconographic context of elaborate eccentrics in Mesoamerica in general and of these nine eccentrics from the cache in particular; and Payson Sheets focusing on the manufacturing techniques required for the creation of the nine eccentrics and three bifaces. The nine are the largest and most elaborate set of eccentrics ever excavated in the Maya area, and because they required extraordinary skill, indicting their unusual importance, their manufacture is considered here in detail. Because the cache was carefully excavated, it presents an unusual interpretive opportunity.

Ancient Maya elites protected sacred space by placing temples on top of high pyramids, restricting access to special zones in acropolises, and hiding tombs with the remains of their revered ancestors beneath ponderous architec-

ture. To these we propose to add eccentrics, the elaborately fashioned, flaked lithics imbued with spiritual power, cached to protect particularly sacred space for time immemorial.

The very material from which they were made had inherent spiritual power, because Mesoamericans believed that obsidian and chert were created by lightning striking the ground. That ancient pervasive belief continues today, as obsidian is commonly called "*piedra de rayo*" throughout Mesoamerica. The inherent religious force of chipped stone was greatly enhanced at Copan by fashioning K'awiil heads with smoking celts into the pieces, as well as Chahk symbols, serpent bodies, maize god heads, and lightning symbols, and then placing them in proactive caches to initiate their protective functioning. They were painted red and then carefully wrapped with multiple layers of plain and painted textiles, creating a sacred bundle of great supernatural significance. Especially important is the deity K'awiil: as the lightning weapon of the rain god Chahk and a supernatural protector in Classic-period Maya belief, his incorporation into the eccentric weapon gave it immense power.

The Classic Maya dynasty at Copan was founded in AD 427 with the arrival of the king K'inich Yax K'uk' Mo', a "foreigner" who may well have come from the central Peten. His apparent tomb is deep below the Rosalila structure, and all Copan royalty since his demise celebrated his initiation of the dynasty and its successful continuation. Rosalila was the most elaborate architectural celebration of kingship at Copan (Sharer et al. 1999; Stuart 2000; Bell et al. 2004). It was built in the late sixth century AD and functioned until it was carefully entombed in the early-to-middle eighth century. Its decoration in polychrome, deep stucco relief featured the sun god K'inich Ajaw along with direct references to K'inich Yax K'uk' Mo' as the sun god. The structure was so esteemed that it was painted white and then systematically entombed in its entirety. It thus violated the common Classic Maya custom at Copan of razing a building before building its successor. A critical part of the burial of the structure involved the placing of a cache of chert eccentrics and bifaces in its interior. The cache also included stingray spines, fish vertebrae, animal bones, and a jade bead. Presumably it was intended to be a powerful cosmogram embodying the primordial ocean below, the earth, and the heavens above.

The following sections explore the intricate symbolism of Maya eccentrics, the context of the cache of eccentrics with its diverse artifacts in the Rosalila structure of the Copan acropolis, and the sophisticated manufacturing techniques used in the production of the nine eccentrics and the three bifaces.

As our analysis bears out, the eccentric cherts were ritual weapons of enormous religious power designed to protect the hallowed spaces of Rosalila and the Hieroglyphic Stairway of the Copan Acropolis. They were the most delicate of fighting instruments, created by masters of lithic technology in exotic forms that while denoting major, powerful deities never lost their basic modality as a weapon. They were made specifically to be buried and have no signs of wear to indicate otherwise. Placed in critical locations of special buildings, their primary role was in the spiritual world.

The Symbolism of Eccentrics in Classic Maya Religion

One of the most striking and enigmatic objects of the Classic Maya are "eccentrics"—non-utilitarian artifacts of chipped stone varying from simple modified flakes to elaborately worked, multi-headed pieces featuring exquisitely fine indirect percussion and pressure flaking, as is the case of the nine examples from the Rosalila offering at Copan. Although best known from the Late Classic period (AD 600–900), eccentrics appear as early as roughly the first century BC. Bearing a Long Count date of AD 37, Stela 1 from El Baúl, Guatemala, features a standing ruler wielding a short spear or knife with an undulating blade, quite unlike typical bilaterally symmetrical points known from the Late Preclassic Maya (Figure 2a). Similar Late Preclassic examples appear on monuments from Takalik Abaj. On Stela 2, a celestial sun god holds a writhing serpent with an undulating blade protruding from its brow (Figure 2b, c). Stela 5 features two standing rulers, one holding a serpent with the tail tipped by a head displaying a curving blade and the other carrying an apparently infant form of K'awiil, a deity of lightning to be subsequently discussed in detail (Figure 2d, e). As will be noted, both serpents and eccentrics were basic symbols of lightning among the ancient Maya.

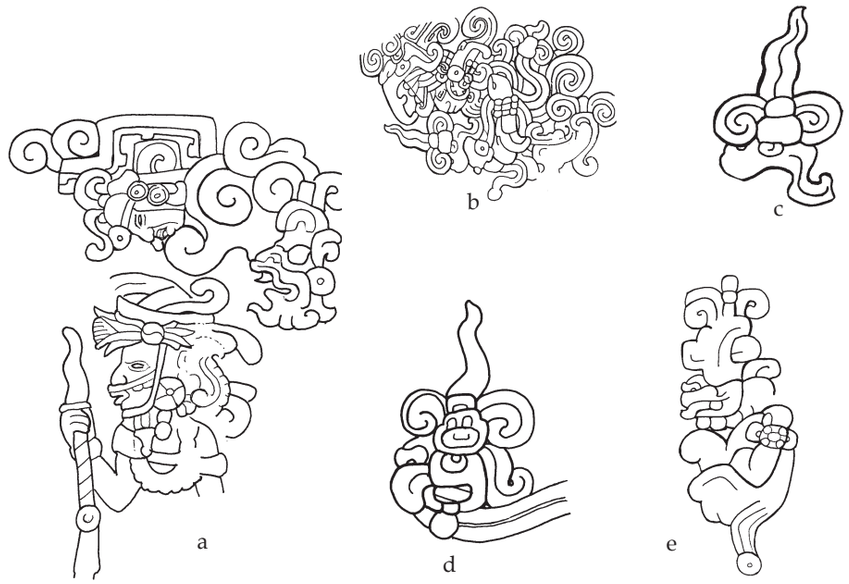

Figure 2. Late Preclassic portrayals of eccentrics and lightning symbolism: (a) ruler wielding weapon with undulating eccentric blade, note Chahk head in sky above, El Baúl Stela 1 (after Schele and Miller 1986:Fig. 8); (b) sun deity grasping snake with eccentric blade atop head, Takalik Abaj Stela 2 (from Taube 1992:Fig. 23a); (c) detail of serpent head from Takalik Abaj Stela 2; (d) serpent with undulating blade on brow, Takalik Abaj Stela 5 (after drawing courtesy of James Porter); (e) K'awiil held in arm of ruler, Takalik Abaj Stela 5 (after drawing courtesy of James Porter). Drawings in Figures 2–17 by Karl Taube unless otherwise indicated.

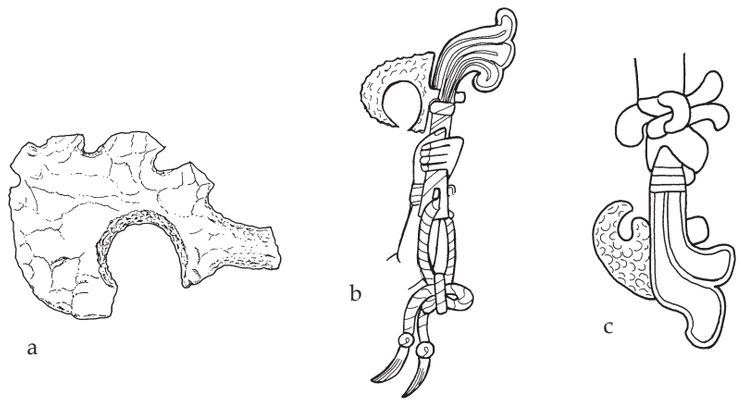

Figure 3. Eccentric axe blades from Kaminaljuyu: (a) eccentric chert from Tomb 1, Mound E-III-3 (after Shook and Kidder 1952:Fig. 79c); (b) portrayal of axe with eccentric blade, Stela 10 (after Parsons 1986:Fig. 175); (c) axe with eccentric blade, Stela 9 (after Fields and Reents-Budet 2005:No. 6).

Roughly contemporaneous with the El Baúl and Takalik Abaj monuments, Kaminaljuyu Stela 10 (Figure 3b) depicts a Late Preclassic deity wielding an axe with an impossibly delicate blade for chopping—the central part hollowed through flaking to create a lunate form with oblique notching on the back side (see Figure 3a). The ruler on Kaminaljuyu Stela 9 grasps a very similar weapon on a monument also dating to the Late Preclassic (Figure 3c). In both cases, the blade is carefully rendered with flaking over its surface, a convention not found with subsequent Classic depictions of bifacially worked stone axes, points, or blades, suggesting the importance of these unusually worked pieces at Kaminaljuyu. Excavations in Mound E-III-3 at the same site uncovered a chert axe head of this very form from Tomb I, and when this discovery was first published it was referred to as an "eccentric flint" (see Shook and Kidder 1952:112) (Figure 3a), that is, a lithic artifact that cannot be used as a functional tool or weapon. Nonetheless, eccentrics of chipped stone are symbolic weapons and commonly have stems as if to be hafted or hand-held, including examples from the Rosalila offering as well as the Kaminaljuyu axe heads. However, rather than only being "symbolic" arms for battle, eccentrics constituted *supernatural* weapons to ward against negative spiritual forces and to protect sacred spaces.

The Stones: Chert and Obsidian

Ancient Maya eccentrics are of two very different types of stone, one being chert (often referred to as "flint"), which is formed in sedimentary beds of limestone, while the other, black obsidian, is a volcanic glass.[1] In comparison to the chert examples from Rosalila, obsidian eccentrics tend to have far simpler outlines,

[1] For a recent discussion of the symbolism of chert and obsidian in Maya thought see Houston 2014:23-27.

perhaps in part because the stone is far more brittle. However, contemporary knappers replicating ancient stone-working generally prefer working obsidian rather that chert for "eccentric" forms, as the material is more responsive and they are more used to its fracture properties. That said, it remains to be seen whether chert eccentrics on the scale of the Rosalila examples can be readily fashioned today. Somewhere in the Maya area knappers discovered a source of tabular chert and used it to fashion these eccentrics. The source is unknown to us today; it could have been somewhere in the Copan area, or in the Maya lowlands. In this study, we will note that in Classic Maya thought the ontology of obsidian and chert was sharply different, with obsidian being related to Teotihuacan, darkness, and the west, and chert solidly with the eastern Maya realm of the dawning sun.

Chert throughout the lowland Maya area predominantly occurs in nodules, and manufacture of tools was by shaping the nodule into a core and then producing large flakes and blades by percussion blows. Such flakes and blades have a longitudinal curvature that can be eliminated by continued flaking in making artifacts smaller and simpler than these eccentrics. However, it is simply not possible to have made the Rosalila eccentrics from nodular chert. The Copanec Maya were fortunate to have encountered a source of chert that was tabular instead of nodular. Although rare, tabular chert is known in a few other areas of the world, and there is at least one and, we think, two sources that Copanec Maya used, based on visual examination of the colors and microgranularity of the chert. All but one of the bifaces, and all of the eccentrics, appear to have been made from the same source of tabular chert, as they share the same color and grain. The exception is the large biface, which was made from a more white and lustrous chert that presumably came from a different source. See Appendix A for details of each artifact. Thus the knapping starts with a slab of chert that is not much thicker than the finished eccentric.

Although relatively small in size and plain in outline, obsidian eccentrics often have incised images of deities, celestial signs, and other motifs, as seen in examples from Uaxactun, Tikal, and Piedras Negras (Joyce 1932; Kidder 1947; Coe 1959, 1965). Although there are no known examples of incised chert eccentrics, recent research demonstrates that examples from Piedras Negras were *painted* with images similar to those found on incised obsidian eccentrics (Hruby and Ware 2009). The eccentrics from Rosalila were also painted, but not with any designs or images that have been detected. However, while other archaeologically excavated or looted chert eccentrics may have had the ancient paint scrubbed during cleaning, this is by no means the case with the Rosalila examples, which were carefully handled from the moment of excavation to preserve the remnants of textiles and cinnabar pigment on their surfaces. It is important to note that the nine Rosalila cherts bear no remnants of painted designs or images, indicating that the symbolic imagery was conveyed by their outlines and not through more detailed imagery on the interior surfaces. In other words, when we approach interpreting the meaning of these complex objects from Copan, we are dealing with a "full deck of cards."

Chert, Obsidian, and Directional Symbolism

Whereas chert commonly has Kawak "stone" markings in Maya art, obsidian is denoted with the Ak'bal sign signifying darkness as well as blackness, a color solidly identified with the west in Maya thought. Possessing sharp edges when broken, both stones were used along with stingray spines as bloodletters in auto-sacrifice. An Early Classic cache vessel lid portrays an offering bowl containing these three types of bloodletting tools, a central vertical stingray spine flanked by an obsidian lancet and an undulating chert blade (Figure 4a). A very similar sacrificial bowl appears in a Late Classic vessel scene, although with a cruciform world tree standing in place of the vertical stingray spine (Figure 4b). Flanking the central stingray spine and world tree, the obsidian and chert blades appear as if in dualistic opposition, and indeed this is the case. The text on the columnar Stela 11 at Copan describes in couplet fashion the Teotihuacan War Serpent, or Waxaklajuun Ubaah Kaan, having eyes of both obsidian (*taaj*) and chert (*took'*) (David Stuart, personal communication 1994) (Figure 4c). In addition, a bowl bearing the name of the sixth-century Tikal king Wak Chan K'awiil portrays a

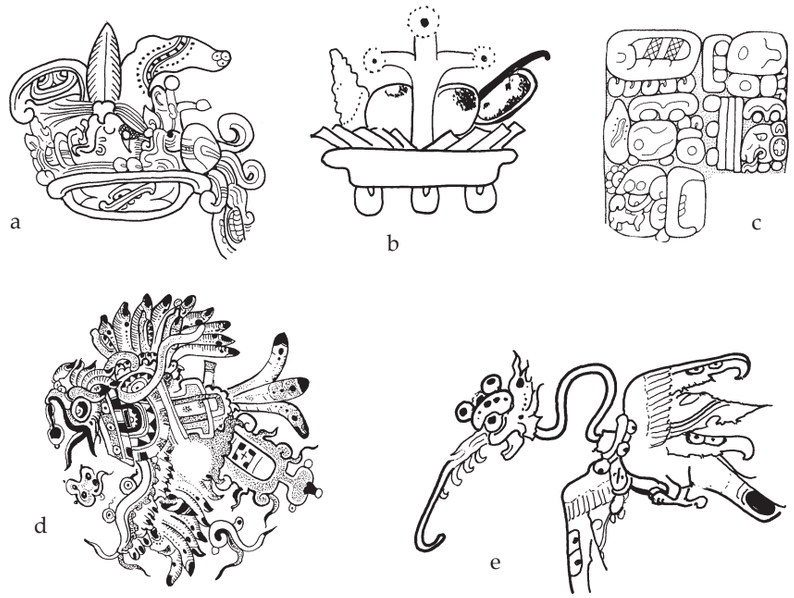

Figure 4. Contrasting pairing of chert and obsidian in Classic Maya art: (a) Early Classic portrayal of offering bowl with stingray spine flanked by obsidian and chert blades (after Schele and Miller 1986:Pl. 75); (b) cruciform tree flanked by chert and obsidian blades, detail of Late Classic vase (after Coe 1989:Fig. 23); (c) detail of Copan Stela 11 text mentioning the obsidian and flint eyes of the War Serpent, Waxaklajuun Ubaah Kaan (detail of drawing by Simon Martin after Martin and Grube 2008:212); (d) Teotihuacan-style owl from Tikal with upper wing having obsidian blade and the lower banded chert (drawing by Simon Martin from Martin and Grube 2008:39); (e) supernatural bird with wings bearing obsidian and chert blades (after Robicsek and Hales 1981:Vessel 53).

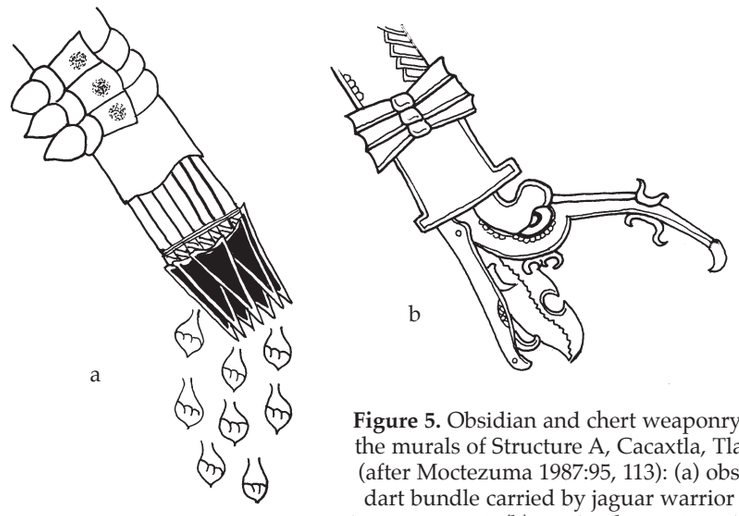

Figure 5. Obsidian and chert weaponry from the murals of Structure A, Cacaxtla, Tlaxcala (after Moctezuma 1987:95, 113): (a) obsidian dart bundle carried by jaguar warrior atop jaguar serpent; (b) centipede scepter with red chert tongue carried by eagle warrior atop quetzal plumed serpent.

flying Teotihuacan-style owl with obsidian blades on one wing and chert on the other (Figure 4d). A Late Classic codex-style vase depicts a supernatural bird with chert and obsidian blades on its wings, although in this case the stones alternate on each wing (Figure 4e). Chert was probably regarded as local stone by Classic lowland Maya, but obsidian was not, and in Maya art, including at the sites of Copan and Piedras Negras, it commonly occurs in the context of Teotihuacan far to the west (Houston 2014:25-26, Fig. 15b).

Rendered in strong Maya style, the murals flanking the doorway of Structure A at Cacaxtla, Tlaxcala, portray two men in animal costume, one dressed as a jaguar and the other an eagle (see Moctezuhma 1987:95, 113). Whereas the feline personage is atop a jaguar serpent, the other dances on the back of a quetzal-plumed serpent, or Quetzalcoatl. Classic Maya iconography features a similar contrast between serpents, one having the head of the "Bearded Dragon," and the other with jaguar attributes (Taube 1994). While the jaguar serpent denotes the night sky and the west, the Bearded Dragon alludes to the diurnal sky and the east, a concept also consistent with the highland Mexican Quetzalcoatl, a preeminently eastern deity that carries the dawning sun as well as being Venus as the morning star (Taube 2010). Both human figures bear weapons, the jaguar individual grasping a bundle of seven darts and the eagle personage holding a Maya-style ceremonial bar with a blade emerging from the mouth of a skeletal centipede (Figure 5). Whereas the dart points are black obsidian, the centipede blade is red chert (i.e., jasper). As in the case of the jaguar and plumed serpents, these two stones allude to distinct regions of Mesoamerica, obsidian being the preeminent tool stone of Central Mexico and chert coming from the Maya lowlands far to the east. In addition, the contrast of these two stones is entirely

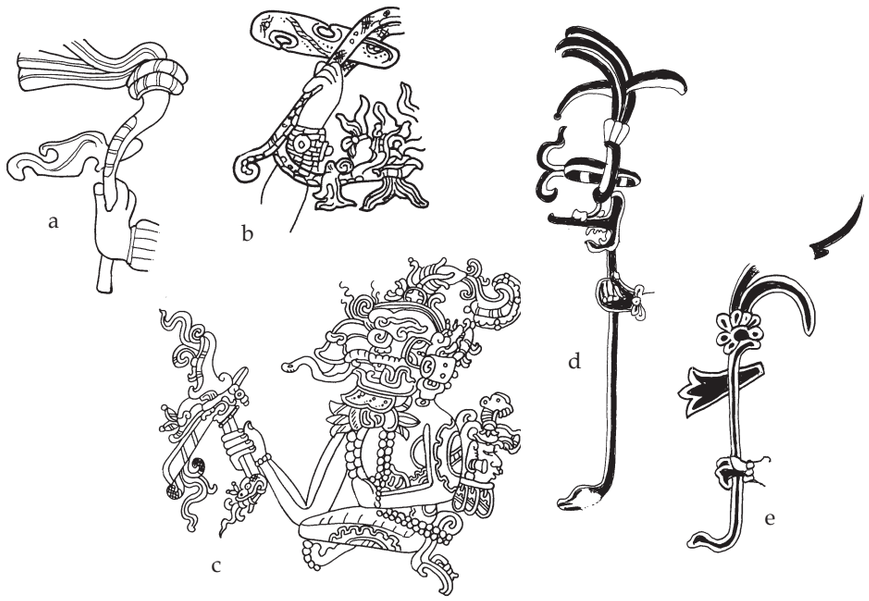

Figure 6. Lightning axes in Classic Maya art: (a) axe with eccentric blade emerging from Chahk headdress, Machaquila Stela 2 (after Graham 1967:Fig. 44); (b) lightning axe with eccentric blade and handle in the form of a serpent with fiery breath, detail of Palenque panel in the collection of Dumbarton Oaks (from Taube 1992:Fig. 6b); (c) Early Classic Chahk with K'awiil lightning axe with fiery blade and serpent breath (from Taube 1992:Fig. 35a); (d) K'awiil lightning axe with burning blade and serpent foot, detail of painted tomb in Temple XX, Palenque (after Robertson 2001:Fig. 3); (e) lighting axe with trefoil eccentric blade and serpent foot, detail of Temple XX tomb, Palenque (after Robertson 2001:Fig. 6).

consistent with Maya color directional symbolism, as red is the color direction for east, and black for west.[2] Along with being well known for the Postclassic Maya codices and the early colonial Yukatek documents, this color direction symbolism was also present among the Classic Maya, as can be seen for the 819-day cycle in Maya texts (Berlin and Kelley 1961).

The relation of obsidian with the west and chert with the east in Classic

[2] Among the Navajo of the American Southwest, particular "precious stones" symbolize world directions and their associated colors, with white shell being the north and white, turquoise the south and blue, abalone the west and yellow, and finally jet for the north and black (Reichard 1950:208-210). Similarly, the Hopi have specific stones and shells oriented to the intercardinal points along with zenith and nadir, all associated with specific colors (see Whiteley 2012:Fig. 4). It is more than likely that the Classic Maya also identified particular hard materials of stone and shell with world directions and colors. As has been mentioned, chert appears to have symbolized the east with the color red whereas obsidian is consistently related to the west and black. Clearly enough, jade was the stone of the world center and color green (*yax*), and David Stuart (2006:131) has noted that the text of a jade pendant excavated at Palenque refers to it as "Green Precious Stone." Much like the Navajo, conch and other white shells may have served for the direction north and its associated color among the Classic Maya. In addition, with its shades of orange and yellow, *Spondylus* may have represented south and the color yellow.

Maya thought suggests a strong relationship of chert to the diurnal sun god, K'inich Ajaw, who rises at dawn every day from the east. Indeed, the favored weapon of the bellicose sun god is a centipede lance tipped with a chert blade as its protruding tongue, the same weapon carried by the eagle warrior from Cacaxtla Structure A (see Taube 2009:Fig. 16b, c) (Figure 5b). A pair of such lances appears on the Tablet of Temple of the Sun at Palenque, a structure dedicated to GIII of the Palenque Triad, that is, the sun god (see Stuart and Stuart 2008:209-210). Copan Stela A portrays Waxaklajuun Ubaah K'awiil holding a ceremonial bar with two sun gods as personified chert blades emerging as the tongues of centipede maws (see Maudslay 1889-1902:1:Pl. 26). In addition, Structure 8N66-C at Copan has sculptural facades featuring solar cartouches of the sun god along with massive eccentric chert blades on the roof (see Fash 2011:170-171) (Figure 7a). This structure faces due west, and although this could be thought of as an allusion to the setting sun, it is quite the reverse. As in the case of Structure 10L-16 and earlier artistic programs of the Copan Axis—including Rosalila—the westward orientation of K'inich Yax K'uk' Mo' as the sun deity denotes the eastern dawning sun: "such western-facing sculptures are not passive, inert objects awaiting the first solar rays but rather are living embodiments of the sun itself traveling from east to west" (Taube 2013:98). In this regard it is important to note that the Rosalila eccentrics were all positioned to face to the west.

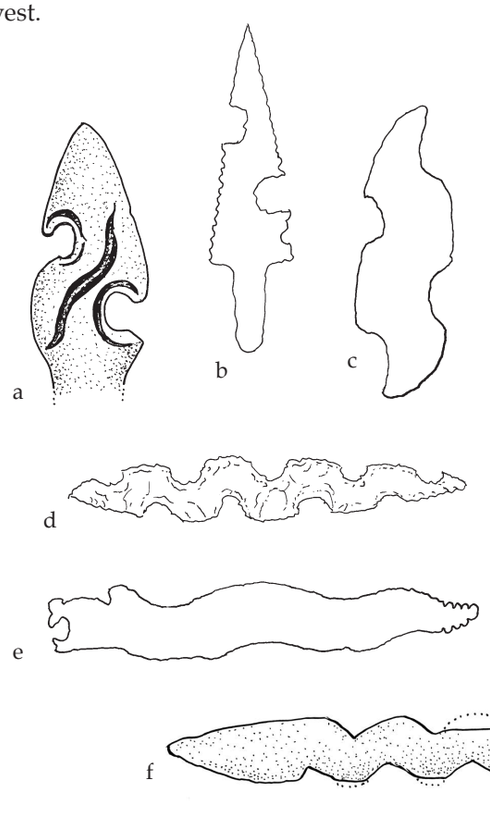

Figure 7. Undulating eccentrics and related objects pertaining to lightning: (a) *almena* sculpture of massive eccentric blade, Structure 8N66-C, Copan (after Fash 2011:Fig. 195); (b) Late Classic Maya chert eccentric blade with undulating indentations (after Robiscek and Hales 1984:Fig. 19a); (c) undulating chert eccentric, Uaxactun (after Kidder 1947:Fig. 68.7); (d) undulating chert eccentric, Altun Ha (after Robicsek and Hales 1984:Fig. 19a); (e) obsidian eccentric as undulating snake, Teotihuacan (after Solís 2010:Fig. 89a); (f) Aztec wooden portrayal of undulating lightning serpent, Nevado de Toluca, State of Mexico (after Guzmán Peredo 1972:62).

Lightning

Aside from the sun, Maya chert had another basic meaning, in this case pertaining to the celestial phenomenon of lightning. Chert axes not only cut wood and cleared the fields for planting, but also were basic symbols of lightning in ancient Mesoamerica and served as weapons of the rain deities, including the Maya Chahk as well as Tlaloc of Central Mexico (Taube 1992:22). Dating to roughly the third century AD, an incised jadeite celt from Kendal, Belize, bears an incised image of Chahk on its blade (see Schele and Miller 1986:Pl. 90). In Classic Maya art and the Late Postclassic Dresden and Madrid codices, Chahk commonly grasps a lightning axe, and on Dresden page 36a, he has an undulating serpent bolt as well (see Taube 1992:Fig. 6a) (Figures 6c, 7a, 9b). At times, the lightning axe head is an eccentric, including one emerging from the center of a Chahk headdress on Machaquila Stela 2 (Figure 6a).

As mentioned for the Dresden page 36a scene, snakes and axes are lightning symbols in Mesoamerica and can appear together as a single weapon. A Late Classic panel at Dumbarton Oaks features the Palenque king K'an Joy Chitam II dancing as Chahk grasping an axe with an eccentric chert blade and a fire-breathing serpent as its handle (Figure 6b). The eccentric axe has a pair of deep indentations on both sides of the blade, a convention also found with the massive *almena* eccentrics atop the roof of Copan Structure 8N-66C (Figure 7a). For both the Palenque and Copan blades, the sharply recessed areas create a sinuous outline, a convention also found with worked Classic Maya eccentrics (Figure 7b–d). Lighting often has an undulating, serpentine form in ancient Mesoamerican art, including Early Classic obsidian rattlesnake eccentrics from Teotihuacan (Figure 7e). Aztec offerings in the lakes atop the Nevado de Toluca west of Mexico City included wood renderings of sinuous lightning bolts (Figure 7f). In addition, an Aztec eccentric chert lightning bolt encrusted with a mosaic of turquoise tesserae and iron pyrite discs was discovered at the Templo Mayor (see Johansson 2012:Fig. 8).

The undulating form of the aforementioned blade from the Late Preclassic El Baúl Stela 1 also relates to lightning symbolism, as its upper portion features the head of Chahk along with a probable ancestor in roiling clouds (Figure 2a). Clearly enough, the blades atop the serpent heads on Takalik Abaj Stelae 2 and 5 are also lightning (Figure 2b, c). Whether by only two alternating indentations or many, the undulating outlines of Classic Maya eccentrics denote lightning, including examples from the Rosalila cache, especially Artifact 90-12 (Figure 8). In addition, these deep marks may symbolically indicate violent blows against the stone, a concept entirely appropriate with bolts of lightning. Being dense, many hammerstones contain traces of iron, causing hot sparks when they strike against chert. Moreover, when lightning strikes beds of sand or soils rich in silica, fulgurites are created—basically "fossilized lightning" when a bolt fuses the silica into natural glass. In other words, both chert and molten obsidian are

Figure 8. Rosalila Artifact 90-12, with an undulating outline denoting lightning. Photo: Ken Garrett.

intrinsically related to concepts of burning shafts of lightning.

A painted eccentric chert flake from Piedras Negras depicts a pointed, undulating motif notably similar to the base of Artifact 90-12 and surely alludes to lightning (see Hruby and Ware 2009:Fig. 11b). Clearly enough, such flakes were created by strongly striking the mother core. Dating to roughly the fourth century AD, an elaborately incised Maya vessel features Chahk holding a burning lightning axe with a serpent handle displaying the head of K'awiil (Figure 6c). The preeminent lightning weapon of Chahk, K'awiil often is an axe with a serpent foot as the handle and a fiery celt or torch in his brow as the symbolic "blade." Two similar serpentine sculptures of K'awiil axes have been published, although they may well be modern forgeries (see Miller and Martin 2004:Pl. 3; Fields and Reents-Budet 2006:177). However, there is a chert eccentric in the form of the K'awiil serpent-footed axe, and given the sheer difficulty of creating this item, it is probably authentic (see Clark et al. 2012a:Fig. 164).

In a watershed study devoted to ancient objects used by contemporary Tz'utujil Maya ritualists in Santiago Atitlan, Guatemala, Linda Brown (2015) marshals a host of evidence documenting ancient artifacts—including chipped obsidian and polished stone celts—as powerful forms of lightning. These are the fossil weapons of the *AchiJab*, or "Rain Men," who protect the community from evil forces by shooting lightning from the surrounding mountains (Brown 2015:58, 63). As noted by Brown (2015:63), "Atitecos understand obsidian to be created from a lightning strike, and, as such, to be a form of materialized lightning." Citing a broad range of sources, Brown notes that this is an extremely widespread concept in ancient and contemporary Mesoamerica, suggesting a tradition of great antiquity, as is also noted by Staller and Stross (2013:173) in a recent study of lightning symbolism in Mesoamerica and the Andes: "Almost everywhere in Mesoamerica, flint and obsidian chips, flakes and cores as well as jade axes are viewed as products and symbols of lightning and the lightning-rain deity."[3]

The widespread concept of certain stones as "fossil lightning" suggests that this is a very ancient tradition in Mesoamerica, and in fact it is also very much present in the nearby American Southwest. As noted by Frank Hamilton Cushing (1883:9) in one of the first ethnographic accounts of Zuni, New Mexico, "lightning is often given the form of a serpent, with or without an arrow tipped tongue."[4] In addition, Cushing mentions that Zuni consider ancient flint points as lightning:

> Although fashioned by man, it is regarded as originally the gift or "flesh" of lightning, as made by the power of lightning. (Cushing 1883:10)

According to Zuni creation mythology, the Ahayuta hero twins transformed animals into stone with lightning, and unusual concretions and other stones encountered by Zuni are treasured as powerful talismans of this mythic

[3] For specific ethnographic examples, see Staller and Stross 2013:175.

[4] For the relation of lightning to serpents in Mesoamerica and the American Southwest, see Schaafsma and Taube 2006:266-267.

event (Cushing 1883:14-15).

Among the Tewa of San Juan, New Mexico, there are the ancestral *xayeh* souls of the four directional altars framing the pueblo and embodied in such items as seashells and fossil bone, as well as ancient stone axes and arrowheads (Ortiz 1969:20, 31). Four days after birth, a pair of *xayeh* quartz crystals are rubbed "to cast lightning" sparks to the world directions to provide rain for the newborn as a sign of cosmic support (Ortiz 1969:31). In addition, four protective household *xayeh* are invoked, the

> *xayeh* which are buried in the four corners of every Tewa home and which are called "life root giving stones." (Ortiz 1969:31)

As will be noted, these buried stones closely resemble ancient Maya "caching" practices, including Classic-period examples from Copan and even earlier ones among Maya commoners at Chan, Belize (Taube 2005, 2012; Robin 2012).

Protective Stones of Castigation

In her study of ritual objects used by contemporary Tz'utujil ritual practitioners, Brown (2015) notes that among many Maya groups, including the Yukatek, Tzotzil, Q'eqchi' and Ch'orti', lightning is a protective weapon against malevolent spiritual forces (see also Spero 1987). Brown also argues that the K'awiil axe (also referred to as the Manikin Scepter) commonly wielded by Classic Maya rulers was a supernatural lightning weapon to protect the community against "denizens from the dark." It is also conceivable that when portrayed on monuments dancing with such weapons, rulers are frozen in position as beings continually creating and guarding sacred space for public ceremonies. In fact, James Porter (1996) noted that Olmec and Classic Maya stelae symbolically constitute great axes, an argument supported by subsequent research (Taube 1996, 2000; Stuart 2010). Of course the best-known "offerings" under Late Classic Maya stelae are eccentrics, surely to energize them and protect them with spiritual force. Brown (2015) suggests that along with K'awiil axes, eccentrics of chert and obsidian bearing images of this deity may have been regarded as protective supernatural weapons, an interpretation applying to the nine from the Rosalila termination offering. Our discussion of the Rosalila offering directly supports Brown's original and illuminating argument, and probably many eccentrics served similar purifying and protective functions when placed under stelae as well as in temples and major burials.

Brown's suggestion of K'awiil as a supernatural protector brings up the matter of the social meaning of such a being *within* communities. Omnipresent and omniscient, K'awiil may be the embodiment of moral rectitude and subsequent punishment, that is, "justice." Among the contemporary Tzotzil Maya, lightning "is said to maintain social order by meting out punishment to transgressors" (Spero 1987:86). Similarly, there is the Tzeltal being known as "Lord of Lightning," who punishes inappropriate behavior with lightning

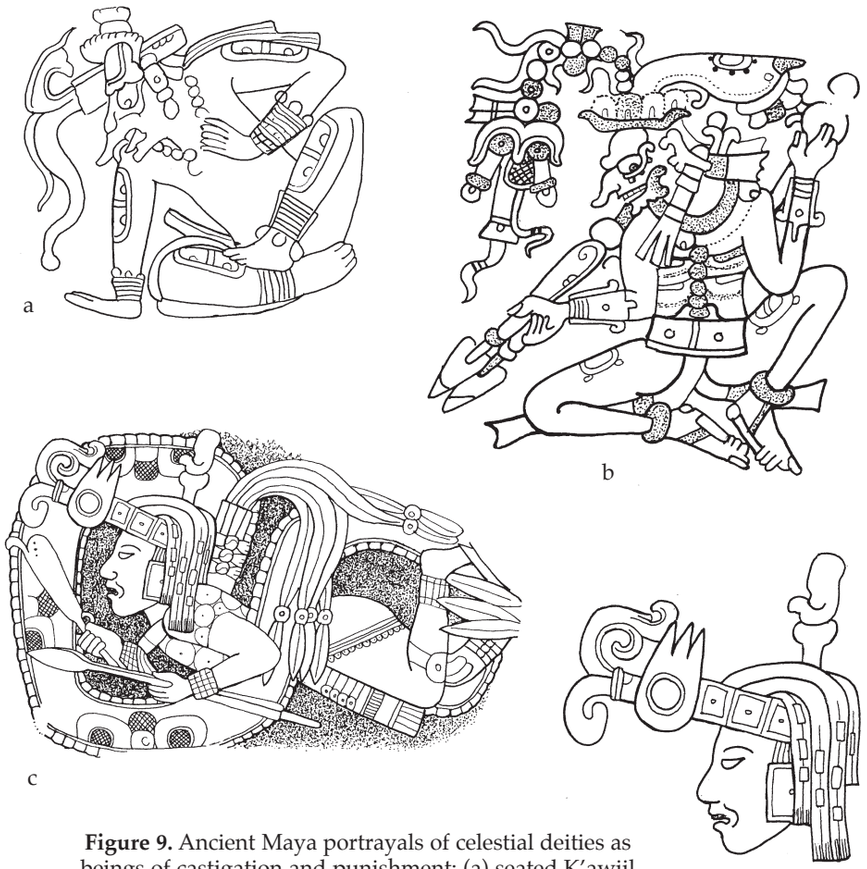

Figure 9. Ancient Maya portrayals of celestial deities as beings of castigation and punishment: (a) seated K'awiil looking downwards, detail of Late Classic incised vase (after Kerr 1997:830 [K6069]); (b) Venus god as morning star with darts and spearthrower, compare pose with K'awiil figure in *a*, Codex Dresden page 47; (c) celestial figure with darts and spearthrower in dark, S-shaped cloud, Ucanal Stela 4 (after Graham 1980:159); (d) detail of celestial figure from Ucanal Stela 4, note smoking eccentric flint on brow.

bolts: "[w]henever the lightning strikes, people know that some sin has been committed" (Nash 1970:141). Although the Manikin Scepter is never shown in true battle in Classic Maya art, Yaxchilan Stela 11 depicts Bird Jaguar masked as Chahk wielding this over a bound group of prisoners, perhaps to denote the purificatory act of their punishment at a supernatural level. Dating to the Terminal Classic period, Ucanal Stela 4 portrays a ruler with a smaller figure—probably his son—wielding K'awiil axes atop a screaming captive (Figure 9c).[5] Above this tableau, a male figure flies in a dark cloud wielding darts and a spearthrower. His brow bears the smoking torch of K'awiil projecting from a trefoil eccentric

[5] For a photo of the captive's face, see Graham 1980:160.

Figure 10. Eccentric chert excavated at El Palmar, Campeche; note human profiles at four corners of object. Photo: Jorge Pérez de Lara.

flint (Figure 9c–d).[6] The burning cranial element not only relates this figure to eccentrics and the K'awiil scepters below, but also suggests that this dart-throwing individual is a living symbol of castigation, much like the later scenes of the dart-throwing Morning Star appearing in the Late Postclassic Codex Dresden, as well as the Borgia, Vaticanus B, and Cospi of the roughly contemporaneous Borgia Group of highland Mexico (see Figure 9b). A Late Classic carved vessel portrays two scenes of K'awiil looking down much like a wrathful and angry lord, with the pose of one notably like one of the menacing Venus gods in the Codex Dresden (Figure 9a, b).[7]

In Late Postclassic Central Mexico, there is a specific deity of castigation known as Itztlacoliuhqui-Ixquimilli, meaning "curved obsidian blindfolded one," an aspect of the Black Tezcatlipoca of the North (Seler 1963). For the scene pertaining to the north in the Codex Cospi, he stands atop sharp stones of banded chert or agate and faces a temple with smoke containing another stone with a stick. This pertains to the Nahuatl term for punishment, *in tetl in cuahuitl*, meaning "stone and wood," hard and readily accessible items commonly used for public punishment. Itztlacoliuhqui-Ixquimilli appears as either eyeless or blindfolded, often with a face of banded chert rather than obsidian, the blank featureless face recalling many Maya eccentrics, including the nine from Rosalila (see Taube 1992:110, Fig. 92f-h). In addition, his brow is a sharply back-turned blade with pointed serrations; in other words, he is indeed a personified eccentric. In Aztec manuscripts and the Borgia Group, Itztlacoliuhqui-Ixquimilli is the patron of the 13-day *trecena* of 1 Lizard, where he can appear with adulterers executed by stoning (see Codex Borbonicus page 13, Codex Telleriano-Remensis fol. 16v-17r).

For many of the more elaborate chert eccentrics, including six from Rosalila, they are multi-headed and facing outwards in many directions, perhaps pertaining to their vigilant, all-seeing role as protectors.[8] An extraordinary eccentric excavated at El Palmar, Campeche (Thompson 1936), features four deity heads at its corners, possibly alluding to cosmic guardians of the four-sided world (Figure 10). Their lips are curiously pursed and protruding, much as if they were whistling, a convention also found with two eccentrics from the Rosalila offering (Artifacts 90-8 and 10; Figure 11). Among contemporary Yukatek Maya, there are the Balam spirits who guard the maize fields and community by shooting malevolent spirits:

> By night you may hear a high whistling sound; this is made by the Balams, who are driving away evil winds or animals by shooting at them with fragments of obsidian [...] These fragments (pieces of knife or lance-point of the ancient Maya) are found in the bush; then people know the balams have been shooting at the evil winds. (Redfield and Villa Rojas 1934:113)

[6] Along with three other gods flying in clouds, this same being appears on the roughly contemporaneous Stela 2 from Ixlu, Guatemala (see Jones and Satterthwaite 1982:Fig. 81).

[7] See vessel K6069 in Justin Kerr's database at MayaVase.com.

[8] Similarly, many Oceanic wooden weapons, including the Maori *taiaha*, the Marquesan *u'u*, and the Easter Island *ua* are Janus-headed to see in both directions simultaneously (see Meyer 1995:506, 564, 591).

Figure 11. Rosalila Artifacts 90-8 and 10, with lips protruding and pursed as if whistling. Photos: Ken Garrett.

Such stones are collected to protect entire communities as well as homes:

> [...] these fragments have magical protective power, and so when the h-men [native priest] performs the Loh ceremony to protect the village from the evil winds, he buries toks [flints] (as these pieces are called) at each of the four entrances to the village and in some cases, when a new house is dedicated, one of these "arrows of the balam" is set above the door. (Redfield and Villa Rojas 1934:113-114, glosses in square brackets added)

This account of protective stones for towns and individual homes immediately recalls the *xayeh* stones at the four corners of Tewa households as well as the *xayeh* ancestral spirits of the four community shrines. In addition, just after mentioning the guardians of nine hills and nine rivers, the colonial Yukatek Chilam Balam of Chumayel describes in detail the placement of directionally colored "flints," trees, and other cosmic elements to the four cardinal points (Roys 1933:64).

Obviously, a huge geographic and cultural distance exists between the Tewa of New Mexico and the lowland Maya region, but throughout this broad area, ritually creating and nurturing sacred space is strikingly similar, including offerings to the four corners and centers of maize fields, houses, and communities. The early colonial Nahuatl (formerly Aztec) of Central Mexico placed stones "of good color" in the four corners of the house as a form of ritual dedication (see Taube 2005). The Classic Maya and still-earlier Olmec buried jades to the cardinal or intercardinal points as precious objects symbolizing maize, much like planting a maize field, recalling the Tewa household concept of "life root giving stones" (Taube 2005, 2012). In fact, considering their many branching elements,

certain eccentrics were probably considered as symbolic trees. Seibal Stela 3 features a ruler before a massive eccentric as a flowering tree with a hollow interior having blade serrations on both sides as well as Kawak markings denoting stone (see Graham 1996:17). In the case of Seibal Stela 8, the king holds a personified eccentric K'awiil head with sharply curving elements curling out of the cranium (Figure 12a). Given the fact that K'awiil is a major theme on eccentrics, these cranial elements probably refer to worked chert, although perhaps also alluding to vegetal growth.

The most developed Late Classic Maya merging of a growing tree and an eccentric is on the so-called "Cosmic Plate," published in the well-known exhibition catalog, *The Blood of Kings* (Schele and Miller 1986:Pl. 122). The scene portrays Chahk wielding a lightning axe waist deep in water with his cranium sprouting an elaborate tree, much like the Seibal Stela 8 example. On close inspection, it can be seen that the branches have four curving blades with serrated edges and stony Kawak markings growing from the branches of this "lightning tree."

Weapons and Personified Eccentrics

Mention has been made of eccentric chert forms alluding to weapons, and many examples have central stems, as if to be hafted to the shafts of spears or held as scepters, including three from a cache at the base of the Hieroglyphic Stairway of Structure 10L-26 as well as the nine from Rosalila at Copan (see Fash 2001:Fig. 92; Miller and Martin 2004:Pl. 79). In addition, the aforementioned eccentric from El Palmar also has a rudimentary stem, thereby not only denoting its significance as a symbolic weapon but its orientation as well (Figure 10). At times, eccentrics were surely hafted to wooden handles, including the Late Preclassic weapons portrayed on El Baúl Stela 1 and the eccentric flint axe known for Kaminaljuyu (Figures 2 and 3). In addition, Piedras Negras Stelae 7 and 8 depict Maya rulers in Teotihuacan-style garb grasping lances tipped with obsidian eccentrics in the form of skulls with sharply curving crania, much like the aforementioned Itztlacoliuhqui-Ixquimilli god of castigation from Late Postclassic Central Mexico (Figure 13f, g).

Linda Schele (1979) was among the first to identify personified eccentrics in Maya art, including one from Tikal Altar 7 (Figure 12b). Although eroded, it is more than likely that Altar 7 portrayed four eccentrics, possibly alluding to world directions, recalling the four heads on the eccentric from El Palmar (see Jones and Satterthwaite 1982:Fig. 50b) (Figure 10). In addition, a massive jade cache from Blue Creek, Belize, contained a large cruciform eccentric with a natural central hole and four projecting points: "The chert eccentric was oriented to the cardinal directions, and its north and south tips were broken off" (Guderjan 1998:105, Fig. 9.3). Aside from Tikal Altar 7, Schele also noted examples from Late Classic Palenque where the personified eccentrics are paired with shields (Figure 12c, d). For the two illustrated Palenque examples as well as the Tikal Altar 7 flints, the heads strongly resemble the visage of Chahk, although here entirely skeletal.

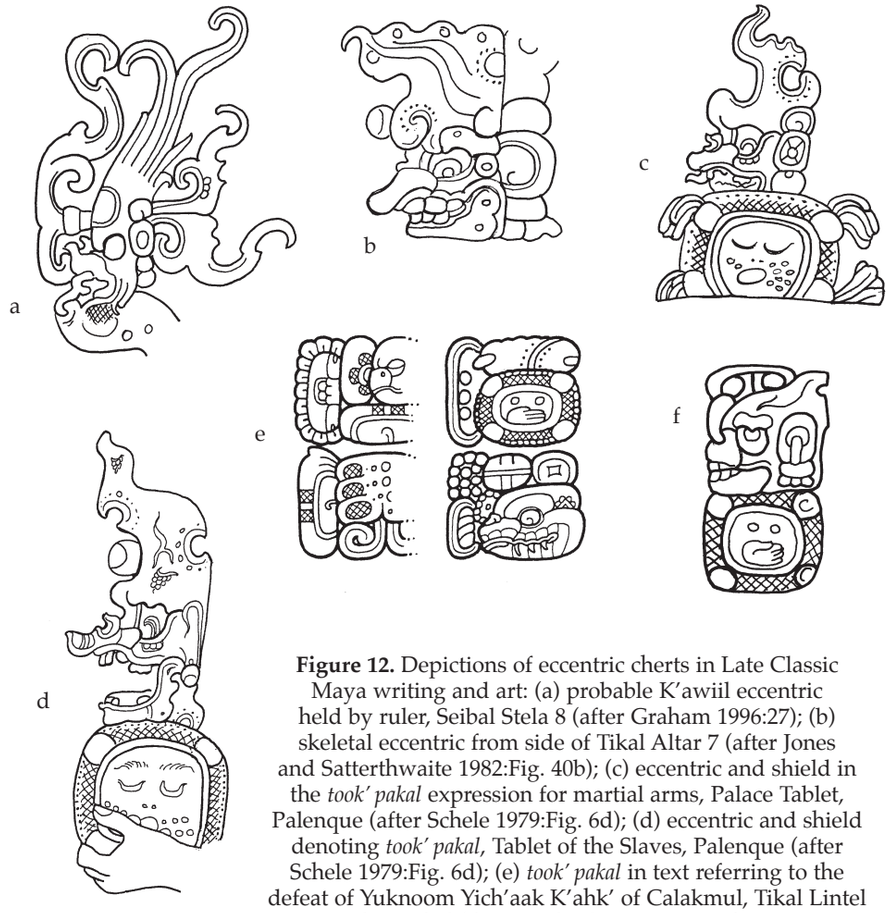

Figure 12. Depictions of eccentric cherts in Late Classic Maya writing and art: (a) probable K'awiil eccentric held by ruler, Seibal Stela 8 (after Graham 1996:27); (b) skeletal eccentric from side of Tikal Altar 7 (after Jones and Satterthwaite 1982:Fig. 40b); (c) eccentric and shield in the *took' pakal* expression for martial arms, Palace Tablet, Palenque (after Schele 1979:Fig. 6d); (d) eccentric and shield denoting *took' pakal*, Tablet of the Slaves, Palenque (after Schele 1979:Fig. 6d); (e) *took' pakal* in text referring to the defeat of Yuknoom Yich'aak K'ahk' of Calakmul, Tikal Lintel 2, Temple I, Tikal (drawing by Simon Martin from Martin and Grube 2008:45); (f) *took' pakal* phrase from Hieroglyphic Stairway at Copan referring to the capture and death of Waxaklajuun Ubaah K'awiil (after Stuart 2005:Fig. 10.5).

Thus while having the blunt, downturning snout of the god of rain and lightning, they also have fleshless mandibles and snouts. In addition, the example from the Tablet of the Slaves displays the undulating Etz'nab markings typically found on bone, and this is commonly found with other Maya Classic and Postclassic portrayals of chert (Figure 12d, cf. Figure 6a). Given their resemblance to bony sutures, such markings are strongly indicative of death. The skeletal Chahk heads and Etz'nab elements probably denote eccentrics and chert as spent and moribund "fossil lightning." Although this may seem contrary to the concept of eccentrics, lightning gods, and the Yukatek Balams as potent protectors, it also fits the reality of revering spiritual power in enduring but also inert physical form, whether it be sculpted god images or the silent bones of buried ancestors. Whereas the being commonly designated as God C is the embodiment of invisible spiritual godhood or *k'uh*, K'awiil corresponds to solid images of godly

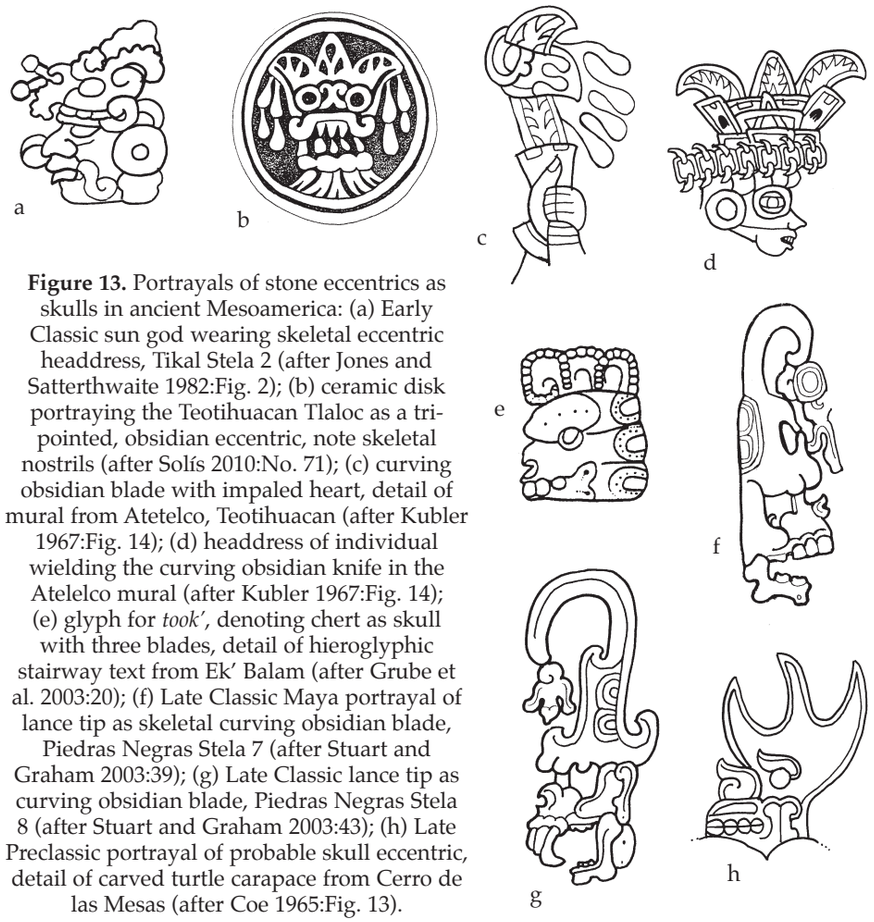

Figure 13. Portrayals of stone eccentrics as skulls in ancient Mesoamerica: (a) Early Classic sun god wearing skeletal eccentric headdress, Tikal Stela 2 (after Jones and Satterthwaite 1982:Fig. 2); (b) ceramic disk portraying the Teotihuacan Tlaloc as a tri-pointed, obsidian eccentric, note skeletal nostrils (after Solís 2010:No. 71); (c) curving obsidian blade with impaled heart, detail of mural from Atetelco, Teotihuacan (after Kubler 1967:Fig. 14); (d) headdress of individual wielding the curving obsidian knife in the Atelelco mural (after Kubler 1967:Fig. 14); (e) glyph for *took'*, denoting chert as skull with three blades, detail of hieroglyphic stairway text from Ek' Balam (after Grube et al. 2003:20); (f) Late Classic Maya portrayal of lance tip as skeletal curving obsidian blade, Piedras Negras Stela 7 (after Stuart and Graham 2003:39); (g) Late Classic lance tip as curving obsidian blade, Piedras Negras Stela 8 (after Stuart and Graham 2003:43); (h) Late Preclassic portrayal of probable skull eccentric, detail of carved turtle carapace from Cerro de las Mesas (after Coe 1965:Fig. 13).

power, or in simple terms, "idols" (Houston et al. 2006:67-68). Clearly enough, eccentrics are among the most striking and potent distillations of the latter.

The pairing of personified eccentrics with shields at Palenque creates an elaborate form of the glyphic couplet *took' pakal*, meaning "chert and shield," a term signifying armaments of war (Figure 12c, d). Appearing in the text of the Hieroglyphic Stairway at Copan, the chert is again a skull, displaying a pendant ear element found with Classic Maya death gods (Houston et al. 2006:Fig. 4.16) (Figure 12f). The *took' pakal* phrase often appears in Classic Maya inscriptions concerning the capture of important individuals, with Stuart (2005:385-286) noting that the Copan text refers to the capture and death of Waxaklajuun Ubaah K'awiil. Similarly, Lintel 2 of Tikal Temple 1 records the capture of the great king Yuknoom Yich'aak K'ahk' of Calakmul with the same glyphic term (Figure 12e). In contrast to the Copan example, a simple chert blade denotes the weapon, or *took'*, indicating that the skull eccentrics are but elaborate symbolic forms of points and blades, in other words, weapons.

The concept of eccentric flints as moribund skulls can be traced as early

as the Early Classic, and probably before. Stela 2 of Tikal features a ruler wearing a frontal beltpiece of the sun god with an eccentric as his headdress (Figure 13a). Although eroded, the undulating outline as well as a hollow region for the nostrils indicates that this headdress is a skeletal eccentric, with a sharply downwardly curving portion at the side of the face. Although presented in profile, when viewed en face this headdress would resemble the trefoil, foliated form of the Maya "Jester God" (see Taube and Ishihara-Brito 2013:Fig. 81). However, in terms of eccentrics, this would pertain directly to the trefoil form commonly wielded by individuals in Late Classic Maya art, where in many contexts it is wielded by individuals with jaguar attributes, much as if the chert embodies the claws of the jaguar (see Robicsek and Hales 1984).

A text on the Hieroglyphic Serpent Balustrades at Ek' Balam in the state of Yucatan, Mexico, displays an excellent example of a personified trefoil eccentric chert as a skull (Figure 13e). With a **to** superfix, this glyph is clearly to be read as *took'*, in other words chert. Portrayed with Kawak markings, the back of the skull terminates in three blades. This glyphic compound forms part of the name of the preeminent ruler of Ek' Balam, Ukit Kan Lehk Took' (Grube et al. 2003:36), perhaps best translated as "Patron of the Four Chert Blades," where Proto-Yukatekan *lehk* is a likely cognate of the Tzeltalan numeral classifier *lehch* used for "thin, non-flexible objects of variable shape" (Marc Zender, personal communication 2016). Clearly enough, the number four strongly evokes the concept of world directions, and with the reference to chert, possibly cosmic protection as well.

Dating to roughly the sixth century AD, a circular ceramic disc in the regional museum at Teotihuacan portrays a frontally facing Tlaloc with three elements projecting from the top of his head (Figure 13b). The sides of the three points have V-shaped elements which in Teotihuacan iconography denotes blades of obsidian. In other words, this head is essentially an obsidian personified form of a trefoil eccentric. Drops cascade from the tips of the blades, clearly denoting sacrificial blood. Moreover, the item in the mouth is quite probably a bleeding heart. The lower nasal area of the ceramic piece appears as an upended triangle, a motif denoting skulls in Teotihuacan iconography. In other words, this object denotes the Teotihuacan Tlaloc as a personified but moribund aspect of lightning, much like the discussed examples of probable Chahk skulls as embodiments of lightning eccentrics.

The curving side elements of the Teotihuacan Tlaloc head clearly relate to the sickle-like obsidian blades appearing in scenes pertaining to heart sacrifice at Teotihuacan. In a number of cases, the heart is impaled on the tip of the blade, indicating these tools as objects of sacrifice (Figure 13c). For the illustrated example from a mural at Atetelco, the warrior figure holding the obsidian sacrificial blade has three more in his headdress, with the entire composition directly recalling the circular Tlaloc tile (Figure 13c, d). Such curving obsidian blades are evoked in subsequent Late Classic Maya iconography, including Structure 10L-26 at Copan as well as stelae from Piedras Negras, Guatemala. Piedras Negras Stelae 7 and 8 feature Maya kings in Teotihuacan war costume wielding lances tipped with curving, obsidian skeletal heads displaying Ak'bal markings (Figure 13f, g).

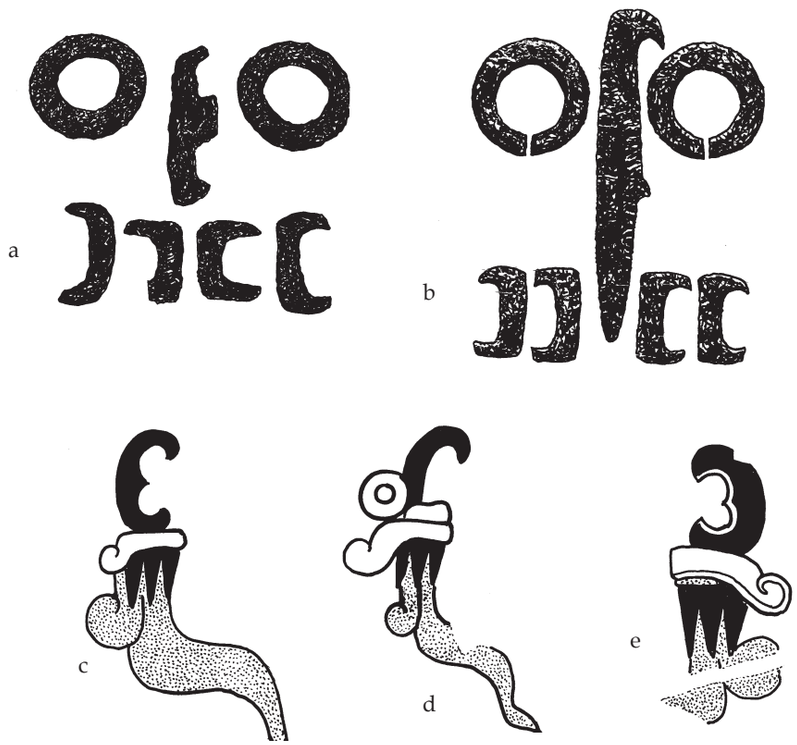

Figure 14. Obsidian eccentric Tlaloc masks in Terminal Classic highland Mexico: (a) obsidian mask from Xochicalco, Morelos (drawing courtesy of Andrew Turner); (b) obsidian mask from Cacaxtla, Tlaxcala (drawing courtesy of Andrew Turner); (c) portrayal of Tlaloc obsidian mask, Structure B, Cacaxtla (after Matos Moctezuma 1987:77); (d) Tlaloc obsidian mask beltpiece also worn by figure with the Tlaloc mask in the Stucture B mural (after Matos Moctezuma 1987:77); (e) Tlaloc obsidian mask, Structure B, Cacaxtla (after Matos Moctezuma 1987:74).

The concept of chert or obsidian eccentrics as skulls may well date as early as the Late Preclassic (100 BC – AD 250). A carved turtle carapace excavated at Cerro de las Mesas features a lord or deity wearing a headdress displaying a skull with three points emerging from its brow (Figure 13h). Clearly enough, this motif denotes a trefoil eccentric blade personified as a skull, recalling the much later scene appearing on Ucanal Stela 4, which portrays a supernatural figure wearing a three-pointed eccentric on his brow (see Figure 9c, d).

In a recent paper, Andrew Turner (n.d.) discusses two remarkable masks discovered at Cacaxtla and Xochicalco (Figure 14a, b). Fashioned from obsidian eccentrics, they explicitly portray the goggled eyes and fangs of Tlaloc, along with a central protruding nose. In the case of the Xochicalco example, the nose is lunate in form with a central protrusion (Figure 14a). This form is strikingly similar to "trilobal eccentrics" reported by Stocker and Spence (1973),

and it is conceivable that these cited examples may have also been part of Tlaloc masks fashioned of obsidian. In contrast to the Xochicalco "trilobate" form, the Cacaxtla example has a central nose element more resembling a sickle with a sharply curved point at the upper tip. In his study, Turner (n.d.) notes that in the famed battle murals from Structure B at Cacaxtla, the victorious ruler Lord 3 Deer, is twice shown wearing the Tlaloc obsidian mask, with the nose and fangs rendered in black (Figure 14c, e). For these two examples, the nose element is much like the mask from Xochicalco rather than Cacaxtla. However, the mural to the east of the central stairway of Structure B also features another obsidian Tlaloc mask worn on the belt of 3 Deer (Figure 14d). In this case the central nosepiece is virtually identical to the mask excavated at Cacaxtla (Figure 14b). As Turner noted, the ruler is wearing obsidian eccentric masks of the god of rain and lightning. However, one major difference between the two actual masks and Cacaxtla Structure B is that the mural fangs are not lunate but sharply triangular, strongly suggesting obsidian prismatic blades. It could well be that when such pieces were anciently encountered in the fields, they were considered as the "fangs" of the god of lightning.

Two royal tombs at Palenque contain elaborate portrayals of supernatural guardians, the most famous being that of K'inich Janahb Pakal in the Temple of the Inscriptions. The walls surrounding the sarcophagus bear stucco images of nine human figures wielding K'awiil axes and shields protecting the interred king (see Schele and Mathews 1998:128-129). An earlier painted version occurs in the tomb of Temple XX, where there are also nine figures with shields and K'awiil axes, but with one important exception. Rather than a K'awiil-headed weapon, one figure grasps an axe with a trefoil eccentric blade, a substitution indicating that they are equivalent (Figure 6d, e). The nine supernatural guardians in the Palenque tombs immediately recall the nine eccentrics from the Rosalila offering. William Coe (1965:465) notes that for eccentric caches found with Late Classic Maya stelae, they typically appear as "nine as a rule." In addition, it will be recalled that in the Chilam Balam of Chumayel, there is mention of the protectors of nine hills and nine rivers immediately before the description of colored flints of the four directions, although in this case it is not clear if the reference to nine has anything to do with the discussion of directional symbolism. However, many researchers regard Ah Bolon Tz'akab or "He of Nine Generations" as a colonial Yukatek epithet for K'awiil (see Taube 1992:73).

All nine Rosalila cherts bear outlines of one or more human heads wearing feather headdresses, with a good many bearing a bifurcated cranial torch element of the Classic Maya K'awiil (see Taube 1992:69-79). However, K'awiil has a zoomorphic face and upturned serpent snout rather than a human head, including the many known examples of the Manikin Scepter (see Schele and Miller 1986:73). In fact, silhouette images of K'awiil are rarely found on eccentrics, and a recent exhaustive study notes only four examples with this motif (Clark et al. 2012a:280, Figs. 161, 163a-b, 164). Schele and Miller (1986:73) cite two Late Classic Maya examples of human figures bearing the burning cranial element of K'awiil, one being the image of K'inich Janahb Pakal from the Sarcophagus Lid

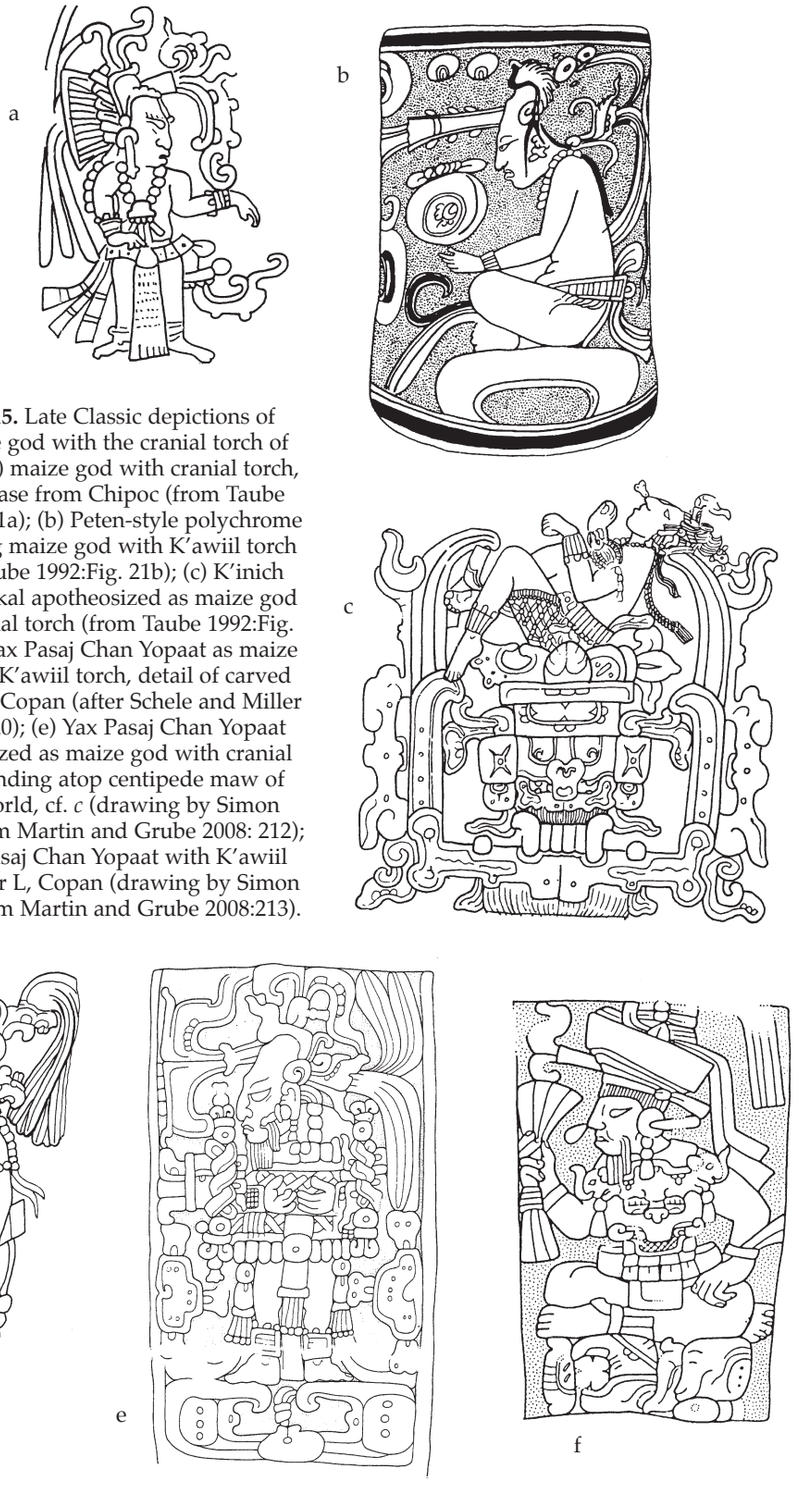

Figure 15. Late Classic depictions of the maize god with the cranial torch of K'awiil: (a) maize god with cranial torch, incised vase from Chipoc (from Taube 1992:Fig. 21a); (b) Peten-style polychrome portraying maize god with K'awiil torch (from Taube 1992:Fig. 21b); (c) K'inich Janahb Pakal apotheosized as maize god with cranial torch (from Taube 1992:Fig. 21e); (d) Yax Pasaj Chan Yopaat as maize god with K'awiil torch, detail of carved bone from Copan (after Schele and Miller 1986:Pl. 20); (e) Yax Pasaj Chan Yopaat apotheosized as maize god with cranial torch standing atop centipede maw of underworld, cf. *c* (drawing by Simon Martin from Martin and Grube 2008: 212); (f) Yax Pasaj Chan Yopaat with K'awiil torch, Altar L, Copan (drawing by Simon Martin from Martin and Grube 2008:213).

at Palenque and the other being Stela 11 at Copan, here portraying the last Copan king, Yax Pasaj Chan Yopaat (Figure 15c, e). At Copan, Yax Pasaj also appears with the cranial torch on Altar L as well as a carved bone from Structure 10L-11 (Figure 15d–f). For the carved bone, he wears above the burning torch a cranial device commonly worn by Late Classic Chahks, this being an undulating, centrally projecting element flanked on the sides by two upwardly turning curls, an item first noted by Michael Coe (1978:76) in his initial identification of the "Rain Beast," that is, the Classic Maya Chahk. In other words, the king here embodies two beings of lightning, both K'awiil and the rain god Chahk.

Figure 16. Maize god with floral torch and serpent foot of K'awiil, detail of Late Classic mold-made vase (after photo K3367 by Justin Kerr [1992:409]).

In all three Copan cases, the ruler sports a long beard, a rare trait indicating that these are all portrayals of the same individual. Schele and Miller (1986) note that both the Palenque sarcophagus and Copan Stela 11 are posthumous monuments, and this is surely the case for Altar L and probably the carved bone as well. Given this context, Schele and Miller (1986) suggest that such images on eccentrics portray deceased ancestors. The Copan Hieroglyphic Stairway of Structure 10L-26 depicts a series of reclining males with cranial torches (see Gordon 1902:Pls. 5, 6, 12) (Figure 17b). For one example, the figure wears a "death collar" with eyeballs as well as a loincloth bearing the Kimi "division sign" also denoting death (Gordon 1902:Pl. 5).

Rather than simply being generic ancestors, the Late Classic Maya examples of K'inich Janahb Pakal and Yax Pasaj Chan Yopaat with cranial torches allude to a specific being, an aspect of the maize god, quite possibly corn as an idealized ancestor (Taube 1992:48-50) (Figures 15–17). An incised vessel from the site of Chipoc, located in the central Motagua Valley near Copan, features four aspects of the maize god, one displaying the burning torch, a convention also found on Peten-style polychrome vessels (Figures 15a, b, 17a). In addition, one of the aforementioned reclining figures from the Hieroglyphic Stairway has a long lock of hair growing out of apparent foliation, probably denoting an ear of corn with maize silk and thereby making this another example of the maize god with the cranial torch (Figure 17b). For the aforementioned Sarcophagus Lid from Palenque, Pakal is clearly the maize god (see Taube 1992:48-50) (Figure 15c). The same can be said for the portrayal of Yax Pasaj on Copan Stela 11 (Figure 15e). In both scenes, the rulers appear in or atop centipede jaws denoting the maw of the underworld. The striking similarities between these two scenes are probably not coincidental, as the mother of Yax Pasaj was from Palenque (Martin and Grube 2008:209). In the case of the carved bone from Copan Structure 10L-11, Yax Pasaj appears to be passing something to the hands of another maize god wearing a jaguar-pelt skirt (for the entire scene, see Schele and Miller 1986:Pl. 50a). It is quite possible that it is generational and generative maize seed, linking this

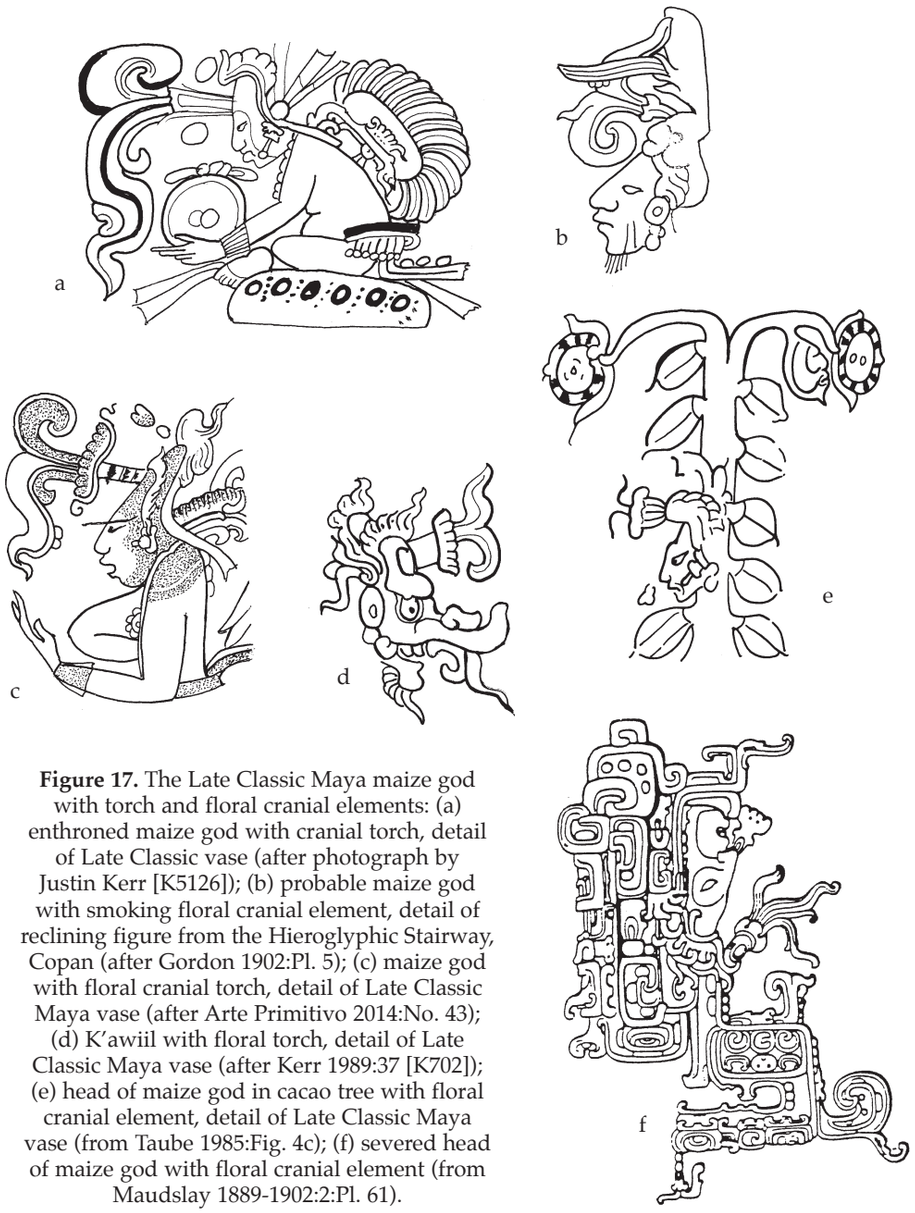

Figure 17. The Late Classic Maya maize god with torch and floral cranial elements: (a) enthroned maize god with cranial torch, detail of Late Classic vase (after photograph by Justin Kerr [K5126]); (b) probable maize god with smoking floral cranial element, detail of reclining figure from the Hieroglyphic Stairway, Copan (after Gordon 1902:Pl. 5); (c) maize god with floral cranial torch, detail of Late Classic Maya vase (after Arte Primitivo 2014:No. 43); (d) K'awiil with floral torch, detail of Late Classic Maya vase (after Kerr 1989:37 [K702]); (e) head of maize god in cacao tree with floral cranial element, detail of Late Classic Maya vase (from Taube 1985:Fig. 4c); (f) severed head of maize god with floral cranial element (from Maudslay 1889-1902:2:Pl. 61).

ancestral form of the maize deity to the living god.

Along with sharing the cranial torch found with Late Classic Maya depictions of the maize god, many of the Rosalila cherts also bear the profile of this being. Although we have noted that Copan Stela A has images of the sun god as an eccentric, his profile is very different as he typically has a projecting "Roman nose," as is also found with the aged creator deity Itzamnaaj (see Taube 1992:Figs. 12, 14, 22-23). In contrast, the Rosalila eccentrics portray profiles of beings with

Figure 18. Rosalila Artifact 90-5, with downwardly pointing tangs flanking the lower central stem. Photos: Ken Garrett.

the elongated nose and brow forming one gentle curve, a basic trait of the Late Classic Maya maize god, including examples discussed here (see Figures 15–17). In fact, Hruby and Ware (2009:Fig. 10b caption) note that a notched-flake eccentric from Piedras Negras bears a profile image of the maize god.

In Classic Maya art, K'awiil shares a basic aspect of the maize god, this being the elongated tonsured cranium alluding to a mature maize ear (Taube 1992:78). In addition, the Tablet of the Temple of the Foliated Cross is filled with maize iconography, with the central theme of the accompanying text referring to the birth of K'awiil (Stuart and Stuart 2008:199-209). However, rather than simply being a more human aspect of K'awiil, the Classic Maya maize god is a distinct being, and he almost never appears with K'awiil's serpent foot, the one known example appearing on a Late Classic mold-made vase perhaps from the Copan region (Figure 16). Given his widespread appearance with eccentrics, including many examples from the Rosalila offering, it is conceivable that this aspect of the maize deity denotes an ancestral guardian and protector having powers of lightning. Among the Pedrano Tzotzil of Chenalho, the term *'anhel* for the lightning protector is also used for an ear of corn: "An ear of maize is called *x'ob* or *'anhel* because it is said to have a soul that is the guardian and defender from evils that may befall mankind or the milpa" (Spero 1987:86; see

Figure 19. Rosalila Artifacts 90-10 and 11, with central stems resembling sharply pointed knives. Photos: Ken Garrett.

Guiteras-Holmes 1961:177-185). The reclining maize deity from the steps of the Hieroglyphic Stairway at Copan may denote him as a heroic, vanquished ancestor, much like one of the most important historic events mentioned in the text, the defeat and death of Waxaklajuun Ubaah K'awiil (see Stuart 2005:385-386) (Figure 17b).

To return to the rare example of the maize god with a serpent foot (Figure 16), he displays a flower and quetzal feather cranial element rather than the usual smoking torch of K'awiil, which does appear with the other depictions of the maize deity from the same vase, although here without the serpent leg (see K3367). Another Late Classic vessel portrays the corn god with another blossom protruding from his head, in this case with the asymmetrical smoke curls commonly found with K'awiil (Figure 17c). In addition, K'awiil can also have the same smoking floral element in his head, and the maize god often has floral cranial elements in scenes where he appears as if dead (Figure 17d–f). A Late Classic vessel in the collection of the Museo Popol Vuh depicts the head of the maize god in a cacao tree, much like the Popol Vuh episode of the severed head of Hun Hunahpu being placed in a gourd tree (Figure 17e). In addition,

Figure 20. Rosalila Artifacts 90-3, 4, and 9 stand out as a distinct group that exhibits less technical skill than the other six. Photos: Ken Garrett.

Quirigua Zoomorph P portrays two inverted, severed heads of the maize god with prominent blossoms on the brow emanating scrolls of smoke or aroma (Figure 17f). The form of the floral element is virtually identical to that of the reclining maize god from the Hieroglyphic Stairway (Figure 17b). Clearly enough, there is considerable play between cranial elements of torches and flowers in Late Classic images of K'awiil and the maize deity.

In terms of the nine Rosalila eccentric cherts, all appear to be based on the concept of stone lance heads, as is also clearly the case from the three cached at the base of the Hieroglyphic Stairway at Copan (see Fash 2001:Fig. 92; Miller and Martin 2004:Pl. 79). For Artifacts 90-5 and 7 from the Rosalila offering, the eccentrics have what appear to be downwardly pointing tangs flanking the lower central stem, similar to what one finds on a lance point (Figure 18). However, it is clear that the Rosalila cherts were not hafted, as can also be readily seen by them being individually wrapped in cloth in the cache, as will be discussed below. Especially developed and hooked "tangs" can be found flanking the diminutive stem of the aforementioned El Palmar eccentric (Figure 10). However, the central stems are much more developed with the Rosalila examples, with most resembling sharply pointed knives. This is especially clear for Artifacts 90-10 and 11 (Figure 19), as well as a chert eccentric placed under Zoomorph O at Quirigua (Strömsvik 1941:Fig. 32). In the case of the Quirigua example, one blade side has a deep semi-circular indentation at its center, recalling Classic Maya portrayals of lightning axes and the massive blades on Structure 8N-66C at Copan, as well as actual chert eccentrics (Figures 6a, b, 7a–d). For the Rosalila

Figure 21. Rosalila Artifact 90-8, with arm extended at a right angle and terminating with the head of another K'awiil maize deity. Photo: Ken Garrett.

offerings, Artifacts 90-3, 4, and 9 stand out as a distinct group that although still impressive, exhibit less technical skill than the other six (Figure 20). All three have the semicircular depressions found with the Quirigua example, which not only suggest that these indentations may refer to lightning, but that all four may have been crafted by the same workshop or even hand. In contrast to these examples, the other Rosalila eccentrics lack semicircular or lunate silhouettes and present much more complex and irregular contours of straight lines and right angles, as well as sharply turning and at times undulating curves.

A consistent trait of almost all of the Rosalila eccentrics is the "K'awiil maize god" as the principal figure with his arm extended sharply outward, a physically exacting pose that may denote defense and protection. In the case of the simpler Artifacts 90-3, 4 and 9, the arm is simply upraised with fingers denoted at the terminations, a theme also appearing in Artifacts 90-10, 11, and 12 (Figures 20 and 50). However, Artifact 90-8 has the arm extended at a right angle terminating with the head of another K'awiil maize deity (Figure 21). This pose recalls Lintel 2 of Temple IV at Tikal, which portrays a great anthropomorphic jaguar behind the seated ruler, clearly as a supernatural guardian (see Jones and Satterthwaite 1982:Fig. 73). Similarly, Piedras Negras Stela 10 also portrays a massive jaguar behind an enthroned king (see Stuart and Graham 2003:54). The principal side figures on the El Palmar eccentric appear to hold objects before their torsos, possibly either shields or mirrors (Figure 10).

Clearly enough, there is a very rich body of data pertaining to eccentrics in terms of depictions in Classic Maya art and actual objects, including many found and documented through archaeological excavations. However, the discovery of the Rosalila offering with no less than nine finely worked examples adds a whole new dimension to the meaning of these exquisitely worked but also highly enigmatic objects.

Copan and Rosalila's Eccentric Cache

Copan

The ruins of Copan, in the highlands of western Honduras, once sustained a population of over 20,000 people. The Classic or Dynastic Period begins around the year AD 427 with the arrival of the first ruler of the site, K'inich Yax K'uk' Mo', and is characterized by the strong presence of the Maya tradition that flourished earlier to the west of Copan. The archaeological record indicates that it overlies an older, non-Maya tradition, referred to by some as "Lenca," whose ties are to the south and east. The twelve-hectare Copan Principal Group holds the site's major architectural features, the Great Plaza and the Acropolis (Figure

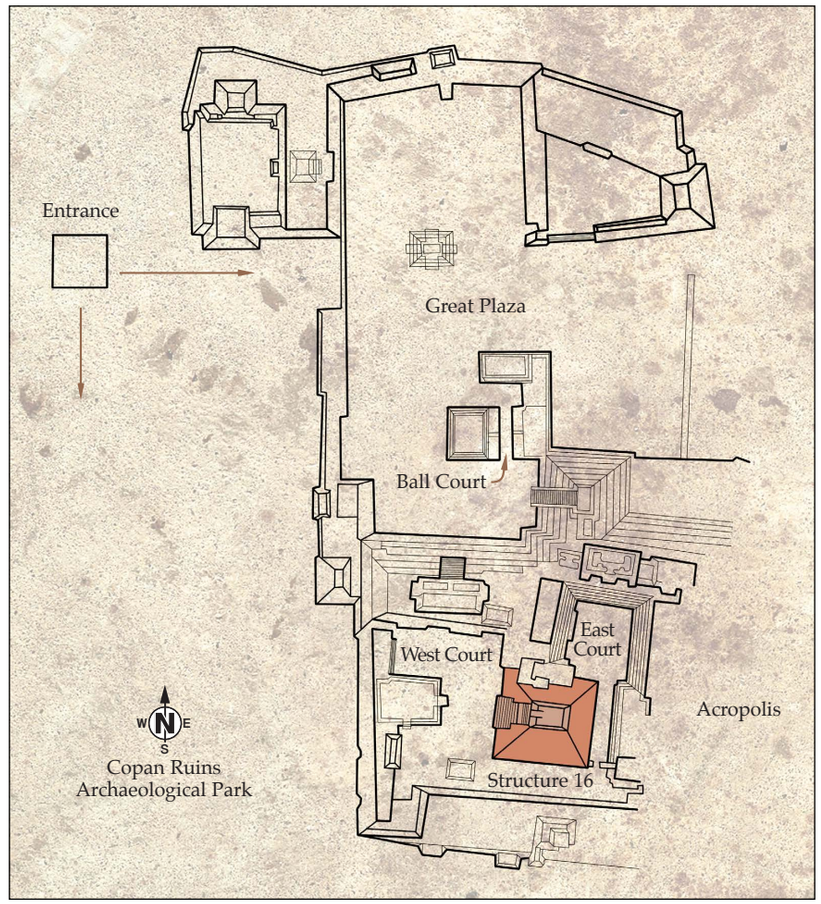

Figure 22. Copan's Principal Group. Drawing by Azaria Canales.

Figure 23. Main stairway of Structure 10L-16 (Temple 16). Photo: Ricardo Agurcia F.

22). Both are composed of smaller, rectangular courtyards surrounded by pyramidal platforms topped by buildings. Both the Great Plaza and the Acropolis reflect enormous amounts of labor: the former for its great extension of more than three hectares of leveled and paved surfaces, and the latter due to its great mass constructed to rise more than 30 meters above the natural terrain.

In contrast to the wide-open spaces of the Great Plaza, the Acropolis is a private area, with restricted access and internally focused, reduced spaces. This was the central precinct of political and religious power, the headquarters of the ruler and his court. Architecturally, the Acropolis is composed of two courtyards: the East Court, or Court of the Jaguars, and the West Court. Access to the lofty summit is restricted by the very steep stairway that rises from the Court of the Hieroglyphic Stairway up Structure 10L-11 (the Temple of the Inscriptions). High terrace walls characterize the other sides of the Acropolis. Once on top of the platform, walls and gates further restrict pedestrian movement.

The West Court is a symbolic sacred landscape representing major elements of the Maya cosmos, as indicated by its architecture and sculpture. This is a place for the celebration of rituals to commune with and venerate the royal ancestors (Miller 1986; Schele and Miller 1986; B. Fash 1992; W. Fash and Agurcia 1996; W. Fash 2001; Taube 2004a, 2004b). Delineating the east side of the West Court and towering over the entire Acropolis at its very heart is Structure 10L-16 (Temple 16) (Figure 23). At the base of its twenty-meter-tall stairway lies Altar Q, arguably the most important single historical monument of the site and one that, in keeping with the theme of the courtyard, emphasizes the role of the royal ancestors (Figure 24). The city's sixteenth ruler, Yax Pasaj Chan Yopaat, commissioned both the structure and the altar in AD 775. The sculpture program associated with Structure 10L-16 implies that it was dedicated to warfare, sacrifice, and the veneration of royal ancestors, principally K'inich Yax K'uk' Mo', who is shown in

Figure 24. Altar Q. Photo: Ricardo Agurcia F.

one of the stairway panels dancing and rising as the dawning sun (B. Fash 1992, 2011; W. Fash and Agurcia 1996; W. Fash 2001; Taube 2004a, 2004b; Ramos 2006).

The Excavation of Structure 10L-16

In the process of consolidating the cut that was created by the Copan River on the East side of the Acropolis, and in order to better comprehend the evolution of the architecture exposed by it, a major program of tunneling (under the aegis

Figure 25. Beginning of tunneling and excavations on Structure 10L-16 (1989). Photo: Ricardo Agurcia F.

of the Honduran Institute of Anthropology and History, IHAH) was carried out between 1989 and 1997 under the direction of William Fash, who assembled a large consortium of international scholars and their institutions to undertake the task. As this program proved, the vast majority of the buildings found buried in the Acropolis had been destroyed by the Maya in order to create solid foundations for the new constructions that went up over them. Nevertheless, in some cases these were preserved almost to perfection, retaining details as delicate as modeled plaster reliefs and paint (W. Fash 2001; Bell et al. 2004; Andrews and Fash 2005).

For the Copan Acropolis Archaeological Project (PAAC) excavations, tunnels go in at precise points in the stratigraphy, such as the intersections of plaza floors and building walls, to trace out entire building compounds with minimal amounts of damage to these or other ones above them. Thus excavation takes place in fill, between the finished surfaces of extant architectural features. This kind of research is less harmful to the buried remains of monuments and more favorable for their conservation than traditional practices. Furthermore, the amount of archaeological data produced per man-hour of labor is greater than that of older trenching methods.

Jeffrey Stomper began the contemporary tunneling of Structure 10L-16 in 1988 under the direct supervision of William Fash. The following year, the operation (Op. 41) was handed over to Ricardo Agurcia Fasquelle, who continued it under his own initiative past the end of the PAAC (Figure 25). In all, nineteen field seasons have been carried out, the most recent one ending in 2012. These led to the excavation of ninety-nine major tunnels (main excavation units), yielding over 1600 lots (artifact provenience units), in three sub-operations (Nos. 2, 3, and 7). For the purpose of Operation 41, tunnel designations remained in

Figure 26. First feature of Rosalila in Tunnel 11 (RC-2-128). Photo: Ricardo Agurcia F.

effect so long as the excavations continued along the same grid axis; thus the tunnel number would change as soon as the excavation changed direction. Within the tunnels, lots would be changed every meter of excavation (somewhat like horizontal test pits with arbitrary one-meter units). They were also changed wherever clear changes of context occurred, be it as a result of changes in the soil matrix or those caused by major cultural features (primarily floors and walls). For the most part, the fill of these pyramidal substructures consists of dark brown, clayish soils, laid wet and interspersed with large river cobbles. The matrix created by these is generally so solid that tunneling can be safely carried out without the need of additional bracing.

Rosalila

On June 23, 1989, Tunnel 11, which was following a low parapet (Cultural Feature RC-2-138) on the northern edge of a platform covered by a plaster floor (RC-2-100, nicknamed "Don Gustavo"), came upon a beautifully plastered wall (RC-2-128) (Figure 26). This proved to be the first feature discovered of the now famous "Rosalila Structure" (10L-16-3rd), which became the main focus of excavations directed by Ricardo Agurcia Fasquelle for the next three seasons. Rosalila is the best-preserved example of monumental architecture known for the Classic Maya (Agurcia Fasquelle and W. Fash 1991; Agurcia Fasquelle 1996, 1997, 1998, 2004, 2007; Agurcia Fasquelle and B. Fash 2005). Unlike most of the other buildings buried in the Copan Acropolis, Rosalila was not destroyed to make room for later constructions. Rather, it was entombed with great care and ceremony. Its ornate façades were delicately covered with a thick layer of white

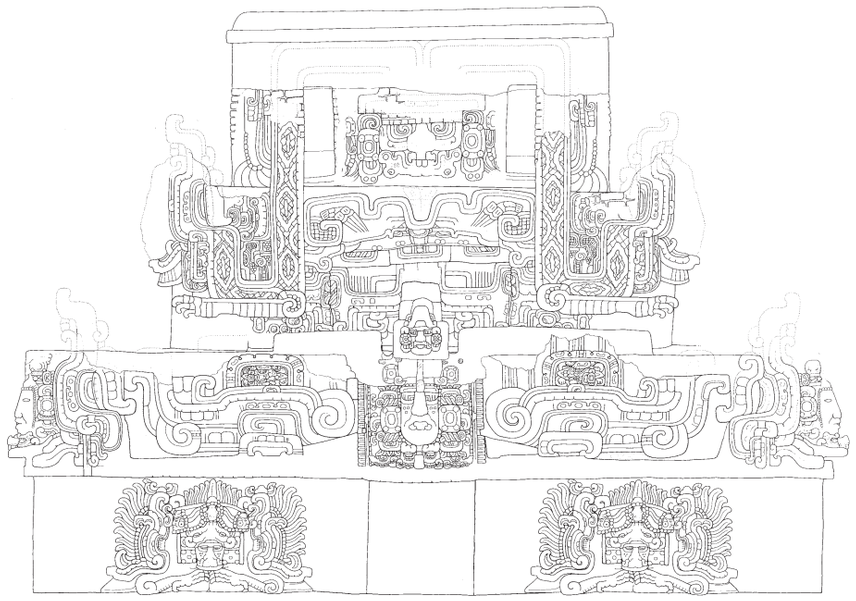

Figure 27. Reconstruction drawing of Rosalila's western facade. Drawing: Barbara Fash.

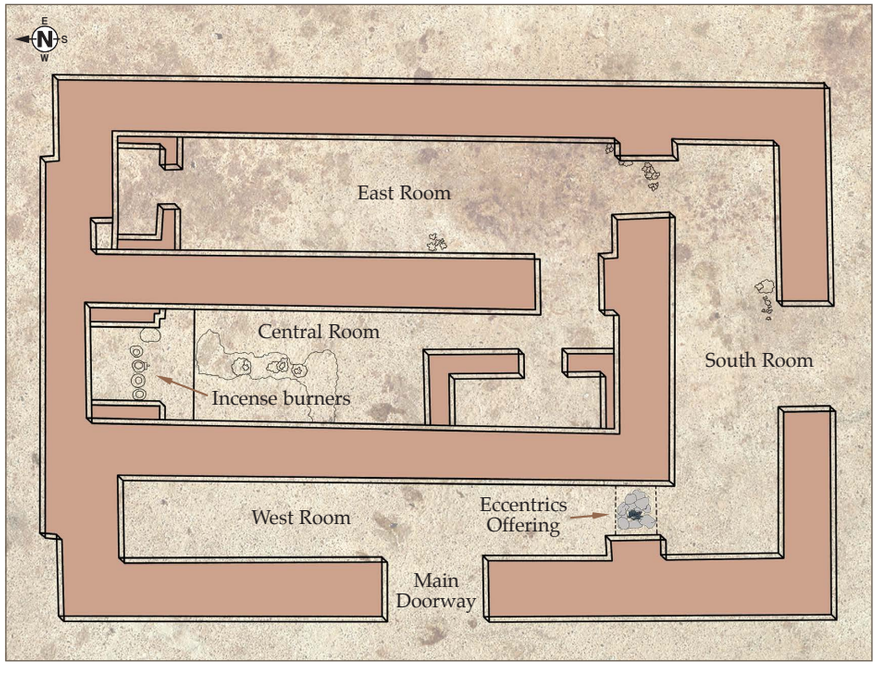

Figure 28. Plan view of Rosalila's first floor with the location of the main artifacts found. Drawing: Azaria Canales.

Figure 29. Interior of Rosalila's west room as reconstructed in the Sculpture Museum. Photo: Ricardo Agurcia F.

plaster before being sealed by a fill of mud and cobbles.

The building has three levels reaching a total height of 12.9 meters (Figure 27). The lowest one has four long and narrow rooms (with an average floor-plan size of 2.4 by 11.2 meters), and only by walking through the first three in a spiral can one reach the central and most private chamber (Figure 28). It is within the sacred spaces created by these high vaulted rooms (with an average height of 4.80 meters) that the Maya carried out elaborate ceremonies documented by plaster walls covered in soot from the burning of copal incense and torches—not unlike the walls of many old churches in the Maya area today. Furthermore, the excavations found many ritual artifacts, including seven ceramic incense burners with charcoal still inside (two of these on sculpted, stone jaguar pedestals) and the cache of eccentric cherts and bifaces that is the focus of this monograph. These rooms also retain red-painted ornamental bands on the walls and remnants of the round wooden beams built into the sidewalls of the vaults (Figure 29).

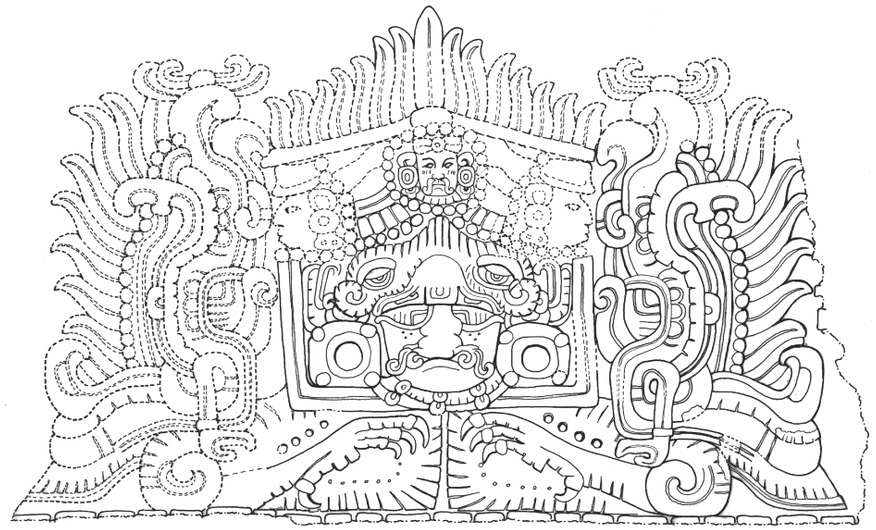

Figure 30. North-side panel on Rosalila's first level spelling out the name of the founder, K'inich Yax K'uk' Mo'. Drawing: José Espinoza.

Figure 31. Witz monster mask on Rosalila's second level. Photo: Justin Kerr.

Like all other temples constructed on the Acropolis's central axis, the main stairway for Rosalila faces west. Although this direction is often associated with the entrance to the otherworld, the world of the dead, and the place where the sun ends its daily cycle, it can signify quite the reverse in monumental Maya architecture—that is, the sun rising from the east to follow its diurnal journey to

Figure 32. Smoking skull on Rosalila's third level. Drawing: Heather Hurst.

the west (Taube 2013). Rosalila is the best-preserved example of the monumental art and architecture of the mid-sixth century AD at Copan and indeed of the entire Maya area. Like the cover of an illuminated manuscript, its facades are elaborately decorated with complex religious iconography. The themes are cosmological and emphasize the sun god, K'inich Ajaw—divine patron for Maya kings and the spiritual namesake of the founder of the dynasty, K'inich Yax K'uk' Mo'. In fact, the founder's name is interwoven with the images of this god on the artwork of the first level of the building (Agurcia Fasquelle 1996, 1997, 1998, 2004; Agurcia Fasquelle and B. Fash 2005) (Figure 30). Witz monster masks dominate the second level of the building and mark it as a sacred mountain (Figure 31). In addition, pairs of massive rattles are placed diagonally at the sides of the Witz monster head on the west facade, indicating it as a place of music and song, concepts entirely consistent with sacred incense as well as ancient Maya concepts of the celestial solar paradise of honored ancestors (Taube 2004a, 2013). A smoking skull that represents an incense burner dominates the third level (Figure 32). In this fashion, the building is also marked as a "house of smoke" or a "temple" (Taube 1998, 2004b, 2013; Agurcia Fasquelle 2004).

Three levels below Rosalila and directly aligned with its central room, archaeologist Robert Sharer (who directed the excavations of the earliest archaeological levels under Temple 16) found a royal tomb that appears to be that of the founder, K'inich Yax K'uk' Mo' (Sharer et al. 2005). The iconography of all the buildings on this axis (Yehnal, Margarita, Rosalila, and Temple 16) supports this interpretation (Agurcia Fasquelle and B. Fash 2005). The skeletal remains Sharer found show that this individual was born and raised in the Central Peten

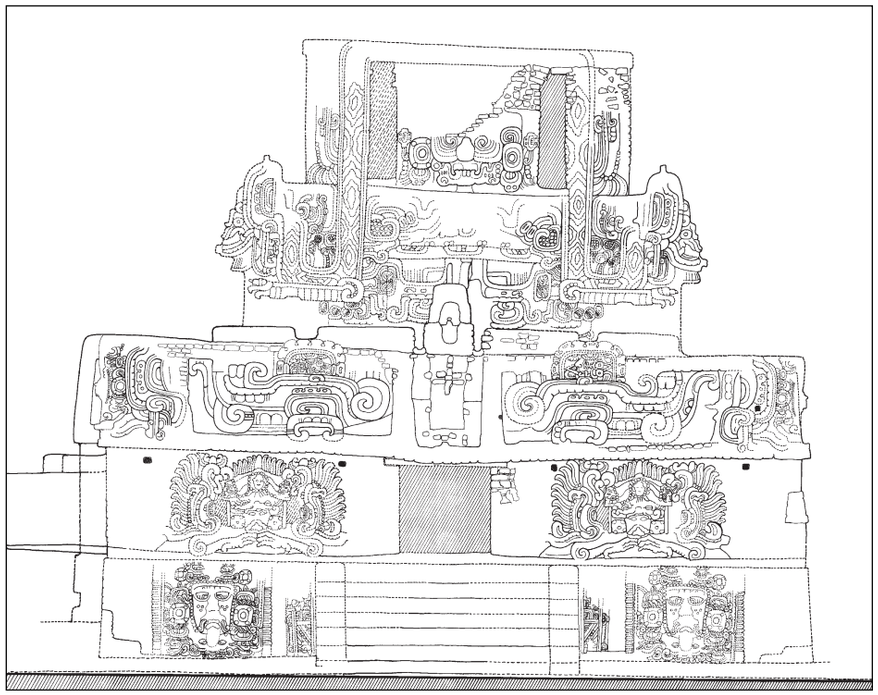

Figure 33. Rosalila resting on the small Azul pyramid. Drawing: Jorge Ramos.

area of Guatemala. This ties in well with the information written on Altar Q and confirms the complex set of circumstances that accompanied the foundation of the kingdom at Copan by a foreigner. The historical threads revealed by this archaeological and epigraphic research clearly intertwine through Mesoamerica, from Central Mexico to Western Honduras, at this time.

Life History of Rosalila

Rosalila rests on a three-meter-tall pyramid named "Azul" (Figure 33). It is small compared to others in Copan, which can reach up to twenty meters. There are seven steps on Azul's west-facing stairway, and the fifth has a badly eroded hieroglyphic inscription (Figure 34). The initial appraisal of this text, carried out by Linda Schele and Nikolai Grube (1992), led these scholars to propose that the date on it reads 9.6.17.3.2 in the Maya Long Count (February 21, AD 571). This corresponds to the end of the reign of Moon Jaguar, the tenth ruler of Copan. However, more recent studies of the text by David Stuart and Marc Zender have discerned in it the name of the eighth ruler, Wi' Ohl K'inich (who ruled from 532 to 551). The stratigraphic data mentioned below favors the earlier date.

In terms of proximity, the closest well-dated monument to Rosalila in the Early Acropolis is the carved step of the Ante Structure. Robert Sharer and his team excavated this structure, as part of the PAAC (Sharer et al. 2005). Based

Figure 34. Rosalila's hieroglyphic step. Photo: Ricardo Agurcia F.

on an analysis of the hieroglyphic text by David Stuart, they date it to 9.5.7.?.2, corresponding to ca. 540, during the reign of the eighth ruler, Wi' Ohl K'inich. The stratigraphy of the plaster floors connecting Azul to Ante indicates that the former was built before the latter. Ante rests on the floor called "Hunter" at an elevation of 599 meters above sea level, whereas Azul was built on one called "Don Lupito" at an elevation of 597.5 m. This relationship favors an early date (mid–sixth century) for the construction of Azul and Rosalila.

The style of the façade decoration and the thick layers of stucco in which it is executed combine to confirm a fairly early date for Rosalila structure. Furthermore, the ceramics found in the fill of Rosalila's substructure, Azul, strengthen this interpretation. They are part of the Acbi ceramic complex, which dates to Copan's Early Classic Period (AD 400–625; Viel 2006). In general, our radiocarbon dates support the ceramic and stratigraphic chronological assessment (Chart 1). These place the construction of Rosalila somewhere between AD 420 and 560, that is, squarely in the latter portion of the Early Classic period.

Termination and Burial of Rosalila

In terms of its burial, the sequence of Rosalila is somewhat complicated, as the building was not interred in a single episode. It was buried little by little as other platforms and buildings went up around it in the Acropolis. In a general sense, the first section to be buried was its substructure, Azul (Stage 1). This was followed by parts of the first floor on its north, east, and south sides (Stage 2). Then what remained exposed of its first floor and the entire second floor were buried (Stage 3), to be followed in a last stage (Stage 4) by the burial of the third floor. The entire process took an estimated 100 years.

For our purposes, the most important stage was the third one, when most of Rosalila's iconographic program was buried and the cache of eccentric flints was placed in its interior as an offering. Enormous care was taken by the Maya in

Structure	Operation, Sub-operation, Lot, Archaeological Context and Material	Phase, Ruler Expected Age	10L Sample No.	Laboratory Code	Radiocarbon Age B.P.	Calibrated BC–AD Date Ranges (Probabilities) Top Line 1 Sigma (68.3%), Lower Line 2 Sigma (95.4%)
Purpura	41/2/131, Tun.6, charcoal from fire on top of Purpura in fill of 10L-16 1st	Coner, R.16	C-89-8	Beta-104944	1310 ± 50	AD 660–720 (.698), 740–770 (.302) AD 640–780 (.935), 790–820 (.044), 840–860 (.021)
Rosalila 1st Fl	41/2/334, Tun.31, Room 3, termination cache	Coner, R.12-13	Org-92-3	Beta-105584	1390 ± 50	AD 610–670 (1.000) AD 560–710 (.966), 750–770 (.034)
Rosalila 1st Fl	41/2/719, Tun.39, Room 7, residues in incense burner	Coner, R.12-13	C-93-8	Beta-104946	1160 ± 50	AD 780–790 (.074), 810–900 (.681), 920–950 (.233), 959–960 (.012) AD 720–740 (.031), 770–990 (.969)
Azul	41/2/840, Tun.26, dedicatory cache	Acbi, R.8	C-93-14	Beta-105586	1580 ± 60	AD 420–540 (1.000) AD 350–370 (.031), 380–610 (.969)
Azul/ Celeste	41/2/888, Tun.63, termination Celeste & dedication Azul cache	Acbi, R.8	C-94-2	Beta-105587	1580 ± 50	AD 430–540 (1.000) AD 390–600 (1.000)
Azul/ Celeste	41/2/1060, Tun.39, termination Celeste & dedication Azul cache	Acbi, R.8	C-95-2	Beta-104948	1500 ± 60	AD 444–446 (.011), 460–480 (.102), 530–630 (.887) AD 430–650 (1.000)
Rosalila 1st Fl	41/2/273, Tun.26-A, Eccentric Cache, shell #2 (Spondylus princeps)	Coner, R.13-15	Sample #18	OZN-042	1780 ± 25	AD 710–819 (.8013) AD 684–885
Rosalila 1st Fl	41/2/273, Tun.26-A, Eccentric Cache, shell #3 (Spondylus princeps)	Coner, R.13-15	Sample #19	OZN-043	1754 ± 25	AD 736–855 (.8039) AD 697–904 Note: Weighted mean, Samples 18, 19=17654 ± 17, Cal to AD 787

Chart 1. Eccentric cache: associated radiocarbon dates.

Figure 35. Thick coat of white plaster resting over earlier red colored ones on Rosalila's west side. Photo: Ricardo Agurcia F.

this process: the first part of it (Stage 3.1) entailed the covering of all the exposed external areas of the building with a thick, coarse coat of white plaster (embalming or bundling it), which contrasted with all of the earlier redressings of it when Rosalila's colors (mostly red with details in green, yellow, orange, and black) were kept visible (Figure 35); next (Stage 3.2) the moldings and recesses were

carefully filled in with mud and smaller rocks, as were its large stucco-modeled decorative panels; and finally (Stage 3.3) the massive construction fill of the next pyramidal platform (Purpura, 10L-16-2nd) was put in place. The materials of this fill consisted of wet-laid dark reddish-brown soils, with a high content of clay, interspersed with large river cobbles.

The ceramics from the fill of Rosalila's first floor rooms date from the Coner Phase AD 625–830 (Viel 2006), which gives us a first approximation of the date in which this burial occurred. Unfortunately, we have no carved monuments with inscribed dates associated with this event. Radiocarbon assays from surrounding contexts allow us to place the burial between AD 610 and 900, with a clustering of the samples from the cache itself between AD 710–855 (1 sigma, with a weighted mean sample calibrated to AD 787; Chart 1). In summary, the best estimate for the burial is sometime between AD 710 (lower limit of shell dates) and 775 (dedication of Altar Q and 10L-16). Consequently, the temple had a long history, being built in the mid–sixth century (probably by Ruler 8, whose reign ends in AD 551), used for about two centuries, and buried by the mid-eighth century (in a time span covered by the thirteenth to fifteenth rulers; Ruler 13's reign ends in AD 738 and Ruler 15's in AD 763).

The Cache

Inside the temple many artifacts were found that reflect ancient religious practices (Figure 28). Among these were seven ceramic incense burners with charcoal still inside. Four of these incense burners were on the small altar-bench at the back of Rosalila's central room (Figure 36). Interestingly, the other three were found next to three of Rosalila's five doorways. As we shall see below, the eccentric cache was inside another one of these. Many of these remains bring to mind religious practices still in use among the modern Maya (Wisdom 1961). Nevertheless, the ones that have come to the attention of the widest audience (Agurcia Fasquelle and W. Fash 1991) are the eccentric cherts coming from a termination cache (RC-2-165) placed in the passageway between the west and south rooms. In this study we follow David Maxwell's definition of a cache, which in his 1996 dissertation he says is

> defined as a discrete deposit containing the residue of ritual behavior. Offerings are probably the most common type of behavior which will result in a cache deposit, and indeed the majority of the caches known throughout the Maya lowlands are probably offerings of one sort or another. (Maxwell 1996:32)

Archaeological Context

On May 28, 1990, Tunnel 26-A, which was running south, tracing the interior of Rosalila's west room, came upon a rough wall (RC-2-162) (Figure 37). This wall proved to be the northern limit of a crudely built, large niche, which sealed off the passage between Rosalila's west and south rooms (Figure 38). The southern

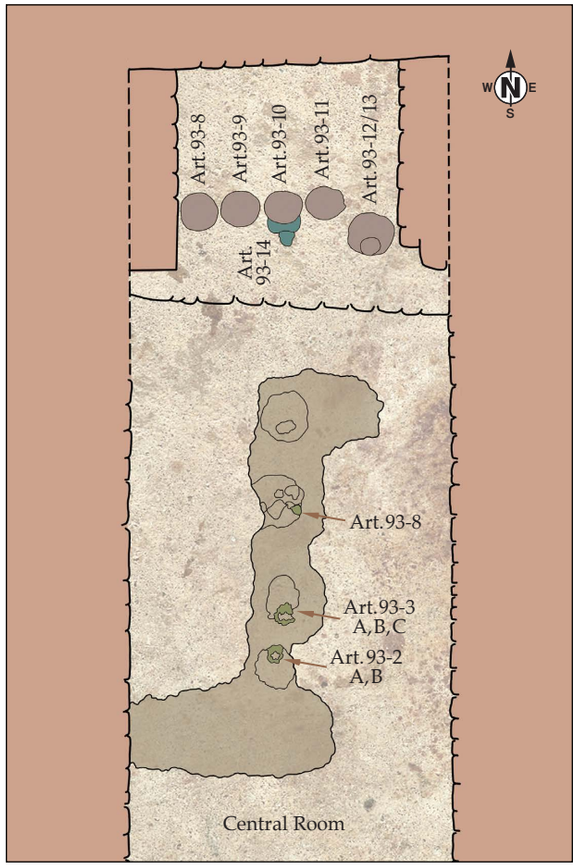

Figure 36. Artifacts found in Rosalila's central room: (above) map of artifact location (drawing: Azaria Canales); (below) altar-bench during excavation, with incense burners starting to reveal themselves (photo: Ricardo Agurcia F.).

Figure 37. Tunnel 26-A in Rosalila's west room reveals the outer niche wall (RC-2-162). Photo: Ricardo Agurcia F.

edge was marked by another rustic wall (RC-2-606), whereas the eastern and western sides consisted of the elegant, plastered walls of the passageway. The floor of the niche consisted of the same plaster floor that served both rooms (RC-2-158), whereas the roof originally consisted of wooden beams that formed a lintel over the passageway. The space defined by these features was approximately 1.05 m (N-S) by 1.31 m (E-W) and had an estimated height of 2.25 meters.

On June 1, after completing the documentation of wall RC-2-162 by notes, drawings, and photographs, its removal was begun. Not long after beginning this process, the cache of eccentrics was detected on the other side. These were placed inside a smaller, crudely built niche (Feature RC-2-165) outlined mostly with river cobbles and resting on the plaster floor (Figure 39). The rough circle formed by the cobbles had a diameter of about 40 cm and a height of about 45 cm. The fill around this niche and in the rest of the sealed passageway was

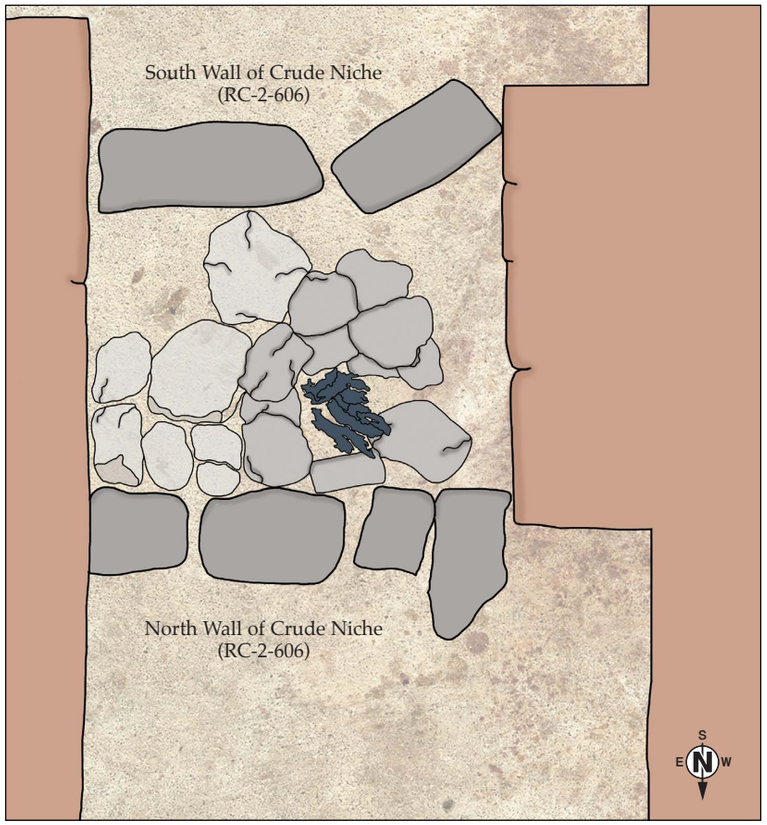

Figure 38. Map of the location of the eccentric cache within the large niche constructed between the west and south rooms. Drawing: Azaria Canales.

Figure 39. Smaller, circular niche within which the eccentric cache is placed (RC-2-165). Photo: Ricardo Agurcia F.

Figure 40. Organic sample collected in Riker Mount (photo: Ricardo Agurcia F.).

similar to that used to fill Rosalila's rooms. It consisted of dark reddish-brown soils, with a high content of clay, interspersed with river cobbles. The soils inside the larger niche were slightly darker than the ones outside, and in a general sense the fill was not as compact, making it easier to excavate.

Cache Contents

The excavation of the niche was carried out over the next few days and for the most part was executed by Jorge Ramos and Barbara Fash. What stood out in this cache at first glance were the remains of bright blue and green textiles and a number of eccentric cherts. A considerable effort was made to remove the contents with as much care as possible and maintain the textile in place over the objects. Extreme measures were also taken to secure the excavation site and control access. Excavation personnel also took special measures to try to prevent contamination of the cache with external elements.

In all, three major "organic" samples were retrieved. Sample 1 consisted of the materials over Artifact 90-1, a very large chert biface that was lying practically flat in the mid-section of the small niche. The materials removed in this sample and in Sample 2 were the ones that were in greatest danger of falling off of the object in the process of its transfer to the laboratory. They were placed inside Riker Mounts (small cardboard boxes with glass lids) and moved with extreme care (Figure 40). Conservators were consulted on their handling and

a

b

c

d

Figure 41. Faunal remains of cache: (a) marine shells identified as *Spondylus princeps*; (b) stingray spine; (c) fish vertebrae; (d) terminal phalanx from a large feline. Photos: Ricardo Agurcia F.

Figure 42. Large cobblestone covering cache. Photo: Ricardo Agurcia F.

housing from the very beginning. Sample 1 is held in just one box and consists mostly of fabrics (green and blue textiles and barkcloth). Sample 2 consists of the materials over artifacts 90-8, 10, 11, and 12, which were the larger eccentrics. It is held in four boxes. Like Sample 1, it consists mostly of fabrics. Sample 3, the largest one of the set, is held in 21 small boxes. It contains all of the materials found at the base of the niche, over the plaster floor. Much of this had fallen off the objects over the centuries. Besides large samples of fabrics, this sample held all of the faunal remains that were in the cache: three complete spiny oyster shells (*Spondylus princeps*) (Figure 41a), at least three stingray spines (Figure 41b), fish vertebrae (probably from a very young shark or stingray) (Figure 41c), and animal bones (terminal phalanges from a large feline, a jaguar or puma) (Figure 41d).

The lithic materials in the cache consisted of three chert bifaces, nine "eccentric flints," and one small, carved jade bead. Most of the fabrics recovered in the samples listed above were used to wrap the chert objects. The state of conservation of these objects is truly exceptional; only two of the eccentrics (Artifacts 90-7 and 90-9) have missing pieces and these are minute. Upon discovery, a fairly large cobblestone was lying on top of the cache (Figure 42). This made the excavators fear for the worst, and in fact upon removal of the stone the chert objects made a sound like a stack of dishes being moved. It was thought that the objects were disintegrating after being held in place by the cobblestone. Fortunately this

was not the case, as it seems that the complex bundling of the objects (discussed in detail below) was sufficient to protect them for many centuries in spite of numerous earthquakes and having a heavy stone over them.

The first biface (Artifact 90-1) and eccentric (Artifact 90-3) that were excavated were lying flat, seemingly slipped from their original positions. All the other chipped stone objects were standing on their bases and stacked against Artifact 90-12 (the largest of the eccentrics), which rested against the niche wall on its northern edge. In a general sense, the stack ran from southeast to northwest within the niche, and the artifact numbers reflect their position in this direction. Over time, the standing eccentrics had shifted into a fan-like array with their principal human profiles facing in a westerly to a southerly direction. Since the five that had moved the least (Artifacts 90-8 through 12) were looking directly west (Figure 43), it would seem safe to assume that all of them looked west originally.

We cannot be sure that most of the faunal remains were in their original position, since some of them could have been higher up in the bundle and slipped down as the ages passed. Nevertheless, the *Spondylus* shells were in place at the bottom of the niche and had not been wrapped in textiles. Two were clustered together on the western side of the niche whereas the other one was at the center. The layout of this cache leads us to believe that it was meant to represent a symbolic Maya cosmogram, as in many other offerings at Copan. In this sense, the shells represent the watery underworld whereas the eccentrics, with their blue-green wrappings can be seen as "world trees" or sacred ceibas growing out of the center.

Figure 43. Eccentric cherts 90-8 through 90-12 resting on their stems and facing west. Photo: Jorge Ramos.

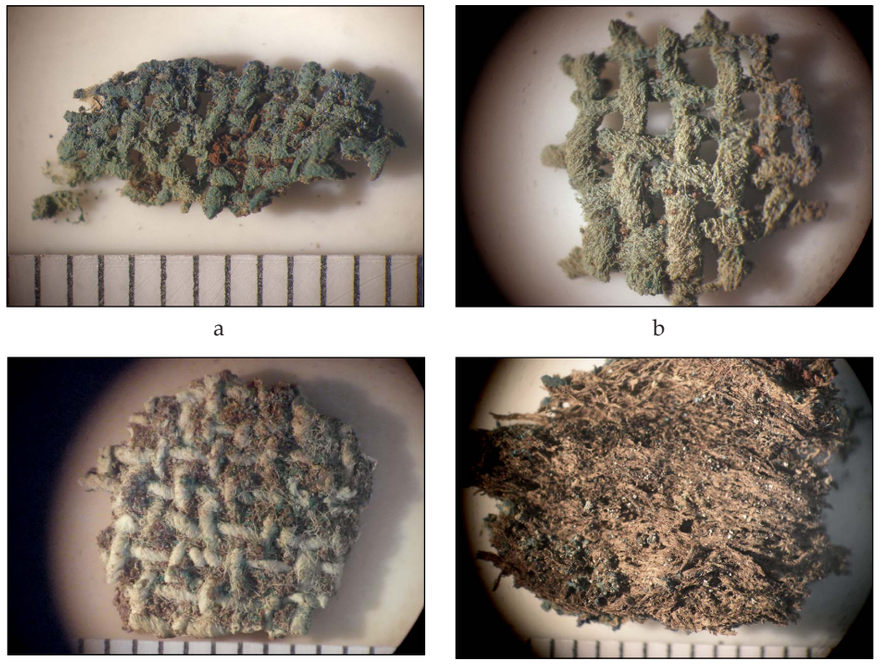

Figure 44. Fabrics associated with the cache: (a) plain weave cotton fabric no. 1; (b) plain weave cotton fabric no. 2; (c) unusual plain weave fabric no. 3; (d) brown colored barkcloth. Photos: Margaret Ordoñez.

Textiles

A recent analysis of the fabrics associated with this cache by Margaret Ordoñez (2012), of the University of Rhode Island, concluded that there were at least four different kinds:

1. A plain-weave cotton fabric made of single z-spun yarns with a fabric count of approximately 15 x 15 yarns/cm; yarn diameters of 0.1 to 0.6 mm; exposed yarn surfaces coated with green malachite powder and crystals and blue azurite crystals (Figure 44a).
2. A plain-weave cotton fabric made of single z-spun yarns with a fabric count of approximately 10 x 10 yarns/cm; yarn diameters of 0.2 to 0.7 mm; yarns in some of these fragments are not cylindrical and instead have a sunken longitudinal center area that produces a ridge on each side; malachite and azurite are also found on these yarns (Figure 44b).
3. An unusual plain-weave fabric made of large, white, single z-spun yarns; diameters up to 0.8 cm; many of the yarns have hollow centers; malachite crystals are scattered on the surfaces; these fibers remain unidentified (Figure 44c).
4. A brown-colored barkcloth made from the fibrous inner bark of woody plants (Figure 44d).

Figure 45. Bright green and blue pigments on the fabrics of Artifact 90-10. Photo: Ricardo Agurcia F.

A close inspection of the distribution of these fabrics on the chert artifacts in the cache shows that they were individually wrapped. All had textile remains on their upper/outward sides, and in all cases they had some in a location that was "covered" by another artifact in the cache, making it evident that they were separately wrapped. Additionally, seven out of the twelve objects (58%) also had traces of fabrics on their undersides. The fourth fabric, the brown-colored barkcloth, is generally found overlying the green-blue textiles. Traces of this fabric were found on all objects except for Artifact 90-6 (one of the two smaller bifaces). Although it is possible that they were enclosed in a still-larger bundle, given the fragmentary nature of the remains this cannot be stated conclusively. It is likely that the variety of fabrics identified by Ordoñez is also indicative of a fairly elaborate wrapping process that could have included larger bundles.

The bright green and blue pigments that were applied to the exterior surfaces of the first three fabrics (Figure 45) were identified (using x-ray diffraction) by Harriet (Rae) Beaubien (2007) of the Museum Conservation Institute, Smithsonian Institution, as malachite [Cu2(CO3)(OH)2] and azurite [Cu3(CO3)2(OH)2].

Three of the artifacts (two bifaces, 90-1, 90-2 and one eccentric, 90-8) also provided clear evidence of the use of a fibrous, brown-colored material directly over the chert and covering both sides of the objects at their bases. In these cases, this substance was found underneath the colored textiles. It is probably also barkcloth, but in the case of Artifact 90-1 its linear structure over the object suggests a twine-like material (Figure 46).

All chipped stone artifacts in the cache had some trace of a red pigment, probably cinnabar (mercuric sulfide [HgS]), directly over the blade (Figure 47). The three bifaces provided the best examples of this, as did some of the eccentrics (notably 90-3, 4, 7, 9, and 10).

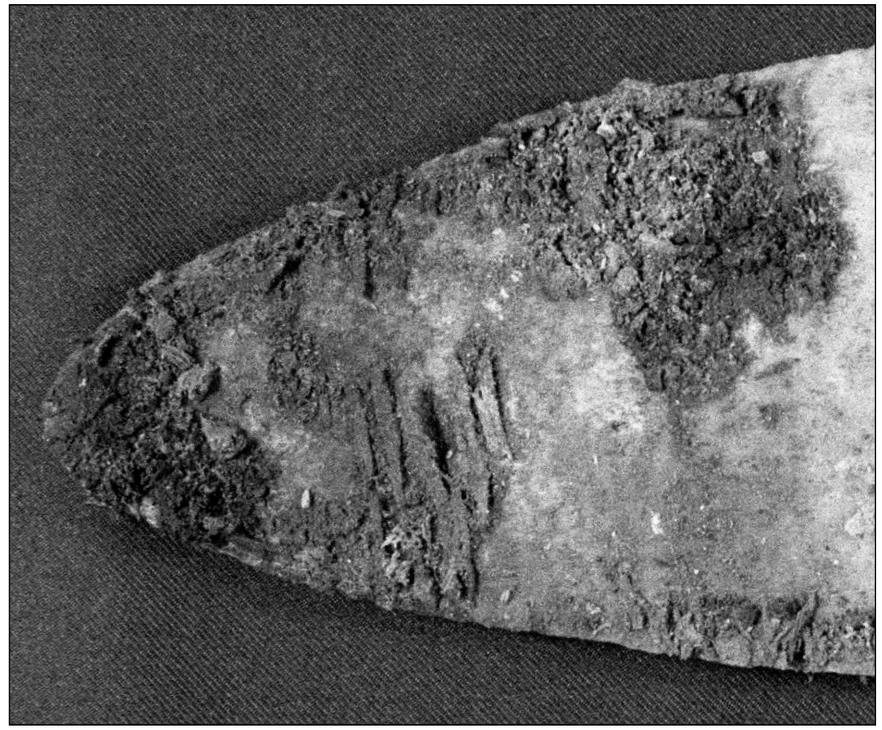

Figure 46. Twine-like fibrous material on Artifact 90-1. Photo: Ricardo Agurcia F.

Figure 47. Red pigment (cinnabar?) on Artifact 90-1. Photo: Ricardo Agurcia F.

Figure 48. First elaborate eccentric from Copan, found by Gustav Strömsvik in the rubble of the Hieroglyphic Stairway. Length 185 mm; width 167 mm; thickness 11 mm; weight 165.9 grams.

Julia Guernsey and F. Kent Reilly (2006) give a thorough review of bundling practices in Mesoamerica and especially among the Maya. In their introduction (Guernsey and Reilly 2006:x), they highlight the fact that the carved monuments of Copan have long been noted for their representations of bundling. One of the chapters, written by Dorie Reents-Budet, emphasizes the use of cloth (especially cotton) "to wrap sacred implements and hallowed offerings" (Reents-Budet 2006:107). Furthermore, Reents-Budet provides an image from the Palace Tablet of Palenque in which an eccentric is shown as part of a bundle (Reents-Budet 2006:Fig. 9c) (see Figure 12c for detail of this eccentric with a shield).

Other Eccentrics at Copan

Over the past century, archaeologists have found thirteen elaborate, or "effigy," eccentrics at Copan, more than at any other Maya site. Gustav Strömsvik found the first one in the rubble of the Hieroglyphic Stairway (published in Kidder 1947:27, Fig. 73c, and in Longyear 1952:110, Fig. 93) (Figure 48). Many decades later, William Fash found a cache with three more under the altar at the base of that same stairway (Fash 2001:147). These can be dated to the dedication of the Hieroglyphic Stairway in AD 755 (9.16.4.1.0, during the reign of Ruler 15). However, the find containing the most numerous collection is the one described in this publication. In addition, the size of many of the cherts from the Rosalila offering are noteworthy and constitute the largest examples of the elaborate style known for the Classic Maya. In view of the technical considerations implied in the production of these objects, as discussed in the next section, and their relative abundance at the site, we can postulate that in fact the workshop for these exotic objects was in the immediate vicinity of Copan.

Lithic Technology[9]

Manufacture

The consistent thinness and flatness of the Rosalila eccentrics indicates that they must have been made from flat tabular slabs of chert that initially were not much thicker than the finished artifacts. It is clear that they were not made from large percussion blades, and thus they do not formally have ventral and dorsal sides. However, here and in Appendix A we artificially identify the ventral side as the side with the principal figure facing toward the left, in order to locate certain aspects. The chert source (or sources) remains unknown but could have been somewhere near Copan or in the Maya lowlands. A recent study argues that the source may be in or near the southeast Maya area, including Copan, because of the higher frequency of these kinds of eccentrics in that area (Clark et al. 2012a). Because the source has yet to be found and the debitage from manufacture of chert eccentrics along with broken and discarded fragments has yet to be

[9] This section focuses on the material used to make the twelve lithic artifacts from the Rosalila cache, the processes used in their manufacture, and some considerations regarding the workshop in which they were fabricated.

discovered, much remains to be understood about this fascinating topic. All chert artifacts, including debitage, from Copan have yet to be analyzed. When they are, it will be important to know if fine brown chert debitage is present, as well as its provenience within the site. The evidence, presented below, indicates clearly that these eccentrics and the accompanying bifaces were manufactured very close to the Rosalila building and colored, wrapped, and placed in the cache right away. The quality of the chert for controlled fracture is exceptional. It is a moderately dark brown color with no concentric banding or observed inclusions.

The general sequence of manufacture of the eccentrics and the bifaces started with obtaining a large flat slab of chert from the source, whether nearby or at a distance, and checking it for quality. That would include careful visual inspection and also tapping the piece with another stone to listen for the ringing sound that denotes a piece without significant flaws such as inclusions, internal fractures, or cleavages. Because of the thinness of the chert slabs, not much thicker than the final products, the lengths and widths of the slabs may have been only slightly greater than the end product.

Manufacture began in the workshop with some percussion shaping and then shifted to the use of a punch, presumably of deer antler, in indirect percussion. The advantage of using a punch is that both the point-of-force application and the direction of force are precisely determined before that force is applied. Most of the shaping was done with a punch. The biggest unknown is how the piece was stabilized during percussion and indirect percussion, as the further along the process went, the greater the chance of error. Major errors could have occurred, and must have occurred, when excessive or misdirected force broke off major components or even resulted in breaking the eccentric in half, as may have happened with an eccentric fragment in the collection of Dumbarton Oaks (Clark et al. 2012a:277, Fig. 161). It is likely that many hands held the piece during both kinds of percussion and could well have held it against a deer hide or similar relatively firm but not rigid surface. The final edge finishing and notching was done by pressure flaking, which rarely risks making major breaks but sometimes results in the fracturing away of small portions. Many of the Rosalila eccentrics exhibit that kind of minor error, where a small portion broke off accidentally (see Appendix A with individual artifact descriptions). When the debitage from manufacture of these eccentrics and bifaces is discovered, along with failures in manufacture, much will be learned about the workshop that cannot be learned from finished specimens.

Bifaces

The three bifaces were made by highly skilled artisans and share the same general form in that each has a more sharply pointed distal end and a more rounded proximal end. They are reminiscent of bifacially flaked sacrificial blades found commonly at many Maya and Mesoamerican sites. The two smaller ones (Artifacts 90-2 and 90-6) (Figure 49b, c) were quite well made and had cinnabar

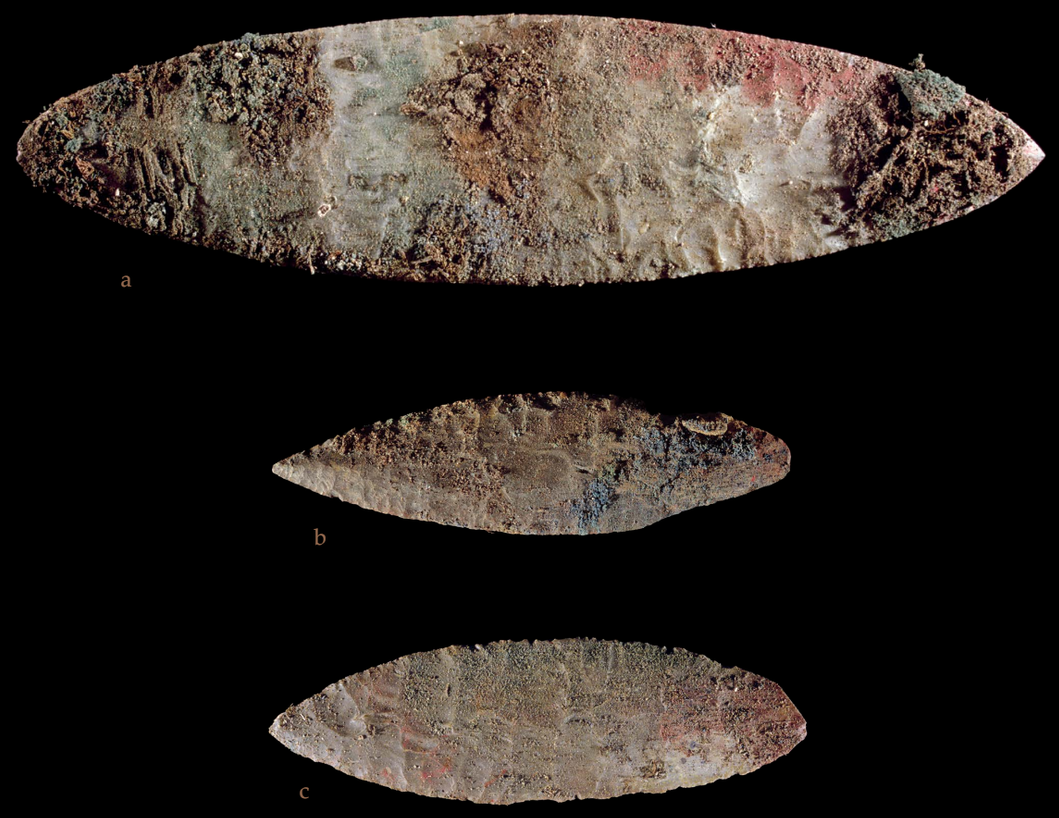

Figure 49. Rosalila bifaces (to relative scale): (a) 90-1; (b) 90-2; (c) 90-6. Photos: Ken Garrett.

pigment added to them before they were wrapped in a fabric. Flaking control and the resulting morphology was not up to the achievement of the large biface, and thus we attribute their manufacture to an apprentice in the workshop. The large biface (Artifact 90-1) is a magnificent specimen in controlled manufacture of a very large artifact by the most skilled knapper in the workshop (Figure 49a). We call him "the master" for process and product. This is the only artifact from this group of twelve that came from a different chert source, as it is a lighter color and not as fine-grained as the others. This large biface was colored with cinnabar, wrapped in fabric, and then cached. Descriptive and quantitative data for individual artifacts are available in Appendix A.

Eccentrics

The nine eccentrics are here described in two groups. The first group is composed of the three eccentrics attributed to the apprentice, and the second is composed of the six attributed to the master craftsperson.

The three eccentrics attributed to the apprentice are Artifacts 90-3, 90-4, and 90-9 (see Figure 20 on page 35). In basic design they are less complex than the other eccentrics, as each has a single anthropomorphic face, and fewer details in headdresses and projections. The larger thinning and shaping flake scars, presumably resulting from indirect percussion with a deer antler, are not as well controlled as those on the other six eccentrics, and quite a few hinge and step fractures are discernable. The notching on these three eccentrics was done with a larger-diameter pressure flaker than the tool used for notching the other six eccentrics. All the notching on these three was done directly, likely indicating feathers, but with only one exception. The headdress of Artifact 90-9 has oblique notching, suggestive of lightning. The pressure flaking to regularize the outline and achieve feather edges all around the eccentrics is also not as finely done as that on the other eccentrics, but with one area of exception. Fine pressure flaking was done on all three in the face and arm areas. More specifically, the highly skilled final pressure flaking extends from the forehead through the face and neck and all the way around the arm. It appears that after the apprentice had taken manufacture as far as his or her skills allowed, the master did the pressure finishing of the most important portions. This probably indicates the most important, and most supernaturally powerful, component of these eccentrics is the face, neck, and arm of the principal figure.

The six eccentrics attributed to the master (Artifacts 90-5, 90-7, 90-8, 90-10, 90-11, and 90-12) (Figure 50) are among the most magnificently crafted lithic artifacts in the Maya area. Hruby (2007:68) suggests that eccentrics are "god effigies" and the K'awiil and Chahk references of these eccentrics substantiate that interpretation, as they were placed in the special cache to protect the most sacred space at Copan.

Each eccentric in this group has a stem, and the stems vary quite a bit. Some have cortex at the base, some have a front-facing facet, and one has elegant curves that probably depict the serpent leg and foot of K'awiil. The stem becomes the body of the seated principal figure. Beyond that magnificently created profile, usually with a smoking axe atop the forehead, are other anthropomorphic heads. They range from one to three, and they all have the smoking axe atop their foreheads. The principal figures in all six of these eccentrics are quite similar. What is striking is the range of variation beyond the principal figure in the stem and especially in the other faces, headdresses, and other accouterments. That variation is so great that the suitable place to describe it is with individual artifact descriptions in Appendix A.

Evidence of thermal pre-treatment was sought, but none was detected. The chert for eccentrics and for the bifaces presumably could have been improved by careful heating and slow cooling, in order to reduce the amount of force needed for fracture. Thermal alteration would have been easier with a flat thin slab than

Figure 50. Rosalila Artifacts 90-5, 90-7, 90-8, 90-10, 90-11, and 90-12. Photos: Ken Garrett.

with a thicker piece. It would be important to know if this was a deliberate decision to not heat-treat, or if that technology was unknown to the artisans. The former alternative is more likely.

As with the two complete eccentrics in the Dumbarton Oaks collection (Clark et al. 2012b), four of these eccentrics also had cortex at the bottom of their stems. The cortex presumably is largely $CaCO_3$, from the limestone matrix in which the chert formed. Because of the Maya belief that the chert was formed by lightning and is associated with fire, the white cortex could symbolize the white clouds from which lightning comes. Or the white could signify the earthen limestone context into which the lightning bolt blasted, creating the chert. Another common attribute of the stem is the blunt surface at the very bottom, consisting of the cortex itself or a perpendicular facet of the chert created at the bottom in five cases.

All nine eccentrics have sets of notching along the margins of various elements, and within a set the notching is consistent. However, two styles of notching are clearly distinguishable, especially with the six eccentrics attributed to the master. Notching directly into the edge produces a series of regular notches that probably indicate feathers. The notches consistently are small and achieved by a tiny pressure flake removed from each face. The other style creates notches that angle into the edge, here called oblique notching. These usually are larger than the direct regular notches. The oblique notches are carefully done with one or two larger pressure flakes removed from each face, followed by a few very tiny pressure flakes to make them more precisely regular. The oblique notches may depict lightning. It is notable that there is no oblique notching on the three artifacts made by the apprentice, with the sole exception of the few on Artifact 90-9 where some difficulty was encountered in achieving them. Although this kind of oblique notching requires slightly more skill and effort than direct notching, the apprentice apparently had sufficient skill to achieve it, albeit roughly.

From examining the nine eccentrics from this unique Rosalila cache it is clear that the artisans worked hard to maintain acute "feather edge" terminations around the entire circumference of all pieces, with the exception of some eccentrics where the very bottom of the stem terminates in cortex or a flat facet. Many of the eccentrics found in the Maya area exhibit apparent errors, generally at the ends of projecting elements, where something broke off during manufacture and left a surface perpendicular to the face of the artifact. Such a blunt end is very rare on these eccentrics, and is here interpreted as most likely a manufacturing error. Given the extraordinary elaboration of these eccentrics, their great lengths and widths, and extreme thinness, a break due to mishandling during transport from workshop to Rosalila would more likely be at an interior or connecting location (e.g., the bridging elements in Artifact 90-10) and not to the tip of a tiny projection. The lack of handling breaks, as distinct from manufacturing errors, is evidence that they were made in close proximity to where they were cached.

Function as "Scepters" or Manufacture for Direct Deposit in the Cache?

All eccentrics and the three bifaces were examined macroscopically and microscopically for evidence of handling or use wear, to see if there is evidence that they were brought into ceremonies or other performances and then returned to storage. No such evidence was found. They all seem to have been made at close to the same time, with the intention of caching in Rosalila. They were never intended to be seen by people in ceremonies, but rather they were meant to protect that most sacred space.

Morphologically, each eccentric has a "handle," although we prefer the word "stem" because they do not appear to have been scepters. If they had functioned as scepters, moving them into and out of storage as well as their handling in ceremonies would have resulted in damage to the acute and extremely fragile feather edges. In this regard we agree with Clark et al. (2012a). Each has a principal anthropomorphic face, torso, and a well-defined shoulder, and from there on the details vary.

The Workshop: Some Considerations and Speculations

All eccentrics and bifaces apparently were made in the same workshop, from chert from the same source, but not all by the same person. We see two skill levels, with the highest being exhibited by the master and a slightly lower level by the apprentice. It is possible that there was more than one individual at these levels, but we doubt it. The three eccentrics we attribute to the apprentice are Artifacts 90-3, 4, and 9. The two smaller bifaces are also attributed to the apprentice. The other six eccentrics and the large biface are extraordinary accomplishments by the master.

An approximate estimate of the amount of time necessary to create these nine eccentrics and three bifaces can be made. Assuming two knappers in the workshop, and that both of them would be working on only one item at a time (one doing the flaking while the other was stabilizing the piece), then the estimate of Clarke et al. (2012a:274) of about 15 hours for each of the complete Dumbarton Oaks eccentrics is relevant. The Dumbarton Oaks eccentrics are only about 23 and 24 cm high, smaller than all of the Rosalila eccentrics and less than half the height of the largest ones. Moreover, the necessity of successful stabilization while flaking increases considerably with increase in size. Therefore, we estimate a minimum of 35 hours was needed for two people per artifact, for a total of over 600 worker hours needed to manufacture all eccentrics. This estimate does not include the hours of obtaining the raw materials, or of post-manufacture painting and wrapping.

One wonders what the artisans in the workshop that produced these eccentrics were doing when they were not producing eccentrics at Copan. One possibility is that they were itinerant artisans and arrived when elites called for

their special duties at Copan's Rosalila, with a later generation called upon to produce the three at the Hieroglyphic Stairway. If this is the case, it will be difficult to try to find their home base, if indeed they had one, unless a fortunate excavator can find a well-stocked tomb with good bone preservation. The other alternative is that they were residents of Copan, and if so, eccentric manufacture would have been only an occasional task, while manufacturing other chert tools was the principal activity. They likely made great numbers of large chert bifacial choppers for quarrying building and sculptural stone and agrarian purposes as well as knives, projectile points, scrapers, and finer flake-derived tools for fine sculpting and finishing stelae and other sculptures. They might also have been the manufacturers of obsidian implements. The degree to which they would have been full-time or part-time is unknown, but at least the workshop head maintained exceptional abilities.

In this residential scenario the Copan artisans may have manufactured eccentrics for other localities. Without chert debitage studies, it is unknown if manufacture was done at Copan or whether they traveled to recipient communities and did manufacture there. An example is the unpublished eccentric that Stanley Boggs excavated from San Andrés in El Salvador. The high degree of similarity in material, flaking, style, and iconography of these Rosalila eccentrics with the unpublished one suggests the high likelihood that it was made by the same specialists who created the Rosalila eccentrics. As it is undated, it could have been manufactured by an earlier or later generation of the Rosalila knappers. Because it is not as elaborate as the three eccentrics from the Hieroglyphic Stairway (Fash 1999:147), it probably was not made by that generation.

Conclusions

In both the New and Old Worlds, the earliest human presence is marked mostly by chipped stone tools. These ancient instruments were first devised mostly for hunting, fighting, and processing foodstuffs. The manufacture of lithic artifacts reached its apex with Maya eccentric cherts, an art form that is unprecedented in the ancient world. Comparable examples approaching this quality of craftsmanship in the Old World would be the chert daggers of late Neolithic Denmark or pressure-flaked Gerzean blades of Predynastic Egypt. However, for both these cited examples, the items could be readily used as tools or weapons. This is by no means the case with the nine eccentrics from Rosalila, which clearly had a symbolic use and function pertaining to the supernatural realm rather than being objects wielded by human hands. Therefore we do not agree with the common assumption that they were scepters, used in public or private ceremonies.

A further similarity with the examples of Gerzean knives from Egypt and flint daggers from Neolithic Denmark is that these remarkable examples of Old World stone technology appeared just at the advent of the Chalcolithic, or Copper Age. One might surmise that lithic experts were pressured to push the limits of stone working to compete with the advent of metallurgy. Likewise, it is worth considering that this most impressive of all examples of Mesoamerican chert working from Rosalila also could have been partly a response to the advent of metal from the south, as one of the earliest examples of metal in Mesoamerica is a *tumbaga* piece discovered in a cache under Stela H at Copan (Strömsvik 1941:71).

It is profoundly regrettable that most eccentrics available for study do not come from documented archaeological contexts. It is for this reason that this unique sample from the Rosalila Structure is of preeminent importance. Along with being delicately placed by the ancient Maya over a millennium ago, the Rosalila eccentrics were carefully excavated, recorded, conserved, and stored in Honduras, greatly facilitating the analysis presented in this monograph. In addition, there is no known Classic Maya chert eccentric offering presenting the scale of effort in workmanship—including the sheer size of the objects—that approaches what was discovered in Rosalila.

The context and content of the Rosalila cache suggest that the eccentrics formed part of an elaborate cosmogram embodying the primordial ocean below, represented by three spiny oyster shells. Additionally, although clearly related to the sea, *Spondylus princeps* was also closely related to corn and the maize god among the Classic Maya, including Early Classic caches at Copan featuring jadeite images of this deity within or surrounded by these bivalves (see Finamore and Houston 2010:No. 89). In this regard, the shells in the Rosalila offering may allude to life-sustaining water nurturing the painstakingly planted, upright eccentric blades whose branching elements denote the maize god bearing the cranial torch of K'awiil, a being solidly identified with lightning as well as sustenance. As our analysis of their iconography further bears out, they were also ritual weapons of enormous religious power designed to protect the hallowed spaces of Rosalila and the Copan Acropolis. They were the most delicate of fighting instruments, created by masters of lithic technology in exotic forms that while denoting major, powerful deities never lost their basic form as a weapon. They were made specifically to be buried and have no signs of wear to indicate otherwise. Placed in critical locations of special buildings, their primary role was in the spiritual world.

Appendix A
Individual Descriptions of Bifaces and Eccentrics

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The cache of lithic artifacts is so extraordinary that we believe each artifact warrants individual description and abundant illustration.

A note on terminology: As Clark et al. (2012a) observe, the term "eccentric flints" is far from an ideal term for these artifacts. They are made of chert, not flint. So we prefer not to continue the misnomer and therefore simply refer to them as "eccentrics" or "eccentric cherts." Even the term eccentric has nothing to do with what they may have been called during the Classic period, but it is deep in the literature so we will continue to use it. They are often called scepters as a functional term, but we could find no evidence that any of these nine were so used. Rather, we believe they were made specifically for this cache, and little time elapsed between their manufacture, coloring, wrapping, and placement in the Rosalila building.

Clark et al. (2012b) counted the notches on the three Dumbarton Oaks eccentrics that they described and analyzed in detail. We have also provided notch counts but find that the number of notches is not as important as the two styles: smaller direct notches that probably depict feathers, and larger angled (oblique) ones that may depict lightning.

Because each eccentric and biface was made from tablular chert instead of nodular chert from large percussion macroblades, they do not have a ventral and a dorsal face. Arbitrarily, the term ventral is used for the face visible when the principal figure is facing left, and dorsal is used for the principal figure facing right. Also, sides occasionally are referred to in terms of storage. The face with the least fabric is stored down, and here referred to as the underside. Of course, the faces with the most fabric are stored with no contact with other surfaces and are referred to as the top side.

Each artifact is identified with an "Artifact" number that was assigned in the field as they were being excavated, and a "P" number that is the accession number assigned by the Honduran Institute of Anthropology and History (CPN/IHAH).

Figure A.1. Detail of Artifact 90-7. Photo: Ken Garrett.

Artifact 90-1; P-2758; Chert Biface (Figures A.2–A.4)

This is one of the finest large chert bifaces of the Maya area.

This huge chert biface is notable for its size, thinness, lack of flaking problems such as step or hinge fractures, and the precision in creating its outline. The presumed manufacturing steps began with percussion for early shaping of a thin and large piece of tabular chert. The flaking changed to indirect percussion rather early in the process because of the size and thinness requiring precision in the direction and amount of force and the point of force application. Final finishing was done by pressure flaking. The base is slightly rounded and the tip is pointed. The chert likely came from a source different from the eccentrics and the two smaller bifaces, as it is made from a whitish and slightly more fine-grained material. Flaking details initially were scant in this description because only one side could be examined, and that side was rather heavily coated with organic material, largely green-colored fabric. It also was coated with cinnabar, particularly heavily toward the pointed tip.

Close examination indicated that the biface was covered with multiple layers of organic materials. In some areas the blue-colored cloth was covered with uncolored cloth, in other places the reverse. And another kind of fiber was used for covering, both above and below the blue cloth. It could be agave (maguey) fiber, and it was uncolored. Remnants of twine thread are visible at the basal end. Both basal and distal ends have some possible barkcloth. All three bifaces and nine eccentrics presently are stored with the side with the least incrustations of fiber down, for conservation purposes. The undersides were photographed recently and reveal more manufacturing information than the top sides. Most of the flaking was done by expanding broad fractures, probably by at least two craftspeople. One would operate the punch, presumably of deer antler, while the other or others immobilized the piece to minimize the chances of breaking it by end-shock. Flaking was impressively well controlled, with only two flakes terminating in small hinge fractures. That was followed by careful pressure flaking of the margins to achieve the precise outline. The underside had a considerable amount of red pigment, apparently cinnabar, applied to its more pointed end.

The thinness of the biface relative to its length is extraordinary, and clearly it could only have been manufactured by a highly skilled artisan. The skill exhibited in this piece is equal to the finest of the eccentrics. Because there is no curvature along its longitudinal axis, there is no evidence that it was flaked from a very large percussion macroblade, although that is conceivable. However, it is much more likely that it was made from a chert source morphologically similar or identical to that from which the eccentrics were made (i.e., a laminar chert source). No cortex was detected.

Length 360 mm. Width 96 mm. Thickness 12.2 mm. Weight 517 grams.

Figure A.2. Artifact 90-1, Great Biface. Photo: Ken Garrett.

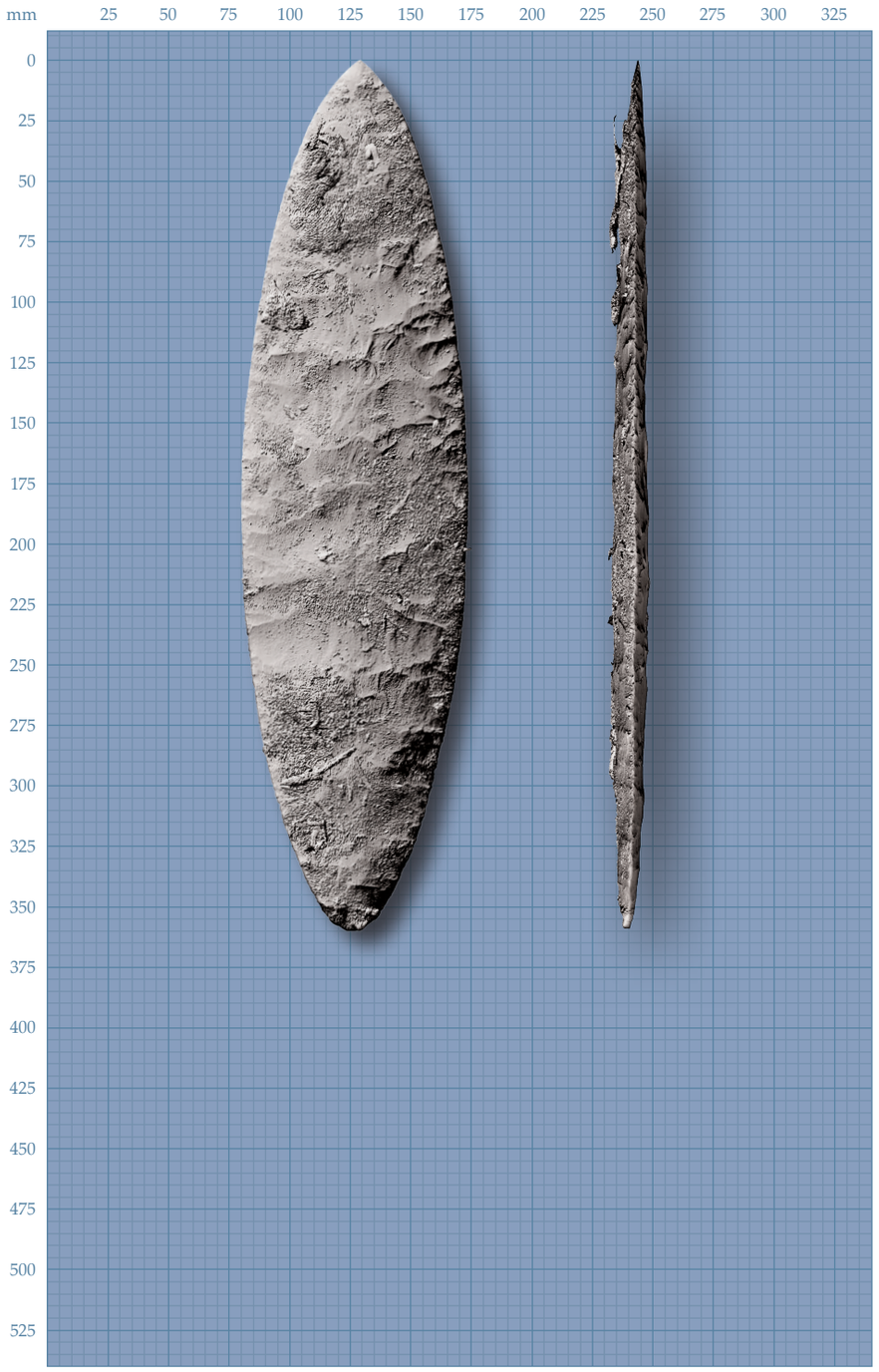


Figure A.3 Artifact 90-1, Great Biface: top and side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

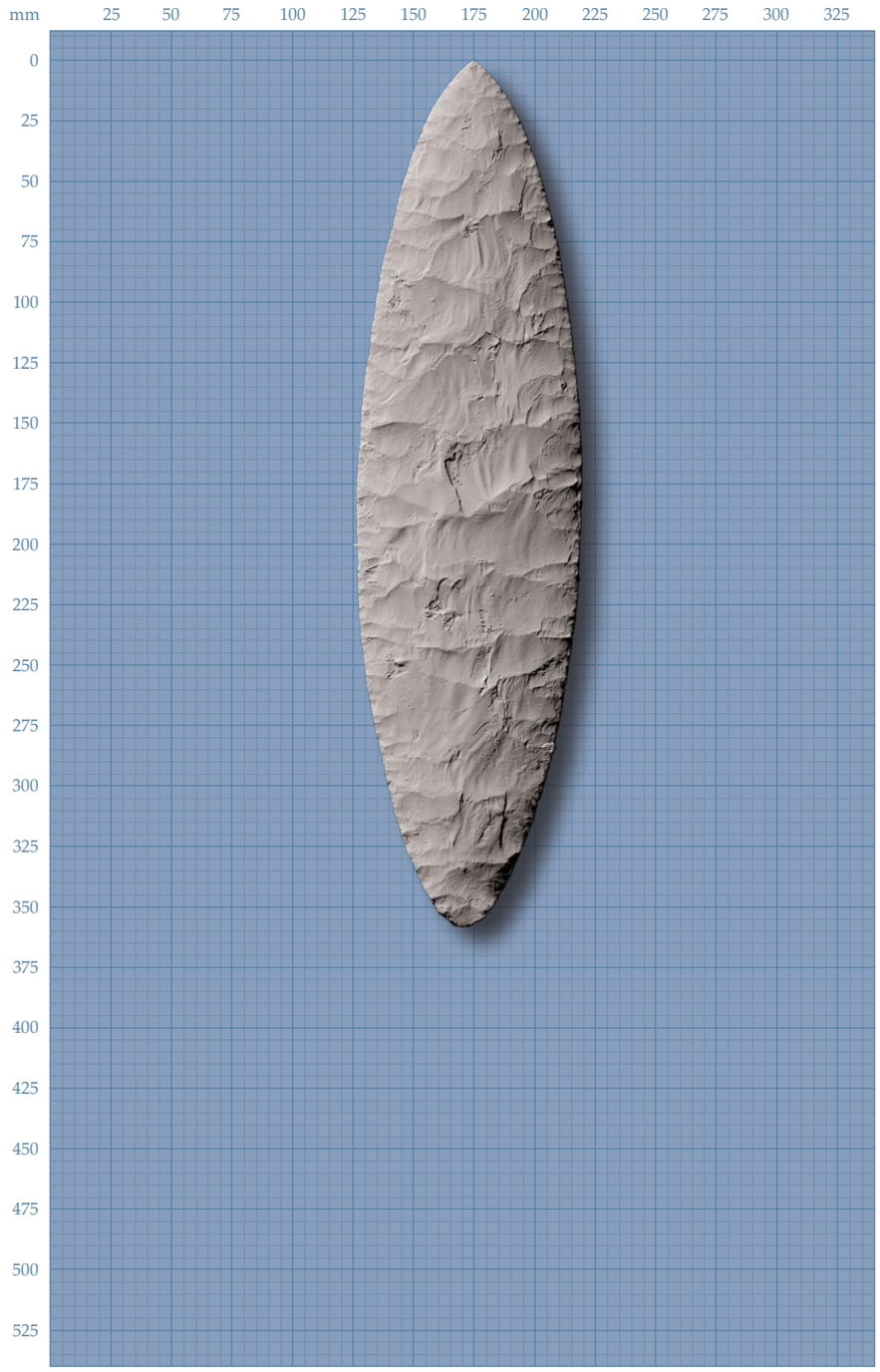


Figure A.4. Artifact 90-1, Great Biface: bottom. 3D scan rendering by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-2; P-2710; Chert Biface (Figures A.5–A.8)

This is one of two smaller chert bifaces from the Rosalila cache. This biface shows considerable manufacturing skill compared to the usual chert artifact manufacture in Classic-period Maya sites. However, compared to the large biface and the finer eccentrics, this was made by a less skilled artisan in the chert workshop. The evidence is in the minor but fairly common step and hinge fractures on both faces, the less regular outline, and the lack of a sharp pointed tip. It is stemmed, but not quite symmetrically. Both sides of the base of the stem have relatively moderate amounts of cinnabar adhering. It is possible that manioc provided the binder for the cinnabar, as the liquid extracted from it is an effective glue. The underside toward the base has a brownish incrustation that could be barkcloth. Near it is a possible fragment of wood, which may be a deliberate or inadvertent inclusion in the cache. Both of these two smaller bifaces are made from the same chert as all the eccentrics. It is a brown color and exceptionally fine-grained.

Many tiny flecks of blue pigment are visible on both faces, with a few of them clearly coming from fabric remnants. The blue was thus not painted on, but came from the cloth wrapping that was put on after the cinnabar was applied.

Length 154 mm. Width 43 mm. Thickness 8.3 mm. Weight 65 grams.

Figure A.5. Artifact 90-2, smaller biface with partial stem: hinge fracture errors. Photo: Payson Sheets.

Figure A.6. Artifact 90-2, small biface with partial stem. Photo: Ken Garrett.

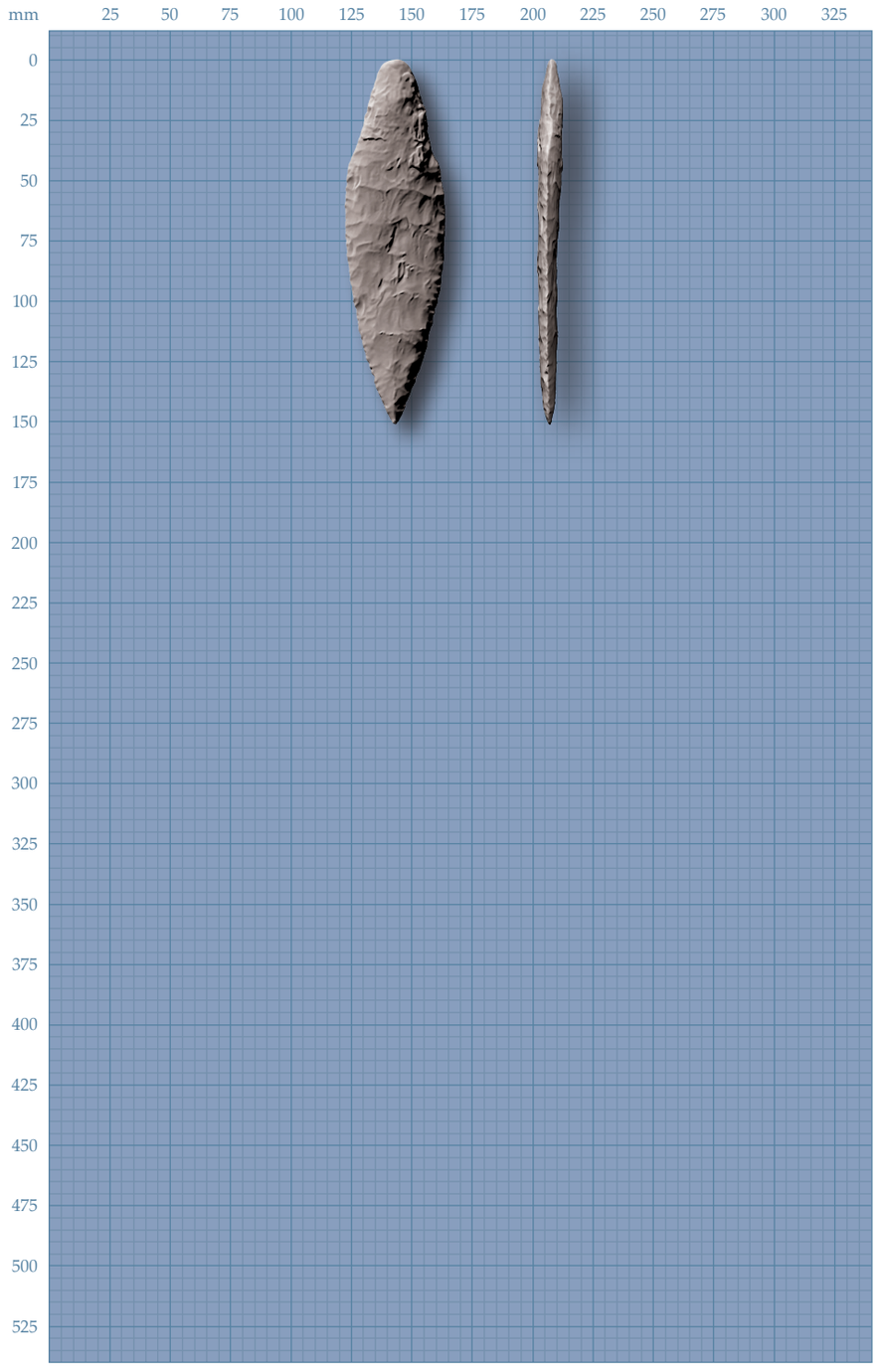


Figure A.7. Artifact 90-2, small biface with partial stem: top and side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

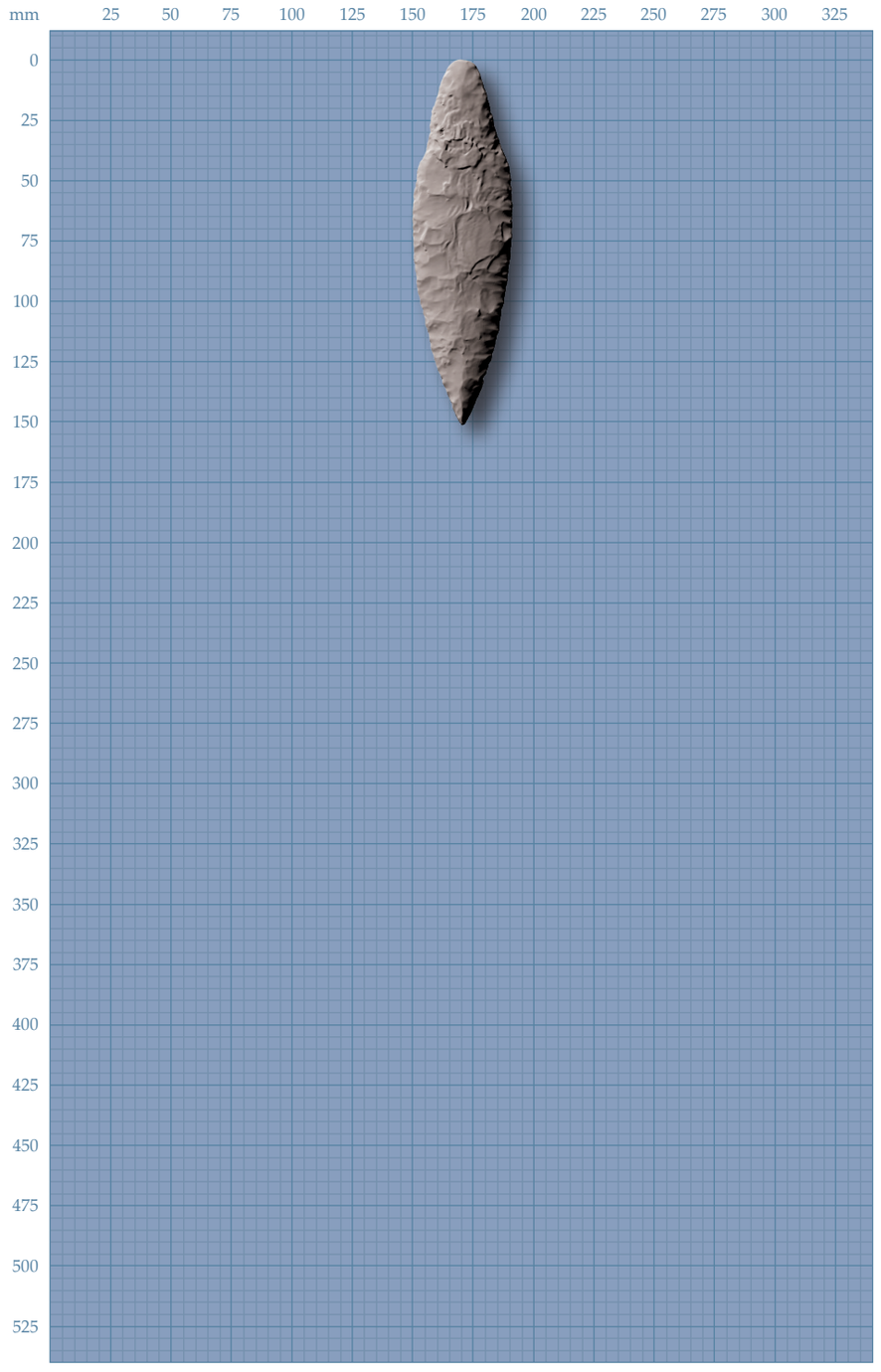


Figure A.8. Artifact 90-2, small biface with partial stem: bottom. 3D scan rendering by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-3; P-2761; Eccentric (Figures A.9–A.15)

This eccentric shares sufficient characteristics with Artifacts 90-4 and 90-9 that they all evidently were made by the same artisan. All have only one anthropomorphic face and an arm extended upward with two or three fingers, and the finishing of the head and arm is notably more carefully done than the rest of the artifact. All three of them feature the K'awiil maize deity as the principal figure. All have a somewhat irregular center line, with curves in the stem, and the lack of a rigid straight centerline running up the rest of the eccentric, in contrast to the formality of eccentrics 90-7, 90-8, and 90-10. All have three projections with multiple "teeth" in the lower portion, but above the stem. And those projections are quite similar in their shapes and the fact that they vary from simpler to a bit more complex. All three have semi-circular forms that may have been almost as important to shape as the projections that outline them. All have elaborate notched headdress crests, but they differ in how they were achieved. And all have similar numbers of hinge and step fractures on both faces and large scars from slightly irregular percussion/indirect percussion manufacture from the earlier stages of manufacture. All have similar errors/breaks experienced when the notching was done on projections.

Length (height) 308 mm. Width 115 mm. Thickness 14 mm. Weight 356 grams. Length of cortex 3.6 mm.

Artifact 90-3 has a significant zone of cortex at the bottom of the stem. Above the stem are three projections with teeth and one small projection that looks like a little tail. The notching is not very uniform, with notch diameters of about 6 mm (created by a pressure flaker with a tip of that diameter). The front projection has five notches and six "teeth" but the topmost element was broken, presumably in manufacture. If complete it would have had seven teeth. The two projections behind the primary figure also have irregular notching. The top one has four notches and five teeth, while the lower one has three notches and four teeth. The uppermost projection flares out and has no notches.

Figure A.9. Artifact 90-3, eccentric.
Photo: Ken Garrett.

Figure A.10. Artifact 90-3, eccentric: detail of face and headdress flare. Photo: Payson Sheets.

Figure A.11. Artifact 90-3, eccentric: principal figure detail. Photo: Payson Sheets.

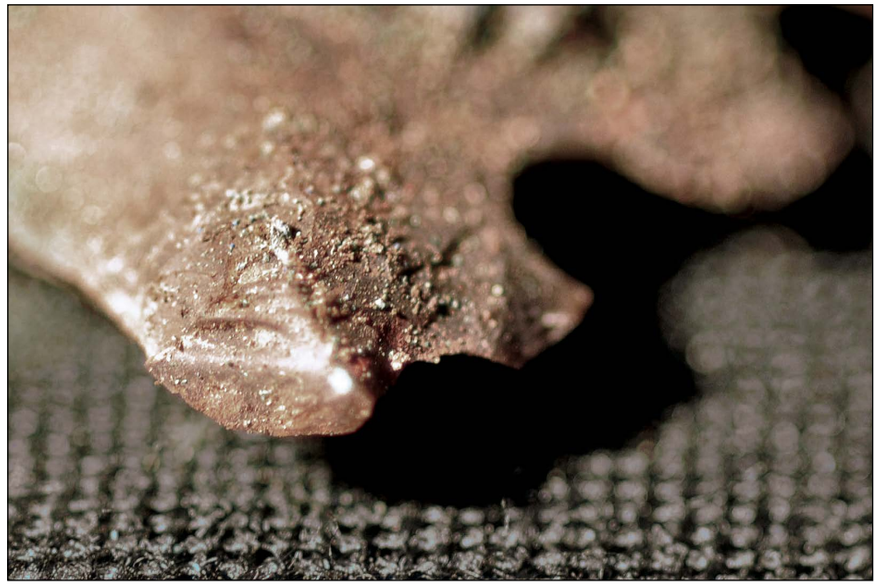


Figure A.12. Artifact 90-3, eccentric: snapped element detail. Photo: Payson Sheets.

The back of the headdress has slightly more regular notching, with three notches creating four teeth. At the top is a break that removed one tooth and most of the notch, so if it were complete it would have had four notches and five teeth. The main headdress is elaborate, with careful notching progressing from smaller to larger toward the front, culminating in an elegant double flare above the person's head. It has the appearance of a multi-legged upside-down animal but more likely is portraying feathers.

The final pressure flaking to regularize the forehead, face, neck, and arm, along with the back of the head and shoulder, is notably more finely done than elsewhere on this piece. A smaller diameter pressure flaker, presumably deer antler, was used to create the lips of the open mouth and the two fingers. It was about 4–5 mm in diameter, the same diameter as that used by the master to achieve the fine notching on the six ultra-sophisticated eccentrics. It appears that the person who did most of the manufacture handed the eccentric to a different flaker who more carefully finished these details. After it was manufactured, cinnabar was added, followed by large amounts of blue, green, and brown fabrics, and then some barkcloth on top of the colored cloth layers.

Figure A.13. Artifact 90-3, eccentric: detail of flaking difficulties and blue fabric. Photo: Payson Sheets.

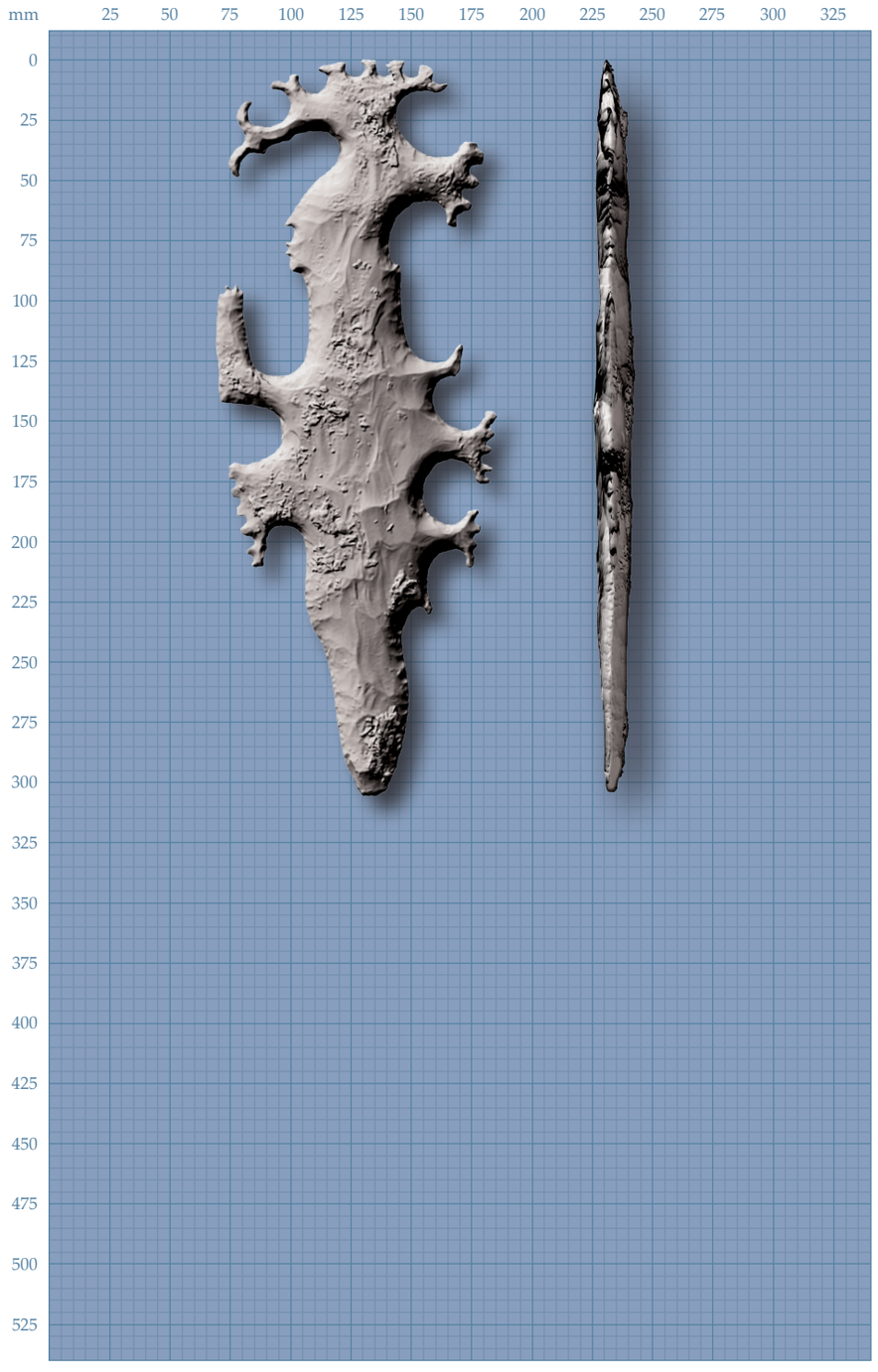


Figure A.14. Artifact 90-3, eccentric: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

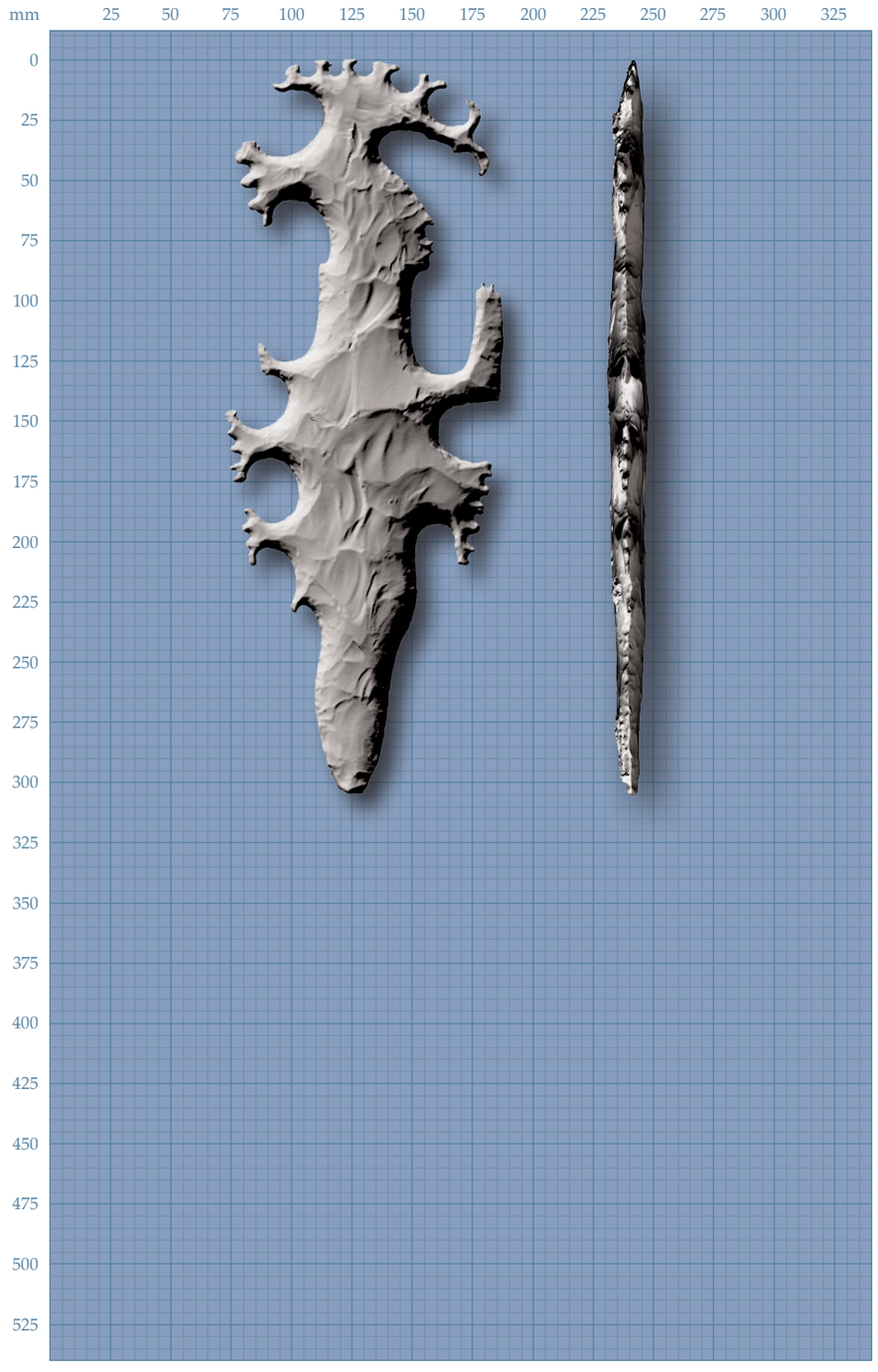


Figure A.15. Artifact 90-3, eccentric: bottom and right side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-4; P-2765; Eccentric (Figures A.16–A.18)

This eccentric is one of the least complex of the group of nine. In the general domain of lithic manufacture, it is of course impressive in the details depicted of the face and arm of the anthropomorphic figure, the serrated crest headdress, and other details. Compared to the other eight it is the least complex in morphology and iconography, and the artisan experienced some difficulties in manufacture. There are some large percussion flake scars from early stages of manufacture on both faces, over 5 cm long, and a few of them end in step and hinge fractures. A mistake was made in manufacture when a short (est. 10 mm) section of the front of the headdress crest broke off, leaving a blunt end. It was not re-flaked into a feather edge. Very small patches of red pigment (evidently cinnabar) were seen on both faces, with larger patches on the stem.

The serrated headdress crest has 16 notches and 16 teeth. The notches in the headdress and the other three projections are relatively large and were made with a pressure flaker with a point diameter of about 6 mm. The flaker presumably was deer antler. The flaker that made the mouth and the finger notches was smaller, with a diameter of about 5 mm. The larger notches in the headdress are fairly consistently made, but the notches in the other three projections are more irregular. In contrast, the hand and mouth notching is more finely done, as is the flaking from the top of the forehead, through the face, and along the body including the arms. It is possible that the apprentice did the majority of the manufacture, with the master doing the final finishing of the face, arm, and hand with its three fingers. The only place where very fine pressure flaking was done is from the top of the forehead through the face and neck and all the way around the arm. The size, care, success, and end product of the fine pressure flaking is identical to that done all the way around the six more complex eccentrics that are here attributed to the master.

The projection below the arm has four notches, creating five "teeth." Because of the number and the location, the reference might be to toes. However, the upper back projection has the same number of teeth and notches. The lower one is not well finished, and it is unclear what its form was intended to be. It has one clear notch, one partially formed one, and two that barely qualify.

After completion of the manufacture and application of the paint, it was wrapped in blue, green, and brown fabric.

Length (height) 280 mm. Width 125 mm. Thickness 16.5 mm. Weight 341 grams.

Figure A.16. Artifact 90-4, eccentric. Photo: Ken Garrett.

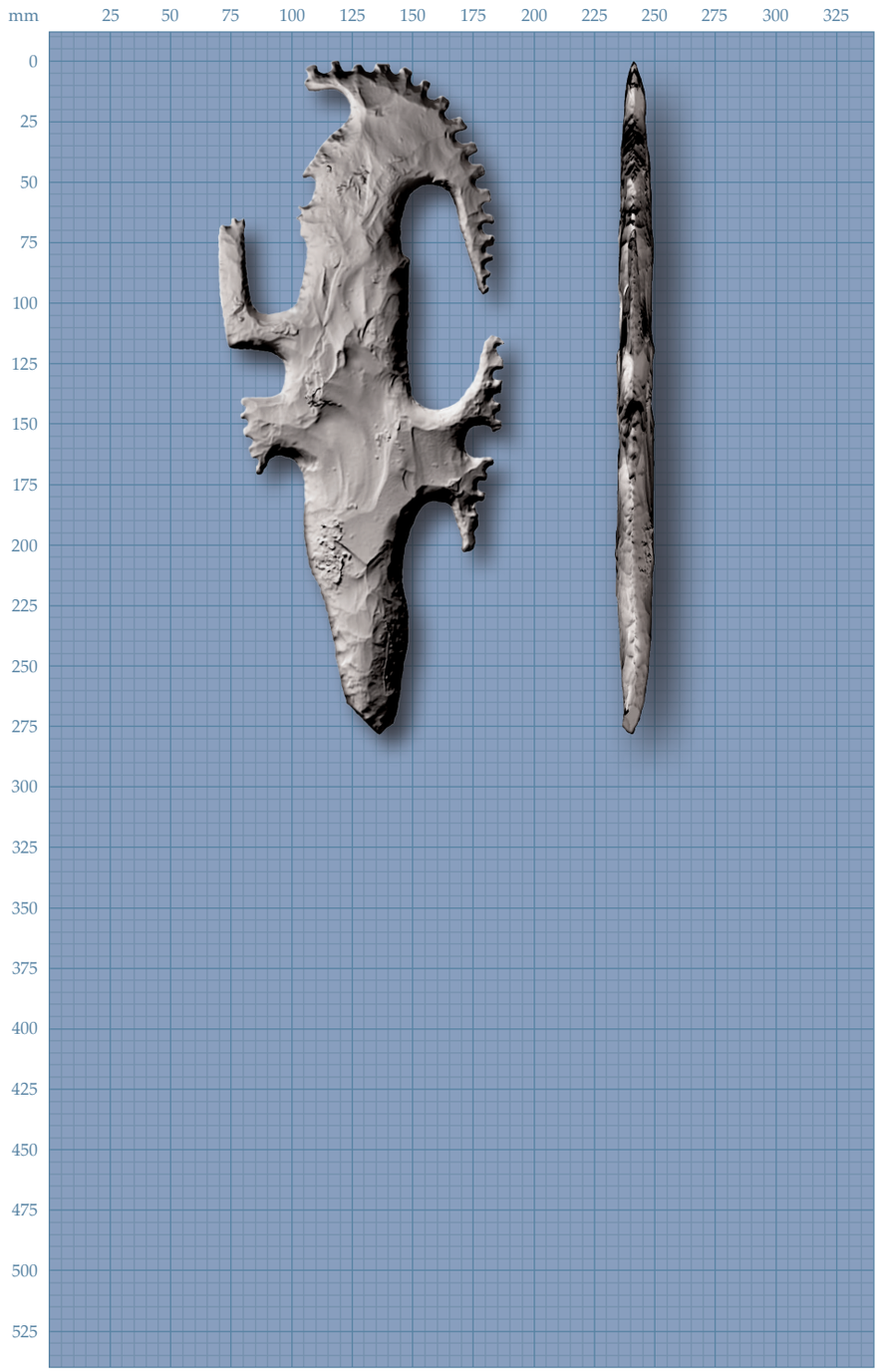


Figure A.17. Artifact 90-4, eccentric: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

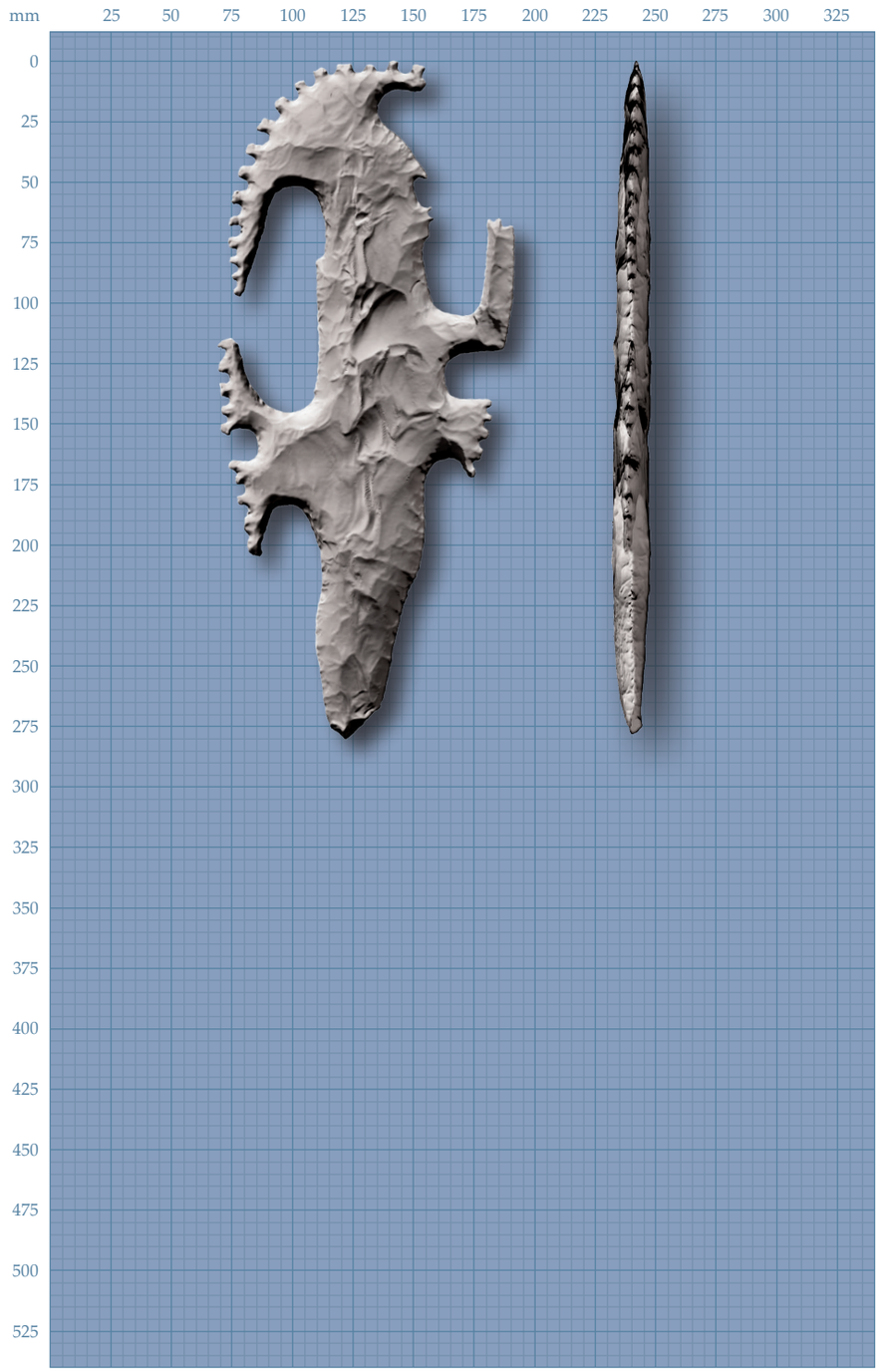


Figure A.18. Artifact 90-4, eccentric: bottom and right side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-5; P-2760; Eccentric (Figures A.19–A.24)

In terms of crafting skill this eccentric is about midway between the exceptionally well-made ones and the less well-made ones. It is moderate in elaborateness and shows considerable skill in manufacture. Manufacturing difficulties in terms of step or hinge fractures are rare, with a few more on the bottom than on the top side. The final finishing is not quite to the standard of the most finely finished of these eccentrics. If there were more than two artisans in the chert workshop, this could have been made by a senior apprentice. It is also possible that it was made by the master, who decided to produce a less complex one, perhaps under time pressure to complete the cache. In contrast to Artifacts 90-3, 90-4 and 90-9, where one person did most of the shaping and apparently another did finishing touches, this eccentric could well have been made entirely by one person, from the first series of flakes (percussion) through the second series (indirect percussion) and the final series (pressure). Only small amounts of cinnabar red pigment are visible. After the cinnabar was added, the eccentric was wrapped in blue and green fabric, with barkcloth wrapped around the complete bundle.

Length (height) 355 mm. Width 165 mm. Thickness 16 mm. Weight 404 grams.

The stem retains a facet at the base, as with most of these eccentrics. It has only a tiny trace of cortex remaining on it. The principal figure appears to be seated on a chair or throne, indicated by the two downward projections that may be the legs of the chair or throne. His legs may be indicated by the downward curl below the torso. The principal figure is carefully shaped by pressure flaking, so the outline of forehead, face, torso, and back are finished quite well. What is unusual about this eccentric compared to the other eccentrics in this cache is that his lips are not individuated by notching on the ventral and dorsal sides. The other anthropomorphic faces on the other eccentrics had careful pressure flaking done to create the pursed lips.

The principal figure has a double-element headdress consisting of two curving serrated crests. The notching on the top one is oblique and may represent lightning, while the notching on the back one is straight-in, presumably depicting feathers. The top crest has 28 oblique notches, and the back crest has 30 straight notches. There is no smoking/burning torch of K'awiil on the forehead of the principal figure. The elongated forehead may be referencing the Maize deity.

Figure A.19. Artifact 90-5, eccentric. Photo: Ken Garrett.

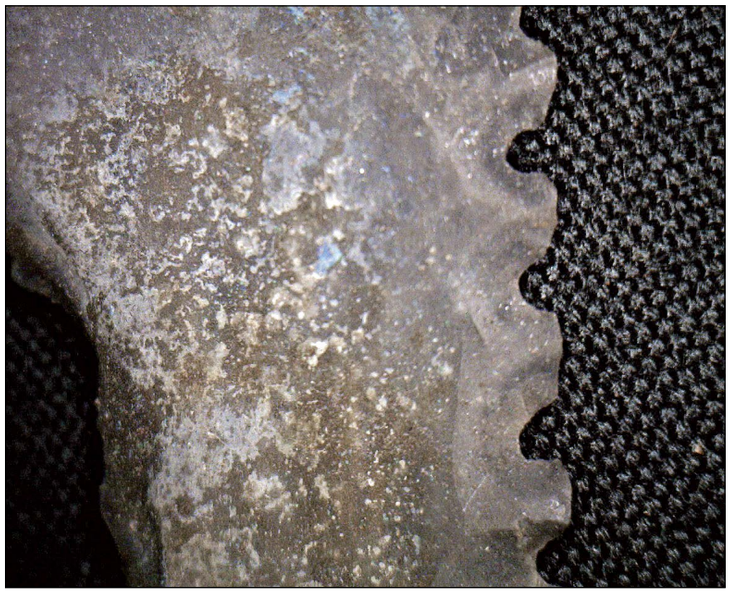


Figure A.20. Artifact 90-5, eccentric: detail of direct-in pressure flaking presumably depicting feathers. Photo: Payson Sheets.

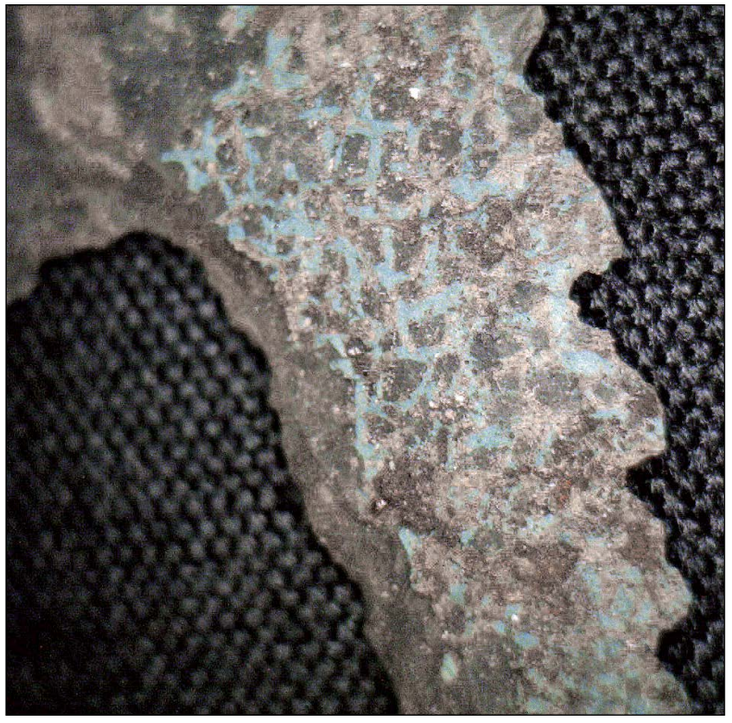


Figure A.21. Artifact 90-5, eccentric: detail of oblique notching, perhaps depicting lightning. Photo: Payson Sheets.

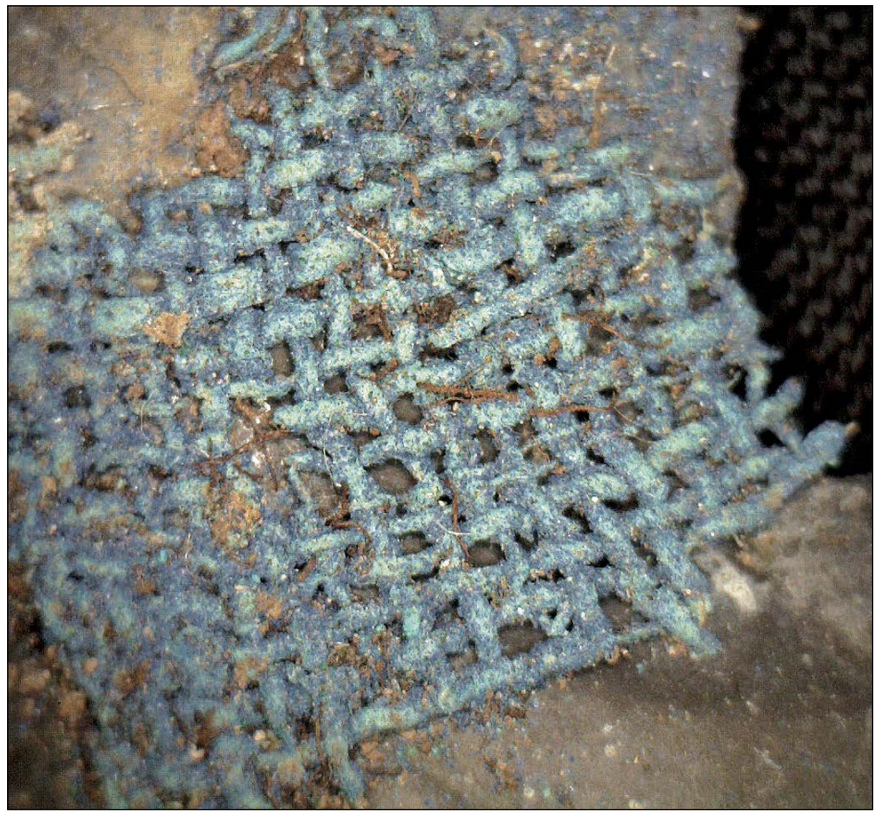


Figure A.22. Artifact 90-5, eccentric: detail of blue-colored fabric wrapping. Photo: Payson Sheets.

The arm of the principal figure is extended outward, as with the other eccentrics (except for Artifact 90-7), but in this case only for a short distance. The hand is holding an anthropomorphic face that is carefully shaped, but the lips are not individually defined on this face either. Above the head is a headdress that appears to be a bird, an owl or a turkey. If a bird is depicted, its feet also look like the smoking celt/torch of K'awiil. It is possible that both were intended by the artisan. The most prominent oblique notching on this eccentric is on this element, and it was achieved by seven notches, larger on the front and diminishing toward the back. It probably was intended to be an ascending series. If the oblique notching depicts lightning, it would be appropriate that the item below it is the smoking cranial element of K'awiil.

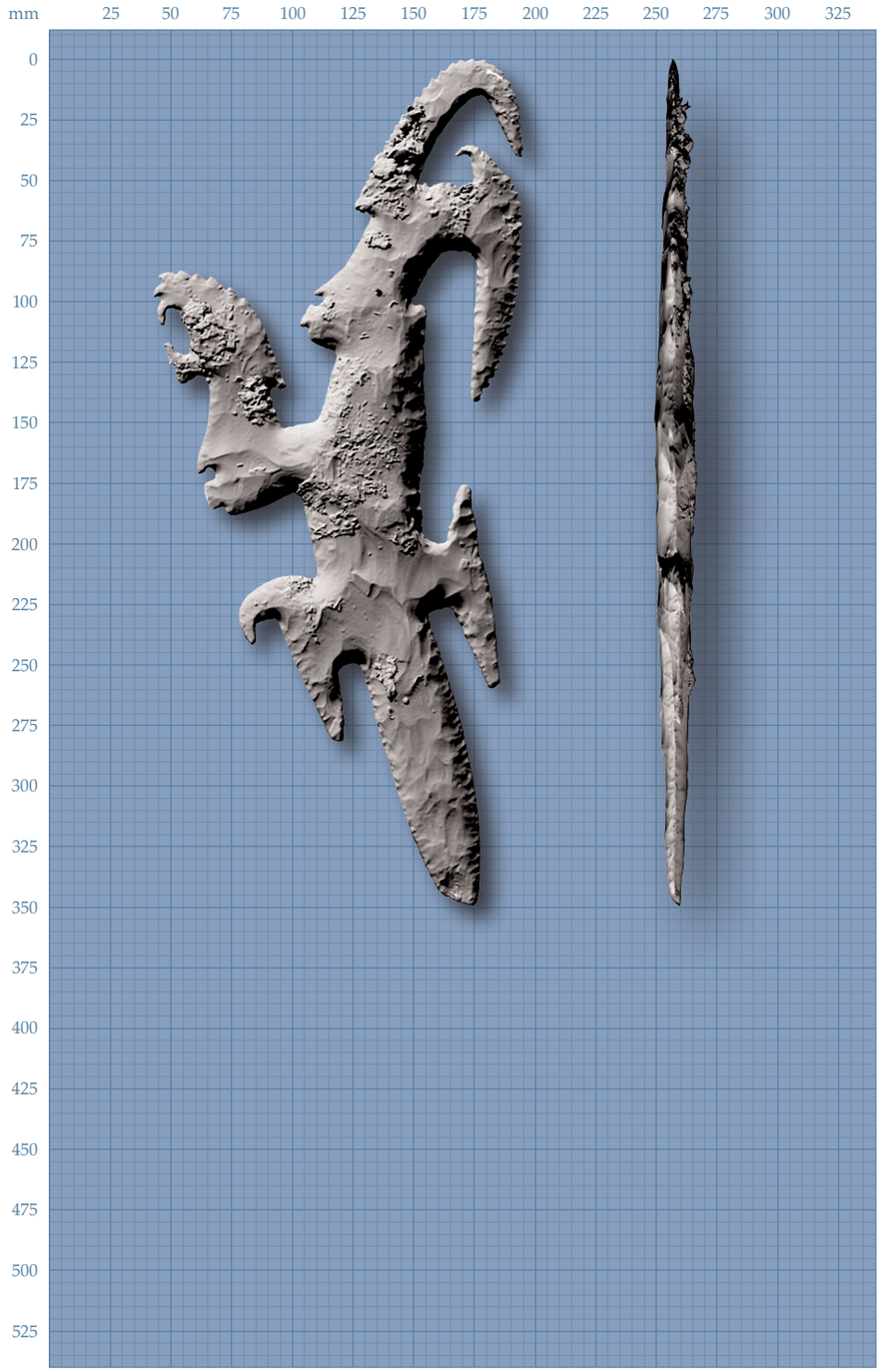


Figure A.23. Artifact 90-5, eccentric: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

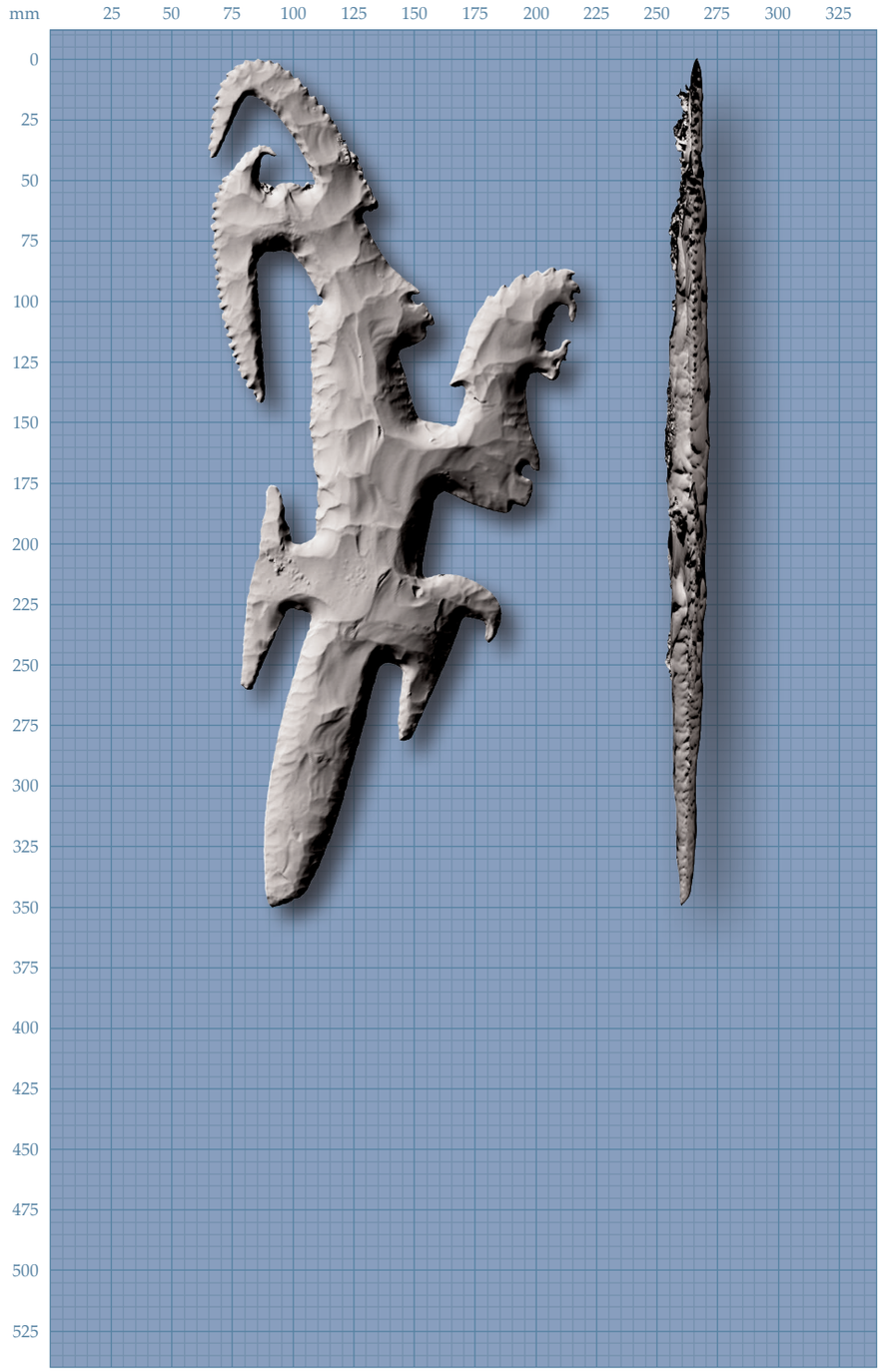


Figure A.24. Artifact 90-5, eccentric: bottom and right side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-6; P-2711; Chert Biface (Figures A.25–A.27)

This is one of two smaller chert bifaces, much smaller than Artifact 90-1, the large biface. This biface is 160 mm long, 49 mm wide, and 10.9 mm thick. It weighs 87 grams. Both this one and the other smaller one (Artifact 90-2) were manufactured in similar fashion and were likely made by the same person, the apprentice. And these two smaller bifaces show the same style of manufacture and level of expertise as the three eccentrics, Artifacts 90-3, 90-4, and 90-9. Both smaller bifaces exhibit a quite high level of skill in manufacture, with only very slight manufacturing errors in the form of hinge or step fractures. The lack of curvature along the longitudinal axis indicates this probably was not made from a large percussion blade from a large core. Rather, it probably was made from a piece of laminar chert from the same yet-to-be discovered source as the other small chert biface and all the eccentrics from this cache. Virtually all the flaking visible on both faces probably was achieved by indirect percussion (i.e., using a punch) and effectively stabilizing the biface to avoid end shock. A small facet was left toward the base. This and the other smaller biface lack the careful and precise pressure flaking that was performed on the larger one (Artifact 90-1). The two smaller bifaces were pressure-flaked as the last manufacturing step, and the precision of that final work is not quite as good as that on the three rougher eccentrics. The result is a slightly more irregular edge in outline and in edge-in view, in clear contrast to the precision of an exceptionally acute and sharp feather edge as achieved on the large biface.

The biface has a 14 mm–long basal facet, similar to the basal facets on many of the eccentrics. The base up to about 45 mm on the blade surface has considerable amounts of cinnabar coloring on both faces. It also has some blue and green pigment applied to it.

Figure A.25. Artifact 90-6, small biface. Photo: Ken Garrett.

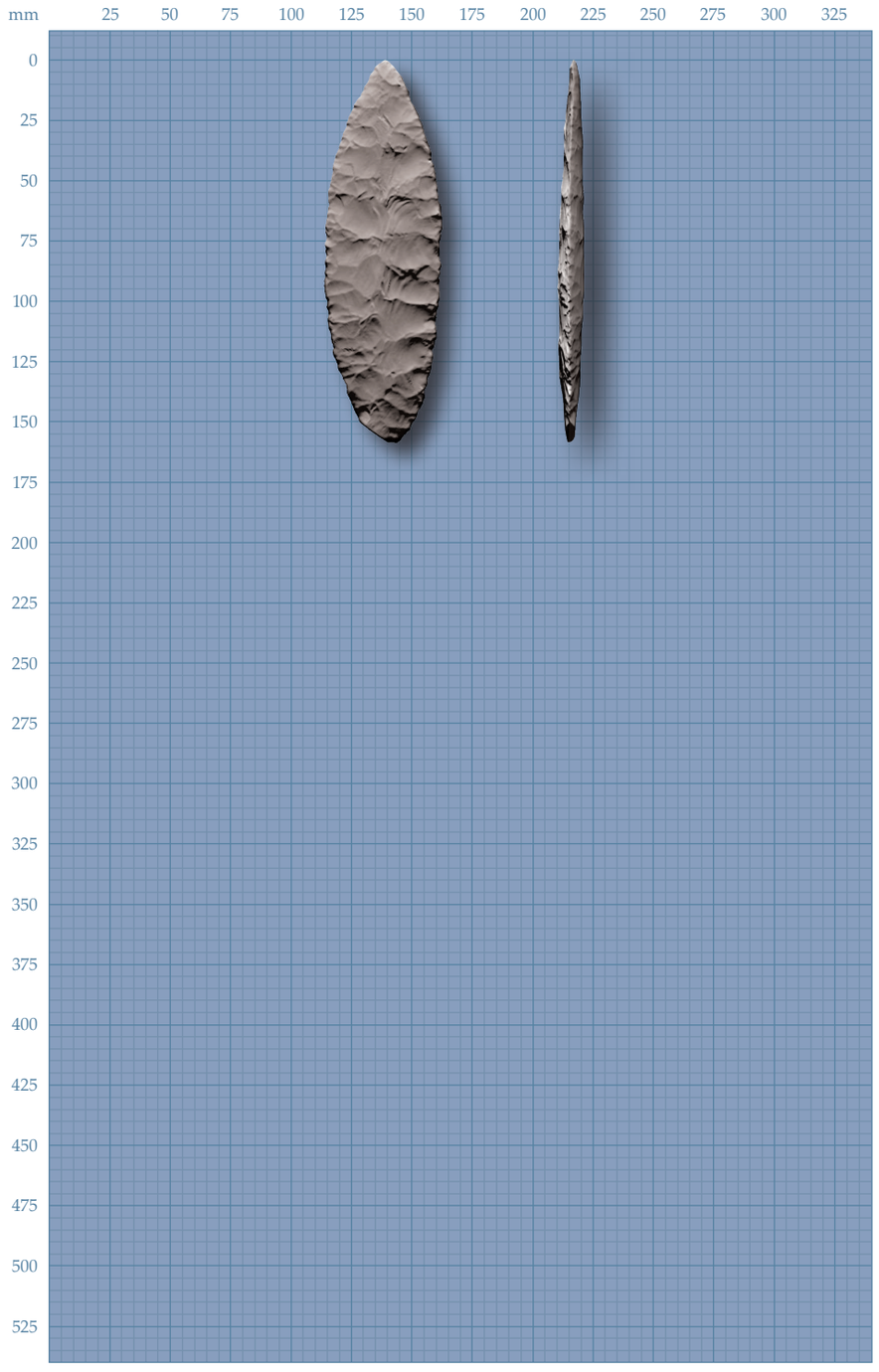


Figure A.26. Artifact 90-6, small biface: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

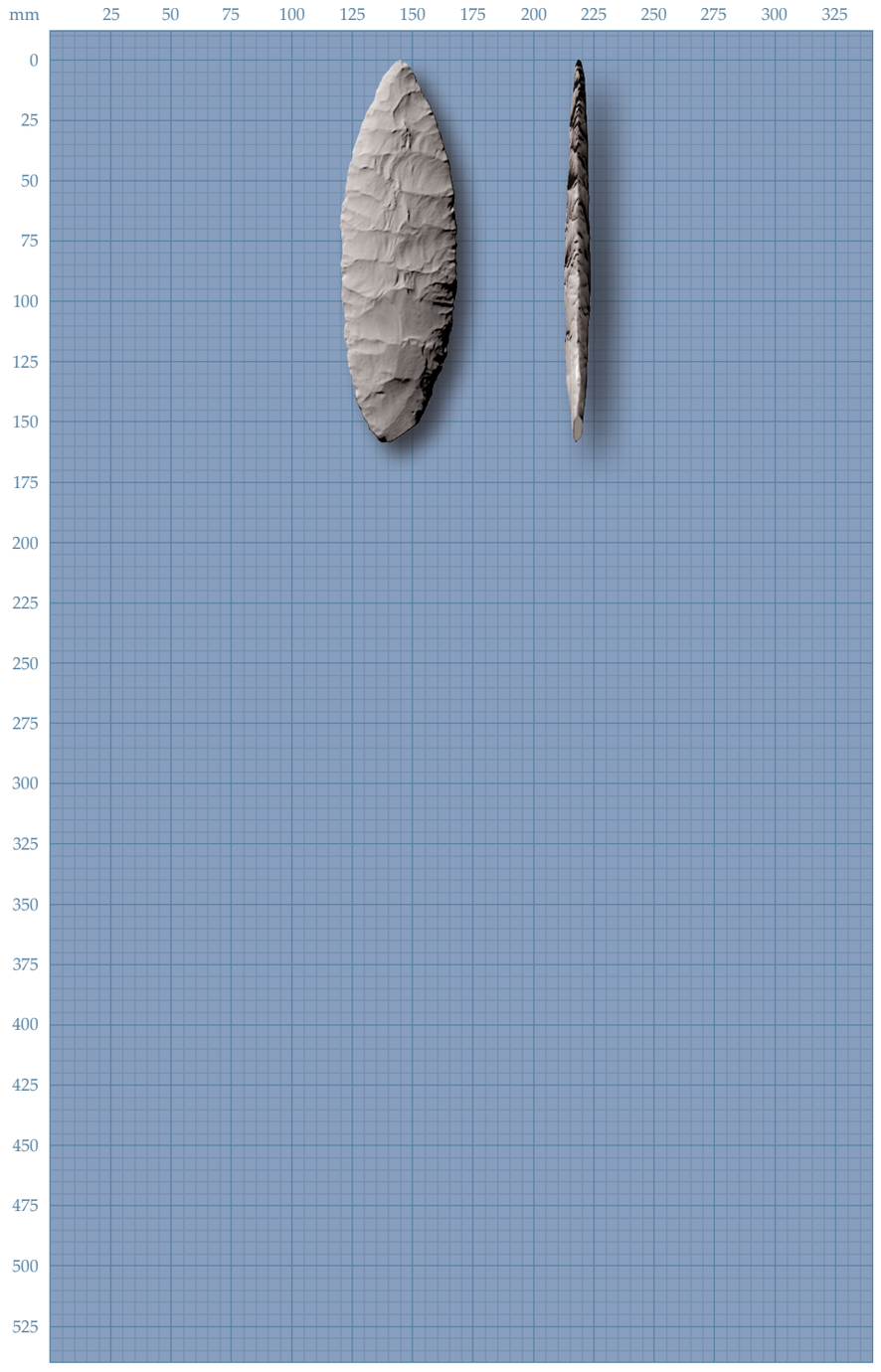


Figure A.27. Artifact 90-6, small biface: top and right side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-7; P-2763; Eccentric (Figures A.28–A.31)

This tricephalic eccentric was made by one of the finest artisans of the workshop, presumably the master. There are virtually no step or hinge fractures, and there is not a single error detected in shaping and final finishing of all components. The centerline is straight from the stem through the torso and head of the principal figure, and all three faces are finely modeled and have elaborate headdresses.

Length (height) 390 mm. Width 235 mm. Thickness 13 mm. Weight 433 grams.

The base of the stem is composed of cortex, presumably $CaCO_3$, 18 x 7 mm in extent. Moving upward, the first features encountered are sets of angled teeth pointing downward, created by oblique pressure flaking of notches, which are here interpreted as symbolizing lightning. On the left of the top (ventral) side (i.e., principal figure facing left) the four angled notches create five projecting "teeth" that point downward. On the opposite side five notches create six downward-projecting teeth.

The principal figure has a rectangular projection from the upper chest. It is possible that it is an attenuated reference to an arm. However, it is not a failed flaking of an arm, as there is insufficient room to create an arm, given the proximity of the headdress of the secondary figure in front of it. The principal figure's face was created by relatively deep notching for the nose and lips, over 5 mm in diameter in both cases. This is the apparent diameter of the master's fine pressure flaker. The upper back of the head has four angled notches creating three downward-oriented "teeth" likely referring to lightning. The headdress itself is large and consists of a central portion decorated with six elements. The first, above the forehead, is a projection with three curves and eleven teeth created by ten notches. This is followed by a very small projection and then a moderately sized projection with three elements. Toward the top is a long thin projection with three elements. This is followed by two major components, each with many notches and "teeth" that probably depict feathers.

The face in front of the principal figure has rather deeply notched nasal and lip features, like the other two on this piece, and three components to its headdress. The back component has an obtuse angle with many notches probably simulating feathers. The component in the middle has angled notching, and that is followed by straight notching on a moderately sized projection overhanging

Figure A.28. Artifact 90-7, eccentric. Photo: Ken Garrett.

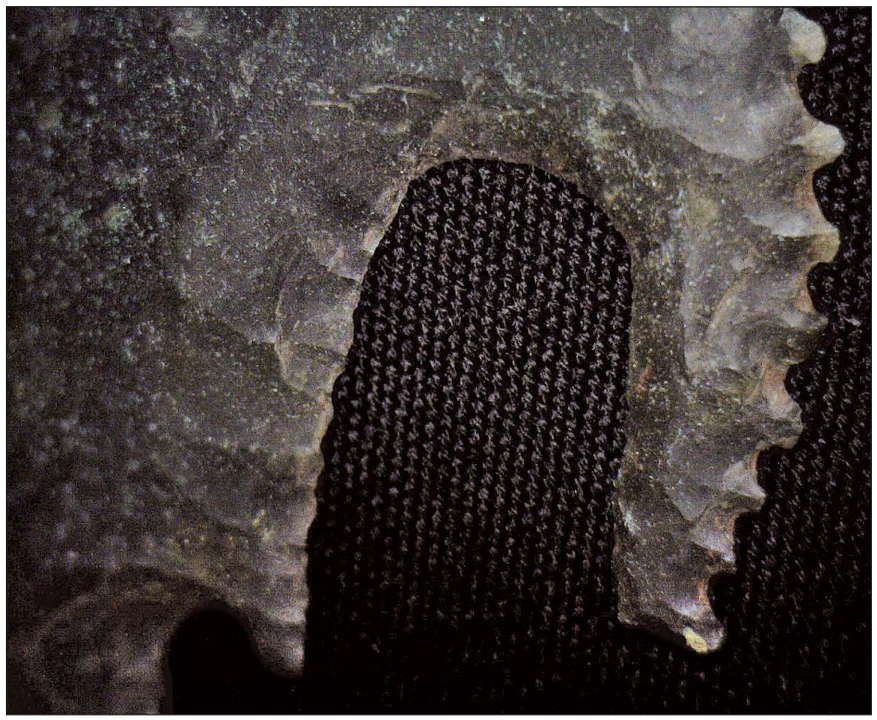


Figure A.29. Artifact 90-7, eccentric: direct flaking probably indicating feathers. Well controlled. Photo: Payson Sheets.

the face. The very end of that projection broke off after the eccentric was placed in the cache, and was recovered at the bottom of the cache. It might have broken when it was being placed in the cache. Or more likely, it broke during a strong earthquake as the cache components were being jostled around. The missing portion is only a few millimeters long.

The face behind the principal figure has prominent oblique notching along the neck (mentioned above) and along the back of the headdress. A large bifurcated smoking torch symbol decorates the forehead, presumably a reference to the K'awiil deity. It appears appropriate that the most prominent oblique notching in the headdress of the three heads is on this one. The headdress is composed of a curving element with direct notching along the outside curve.

After the eccentric was manufactured, a considerable amount of cinnabar was painted onto it, and then it was wrapped with blue, green, and brown fabric, and then finally in barkcloth.

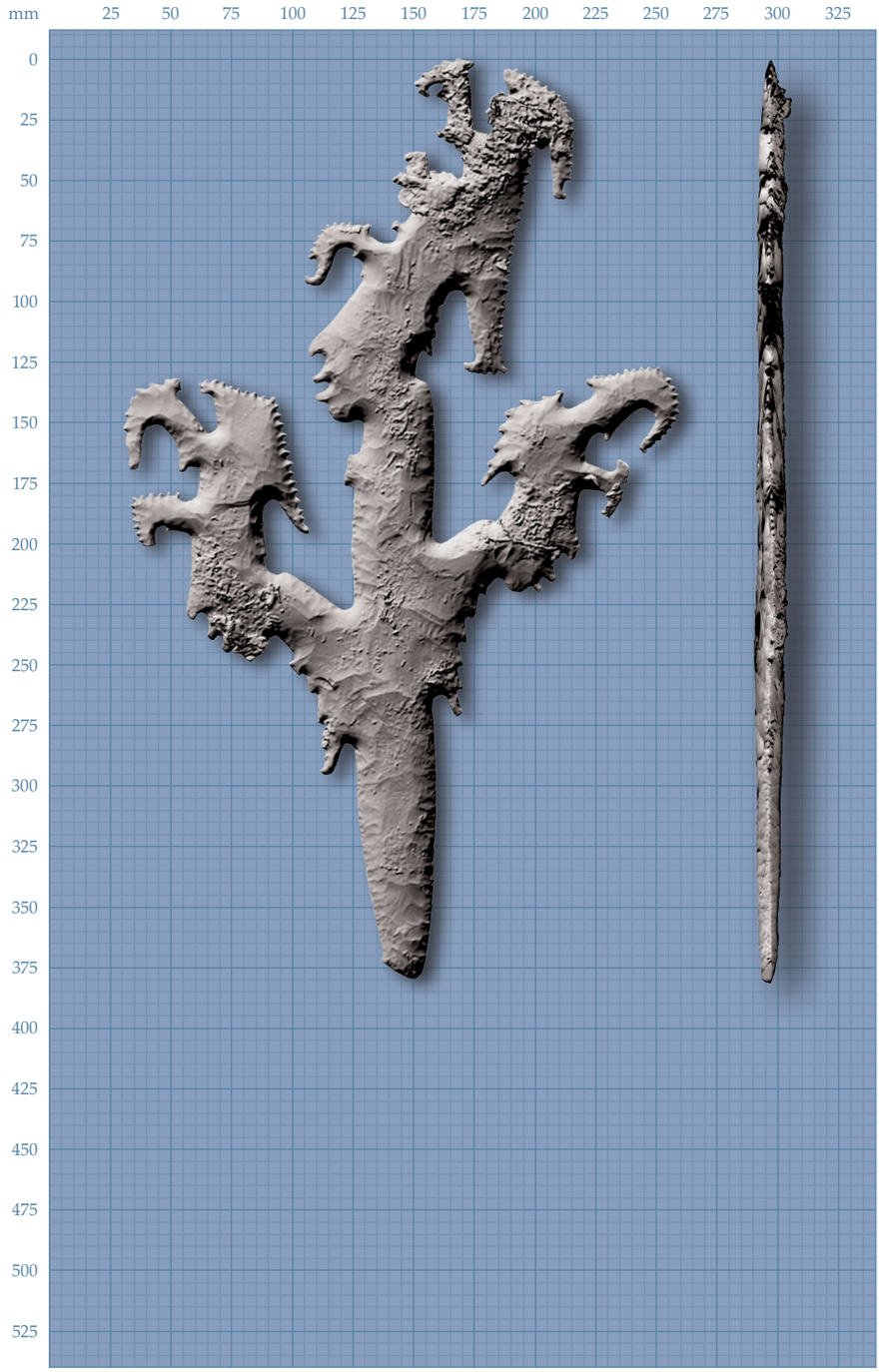


Figure A.30. Artifact 90-7, eccentric: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

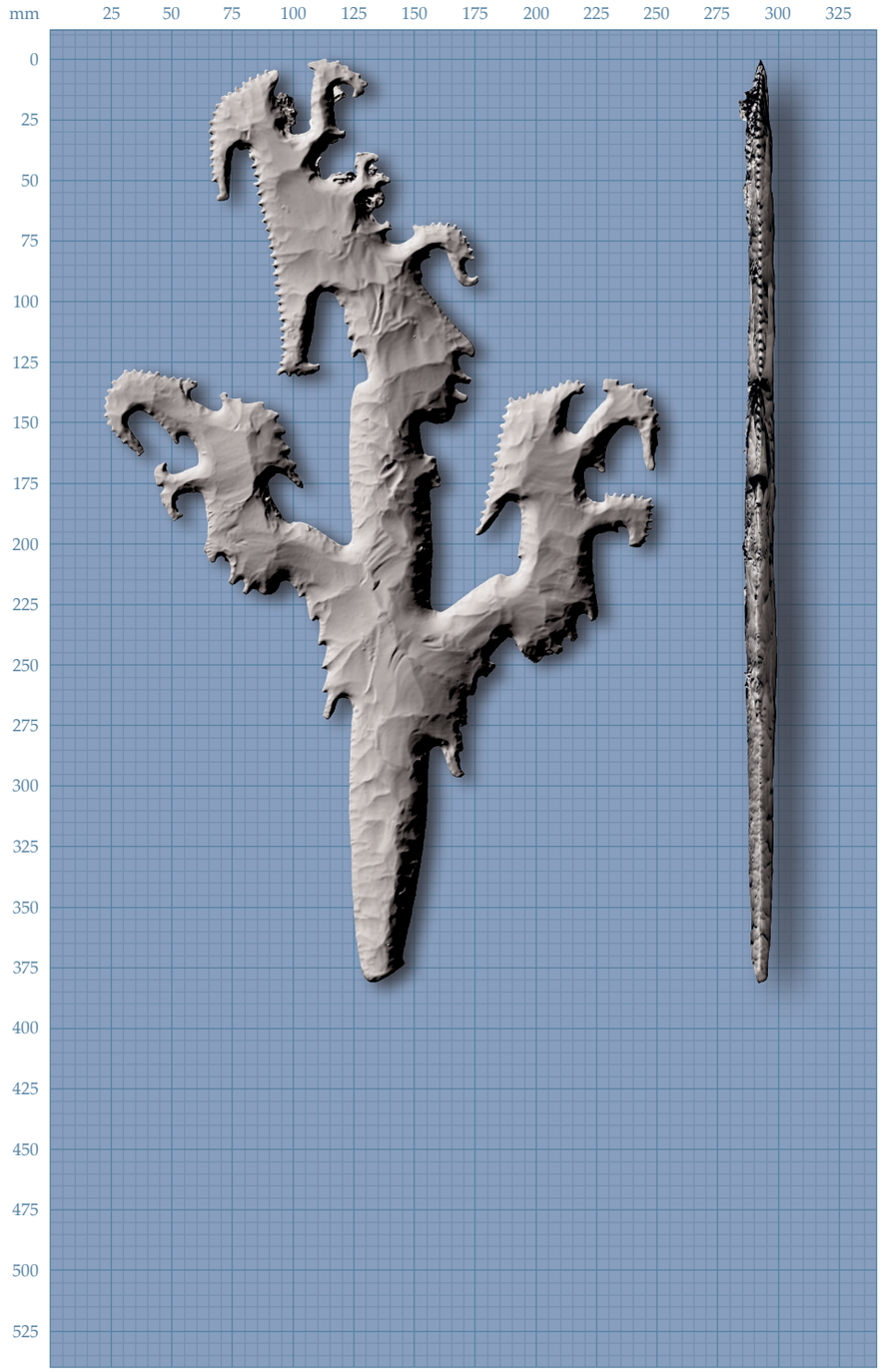


Figure A.31. Artifact 90-7, eccentric: bottom and right side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-8; P-2762; Eccentric (Figures A.32–A.36)

This eccentric was superbly crafted by one of the top artisans in the workshop, likely the master. In this case the full sequence of manufacture may have been done by the same person, from initial percussion flaking to final shaping. All stages of manufacture for which evidence is preserved on this artifact show exceptional skill and experience. The larger flake scars, presumably from indirect percussion with an antler punch, rarely show any difficulties in terms of hinge fractures. And their regularity, especially visible on the bottom side (dorsal face, principal figure looking right) of the headdress decoration, is impressive. One result is more uniform thickness of the entire piece, in contrast to Artifacts 90-3, 90-4, and 90-9. The final finishing by pressure flaking also exhibits excellent control. Only one very small error was observed: a very small piece of the end of the headdress decoration broke off, probably during manufacture. The missing piece was only about 4 mm long and is barely noticeable. The base of the stem retains white cortex 14.9 mm thick, presumably largely $CaCO_3$ but with high silica content.

Length (height) 330 mm. Width 213 mm. Thickness 15 mm. Weight 401 grams.

The principal axis of the piece is quite straight from stem up through the torso of the principal figure, with a slight offset. The figure is seated, and his leg(s) project and are finished with careful angled oblique notching, here interpreted as referencing lightning. Ten oblique notches create eleven teeth, all angled downward. The other side of the piece, opposite from the legs, also has angled notching, angled downward, with four notches creating five teeth. Above this is an elongated "tail" with five curves and smaller direct (perpendicular to the edge) notching.

On the forehead of the principal figure is an unusual feature composed of a rounded element and an elongated curvy part. It could be a variant on the smoking celt, in this case depicting the rounded bit end of the celt with a curl of smoke above it headed skyward. Or it could be something quite different, perhaps representing elements of actual royal headdress decoration. The serrated crest headdress is an elegant one, with 34 notches and 34 teeth.

The arm of the principal figure is extended straight out and holds an anthropomorphic head that has a cranial torch/smoking celt on its forehead, presumably the K'awiil (God K) deity. Taube (1992:69) notes that God K often has a smoking torch as the fire element in the forehead, and that could well be what is represented here. The smoking celt refers to K'awiil, the lightning deity. If lightning creates chert from the limestone bedrock, leaving some chert at the end of the stem could be another instance of Maya cyclicity, showing

Figure A.32. Artifact 90-8, eccentric. Photo: Ken Garrett.

the original material before the lightning strike and the chert created by the lightning impacting the limestone. Clark et al. (2012a) suggest that when the smoking celt is on the forehead of a human figure, a K'awiil impersonator may be represented. It is appropriate that the longest series of oblique notches are on this K'awiil headdress. The headdress curves backward, decorated by a series of notches that progress from larger to smaller. These notches are angled, likely a reference to lightning. A very thin, needle-like fragile projection was flaked between the back of the head and the headdress.

Following manufacture, the eccentric was colored red with cinnabar and wrapped in blue, green, and brown fabric and then barkcloth. The stem was wrapped with barkcloth or twine before being wrapped with the colored textile.

Figure A.33. Artifact 90-8, eccentric: detail of direct notching, presumably depicting feathers. Photo: Payson Sheets.

Figure A.34. Artifact 90-8, eccentric: detail of angled oblique notching, perhaps depicting lightning. Photo: Payson Sheets.

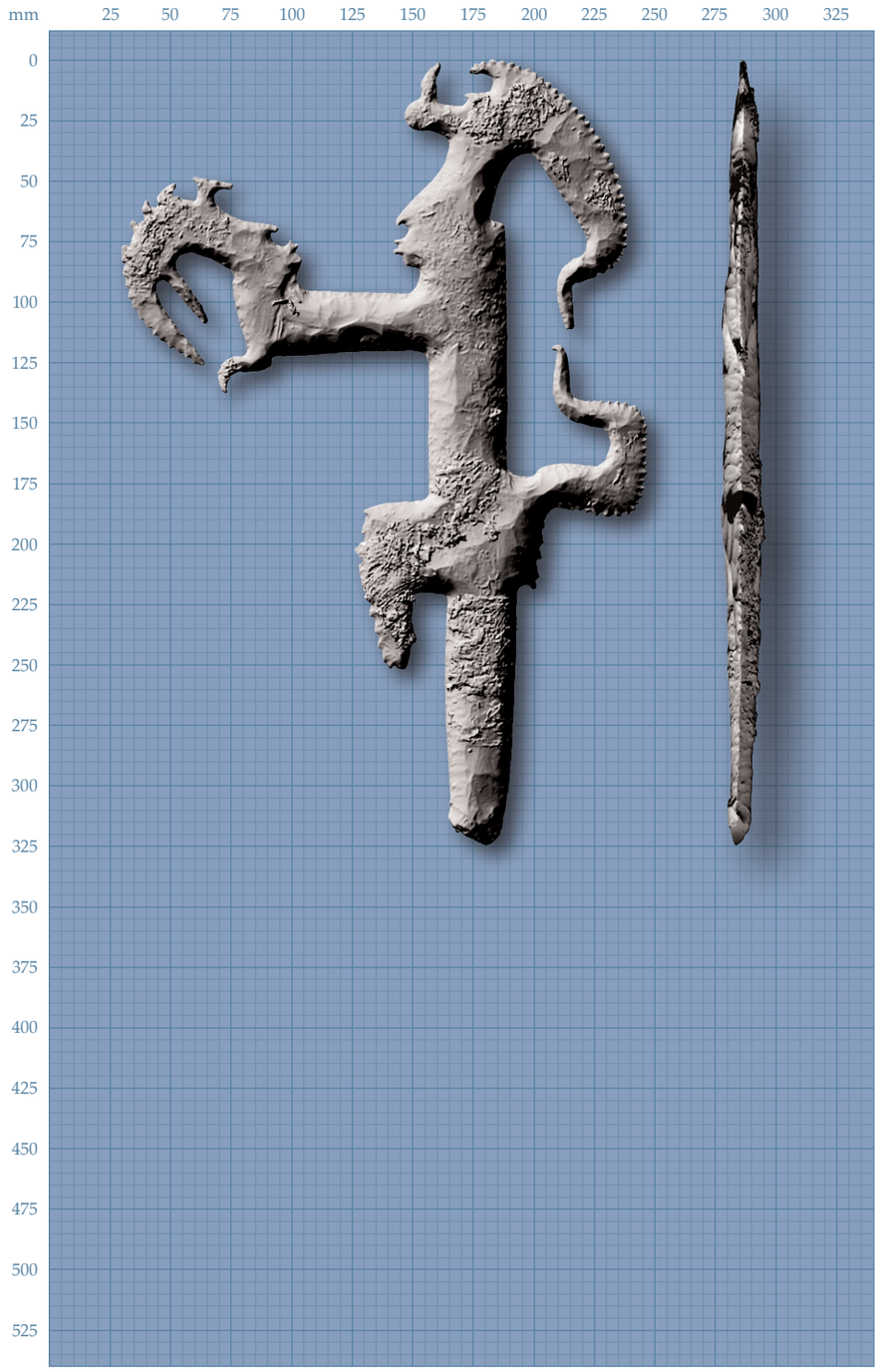


Figure A.35. Artifact 90-8, eccentric: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

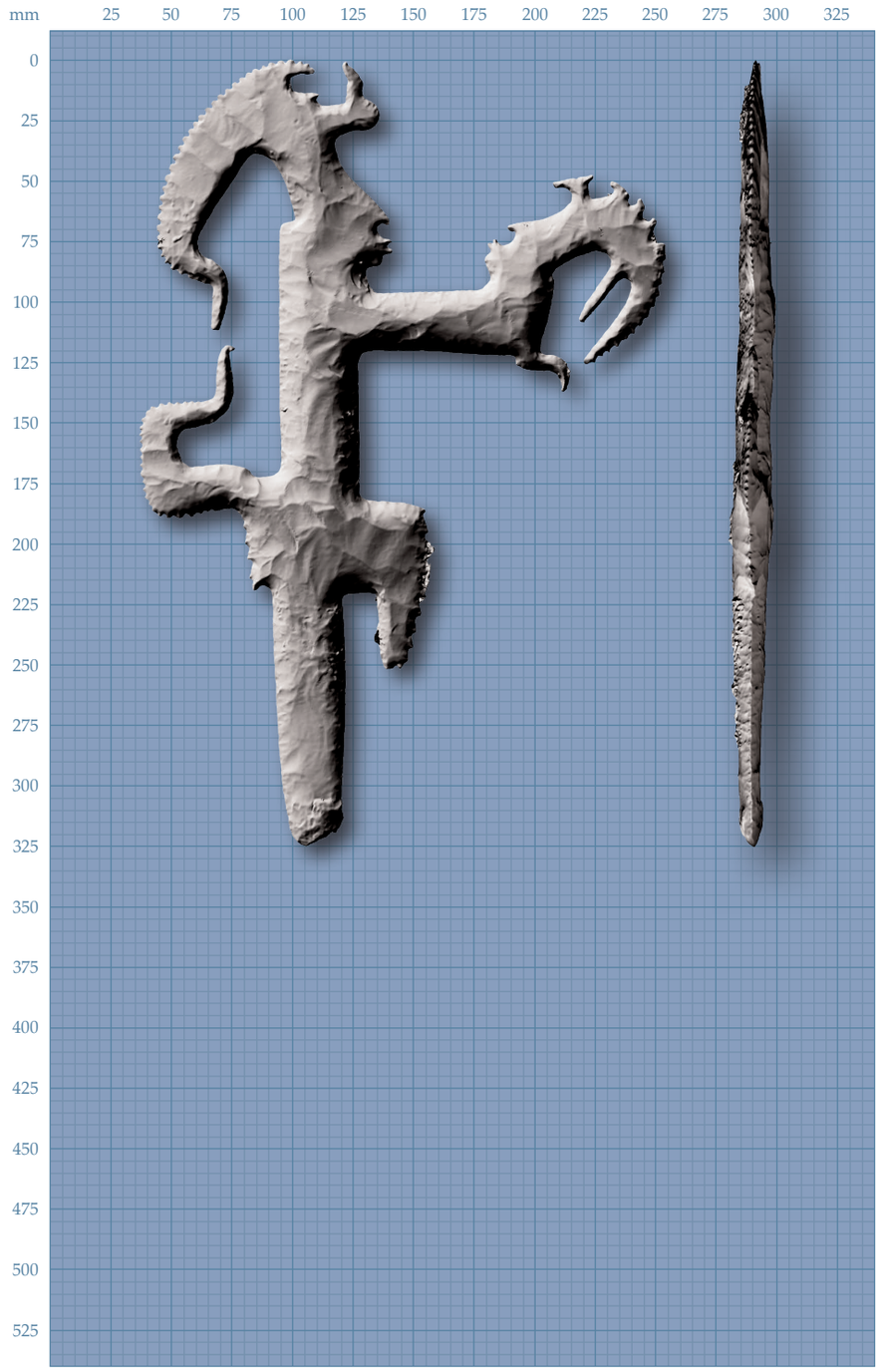


Figure A.36. Artifact 90-8, eccentric: bottom and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-9; P-2759; Eccentric (Figures A.37–A.40)

This eccentric probably was made by the same person who made eccentrics 90-3 and 90-4. As with those other two, this eccentric shows some difficulties in controlled flaking, with rather frequent flakes terminating in hinge or step fractures. All three in this group have quite broad notching and have protrusions at the top of the stem (base of the principal figure) that are almost identical. All three have flaring headdresses with broad and comparatively rough notches. All have an arm extended outward with the forearm held vertically, with tiny fingers at the end. And all three seem to show the results of a more experienced artisan in the final shaping of the forehead, face, arm, and hand.

Length (height) 375 mm. Width 140 mm. Thickness 18 mm. Weight 627 grams.

This is the thickest of all the nine eccentrics even though it is relatively short, and it shows more manufacturing difficulties than any other. The stem has no cortex, but the whitish discoloration at the very base may indicate a higher $CaCO_3$ content of the chert, close to what was cortex. Importantly, the bottom (dorsal) side (i.e., principal figure facing right) has a patch of beige-colored cortex at the juncture of the stem and the main portion. Because that cortex is at the middle of the side, it is a reliable indicator that this artifact was made from a piece of tabular chert and not from the common nodular form of chert. The shape of the stem is somewhat irregular, as with eccentrics 90-3 and 90-4, and this may be deliberate. At the top of the back of the stem is a small protrusion that is quite thick as it leaves the stem and tapers rapidly to a feather edge. Perhaps it was a larger protrusion that was intended to be deeply notched, as were artifacts 90-3 and 90-4, but it broke in manufacture and was finished by indirect percussion and some pressure flaking into its present form. The remaining two protrusions are roughly shaped and have deep notching. The protrusion at the base of the back of the figure has five "teeth" but it would have had six. The bottom one broke, probably in manufacture but possibly in transport from workshop to cache. There is a good chance that the workshop was a provisional one that was set up very close to Rosalila. The protrusion below the arm has three deep notches and four shallower notches, alternating with each other, creating an unusual outline that was not replicated in any of the other eccentrics.

Figure A.37. Artifact 90-9, eccentric.
Photo: Ken Garrett.

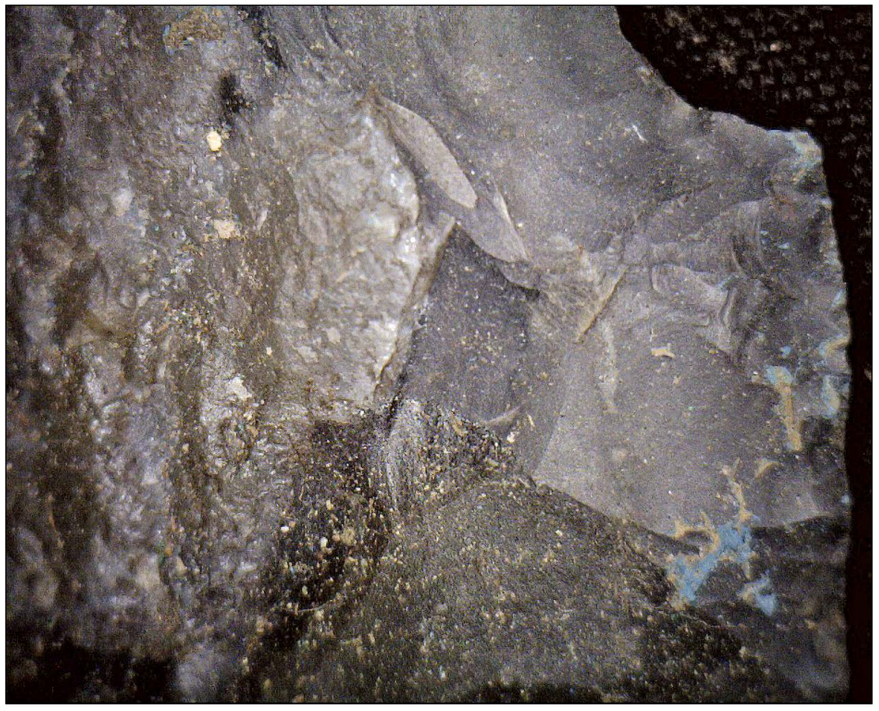


Figure A.38. Artifact 90-9, eccentric: step and hinge fracture difficulties in manufacture. Photo: Payson Sheets.

The headdress has deep oblique notching, perhaps signifying lightning. The artisan had some difficulty in achieving the individual notches and in creating an ascending series (getting larger toward the front end). The present 16 notches create 16 "teeth," but the headdress is missing a significant portion of the front. It most likely broke after being emplaced in the cache, perhaps by a strong earthquake that jostled the various artifacts against one another. It is unlikely that it was broken during emplacement in the cache, because it and all other eccentrics and the bifaces were elaborately wrapped before they were deposited. The broken fragment is missing at least 15–20 mm in length. And the notching and "teeth" are more elaborate at this frontal end, so it appears likely the artisan was intending treatment like eccentric 90-3. The pressure thinning and shaping on the most frontal extant "tooth" closely resembles that on the third-from-most-frontal "tooth" of eccentric 90-3. If something similar to eccentric 90-3's frontal finishing of the headdress was intended with this one, then what is missing here is over 25 mm in length, consisting of perhaps two elaborate flares.

The final finishing, by pressure flaking, of the forehead, face, neck, arm, and hand was very well done, probably by a more skilled artisan in the workshop. The hand ends with two fingers, as with eccentrics 90-3 and 90-4. The notching to create the lips and fingers was done by a pressure flaker with a much smaller diameter tip than the rest of the notching on this piece, and the care and skill were greater, all pointing toward the master likely doing the final touches on the most important portions.

Following the final pressure flaking, the eccentric was wrapped in blue, green, and brown fabric, and finally in barkcloth, to complete the sacred bundling of this eccentric.

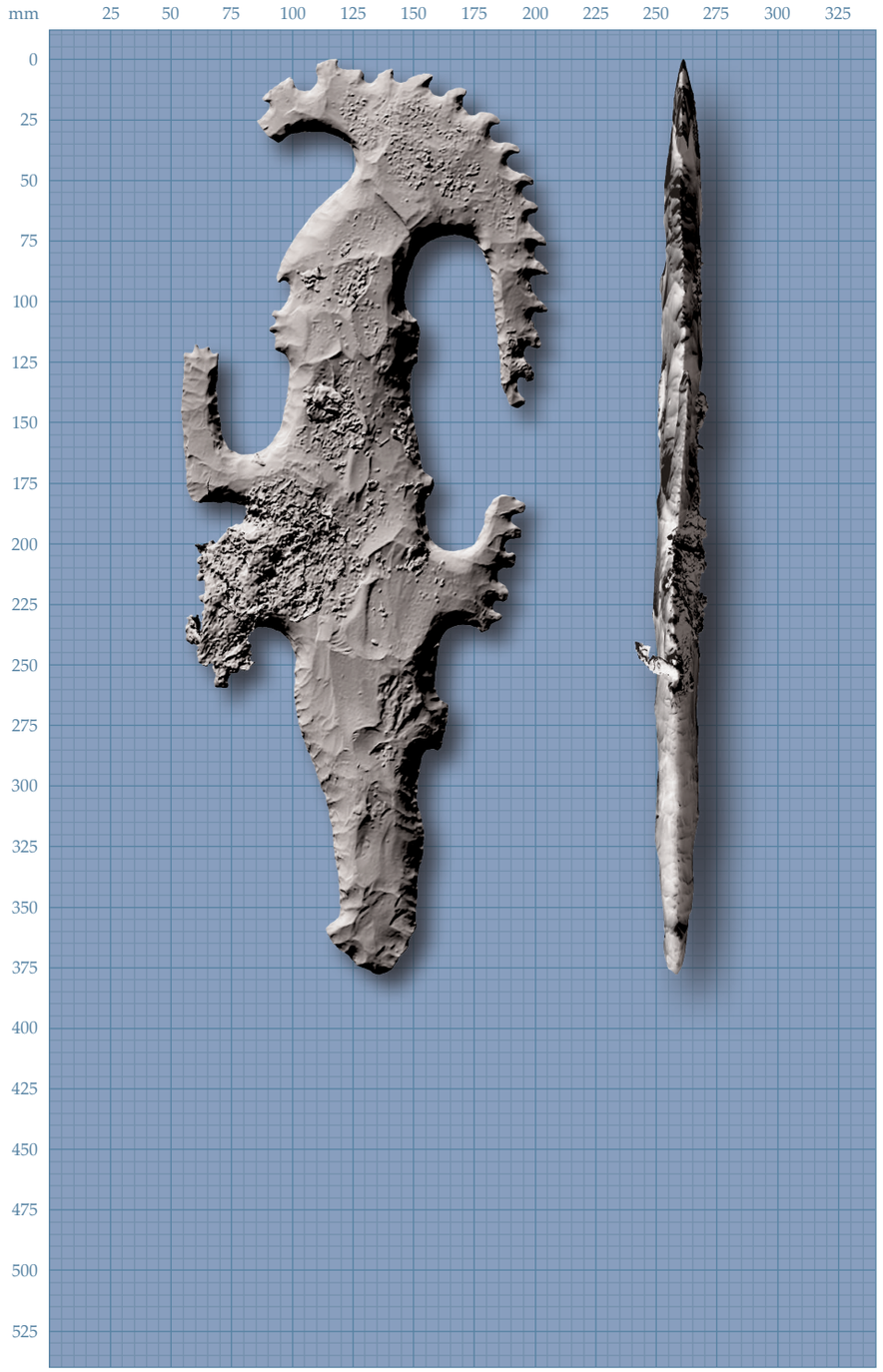


Figure A.39. Artifact 90-9, eccentric: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

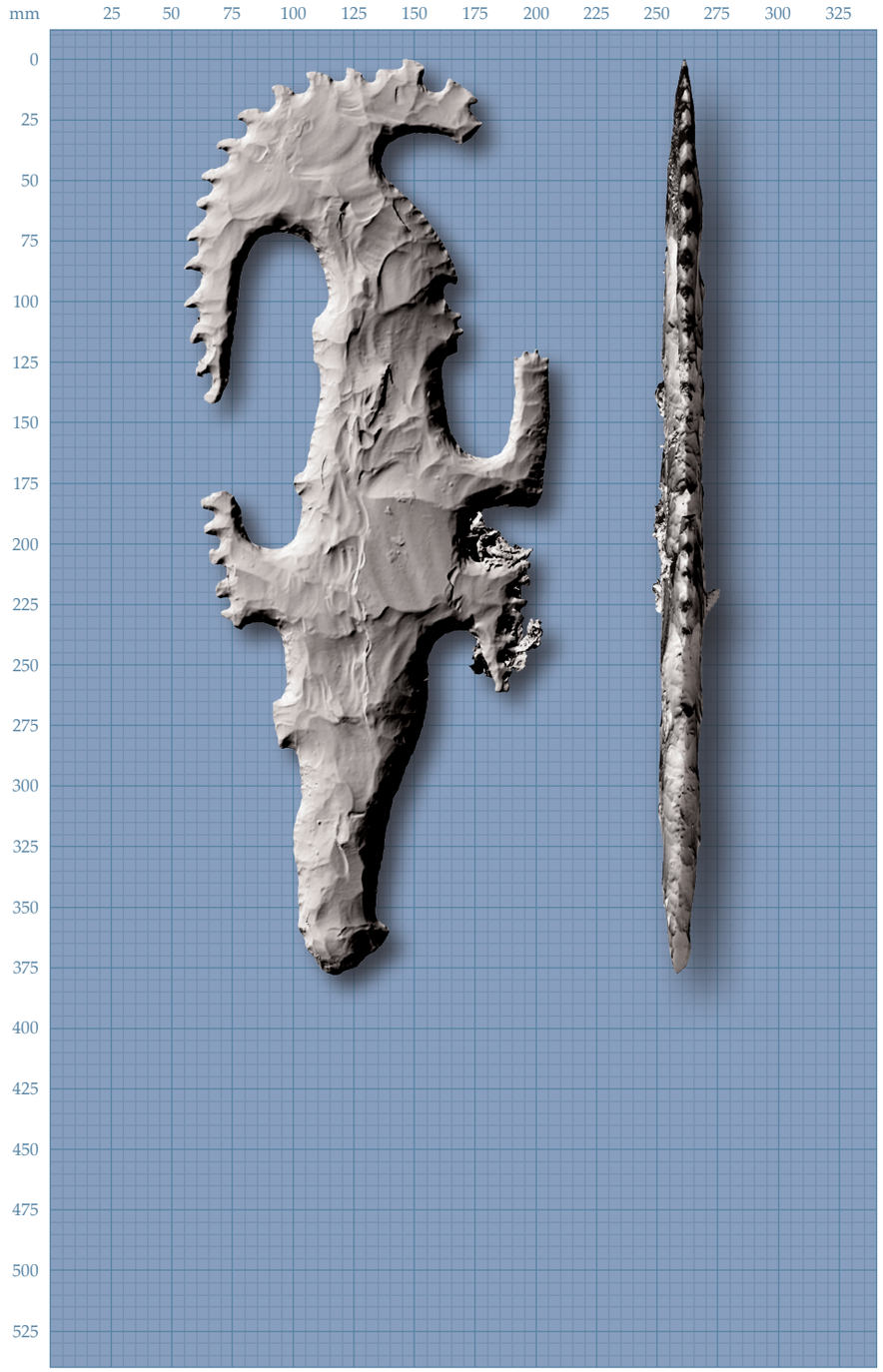


Figure A.40. Artifact 90-9, eccentric: bottom and right side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-10; P-2764; Eccentric (Figures A.41–A.44)

This magnificently crafted eccentric has four human heads and thus would be a quadracephalic eccentric in the terminology of Clark et al. (2012a). The artisan had exceptional control of all stages of manufacture that are preserved on this artifact, from early percussion shaping and thinning, through indirect percussion for most of the flaking, and finally with pressure flaking. Of all the eccentrics in this cache, this one presented the greatest challenge in manufacture due to the hollow space achieved above the principal figure's head. Just the slightest misapplication of force would have snapped the thin bridge. Difficulties such as step or hinge fractures are rare, and only one break was discerned, and that probably occurred in manufacture. If the break occurred in handling between the workshop and caching, it likely would have broken a larger portion of the artifact, given the extraordinary fragility of the uppermost third, above the face of the principal figure. The break is at the very top of the piece where a curving element is missing, estimated to have been about 10–15 mm in length.

Length (height) 440 mm. Width 145 mm. Thickness 14.5 mm. Weight 524 grams.

The stem retains a significant amount of cortex, measuring 25.4 by 4.7 mm. And the base of the stem has a small flat facet, common with these eccentrics from Rosalila and with one of the small bifaces. Whether these facets are manufactured or are a remnant of original conditions prior to manufacture, like the cortex, is unknown. But their prevalence indicates that they were important and must have had symbolic and perhaps powerful meaning. The facets may somehow be connected with the carbonate cortex, contexts, and origins.

The first feature of the primary figure one sees above the stem appears to be a leg, and if this is correct he is in a seated position. The lower part of the leg features oblique notching pointed downward, created by six notches resulting in six "teeth" which probably represent lightning.

Behind the leg is a human head with oblique notching pointed down and inward, achieved by eight notches leaving eight teeth. The headdress has two oblique notches creating three downward angled teeth and a nicely formed thin curving element at the top.

Figure A.41. Artifact 90-10, eccentric.
Photo: Ken Garrett.

Figure A.42. Artifact 90-10, eccentric: oblique notching, possibly signifying lightning. Photo: Payson Sheets.

This eccentric is unusual in this group in having almost perfectly straight lines of the stem continuing up through the principal figure's chest, neck, and back. The principal figure's arm has an upturned hand pointing to the face, and that gesture may have a particular meaning. Above the head is a masterpiece of controlled flaking consisting of two decorated heads connected by a bridging element. Only the most highly skilled artisan could achieve a hollow space with thin circumferential elements without breaking it, and those potential breaks could have occurred by even slight misapplications of pressure or indirect percussion force at the many loci of fragility. Only a master could create a hollow space in a chert eccentric with such impressive flaking control resulting in such elegant detail. Those of us who do lithic manufacture are humbled by this accomplishment.

Above the principal figure's forehead is a smaller head with what looks like a diminutive arm and perhaps a leg. The figure has a smoking celt or torch on the forehead, a reference to K'awiil, the deity of lightning. Above the smoking celt are four oblique notches creating three forward-pointing teeth, likely representing lightning. Above them is the topmost curving element that is missing a few millimeters from its end. It appears to have been a manufacturing error. A thin bridge connects the back of the head to the back of the headdress of another human head. Atop that head are two relatively deep notches creating three large forward-projecting teeth. Below the figure's head is a small projection that likely is a stylized but very short arm/hand. And below that is a long pointed element with oblique notching. It has thirteen notches creating thirteen teeth, all pointed downward, and looking much like a lightning strike.

Considerable painting with cinnabar was done after the flaking was completed, especially on upper portions of the eccentric. The painting was followed by wrapping with blue and green fabric, and finally with barkcloth.

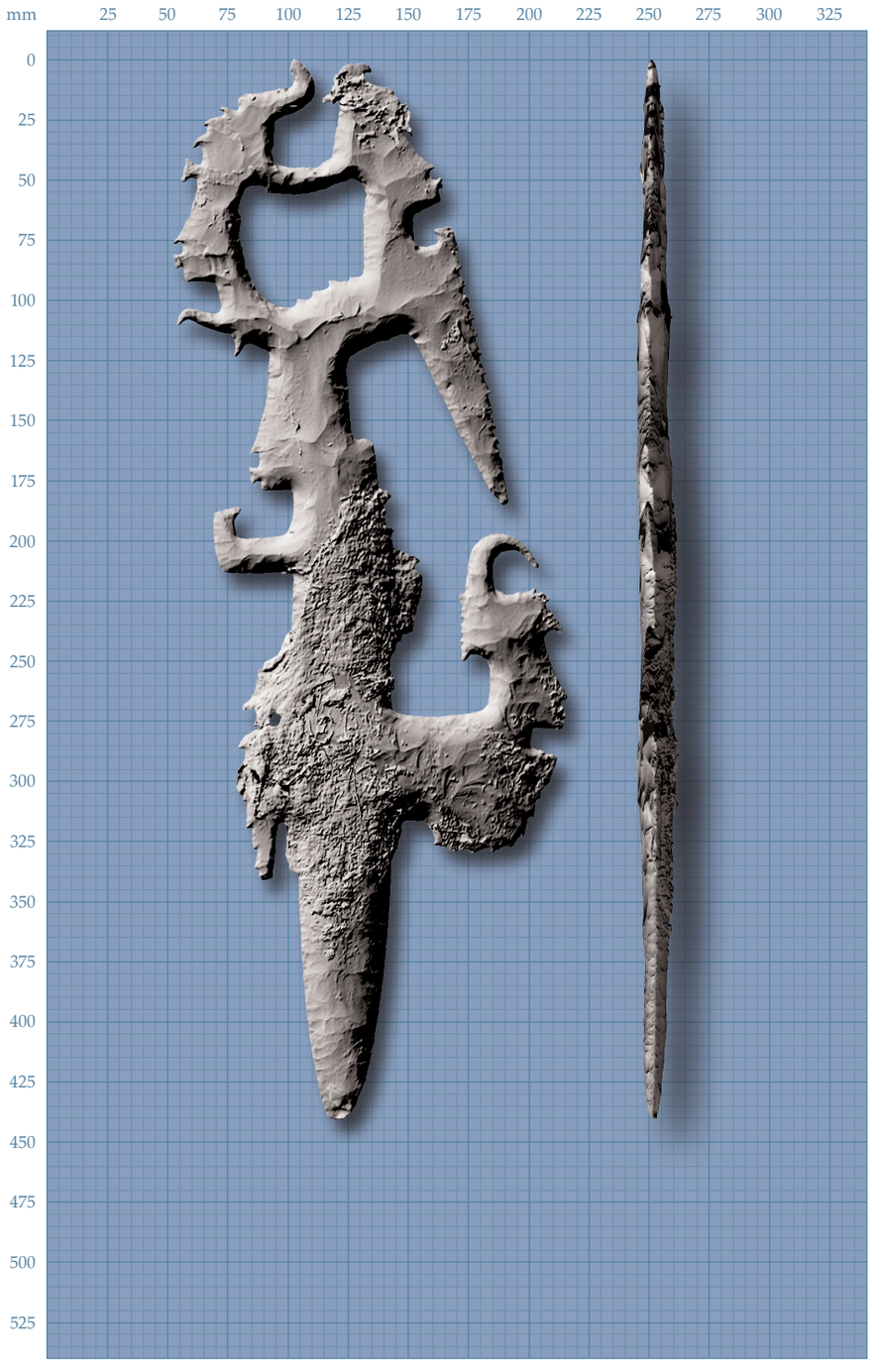


Figure A.43. Artifact 90-10, eccentric: top and left side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

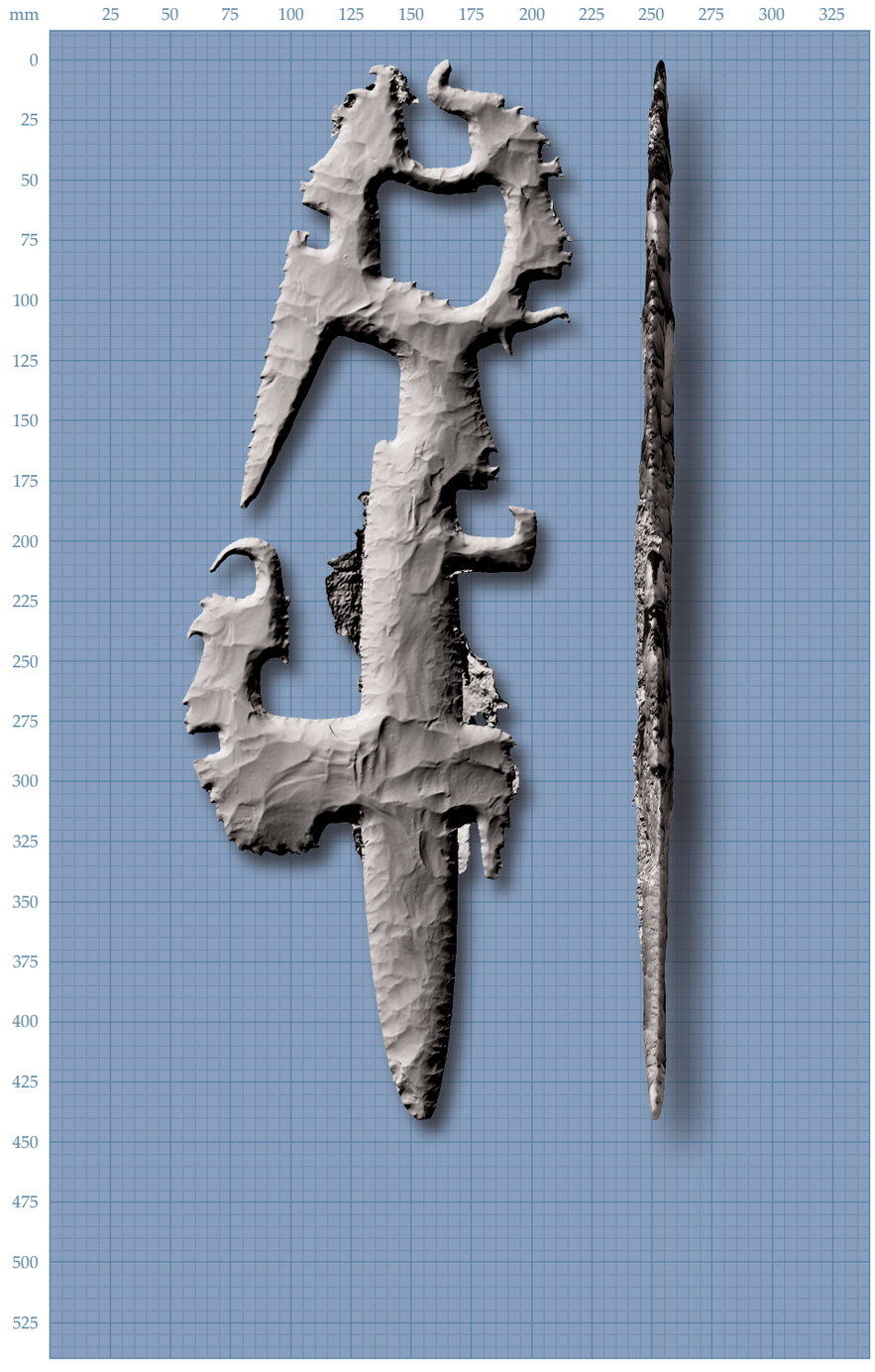


Figure A.44. Artifact 90-10, eccentric: bottom and right side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-11; P-2706; Eccentric (Figures A.45–A.47)

This finely crafted bicephalic eccentric was made by one of the more skilled people in the chert workshop, most probably by the master. Almost no manufacturing difficulties were encountered—just a very few on the dorsal side (principal figure facing right) that did not inhibit final finishing. There were no errors detected on the ventral side. At first glance one might think that the ascending projection from the lower back or seat of the principal figure has the tip missing. But that end is finely finished, and it needed to end there so the long descending element could finish in a free-standing point. Favoring the descending element over the ascending element could indicate that the former, with its oblique notching likely symbolizing lightning, carried more importance and power than the ascending one.

Length (height) 435 mm. Width 175 mm. Thickness 16 mm. Weight 610 grams.

The stem joins the seated principal figure where the leg is decorated with fine notching. Behind the back of the principal figure is a long ascending feature decorated with many notches, the straight-in notches of the top two-thirds presumably indicating feathers. The lower third of the notches are descending oblique, in a clear and deliberate change in notching. In contrast, the principal figure's outline is crisp with no notching other than that creating the nose, lips, and chin. The arm is held upward, as with some other eccentrics in this cache, and the hand turns toward the face in what likely is a meaningful gesture. Three notches create three fingers of the hand. At the top of the forehead is a bold K'awiil bifurcated cranial smoking torch. The torch element is unusually large and well-fashioned compared to the others in this cache.

Above the smoking torch are two elements of headdress decoration, one with oblique notching occupying one third of the sequence, and straight-in notching for the remaining two thirds. At the very top of the artifact eleven prominent oblique notches create eleven angled teeth. The descending long pointed element of the headdress has less prominent but still very clear oblique notching.

Above the large smoking celt of the principal figure is a secondary anthropomorphic face that also has a K'awiil smoking torch at the top of the forehead. The headdress decoration is in the form of oblique notching, beginning with more prominent notches and diminishing toward the back.

The final preparation before caching involved painting some cinnabar on the eccentric and then wrapping with blue, green, and brown fabric and with barkcloth to complete the sacred bundle.

Figure A.45. Artifact 90-11, eccentric. Photo: Ken Garrett.

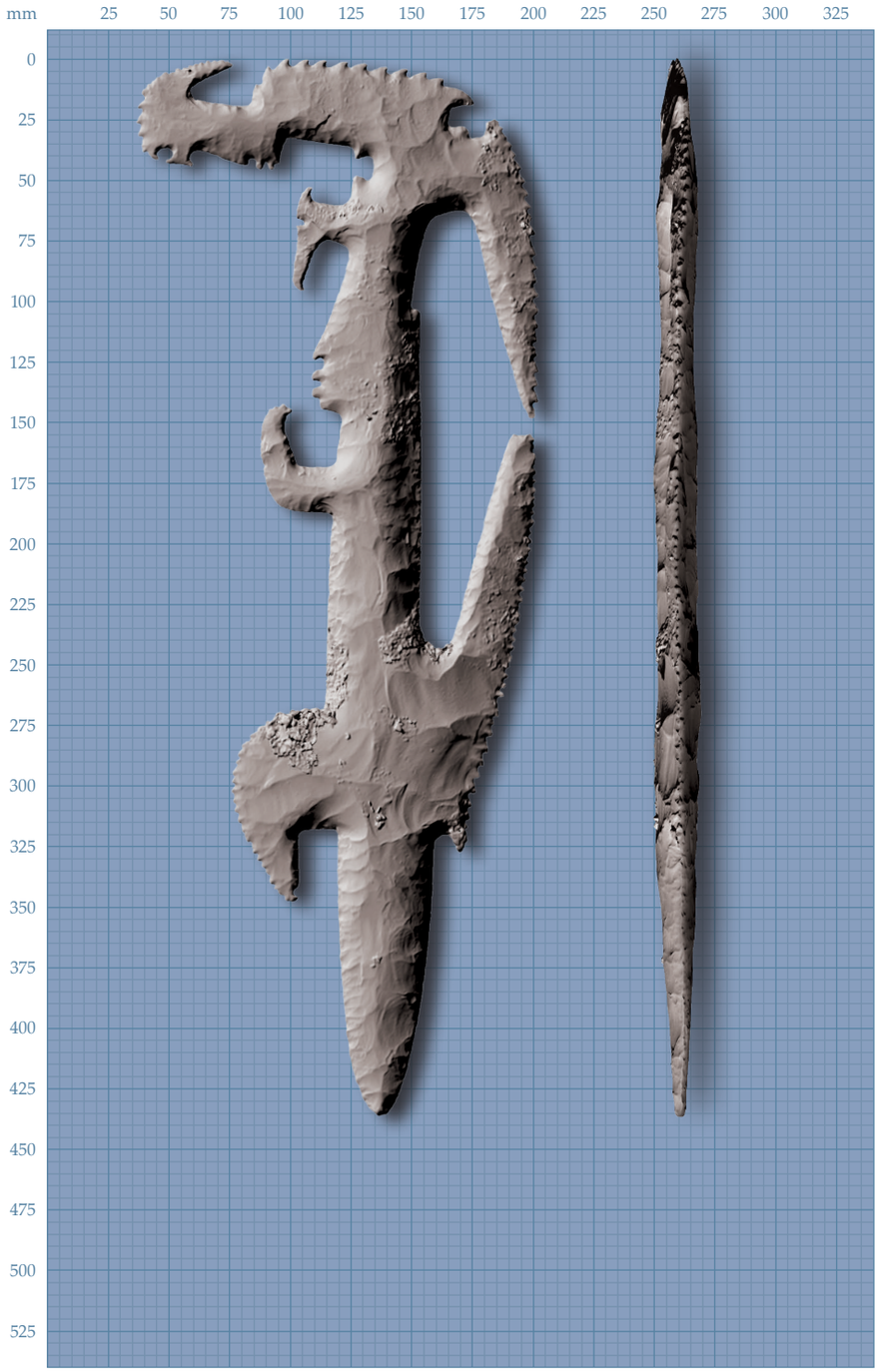


Figure A.46. Artifact 90-11, eccentric: top and side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

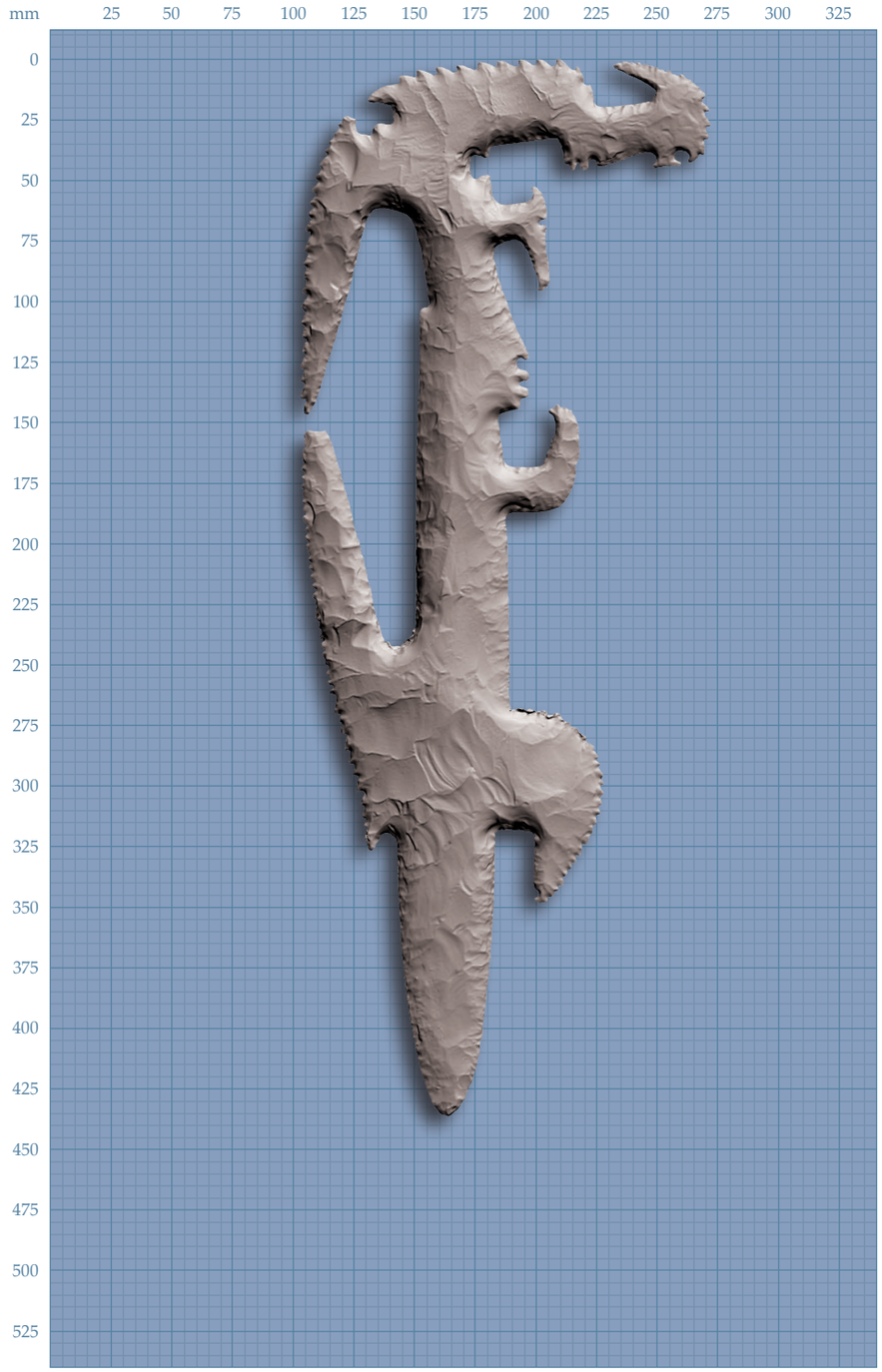


Figure A.47. Artifact 90-11, eccentric: bottom. 3D scan rendering by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

Artifact 90-12; P-2707; Eccentric (Figures A.48–A.50)

Without a doubt this eccentric was manufactured by the most highly skilled artisan in the chert workshop—that is, by the master. This magnificent eccentric has four anthropomorphic faces, hence it is a quadracephalic eccentric in the terminology of Clark et al. (2012a). All faces have more deeply notched details than the other eccentrics in the Rosalila cache. Its sheer size, at 532 mm in length, its magnificent details, and the lack of manufacturing difficulties or errors renders it a most impressive artifact.

Length (height) 530 mm. Width 220 mm. Thickness 19.5 mm. Weight 1104 grams.

The stem has three pronounced curves, with that sinuosity surely referring to the serpent leg and foot of K'awiil. The stem has a thin zone of cortex at the very bottom. The lowermost anthropomorphic face looks backward in the dorsal view (principal figure facing right) and has a finely-notched extension below the head that is decorated with fine oblique notching. Above the forehead is an apparent small K'awiil bifurcated smoking torch, with more headdress decoration above that. Two oblique notches create three "teeth" that may represent lightning. Above that a curving element projects, composed of four curves.

The notching on this eccentric is unique among these nine in that all is oblique; no notching is straight-in. All are suspected of signifying lightning, which would be appropriate given the K'awiil representation.

Slightly above the lower face, on the opposite side, is another face. It is an anthropomorphic face in the unusual orientation of looking upward at the principal figure. Facial details are difficult to discern, due to being largely covered by fabric on both sides. As with the other three faces, it too has a K'awiil smoking celt in the forehead. The notching in the headdress is increasingly oblique toward the forehead.

At the top of the long torso, and just below the face of the principal figure, is an arm terminating in a small hand. The face is carefully shaped, and the forehead has a smoking torch at the top. Above the torch is a curving headdress decoration with twelve oblique notches creating thirteen angled "teeth."

A horizontal bar from the back of the principal figure's headdress carries an elaborate design with an anthropomorphic face with a K'awiil smoking torch and an arm with tiny fingers on the hand. The fingers are reminiscent of those on the three less-elaborate eccentrics (Artifacts 90-3, 90-4, and 90-9), and it is possible the master who crafted this specimen did the final touch-ups of those three eccentrics. Below the arm is a series of oblique notches creating prominent downward-pointing "teeth." Those culminate in a short curving element, with a longer curving element on the other side. The headdress is moderately elaborate with two flaring components, each with subtle oblique notching.

Once the flaking was completed, cinnabar pigment was added, and then the sacred bundle was created by wrapping the eccentric with blue, green, and brown fabric, and then doing a final wrapping with barkcloth.

Figure A.48. Artifact 90-12, eccentric.
Photo: Ken Garrett.

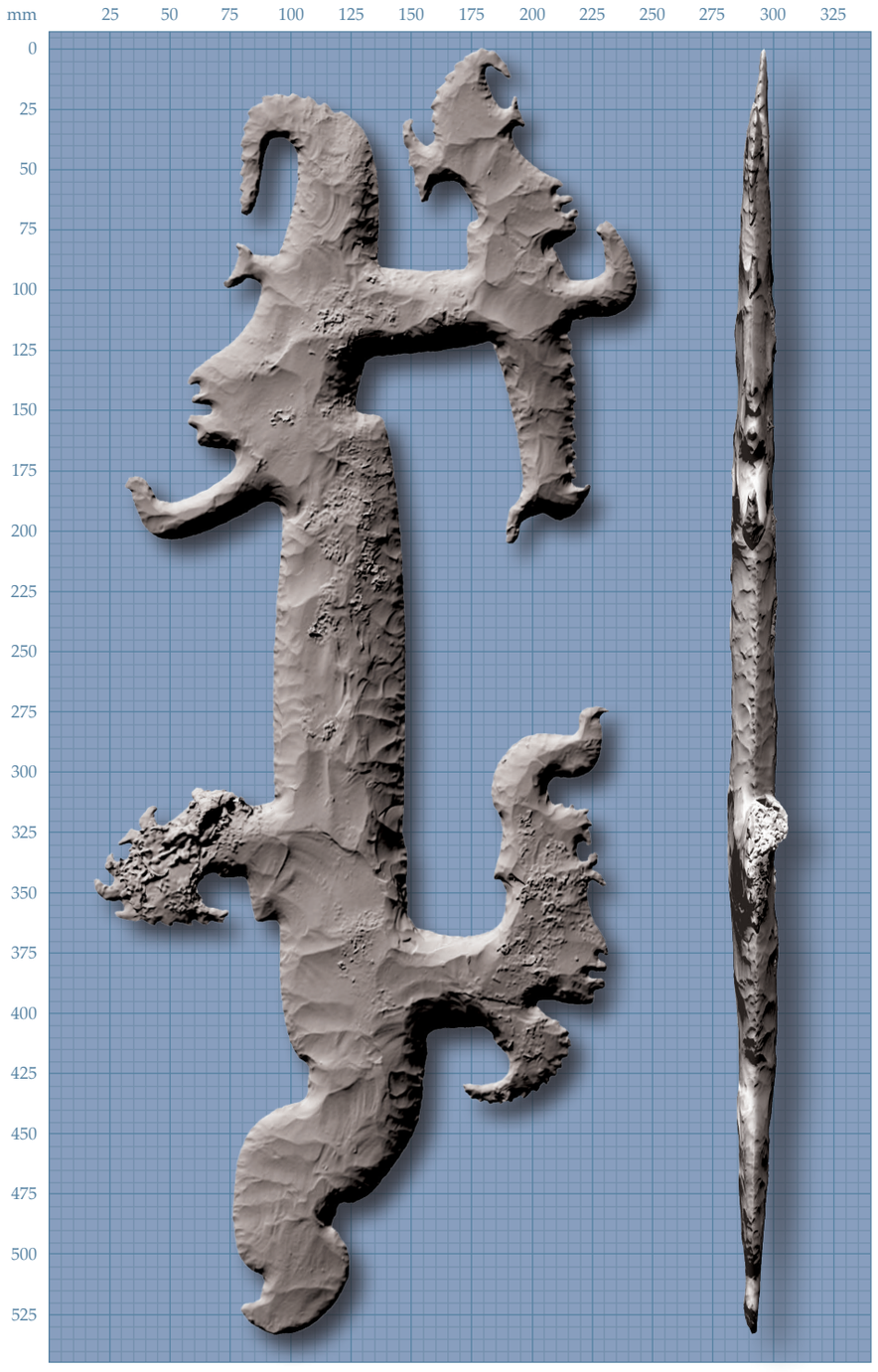


Figure A.49. Artifact 90-12, eccentric: top and side. 3D scan renderings by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.

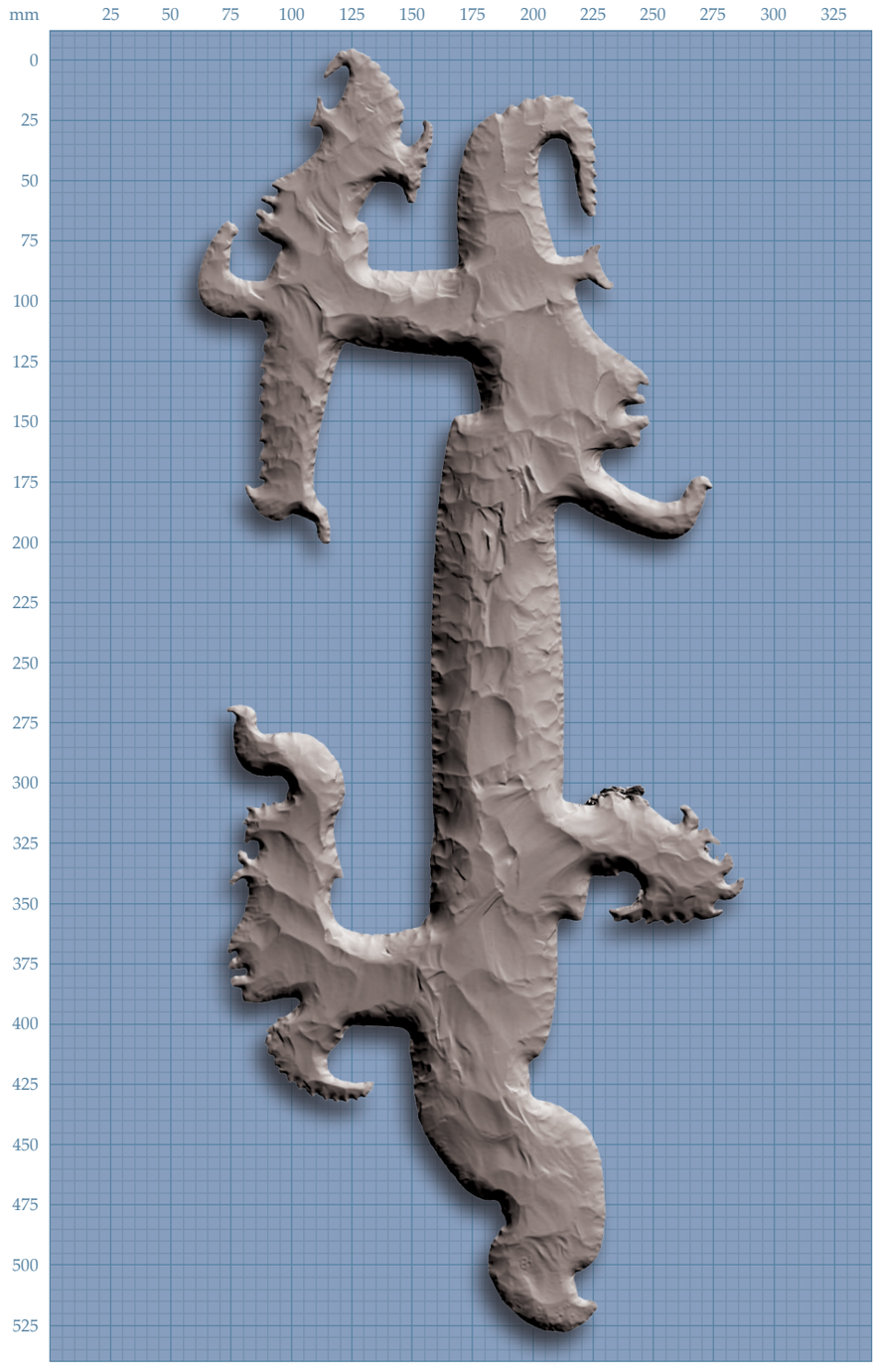
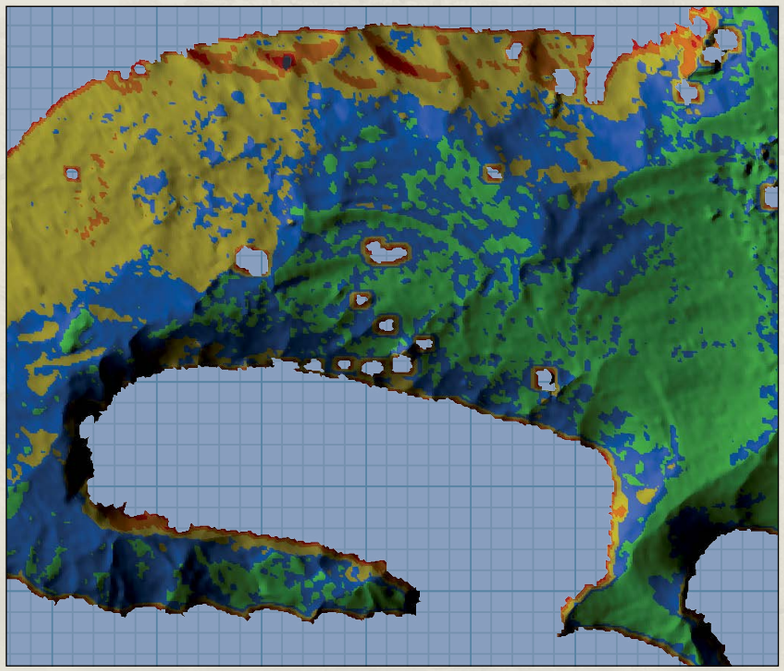


Figure A.50. Artifact 90-12, eccentric: bottom. 3D scan rendering by Alexandre Tokovinine, courtesy of the Corpus of Maya Hieroglyphic Inscriptions, Peabody Museum, Harvard University.



Appendix B

3D Scanning of the Eccentric Cherts and Bifaces from the Rosalila Cache

Alexandre Tokovinine
Peabody Museum of Archaeology and Ethnology, Harvard University

The ongoing project of 3D documentation of Copan sculptures by the Corpus of Maya Hieroglyphic Inscriptions of the Peabody Museum of Archaeology and Ethnology created additional opportunities to explore the application of the technology to a wider set of artifacts and materials. One of these sideline projects centered on chert artifacts known as "eccentrics" or often referred to as "eccentric flints."

The principal goal of 3D scanning of the nine eccentric cherts and three bifaces from the Rosalila cache was to facilitate measurement and study of these elaborate stone artifacts without endangering fragile textile fragments adhering to their surface. The digital record would assist in the conservation of the textiles by potentially reducing the necessity to physically interact with the original artifacts. It would also enable the production of physical replicas.

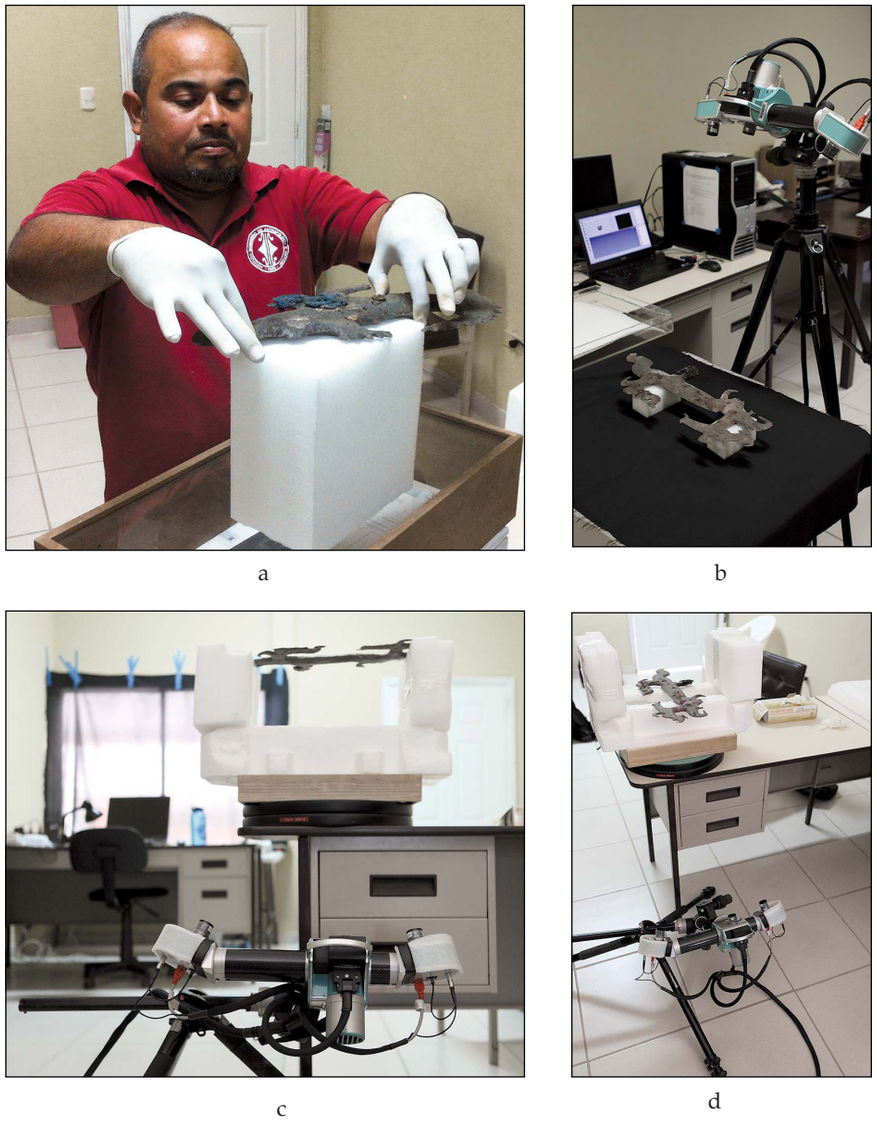
A structured light system SmartSCAN Duo was used for the documentation. It operates by projecting a pattern of stripes onto the surface captured by two cameras. The cameras and the structured light projector are mounted on the same carbon fiber rod and pre-calibrated. No physical contact with the scanned object is required and the light source is a simple halogen bulb, so the digitizing process is relatively non-invasive. SmartSCAN remains one of the top optical 3D scanners in terms of its XY resolution, precision, flexibility, and accuracy. Each scan generates a point cloud that reflects the surface topography of the object within the scanner's field of view and measurement depth. Multiple digital meshes from point clouds are then aligned and merged into a single 3D model. SmartSCAN is available with different lenses for its projector and cameras that offer progressively higher resolution, precision, and accuracy, but with the tradeoff of an ever-smaller field of view and measurement depth. Like any other structured light system, SmartSCAN struggles with capturing high-contrast, translucent, and highly reflective surfaces.

The extremely fragile nature of the textile remains on the eccentric flints meant that scanning had to be done as quickly as possible with minimal exposure to different temperature and moisture and with as little movement of the objects as possible. After some consideration, a specific protocol was established. The artifacts were taken from the vault to the 3D project office which was only several meters away. The artifacts were placed on blocks of Styrofoam on a turntable (Figure B.1a). Turntable and scanner tripod adjustments were sufficient to capture the top textile-covered surface of the artifacts (Figure B.2b). 3D scanning of the other side involved placing the objects on higher Styrofoam supports with a gap in the middle or at the tips of the artifact and positioning the scanner at a slightly oblique angle below (Figure B.3c and d). That avoided the problems that

Facing page: details of Figures B.3 and B.6.

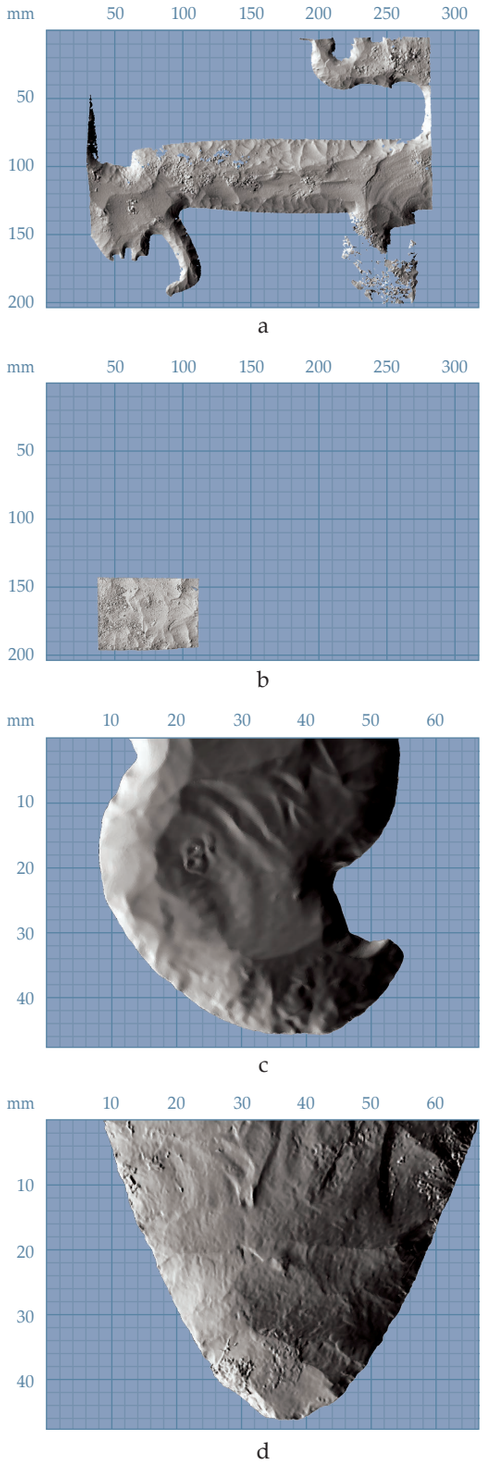
would have been created by flipping the artifacts.

The issue of time was crucial in determining the appropriate field of view and resolution. One option was the field of view with a diagonal of 300 mm. Each scan would be approximately 200 x 250 mm with a depth of 100 mm (Figure B.2a). The field of view with a diagonal of 90 mm, on the other hand, would cover only 50 x 75 mm with each capture (Figure B.2b). That said, the larger field of view would produce 3D models with a resolution around 0.2 mm, barely



a b c d

Figure B.1. Scanning procedure: (a) museum curator placing the artifact on a Styrofoam support; (b) scanning the top side of the artifact; (c) scanning the middle section of the bottom side; (d) scanning the tip of the bottom side.



a b c d

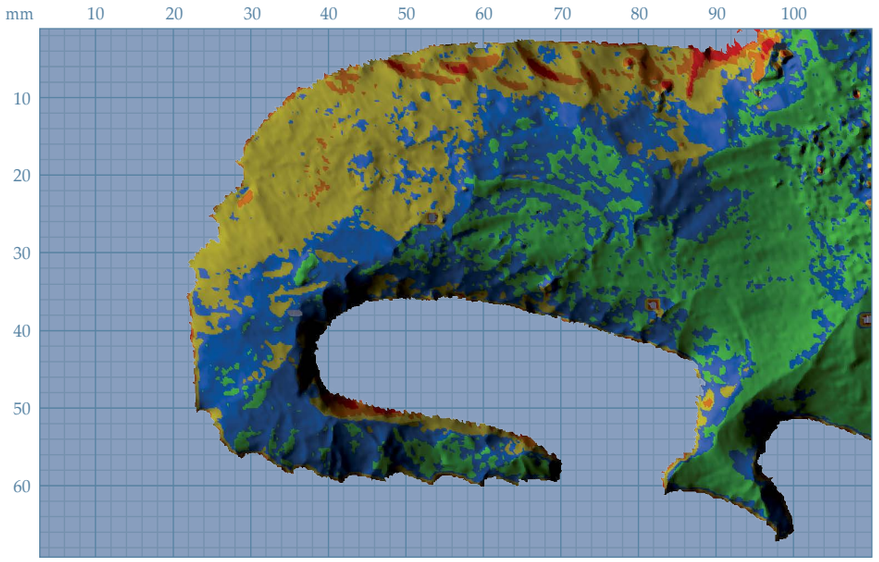
enough to capture key surface details (Figure B.2c). The lens setup with a smaller field of view would lead to much more detailed scans with as little as 0.06 mm between the measurement points (Figure B.2d).

The complex topography of the artifacts, particularly along the edges, meant that multiple shots were required to capture the objects in order to achieve an optimal angle range of 60–88 degrees between every detail of the scanned surface and the scanner. Even with the advantage of a larger field of view and a greater measurement depth, each artifact would require a hundred scans or about five hours of scanning. Consequently, capturing the artifacts at the 90 mm field of view lenses seemed unfeasible. One of the bifaces was documented at that resolution for reference purposes and in order to have a more detailed 3D record of at least some of the textile fragments. A test model of a more complex eccentric was created from the 300 mm field of view data set and examined by the researchers. The quality was deemed adequate for the primary purpose of measurement

Figure B.2. Comparing field of view (FOV) and resolution: (a) a single scan with 300 mm FOV; (b) a single scan with 90 mm FOV; (c) close-up of a 3D model from 300 mm FOV scans; (d) close-up of a 3D model from 90 mm FOV scans (CPN-P-2707/Artifact 90-12 and CPN-P-2758/Artifact 90-1).

and illustration. It was decided, therefore, to scan the other artifacts using the 300 mm field of view lenses.

The surface of the artifacts presented certain challenges for the scanner. Some areas were slightly translucent or had high contrast (very light and very dark spots next to each other). Some textile fragments were reflective because of the protective coating used in conservation. The other sides of the eccentrics were



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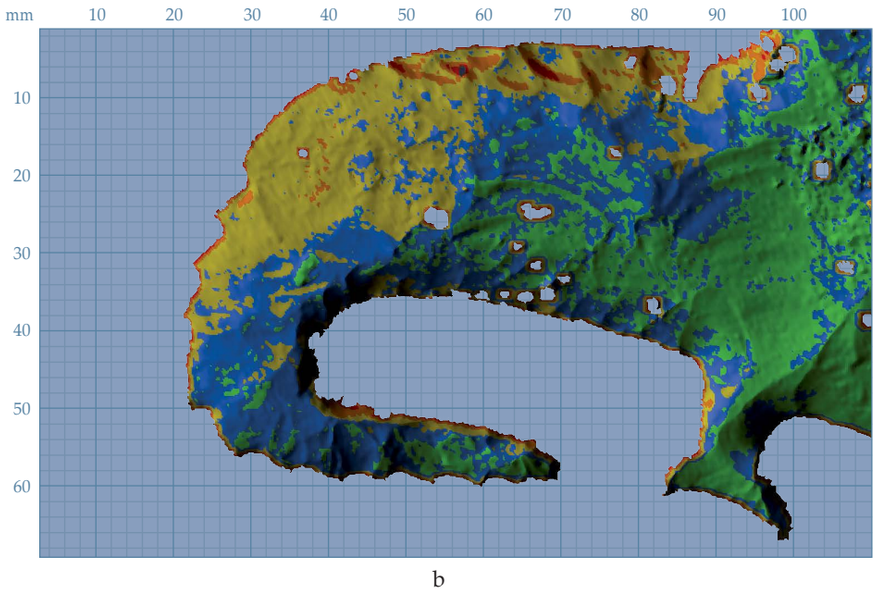
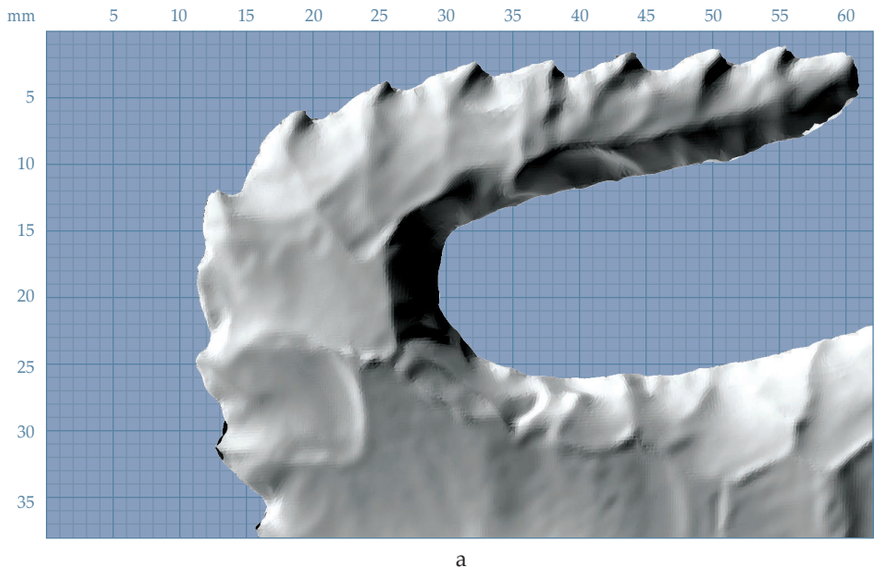


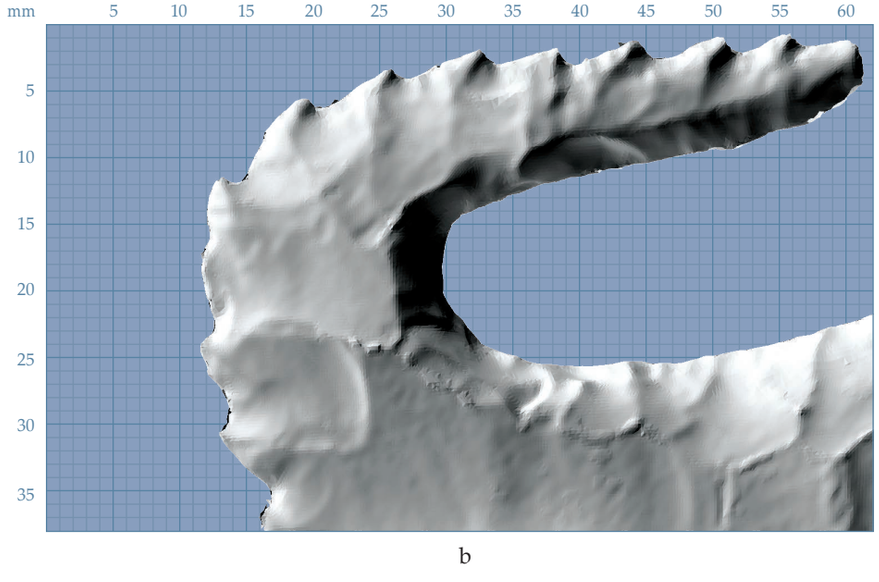
b

Figure B.3. Masking and its effects: (a) single scan with less masking; (b) single scan with more aggressive masking (CPN-P-2707/Artifact 90-12).

more polished and reflective. Some of these challenges were overcome by using an average of eight captures for each scan and by scanning at a more oblique angle to reduce glare from the projector. Nevertheless, parts of individual scans contained substantial errors and had to be removed manually during processing. It was important to have enough overlap between the scans so that removal of bad sections would not cause gaps in the final model.



a

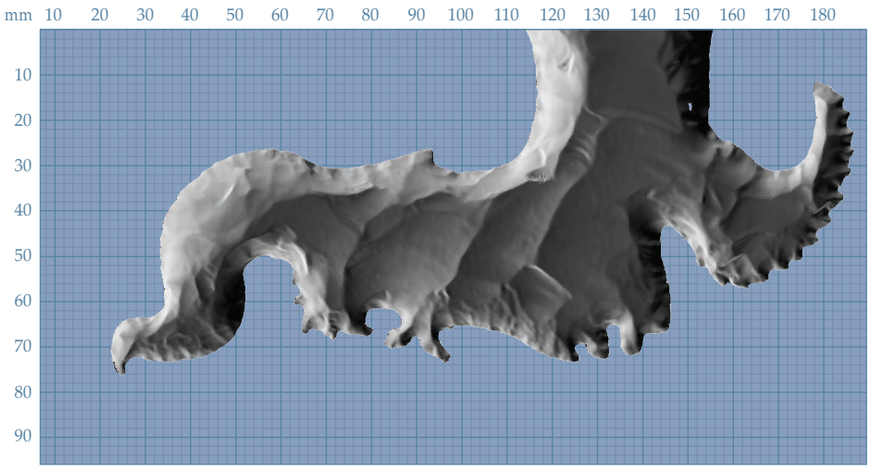


b

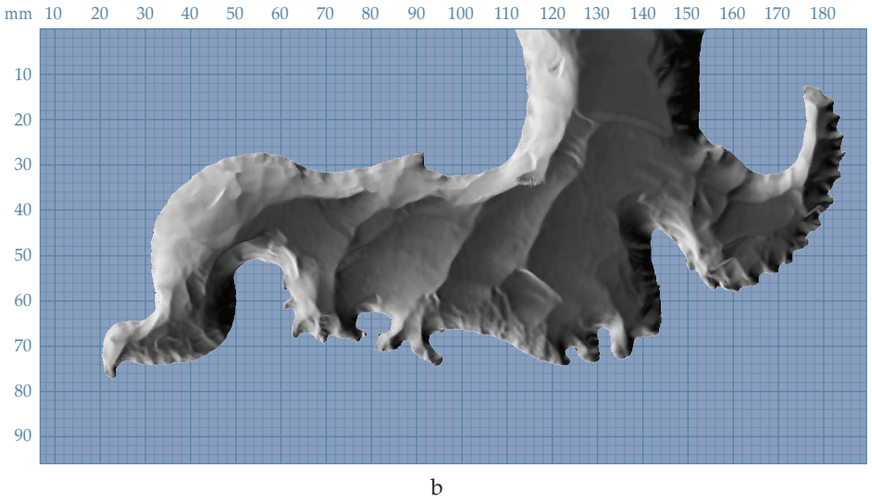
Figure B.4. Reliability threshold during scan merger: (a) close-up of a 3D model with high reliability threshold; (b) close-up of a 3D model with low reliability threshold (CPN-P-2707/Artifact 90-12).

The processing of the data involved additional choices that were made with the goals of the project in mind. The first such choice was the extent to which the pixels along the edges of each scan and in the areas of high contrast had to be masked away. Less masking would result in a 3D surface with more data but potentially more errors (Figure B.3a). Aggressive masking would remove some errors but also simplify the overall surface, particularly at the edges of the scans (Figure B.3b), which would nearly always correspond to the edges of the blades unless they faced the scanner so that both sides of the blade were visible during capture.

The parameters of merging the scans into a single mesh also affected the



a



b

Figure B.5. Filling the holes in the mesh: (a) close-up of a 3D model edge with unfilled holes (visible as lighter or darker areas depending on the orientation of surface triangles); (b) close up of a 3D model with filled holes with some edge modification visible (CPN-P-2707/Artifact 90-12).

appearance and potential accuracy of the final 3D model. A greater preference for data taken within a reliable range of angles between the scanner and the artifact would eliminate some surface and edge errors, but would also remove some potentially useful data (Figure B.4a). Introducing less reliable data into the merging process would produce a visibly less regular surface with more detail and more errors (Figure B.4b). Finally, leaving the gaps in the final mesh would make the files unsuitable for 3D printing (Figure B.5a). However, attempts to fill the holes, particularly at the edges, would potentially change the geometry of the edges by cutting some triangles and introducing new ones to fit the shape of the gaps (Figure B.5b). Consequently, it was decided to strive for more data in the merge settings (depending on the overall composition of the data set) and to leave the gaps along the edges unfilled. The resultant 3D models were better suited for measurements and study and less for artistic rendering and physical replication. It is important to emphasize here that the raw scan data remained unchanged, so it may be used again to generate new models with different parameters, for example, with 3D printing in mind.

The finished 3D models were saved as PLY (Stanford Triangle Format) files with color information included. The scanner's own Optocat software was used to make two-dimensional renderings of the models from several view angles with a simulation of multiple raking light sources. Larger images were obtained with free Meshlab software that offered additional filters to enhance the visibility of the surface topography such as radiance scaling (Figure B.6). All renderings were geometrically uniform and distortion-free orthographic views, which could be used for taking measurements and making accurate drawings of the artifacts. Meshlab was also used to downsample the digital models using quadric edge collapse decimation and convert them into U3D (Universal 3D) files, which could be embedded in 3D PDF documents.

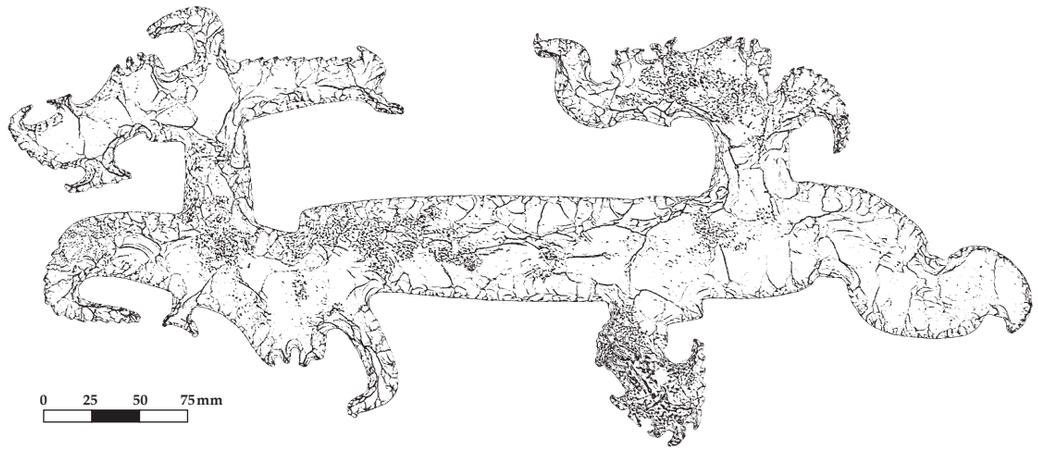


Figure B.6. Meshlab-generated grayscale rendering of a 3D model with the radiance scaling filter to enhance the visibility of the surface topography (CPN-P-2707/Artifact 90-12).

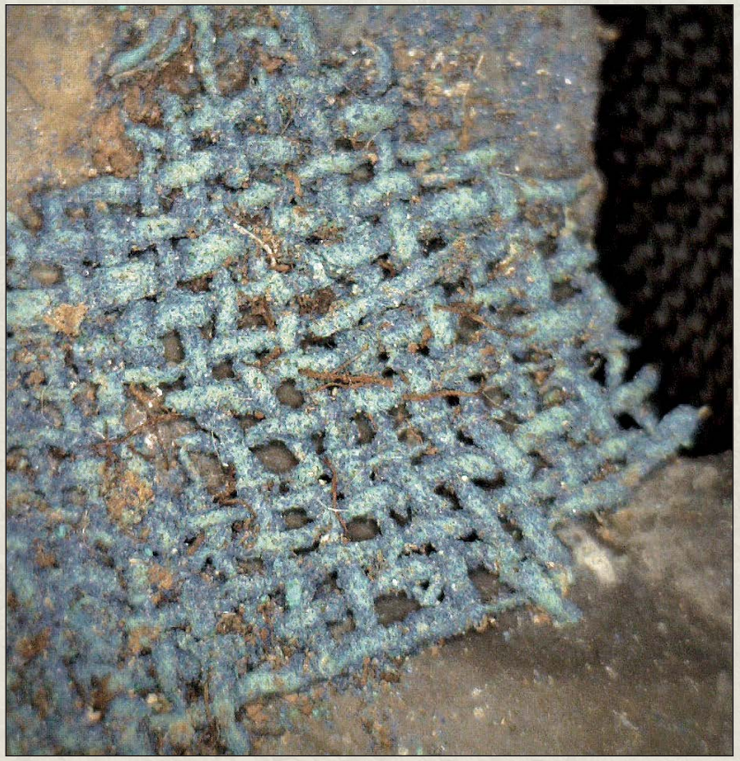


Photo: Payson Sheets.

Photo: Ricardo Agurcia F.

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