Maya Concepts of Zero

ANNA BLUME
History of Art Department
School of Liberal Arts
State University of New York, FIT

INSCRIBED IN STONE on the Hieroglyphic Stairway at Copan is a description of Ruler 13, Waxaklahun Ub’aah K’awil, dying on 3 May AD 738 with k’a’ay u-ʔ-sak-ik’, “his breath expired in war” (Stuart 2005, 385). After this evocation of the ruler’s last breath, the inscription continues as a poetic lament in the form of a triplet: mi-‘temple’, mi-‘altar’, mi-kab’-ch’e’n? translated as “no pyramid, no altar, no earth/cave” (Hull 2003, 464) (fig. 1). The “no” in these clauses was written by the Maya scribe with the partially visible quatrefoil glyph (T173).1 In the Classic Maya inscriptions scribes also used this same glyph (T173) along with several other variants to write a sign that functioned as zero in their calendrics and mathematical calculations (fig. 2). How to read this mi—“no”—and other Maya signs for zero is the topic of this essay.

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From the third to the fifteenth century, in stone inscriptions and bark-paper screenfold manuscripts, the Maya calculated and represented extraordinarily vast expanses of time, from the past through the present and into the future. In multiple parallel calculations they followed and recorded historical events and the movements of the sun, moon, Venus, and several other bodies in the sky. To record these complex calculations, they adopted and devised different written calendars and almanacs, several of which are written in a base-twenty place-value notation system that includes a visualized symbol for zero. With precision and clarity, this zero was used as a placeholder in a system that allowed the Maya to grow their numbers exponentially.

1Throughout this essay, I will refer when possible to the T numbers of specific glyphs established by Eric Thompson (Thompson 1962).
Figure 1. Copan Hieroglyphic Stairway, Step 61 Block 568, with T173 logograph MIH in the clauses *mi-*‘temple’, *mi-*‘altar’, *mi-kab’-ch’e’n, drawn by David Stuart from preliminary drawing by Barbara Fash (Stuart 2005, 386, fig. 10.5). Photograph courtesy of CMHII Peabody Museum.

Figure 2. Quatrefoil T 173 Glyphs for Zero in Long Count Inscriptions  

*All drawings by Linda Schele are © David Schele, courtesy Foundation for the Advancement of Mesoamerican Studies, Inc., www.famsi.org.
In the West, the decimal place-value system, with its ten numerals 0–9, came from India via Arab mathematicians beginning in the tenth century (Hill 1915, 29; Chrisomalis 2010, 219). In their vigesimal system the Maya counted with only three numerals, a dot • for one, a bar — for five, and a diverse group of symbols and glyphs made up of iconic components for zero. The Maya adopted the dot and bar from earlier Mesoamerican numerical systems dating back to 1000 BC (Coe 1965, 756; Marcus 1976, 36; Justeson 1986, 440). To the dot and bar, the Classic Maya added an explicitly visualized zero. To represent this zero in the stone inscriptions, the Maya used, in addition to the partially visible quatrefoil ꞌ (T173), a shell-in-hand ꞌוח (T17:713a), a head variant ꞌוח (T1085), and a full-figure form (figs. 2–8). In the bark-paper screenfold manuscripts (extant in four Precolumbian codices) the Maya drew zero in the form of a stylized image of an oliva sea-shell ꞌוח (fig. 9). This range of visual expression for a single number or word is standard within the Maya hieroglyphic corpus made by scribes who delighted to form their written language out of syllables, words, and numerical signs that intertwine and change like the animate elements of the tropical, mountainous, and coastal region in which they lived.

Figure 3. Shell-in-Hand T 17-713 Glyphs for Zero in Long Count Inscriptions
a. Quirigua Stela C, “0” k’atun drawn by Linda Schele; b. Quirigua Stela C, “0” k’in, drawn by Linda Schele; c. Quirigua Stela C “0” k’in (after M. Looper 2003, 159); d. Copan Stela 18, “0” k’in drawn by M. Van Stone @ Linda Schele Drawing Collection FAMSI; e. Palenque Tablet of the Cross, A7 drawn by Huberta Robinson (after Thompson 1950, figs. 25, 57).

Figure 4. Mi Glyphs with il Elements Suffixed or Infixed
a. Quirigua Stela A, drawn by Huberta Robinson (after Thompson 1950, figs. 25, 58); b. Quirigua Stela F, 14d (after Looper 2003, fig. 4.5); c. Quirigua Stela E (after Looper 2003, 151).
Figure 5. Head Variants of Zero T1085 in Long Count Inscriptions
a. Copan Stela 1; b. Palenque Foliated Cross; c. Quirigua Stela J; d, e. Quirigua Stela F; f, g. Quirigua Altar P; drawings by Huberta Robinson (after Thompson 1950, fig. 25).

Figure 6. Full-Figure Zeros in Long Count Inscriptions
a. Copan Stela D, “0” winal, “0” k’in, drawn by Linda Schele; b. Quirigua Stela D, “0”k’in, “0” winal (after Looper 2003, 142); c. Palenque Palace Tablet, “0” k’in, drawn by Linda Schele.
Part I

Maya Use of Zero in Long Count Inscriptions

As early as the first century BC Preclassic civilizations of Mesoamerica began to record historical time from a chosen starting point that has been correlated to 3114 BC. This count of days, known as the Long Count, consists of five periods identified by epigraphers as

Occasionally the Maya scribe would write Long Count dates with periods beyond the bak’tun such as the piktun = 8,000 tuns; kalabtun = 16,000 tuns; kinchiltun = 320,000 tuns; alawtun = 6,400,000 tuns. For a general discussion of these large numbers see Lounsbury 1978, 762.
As a count of days it is a base-twenty system with each step equal to twenty times the previous step, with the constant exception of the third step, which was calculated as times eighteen.

In addition to the Long Count the Maya used several other calendars that were day counts. One of these is a 260-day almanac that consists of 20 named-days and numbers 1–13. This almanac is the oldest of the Mesoamerican day counts adopted by the ancient Maya; it is still counted and used by Maya priests today (Tedlock 1982, 89; Earle 2008, 69). Another calendar of days that the ancient Maya counted is a solar year of 365 days that consists of 18 “months” of 20 days with a residue period of 5 days. In what is called the Calendar Round, the Maya recorded days in relation to both their almanac and solar dates,
and noted with great care every 18,980 days (52 solar cycles, 73 almanac cycles), when a specific day in the almanac and the calendar year recurred. From the Early to the Postclassic period scribes recorded Long Count and Calendar Round dates together to firmly locate days within historical time that can be correlated with the Julian calendar.  

The earliest Mesoamerican Long Count is inscribed on Stela 2 at Chiapa de Corzo with a date of 7.16.3.2.13, correlated as 36 BC (Marcus 1976, fig. 6). This and subsequent Long Count dates were written in dot and bar place-value notation with the lowest period of k’in at the bottom of a column and the highest quantity of bak’tun at the top. Epigraphic
During the Classic Maya period scribes made several significant changes to their Long Count inscriptions. On Tikal Stela 29, as had been done for more than three hundred years in Mesoamerica, the Long Count 8.12.14.8.15 13 Men 3 Sip (8 July 292) is inscribed in a single column (fig. 10b). What is different, however, is that the Maya scribe has chosen to include period glyphs for the bak’tun, k’atun, tun, winal, and k’in to the right of the Long Count numerical coefficients.

Sixty-five years later, at Uaxactun on Stela 18 and 19, the Maya scribe included another new element by depicting explicit zeros in k’atun endings on these Long Count inscriptions: 8.16.0.0.0 (AD 357). The inscriptions thus read

- 8 bak’tun
- 16 k’atun
- 0 tun
- 0 winal
- 0 k’in

Each of these zero placeholders is written with (T173) glyphs. The use of these zero signs at Uaxactun marks the beginning of a visualized

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4 Though there is complete agreement that the inscription on El Baul Monument 1 is an early Long Count date, due to the weatherworn stone there are alternative interpretations of the coefficients that include the first reading in 1926 by Walter Lehmann of 7.19.7.8.12 (AD 29) (Lehmann 1926, 32).

5 Uaxactun Stelas 18 and 19 are both heavily weatherworn. Photographs and drawings by Ian Graham can be found in the Corpus of Maya Hieroglyphic Inscriptions (CMHI 1986, 5.3: 175; 180).
The last known Maya Long Count inscription is also a k’atun ending 10.4.0.0.0 (AD 909) on Tonina Monument 101, where 552 years later the scribes used the same (T173) glyph to write their zeros (CMHI 1996, 6.2: 125) (fig. 2e).

Within the already established Mesoamerican Long Count system the Maya conceived of and experimented with ways to represent zero, a concept that involves a quantity that signifies the paradoxical absence of quantity. On Quirigua Stela C the Maya scribe wrote the Long Count date 13.0.0.0.0 (3114 BC), the auspicious date in the past when the Long Count began (fig. 11a). The four zeros of the last digits of this Long Count are here written with three shell-in-hand glyphs (T17.713a) and a quatrefoil glyph (T173), the two most commonly written variants for zero in the inscriptions. As a dialectical correlate to zero, the Classic Maya scribe also computed and inscribed Long Counts into an

\[6\] The first known zero-sign placeholder in a notational system was developed by Mesopotamian mathematicians in the eighth century BC (Pingree 2003, 137).
inconceivably distant past and deep into a distant future, far beyond the scale of previous Mesoamerican Long Count dates.

Along with the introduction of period glyphs and a visualized zero, the use of exponentially large numbers to represent deep time was a distinctly Maya fascination within Mesoamerican numerical notation systems. On Coba Stela 1 the base date of the Long Count goes back in time over twenty-four digits, nineteen of which go beyond the bak’tun as is visually evident in Linda Schele’s drawing of this inscription (fig. 11b). Transposed numerically it reads:

0.0.0 1Aha 8 Cumku.

The enormous Long Count date on Coba Stela 1 tells us something about the existential nature of that base date: that it is a mark in the
sand, so to speak, from which we can read historical dates, but also a mark that exists in a vast expanse of past and future time.

On Quirigua Stela F the Maya scribe refers to a past time calculated back beyond millions of years to a place called *ik’ najb’ nal* “black water place” (fig. 11c). With his larger than life-size, full-bodied portrait on the south face of the stela, Quirigua ruler K’ak’ Tiliw is linked to this radically distant past and place that passes back through and beyond historical time (Looper 2003, 125, 219). As to the future, Classic Maya scribes at Palenque indicated the 80th Calendar Round anniversary of the ascension of K’inich Janaab’ Pakal I on the Temple of Inscription West Tablet as 1.0.0.0.8 5 Lamat 1 Mol, correlated to 23 October 4772, a date nearly four thousand years after the death of this Maya ruler and the abandonment of this ancient city. Dates such as these, calculated deep into the past or future, were often indicated with Distant Numbers that the Maya scribe used to record a count of days between Long Counts. These Distant Numbers were often written in clusters of glyphs that frequently included zero coefficients. In these notations, whether Long Counts or Distant Numbers, the Maya used their zero as a placeholder to precisely note an expanse of time that had no expressed beginning or end.

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The Classic Maya visualization and use of zero in a numerical notation system appears only in calendrical dates and astronomical calculations. There are no extant tribute or trade documents from the Pre-columbian past in which the Maya recorded a vigesimal notation system equivalent to the Long Count. Given the material wealth and social complexity of Classic Maya everyday life, it is important to ask whether the Maya devised a written numerical system for accounts as extensive as Quechua *khipu*. What these accounts might have looked like, what numerical notational system was used, and why we have no current trace of such a system remain open to speculation. The four Maya codices that we do have are primarily calendrical. Were there other codices, destroyed by the Spanish or by natural erosion, that focused on trade, tribute, and demographics? Did the Maya use their extensive vigesimal notation system to record these details, as Lounsbury has suggested (Lounsbury 1978, 764)? In such notations did they maintain the value of 18 in the third step as they did in the Long Count to keep

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7 For an analysis of the numerological complexities and use of Distance Numbers on the Palenque Temple of Inscriptions West Tablet inscriptions, see Lounsbury 1978, 805; Lounsbury 1991, 811.
the third step \([\text{tun}]\) at a count of 360, or did they have an unvaried base-
twenty notation that went from 1 to 20 to 400 to 8,000 to 160,000, as
Diego de Landa has described regarding sixteenth-century Yucatec ca-
cao bean counts made on the ground “in infinitum, counting the num-
ber 8,000 twenty times, which makes 160,000; then again this 160,000
by twenty, and so on multiplying by 20, until they reach a number
which cannot be counted” (Tozzer 1941, 98).

These questions regarding ancient Maya numerical notations will
need to wait until another Precolumbian manuscript is found in a Eu-
ropean collection, until a new site is uncovered, or until we learn to see
what is in front of us in a different way.

In his description of Maya numbers, the colonial missionary Landa
does not mention Maya zero. Later editions and translations of the
original lost manuscript of his \(\text{Relación}\) translate Maya numerals and
numbers using Indo-Arabic numerals, but one cannot deduce from
these later translations whether Landa himself used them in his original
text or how thoroughly he may have understood them. In terms of
counting systems within Western Europe, the period from the twelfth
to the sixteenth century was a time of transition between Roman and
Indo-Arabic numeration (Hill 1915, 30–52). Ironically, while Indo-
Arabic numerals, including “0,” were becoming more common and
widespread in sixteenth-century Europe, Landa was burning hundreds
of Maya bark-paper manuscripts, which nearly eliminated all Maya
zeros on paper.

**Syllabic and Logographic Uses of \(\text{mi/MIH}\)**

Since the late nineteenth century there has been an ongoing debate on
how to read \(\text{glyph} (T173)\), \(\text{glyph} (T17:713a)\), and \(\text{glyph} (T1085)\) within the
Long Count. Several writers believed that these glyphs, including the
shell signs \(\text{glyph} in the \text{Dresden Codex, were zeros (Förstemann 1886,}
4, 29; Morley 1915, 92). Others argued that they were the coefficient
twenty (Goodman 1902, 65; Maudslay 1902, I-41). In the 1950s, Eric
Thompson, following G. B. Gordon and H. J. Spinden (Gordon 1902,
243; Spinden 1924, 28), argued that these glyphs functioned mathemati-
cally as zero placeholders, but meant completion to the Maya.
Convinced of this, Thompson hypothesized specifically regarding
\(\text{glyph} (T173)\): “I am sure, although there is no evidence pro or con, that the
Maya would not have used this sign in the sense of nil had they, for ex-
ample, been required to report on the production of some crop that
had been a total failure” (Thompson 1950, 137). When Thompson
wrote this, there was “no evidence pro or con” regarding the linguistic
value of these signs. Since 1990, however, with the increase in decipherments of Maya glyphs, (T173), (T17:713a), and (T1085) have been found to represent the syllabic sign mi and logograph or word sign MIH, which can be translated, according to several spoken Mayan languages, as “no,” as in lacking, i.e., there are no crops (Kaufman 2002, 1533). This recent decipherment of these signs as indicating the absence of something allows us to see, contrary to several decades of doubt amongst specialists, that the Maya did have their own concept of zero, which within the history of mathematics is aligned with the Babylonian diagonal double wedge ⬛, the Indo-Arabic “0,” the space between Quechua khipu knots, and several other explicit and implicit zero placeholders used in numerical notational systems worldwide.8

In 1990, Nikolai Grube and Werner Nahm were the first to identify the partially visible quatrefoil (T173) as a syllable with the phonetic value of mi (Grube and Nahm 1990, 16). David Stuart later identified the hand-over-jaw glyph (T1085) on the Palace Tablet at Palenque as the syllable mi in the word sam-i:y bUl-i:y that he translates as: “earlier today” (Stuart et al. 1999, II-35) (fig. 12a). More recently Simon Martin has identified (T173) as the syllable mi in aj atz’äm, “salt people” (Carrasco 2009, 19248, fig. 6) (fig. 12b). Inscribed on a Classic Maya pot, a coati (hog-nosed coon) confesses his lack of tribute to a seated lord in front of him (fig. 12c). In this case, mi is not a syllabic sign, it is the logograph MIH, a word used to describe the absence of tribute written at the upper left of the inscription with (T1805) the hand-over-jaw head variant for zero (Grube and Nahm 1994, 699).

It is this mi, used as a word to signify the absence of things, that appears three times on the Hieroglyphic Stairway at Copan in the clauses: mi-‘temple’, mi-‘altar’, mi-kab’-ch’e’n? an enigmatic description of Copan after the sudden death of Waxaklahun Ub’aah K’awil, the city’s thirteenth ruler (fig. 1 and 12d).9 The first two clauses—“no pyramids,” “no altars”—are visually and verbally transparent. Mi is written over the logograph for pyramid, and again over the logograph for stone altar, and though the words are clear their meaning remains obscure. When this inscription was written, twenty years after the death of a ruler who was known to have commissioned and built monumental structures at Copan, including the first phase of the Hieroglyphic Stairway itself, did

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8 For a global history of numbers, see Chrisomalis: 2010. For a specific discussion of zero in khipu, see Urton 1997, 48.
9 At Quirigua, where Waxaklahun Ub’aah K’awil presumably was betrayed and killed, he is described in less poetic terms as being beheaded on 9.15.6.14.6 6 Kimi 4 Tzek in the month of May AD 738 (Looper 2003, 76).
these monuments seem to disappear or appear less powerful due to his sudden death? Or is this a lament that in the first two decades after the death of Waxaklahun Ub’aaah K’awil no pyramids or altars were built (Martin and Grube 2000, 206)? Either reading reveals a perceived loss regarding architectural and sculptural monuments crucial to the efficacy of rulership.

In the third clause the scribe has written *mi* over a compound noun *kab’* for earth, itself written over *ch’e’n* for cave, compressing words into a metaphorical expression about the relationship between earth

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10In the twenty years between the death of Waxaklahun Ub’aaah K’awil and the writing of this inscription, Structure 10L-22A may have been the only major construction in AD 746 in Copan.
and caves often considered by the Maya as auspicious links to the sky or the watery underworld of supernatural entities and the dead. “No earth/cave” would then be a metaphor reiterating the sense of profound loss at Copan not just of things carved in stone, like pyramids and altars, but a loss of what those structures had come to mean, in a culturally collective social, political, and metaphysical sense.

To express the depth of this collective loss after the death of Waxaklahun Ub’aah K’awil, the scribe relies on the poetics of parallelism and compression in heightened triplet form, a form of expression still used by contemporary Ch’orti speakers, especially in publicly recited laments (Hull 2003, 464). On the Hieroglyphic Stairway the scribe uses these poetics to point to something beneath the surface or literal meaning, a sense that Copan was suspended—unsure of itself as a city in the face of such a defeat. Seen here in literary form, the Maya used (T173)  to indicate this deep loss to the point of its immeasurability. The presence of absence: lost ruler, no pyramids, no altars, no earth/cave, is thus represented in the full force of its complexity, similar to the way zero in the Long Count mathematically and paradoxically holds a space for nothing.11

“Seating” of the Calendar Year and Months and Why Not to Write This as “0”

In the inscriptions and codices the Maya numbered the days of their 365-day solar calendar with the same dot and bar notation used for coefficients of Long Count quantities. In this calendar of 18 months of 20 days and a remaining short month of 5 days, Classic Maya scribes did not indicate the beginning of the month as day “1.” Instead, they wrote  . For instance the beginning of the month Yaxk’in is written  followed by  .12 Early epigraphers and historians of Maya calendrics debated how to read , which conformed to no known signifier for a number in Maya inscriptions or codices.

11 Within the Classic Maya glyphic corpus the logograph MA (T504, T74) is used throughout as a negative marker. These glyphs for ma, however, were not used in the Classic or Postclassic period to indicate “zero” in numerical notations, indicating that ma and mi have subtly different meanings, with mi exclusively used by scribes as zero in the Long Count.

12 When scribes occasionally deviated from their own custom and chose to represent the 20th day of the month, they did so by prefixing the logograph ti’ deciphered as “mouth of” or “edge of” to a tun or haab sign. When they did this, as with , the Maya chose a word or phrase that represents transition, with a word like “edge,” rather than the specific number 20, reinforcing the idea that the space between months is a different kind of time than a numbered day. Out of hundreds of recorded days of the month, Thompson cites only nine known examples of this way of indicating the end of the month (Thompson 1950, 120).
Specifically, they debated whether *chum* should be understood as the 20th day at the end of one month, or as what they began to call the zero day at the beginning of the proceeding month. Goodman and others strongly argued for the reading of 20 (Goodman 1902, 64). After a careful inventory of first days of the months and years, however, Charles Bowditch proposed that these should be read as the “0” day of the month (Bowditch 1901, 8).

As early as 1948 Charles Fulton read the glyphs for the beginning of the months as *neither* 20 or “0,” but as a word, later deciphered by Lounsbury as “to set in place,” a translation of the word *chum* in the Cholan Mayan language (Fulton 1948, 236; Lounsbury 1978, 765; 1989, 207). Between each month of their solar calendar, the Maya semiotically shifted out of numbers into a word. In making this shift from number to word, the Maya focus attention on *chum*, the seating of the month as a day specifically different from other days.

In the inscriptions *chum* is written in various glyphic forms, several of which iconically read as a seated figure \(\text{T702v}\), \(\text{T700}\). Other glyphs for *chum* are more abstract, such as \(\text{T644}\) and \(\text{T644b}\), while other variations are formed of entirely phonetic composites (Lounsbury 1989, 226). 13 On Formative period Mesoamerican inscriptions, signs for seating had previously been used to signify the enthronement of a ruler (Justeson 1986, 447; Urcid 2005, fig. 2.6). Maya scribes continued to indicate the “seating” of a ruler with *chum*, while expanding its use to indicate the *chum* day of the month and year. These scribes did not use any of their signs for *mi* or zero in this capacity. To use “0” as a translation for *chum*, as is commonly done in contemporary literature on the Maya, confounds the meaning of *chum* and zero in a way that has confused many scholars, especially those outside the field of Maya studies who seek to interpret Maya numbers and concepts of time, and has led to the mistaken belief that the Maya literally had a zero day of the month within their solar calendar (Kaplan 1999, 83; Ifrah 2000, 318; Seife 2000, 18). To avoid this confusion, instead of “0” *Yaxk’in*, we could write “C” *Yaxk’in*, in this way revealing rather than glossing over the difference between *chum* and zero. And though the *chum* day of the solar calendar and the zero of Long Count coefficients both occupy a liminal space between 19 and 1, they do so in ways that are significantly different from one another within the history of Maya writing and meaning of their numbers.

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13 In the codices, to represent the *chum* of the month the Maya consistently used a vertically oriented stylized cross-section of the iconic signs for *chum* used in the inscriptions \(\text{T298}\).
Part 2. Visual Forms of Maya Zero

Head and Full-Figure Variants of Zero

In his analysis of \( \text{(T173)} \) and \( \text{(T17:713a)} \), Thompson paused to consider whether these signs may mean zero or, like \( \text{chum} \) (for the “seating” or beginning of the months in the 365-day solar calendar), they may not represent a numeral at all, but rather a verbal expression (Thompson 1950, 138). More recently, John Justeson has proposed that the Maya zero signs within the inscriptions are not numbers, but the adjectival predication to be read as the word “lacking.” (Justeson 2010, 51). He recounts how the Babylonians inscribed a pair of diagonal elements \( \text{ι} \) to indicate a zero value placeholder between numerals in their base-sixty place-value notation system. These diagonal elements \( \text{ι} \) had originally been used as a separation mark between written sentences (Neugebauer 1941, 214; 1969, 20). As placeholders in a positional notation system, found as early as the eighth century BC, these diagonal signs are a form of punctuation, functioning as a sign similar to a comma \( [,] \) or dash \( [-] \) between numerical terms (Pingree 2003, 137). Thus, the first “zero sign” in the history of notational numerical systems was not originally a numeral or number at all.

Had the Maya only inscribed \( \text{(T173)} \) and \( \text{(T17:713a)} \) as coefficients for their Long Count periods, it would be difficult to unequivocally propose a numerical as opposed to a verbal reading for these signs. However, there are instances when the scribes recorded Distance Numbers in an alternate manner, combining the moon glyphic variant for number 20 with numbers from 0–19 to represent numbers of days from 20 to 39. When three dots were placed in front of this moon glyph, the 3 was understood as being added to the 20 to equal the quantity \( 23 \). When a \( \text{(T173)} \) glyph \( \text{ι} \) was inscribed before the moon glyph, “0” quantity was understood as being added to indicate the quantity 20.\(^{14}\) This cannot be read as “no 20’s,” the way \( \text{mi k’in} \) could be read as “no days,” but rather it is to be read numerically as \( 0 + 20 = 20 \), where \( \text{mi} \) is the abstract and complex number “0.” In fifth-century India, mathematicians would also write zero as an abstract number in the form of a dot or small circle “\( o \)” that over time would be written as “0” throughout Europe (Pingree 2003, 139).\(^{15}\)

\(^{14}\)These Distance Numbers are both segments of Lunar Series Glyph A written with moon-glyph shorthand, and are from: \( 3+20 \), Piedras Negras Lintel 3 (Z1); \( 0+20 \), Palenque Temple of the Cross, West Panel (B13); drawn by Huberta Robinson (after Thompson 1950, fig. 4:17, 18). See figure 2 for variants of \( \text{(T173)} \).

\(^{15}\)Before the adoption of the numerical symbol “\( o \)” in India, words were written to serve as placeholders in their decimal place-value system. The various Sanskrit words used by mathematicians to indicate zero included \( \text{sûnya} \): nothing, void; \( \text{pruna} \): full; \( \text{ananta} \): infinite; \( \text{ambara} \): atmosphere, sky; \( \text{puskara} \): lotus flower; \( \text{nagna} \): naked; and \( \text{bindu} \): dot (Gupta 2003, 24).
What tips the balance even further toward a numerical reading of Maya zero in the inscriptions is the head and full-figure representations of numbers (figs. 5–6). During the Classic period, instead of only using dots and bars in a cumulative manner, Maya scribes created for the inscriptions an alternative numerical notation system drawn as individual heads and full figures for each numeral from 1 to 19 (fig. 13). In addition to variants for 1 to 19, the Maya scribes also drew a head and full-figure form for zero explicitly treating $mi$ as a numeral with the value of “0” in a visual sequence along with their other nineteen numerals.
The Maya scribes did not devise head or full-figure variants for the *chum*, the seating of the month, further indicating that the Maya did not treat *chum* as a number in the way they treated *mi* as the specific number “0.”

Even before these head and full-figure variants were identified as numbers, scholars dating back to Förstemann in the early twentieth century believed them to be Maya deities (Förstemann 1904, 549). After their decipherment as numbers, Thompson would go on to write that though “it cannot be proved that every numerical profile is that of a god,” “nearly all can be identified as such” (Thompson 1950, 131). Other scholars, less convinced or focused upon the deity status of these radically iconic numbers, have focused on the linguistic links to, or origins of, the head and full-figured numbers (Cordy 1946, 109; Macri 1985, 54).

Within the history of number technology, people develop words for numbers more often and well before they devise numerical notation systems. The relationship between words for numbers, like the words *one, two, three* and the numerical notation 1,2,3 is idiosyncratic from culture to culture. In spoken Yucatec there are single distinct words for numbers one through twelve (Lounsbury 1978, 762) (table 2). For thirteen through nineteen Maya Yucatec speakers combine the words for three, four, five, etc., with the word *lah* for ten in the same way that *eighteen* is a compound word: eight + ten. Similarly, in the inscriptions the Maya scribe drew distinctly different head variations for numbers 1–12. For numbers 13–19 the scribe drew composite portraits of the head for 10 combined with attributes from the head variants for 3–9 (figs. 13 and 14).

Beyond such structural similarities between spoken Maya words for numerals and Classic inscriptions of numerals, there are phonetic links between spoken numbers and their iconographic representation

<table>
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<th>Table 2. Contemporary Yucatec Mayan spoken words for 1–19</th>
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<tr>
<td>1. hun</td>
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<td>2. ca</td>
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<td>3. ox</td>
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<td>4. can</td>
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<td>5. hoo</td>
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16 There are rare instances when the scribe drew a head variant for the number twenty with moon attributes infixed at and below the eye, as on Quirigua Stela F C8 (after Looper 2003, fig. 4.5).

17 In the inscriptions the head variant for thirteen was occasionally drawn as a distinct head without the flayed jaw compound element of ten (Thompson 1950, fig. 25: 9,10).
in writing, most apparent in the head variant for the numeral 10. The word “ten” spoken in several Mayan languages is *lah*, a word that is also translated as “finish,” “end,” or “die” (Kaufman 2003, 1271, 1482), and was first proposed in 1946 by Napoleon Corby as the phonetic origin for the flayed or skeletal jaw iconography of head variants for 10 and 13–19 (Cordy 1946, 109). To visually represent *lah*, the scribes drew the head variant for 10 as a variously shaped skull with a flayed jaw, a well-established Mesoamerican signifier for death (Freidel 1986, 104; Taube 1992, 105), thereby exploiting the homonym *lah* that could mean both ten and death. Such rebus writing, however, could take countless forms, leaving open the question why the Maya scribes chose to visualize these phonetic elements as a sequence of heads rather than some other form, making them amongst the most animated and personified representations of numbers ever written.

The head variant for zero is a face in profile with a circular or curled protuberance at its forehead and a hand over its jaw (T1085). The representation of these heads varies in terms of the drawing of their features, some being distinctly human while others are hybrid in nature (fig. 5c, b). The full-figure forms of zero repeat this distinguishing motif of the hand-over-jaw that Linda Schele and Mary Miller have read as a representation of death or sacrifice by jaw removal (Schele and Miller 1986, 54; 61 fn. 61, 257, 268, 281) (figs. 6–8). This reading of the hand-over-jaw motif as related to sacrifice aligns the zero head and full-figured variants with death and the flayed jaws of numerals 10–19. The appearance of hand-over-jaw motifs, commonly drawn on zoomorphic representations of the *bak’tuns* and several other period glyphs, however, further raises the question of the possible origins and meanings of this hand-over-jaw motif in calendrical writing and the representation of numerical values (fig. 15).

Focusing on the five numbers of the Long Count on Copan Stela D and Quirigua Stela D, it is strikingly apparent that the Classic Maya scribe imagined numbers as dramatic and transformative entities (figs. 16 and 17). At Copan the scribe renders the number nine with its distinctive spotted pelt for a lower jaw, seated with legs crossed, head
forward, wearing a tumpline in which this number nine carries the bak’tun period glyph, itself a full-figured avian zoomorph. At Quirigua the scribe renders the number nine coefficient of the bak’tun with a long pelt beard and upward tuft of hair similar in profile and imaginative exuberance to the eccentric flints often found buried at the base of pyramids (Miller and Martin 2004, figs. 78–82). At Copan the numbers carry or pull their period glyphs along, while at Quirigua the two figures clutch one another, bursting at the edge of their confinement within each glyph block.

On Copan Stela D the full-figure zeros both have a hand over their jaws and their hair pulled back and knotted at the top of their heads (figs. 16 and 6a). The first of these zero figures leans forward, locking arms with the appendage of a winal period glyph in the form of a toad. His neighboring zero holds the vegetative arm of a k’in period glyph figured as a hybrid monkey. On Quirigua Stela D the full-figured zero has a hand over its jaw and diagonal line and two dots, similar to a percentage sign, drawn on its face and leg (figs. 17 and 6b). The zero below tilts its head back as if screeching with a hand over its jaw and percentage signs on its face, arms, and legs as it clutches the personified k’in.18

Outside the Long Count system, the full-figure form of zero is occasionally represented as a stand-alone figure or part of a narrative. At Copan, the full-figure form of zero appears carved in low relief on a central ballcourt marker (fig. 8). Here the personified zero is depicted in a narrative scene as one of two ball-players dressed in a jaguar pelt with the distinctive hand-over-jaw motif and deer ears folded down at the edge of his headdress. Just in front of and above him is a glyph block that includes the number six and logograph MIH that names him, followed by the syllable wa. Across the large ball is his opponent,

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18 One anomalous full-figure zero, carved at Palenque, does not have a hand over his jaw but instead has two (T173) glyphs prominently displayed on his arm, marking him as a zero coefficient of k’in (fig. 6c).
Figure 16. Copan Stela D (9.15.5.0.0) AD 736, drawn by Linda Schele

Figure 17. Quirigua Stela D (9.16.15.0.0) AD 766 (after M. Looper 2003, 14)
identified in the glyphic text in front of him with the number one affixed to a face with distinctive jaguar spots and a crosshatched element at the upper right. Beneath the players, across the divide of a double band, there are two bowls inscribed with *k’in* signs, each filled with crossbands for the sky and conch shell forms bringing together elements of the sky and sea.

Also at Copan, a personified zero is carved as one of eight life-sized figures originally set into niches on the upper façade of Structure 10L–22A (fig. 7). All that currently remains of this once-seated full-figure zero is his portrait head in high relief. As with the full-figure number zero in the Long Count, he has a hand over his lower jaw and bound hair tied at the top of his head. Prominently carved at the center of his head is a scroll sign, often signifying speech or breath or the spiral shape of a shell. Over the large circular disk earflares there are two additional scroll signs and large deer ear attributes. Whether representations of a deity or not, these narrative and free-standing images of zero point to something beyond the animation of numbers toward a distinct personified presence of zero, along with their other numerals, within Maya imagination. Specific elements of this portrait of zero read like a compound glyph, from the scroll sign above to the hand-over-jaw that covers the mouth, compressing together speech and breath and their muted absence, as if zero itself were a being or entity through and after which the other numbers would follow.

*The Quatrefoil, *(T173) Representations of Zero*

Alfred Maudslay and J. T. Goodman in their joint publication of the 1902 *Archaeology* both concluded that *(T173)* was a Maya symbol for twenty. While Goodman’s interpretation was influenced by his desire to see the Maya as analogous to the Greeks and Romans, who shunned zero in their number system, Maudslay followed a Precolombian iconographical path to his conclusion (Goodman 1902, 65). As epigraphers do to this day, Maudslay read the three-sided glyph *(T173)* as a four-sided form whose fourth side was suppressed when used in combination with another sign that it modified, like the sign for *tun* or *winal* or *k’in* (Maudslay 1902, 1:41) (fig. 2). As a four-sided form in systems of calendrics, Maudslay noted two Precolombian calendars

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19 Representations of the number zero in all of its visual forms are more varied and frequent at Copan than at any other site during the Classic Maya period. In this essay, examples from Copan include figs. 1; 2h; 3d; 5a; 6a; 7; 8; 16.

20 The ancient Greeks, who had an alphabetic numerical notation system, occasionally adopted the Babylonian zero and sexagesimal place-value system, but only for the fractions of their astrological calculations (Pingree 2003, 138).
that were drawn in quadrangles (Maudslay 1902, Pl. 32). The first of these calendars is the Maya 260-day almanac on pages 75–76 of the Madrid Codex. The second was the Mixteca-Puebla 260-day almanac on the first page of the Fejérváry-Mayer Codex. Through this comparison he concluded that (T173) was the Maya sign for twenty, a quadrangle composed of four sections of five.

Among the multiple quantities of time that the Maya wrote in the inscription, the 260-day almanac is one of several calendrical sequences. The Maya had no need for zero in this calendar, with its 20-day names repeating against 13 numbers. Its endless and ongoing return in quantities of 260 fits within the symmetry of a quadrangle of four sections of sixty-five and suited the representations that Maudslay noted in the codices. (T173) is, however, a component within a different kind of Maya technology of time. In the Long Count, zero is not analogous to a quadrangle meaning twenty, as Maudslay proposed. It is, rather, a pure zero with a value of nothing that holds a place within a number system, propelling quantity along an ongoing sequence of days with no known end.

To consider other possible iconographic readings of the (T173), we can begin with a morphology of scribal variations (figs. 2 and 18b-h). Whether used to write the number zero or the *mi* syllable/logograph, (T173) is a quatrefoil form with only three sides visible. Many (T173) of these glyphs are drawn with straight, curved, or dotted lines at the corner of the lobes that meet at a central opening, often marked by a dot (fig. 18b, c, d, h). Other representations of this glyph are drawn with layers of lobes around the central opening (fig. 18e, f). In the stone inscriptions, the scribe indicates and emphasizes the black color or darkness of the lobes with crosshatching (fig. 18b, c, f). In Classic Maya painted murals, the three lobes of the *mi* signs are blackened with pigment (fig. 18g). In the Postclassic manuscripts the lobes of the *mi* sign are drawn by the scribe as three radiating circular forms, each attached by lines to a central opening, often with a dot at its center, with dotted lines between on either side of the lobes (T163) (fig. 18h). Anomalous representations of zero coefficients of the Long Count were carved on Stela 63 at Copan, where the scribe drew each of the four zeros of the *bak’tun* ending as a composite of (T173) and the zoomorphic head variant for TUUN (T528) (fig. 18f).

In its mathematical role as a zero placeholder, marking and holding a space, the (T173) glyph visually relates to quatrefoil floral forms and the foliated frames of portals and caves discussed by Houston and Taube (Houston and Taube 2000, 271).21 Like many aspects of Maya

21 For an in-depth discussion of Classic Maya floral imagery, especially in relation to passageways, see Taube 2004.
Figure 18.  a. Chalcatzingo Monument 9, carved granodorite 183 cm × 142 cm, private collection, photograph courtesy of Richard Townsend; b. Caracol Stela 1, “0” tun (after Beetz and Satterthwaite 1981, fig. 1); c. Quirigua Stela C East Text “0” winal drawn by Linda Schele; d. Tonina Monument 101 “0” winal drawn by Ian Graham CMHI 6.2 p. 125; e. Yaxchilan Stela 11 “0” k’in drawn by Linda Schele; f. Copan Stela 63 “0” drawn by Barbara Fash (after W. Fash 2001, fig. 37); g. Calakmul polychromed mural detail, Structure Sub 1–4, Chiik Nahb Acropolis, T 173 mi as syllable in aj atz’aam “salt person,” drawn by Simon Martin (Carra-cos 2009, 19248, fig. 6); h. Dresden Codex page 20, syllabic mi to spell ehm “she/ he/it descends,” Photochromolithographic edition, 1880–92 © FAMSI; i. Machaquila Stela 4; j. Seibal Stela A (after Stuart and Houston 1994, fig. 37 a,b).
art and calendrics, the foliated quatrefoil portal is fully conceptualized and visualized in Middle Formative works such as Monument 9 from Chalcatzingo, Morelos (fig. 18a). Here a zoomorphic mouth in the form of a stone-carved quatrefoil appears open and liminal between the underworld, the earth, and the sky. With animal eyes and nose above and shoots of plant stalks at all four cardinal corners of its gaping four-sided opening, this aperture invites us to look through and beyond its opening. Similar to zero, which was mathematically conceived to hold a space within vast expanses of time, this portal opens out toward something far beyond the here.

Maya representations of portals, especially ones in and through watery places, are often quatrefoil in form, such as the place-name glyphs for Machaquila and Seibal, both of which have foliage at their corners and najb’ infixes for water at their center (Stuart and Houston 1994, 37) (fig. 18i, j). The floral, foliage, and portal-like aspects of (T173) glyphs for the number zero, with their blackened lobes, are attributes that visually link zero to dark and watery places of transition. Literally, within the base-twenty Long Count, at each step of the notational system, zero is a space held open for transition from nineteen through zero and back to one again.

**Shell-in-Hand (T17:713a) Representations of Zero in the Stone Inscriptions**

In the inscriptions, in addition to (T173), (T1085), and the full-figure form the Maya also wrote their zero in the form of a hand holding a shell (T17:713a) (fig. 3). In most cases it is a right hand with the wrist facing out. The wrist is usually marked with a circular infix with a dot at its center. Beneath the shell-in-hand, there is often an oval element with diagonal or anomalous lines drawn within it (fig. 3b, c, d; fig. 4a). Occasionally the scribes would also draw a more abstract shell form as a component of this composite glyph (T807) (Boot 2003, 11) (fig. 3e). Gordon read the hand in Maya inscriptions as a symbol for twenty that had over time been adopted as a “zero” sign (Gordon 1902, 244). As he did with the quatrefoil form, Thompson read the hand symbols in Maya calendrics as completion signs (Thompson 1950, 137, 184). Within a section entitled “Hand Symbols for Completion,” however, he goes on to list several other possible meanings of hand imagery in the glyphic corpus and the ethnographic literature, opening up interpretation for what the hand component holding a shell as well as the hand across the jaw of the head and full-bodied zero signs may represent.

With up to forty-five different variations, hand gestures are one of
the most common elements of Maya glyphic writing (Boot 2003, 1). Within various ancient Mesoamerican notation systems, hands abstracted from the body and combined with elements such as shells may represent a verb/object relationship where the hand indicates an action in relation to the shell it clasps (Justeson and Mathews 1990, 100). The third element, often drawn beneath the shell-in-hand zero signs, may indicate pronunciation or have grammatical meaning (fig. 4). With the current decipherment of mi glyphs linguistically as “no, none or lacking” and numerically as “0,” the shell-in-hand glyph (T17:713a) is a composite glyph of two or three elements placed together to represent Maya thoughts about holding or literally gesturing toward absence and zero in the form of a shell. Like the space that the quatrefoil (T173) holds open, the shell, too, as a form, is a container, a home built by the accumulated secretions of a gastropod that after death leaves its exoskeleton for others to inhabit.

**The Seashell Representation of Zero in the Post-Classic Screenfold Manuscripts**

As established in Part 1, the first fully visualized Classic Maya zeros on stone inscriptions are found at Uaxactun on Stelas 18 and 19 in 8.16.0.0.0 (AD 357). Five hundred years later Maya scribes carved the last of these known inscriptions on Tonina Monument 101 in 10.4.0.0.0 (AD 909) using (T173) glyphs for the three zeros of this k’atun ending (fig. 2e). Shortly before or after AD 900 Maya cities such as Copan, Quirigua, and Palenque were abandoned, marking the end of many aspects of Classic life and art, including the end of monumental stone carving with inscribed Long Count dates. After this period, to follow Maya numerical notation practices, we must shift to their written manuscripts. The four surviving Maya screenfold manuscripts date from the Late Postclassic period, AD 1200–1500, between three and six hundred years after the last stone inscription at Tonina.

Three of the surviving Postclassic Maya manuscripts were sent to Europe in the early Colonial period, sometimes lost to sight for several decades, and finally documented in book collections in Paris, Madrid,

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22 This oval element beneath the shell-in-hand glyph occasionally is drawn beneath head variants for zero as seen on Quirigua Stela F, D14 (fig. 4b), and may be the suffix *il* transforming this number from zero into a generalized quality of “zeroness,” similar to the way the suffix *il* transforms dark into “darkness” on the Tablet of the Orator at Palenque (Houston et al. 2001, 25). On Quirigua Stela E, D16 there is an anomalous (T173) glyph that may be part of the spelling of a name that has this same element infixed at the center opening of the partially visible quatrefoil (fig. 4c).
and Dresden. The difference in Maya writing between these books and the stone inscriptions is significant. The majority of Classic period stone inscriptions are outdoor public monumental carvings. Copan Stela D measures 12 feet in height, with the Long Count numbers carved into glyph blocks of up to a foot in height and width and legible from the ground (fig. 16). By contrast, the Dresden Codex, a seventy-four-page screenfold manuscript, with each page measuring $8.1 \times 3.5$ inches, was made to be held in the hand and read intimately (fig. 19).

In these screenfold manuscripts the Maya scribes continued to write the number one as a dot and five as a bar. For zero, they replaced the various glyphic forms that had been previously drawn in the stone inscriptions with a series of stylized oval forms $\textcircled{\text{O}}$. Regarding the representation of zero $\textcircled{\text{O}}$ in the manuscripts, in his 1886 commentary on the Dresden Codex, Förstemann originally thought these oval forms “looked like a symbol for the human eye [einem menschlichen Auge]” (Förstemann 1886, 4). Twenty-four years later, in their 1910 study “Animal Figures in the Maya Codices,” it was Tozzer and Allen who identified the standard oval form that the Maya used to represent zero in the codices as a stylized oliva shell $\textcircled{\text{O}}$ (Tozzer and Allen 1910, 297).

This streamlined and highly consistent method of writing numbers in the manuscripts, compared with the exuberant visualization and experimentation with epigraphy throughout the Classic period stone inscriptions, is not the only difference between writing on stone and writing on paper. In the manuscripts Maya scribes wrote Long Count numbers of great quantity without period glyphs, thereby continuing the Early Classic practice of writing in a pure positional notation system with the value of each number determinable only by its position relative to other numbers. For instance, on Tikal Stela 29 we can read the Long Count date as $8 \text{ bak’}tun$, $12 \text{ k’atun}$, $14 \text{ tun}$, $8 \text{ winal}$, and $15 \text{ k’in}$ because the coefficients for these period glyphs are consistently written in positional notation form from the $\text{k’in}$ up to the $\text{bak’}tun$, but we can also read it this way because the period glyphs are explicitly written next to the coefficient numbers (fig. 10b). In the codices, numbers are written vertically in pure positional notation, as on page 24 of the Dresden Codex at 13B where the five numbers $9.9.16.0.0$ can be properly calculated only with an implicit understanding of the place value for each coefficient (fig. 19).

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23 Occasionally, as on Dresden page 61, A14–B15, scribes wrote coefficients with period glyphs.

24 The latest recorded Long Count in the Dresden Codex appears in red on page 51a: 10.19.6.1.8 (AD 1210).
Figure 19. Dresden Codex page 24, painted *ficus* bark paper screenfold manuscript of 39 leaves attached with animal skin hinges, consisting of 74 inscribed pages, 3.56 m long with each page 20.5 cm × 9 cm (8.1″ × 3.5″). Photograph courtesy of Sächsische Landesbibliothek-Staats- und Universitätsbibliothek, Dresden.
It is possible that the different technology of writing numbers that we find in the Postclassic manuscripts represents a historical shift that took place over time, or it may be more specifically a shift in materiality and context. At Classic Maya burial sites we find the dissolved illegible remains of books that could not withstand the moisture of the tropics. We can also see images of screenfold manuscripts on Classic period ceramic pots, confirming that during the Classic period the Maya made and wrote books that simply have not survived. We can only surmise what they might have looked like and how numbers would have been written in them. During the Classic period Maya scribes could have written numbers with greater visual variation and drama for public stone inscriptions and then at the same time written numbers for paper manuscripts in a more streamlined way, without period glyphs, such as we find them in the Postclassic period. For now, this remains one of many open questions concerning the diachronic and synchronic history of written Maya numbers.

In the Dresden Codex the Maya meticulously recorded the movements of the sun, predicted lunar eclipses, and charted the movements of the planets Venus and Mars. They noted all of these phenomena not only as isolated astronomical events, but as numerically linked to each other, constituting an interwoven numerology aligned with the 260-day almanac. For each of these calculations, the Maya scribes continued to use their base-twenty positional notation system, written vertically from bottom to top, with each higher step equal to twenty times the previous step, with the constant exception of the third step, which was calculated as times eighteen. One such calculation that the Maya revealed in was the 2,920-day count in which \(5 \times 584\) days of the Venus cycle corresponded to \(8 \times 365\) days of the solar cycle. In Maya calendrical numerals in line 18D of page 50 of the Dresden Codex 2,920 is written 8.2.0.

Throughout the Dresden Codex the Maya scribes drew the oliva shell sign for zero in red with more than thirty different surface design variations (fig. 20b). On page 24 alone the Maya scribe drew six different variations of zero in the form of an oliva shell (fig. 19). One of them appears with a second oval underline and three cross lines, others with a series of oval underlines, and still others with a series of dots or straight or curved lines across the surface. These variations are consistent with the variations of naturally forming oliva shells, as they would have been found in seas and oceans bordering Maya territories such as the Gulf of Campeche, the Caribbean Sea, and the Pacific Ocean (fig. 20a). The oval form and repeating oval lip represent the shape of the shell and outer edge of its aperture, out of which the live mollusk would stretch its probing appendages. The varied designs drawn by the Maya
scribe are consistent with the vast range of two-dimensional designs on the shells of these marine gastropods. From the *oliva reticularis greenwayi*, with its smooth golden brown surface that visually emphasizes the swirl of the shell, to the *oliva caribaeensis*, with its surface covered in etching-like lines of what appears to be an undeciphered writing, the *oliva* species of shells provided the Maya scribes with a panoply of forms and designs from which to represent their zero (fig. 20b).

Other than these horizontally oriented, stylized *oliva* shells for zero, the Maya scribes of the *Dresden Codex* wrote four additional symbols for zero, all of which can also be identified as seashell forms (fig. 21 a–d).

On page 24 they wrote one of their zeros as an up-ended oval with what appear to be appendages of the mollusk probing out (fig. 21a).

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**Figure 21. Dresden Codex** details from a. page 24; b. page 54; c. page 63; d. page 64; e. page 20; f. page 61; g. page 67. Postclassic AD 1200–1500, Photochromolithographic edition, 1880–92 @ FAMSI; a–d drawn by Mark Van Stone.
On page 63 they drew another variation in the form of a bivalve, similar to a mussel that has been opened (fig. 21c). And on pages 54 and 64 they drew zero in the form of a larger gastropod such as the *strombidae* or *turbinellidae* species, commonly called conchs, which they used for trumpets and containers (fig. 21b, d). The latter of these two conch shell forms has two dotted lines curling out of its aperture that may represent beads of water. Or, as Justeson has proposed, they may be visual elements that link this iconic shell form to other, more abstracted representations of *mi* drawn as logosyllabic elements with similarly dotted lines in the text portions of the codices (Justeson 2010, 50) (fig. 21e, f). To further confirm that these zeros are stylized seashells, one need only look at the bottom of page 67 of the *Dresden Codex* to see an *oliva* shell to the left and a conch to the right floating alongside a fish in this image of the sea (fig. 21g).

* * *

The Maya scribes chose not just any shell, such as a terrestrial snail-shell or freshwater shell, but a seashell to write their zero �WebpackPlugin in the codices. Thinking geographically, Maya territories from the Yucatan Peninsula to the west coast of Guatemala are bordered by seas and oceans with their dramatic tides, waves, and far-off horizons. By literally drawing their zero from the realm of the sea, they may have been linking their number zero to endless expansiveness, as they had done on Coba Stela 1 (fig. 11b) with the four zeros of its Long Count combined with time projected back into an exponential quantity of years. With their base-twenty notational system and their zero, counting for the Classic Maya literally went from zero to exponentially large numbers, expanding like the ocean, something visible at the shore that moved out beyond what could be seen or touched.

For the Classic Maya, or any culture, the origin and nature of time pose particularly difficult ontological challenges, especially since time has no corporeality in itself and no single sense is engaged for its apprehension. When we say time, it is a system of telling or marking time that we are referring to and *not* what is being marked. To say one has a good sense of time is to imply that there is a sixth sense, but in a way time is constructed of thin air, and the numbers devised and used to express time hold and reflect the elusiveness of what they seek to represent. How the Maya represented time, from the incalculable expanses to the paradoxical absence of value in zero, tells us something about the far end of their thoughts. The specific glyph �WebpackPlugin (T17:713a) depicting a shell in the grasp of a human hand perhaps signifies a bold gesture of reaching out across the sea, an image Maya scribes would know very
well, since their inkpots were often cut-opened seashells, sometimes even carved in the shape of a human hand (fig. 22). When the Maya scribes wrote, on some level they engaged in a willful act of expression that ranged from vast quantities of time to an expanse of nothingness.

Summary

Maya zero is predominantly used in stone inscriptions and screenfold paper manuscripts as a coefficient of Long Count quantities and in counts of the phases, movements, and cycles of celestial bodies including the moon, sun, and Venus, and their various numerical relationships to one another. The base-twenty place-value system and Long Count were first invented and used in Mesoamerica hundreds of years prior to the Classic Maya; however, in these Long Count dates and Distant Numbers there are no explicit visual notations of a zero. Subsequent archaeological findings may give us an earlier representation of a zero that would be extremely meaningful both conceptually and visually. For now, however, it is only in the Classic Maya inscriptions, on pots, and in Postclassic codices that we have an explicitly visualized Mesoamerican zero. Throughout the Maya hieroglyphic corpus scribes often used these zeros to calculate and record numbers so large as to imply limitless expanses, constituting a vast range of time and number itself. Mi-‘temple’, mi-‘altar’, mi-kab’-ch’e’n? (no temples no altars no earth/cave) on the Hieroglyphic Stairway give us a narrative glimpse of the existential nature of absence, the mathematical correlate of which
is the number zero, unique in its signification of absence, or, to say it in a different way, the meaningful presence of nothing.

Fundamentally, this essay is a historical and morphological account of the visualization and uses of Maya zero, with tentative hypotheses about potential meanings. Further work on the numerical uses of zero, representations of zero, and the logosyllabic variations of mi/MIH will reveal greater depth, contradictions, and nuanced understanding of this complex concept of Maya zero.

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