# The Diety Head Variants of Glyph C

JOHN H. LINDEN
SUNNYVALE, CA

Among the Lunar Series hieroglyphs of the Maya Classic period inscriptions is a group of small carved heads known as the Deity Heads. Often heavily eroded and difficult to make out, these Deity Heads constitute an uninterpreted set of variable glyphic infixes found within Glyph C of the Lunar Series. Analysis of the associated Long Count dates for these Lunar Series inscriptions reveals that the Deity Heads functioned as semester patrons for the six month period recorded by Glyph C, and that these Deity Heads in combination with Glyph X served to mark the Glyph C moon number in a larger calendar of eighteen lunar synodic months.

**The Diety Heads**

The Deity Heads are a group of variable hieroglyphic infixes that occur within Glyph C of the Classic period Lunar Series inscriptions. Glyph C, the lunar month glyph of the Lunar Series, is very consistent in its format. Most inscriptions show the Deity Head variants just above a T713 "hand" main sign and before a T181 lunar postfix. Aside from the prefixed coefficient that recorded the Glyph C moon number, the Deity Head infixes constitute the main variable element within Glyph C.

It is generally accepted that these Deity Heads form a group of patron deities for the lunar month recorded by Glyph C. But to date, the pattern of their occurrence has remained uninterpreted.

**Long Count dates and the Lunar Series**

The Lunar Series of the Classic period inscriptions constitutes a lunar calendar that recorded day and month positions for the Long Count date associated with each inscription.

The Long Count date together with the Initial Series Introductory Glyph (ISIG), the Tzolkin day glyph, and the Haab day glyph comprise the Initial Series. The Supplementary Series is composed of Glyphs G and F and the Lunar Series glyphs. The Initial Series and Supplementary Series precede most Classic period inscriptions, showing the position of the Long Count date in several calendars. The Initial and Supplementary Series glyphs can be summarized as follows:

Initial Series: ISIG, Long Count date, Tzolkin day, Haab day
Supplementary Series: Glyph G, Glyph F, Lunar Series

Figure 1 presents the Initial and Supplementary Series inscription from Piedras Negras Stela 8 as an example of a typical Lunar Series. Glyph C, the hieroglyph that recorded the Lunar Series moon number and contains the Deity Head variant, is shown in fig. 1, B6.

The Piedras Negras Stela 8 inscription begins with an Initial Series Introductory Glyph (fig. 1, A1-B1) that has an infix of the patron deity for the Haab month of Pax. Next, the Long Count date and the Tzolkin day glyph follow (fig. 1, A2-B4), recording 9.11.12.7.22 Ahau. At the end (fig. 1, B8), the Haab month position of 10 Pax is recorded. These glyphs form the Initial Series.

The remainder of the inscription contains the Supplementary Series, comprising the Glyph G and Glyph F variants (fig. 1, A5-B5) and the Lunar Series glyphs (fig. 1,A6-A8).

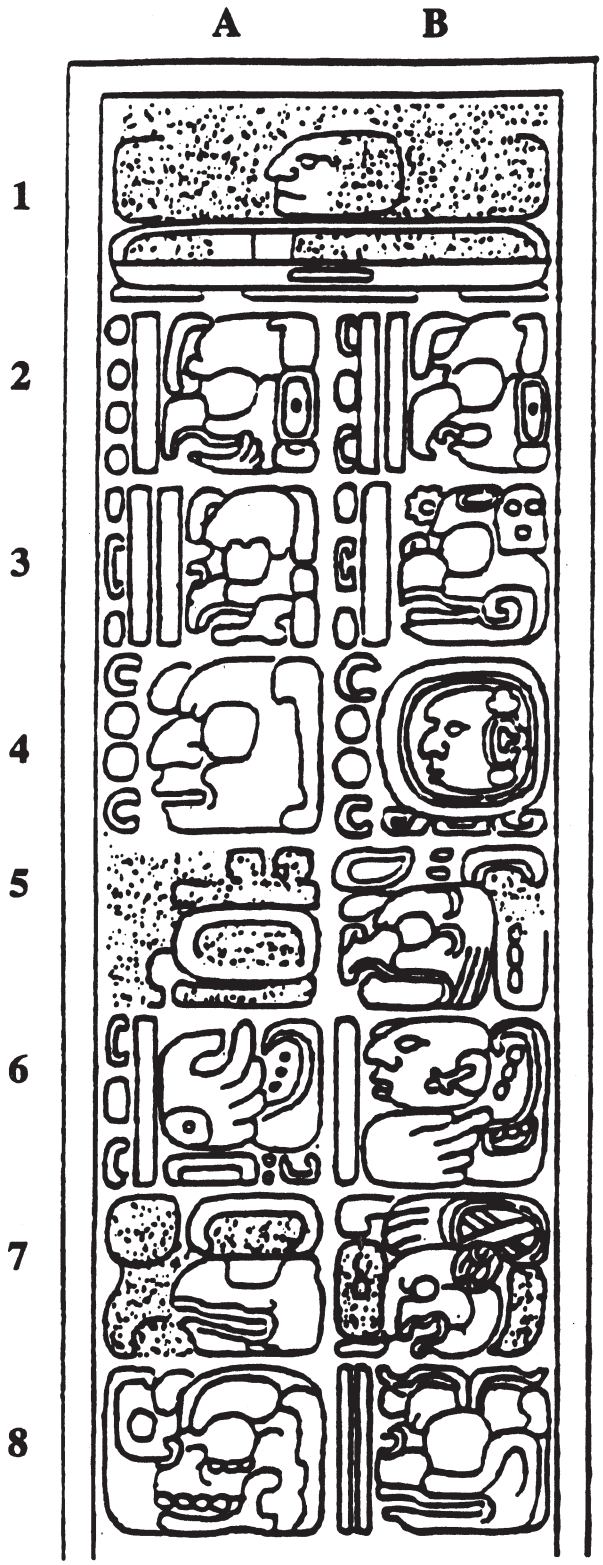
The Lunar Series on Piedras Negras Stela 8 can be represented as follows:

| | | | |
|---|---|---|---|
| 6D | (fig. 1, A6) | 5C | (fig. 1, B6) |
| X5 | (fig. 1, A7) | B | (fig. 1, B7) |
| A10 | (fig. 1, A8) | | |

Glyph 6D records the sixth day of the month, and Glyph 5C marks the fifth month in a cycle of six lunar synodic months. The length of this fifth month is recorded by Glyph A as a 30-day month. The role of the Deity Heads within Glyph C and the Glyph X variants are discussed below in an analysis that shows their relation to an eighteen month lunar synodic calendar.

**Glyph C, the Diety Head Variants and Glyph X**

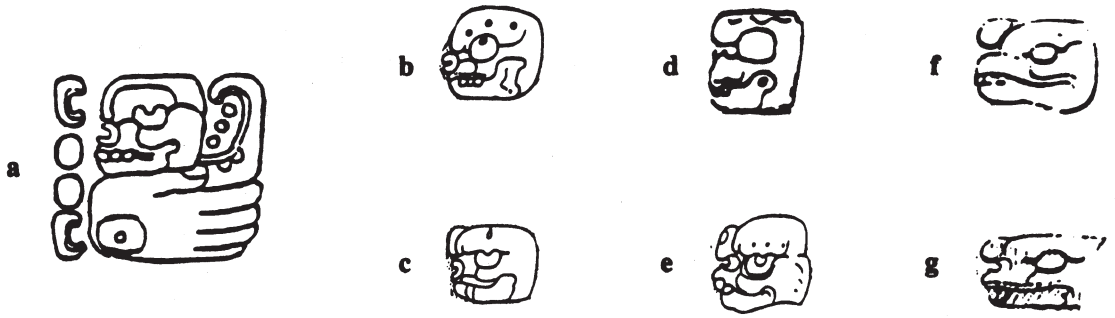
The Deity Head variants are a group of small hieroglyphic infixes that make up part of Glyph C. These Deity Heads, along with the numeral coefficients that precede Glyph C, are the vari-



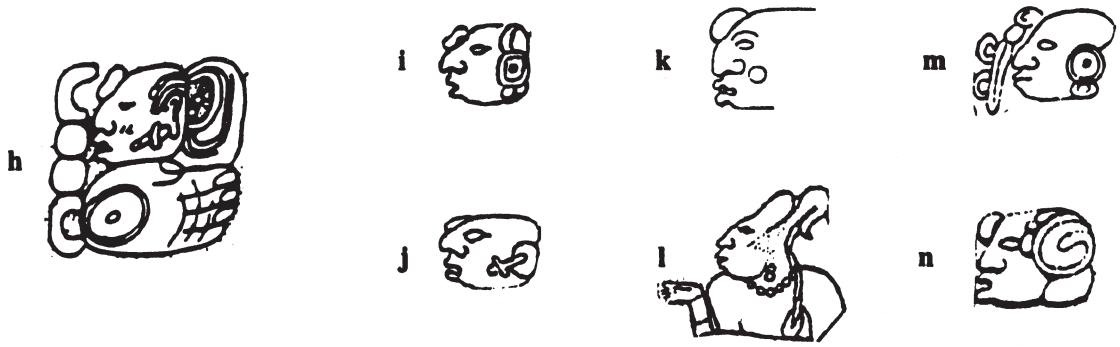

| Initial Series Introductory Glyph (Pax patron deity infixed) | |
|---|---|
| 9 Baktuns | 11 Katuns |
| 12 Tuns | 7 Uinals |
| 2 Kins | 2 Ik |
| G7 | F |
| 6D | 5C |
| X5 | B |
| A10 | 10 Pax |

*Fig. 1 Piedras Negras Stela 8, drawing by Morley (1938, plate 31 ): Initial Series and Long Count date: 9.11.12.7.2 2 Ik 10 Pax; Supplementary and Lunar Series: G7, F, 6D, 5C, X5, B, A10.*

**SKULL Deity Head variants**




**HUMAN Deity Head variants**




**MYTHICAL Deity Head variants**

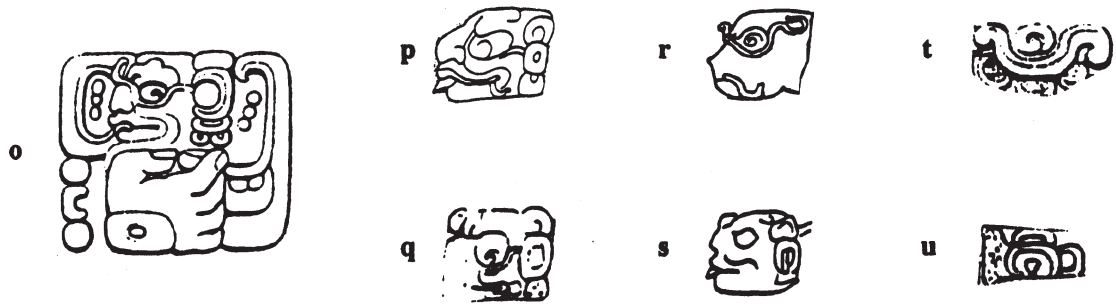



*Fig. 2 Typology of the Deity Head variants:SKULL Deity Head variants: (a) Glyph 2C with Skull Deity Head infixed, P.N. St. 3 (back); (b) Skull, Yax. Lin. 46; (c) Skull, Yax. Lin. 21; (d) Skull, P.N. St. 1 (back); (e) Animal Skull, Pal. TS (bod. #487a); (f) Animal Skull, Copan St. M; (g) Animal Skull, Quir. St. J. HUMAN Deity Head variants: (h) Glyph 2C with Human Goddess DeityHead infixed, Pal. TC; (i) Human God E, P.N. St. 11; (j) Human Goddess, P. N. St. 8; (k) Human, Quir. St. E(e); (l) Human, Copan HS #24; (m) Human, Copan St. 20; (n) Human God E, Quir. St. F.MYTHICAL Deity Head variants: (o) Glyph 2C with God of 7 infixed, Quir. St. A;(p) Mythical, Pal. T. 18 (bod. #274a,b); (q) God of 7, Sacul St. 1; (r) God of 7,P. N. St. 30; (s) Mythical, Dumb. Oaks RP #1; (t) God M, Copan St. N;(u) T173, Pusilha St. O.*

able elements in Glyph C. Three Glyph C variants from the Lunar Series are shown in fig. 2 a, h, o, and each of these Glyph C variants has a prefixed coefficient of two. Glyph C typically contains the T713 "hand" main sign followed by the T181 lunar postfix.

This format is very consistent, making Glyph C one of the easiest glyphs to identify when look-

Table 1. Deity Head Inscriptions: SKULL VARIANTS
(predicted 18 month lunar synodic calendar position: 0.00 - 5.99 months)

| LC Date | Monument | Glyph E/D | Glyph C | Deity Head | Glyph X | Glyph A | 18 Month (COP) |
|---|---|---|---|---|---|---|---|
| 8 17 17 0 0 | Bejucal St. 2 | 27E | 5C | S | X? | A? | 0.81 |
| 9 4 11 8 16 | Yax. Lin. 47/48 | 12D | 2C | S | X2/3 | A9 | 2.35 |
| 9 6 10 0 0 | Copan St. 9 | 25E | 5C | S | X1a | A10 | 3.84 |
| 9 9 0 0 0 | Copan St. 7 | 13D | ?C | AS | X4 | A10 | 1.38 |
| 9 9 2 17 0 | Copan St. E | ?D | 4C | AS | X4 | A10 | 1.28 |
| 9 10 14 5 10 | Pal. T. Olvidado | - | 6C | AS | X? | A? | 5.60 |
| 9 11 6 2 1 | P. N. Lin. 2 | 19D | 5C | S | X1a | A9 | 5.55 |
| 9 12 0 10 11 | Dos Pilas St. 8 | 3D | 3C | S | - | - | 1.98 |
| 9 12 3 14 0 | Copan St. I | NMG | 4C | AS | X? | A9? | 4.88 |
| 9 12 8 3 9 | Copan Altar H' | 22E | 5C | AS | - | A9 | 4.70 |
| 9 12 9 8 14 | Yax. Lin. 46 | 14D | 3C | S | X4 | A10 | 2.45 |
| 9 12 19 14 12 | Pal. TS, bod. | 11D | 3C | S | X4 | A10 | 2.35 |
| 1 18 5 3 6 (DD 9 13 0 0 0) | Pal. TS | 26E | 4C | S | X4 | A10 | 4.03 |
| 9 13 10 0 0 | Copan St. J | 18D | 0C | AS | X1 | A10 | 0.57 |
| 9 12 2 0 16 (DD 9 13 15 0 0 ) | P.N. St. 1 (b) | 8D | 3C | S | X4 | A10 | 1.76 |
| 9 12 2 0 16 (DD 9 14 0 0 0) | P.N. St. 3 (b) | 27E | 2C | S | X2/3 | A9 | 1.76 |
| 9 13 10 6 8 (DD 9 14 8 14 15) | Pal. Palace Tab. #2 | GC1 | 6C | S | X? | A? | 4.90 |
| 9 15 10 0 0 | P.N. St. 10 | 9D | 3C | S | X4 | A10 | 2.20 |
| 9 13 17 12 10 (DD 9 16 1 0 0) | Yax. Lin. 29 | 15D | 5C | S | X4 | A10 | 4.37 |
| 9 0 19 2 4 (DD 9 16 1 0 9) | Yax. Lin. 21 | 7D | 3C | S | X4 | A9 | 2.14 |
| 9 16 5 0 0 | Quir. St. J | 4D | 6C | AS | X1 | A9 | 5.07 |
| 9 16 5 0 0 | Copan St. M | 5D | 5C | AS | X1a | A10 | 5.07 |
| 9 16 15 0 0 | Quir. St. D (e) | NMG | 0C | S | X2/1 | A10 | 0.97 |
| 9 17 10 0 0 | Quir. Zoo. B | 27E | 0C | S | X2/3 | A? | 3.84 |
| 9 18 15 0 0 | Quir. St. K | 18D | 3C | S | X4 | A10 | 2.61 |

Note: For the Deity Head variants, "S" = Skull, and "AS" = Animal Skull. For the Glyph X variants, "X2/1" = X2, with a coefficient of 'one' superfixed, and "X2/3" = X2 with a coefficient of 'three' superfixed. For the moon age Glyph E/D variants, "NMG" = New Moon Glyph, and "GC1" = God C with a coefficient of 'one' prefixed. Two dotted lines enclose the inscriptions recorded during the Period of Uniformity (9.12.15.0.0 - 9.16. 5.0.0). The "DD" abbreviation refers to the Dedicatory Date of the monument.

ing at a Lunar Series inscription. The function of Glyph C is to mark the associated Long Count date in a recurrent cycle of six months. It is possible that alternating counts of five and six month groups were used at different times and different sites during the Classic period, but by the Period of Uniformity (9.12.15.0.0 - 9.16.5.0.0) Glyph C is used to record the moon number in fixed cycles of six months. While the moon numbering function of Glyph C's coefficients is fairly well understood, the purpose of the Deity Heads infixed within Glyph C remains an enigma. Part of the problem with interpreting the Deity Heads is that identifying them is difficult. They are small and in many cases heavily eroded.

Thompson (1950:242) analyzed the Deity Head variants and divided them into two groups: "young" and "old" heads. Later, Kelly (1976:93) presented examples of the Deity Heads, showing at least a dozen different deities and suggested there might be more unidentified gods.

Figure 2 presents a new typology for the Deity Head variants. This new typology arranges the heads into three main groups: Skull, Human, and Mythical variants. The analysis presented with this new typology makes two key points:

Table 2. Deity Head Inscriptions: HUMAN VARIANTS
(predicted 18 month lunar synodic calendar position: 6.00 - 11.99 months)

| LC Date | Monument | Glyph E/D | Glyph C | Deity Head | Glyph X | Glyph A | 18 Month (COP) |
|---|---|---|---|---|---|---|---|
| 9 1 10 0 0 | Copan St. 20 | ?E | 2C | H | X3 | A? | 8.75 |
| 9 8 0 0 0 | Brussels St. 1 | 17D | 4C | H | X5a | A9 | 9.57 |
| 9 11 3 5 14 | Moral St. 4 | 13D | 0C | H | X3 | A9 | 7.45 |
| 9 11 3 10 13 | Yax. St. 6 | 26E | 2C | H | X3a | A9 | 10.81 |
| 9 11 12 7 2 | P.N. St. 8 | 6D | 5C | HG | X5 | A10 | 10.12 |
| 9 12 0 0 0 | Pusilha St. K | 1D | 3C | H | X? | A9 | 12.84 |
| 9 12 10 0 0 | Copan St. 6 | 22E | 0C | HG | X3a | A10 | 8.73 |
| 12 19 13 4 0 | Pal. TC | 5D | 2C | HG | X3 | A9 | 7.13 |
| (DD 9 13 0 0 0) | | | | | | | |
| 9 13 3 7 8 | Copan HS #24 | 10D | 4C | H | X? | A? | 10.24 |
| 9 13 15 0 0 | P.N. St. 1 (l) | 17D | 2C | H | X3 | A9 | 7.52 |
| 9 13 15 1 0 | Copan St. 5 | 8D | 3C | H | X3 | A9 | 8.20 |
| 9 15 0 0 0 | P. N. St . 11 | 10D | 0C | HGE | X? | A10 | 6.29 |
| 9 15 0 0 0 | Calakmul St. 52 | ?D | 0C | HGE | X3 | A? | 6.29 |
| 9 15 4 6 4 | Dos Pilas St. 16 | 10D | 0C | HGE | X3 | A10 | 5.26 |
| 9 15 13 13 0 | Seibal HS | 19D | 6C | H | X5b | A9 | 11.58 |
| 9 16 1 0 0 | Yax. St. 11 (f) | 12D | 4C | H | X5 | A9 | 10.30 |
| 9 16 1 0 0 | Yax. St. 11 (r) | 12D | 5C | H | X5 | A10 | 10.30 |
| 9 16 6 17 1 | P.N. St. 14 | 26E | 4C | H | X5a | A9 | 10.80 |
| 9 16 10 0 0 | Quir. St. F | NMG? | 6C | HGE | X5b | A10 | 12.02 |
| 9 17 0 0 0 | Quir. St. E(e) | ?D | 2C | H | X3 | A9 | 7.93 |
| 9 17 14 16 18 | Quir. Altar O | ?D | 5C | HGE | X5 | A10 | 10.05 |
| 9 19 0 0 0 | Quir. Str. I | ?D | 4C | H | X5a | A? | 9.57 |

Note: For the Deity Head variants, "H" = Human, "HG" = Human Goddess, and "HGE" = Human God E. For the moon age Glyphs E/D, "NMG" = New Moon Glyph. Two dotted lines enclose the inscriptions recorded during the Period of Uniformity (9.12.15.0.0 - 9.16.5.0.0). The abbreviation "DD" refers to the Dedicatory Date of the monument.

1 all the Deity Head infixes fall into one of three main groups: Skull, Human or Mythical
2 the calendric purpose of the Deity Heads, in combination with the Glyph X variants was to define the current moon's position in an eighteen month lunar synodic calendar.

An early analysis of the Deity Head infixes of Glyph C was presented by S.G. Morley (1920:560) as part of his review of the Supplementary Series. In that review, Morley offered several possible explanations for the Deity Head infixes, noting that the same Deity Head variant often occurred with different coefficients of Glyph C. From this last observation, he correctly concluded that the period of time referenced by the Deity Heads must be greater than the interval recorded by the coefficients of Glyph C.

At first, Morley believed the Deity Heads were numeral coefficients themselves, identical to the Head variants sometimes used to record numeral coefficients in the Long Count of the Initial Series. Later he concluded that they were most probably the names of deities that were patrons for some uninterpreted period of time. As a possible explanation, he offered the nine "Lords of the Night" known from the Aztec calendars shown in the Codex Borbonicus. He then went on to observe that this explanation probably was not correct due to the occurrence of different Deity Head variants in lunar inscriptions from different monuments that recorded the same Long Count date. Later Thompson (1929) demonstrated that the nine-day cycle of the "Lords of the Night" was recorded by the variants of Glyph G.

Finally, S.G. Morley (1920) offered a fascinating explanation for the Deity Heads, citing a suggestion from R.K. Morley that these Deity Head variants marked periods of five or six months similar to those shown in the Eclipse Tables of

Table 3. Deity Head Inscriptions: MYTHICAL VARIANTS
(predicted 18 month lunar synodic calendar position: 12.00 - 17.99 months)

| LC Date | Monument | Glyph E/D | Glyph C | Deity Head | Glyph X | Glyph A | 18 Month (COP) |
|---|---|---|---|---|---|---|---|
| 9 0 10 0 0 | Tikal St. 31 | 1D | ?C | T173 | X6a | A9 | 16.93 |
| 9 5 0 0 0 | P.N. St. 30 | 5D | 5C | Myth. | X? | A10 | 16.11 |
| 9 7 0 0 0 | Pusilha St. P #1 | 23E | 3C | God M | - | A9 | 17.75 |
| 9 7 0 0 0 | Pusilha St. O | 25E | 6C | T173 | X6a | A9 | 17.75 |
| 9 10 6 5 9 | P. N. St. 36 | 4D | 4C | God M | X4a | A9 | 16.04 |
| 9 10 15 0 0 | Pusilha St. D #2 | 23E | 3C | God M | - | A9 | 14.07 |
| 9 10 15 0 0 | Pusilha St. P #2 | 3D | 3C | God M | - | A9 | 14.07 |
| 9 10 16 8 14 | D. O. RP #1 | 7D | 3C | Myth. | X4a | A10 | 14.15 |
| 9 12 6 5 8 | Pal. St. 1 | 19D | 5C | God M | X5 | A10 | 17.64 |
| 1 18 5 4 0 | Pal. TFC | 10D | 5C | God M? | X1a | A10 | 4.50 |
| (DD 9 13 0 0 0) | | | | | | | |
| 9 10 11 17 0 | Pal. Palace T. #1 | GC1 | 2C | Myth. | X2/j | A9 | 12.82 |
| (DD 9 14 8 14 15) | | | | | | | |
| 9 14 8 12 5 | Yax. Lin. 26 | 8D | 4C | Myth. | - | A10 | 12.30 |
| 9 14 8 14 15 | Pal. Palace T. #3 | 0D | 3C | God M | X4a | A9 | 13.99 |
| 9 14 13 4 17 | Quir. St. E (w) | 7D | 3C | Myth. | X4a | A10 | 14.24 |
| 9 14 19 5 0 | Calakmul St. 51 | 14D | 4C | God M | X4a | A? | 15.49 |
| 9 14 19 8 0 | Copan St. A | 15D | 6C | God M | X6a | A9 | 17.52 |
| 9 15 18 3 13 | P.N. Lin. 3 | 9D | 0C | Myth. | X2a | A10 | 12.20 |
| 9 16 10 0 0 | Yax. St. 1 | 3D | 0C | God M | X2 | A10 | 12.02 |
| 9 16 10 0 0 | Sacul St. 1 | 4D | 0C | God of 7 | X2a | A10 | 12.02 |
| 9 16 10 0 0 | Copan St. N | GC1 | 0C | God M | X2a | A10 | 12.02 |
| 9 16 13 4 17 | Quir. St. D(w) | 24E | 4C | Myth. | X4a | A9 | 15.88 |
| 9 17 5 0 0 | Quir. St. A | 26E | 2C | God of 7 | X2a | A9 | 14.88 |
| 9 18 10 0 0 | Quir. St. I | 16D | 2C | God M | X5 | A9 | 13.66 |
| 9 18 10 0 0 | Naranjo St. 8 | 21E | 2C | God M | X2? | A9 | 13.66 |

Note: For the Deity Head variants, "T173" = The Thompson catalog glyph #173, "Myth." = Mythical, "God of 7" = the God of 7, and "God M" = God M. For the Glyph X variants, "X2/j" = X2 with a jaguar head superfixed. For the moon age Glyphs E/D, "GC1" = God C with the coefficient 'one' prefixed. Two dotted lines enclose the inscriptions recorded during the Period of Uniformity (9.12.15.0.0 - 9.16.5.0.0). The abbreviation "DD" refers to the Dedicatory Date of the monument.

the Dresden Codex. R.K. Morley also noted that in the cases where there was a different Deity Head variant recorded for an inscription showing the same date, the Glyph C coefficients were different, recording either the first or sixth month. In effect, a different Deity Head variant was shown when the lunar month count changed from the sixth month back to the first month, because a different god presided over each six month period. This last suggestion of R.K. Morley's was inspired. Although neither S.G. Morley nor R.K. Morley offered a typology for the Deity Heads, nor demonstrated a calendric explanation for the pattern of the Deity Head occurrences, they were correct in noting that the Deity Heads mark a period of six months.

Thompson (1950:242) noted that there was clearly some relationship between the Deity Heads and the Glyph X variants. Thompson's grouping of the Deity Heads into two main divisions, "old" and "young" heads, suggested that the function of the Deity Heads was to choose between one of two possible Glyph X variants that might occur with the same coefficient of Glyph C. In his tabular comparison of Glyph C and Glyph X variants, he correctly demonstrated the relationship between the "young" heads and the Glyph X3 variants. Although Thompson noted there was a pattern in the occurrence of the Deity Head and Glyph X variants, his division of the Deity Heads into only two groups hid the tripartite nature of the relationship.

The Deity Heads are indeed associated with the Glyph X variants, but there are three not two significant groupings of the Deity Heads. For example, Thompson showed both the X4 and X4a

Table 4. Deity Head Inscriptions:
COPAN: ADJUSTMENT OF THE 18 MONTH LUNAR SYNODIC CALENDAR (9.9.10.0.0 - 9.11.15.14.0)

| LC Date | Monument | Glyph E/D | Glyph C | Deity Head | Glyph X | Glyph A | 18 Month (COP) |
|---|---|---|---|---|---|---|---|
| 9 9 10 0 0 | Copan St. P | 9D | 3C | H | X3a | A10 | 15.29 |
| 9 10 14 1 15 | Copan St. 12 | 3D | ?C | Myth.? | X2a? | A? | 3.06 |
| 9 10 15 0 0 | Copan St. 2 | - | 0C | AS | X3 | A10 | 14.07 |
| 9 10 18 12 8 | Copan St. 23 | 5D | 0C | ? | X2a? | A10 | 5.04 |
| 9 10 19 5 0 | Copan St. 3(e) | 10D | 3C | ? | X3 | A10 | 12.22 |
| 9 10 19 5 11 | Copan St. 3(w) | 20E | ?C | ? | X3 | A? | 12.59 |
| 9 10 19 13 0 | Copan St. 10 | 23E | 6C | H | X? | A9 | 17.63 |
| 9 10 19 15 0 | Copan St. 19 | 4D | 0C | God M? | X2a | A? | 0.99 |
| 9 11 0 0 0 | Copan St. 13 | 5D | 3C | Myth. | X4a | A9 | 3.02 |
| 9 11 15 0 0 | Copan E/Alt St. 5 | - | - | - | X4a | A9 | 5.88 |
| 9 11 15 14 0 | Copan St. 1 | 12D | 5C | H | X5 | A? | 15.37 |

Note: For the Deity Head variants, "H" = Human, "Myth." = Mythical, "AS" = Animal Skull, and "God M" = God M. These lunar series inscriptions at Copan demonstrate a consistent one semester forward shift in the base of the eighteen month lunar synodic calendar for the Deity Head and Glyph X variants.

Glyph X variants (fig. 3) associated with "old" heads, in effect combining the Skull and Mythical groups presented in fig. 2. Thompson was on the right track, but the Deity Heads do not determine which Glyph X variant is correct. Rather, both the Deity Heads and the Glyph X variants are correlated with month positions in the same recurrent eighteen month lunar synodic calendar.

**Analysis of the Deity Head Lunar Inscriptions**

The interpretation presented by this paper for the Deity Heads is that they determine which lunar semester of six months in a larger calendar of eighteen lunar synodic months is recorded by Glyph C. This discussion continues my earlier work on Glyph X (Linden 1986) in which an analysis of 121 lunar inscriptions demonstrated a calendric association for the Glyph X variants, based upon a recurrent eighteen month lunar synodic calendar. This report does not focus on the Glyph X variants directly, but shows that their occurrence is related to the Deity Head variants, and that both Glyph X and the Deity Head variants are linked to the eighteen month lunar calendar.

The Deity Head variants shown in fig. 2 are divided into three groups: Skull, Human, and Mythical variants. These three groups correspond to the three six month divisions of the eighteen month calendar, and in effect show which of the three semesters is recorded by Glyph C.

Figure 3 presents the eighteen month lunar synodic calendar with the three Deity Head groups shown on the left, next to the semester numbers they indicate. Glyph C coefficients are listed above each column, and the associated Glyph X variants are shown within each month of the eighteen month calendar.

The explanation that the Deity Heads mark one of three possible six month semesters in an eighteen month lunar calendar fits well with both Thompson's (1950) observations on the correlation of Deity Head variants with the Glyph X variants and R.K. Morley's supposition (S.G. Morley 1920) that the Deity Heads recorded six month semesters in some larger lunar calendar. In effect, the explanation that the Deity Heads function as semester patrons for the eighteen month lunar calendar matches both Thompson's and R.K. Morley's observations and can be demonstrated by a calendric analysis of the Long Count dates associated with each Deity Head Lunar Series inscription.

Data for the Deity Head Lunar Series inscriptions are shown in Tables 1-4. These tables show the Lunar Series inscriptions for each of the three main Deity Head groups presented in this paper. Table 1 shows the Skull Head variant inscriptions. Table 2 shows the Human Head variant inscriptions, and Table 3 presents the Mythical Head variant inscriptions. Table 4 presents a set of Copan lunar inscriptions that demonstrates a possible adjustment to the base of the eighteen month lunar synodic calendar.

The Long Count date of each inscription is used to predict a calendric position for that in-

scription in the eighteen month lunar synodic calendar. Month positions in the eighteen month calendar are predicted by first removing all multiples of the eighteen month period from the total number of days recorded by the Long Count date, and then assigning the remaining number of days to a month position in the eighteen month calendar. This procedure is used for each inscription and produces the eighteen month calendar positions shown in Tables 1-4 under the column "18 month (Cop.)."

The abbreviation "Cop." stands for the Copan formula, a lunar synodic month average of 29.5302 days that was used during the Period of Uniformity (9.12.15.0.0 - 9.16.5.0.0) to calculate moon numbers for Glyph C in a fixed cycle of six months. The Copan formula as presented by Teeple (1930) has been selected for calculating the length of the synodic month because its use with lunar inscriptions recorded during the Period of Uniformity provides an established standard for comparing lunar inscriptions.

From an analysis of the Deity Head inscriptions' month positions in an eighteen month calendar, a clear pattern emerges: the Skull variants fall into the first semester (0.00 - 5.99 months), the Human variants fall into the second semester (6.00 - 11.99 months), and the Mythical variants fall into the third semester (12.00 - 17.99 months).

A demonstration of how the eighteen month calendar position is calculated for each inscription is shown by considering an example in Table 2: the lunar inscription on Piedras Negras Stela 8. The Long Count date on P.N. St. 8 (fig. 1) is 9.11.12.7.2, which stands for nine baktuns, eleven katuns, twelve tuns, seven uinals, and two kins. The total number of days recorded by this Long Count date is produced by adding the nine baktuns (9 x 144,000 days = 1,296,000 days) with eleven katuns (11 x 7,200 days = 79,200 days) and twelve tuns (12 x 360 days = 4,320 days) and seven uinals (7 x 20 days = 140 days) and two kins (2 x 1 day = 2 days) to equal 1,379,662 days.

The length of the eighteen month lunar calendar (using the Copan formula synodic month average) is 18 x 29.5302 days = 531.5436 days. To predict the eighteen month calendar position, one removes all multiples of the eighteen month calendar from the total number of days recorded by the Long Count to see where the remaining days fall in the eighteen month calendar. The 1,379,662 days of P.N. St. 8 divided by the 531.5436 days of the eighteen month calendar equals 2,595.5763 eighteen month periods. Subtracting the 2,595 multiples of 531.5436 days from the 1,379,662

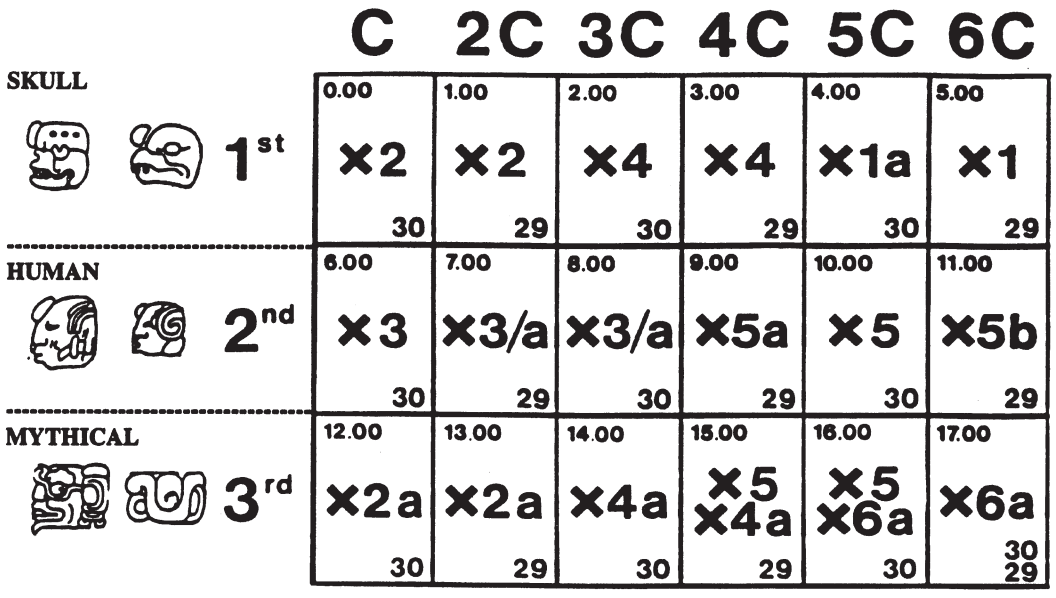



*Fig 3. The Eighteen Month Lunar Synodic Calendar: Three lunar semesters of six months (C-6C) form the eighteen month lunar synodic calendar. The Deity Head variants that reference each semester appear to the left of the three semesters. SKULL variants mark the 1st semester. HUMAN variants mark the 2nd semester, and MYTHICAL variants mark the 3rd semester. Month positions (0.00 - 17.00) are shown in the upper left corner of each square. The Glyph X variant associated with a month is shown in the center of that square. The number in the lower right corner marks the length of that month as either a 29 or 30-day month.*

days of the Long Count date yields a remainder of 306.358 days (i.e., 1,379,662 - 1379355.642 = 306.358 days). Dividing these remaining 306.358 days by the Copan formula estimate for the length of the synodic month (29.5302 days) will predict the inscription's month position in an eighteen month calendar. Thus 306.358 days divided by 29.5302 days per month equals 10.374 months. Adjusting for the Era Event base of the Copan formula, which Teeple (1930) established as six months and 22 days (i.e., Glyphs 22E, 6C), one subtracts 7.5302 days (0.255 months) from the first calculated month position to correct for the seven and a half days of the moon's age at the Era Event.

This last step (10.374 months minus 0.255 months) predicts an adjusted eighteen month calendar position for the inscription on Piedras Negras Stela 8 of 10.12 months; and this value is shown in Table 2 for P.N. St. 8. Having calculated the eighteen month calendar position for each inscription, one arranges these Deity Head inscriptions in sequential order according to their month position. This procedure produces a fascinating pattern for the Deity Head inscriptions. Although there was no correspondence between the Deity Head variants and the coefficients of Glyph C, the Deity Head variant inscriptions fall in three different semesters of the eighteen month lunar synodic calendar, when grouped according to the Skull, Human, and Mythical variants typology presented in fig. 2.

There are twenty-five Skull Deity Head inscriptions presented in Table 1; and **all** agree with the eighteen month lunar synodic calendar. Each one has a predicted month position that falls in the first semester (0.00 - 5.99 months) of the eighteen month lunar synodic calendar. The Skull Deity Head variants are usually the easiest to identify, the two main types being Skull and Animal Skull variants. Calendrically, they are interchangeable and designate the first semester.

The Human Head variants mark the second semester (6.00 - 11.99 months) comprising three types: the Human, Human Goddess, and Human God E variants. There are twenty-two inscriptions listed in Table 2 for the Human Deity Head variants; and of these, all but three have eighteen month calendar positions that fall in the second semester. The three exceptions are Pusilha St. K, Dos Pilas St. 16, and Quirigua St. F.

*Fig. 4 Glyph C variant on the Hauberg Stela: drawing by Linda Schele (1985:136). Note the prefixed coefficient of seventeen.*

The eighteen month calendar position for Pusilha St. K (12.84 months) falls in the first month of the third semester, and since the Glyph X variant is unclear, no association with a second semester Glyph X variant can be made. Additionally, the Glyph C coefficient on Pusilha St. K is three, which does not agree with either the Palenque or Copan formula predicted moon numbers. In review, it must be acknowledged that Pusilha St. K does not fit the second semester month positions predicted for the Human variants, and that the moon numbering system used for Glyph C remains unknown.

The inscription on Dos Pilas St. 16 has an eighteen month calendar position of 5.26, which is less than one month short of the predicted second semester position for its Human God E Deity Head variant. Despite the fact that the predicted month position for Dos Pilas St. 16 falls in the last month of the first semester, the lunar inscription was most certainly intended to show a second semester position for the Glyph X and Deity Head variants. The Glyph C coefficient for Dos Pilas St. 16 is absent, marking the first lunar month, and the associated Glyph X3 variant agrees with a first month position of the second semester. In short, even though the predicted eighteen month calendar position for the Long Count date of Dos Pilas St. 16 falls in the last month of the first semester, the moon number of Glyph C and the associated Glyph X3 variant make it clear that the Maya intended the inscription to record the first month of the second semester in the eighteen month lunar calendar.

Similarly, the inscription on Quirigua St. F can be seen to fit the intended second semester position for its Human God E Deity Head variant. The predicted eighteen month calendar position for Quirigua St. F is 12.02, which puts it just into the first month of the third semester. But the recorded Glyph C coefficient is six and the associated Glyph X variant is X5b. The predicted eighteen month calendar position for the Glyph X5b variants is restricted to the last month in the second semester of the eighteen month calendar (fig. 3), and the recorded Glyph C coefficient on Quirigua St. F is clearly 6C. The occurrence of

the Human God E Deity Head variant with a Glyph C coefficient of six and the associated Glyph X5b variant make it clear that the intended eighteen month lunar synodic calendar position recorded on Quirigua St. F was the last month of the second semester.

Reviewing the Human Deity Head inscriptions, a good case can be made that the Lunar Series on Dos Pilas St. 16 and Quirigua St. F were intended to record month positions in the second semester, thus leaving only Pusilha St. K as an exception to the predicted second semester month position for the Human Deity Head variants.

It is possible that the lunar inscription on Pusilha St. K was calculated from a different lunar calendric base, or that a different synodic month average was used to determine the Glyph C and Deity Head positions in the eighteen month lunar synodic calendar. It is highly probable that different formulas and bases were used during the Classic period to calculate lunar month positions. Certainly the 'double date' inscriptions that record different Lunar Series for the same Long Count date (e.g., Piedras Negras St. 1(b) and Piedras Negras St. 3(b), as well as Pusilha St. P (b,#2) and Pusilha St. O), make it clear that the Maya periodically adjusted their lunar calendar. Although Pusilha St. K is an exception to the eighteen month calendar based upon the fixed Copan formula/Era Event base, the Pusilha St. K lunar inscription may have been calculated from an adjusted lunar calendar base, such as are discussed below for the Copan Lunar Series inscriptions shown in Table 4.

The Deity Head variants of the third semester (12.00 - 17.99 months) are designated the Mythical variants. These include the symbolic variants of God M and the T173 infix as well as the head variant for the God of 7. The group is defined by heads that have mythical or animal features, and these mythical features serve to differentiate the group from the Human variants. Table 3 presents the Mythical Deity Head variant inscriptions. Among the twenty-four inscriptions listed in Table 3, only Palenque Temple of the Foliated Cross does not fit the predicted third semester month position for the Mythical variants.

The identification of the Deity Head variant on Palenque Temple of the Foliated Cross as God M is questionable, but it does seem to follow the general outline of the God M variants. The associated Glyph X1a variant in the Lunar Series inscription on Palenque Temple of the Foliated Cross is correct for the fifth month position of the first semester (fig. 3), and the recorded coefficient of Glyph C is five, which agrees with both the Uniformity Period moon numbering system and the 4.50 month position predicted for the eighteen month lunar synodic calendar. In fact, the lunar inscription on Palenque Temple of the Foliated Cross agrees very well with the predicted fifth month position of the first semester, and if the recorded Deity Head is a variant of God M, it constitutes the only exception to the occurrence of Mythical Deity Head variants in the third semester. All the remaining Mythical Deity Head inscriptions listed in Table 3 agree with the predicted eighteen month lunar calendar positions and fall in the third semester (12.00 -17.99 months).

There is a group of inscriptions at Copan that presents evidence that the eighteen month lunar calendar was changed during the 10th, 11th and 12th Katuns. These inscriptions at first appear to be exceptions to the eighteen month lunar synodic calendar, as seen from their predicted eighteen month positions. Upon closer examination, one sees that there is a consistent pattern to these exceptions, and that each Deity Head along with its associated Glyph X variant has a predicted eighteen month calendar position that is one semester in advance of the standard eighteen month lunar synodic calendar.

These inscriptions, which are presented in Table 4, exhibit what appears to be an adjustment in the base of the eighteen month calendar. For example, consider the inscription on Copan St. 13 listed in Table 4. The Deity Head is a Mythical variant and the Glyph X variant is X4a. Both of these variants are correct for the third month in the third semester of the eighteen month lunar synodic calendar, but the predicted month position for the associated Long Count date of Copan St. 13 is 3.02 (a first semester month position).

Similarly, the inscription on Copan St. P shows a Human Deity Head variant associated with a Glyph X3a variant, both of which would be expected to fall in the second semester; but the predicted month position of the monument is 15.29 (a third semester month position). The inscriptions shown in Table 4 would agree with the standard eighteen month lunar calendar if the base for calculating their month positions was moved one semester in advance of the base for the standard eighteen month lunar synodic calendar.

The only possible exception to this pattern is Copan St. 2 in that it shows an Animal Skull Head variant in association with a Glyph X3 variant. The Long Count date for Copan St. 2 is problematic. Most of the Long Count period glyphs are heavily eroded and Teeple (Andrews, 1951) offers an alternate date for Copan St. 2 of 9.10.0.10.0. The 9.10.15.0.0 Long Count date presented in Table 4 and Teeple's 9.10.0.10.0 date fall in the third semester, and as such would be consistent with the other Copan monuments shown in Table 4. The problem with Copan St. 2 is that although the X3 variant is correct for a second semester month position, the occurrence of the Animal Skull variant with it is a contradiction. Whatever the base of the eighteen month calendar, Skull Deity Head variants should not occur with Glyph X3 variants. It is possible that the Glyph X variant on Copan St. 2 is not X3, but the outline generally resembles the Glyph X3 variants and the Deity Head variant is clearly a Skull Deity Head variant. In the interest of presenting the data "warts and all," this discrepancy must be mentioned.

In review, for the four tables of inscriptions presented, there is a clear pattern that supports the conclusion that the Deity Head variants mark semester positions in an eighteen month lunar synodic calendar. Tables 1-4 presents eighty-two lunar inscriptions; and of these, all except three directly fit the eighteen month calendar or can be shown to follow its pattern. The three exceptions are on Pusilha St. K (Table 2), Palenque Temple of the Foliated Cross (Table 3), and Copan St. 2 (Table 4). Pusilha St. K may represent a change in the calendric base for the eighteen month calendar, such as is suggested for the Copan inscriptions listed in Table 4. The identification of a God M Deity Head variant for the Palenque Temple of the Foliated Cross inscription is questionable, as is the case for the Glyph X variant on Copan St. 2.

The lunar inscriptions shown in Tables 1-4 span a period of over 300 years, and come from a dozen different Maya sites. We know from the 'double date' inscriptions that the Maya occasionally changed their lunar calendar; and it is probable that several Maya sites used different lunar calendric bases and synodic month averages throughout the Classic period. Given the number of sites recording Lunar Series inscriptions and the span of time covered, it is not surprising that there are three Deity Head inscriptions, which are exceptions to the eighteen month lunar synodic calendar. It is remarkable there are not more.

The Deity Head variants are often difficult to make out, and at times the presence of a clear Glyph X variant may be needed to confirm the Deity Head identification; but the pattern of association with an eighteen month lunar calendar for both the Deity Head and Glyph X variants is too consistent to be a matter of chance.

**Why an Eighteen Month Lunar Synodic Calendar?**

The analysis presented so far has concentrated on a demonstration of the calendric association between the Deity Head variants and the Long Count dates that accompany them. The data in Tables 1-4 show the semester relationship for each of the three Deity Head types in the eighteen month lunar synodic calendar and fig. 3 explains the association of the Deity Heads with the Glyph X variants. Both the Deity Head and Glyph X variants recorded positions in a larger eighteen month lunar synodic calendar. The Deity Head variant recorded the six month semester, the Glyph C coefficient marked the specific month, and the Glyph X variant recorded a two or possibly three month period within that semester.

The Initial Series Introductory Glyph that began each Initial Series was infixed with the patron deity of the Haab month in which the Long Count date fell; and similarly, Glyph C was infixed with a Deity Head variant that functioned as the patron deity for the six month lunar semester in which that Long Count date fell.

The suggestion that the Classic period Maya recorded an eighteen month lunar synodic calendar is supported by the data in Tables 1-4, but one question arises: why an eighteen month lunar synodic calendar?

A first explanation for why the Maya might have used an eighteen month lunar synodic calendar is that it provided a lunar counterpart for the Haab or eighteen month solar year. Just as the Haab was composed of eighteen months of twenty days plus an intercalary period of five days called Uayeb, the lunar calendar was composed of eighteen lunar synodic months arranged in three semesters of six months each. Additionally, the Tun or 360-day year used in Long Count dates is a unit of time that does not fit the usual base twenty system of the Maya. The Maya numbering system is sometimes referred to as an adjusted vigesimal or base twenty system; and the

Tun period of eighteen twenty-day months (along with the larger Baktun period that ran in cycles of thirteen) provides an exception to the Maya base twenty numbering system. Twenty days made a Uinal, twenty Tuns made a Katun, twenty Katuns made a Baktun; but a Tun was eighteen Uinals. The eighteen month solar year or Haab of 365 days and the eighteen month Tun of 360 days provide good calendric counterparts for a lunar synodic calendar that was also divided into eighteen months. There is a second reason the ancient Maya would have kept an eighteen month lunar synodic calendar. It provides an efficient way to keep track of possible eclipses. Eclipses occur if either the earth or moon comes between the other and the sun, when the moon is within about eighteen degrees of a node position. The nodes are points in the moon's orbit about the earth where the moon passes through the ecliptic or the plane of the earth's orbit about the sun. The moon's orbit does not lie in the ecliptic. If it did there would be lunar eclipse every full moon and a solar eclipse every new moon. Instead the moon's orbit is inclined about five degrees to the plane of the earth's orbit about the sun, and the points where the moon crosses the ecliptic are called the nodes. A straight line drawn through these two crossing points is called the line of the nodes. When a new moon occurs and the line of the nodes is within approximately eighteen degrees of the earth-to-sun alignment, a solar eclipse is possible. For a lunar eclipse to occur, there must be a full moon and the line of the nodes must be within about twelve degrees of the earth-to-sun line. An eighteen month lunar synodic calendar could have been used to track possible eclipses because the 531.54 days in eighteen lunar synodic months are only slightly longer than a double Tzolkin period, a span of 520 days that links the cycling of the nodes to the 260-day Tzolkin calendar.

As Teeple (1930:89) demonstrated, the sum of two Tzolkin periods of 260 days each is almost equal to three eclipse half years. The eclipse half year (173.31 days) represents the time it takes for the line of the nodes to return from one earth-to-sun alignment to another. Two Tzolkin periods added together equal 520 days and three eclipse half years are approximately equal to 519.93 days. Thus, the two Tzolkin periods are less than one day longer than three eclipse half years. What this means is that there would be three node positions in two Tzolkin periods, and that eclipses would only be possible within eighteen days of those node positions. Thus, an eclipse could only occur within the three clearly defined nodal areas of the double Tzolkin period.

Bricker and Bricker (1983) give a complete review of Teeple's original double Tzolkin model and add their own analysis on 'Solar Eclipse Danger Windows'. They show how well a comparison of historical eclipses based on the GMT-2 correlation matches the dates of the Dresden Codex eclipse tables, and how these tables could have been used to further specify 'Solar Eclipse Danger Windows' within the double Tzolkin period.

Since eclipses can only occur within eighteen days of a node, any day more than eighteen days from a node is by definition a day on which an eclipse cannot occur. Eighteen days either side of a node position, plus the node day itself equals thirty-seven days. There are three such nodal periods in the three eclipse half years that nearly equal the double Tzolkin period, making a total of 111 days out of 520 days in which an eclipse can occur. Stated another way, there are 409 days out of the 520 days of the double Tzolkin period in which an eclipse cannot occur.

The eighteen month lunar synodic calendar is about 531.54 days, that is 11.54 days more than the 520 days of the double Tzolkin period. Although the eighteen month lunar synodic calendar is longer than the double Tzolkin period, the two periods are sufficiently close to one another to provide a basic correspondence between multiples of the lunar synodic month and the eclipse half year. If the ancient Maya ran their eighteen month lunar synodic calendar concurrently with a double Tzolkin period, they could track nodal positions in the lunar calendar. As the eighteen month lunar synodic calendar gained 11.54 days each time it cycled, it would in effect move through the double Tzolkin period. Each lunar month could then be checked to see if it fell in any of the three nodal areas of the double Tzolkin period when eclipses were possible.

The six month period recorded by the coefficients of Glyph C is roughly equal to 177.18 days, and is itself close to the 173.31 days of the eclipse half year. Eclipses tend to occur about six months apart and the basic similarity in the length of these two periods probably explains why the Classic period Maya recorded Glyph C in cycles of six month.

The utility of an eighteen month lunar synodic calendar is that by arranging the six month semesters in groups of three, the Maya could integrate their lunar calendar with a double Tzolkin

period, and thus track the nodal positions needed to warn of possible eclipses.

**Early Lunar Series Inscriptions**

The Deity Head variants provide the earliest evidence for the eighteen month lunar synodic calendar and are an older form of the calendar. Later in the Classic period, Glyphs X, B, and A will be added to the Lunar Series, and the use of Glyph X variants will further specify a two or three month period within the eighteen month lunar synodic calendar.

Early Classic period monuments such as Uaxactun St. 18, dated 8.16.0.0.0, and Balakbal St. 5, dated 8.18.0.0.0, reveal that the original format of the Lunar Series inscriptions was simply Glyphs E/D and Glyph C, the glyphs that recorded the moon age and moon number. At that time, the Deity Heads were already present in Glyph C and the concept of the eighteen month lunar calendar is probably older. Later elaborations of the Lunar Series add Glyph X and Glyph A by about 9.1.10.0.0 (Copan St. 20), but it is clear that the core elements of the Lunar Series were the Glyphs E/D and Glyph C (Satterthwaite 1958:130).

Although only a single inscription, the Hauberg Stela presents an interesting example of a Late Preclassic Maya inscription that recorded Glyph C with a coefficient of seventeen (fig. 4). This Glyph C coefficient of seventeen is highly unusual because the normal range of coefficients for Glyph C is C-6C.

Schele (1985:137) concludes that 8.8.0.7.0 is the probable Long Count date of the Hauberg Stela, and noting the unusual occurrence of Glyph C with a coefficient of seventeen writes:

> The presence of the number seventeen suggests that the Late Preclassic Maya were reckoning lunations using a radically different system than the six lunation semester of the Classic period.

Schele identifies the Deity Head in Glyph C of the Hauberg Stela as a variant of God C, but it is more likely that this Deity Head is one of the Mythical Deity Head variants.

In her footnotes, Schele (1985:149) cites an analysis of the Hauberg Stela by Justeson (unpublished manuscript), in which he discusses the Glyph C variant of 17C, and suggests that it:

> . . . **functions as part of some computational system for predicting eclipse possible dates** . . . The initial date of the Seattle monument was on or within a few days of an eclipse station, depending on just which correlation constant in the 584290 - 584286 range relates this date to Christian chronology. Another eclipse station had taken place 17 lunar months earlier, with an anular eclipse on May 23, AD 198 . . . this eclipse was not visible in MesoAmerica.

The Deity Head analysis presented in this paper has shown a calendric association between the Deity Head variants and an eighteen month lunar synodic calendar, and this eighteen month lunar synodic calendar provides a 'computational system for predicting eclipse possible dates'.

The concurrent use of an eighteen month lunar synodic calendar with a double Tzolkin per period of 520 days would tie the lunar synodic calendar to the Tzolkin, and thus show a lunar month's position as it approached the eclipse possible node areas in the double Tzolkin period.

If one calculates a month position in the eighteen month lunar synodic calendar for the Hauberg Stela's Long Count date of 8.8.0.7.0 (using the Copan formula average of 29.5302 days per lunar synodic month without subtracting the Era Event base of seven and a half days), the predicted eighteen month lunar calendar position is 16.19 months. This places the lunar count near the beginning of the seventeenth month in an eighteen month lunar synodic calendar, and matches the Glyph C coefficient of seventeen recorded on the Hauberg Stela.

The Glyph C inscription on the Hauberg Stela is indeed radically different from the standard six month format used for Glyph C during the Classic period. This Glyph C coefficient of seventeen probably recorded the Glyph C moon number in an older lunar synodic calendar of eighteen months, one that during the Classic period would be limited to a cycle of six months, with the Deity Head variants recording the correct semester in a lunar synodic calendar of eighteen months.

## References


Andrews IV, E.W.

1951 The Maya Supplementary Series. In *The Civilizations of Ancient America*, edited by Sol Tax. Selected Papers of the 29th International Congress of Americanists (1949). Chicago.

Bricker H.M. & Bricker V.R.

1985 Classic Maya Prediction of Solar Eclipses. *Current Anthropology* 24:1-24.

Kelley, David H.

1976 *Deciphering the Maya Script*. Austin: University of Texas Press.

Linden, John H.
1986 Glyph X of the Maya Lunar Series: An Eighteen Month Lunar Synodic Calendar. *American Antiquity* 51:120-136.
Morley, S.G.
1920 The Supplementary Series. In *The Inscriptions at Copan*. Carnegie Institution of Washington Pub. 219. Washington, D.C.
1938 *The Inscriptions of Peten*. Carnegie Institution of Washington Pub. 437, Vol. 5, pt. 1. Washington, D.C.
Satterthwaite, Linton
1958 Five newly discovered carved monuments at Tikal and new data on four others. The University Museum, University of Pennsylvania, Museum Monographs, Tikal *Reports #4*. Philadelphia.
Schele, Linda
1985 The Hauberg Stela: Bloodletting and the Mythos of Maya Rulership. In *Fifth Palenque Round Table*, 1983, Vol. VII, edited by Virginia M. Fields (Merle Greene Robertson, series editor). Pre-Columbian Art Research Institute. San Francisco.
Teeple, John E.
1930 *Maya Astronomy*. Carnegie Institution of Washington Pub. 403, Contribution No. 2. Washington, D.C.
Thompson, J.E.S.
1929 Maya Chronology: Glyph G of the Lunar Series. *American Anthropologist* 31:223-231.
1950 *Maya Hieroglyphic Writing: An Introduction*. Carnegie Institution of Washington Pub. 589. Washington, D.C.

# Eighth Palenque Round Table, 1993

Merle Greene Robertson, General Editor

Martha J. Macri and Jan McHargue, Volume Editors

The Pre-Columbian Art Research Institute: San Francisco

Printed by Mallia Printing Inc.
1073 Howard Street
San Francisco, CA 94103

Library of Congress Catalog Card Number 94-061308

ISBN 0-934051-02-X

Volumes IX and X of the Mesa Redonda de Palenque Conferences has been made possible by a loan from Donald Marken and the Geo Ontological Development Society.