The origin of Mayan syllabograms and orthographic conventions

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This paper surveys several processes by which CV and CVC phonetic sign readings were derived in Mayan writing. Four of these are acrophonic derivation processes: C_1V_1 and C_1V_1G signs from C_1V_1G roots (G = /h ʔ y w x/; C_1V_1 and $C_2V_1C_1$ signs from $(CV(G))C_2V_1(G)C_1$ roots/words; C_1V_1 signs from $C_1V_1C_2$ roots/words (C_2 / G); and C_1V_1 from $C_1V_1(G)C_2V_2C_3$ or $C_1V_1C_2V_2(G)C_3$ roots/words. Four more are non-acrophonic processes which have been discussed previously by other authors: script transfer, linguistic change or variation, formal or phonetic divergence, and formal or phonetic convergence. The implications of some of these processes for the origin and history of the Mayan script are discussed here, as well as for some of the underlying linguistic bases for such practices.[*]

1. Introduction

Using the iconic motivation of a sign as a clue to its decipherment is not the most cautious methodological approach, though it has been used, often successfully, in the decipherment of scripts around the world. In some cases, even when the iconic motivation of a sign is known, there may be several possible sourcewords to choose from. In other cases, this approach can be misleading, especially when a phonetic sign is used in pictorial art as a spelling for the name of an object or person rather than as a true icon. This distinction is clear in the following example based on Lounsbury (1989:229–30).
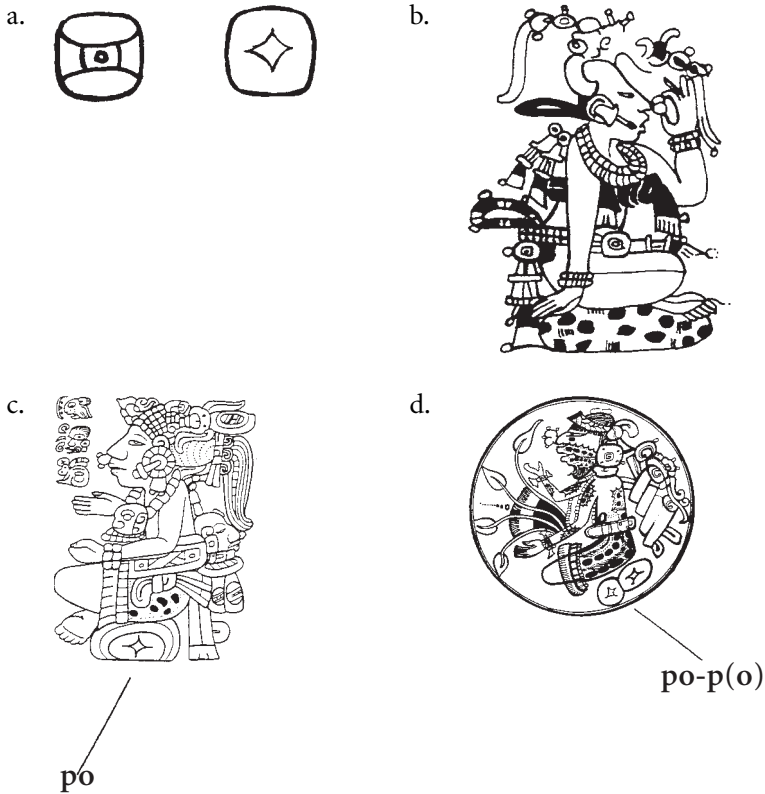
Figure 1. Examples illustrating pictorially embedded glyph with non-iconic function:
a.   Mayan syllabogram T622 **po**. After Thompson (1962: 453).
b.   Noble person seated on a mat with a jaguar pelt laid on top. From Uaxactun vase from Burial A31 in Kelemen (1969: Plate 128).
c.   Lord seated on a throne with mat laid on top and with graphically infixed T622 **po** as a phonetic complement to the **POP** for **pohp* 'mat'. Drawing of Early Classic carved panel from Bonampak in Lounsbury (1989: 230, Fig. 9a).
d.   Lord seated on glyphic spelling T622.622 **po-p(o)** for **pohp* 'mat'. Drawing of painted ceramic plate by Nicolas Helmuth in Lounsbury (1989: 230, Fig. 9b).

Figure 1a shows the Mayan syllabogram T622 **po**.[1] Figure 1b shows a lord seated on a mat with a jaguar pelt laid on top; Figure 1c shows a lord seated on a throne with a mat laid on top, and with an example of T622 **po** placed inside (i.e. graphically infixed) and functioning as a phonetic complement to the MAT icon (i.e. MAT(-**po**) for a descendant of proto-Mayan **pohp* 'mat', such as proto-Ch'olan **pohp*). Figure 1d shows a lord seated on the glyphic spelling T622.622 **po-p(o)** for **pohp* 'mat' instead of on a mat icon. While it is not

obvious what the T622 **po** sign represents iconically, it is clearly not a mat; therefore its use in pictorial art, as in Figure 1d, is not an aid in determining its source word.

Despite these potential pitfalls, establishing the iconic motivation and sourceword of a deciphered sign can lead to rewarding insights into the orthographic practices of the script tradition, and indeed, into the script's structure and origin (e.g. Campbell 1984, Justeson 1989, Justeson & Fox 1989, Zender 1999, Houston et al. 2000). Consequently, the major aims of this paper are to contribute to the systematization of the knowledge about Mayan orthographic practices, and to discuss what such practices reveal about the script's origin. I study some of the methods by which ancient Lowland Mayan scribes innovated new phonetic sign readings.[2] I describe four processes for the acrophonic derivation of phonetic sign readings (i.e. the derivation of purely phonetic readings based on the linguistic sourceword of the iconic referent of the signs). I also describe four more processes for the derivation of new sign readings that are not acrophonic in nature (e.g. script transfer, interlinguistic or interdialectal variation and change, formal divergence, and formal convergence), some of which have been proposed by Fox & Justeson 1984a.
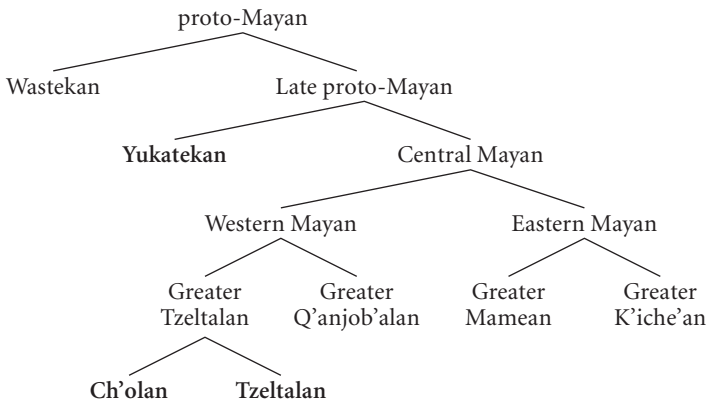
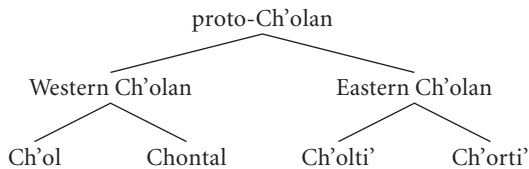**Figure 2.** Mayan diversification model by Kaufmann 1976, 1989.

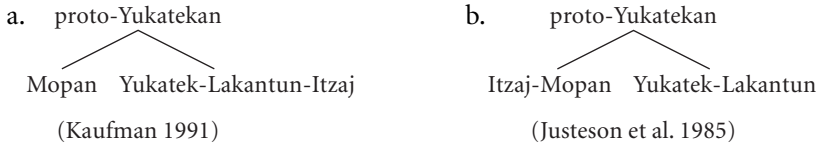**Figure 3.** Ch'olan diversification model by Kaufmann & Norman 1984.

a.   proto-Yukatekan   b.   proto-Yukatekan

Mopan   Yukatek-Lakantun-Itzaj   Itzaj-Mopan   Yukatek-Lakantun

(Kaufman 1991)   (Justeson et al. 1985)

Figure 4. Yukatekan diversification models. (a) Kaufman 1991, (b) Justeson et al. 1985

Common Mayan

Common   **Yukatekan**
Mamean-K'iche'an

Mamean   K'iche'an

Common Q'anjob'alan   Common Wasteko-Ch'olan

Motosintlekan   Q'anjob'alan   **Tzeltalan**   Wastekan
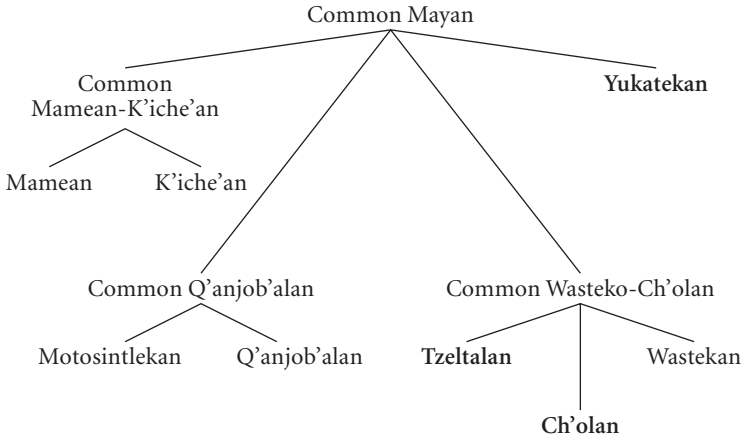
Ch'olan

Figure 5. Mayan diversification model by Robertson 1992, 1999.

a.   proto-Ch'olan   b.   proto-Ch'olan

Ch'olti'   Classic Ch'olti'an

Ch'ol-Chontal   Ch'orti'   Ch'ol   Acalan   Ch'olti'
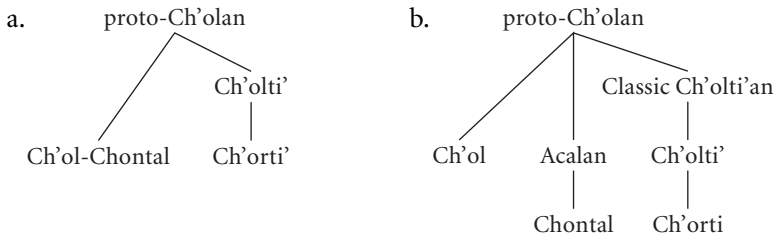
Chontal   Ch'orti

Figure 6. Ch'olan diversification models by Robertson: (a) Robertson 1992; (b) Robertson 1999.

2.   Preliminaries

2.1 The languages of the script

In this section I provide the linguistic and epigraphic assumptions used throughout the rest of the paper. First, I assume the historical linguistic scenarios for the Mayan language family, and for the Ch'olan and Yukatekan

languages, by Kaufman 1976, 1989, Kaufman & Norman 1984, and Justeson et al. 1985, which are favored by most linguists; see Figs. 2–4. Competing diversification models for the Mayan family and for the Ch'olan subgroup have been proposed by Robertson 1992, 1999; see Figures 5–6.

I assume that the languages of the texts were languages of the Lowland Mayan contact area, namely Ch'olan and Yukatekan (Justeson et al. 1985: 9–10, Justeson & Fox 1989, Justeson & Campbell 1997). I agree with Houston et al. 2000 that a Ch'olan language served as the basis for the script; in fact, Fox & Justeson 1982, 1989, MacLeod 1984, Justeson 1985, Justeson et al. 1985, and Justeson & Campbell 1997 had previously provided support for that idea. However, Houston et al. 2000 argue that a descendant of proto-Ch'olan which they call Classic Ch'olti'an — which Robertson 1992, 1999 argues was a direct ancestor of Ch'orti' — was the language that served as the standard of Mayan texts. In contrast, Justeson et al. 1985 and Justeson & Fox 1989 favor a form of Ch'olan prior to its breakup into Western Ch'olan (Ch'ol, Chontal) and Eastern Ch'olan (Ch'olti', Ch'orti') — such as proto-Ch'olan, pre-Ch'olan, or even proto-Greater-Tzeltalan — as the language that forms the basis of the script.[3] Whether the script was used to represent a single standard dialect or language throughout its geographic distribution, or more than one vernacular Lowland Mayan dialect or language depending on the time period and region (cf. Justeson & Fox 1989, Lacadena & Wichmann 1999, 2000, Bricker 2000), is still a matter of debate. In this paper I evaluate the possibility that both Ch'olan and Yukatekan scribes innovated components of the script, including new sign readings.

2.2 Formal traits of the script

The Mayan script reads from left to right and top to bottom. Some texts contain examples of both single- and double-column formats, and a few texts exhibit a triple-column format. The script uses both logograms (signs with both phonetic and semantic values) of CV(G), CV(G)C, CV(G)CVC, and CVCV(G)C shapes, and syllabograms (signs with phonetic values only) of CVC and CV shapes. Two additional types of signs with no specific phonetic value of their own exist (Mathews & Justeson 1984, Fox & Justeson 1984b, D. Stuart 1988, D. Stuart & Houston 1994, Hopkins & Josserand 1999, Zender 1999): diacritics (e.g. sign doubler) and semantic determiners (e.g. DAY.NAME cartouche).[4]

The script used a compositional form of regularized shape and size, the glyph block, as the basic structural unit of texts (e.g. Justeson 1978, 1986, 1989).

In monumental inscriptions, the tendency is for glyph blocks to demarcate syntactic units: noun phrases, verb phrases, prepositional phrases, and adverbial phrases. Recently, I have pointed out that this was not necessarily the case of all types of texts (Mora-Marín 1999).[5]

Logograms spell the following elements:

a. CV(G)C roots, e.g., T744 **K'UK'** for descendants of proto-Mayan *q'u'q' 'quetzal (feather)'.

b. CV(G)CVC, CVGCV(G)C, or CVCV(G)C words, e.g., T751 **B'ALAM** for proto-Ch'olan *b'ahläm 'jaguar'.

c. CV(G) particles, e.g. T51 **TA** and T59 **TI** for proto-Ch'olan *tä ~ *ti 'generic preposition'.

d. Perhaps -VC suffixes, e.g. T181 **ja** possibly for **-AJ** 'intransitivizer', T585 **b'i** for **-IB'** 'instrumentalizer' (cf. Fox & Justeson 1984a, Justeson 1985, 1989, Houston et al. 2001).

While -CVC suffixes were generally spelled phonetically (e.g. T130:116 **-wa-ni** for proto-Ch'olan *-wan(-i) 'intransitivizer of positionals', T178.181 **-la-ja** for pre-Ch'olan *-laj 'completive status of positionals'), sometimes they were spelled by means of CVC syllabograms or logograms (e.g. T86 **NAL/nal** to spell -nal 'native of X place', T528 **TUN/tun** in the spelling of -t-un 'transitivizer') and -V(C) affixes were often spelled phonetically too (e.g. …**Ca-jV**… for -aj). Syllabograms (syllabic signs) spell CV sequences, e.g. T1 **(')u**, T25 **ka**, T501 **b'a**; or CVC sequences, e.g. T86 **NAL/nal**, depicting an ear of maize, probably derived from a presumed logographic use as **NAL** for *näl 'ear of maize'.

Roots and words can be spelled in a purely logographic manner (e.g. **B'ALAM** for *b'ahläm), in a partly logographic and partly syllabographic manner (e.g. **(b'a-)B'ALAM** or **B'ALAM(-ma)**), or in a purely syllabographic manner (e.g. **b'a-la-m(a)**). In logosyllabic and syllabic spellings, the V of the last CV sign was generally not read (i.e. with a phonetic value, though perhaps as a type of diacritic for a phonetic quality of the preceding syllable under some proposals; see below). Purely syllabographic spellings of roots and words were accomplished with CV signs (e.g. **wi-ni-ki** for Lowland Mayan *winik 'person, man'), but also with CVC signs (e.g. via rebus phoneticism, as in the use of T757 **B'AH** 'gopher' as a CVC sign **b'ah** to spell descendants of proto-Mayan *b'aah 'top, head, self'), or with a combination of CV and CVC phonetic signs (e.g. the use of T114 **xa** and T566 **MAN/man** to spell **xa-MAN** for xaman 'north').

There is currently substantial debate about how spellings of nominal and verbal affixes are to be analyzed orthographically. While affixes are spelled with

signs that otherwise have purely phonetic values, some authors have argued that such signs may be used logographically when spelling affixes (Fox & Justeson 1984a, Mathews & Justeson 1984, Justeson 1985, 1989, Bricker 1986, D. Stuart et al. 1999, Houston et al. 2001). For example, is the spelling T710.181 (i.e. T710 **CHOK** for proto-Ch'olan **chok* 'to throw (down)') followed by T181 (phonetic **ja**), which was most likely intended to represent *cho[h]k-aj* 'throw.down[PASS]-PASS/PRTC', to be read as **CHOK-ja** (logosyllabographic), **CHOK-AJ** (logographic), or **CHOKAJ(-ja)** (logosyllabographic, with logographic **CHOKAJ** followed by syllabographic **ja** as a phonetic complement)? I discuss this problem below with regard to the implications derived from the acrophonic processes.

2.3 Graphic segmentation and superimposition

There is a principle of representation called the *pars pro toto* 'part-for-the-whole' or SEGMENTATION principle (Coe 1976) that is shared by the art and writing traditions of Mesoamerica (Justeson 1986). It consists of the representation of an entity (e.g. RULER) by means of a segment of that entity (e.g. the head of a ruler). Mayan writing uses this convention too, so that the head of a person with a royal headband signifying rulership, T1000d, is sufficient to represent **AJAW** 'lord, ruler'.
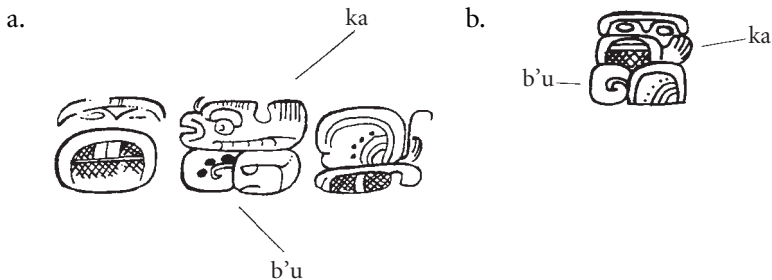

Figure 7. Examples of superimposition principle discussed by Zender (1999, Fig. 29):
a. T1.586:203:21.741.528.116:24 for **u-pa-ka-b'u-TUN-ni-li** in unprovenanced lintel at Nelson-Atkins Gallery in Kansas City. After Stuart et al. (1999: 32).
b. T1.586:25:21.528 for **u-pa-ka-b'u-TUN(IL)** in Po Panel. After drawing by Kornelia Kurbjuhn. Note how T203 FISH in (a) is superimposed by T586 **pa** in example (b), with only T25 FISH.FIN visible. The same for T21.741 in (a) versus T21 in (b)

Mayan writing, in turn, also exhibits a principle of representation of SUPERIM-POSITION, in which part of one sign may be superimposed by another sign

without affecting its reading (cf. Houston 1988, D. Stuart 1995, Zender 1999). For example, T25 FISH.FIN (see Figure 7a) and T203 FISH (see Figure 7b) are probably derived from a descendant of proto-Mayan *kar* 'fish'. Other examples known to epigraphers include the following: T21 and T21.741 **b'u** (see Figs. 7a–b), T19 and T19.741 **mu**, T4 and T4.1008 **na/NAH**, T149 and T604 **k'u**, T278 and T278:553b **sa**, T74 and T74:616/617:255 **ma**, T60 and T60:528 **hi**, T116 and T1019 **ni**, T115 and T115.673 **yo**, and T44 and T44:563b **to/TOK**. Below I discuss two more examples in detail. One is T236 BIRD **k'i** and T77 BIRD.WING **k'i** (Mora-Marín 2000, D. Stuart 2002). The other is T124 **tzi** and T124:507 **tzi**.

2.4 Rebus phoneticism

The process of rebus phoneticism, discussed at length by Justeson 1989 for the Mayan script, was used to derive purely phonetic sign readings as well as logographic sign readings. Since the focus of this paper is the first case, i.e. the derivation of phonetic sign readings, let me offer a novel example of how logographic sign readings could be derived via rebus.
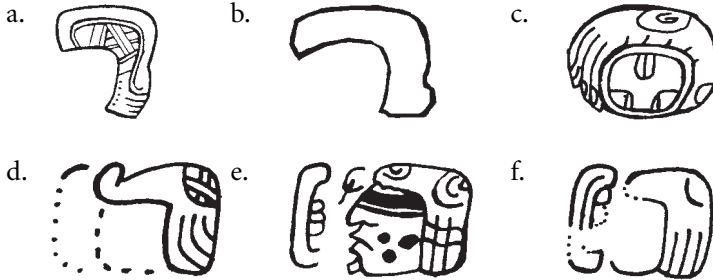

Figure 8. Examples of rebus:

a. T187 **K'AB'Aʔ** for Lowland Mayan *k'a(a)b'a(a)ʔ* 'name'. Drawing from Naranjo Hieroplyphic Stair 1, Step XII:Z2 after Grube (1994a, Figure 2).

b. Early Classic example of T187 from Pearlman conch shell. Drawing by author after Coe 1982.

c. Early Classic example of T187 from unprovenanced carved bowl. After drawing by unknown artist in Schele & Mathews (1998:58).

d. Late Classic example of T187 from Copan Temple 11 Southwest Panel. After drawing in Schele & Grube (1995:138).

e. Classic example from vase K6813. After drawing in Reents-Budet (1994:122).

f. Late Classic example from Naranjo Stela 13. After drawing in Schele & Grube (1995:145).

T187, a logogram known to have the reading **K'AB'A'** for Lowland Mayan *k'aab'aa'* 'name' (proto-Ch'olan *k'ab'a'*) has a very peculiar shape (Figure 8a): it resembles the position of an arm with the elbow flexed and projecting at a right angle. The sign is often shown with a crossed-bands sign on the corner and two sets of parallel lines on each end. It is possible that the conventional nickname for this glyph as "elbow" or ELBOW may not be too far off the mark after all. Some examples of the glyph make it clear that the sign depicts a hand with an upward pointing thumb (Figs. 8b–d). The term for 'hand' and 'arm' is *k'ab'*, which suggests that the logogram **K'AB'** 'hand, arm' was used as a rebus for **K'AB'A'** 'name'. This process may have been motivated by the echo-vowel of Mayan languages. As explained by one of the referees of this paper, in Mayan languages "the phrase-final allophones of consonants include 'echo syllables'; the consonant is repeated in a voiceless syllable with a copy of the preceding vowel" (i.e. $C_1V_1C_2\underset{\circ}{V}_1$). Such a process could lead to a pronunciation of *k'ab'* as *k'ab'.b'ạ*, which in turn makes the resemblance with proto-Ch'olan *k'ab'a'* even stronger.
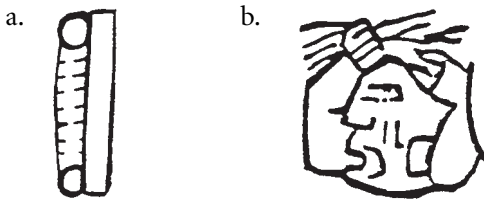

Figure 9. Innovation of a new sign for **AJ** 'male proclitic' based on near homophony between said proclitic and *ya(ʔ)h* 'painful'.

a. Example of T12 **AJ** from Palace Tablet at Palenque, glyph I14. After drawing by Linda Schele.
b. Example of novel sign for **AJ** from Chocola-style pot probably from Xcalumkin, first noted by Stephen Houston. After drawing by unknown artist in Schele & Grube (1995: 128).

Another example of the productivity and elasticity of rebus sign usage in Mayan writing was proposed by Stephen Houston. His argument concerns a sign used as a variant of T12 **AJ** for *aj+* 'male proclitic' (see Figure 9a) on an inscribed Chocola-style vase (Justeson 1989: 32). The variant depicts a man with an expression of pain in his face, holding his head with both hands (see Figure 9b), and was likely intended as a rebus for proto-Ch'olan *aj+* based on proto-Ch'olan *yah* 'painful' from proto-Mayan *ra'h*. It is possible too that the reading **AJ** for the SCREAMING.MAN sign may have been based on a form closer to proto-Ch'olan *aj+*, such as modern Yukatek *'àah* 'excl. ah!' (Bricker

et al. 1998:2). In any case, although the SCREAMING.MAN sign is a Late Classic innovation — and an idiosyncratic one at that, with no other known attestations — it does illustrate the process of rebus phoneticism and the apparent freedom that the highly pictorial nature of Mayan graphemes afforded the scribes when developing new signs or reinterpreting the motivation behind existing signs.

3. Acrophonic derivation of phonetic sign readings

There are four main processes by which a sign can acquire a phonetic reading based on the linguistic referent of its iconic referent. These involve the derivation of C_1V_1 signs from (1) $C_1V_1(G)G$ roots, (2) $C_1V_1(G)C$ roots, (3) $C1V_1(G)CV(G)C$ roots or words, and (4) $CV(G)CV_1(G)C_1$ roots or words, where G stands for a "weak" consonant, such as /h ʔ y, w/, as well as vowel length and / j/.[6] While the first two could be collapsed into one, and described formally as $C_1V_1 < C_1V1(G)C$, the fact is that epigraphers have treated them differently; some have thought it unlikely that C_1V_1 signs were derived from $C_1V_1(G)C$ roots. For that reason I treat them separately here. Processes 1–4 are attested in other writing systems around the world; Process 4 may be unique to the Mayan script.

3.1 Process 1: C_1V_1 signs from $C_1V_1(G)G$

In Process 1, phonetic signs of the shape C_1V_1 were derived from $C_1V_1(G)G$ roots as suggested by examples listed in Table 1. Additional examples of this process of derivation, not listed in Table 1, include the following:

a. T757 **b'a** (iconically the head of a gopher) from descendants of proto-Mayan *b'aah 'gopher' (Campbell 1984, Bricker 1986).
b. T301 **b'i/b'e** (iconically a footprint inside a cartouche) from a descendant of proto-Mayan *b'eeh 'road', such as proto-Greater Tzeltalan *b'eeh and proto-Ch'olan *b'ih (Campbell 1984, Justeson 1984).
c. T120 **ne** (iconically, the tail of an animal) derived from a descendant of proto-Mayan *Neeh, such as Lowland Mayan *neh (Campbell 1984).
d. T117/277 **wi** (iconically, a root) from Lowland Mayan *wi? 'root, bulb' (Fox & Justeson 1984a).

Table 1. Signs derived through Process 1

Sign	Iconicity	Sourceword	Reference
T1 (')**u**	bead	pM **u'h* 'bead'	VB 1986:52, JJ 1989:32
T585 **b'i**	crossroads, axis mundi	C **b'ih* 'road'	JJ 1984
T19(.741)	**b'u** toad	LM **b'u(h)b'* 'tadpole'	this paper
T758a **ch'o**	mouse head	pM **ch'o'h* 'mouse' (?)	this paper
T287 **ch'o**	half-closed eyes	Yu *ch'op* 'to blind temporarily'	MM 2000
T136 **hi**	sand?	GT **hi'* 'sand'	LC 1984
T178 **la**	inverted LORD sign	Col. Yukatek <la-il> 'principal, el ser (de cada uno)'	LC 1984
T220 **ke**	hand	*keh* 'measure between thumb and knuckle of forefinger'	MZ 1999
T582 **mo**	macaw eye	GLM **mo'* 'macaw'	LC 1984
T1000a **na**	head of woman	LM **na'* 'mother'	LC 1984
T116/1019 **ni**	mustache(?)	pM **ni'* 'nose' (?)	this paper
T586 **pa**	net bag	pM **paah* 'net'	LC 1984, JJ 1984
T854 **pu**	cattail	Tzo. *puj* 'cattail'	DS 2000
T87 **te**	tree	pM **tyee'* 'tree'	LC 1984
T370 **tzu**	gourd	pM **tzuh* 'gourd'	LC 1984, JF/JJ 1984a
T203c **tz'u**	fish swallowing something	pM **tz'ub'* 'suck'	MZ 1999
T130 **wa**	tamale	WM+Yu **waj* 'tortilla'	KT 1989
T126 **ya**	penis bloodletting?	C **yah* 'painful'	this paper

The following abbreviations for language subgroups and language areas are used: C = Ch'olan, GLM = Greater Lowland Mayan, GT = Greater Tzeltalan, LM = Lowland Mayan, pM = proto-Mayan, T = Tzeltalan, Yu = Yukatekan, WM = Western Mayan. The following abbreviations for authors' names are used: BM = Barbara MacLeod, BS = Brian Stross, DM = David Mora-Marín, DS = David Stuart, JF = James Fox, JJ = John Justeson, JR = John Robertson, LC = Lyle Campbell, MC = Michael Closs, MM = Martha Macri, MZ = Marc Zender, PM = Peter Mathews, SH = Stephen Houston, TK = Terrence Kaufman, VB = Victoria Bricker, WN = William Norman.

e.   T25 **ka** (iconically, the fin of a fish) and T203 **ka** (a whole fish) from a descendant of proto-Mayan *kar 'fish' such as Yukatekan *kay (Justeson 1989) or proto-Western Mayan *kay (Houston et al. 2000), but not proto-Greater Tzeltalan *chay or proto-Ch'olan *chäy.

f.   T565 **ta** (iconically an obsidian core) from a descendant of proto-Mayan *taah 'obsidian' (Mathews & Justeson 1984).

g.   T740 **hu** (iconically an iguana) from Lowland Mayan *huj 'iguana' (Campbell 1984).

h.   T122:150 **ta** (iconically a pine torch) from a descendant of proto-Mayan *tyaj 'pine/torch' (Mathews & Justeson 1984).

i.   T82 **le** (iconically a leaf) from Yukatekan *leʔ (Campbell 1984).

Figure 10.   Examples of acrophonic derivation of CV signs from CVG roots:

a.   T710 HAND read phonetically as **ye** and probably derived from proto-Ch'olan *yeʔ 'to show'. After drawing in Stuart et al. (1999: 37).

b.   T590 JAWBONE read phonetically as **cho** probably derived from proto-Ch'olan *choh 'cheek'. Drawing from Copan Stela 13:D8 after Grube (1994a, Fig. 2).

c.   T708 CLENCHED.TEETH sign read phonetically as **ko** and probably derived from proto-Yukatekan *kòoh 'teeth'. Drawing from Palenque Palace House C Platform at D3, after Grube & Stuart (1987, Fig. 8).

Other examples are worth a few words. T710, a sign depicting a hand and deciphered as phonetic **ye** by David Stuart, was likely derived from proto-Ch'olan *yeʔ 'to show', given the posture of the hand (see Figure 10a). T669 **k'a**, a sign depicting a closed fist, may have been derived from Lowland Mayan *k'ab' 'hand, arm' (Fox & Justeson 1984a: 69) through this process. Although at first sight b' does not seem to be a weak consonant, in some dialects of Yukatekan and Ch'olan it alternates in final position with glottal stop; cf. Yukatek k'ab' ~ k'aʔ (Bricker et al. 1998: 140), Ch'ol k'äb' ~ k'äʔ (Schumann 1973: 21). Thus k'ab' ~ k'aʔ or k'äb' ~ k'äʔ may have served as the basis for T669 **k'a** as *k'ab' ~ *k'aʔ.

I mention here only two more examples from Table 1. T590, likely phonetic **cho** (cf. D. Stuart 1995), depicts a jawbone with molar teeth (see Figure 10b). It may be derived from a descendant of proto-Mayan *kooh 'cheek; tooth (molar)' (Fox 1978: 119–20). This item underwent the shift of k to ch in Greater

Tzeltalan, where it is attested as *choh* with the meaning 'cheek'; it is reconstruct-ed for proto-Ch'olan as **choh* 'cheek' (Kaufman & Norman 1984:118). Fox points out (1978:119–20) that Yukatekan has *koh* 'tooth', and that **koh* or **kooh* can be reconstructed for proto-Mayan with the meaning 'cheek, tooth (molar)' based on the cognates in other subgroups. Based on this, it is possible that Ch'olans may have retained the 'tooth (molar)' meaning for some time, and that the molar tooth depicted in the T590 sign makes reference to this.

T708, a sign depicting an open mouth with clenched teeth, each tooth showing a jade inlay, is of interest here (see Figure 10c). The sign has been deciphered as phonetic **ko** (Grube & Stuart 1987). Based on the iconic motiva-tion and the phonetic value, the most likely sourceword for the syllabogram is Yukatekan *koh* 'tooth', as argued recently by Macri 2000. In other words, T590 **cho** and T708 **ko** may have had essentially the same sourceword in different languages, suggesting that both Ch'olan and Yukatekan scribes influenced the development of the script's signary.

Table 2. Signs derived through Process 2.

Sign	Iconicity	Sourceword	Reference
T280 (')**o**	bird feather	Yu *ʔòop* 'parrot'	referee
T585 **b'i**	perforated earflare	Yu *b'is* 'pierce, bore, prick'; Itza *b'is* 'perforated with fine holes'	referee
T19(.741) **b'u**	toad	LM **b'u(h)b'* 'tadpole'	this paper
T110 **ko**	turtle carapace?	C **kok* 'turtle'	SH/JR/DS 2000
T669 **k'a**	closed fist	pM **q'ab'* 'hand/arm'	JF/JJ 1984a
T24 **li**	hook-shaped object?	WM **lich'* 'hanging'	this paper
T24 **li**	reflective object?	WM **litz'* 'shine'	MM 2000
T950 **li**	hawk	C **lik-lik* 'hawk (species)' (highland loan)	BM 1990 TK/WN 1984
T21(.741) **mu**	frog or toad	GLM **much* 'toad'	this paper
T134[595] **no**	cotton?	pM **nooq'* 'clothes, cloth'	SH/JR/DS 2000
T126 **ya**	flowing liquid?	GLM **yal* 'throw down'	this paper

3.2 Process 2: C_1V_1 signs from $C1V_1(G)C_2$

A second process consists of the derivation of C_1V_1 syllabograms from $C_1V_1(G)C_2$ roots or stems in which C_2 is not a weak consonant; see Table 2. A few examples have recently been presented by Houston et al. (2000: 328): T110 **ko**, T134[595] **no**, and T44(:563b) **to/TOK**. They suggest that T110 depicts a turtle carapace, and that its sourceword may be proto-Ch'olan *kok* 'turtle'. They also suggest that T134[595] **no** may have been derived from proto-Mayan *nooq'* 'clothes, cloth', although the iconic motivation of T134 is not very clear. Another example they point to is T44(:563b) **to/TOK**, which iconically depicts clouds, and may therefore be derived from a descendant of proto-Mayan *tyooq(-al)* 'cloud', such as proto-Ch'olan *tokal* (Kaufman & Norman 1984: 132).[7]
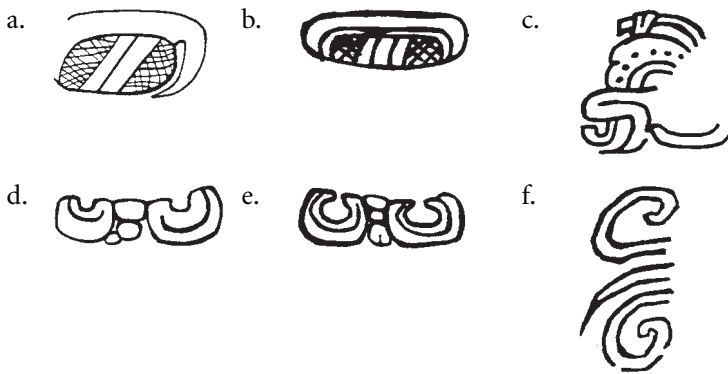
a.   b.   c.

d.   e.   f.

Figure 11. Examples of acrophonic derivation of CV signs from CVC roots.

a.   Early Classic form of T24 **li**. Drawing by D. Mora-Marín of sign in unprovenanced jade plaque.

b.   Late Classic example of T24 **li**. After drawing in Stuart et al. (1999: 61).

c.   Spelling T60:528:358:126 on a jade celt from Rio Azul, suggesting T126 may correspond to the bottom half of the SQUATTING.FIGURE sign. Drawing by D. Mora-Marín.

d.   Example of T126 **ya** from Lacanha Panel 1:K2. After drawing in Lacadena (1996: 219).

e.   Late Classic example of T126 **ya** with central element resembling a penis, from Palenque. After drawing in Lacadena (1996: 238).

f.   Early Classic example of T126 **ya** from an inscribed jade plaque. Drawing by D. Mora-Marín.

Another case may be T669 **k'a**, mentioned above as possibly derived through Process 1. If it originated in a Ch'olan or Yukatekan dialect in which final *b'* was not in alternation with glottal stop in the word *k'ab'* 'arm', it would be an

example of Process 2. A better example may be T24 **li**. The earliest forms of T24 **li** suggest the depicted entity was a hooked object, as in Figure 11a; the later forms, as in Figure 11b, show no hook element. It is possible that its reading may have been derived accordingly from the Western Mayan positional root **lich'* 'hanging' (Kaufman & Norman 1984: 125).[8]

T126 **ya** depicts three flowing or curling elements, with the central element pointing down; see Figure 11c. Later examples show three dots instead for a central element; see Figure 11d. Based on this, it is possible that the reading **ya** derived from Greater Lowland Mayan (Tzeltalan, Ch'olan, Yukatekan) **yal* 'throw down'. However, an example of the spelling T60:528:358:126 on a jade celt from Río Azul suggests a different origin for T126 **ya**. The example shows the central element of T126 as the profile view of the legs of a man performing a penis bloodletting rite, with the side curling elements possibly indicating the direction of the blood flowing down from the perforations; see Figure 11e. If this is the case, then T126 could be a part of a larger sign consisting of T358:126 and acrophonically based on proto-Ch'olan **yah* 'painful', which would make T126 **ya** an example of Process 1. The possibility that T126 **ya** may have been derived from **yah* 'painful' finds support in a late form of T126 **ya** attested at Palenque, in which the central element of the sign is apparently a penis; see Figure 11f. Such form reinforces the association with penis bloodletting apparent in the Río Azul example. For now I consider this only an interesting possibility that requires further testing.

Two more examples include T21(.741) **mu**, which appears to depict a frog or toad and could therefore be based on Greater Lowland Mayan **much* 'toad', and T19(.741) **b'u**, formally identical to T21(.741) except for a series of cross-hatched elements on the T19 component. The latter therefore depicts a toad as well and could be based on Lowland Mayan (Ch'olan, Yukatekan) **b'u(h)b* 'tadpole'. I discuss these two examples below with regard to the process of formal divergence.

A referee of this paper has suggested a few examples that I regard as good candidates for Process 2. One is T280 **(')o**, which depicts a feather and may have been derived from a cognate of modern Yukatek *ʔòop* 'parrot' (Bricker et al. 1998: 18). The referee also suggests that T585 **b'i**, which depicts a perforated earflare, may correspond to modern Yukatek *b'is* 'pierce, bore, prick' and modern Itzaj *b'is* 'perforated with fine holes' (Hofling & Tesucún 1997: 178, Bricker et al. 1998: 32).[9] Macri 2000 has also suggested that T585 **b'i** was derived *b'is*; and she also argues that T287 **ch'o**, which depicts a pair of half-closed eyes, may be derived from a form such as modern Yukatek *ch'op* 'to blind temporarily' (Bricker et al. 1998: 86).

One last example of this process may be the use of a JAWLESS.SKULL sign as a syllabogram **b'a** (cf. Zender 1999: 38–41). This is illustrated on vessel K4357, where a JAWLESS.SKULL sign is used in the spelling **u-ts'i**-JAW-LESS.SKULL-**li** to spell the syllable **b'a**, given its occurrence in the position normally occupied by the high frequency **u-tz'i-b'a-li** glyph. The **b'a** reading for this JAWLESS.SKULL sign may have been derived from its logographic reading **B'AK** 'bone' (cf. proto-Ch'olan *b'ak* 'bone' < proto-Mayan *b'aaq*), which Zender (1999: 65–68) has shown was one of the logographic readings for this sign besides **JOL** 'head' and **CHAM** 'to die'.[10] The term in modern Ch'ol for 'skull' is *baquel joläl,* where *bac* is 'bone' and *jol* is 'head' (Aulie & Aulie 1978: 30, 35, 67); the term is therefore 'the bone of the head'. Consequently, it is quite probable that a descendant of proto-Mayan *b'aaq* could be the source of the **b'a** usage for JAWLESS.SKULL.

Table 3. Signs derived through Process 3.

| Sign	Iconicity	Sourceword	Reference
T513 (')**u**	June bug	Tzeltal *umoh/umuh/omoh* 'June bug'	VB 1986
T1040 **b'a**	human skull	pM *b'aaq*	MZ 1999
T758a **ch'o**	mouse head	C *ch'ohok* 'mouse' (?)	this paper
T918 **PET/pet**	spindle whorl	pM *peteht* 'spindle'	this paper
T44 **to**	clouds	C *tokal* 'cloud'	SH/JR/DS 2000
T507 **tzi**	gourd	pan-Mayan *tzima(h)* 'gourd'	this paper
T124 **tzi**	handle of incense burner	Tojolob'al *tzik* 'to burn incense'	this paper
T115 **yo**	leaf?	pC *yop-ol* 'leaf'	this paper
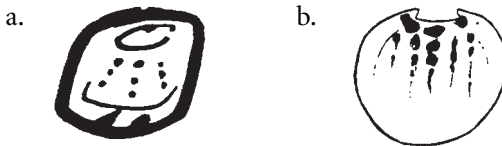
Figure 12. Iconographic evidence for derivation of T507 **tzi**:
a. T507 **tzi**. After example on vase K1453 (Kerr 1989: 86).
b. Depiction of gourd on vase K1453 (Kerr 1989: 86).

3.3 Process 3: C_1V_1 signs from $C_1V_1(G)C_2V_2(G)C_3$

To the processes already mentioned, another can be added: the derivation of C_1V_1 syllabograms from $C_1V_1(G)C_2V_2(G)C_3$ roots or words; see Table 3. One clear example, shown in Figure 12a, is T507 **tzi** from pan-Mayan *⋆tzima(h)* 'gourd', an early borrowing from Mixe-Zoquean *⋆tzima* (Campbell & Kaufman 1976: 84). This is evident through an examination of vase K1453 (Kerr 1989: 86), where a gourd is depicted in the middle of the pictorial scene; see Figure 12b. In the accompanying text, T507 is rendered a few times with a strong resemblance to the gourd in the middle of the scene (Figure 12a). I will return below to T507 **tzi** in order to discuss a especial case of formal convergence between T507 and T124, both read as **tzi**.

There may be other examples of Process 3 besides T507 **tzi**. As discussed by Zender (1999: 38–41), on vase K2206 the logogram T751 **B'ALAM** is apparently used as a syllabogram **b'a** in substitution for T501 **b'a** in the spelling of **u-ts'i-b'a-l(i)**. A somewhat similar example appears on K772, where the head of the Hero Twin **YAX-B'ALAM**, also used as the head variant of the numeral 'nine' (cf. proto-Ch'olan *⋆b'olon=*), was used as a **b'V** syllable — perhaps **b'a**, if based on the reading **B'ALAM**, or **b'o**, if based on the reading **B'OLON=**. Although these examples are rather unusual and clearly of a playful nature, they illustrate the process postulated here for T507 **tzi**, and the fact that scribes could produce such new sign readings on a whim. They confirm that scribes did in fact employ the process $C_1V1 < C_1V1C_2V_2C_3$ for obtaining phonetic signs. The difference between such signs and T507 was simply one of acceptance by other scribes.

Another example may be T758a **ch'o**, which depicts a mouse, possibly derived from proto-Ch'olan *⋆ch'ohok* 'mouse'. However, proto-Greater Tzeltalan may have had *⋆ch'oh*, since the term is a reflex of proto-Mayan *⋆ch'o'h* (Kaufman & Norman 1984: 119). If T758a originated among Greater Tzeltalan speakers, its reading would be an example of Process 1, and not of Process 4.

It is possible that some CVC logograms or syllabograms signs may have been derived in this fashion too. The T818 SPINDLE sign deciphered by Nikolai Grube as **PET**, for instance, may have been derived from proto-Ch'olan *⋆peteht* 'spindle'. Lastly, Bricker (1986: 78–79) has offered another clear example of this process: She has shown that T513 (')**u** depicts a June bug, i.e. *umoh ~ umuh ~ omoh* in modern Tzeltal.

Table 4. Signs derived through Process 4.

Sign	Iconicity	Sourceword	Reference
T280 (’)**o**	macaw feather	GLM *mo’ ‘macaw’ (?)	this paper
T34/266 **hu**	bead necklace	pM **u’h* ‘necklace’	this paper
T528 **ku**	stone	C *chahuk ‘lightning’	MC 1986
T77/236 **k’i**	(bird) wing	Yu **xìik’* ‘wing’	DM 2000
T568 **lu**	heart	Yu *óol ‘heart’	JF/JJ 1984a, MC 1986
T568 **lu**		GTz *jul ‘pierce’	this paper
T51 **ta**	centipede	LM *chapaht ‘centipede’	this paper
T79 **pat**	centipede	LM *chapaht ‘centipede’	this paper
T126 **ya**	liquid flowing downward	C *yal ‘to fall’	this paper
T61/62 **yu**	bead	C *uhy ‘necklace’	this paper
T114 **xa**	component	GLM *yax	MC 1986

3.4 Process 4: C_1V_1 signs from $C_1V_1(G)C2(V_2(G)C_3)$

There are also examples of the derivation of C_1V_1 signs from $C_1V_1(G)C_2$ sourcewords, or C_3V_2 signs from $C_1V_1(G)C_2V_2(G)C_3$ sourcewords; see Table 4. This process is analogous to the convention of phonetic complementation of logographic signs (Closs 1986), although it may not have been necessarily understood in the same terms by the scribes. The process itself was first discussed by Fox & Justeson 1984a and by Justeson 1984; but Closs (1986: 240–41) attempted a more systematic survey of its productivity.

Fox & Justeson (1984a: 24, 71) suggest that T96/103 had a logographic reading EYE and a phonetic reading **ta** in the Postclassic codices. These authors contend that its phonetic reading **ta** may have developed from proto-Greater Tzeltalan or pre-Ch’olan *wat ‘eye’, which may be the iconic referent of T96. Justeson (1984b: 367) also states that, in general, “a VC$_i$ logogram may be used also with the corresponding CV$_i$ phonetic value, and vice versa.” Thus he considers that T24 **li** may be read also as -IL ‘possessive/relational nominal suffix’, and T181 **ja** as -AJ ‘verbal suffix’ or as AJ+ ‘male proclitic’. The orthographic contexts of T181 support most of these readings. For example, the verb

chok 'to throw down' may be spelled as a passive (i.e. *cho[h]k-aj* or *chok-aj*) either as **cho-ka-ja** or as **CHOK-ja**. Given the explicit phonetic spelling of the first example, which renders *chok-aj,* it is normally assumed that the second spelling would render also *chok-aj,* and thus justifying the interpretation of T181 as logographic **-AJ** rather than exclusively as phonetic **ja**. More recently, Stuart et al. 1999 and Houston et al. 2001 are taking up this issue again; they refer to phonetic signs that are used to spell grammatical affixes and particles by the term "morphosyllables."

Closs (1986: 231) has reformulated the orthographic rule proposed by Justeson (1984b: 367) as a "rule of commutativity", and has proposed that the emic basis for this practice may have lain in its equivalence to the practice of synharmonic phonetic complementation of logographic signs. Thus he has argued (1986: 240–41) that the reading **ku** of T528 may have been derived from its logographic reading **CHAHUK** via a process analogous to synharmonic phonetic complementation: **CHAHUK** > **ku**.[11] He has also suggested that T501 **b'a** may be derived from a logographic **NAB'** 'ocean' reading, as well as a few additional examples: T114 **xa** (< T16 **YAX**), T552 **ta** (< T552 **K'AT**), T58 **ka** (< T58 **SAK**), among others. Besides the T528 **ku** example, the cases T114 **xa** and T552 **ta** are especially appealing to me, and I describe them next.

Closs (1986: 236–338) posits that T114 **xa**, a sign deciphered by D. Stuart (1987: 28–31), was derived from the logographic reading of T16 **YAX** for *yäx* 'green, first', which often appears to have T114 inside (i.e. as a graphic infix). If so, T114 may have been innovated similarly to T25 **ka** from T203 **ka**, by means of the *pars pro toto* principle and the postposed phonetic complementation analogy: **YAX(-xa)**. He also argues that T552, thought by some to have the logographic reading **K'AT** 'to cross' or 'crosswise' (Fox & Justeson 1984a), may have developed its reading **ta**, illustrated in the spelling of **yi-ta-ji** with T552 as **ta** (Schele 1990: 106), through the same process: **K'AT** > **ta**. However, there is a possibility that T552 was read logographically as **AT** (Lounsbury 1989); if so, the reading **ta** could still be derived through the same process: **AT** > **ta**.
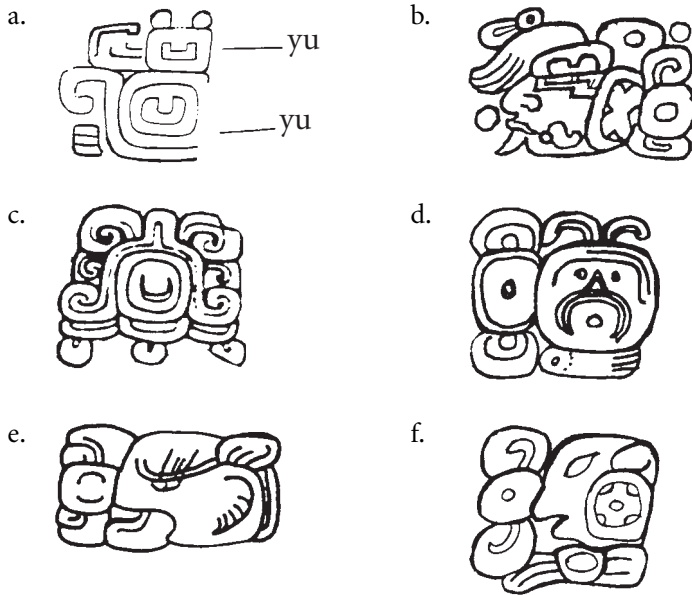
Figure 13. Examples of acrophonic derivation of C_1V_1 signs from $(CVC)C_2V_1(G)C_1$ roots, where C_1 can be any type of consonant.

a   Example of T62:62 spelling for **yu-y(u)** or **y(u)-UY** for *y-uhy* 'his/her bead' on tubular jade bead from the Cenote of Chichen Itza. Drawing by author after photograph in Proskouriakoff (1974, Plate 45–1) and personal examination of piece at Peabody Museum at Harvard.

b.   Example of T62 used pictorially as depiction of a perforated ear bead ornament on the Pomona jade ear flare. Drawing by author after photograph in Kidder & Ekholm 1951.

c.   Example of T62 used pictorially as depiction of perforated pectoral bead ornament on Tikal Stela 31. Drawing by author after drawing in Jones & Satterthwaite (1982, Fig. 52).

d.   Example on Yaxchilan Lintel 23:F2 of sign resembling T62 used as phonetic **u** in parentage statement normally possessed with T1 **u**. After drawing of glyph by Graham 1982.

e.   Example of T62 as **u** on unprovenanced cylindrical stone object. After drawing in Houston & Stuart (1998: 83).

f.   Example of T62 as **u** on Sacchana Stela 2:A3. After drawing in Schele & Grube (1995: 198).

Other examples of this process exist. I have argued (Mora-Marín 1997, 2000) that the reading **yu** of T62, a sign depicting a jade bead assemblage, was derived from a probable logographic reading of T62 as **UY** 'bead, necklace' attested on a tubular bead from the Cenote of Chichen Itza (Proskouriakoff 1974, Plate 45-1).

In this tubular bead, an ownership statement T62:62 spells either **yu-y(u)** or **y(u)-UY** for *y-uhy* 'his/her bead' (see Figure 13a); either way, the iconic referent of T62 is a jade bead or bead assemblage (see Figs. 13b–c). Based on this, T62 was most likely derived from proto-Ch'olan **uhy* 'necklace' (Kaufman & Norman 1984:135) (i.e. **UY** > **yu**), as previously suggested by Grube (1991:230), rather than from Greater Tzeltalan/Yukatekan **u(')h*. Support for this hypothesis is found in rare uses of T62 as (')**u** (see Figs. 13d–f), suggesting that the sourceword for T62 was in fact **uhy* (i.e. **u** < **UY**), and also that a given sourceword could potentially lead to more than one reading for that sign, as argued below also for T51 and T79. Indeed, the **yu** reading of T62 appears to have become the standard reading probably through conventionalization already during Early Classic times; but scribes in the Early Classic (note the unprovenanced cylindrical stone object in Houston & Stuart 1998:83) and the Late Classic (e.g. Yaxchilan Lintel 23:F2, Sacchana Stela 2:A3) still used it as (')**u** on occasion.
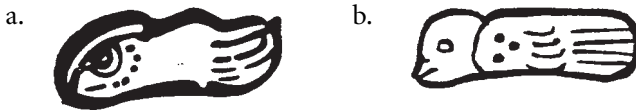

Figure 14. Possible examples of development of syllabogram **k'i** from term for 'wing'.
a.   T77 WING read phonetically **k'i**. After example on vase K504.
b.   T236 BIRD read phonetically **k'i**. After Grube (1990, Fig. 1a).

I have proposed (Mora-Marín 2000) the reading **k'i** for T77, a sign depicting the wing of a bird; see Figure 14. The proposal is based on several contexts, including its probable use as a phonetic complement to T544 **K'IN** in a few ceramic vases (e.g. T77-**K'IN-ja** most likely read as (**k'i-**)**K'IN-ja**) and at Xcalumkin (e.g. **AJ**-T77-**K'IN-a** most likely read as **AJ**-(**k'i-**)**K'IN-a** for *aj+k'in-a'* 'Mr. Priest').[12] Again, I have proposed (in Mora-Marín 2000) an acrophonic origin, following MacLeod & Stross 1990, based on the Yukatekan descendant of proto-Mayan **xiik'* 'wing', which was **xìik'* in proto-Yukatekan, rather than the Ch'olan descendant **wich'* (Kaufman & Norman 1984:136), as follows: **XIK'** > **k'i**. Since the sign could have been derived from a descendant of proto-Mayan prior to the *k(')* > *ch(')* shift of Greater Tzeltalan, the sign could have originated in a Greater Tzeltalan language that preceded that shift. It is possible, as D. Stuart 2002 has proposed, that the reading **k'i** for T77 may have been derived instead through Process 1 if based on *k'iy* 'to spread out' — a term attested in Tzeltal, Tzotzil, and Ch'ol (Aulie & Aulie 1978:102–3) — since the earliest forms of T77

show two spread out wings. Thus, even though *xiik'* 'wing' is at first sight a more direct linguistic referent of the iconic motivation of T77 WING, the fact is, as D. Stuart points out, that some of the earliest versions of T77 show two spread-out wings rather than a single wing. For the moment, therefore, I prefer to include T77 in Table 1 (if derived from proto-Greater Tzeltalan *k'iy*) and Table 4 (if derived from a descendant of proto-Mayan *xiik'*).
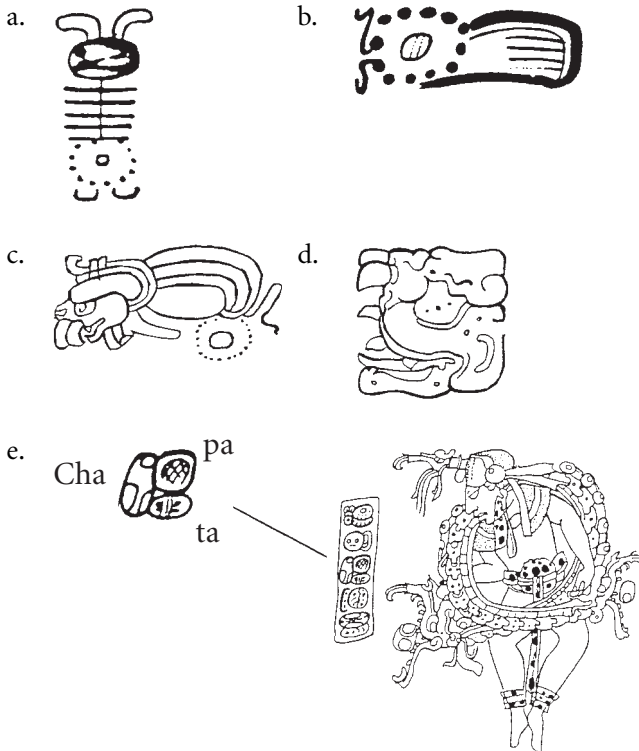

Figure 15. Signs depicting tail of centipede and whole centipede:

a. T51/53 CENTIPEDE with readings **ta/TI/TA**, as attested on Río Azul mural. After drawing by Peter Mathews.
b. T79 **PAT** 'to form' or phonetic **pat**. After example in polychrome vase K1398 (Kerr 1989).
c. Full form of the mythological centipede glyph on a Late Preclassic text inscribed on the back of an Olmec-style pectoral mask pendant on display at the Brooklyn Museum of Art. Probably logographic **CHAPAT** 'centipede'. After photograph in Soustelle (1972, Plate 61) and first-hand examination of the piece at the Brooklyn Museum of Art.
d. Partial centipede glyph from Palenque, showing the head. Probably logographic **CHAPAT** 'centipede'. After drawing by Linda Schele.

e.   Iconographic centipede on pottery vase accompanied by phonetic spelling **cha-pa-ta**
     for *chapaht* 'centipede'. Drawing by Linda Schele in Grube & Nahm (1994: 702).

T51/53 **ta/TI/TA**, as shown in Figure 15a, is thought by various epigraphers to
depict a centipede; it could very well have been derived acrophonically from an
ancestor of Ch'olti' <chapaht> 'cientopies' (Morán 1695: 22), Ch'orti' *chapaht*
'animal said to resemble the centipede' (Wisdom 1940), Colonial Yukatek <(ah)
chapat> 'ciento pies, insecto; sabandija que entra en el oído y mata; nombre
genérico de las escolopendras' (Barrera Vásquez 1980: 84), and Tzeltal *chapat*
'centipede' (Slocum & Gerdel 1971: 132), but not the Ch'olti' entry cited by Grube
& Nahm (1994: 702). As I mention below, T79 **PAT** (see Figure 15b) may also be
acrophonically related to T51/53 **ta/TI/TA.** This acrophonic origin is suggested
also by a Late Preclassic text inscribed on the back of an Olmec-style pectoral mask
pendant (Figure 15c) which shows the full form of the CENTIPEDE glyph (a
mythological centipede), which is also attested in the Late Classic at Palenque
(Figure 15d); the tail of the full-form centipede creature resembles T51/53. In this
way, the phonetic reading of T51/53 may have been derived through the process:
CHAPAT > **ta.**

It is possible that CVC phonetic signs may also be derived this way. T79, as
in Figure 15b, is thought to be logographic **PAT** 'to form' as deciphered by D.
Stuart; it seems to depict the same part of the centipede as T51/53. Since T79
does not seem to depict anything that is related to the concept of 'to form' (i.e.,
its relationship to the verb **pät* 'to form' is entirely arbitrary, rather than
iconic/indexical), it is possible that it was a CVC phonetic sign **pat** that was
frequently used in the spelling of the verb **pät* 'to construct, build' from
proto-Mayan **pat* (Kaufman & Norman 1984: 128).[13] The reading of T79 may
have been derived as **CHAPAT** > **pat.**

Another sign may be T548. There are a few instances in which T548 appears
to have a purely phonetic reading of the shape **b'V**, as other epigraphers have
also recognized (e.g. Marc Zender, p.c. 2000). One example is found on the
pottery vase K4549, where the following appears: **yu-k'i-**T548. In this context
T548 is in free word-final substitution for either T585 **b'i** or T501 **b'a**, and is
probably used to spell **yu-k'i-b' (V)** for *y-uk'-ib'* 'his/her drinking cup'. An
explanation of the apparent **b'V** reading for T548 can be proposed on the basis
of its logographic reading **HAB'** for *ha'b'* 'year' plus the phonetic comple-
mentation or commutativity process: **HAB'** > **b'V.** To my knowledge no word-
initial or word-medial contexts of T548 with a **b'V** reading are known; thus the
precise vocalic value of this **b'V** sign, if indeed a **b'V** sign, is uncertain.
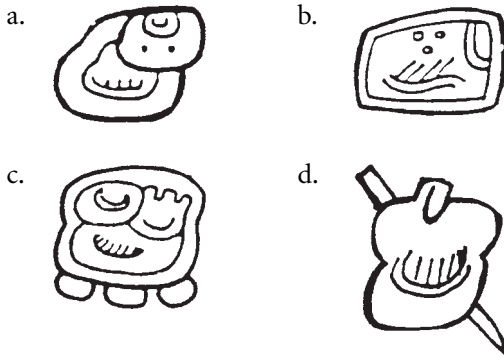
Figure 16. Acrophonic derivation of T568 **lu**.

a. T568 **lu** from Yaxchilan Lintel 3:C7. After drawing in Graham 1982.
b. T568 **lu** from Randel Stela. Drawing by author based on photograph in Mayer (1991, Plate 94).
c. Example of T568 **lu** that shows it as a clear depiction of a presumably human heart. Drawing from Xcalumkin Lintel 4 after Grube (1994b: 320, Fig. 6a).
d. Iconic use of T568 **lu** as part of the logogram T918 **JUL** for *jul* 'to pierce', which shows a spear going through a heart. After example on vase K595 (Justin Kerr Archive, www.famsi.org).

Lastly, T568 **lu**, as in Figures 16a–b, may have its origin in this process too. As seen in Figure 16c, the sign depicts a human heart (cf. Justeson 1984: 344). No lexical item with the meaning 'heart' seems to provide a clear acrophonic basis for the phonetic value of the sign — despite the suggestions by John Justeson and by James Fox (cited in Justeson 1984: 344), as well as by Closs 1986, that its sourceword was *ohl* 'heart'. I think the iconic use of T568 **lu** as part of the logogram T918 **JUL** for Greater Tzeltalan *jul* 'to pierce', which shows a spear going through a heart as on vase K595 (see Figure 16d), suggests that the **lu** reading was derived from **JUL** through the commutativity process: **JUL** > lu.[14]

4.   Non-acrophonic derivation of phonetic sign readings

The following processes were first discussed by Fox & Justeson 1984a. Here I will only mention a few possible examples of these, pending a more thorough investigation in the future.
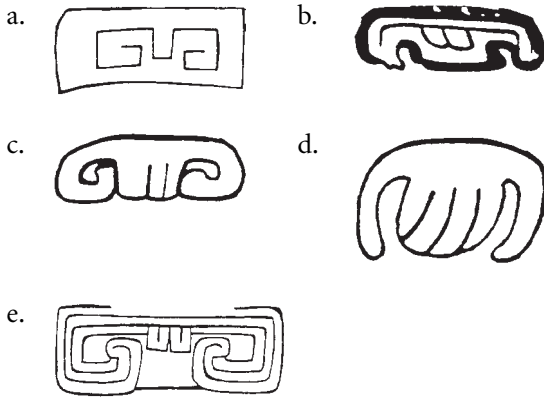
Figure 17. The iconic motivation of Mayan T23 **na** as EARTH/LAND.

a. Epi-Olmec MS44 **na**.
b. Mayan T23 **na**.
c. Early Classic form of Mayan T23 **na** in Yaxchilan Lintel 22:C2, identical to down-turning ground motif. Drawing by D. Mora-Marín after drawing in Graham (1982:51).
d. Early Classic form of Mayan T23 in Yaxchilan Lintel 18:C3. Drawing by D. Mora-Marín after drawing in Graham (1982:45).
d. Early Classic form of Mayan T23 **na**, identical to down-turning ground motif.
e. Iconographic use of MS44/T23 EARTH/CAVE in Kaminaljuyu Stela 11 as the basal or down-turning ground motif.

4.1 Process 5: Script transfer

There are two types of script transfer of relevance here. The first is diffusion between the Mayan and Epi-Olmec scripts, and the second between two Mayan dialects or languages.

There is at least one clear case of diffusion of a CV syllabogram from the Epi-Olmec script to the Mayan script, discovered by Stross 1990 on iconographic grounds, and later confirmed by Justeson & Kaufman 1993 on grammatical grounds, namely Epi-Olmec MS44 **na** and Mayan T23 **na**; see Figures 17a–b. Indeed, as Stross (1990:48–52) points out, the iconic motivation of the **na** sign supports an explanation of the origin of its reading based on the Mixe-Zoquean sourceword *⋆naas* 'land' (Wichmann 1995:582), and not the semantically equivalent Mayan form (cf. proto-Ch'olan *⋆kab'* 'earth, land; town'; proto-Mayan *⋆kab'* ~ *⋆kaab'*). As I have pointed out (Mora-Marín 1996), some Early Classic forms of Mayan T23 **na** are identical to this down-turning ground motif

(see Figs. 17c–d), although later forms often seem to be more stylized (Figure 17b).[13] Also, its iconic use in Late Preclassic Izapan art (see Figure 17e), as what is referred to as the down-turning ground motif (Gay 1973), supports an identification with 'earth', 'land', or 'ground'.
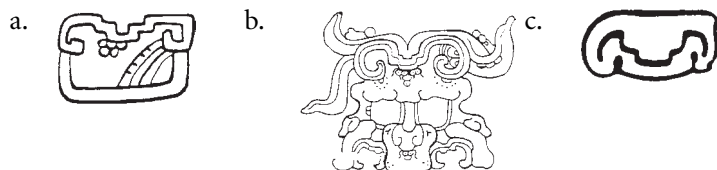

Figure 18. The outline of the down-turning ground motif in Mayan art and writing.

a.   Early Classic T529 **WITZ** 'mountain, hill' logogram in the Tikal Ballcourt Marker at G6. After drawing by P. Morales.
b.   Mountain in Tablet of the Foliated Cross at Palenque. After drawing by Linda Schele.
c.   Late Classic T23 **na** in Dos Pilas Stela 8, dated to 726 CE, and showing down-turning ground motif outline. After drawing by Stephen Houston.

Interestingly, the outline of MS44 **na** and of the down-turning ground motif of Izapan art corresponds to the top part of the split mountain motif of the Early Classic 'mountain, hill' logogram, T529 **WITZ,** as in Figure 18a and in Mayan pictorial art, and of Figure 18b; this suggests that the down-turning ground motif and the split mountain motif are one and the same. The motif's association with 'earth' and 'land', therefore, is made through this split mountain element. Surprising because of its lateness (dating to almost a thousand years after the Izapan down-turning ground motif), an example of T23 **na** from Dos Pilas Stela 8, dated to 726 CE, reflects its Late Preclassic iconic origin quite clearly, as seen in Figure 18c; it shows the split mountain outline.
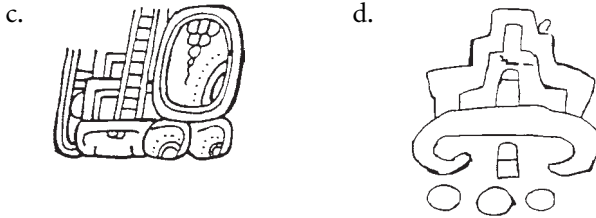
c.

d.
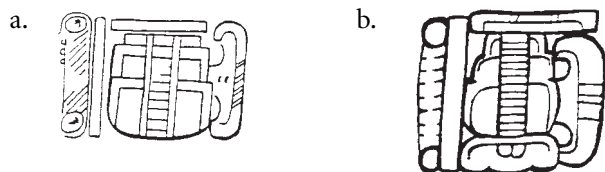
Figure 19. Possible frozen uses of T23 as EARTH/CAVE icon in Classic Mayan writing.

a. Tablet of the 96 Glyphs at Palenque, glyph A4, read as **AJ-5-PYRAMID-NAH** 'He of the 5 [pyramid] house', with no T23 sign. After drawing by Linda Schele.
b. Palace Tablet at Palenque, glyph I14, read as **AJ-5-PYRAMID-T23-NAH**, with T23 sign.
c. Tikal Stela 26:yB2, read as **u-PYRAMID-T23-3.STONE**, and showing T23 sign. After drawing in Jones and Satterthwaite (1982, Fig. 45).
d. Middle Preclassic Olmec-style Ahuelican Greenstone Tablet showing PYRAMID-E-ARTH/CAVE-3.STONE, with down-turning ground motif in the position where T23 is found in the Tikal Stela 26 example.

Furthermore, some frozen uses of T23 **na** as ideographic EARTH/CAVE do in fact exist in the Lowland Mayan texts in association with the T685 PYRAMID glyph. One example from the Tablet of the 96 Glyphs at Palenque, shown in Figure 19a, shows a glyph **AJ-5-PYRAMID-NAH** 'He of the 5 [pyramid] house'. The same glyph appears on the Palace Tablet, also at Palenque, as **AJ-5-PYRAMID-na-NAH**; see Figure 19b. In this instance, though, T23 **na** follows the PYRAMID glyph. The reason for the optionality of T23 in this glyph is not clear at first. It could be a phonetic complement to the reading of the PYRAMID sign, suggesting it ends in *n*. However, based on the spellings **le-ma**-PYRAMID (Tablet of the Cross, I1; Tablet of the Foliated Cross, E2) and **ma-le**-PYRAMID (Naranjo Stela 29), Barbara MacLeod has proposed a reading **LEM** based on *lem* 'to put, place, introduce into, usher in, gain access' for the PYRAMID logogram (Schele 1992: 189). If this reading is correct, then the T23 **na** sign present in the non-verbal (i.e. non-clause initial) contexts of the PYRAMID sign does not contribute to its reading.

When one compares this PYRAMID glyph with a related one attested at Copan, Tikal, and Caracol, among a few other sites, and with yet a third glyph attested in a Middle Preclassic Olmec-style greenstone tablet, then its optionality and possible rationale become clear. The Tikal example shown in Figure 19c shows **u-PYRAMID-na-3-TUN**. This place is a cosmological placename, where **3-TUN** refers to the three hearthstones. When one compares it with the

glyph on the Middle Preclassic Ahuelican Tablet, shown in Figure 19d, it is
evident that the two are the same: PYRAMID-EARTH/CAVE-3.STONE. What
is found in between the PYRAMID sign and the 3.STONE sign in the green-
stone tablet is the down-turning motif — which, as I have explained, corre-
sponds iconically to MS44 and T23 **na**. Thus it seems that T23 **na** is not
functioning phonetically in any of the glyphs in Figure 19, but instead,
iconically, as EARTH/CAVE, confirming that T23 **na** did in fact originate in
the Izapan down-turning ground motif, and also that its sourceword was
Mixe-Zoquean *naas* 'earth, land'. It also suggests that Classic Mayan scribes
and artists (e.g. Palenque, Dos Pilas) did not misunderstand the original
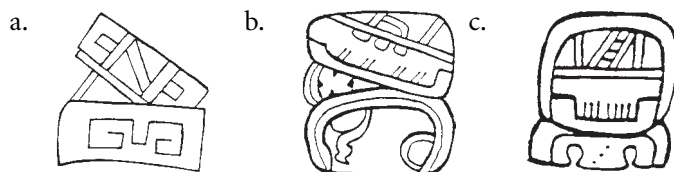motivation of T23, almost a millennium later.

a.   b.   c.

Figure 20. A possible context in which T23 **na** may have been borrowed by Mayans from
Epi-Olmecs, as suggested by Stross 1990.

a.   Epi-Olmec SUN.AT.HORIZON sign. After drawing by George Stuart.
b.   Mayan SUN.AT.HORIZON sign, from Tikal Temple 4 Lintel 2:A7. After drawing
      in Stross (1990, Fig. 10a, 51).
c.   Mayan SKY:T23 sign, for **CHAN/KAN(-na)** sign. After drawing in Stross (1990, Fig.
      10b, 51).

Lastly, consider the comparison between the Epi-Olmec SUN.AT.HORIZON
sign, shown in Figure 20a; the Mayan SUN.AT.HORIZON sign, shown in
Figure 20b; and the typical spelling of the Mayan SKY sign, shown in Figure 20c
(made by Stross 1990, Figures 8–10). This is suggestive of the context in which
Mayans may have borrowed MS44 **na** as a phonetic sign. Indeed, MS44 EARTH
appears below the Epi-Olmec SKY sign in the SUN.AT.HORIZON sign, just as
Mayan T23 **na** appears below the Mayan SKY sign in the typical logosyllabic
spelling SKY(-**na**). As suggested by Stross, the SKY:EARTH graphic relationship
in Epi-Olmec iconography could have led to the Mayan SKY:T23 graphic
relationship, read as SKY(-**na**) (cf. proto-Ch'olan *chan* 'sky' < proto-Mayan
ka'n). The Mayan SUN.AT.HORIZON sign, as in Figure 20b, is read **PAS(AJ)**,
and uses T526 EARTH (i.e. **KAB'(AN)** for proto-Ch'olan *kab'* 'earth') with a
purely iconic function (i.e. T561 SKY over T544 SUN over T526 EARTH), not
an orthographic one (i.e. as **KAB'(AN)**), instead of T23; this suggests that the

iconic use of T23 was indeed contextually frozen.[16]

The second type of script diffusion of relevance here is diffusion between Ch'olan and Yukatekan scribes. Some suggestions for this type have been put forward by Fox & Justeson 1984a and by Justeson et al. 1985. One of them is the use of T671, phonetic **chi**, as the day sign DEER. Justeson et al. (1985:15) suggest, based on the identification of the hand gesture of T671 as a sign for 'food, to eat' by Du Bois 1978, that the sign acquired its phonetic reading **chi** from proto-Yukatekan *chi' 'bite, eat meat' (cf. the proto-Ch'olan cognate *ti'). Ch'olans then borrowed the sign as **chi** and used it as a logogram for the day name DEER, proto-Ch'olan *chij < pre-Ch'olan *chihj. Although this is a plausible argument, more evidence is needed to support it.

4.2 Process 6: Internal linguistic change

A sign may acquire a new reading due to linguistic change. Fox & Justeson (1984a:71) propose T96/103 as an example of this process. Earlier I mentioned that these authors have argued that the phonetic reading **ta** of T96/103 was derived from a logographic reading **WAT** 'eye'. These authors also suggest that the change of pre-Ch'olan *wat > proto-Ch'olan *wut may then have provided the basis for polyvalence in Ch'olan usage of the script. However, as the authors themselves admit, there is no evidence for such polyvalence.

Another case can be made for the phonetic reading **ti** of T59, although two iconic motivations have been suggested, one of which would invalidate the possibility that the phonetic reading of T59 is a case of internal linguistic change. First of all, Campbell (1984:11, 13, 14) suggests that T59 depicts a torch, whose linguistic referent may have been based on proto-Mayan *tyaj 'pine, torch' (cf. proto-Ch'olan *täj). The use of T59 as the generic preposition, reconstructed for proto-Ch'olan as *tä (< proto-Mayan *tya) would suggest that T59's original phonetic reading may have been **ta**, in order to explain its iconic motivation based on *täj 'pine, torch' (Mathews & Justeson 1984:201–2, 227). As John Justeson has pointed out to me (p.c. 2000), Ch'ol and Chontal (Western Ch'olan) and Ch'olti' (Eastern Ch'olan) have *ti* 'preposition', while Chontal (Western Ch'olan) and Ch'orti' (Eastern Ch'olan) have *tä* 'preposition' (Kaufman & Norman 1984, Table 2). Thus, *tä* and *ti* may both be reconstructible for proto-Ch'olan. Also, proto-Yukatekan had the cognate *ti('). This points to the following alternative scenarios:

a. Proto-Ch'olan inherits proto-Mayan *tya as *tä, and later innovates *ti internally, possibly through assimilation to *t*'s place of articulation.

b.   Proto-Ch'olan inherits proto-Mayan *tya* as *tä* ~ *ti* (*tya* serves as source for both).

c.   Proto-Ch'olan inherits proto-Mayan *tya* as *tä,* and later borrows *ti* from Yukatekan *ti(ʔ).*

Kaufman & Norman (1984: 139) reconstruct the proto-Tzeltalan cognate as *ta* with no *ti* variant, suggesting that proto-Greater Tzeltalan had *ta* only, not *tya* or *ta* ~ *ti.* Scenarios (a)–(b) are more likely. If scenario (a) is correct, then the **ti** reading of T59 would be a case of Process 6; but if scenario (b) is correct, then it could be a case of Process 5 (if Yukatekan scribes innovated the reading **ti** for T59, and that reading subsequently became the general phonetic reading for T59), or Process 6 (if Ch'olan speakers borrowed Yukatekan *ti,* and Ch'olan scribes subsequently innovated the reading **ti** for T59). In contrast to Campbell's suggestion, a referee of this paper suggests instead that it could possibly represent "strands of hair above an ear spool." I think the referee's suggestion is right on target (cf. spelling of **ti** in **u-ti** on vase K5458), and therefore that the case of T59 requires more research.
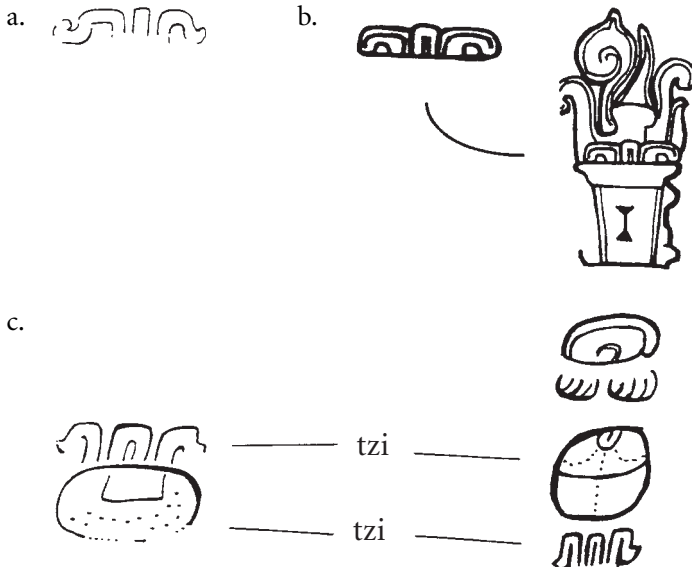

Figure 21. Example of formal convergence.

a   T124 **tzi/TZIK**. From tubular jade bead from the Cenote of Chichen Itza. Drawing by author after photograph in Proskouriakoff (1974, Plate 45–1) and personal examination of piece at Peabody Museum at Harvard.

b. Pictorial example of incense burner with T124 element as triple-handled lid on Kaminaljuyu Stela 11. After Clark 2000.
c. Use of T124:507 as **tzi** rather than **tzi-tzi** on an Early Classic tripod vase from Tikal. After drawing in Culbert (1993, Fig. 19).
d. Spelling T17:25:507:124 for **yi-ka-tz** not **yi-ka-tzi-tzi** on vase K7727. Drawing based on photograph in Kerr Database at www.famsi.org.

4.3 Process 7: Formal convergence

Formal convergence occurs when originally distinct signs become graphically identical and the resulting sign has the readings that the formerly distinct signs had. Lacadena 1996 has described trends in the development of formal convergence between two and sometimes more than two signs. However, a process that may be regarded as convergence may also start out with signs that are quite distinct formally but are related in other ways. This is the case of T124:507 or T507:124, both sign compounds read as a single grapheme with the reading **tzi**; see Figure 21. Indeed, Nikolai Grube (in Schele et al. 1994:114) has proposed that, in addition to having the same phonetic reading **tzi**, T507 and T124 also constitute a graphemic unit. Unlike T507, which I have shown to depict a gourd (Figure 12, above) T124 can be read phonetically as **tzi** and logographically as **TZIK** (Figure 21a); it depicts the lid of an incense burner (cf. Figure 21b), identical to examples recovered archaeologically at Chiapa de Corzo and Kaminaljuyu according to Lowe (1965, Figure 3b). The phonetic reading **tzi** of T124 may have been derived acrophonically from its logographic reading **TZIK**, for proto-Ch'olan *tzik* 'to count'. It is possible that the association between its iconic motivation as the lid of an incense burner and its logographic reading **TZIK** may have been based through rebus on a term attested today only in Tojolob'al as *tzik* 'to burn incense', cited by Schele et al. (1994:2). If so, the phonetic reading of T124 may be an example of Process 2. But regardless of its acrophonic origin, the fact of interest here is that T124 and T507 could form a graphemic unit **tzi** despite the fact that both had different iconic motivations (T124 as LID, T507 as GOURD). This fact requires illustration.

An Early Classic tripod vessel from Tikal contains the following glyph T51.124:507, shown in Figure 21c. The same spelling, only ordered differently, is also attested as T51.507:124 on vase K8042. In both cases the glyph precedes the glyph **ka-wa** for *käkäw* 'chocolate'. Based on its component signs, such spellings could read **ta-tzi-tzi**, since both T124 and T507 are read **tzi**. However, based on other examples of this glyph in other texts, Grube has suggested that

the actual reading is supposed to be **ta-tzi**. Indeed, these spellings are probably equivalent to the more common glyphic phrases **ta-tzi** (e.g. K5006), **ti-tzi-hi** (e.g. K1728), and **ti-tzi-hi-li** (e.g. K4542). As shown by Grube 1990 and MacLeod 1990, this phrase stands for *ti tzih(-il)* 'for fresh/raw', and usually serves as an adjectival modifier to the noun **ka-ka-w(a)** for **käkäw* 'chocolate' (i.e. *ti tzih(-il) käkäw* 'for fresh chocolate') among others in the Primary Standard Sequence. Because the Tikal and the K8042 examples are immediately followed by **ka-w(a)** for **käkäw* 'chocolate', it seems likely that **ti-tzi-tzi** + **ka-w(a)** does in fact spell **ti-tzi** + **ka-w(a)**, for *ti tzih(-il) käkäw* 'for fresh chocolate'. Another text, this time on vase K7727 (Figure 21d) confirms the use of T507:124 as a graphemic unit; in it, T507:124 is used in the spelling **yi-ka-**T507:124 for *y-ihkatz* 'his/her/its cargo', and so a single reading **tzi** for T507:124 is necessary. This shows that T124:507 ~ T507:124 was intended in these contexts as a single **tzi** sign, not as a repeated **tzi-tzi** sequence. Thus T124 and T507, though iconically unrelated, came to be perceived by scribes as a single grapheme composed of two separate signs because of their identical phonetic readings. This separate iconic relation accounts for the fact that they can be arranged either as T124:507 or as T507:124. Other signs with related iconic origins normally have a fixed arrangement: hence we get T168:518 but not T518:168.

There may be other examples of this type of convergence, such as T44 and T44:563b **to/TOK**: while T44 likely depicts clouds, and thus may be motivated by the sourceword **tokal* 'cloud' (Houston et al. 2000), T563b does not seem iconically related to T44. Consequently, if T563b has a reading **to** by itself, it may have been derived from a different sourceword from that of T44.[17]
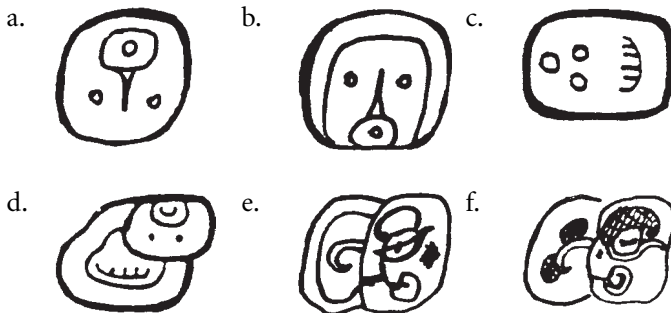

Figure 22. Examples of formal divergence:

a.   T178/534 phonetic **la**, after drawing in Thompson (1962: 452).

b.   T533 **AJAW**, after drawing in Thompson (1962: 452).

c.   T82 **li** from Palace Tablet at Palenque, glyph O10. After drawing by Linda Schele.

d. T568 **lu** from Yaxchilan Lintel 3:C7. After drawing in Graham 1982.
e. T19(.741) **mu**. After drawing by Linda Schele of Palenque Palace Tablet:C7.
f. T21(.741) **b'u**. After drawing in Schele (1994:19).

4.4 Process 8: Formal Divergence

As suggested by Justeson 1984, 1989, some signs may have developed from minor formal modifications to pre-existing signs, acquiring new readings in the process. For example, T178 **la** is a rotated version of T533 **AJAW,** as shown in Figures 22a–b; and T82 **li** is for the most part identical in internal elements to T568 **lu,** as shown in Figs. 22c–d). The only difference between the two is that T82 **li** appears to be a "flattened (affix) version of T568 **lu**" (Justeson 1989:322). I think that, in addition to being somewhat flattened, T568 is also rotated 90° clockwise with respect to T82; thus this pair is similar to the T178/T533 pair. T82 and T568 are phonetically similar in terms of their consonantal value, *l*, and both having high vowels, *i* and *u*.[18]
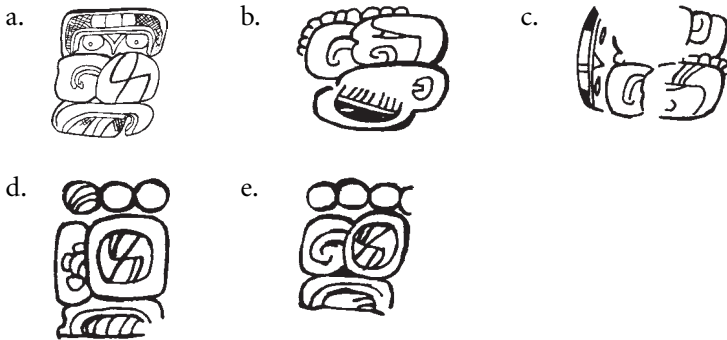
a. b. c.

d. e.

Figure 23. Examples of use of T19(.741) **mu** as both **mu** and **b'u** during Early Classic:

a. T1:19.563:24 **u-TZ'AK-b'u-li** on Hauberg Stela, dated to 197 CE. Drawing by D. Mora-Marín, based on personal examination of monument at the Princeton Museum of Art.
b. T19:568 **b'u-lu** for **b'u?ul* 'beans' on cacao pot from Río Azul. After drawing by David Stuart.
c. T1.62:19.741 **u-yu-mu** for *u-yuum* 'his/her boss' on same cacao pot from Río Azul. After drawing by David Stuart.
d. Glyph from Quirigua Monument 26 showing T21 **b'u**. After drawing in Schele & Looper (1996:66).
e. Same expression also from Quirigua Monument 26 showing T19 **mu/b'u**. After drawing in Schele & Looper (1996:66).

Another pair of signs that exhibits a similar relationship is T19(.741) **mu** and T21(.741) **b'u** (see Tables 1–2, Figs. 22e–f). The two are only different formally in the presence of circles with cross-hatching in the case of T21, and phonetically in the first consonant, although both are labial consonants and have the same high back vowel *u*. In fact, in the first half of the Early Classic period there is generally just one sign, T19(.741), found in the same contexts in which T19 and T21 are used in later texts. I think it is likely that T21 was innovated from T19; T19 **mu** is attested earlier than T21 in contexts that eventually distinguished the two, as in the T563.19 spelling **TZ'AK-mu/b'u** for *tz'ak-b'u* 'follow-CAUS, i.e. cause to follow', later spelled only as T563.21 **TZ'AK-b'u**, and in a possible example of T19:568 for **b'u-lu** 'beans' and T1.62:19 for **u-yu-mu**, both in a pot from Río Azul; see Figures 23a–c. Thus T19 may have had the readings **mu** and **b'u** originally, with the minor formal modifications giving rise to T21 **b'u**. This is supported by the fact that, to my knowledge, T21 is not once used for **mu**. The earliest examples of divergence may be found at Quirigua, as shown in Figs. 23d–e; there, on Monument 26 (493 CE), one finds both T19 **mu** and T21 **b'u** used in the same context (**4-TZ'AK-T19-li** and **4-TZ'AK--T21-li**). Subsequently, the distinction may have spread from Quirigua to other sites, and was probably spread throughout the entire lowlands by ca. 600 CE. It may be worthwhile to trace this development in a future study.

In the case of T82 and T568 the situation is even clearer: T568 **lu** is attested from the Early Classic onward, as on Yaxchilan Lintel 37 (537 CE), while T82 **li** is attested from the early part of the Late Classic onward, as on one of the Site Q panels (603 CE). T568 apparently is not attested during the Early Classic in contexts where T82 is attested during the Late Classic (e.g. **hu-li(-ya)**); so it is not possible, at this time, to suggest that T568 may have originally a dual reading as **lu** and **li**.

Another example may be that of T501 **b'a** and T502 **ma**, although at present I prefer not to deal with this pair because it represents a more tentative case than the first two. (T502 also resembles half of T74, which also has the reading **ma**, and thus T502 could be a case of *pars pro toto* derivation).

5. Discussion

5.1 Process 4 **and the spelling of -VC affixes**

Mayan syllabic structure generally precludes vowel-initial syllables (i.e. VC), allowing only consonant-initial syllables (i.e. CV(G)C, CV(G)CVC etc.) While

Process 4 makes it seem as though Mayan scribes were extracting V_1C_2 phonetic sequences out of $V_1(G)C_2$ roots, it only seems that way. In actuality the scribes were applying commutativity automatically, converting the V_1C_2 sequence of a $C_1V_1(G)C_2$ root into a C_1V_2 syllabogram during the process of extraction (e.g. **UY** > **yu**, **AT** > **ta**, **CHAHUK** > **ku**). To test whether VC syllabograms did exist, one would have to find a case of T528 **ku**, for instance, used as **uk**. Other signs would not be useful for this type of test; e.g., the logographic reading of T62 **yu** was probably **UY**, and similarly for T552 **AT/ta**. Cases of spellings of affixes on logograms, as in the example of T181 **ja** in the spelling **CHOK-ja**, may not necessarily point to VC syllabograms, but simply to the likely scribal practice of spelling out in syllables: just as scribes might have thought or said out loud "**cho**, **ka**, **ja**" while spelling *cho[h]k-aj* or *chok-aj,* they may have also said "**CHOK**, **ja**" where **CHOK** simply takes the place of "**cho**, **ka**"; it is implied that *aj* was represented with **ja**. In English orthography, *waived* is pronounced [wevd] despite the use of the logogram *-ed* 'past tense'. The Mayan example discussed is the exact opposite: **CHOK-ja** represents *cho[h]k-aj* or *chok-aj* despite the use of phonetic **ja**. Mayan scribes may simply have lacked VC syllabograms. Why could commutativity not apply twice, leading to **uy** from **yu**, or to **at** from **ta**? I think it is possible that commutativity may have been used in that way. However, the fact is that, whenever commutativity can be shown to occur, it abides by the consonant-initial constraint of syllabification: **yu** and **ta** are both consonant-initial syllables.

Lounsbury 1973 and Hopkins 1988 have regarded it as possible that there could be a morphophonemic basis in Mayan for the origin of the synharmonic phonetic complementation practice. They suggested that the "echo syllable" process of Mayan languages, whereby the last vowel of a root/word may be repeated in a voiceless manner (i.e. $CV_1C\mathring{V}_1$), could account for the synharmonic tendency in CV-CV spellings of CVC roots and CV(G)CVC words (especially when C_2 is a glottalized root-final consonant). Another process that has been remarked on by various epigraphers as a potential source of analogy for synharmonic phonetic complementation is that of vowel harmony of certain -VC inflectional and derivational suffixes which occurs in Mayan languages in general, and is widely attested in the Lowland Mayan languages. This process involves cases where a suffix repeats the vowel of the root to which it attaches, as in CV_1C-V_1C. Perhaps both processes served Mayan scribes as conscious or unconscious models for spelling words.

5.2 Acrophonic derivation and the *pars pro toto* principle

Also of significant importance is the prevalence of the *pars pro toto* icono-graphic principle in Mayan writing. It not only explains the phonetic values of iconographically related signs, such as T25 and T203 (both phonetic **ka**) and T168 and T168:518 (both logographic **AJAW** 'lord, king') but it may also explain the convergence of separate signs such as T124 and T507, where both are phonetic **tzi**, but each has a seperate acrophonic origin. T124 and T507 probably became associated as a single graphemic unit T124:507 because of their identical phonetic reading.

Lastly, while in cases like that of T25 and T203 the *pars pro toto* principle led to identical readings for two iconically related signs, in other cases it led to different readings. For example, T51/57 **ta** and T79 **PAT** 'to form' may represent the same entity: the tail of a centipede. Yet they acquired different phonetic readings, **ta** and **PAT**. Perhaps they were at first a single graphically indistin-guishable sign with two related readings; with time, it is possible that the different contexts of use of the two readings may have led to a formal graphic distinction (cf. T19 **mu/b'u** > T19 **mu** and T21 **b'u**).

Other ancient scripts exhibit practices similar to those attested in Mayan texts. The Sumerians developed the use of rebus phoneticism quite early. As noted by Green (1989:46–47), the sign ARROW was used to represent **TI** 'arrow' and the homophonous word **TI** 'life', but also the syllable **ti**. Keightley (1989:188–89) explains that early Chinese writing used the acrophonic princi-ple and rebus phoneticism extensively. A graph depicting a weed or plant was used for **ləg* 'to come', based on **ləg* 'to grow grain'. A graph depicting a cauldron, **tieng,* was used for 'cauldron', 'to divine', 'to regulate', and 'then', which had the same pronunciation. Semantic classifiers were soon developed in Chinese to distinguish words with the same pronunciation. These examples are akin to the example of **K'AB'** 'arm, hand' for **K'AB'A'** 'name' mentioned in §2.4, above.

Other scripts show parallels to Processes 1–3 above, where phonetic reduction was involved in the acrophonic process. Egyptian hieroglyphic writing first used MOUTH to represent *r* or *r²t* 'mouth'; and only subsequently did it develop the use of MOUTH to represent any *r* plus vowel sequence, if a vowel was necessary (Healey 1990:210). The users of the first alphabetic system, Proto-Sinaitic or Proto-Canaanite, also developed sign readings acrophonically. In essence, each sign was given the phonetic value of the first sound of the word for the sign's iconic referent. In this way, the sign HOUSE was read *b* based on

bētu 'house', HOOK/PEG was read *w* based on *wawwu* 'hook/peg', WAVE/WATER was read *m* based on *mayyūma* 'water', SNAKE was read *n* based on *naḥašu* 'snake', and so forth (Healey 1990: 211–12). These strategies in Egyptional hieroglyphic writing and Proto-Sinaitic are analogous to Processes 1–3 above. But to my knowledge no other script has been proposed to exhibit a process similar or analogous to Process 4.

5.3 Sign origins and linguistic affiliations

As has been observed by several authors before, establishing the acrophonic origin of the reading of a sign does not always lead to a narrow linguistic identification of its inventors. T1 (')**u** could have been developed by a scribe from any Mayan language that retains proto-Mayan *uʔh 'bead' (cf. proto-Ch'olan *uh). However, T62 **yu** could only have been developed based on proto-Ch'olan *uhy, an innovated variant of *uh (< proto-Mayan **u'h*).

Also, if I am correct about the origin of T590 **cho** from a Greater Tzeltalan descendant of proto-Mayan *kooh 'tooth (molar)', then only a Greater Tzeltalan speaker could have innovated the reading, since they retained proto-Mayan *kooh as *chooh > *choh.[19] However, T708 CLENCHED.TEETH, read as **ko**, most likely developed from *kooh either before the Greater Tzeltalan *k* > *ch* shift, or subsequently on the basis of proto-Yukatekan, which retained proto-Mayan *kooh as *kòoh 'fang (of snake)' (Bricker et al. 1998: 131).

In some cases, such as T25/203 **ka**, a plausible explanation is that Yukatekan speakers innovated the reading based on *kay 'fish'; yet a proto-Western Mayan or pre-Greater Tzeltalan descendant of proto-Mayan *kar 'fish', prior to the Greater Tzeltalan *k(')* > *ch(')* shift that led to *kay > **chay,* could be the source. Besides T25/203 **ka** and T77/236 **k'i**, only the T708 **ko**, can be explained in terms of a Yukatekan origin on phonological grounds — although again, the *k(')* in these cases is a retention from proto-Mayan, so a pre-Greater Tzeltalan stage cannot be ruled out.

Several sign readings, in contrast, can be explained exclusively in terms of Ch'olan or Greater Tzeltalan lexical and phonological innovations, supporting the theory of a Greater Tzeltalan or Ch'olan origin of the Mayan script (Justeson et al. 1985, Justeson & Fox 1989). In Tables 1–4 I have attempted to provide a likely linguistic affiliation for the innovators of a reading whenever possible; in the majority of cases, however, one can only say that the innovator was a Mayan speaker.

6.   Conclusions

The multiple processes for acrophonic derivation of sign readings in the Mayan tradition offer an interesting comparative case to students of other scripts. Processes 1–3 have clear counterparts in other scripts. The Mayan cases only strengthen previous hypothesis for the process of acrophony. And interestingly, Process 4, if confirmed with future research, would constitute a so far unique case in the world.

This paper, also, can serve to warn epigraphers about attempting to use iconic motivation for decipherment purposes: simply recognizing the iconic motivation of a sign may not necessarily lead to a plausible reading. Still, recognizing the various types of processes for acrophonic derivation may allow epigraphers to apply stricter controls if and when they do use iconic motivation as evidence for a phonetic reading.

Lastly, this paper deals with the issue of the presence of VC phonetic signs that could have been used to spell -VC affixes. Process 4, which allows for the acrophonic derivation of C_2V_1 signs from $C_1V_1(G)C_2$ roots, could potentially provide a basis for a process of commutativity that could lead to VC phonetic signs. However, as I have shown, the few cases that provide strong support for this process abide by the phonological constraint of consonant-initial syllables followed in Mayan languages in general. While I do not think it impossible that Mayan scribes may have applied an orthographic rule which in a sense contradicted an unconscious phonological rule, the fact is that the known cases for Process 4 do not attest to this yet. So the question remains open as to whether commutativity could in fact lead to -VC affixes.

Notes

1. I follow the transcription conventions of Thompson (1962: 32–33), which require the use of the numerical labels from his *Catalog,* indicated by a preceding "T" to transcribe individual glyphs, glyphic phrases, and entire texts. Thompson's catalog has been updated in Ringle

& Smith-Stark (1996: 333), whose revisions I reference several times in this paper. I refer readers to these works for signs not illustrated in this paper. The numerical labels for Epi-Olmec glyphs are from Macri & Stark 1993. I also follow the transliteration conventions by Fox & Justeson 1984b and by G. Stuart 1988. The most important ones for this paper are that logograms are transliterated with capital boldface letters (e.g. Mayan T544 **K'IN** 'sun, day'), and syllabograms with small case boldface letters (e.g. Mayan T25 **ka**). I use the following linguistic abbreviations: 1 = first person marker, 2 = second person marker, 3 = third person marker; ABS = absolutive marker, C = consonant, CMP = completive, ENCL = enclitic, ERG = ergative marker, G = glide (/h ʔ y w/ and vowel length), INC = incomplete, IVZR = intransitivizer, MPASS = mediopassive, PASS = passive, PREP = preposition, PROCL = proclitic, s = singular, TRVZR = transitivizer, V = vowel. I use square brackets [ ] to set off infixes, and angled brackets < > to set off linguistic forms cited from a manuscript using conventional orthography. I use *ch* for IPA [tʃ], *j* for IPA [χ], *x* for IPA [ʃ,] *b'* for IPA [ɓ], and *tz* for IPA [ʦ]. Finally, all proto-Cholan and proto-Mayan reconstructions cited in this paper are from Kaufman & Norman 1984. Proto-Mayan reconstructions are useful because proto-Ch'olan, proto-Tzeltalan, and proto-Yukatekan forms can usually be arrived at from a proto-Mayan form (cf. Kaufman 1976, Kaufman & Norman 1984, Justeson et al. 1985: 15), and because recent debates on the historical stage of the language represented in the script makes it relevant to keep in mind the various phonological changes that took place from proto-Mayan to proto-Ch'olan times. Any proto-Yukatekan reconstructions are based on Yukatekan phonological changes summarized by Justeson et al. (1985: 15). In the conventional transcription of Chinese, I use IPA ə for shwa, whereas for proto-Ch'olan reconstructions I use *ä* for shwa.

2. The Lowland Mayan script was used in what is now Mexico, Guatemala, Belize, and Honduras. The periods of its use are named and characterized as follows: Late Preclassic (400 BCE–200 CE), Early Classic (200–600 CE), Late Classic (600–900 CE), and Postclassic (900–1700 CE).

3. In a paper currently under revision (Mora-Marín 2002), I have recently proposed that many of the morphological traits characteristic of Classic Lowland Mayan texts have not been preserved in any of the modern Ch'olan languages, whether Western Ch'olan or Eastern Ch'olan (e.g. *-is* ~ *-as* and *-is* ~ *-as* 'uncertain possession markers'), while some appear in one branch or the other, but not both (e.g. *hin-* '3sg.' in Western Ch'olan, *-b'u* 'causativizer of positionals' in Eastern Ch'olan), and thus could be either innovations of each branch or retentions from proto-Ch'olan that were preserved differentially between the branches. Such a pattern of preservation suggests, if one follows a least-moves approach, that Classic texts are based on a language that preceded the breakup of Ch'olan into its Eastern and Western branches.

4. Diacritics and semantic determiners play no role in the present paper.

5. Portable texts on pottery, for example, sometimes exhibit a different tendency: glyph blocks exhibit less regard in demarcating syntactic units, and sometimes are occupied by single phonetic signs. Interestingly, a similar disregard for demorcating syntactic units by glyph block divisions is often visible in Late Classic texts in the northern Yukatekan, e.g. at Xcalumkin and Chichen Itza, as pointed out by Justeson 1989. I think that these late northern texts reflect the portable pottery text tradition in terms of orthographic conventions

and subject matter; as Schele & Freidel 1990 have pointed out, these northern texts character-istically consist of dedicatory statements, just like pottery texts.

6. In certain positions, such as preconsonantal and root-final, any of these segments could be equated to zero (Campbell 1984: 12–13, 16; Fox & Justeson 1984a: 69; Justeson 1989: 30).

7. A referee also points out that Houston et al. 2000 actually read T44(:563b) as **to/TOK**.

8. Macri 2000 has suggested that T24 **li** could have been derived from **litz'* 'shine', given that all forms of T24, whether as the hook-shaped form or the cartouche-shaped form, show diagonal bands which mark the object represented by the sign as made of a polished material.

9. The referee also suggests that T528 **ku**, which depicts a stone, may have been derived from a term like *-kul* 'numeral classifier for round objects' attested in modern Itzaj (Hofling & Tesucún 1997: 366). Below I discuss the T528 **ku** example as derived through Process 4, which is more likely in my opinion, since such a process directly associates the phonetic reading **ku** with the logographic reading **CHAHUK**.

10. One of the referees of the paper has expressed a strong reservation toward this example; the referee disagrees with the suggestion that the apparent **b'a** reading was based on **b'ak* 'bone'. The referee notes that this is a "highly idiosyncratic" use of JAWLESS.SKULL, and adds that "the reason for its **b'a** usage remains obscure." Nevertheless, based on the logographic reading **B'AK** for the JAWLESS.SKULL sign, a phonetic reading **b'a** can be easily explained through Process 2.

11. The spelling **cha-hu-ku** is actually attested on Piedras Negras Throne 1. It suggests that some logograms for the Rain God were intended as **CHAHUK** instead of **CHAK** for *chahk,* and it supports the hypothesis by Closs that the purely phonetic reading **ku** was derived from the logographic reading **CHAHUK**.

12. David Stuart and Stephen Houston have drawn attention as well (in D. Stuart 2002) to an example of the common Piedras Negras title **K'IN-AJAW** spelled as T77-**K'IN-ni-AJAW**, i.e. (**k'i-**)**K'IN**(-**ni**)-**AJAW** in one case at Piedras Negras.

13. There is a likely case of T79 as **pat** rather than **PAT**, i.e. of T79 being used purely phonetically, on Yaxchilan Lintel 37:A5a, where it is part of the spelling of a person's name. This is suggested by the fact that the glyph that follows is **u-ya-AJAW-TE'**, a glyph that normally intervenes between two named individuals — one a subordinate lord and the other an overlord.

14. One of the anonymous referees of this paper states: "Several scholars have identified [T568] as a catfish (dorsal fin and big head with open mouth) from Yukatekan *lu'* 'catfish' (e.g. Hofling & Tesucún 1997: 425)." The referee is also correct in stating that, if T568 were in fact derived from *lu'* 'catfish', it would not involve anything but Process 1. I do not know the iconographic evidence behind the CATFISH identification for T568, nor does the referee mention the sources for such evidence. Nevertheless, I think the HEART identification is secure based on the examples from Xcalumkin.

15. A referee of this paper does not agree with the transfer of Epi-Olmec MS44 **na** to Mayan. He states that the "equivalence hinges on a purported occurrence of the Maya 'rising sun' sign in the inscription of the La Mojarra stela," which he regards as "highly dubious." While Stross's original argument may have hinged in part on the 'rising sun' sign, my examples do not, and they are sufficient to demonstrate the formal and semantic association. I do think

that the SKY.OVER.EARTH glyph — common to both, though slightly different in the two script traditions — could have offered a graphic textual context for the diffusion process.

16. The term *pas-aj* may be related to the Ch'ol verb *pas-el* 'salir (el sol)' (Aulie & Aulie 1978:92).

17. I do not know whether T563b in fact has a reading **to** by itself, or if so, what its iconic referent and sourceword would be. T44:563b may function more like T168:518 **AJAW**, since T518 is not known to have a reading **AJAW** on its own, but is always used with T168 if that is present.

18. It is harder to find a phonetic relationship or similarity between T533 **AJAW** and T178 **la**, although there is evidence (cf. Mora-Marín 2002) that some signs that had the logographic reading **AJAW** (e.g. T168:518 and T533) were actually logographic **AJAW** or **AJAWAL**; if so, then T178 may have been derived through the process of phonetic complementation or commutativity: **AJAWAL(-la)**.

19. Tojolobal has *choh-tík* (Fox 1978:120). Thus it is possible to say that Tojolobal could have been the source for the sign reading in question. However, this is very unlikely, given abundant evidence for Lowland Mayan (Ch'olan, Yukatekan) scribes as the only Mayan speakers known to have used hieroglyphic script.

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