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Rationalizing the Cretan Hieroglyphic sign-list

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Abstract: Ever since the publication of the first and unsurpassed corpus of Cretan Hieroglyphic inscriptions by Louis Godart and Jean-Pierre Olivier, *Corpus Hieroglyphicarum Inscriptionum Cretae*, known as *CHIC*, there has been no systematic or comprehensive reassessment of several difficult readings of signs and sign groups geared towards a rationalization of the sign-list. In this article, we discuss several readings in depth, by engaging with issues that relate to script classification, sign frequencies, interpretative uncertainties, and new finds post *CHIC*. Specifically, we highlight inconsistencies in the graphic behavior of signs, especially those of singular attestations (‘hapax’) or low frequency, and we also reassign uncertain cases that may be more likely read as Linear A rather than Cretan Hieroglyphic. As a steppingstone in rationalizing the sign-list, we apply a systematic approach to the material by means of a thorough sign-by-sign paleographic and structural reassessment, also presenting the resulting inventory.

Keywords: Cretan Hieroglyphic, sign-list, paleography, scribal variants.

1 Introduction: problems in the Cretan Hieroglyphic sign-list

The Cretan Hieroglyphic script from the second millennium island of Crete is still undeciphered. This status has largely to do with an overall scarcity of data, which amounts to fewer than 400 inscriptions altogether, distributed across a varied

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array of media, mainly documents made of clay, used in the palatial administration (medallions, lames, bars, and nodules), semi-precious stone seals, which account for nearly half of the corpus, and a limited number of ceramic vessels. While the sheer number of inscribed documents cannot in itself shed definitive light on the language/s recorded, the nature of the texts provides further hindrance, as these are inherently short and terse, with limited occurrences of specific signs.

The comprehensive dearth of material is hardly conducive to any substantial progress in deciphering the script. Moreover, the restricted attestation of several signs is particularly problematic, as it escapes any coherent examination in terms of distribution. In other words, we cannot chart the behavior of several signs in the repertoire. This is one of the crucial outstanding problems with the script: the establishment of a definitive sign-list. In any cogent attempt at decipherment, this is the foundational stepping stone, and therefore needs to be addressed systematically and rigorously.

Ever since the discovery of the main bulk of the inscriptions, Sir Arthur Evans proposed a list of Cretan Hieroglyphic signs drawn from the corpus then known (Evans 1909). This was used as the basis for the first corpus of inscriptions published in 1996 by Louis Godart and Jean-Pierre Olivier, *Corpus Hieroglyphicarum Inscriptionum Cretae*, commonly acronymized as *CHIC*. The volume proposed a rationalized sign-list, by adopting a set of criteria for inclusion of signs in the inventory. This approach excluded a number of signs present in Evans's list. The *CHIC* sign-list was scrutinized by Jasink in 2009 and, on specific points of detail, by several other authors (Younger 1996–1997, Civitillo 2016, Decorte 2017).

We believe that further progress can be made to rationalize the sign-list and this article aims to work to that end. We present evidence on several inconsistencies in the graphic behavior of signs, especially those of singular ('hapax') or low frequency. We also propose mergers of signs, reassign function to certain signs, and settle uncertain cases that can be read as Linear A instead of Cretan Hieroglyphic. All these problematic cases can be explained only through a close examination of the paleographic evidence. These trajectories of reassessment work towards offering a new rationalized sign-list. To reach this objective, we apply a systematic approach to the material, with a complete paleographic analysis, and wherever possible adopting criteria that work towards a balanced assessment of the evidence. As these parameters and the overall method we employed require an in-depth exposition, they are explained one-by-one in the following section. The rest of the article is devoted, instead, to a sign-by-sign reassessment of specific graphs that require attention, and the presentation of the resulting sign-list.

First a note on terminology and a note on the data discussed in this article. We will use the following abbreviations for the Aegean (and other) scripts: Cretan

Hieroglyphic as CH, Linear A as LA, Linear B as LB and Egyptian Hieroglyphic as EH. We refer to ‘inventory’ or ‘sign-list’ to indicate rationalized repertoires of signs as presented by different authors (Evans, Godart and Olivier, Jasink) and as ‘repertoire’ for the unadulterated, unexamined bulk of the CH graphs (this may include, naturally, graphic devices deemed in the scholarly literature to be possible decoration, especially as occurring on seals).

The material upon which our analysis is drawn relies on *CHIC* (for Cretan Hieroglyphic) and the *CMS* catalogue (for seals in general), including the *ARACHNE* online catalogue, as well as many individual publications containing editions or discussions of inscriptions. In addition to this, in the framework of our EU-funded ERC INSCRIBE (‘Invention of Scripts and their Beginnings’, <https://site.unibo.it/inscribe/en/about-1>) project, we have also autopsied the following Cretan Hieroglyphic and Linear A inscriptions housed at the Heraklion Archaeological Museum: #006, #019, #030, #035, #041, #048, #049, #053, #057, #058, #065-068, #077, #078, #079, #080, #085, #110, #118, #122, #128, #204, #236, #240, #309, #315, #328, MA 4 and 6, PH 10, 12, 13, and 15.

2 Reassessment methods and criteria

We present evidence and propose an in-depth reassessment of the CH signs, engaging with four main issues. We consider, specifically:

- (1) Signs only attested in documents of dubious classification as CH or LA;
- (2) The high number of hapax and very rare signs;
- (3) The uncertainties in the reading of rare signs;
- (4) The discovery of new inscriptions since the publication of *CHIC* in 1996.

Currently, the inventory of CH signs as reported in *CHIC* contains 144 signs divided in five classes: syllabograms (nos. 001–096), logograms (nos. *151–*182 and *159bis), klasmatograms, i.e. fractions (nos. 301–309), arithmograms, i.e. whole numbers (units, tens, hundreds, and thousands), and stiktograms, i.e. punctuation signs (X and |) (Fig. 1). Our aim is to reassess signs from the first two classes, leaving aside numerals and punctuation marks.

Since syllabograms are distinguished from logograms in *CHIC*’s sign-list, the same sign was assigned two different numbers when thought to be used with both functions. This proves to be the case with CH *151 = 003, CH *152 = 013, *155 = 024, *159bis = 023, *160 = 054, *174 = 031, *175 = 042, *176 = 050, *177 = 062, *178 = 077 (*CHIC*, 16). This criterion deliberately moved away from the rationale of the LA corpus, where signs are listed to maintain their correspondence with LB sign

Syllabogrammes	025	050	075	*153	*177
001	026	051	076	*154	*178
002	027	052	077	*155	*179
003	028	053	078	*156	*180
004	029	054	079	*157	*181
005	030	055	080	*158	*182
006	031	056	081	*159	<u>Klasmatogrammes</u>
007	032	057	082	*159bis	301 Γ /
008	033	058	083	*160	302 Δ ↓ ↓
009	034	059	084	*161	303 ⊖ ↓
010	035	060	085	*162	304 Λ ↓
011	036	061	086	*163	305 E Y
012	037	062	087	*164	306 Π ∫
013	038	063	088	*165	307 Σ + +
014	039	064	089	*166	308 Q ↓
015	040	065	090	*167	309 √
016	041	066	091	*168	<u>Arithmogrammes</u>
017	042	067	092	*169	1 „ „
018	043	068	093	*170	10 •
019	044	069	094	*171	100 / ○
020	045	070	095	*172	1000 ◊
021	046	071	096	*173	<u>Stüktogrammes</u>
022	047	072	<u>Logogrammes</u>	*174	x x
023	048	073	*151	*175	
024	049	074	*152	*176	







Fig. 1: List of CH signs as presented in *CHIC* (after *CHIC*, 17).

numbers rather than by function (*CHIC*, 16, n. 51). Nevertheless, as a research tool, a sign repertoire should distinguish the graphemes of a script system as much as possible, regardless of their potential polyvalence or use as either category. Thus, we propose to integrate these ten “logographic duplicates” under their corresponding “syllabic” entry: e.g., both CH 013 and *152 will be classified as CH 013, and so forth. For the same reason, we do not use the asterisk that marks logograms in the *CHIC* sign-list.

Moreover, we should flag the commonly accepted distinction between syllabograms, assumed to be phonetic and syllabic signs, and logograms, interpreted as signs standing for specific words for commodities (Olivier 1986, 378; Davis 2014, 151–152; Karnava 2016, 79). This widespread opinion owes mainly to an analogy with the characteristics of Linear A (LA) and Linear B (LB), but the structure of CH documents and the distribution of its signs shows meaningful differences (Ferrara, Montecchi, Valério forthcoming 2022). In other words, the category of the signs currently classified as syllabograms, logograms, or both should be further investigated, rather than implicitly accepted. This consideration prompted us to abandon the distinction between syllabograms and logograms in our rationalized list of CH signs.

Beyond these structural issues, the goal of this article is to develop and apply unbiased criteria to propose possible mergers, since some rare or hapax graphs, classified as distinct in *CHIC*, appear similar to others, to the extent that they could be redressed as paleographic variants.

Rare sign shapes, and especially hapax shapes, signs of problematic reading (for example, damaged instances), and signs that might be LA rather than CH indeed skew the evidence. The method of the authors of *CHIC* was akin to that adopted for the corpus of LA inscriptions (*GORILA*), although they preferred not to detail the criteria for differentiating each sign. One important ‘safety measure’ cited from Bennett (1953, vii, *apud CHIC*, 16) is clearly espoused, that it is “preferable to risk distinguishing falsely between variant forms of the same sign, rather than to confuse similar forms of different signs”. One implication of this is the risk of including a high number of hapax or very rare signs. Hapax attestations, particularly, are numerous (33) and yet represent only 2.3 % of the legible corpus. This implies that not all cases can be explained as proper signs which remain poorly attested considering the limited corpus at our disposal; rather, it is likely that some are mere variants of other, better-attested signs. As stressed in Ferrara, Montecchi, Valério (forthcoming 2022), this situation has implications for the investigation of CH, as it can distort our view of its structure or its relationship to LA. To this end, we discuss several cases of hapax that could be allographs.

Within the corpus of *CHIC*, documents #010, #014, #019, #048, #068, #122 have been considered doubtful CH or LA (*CHIC*, 18; Petrakis 2017, 81–82). Signs of uncertain affiliation contribute to a skewed perception and thus the inclusion of four signs attested only on such inscriptions are of disputable CH status: CH 151 , 164 , 165 , and 175 . Furthermore, document #006 also contains a single sign, CH 154 , that could be interpreted as sign LA 122  (Ferrara, Montecchi, Valério forthcoming 2022). These cases too are reassessed below.

With these problems in mind, three main criteria guide our analysis to reassess possible cases of allography:

(1) *Diagnostic versus optional paleographic traits*. This takes as a point of departure signs as identified in *CHIC*. First, we look at the graphic traits that are common to all (or almost all) attestations grouped under the same sign entry in the corpus (diagnostic traits), as well as segments that are not (optional traits). Our premise is that instances of signs listed with different numbers in *CHIC* but sharing the same diagnostic traits should be brought together under the same entry; conversely, a sign might be re-classed and assigned a different *CHIC* number if a reassessment indicates that it has diagnostic traits shared with another sign. Diagnostic and non-diagnostic traits were also a guiding principle in *CHIC*, although the details of the choices for each sign were not discussed (*CHIC*, 16).

Additional considerations will be a foil to this criterion: the variation between suspected allographs should be kept to a minimum (e.g. CH 079 † and 008 ‡), understood as part of a range from more complex to more simplified variants (e.g. CH 077 ☉, 074 ☉ and 075 ☉), or find typological parallels in other Aegean scripts (again, CH 074 ☉ and 075 ☉).

(2) *Complementary distribution*. If two shapes coexist in the same inscription or in a set of homogeneous inscriptions (on similar media with a similar paleographic style), and have distinct traits, then most probably are different graphemes (e.g. 031 † and 032 ‡). However, it is possible that two shapes with one or more different segments, but still very similar, are variants of the same sign if they are never found to coexist in the same document or document type (cf. the case of CH 048 † as engraved on a seal and CH 089 ‡ as incised on clay). This principle can be defined as ‘complementary distribution’. A meagre corpus will skew patterns, as fewer and shorter inscriptions will show a larger number of graphemes *also* found in complementary distribution.

(3) *Contextually-determined alternation*. If two or more shapes that share paleographic traits (criterion 1) are found with the same signs in a sign group, then those similar shapes are said to alternate in the same sign group (e.g. CH 068 † and 086 ‡). This could indicate allography. Ideally, there should be further contextual evidence that the sign groups are the same (e.g. if they occur also in similar texts), and the alternation should be considered alongside the other criteria. This principle is more applicable with sign groups that repeat a lot, and this is, too, one of the founding principles adopted in *CHIC* (but see already Kober 1948, fig. 3).

3 Sign-by-sign analysis

Following the objectives and method exposed above, the next section reassesses the identification of a number of signs, as listed in *CHIC* in increasing order. This will lead to three systemic suggestions, summarized as follows:

1. Mergers of signs as allographs,
2. Exclusion of signs as probable examples of LA,
3. Graphic reassessment and thus new suggestions as to the reading of specific signs.

This will imply a reduction and rationalization of the current sign-list. The analysis is organized around 17 groups of signs (from 1 to 17), which will include new readings and mergers.

3.1 CH 001 as a graph only attested on seals

Sign CH 001 has so far been recognized on two seals (#240.α and #310.β) and on a clay medallion from Knossos (#041.b). Nevertheless, a new autopsy of this last document and a broader comparison with the CH corpus suggests a new reading. On medallion #041.b (Fig. 2) the sign is damaged and stands very close (or is even attached) to two other strokes, which in *CHIC* are treated as a separate sign too damaged to be identified: X 085-011-●-001 (X $\Delta \nabla \bullet \text{☿}$).



Fig. 2: Left: Photograph of medallion #041 (courtesy of the Heraklion Archaeological Museum and the Greek Ministry of Culture and Sport, Archaeological Resources Fund). Right: Drawing of the inscription; the incisions hitherto identified as CH 001 plus traces of an unidentified sign are shown in a darker tone (adapted from *CHIC*).



Fig. 3: From left to right: CH 001 as attested on #240 and #310.β (redrawn based on *CHIC*, and *CMS* III 230 and I 425), respectively; the sign on #041.b (after *CHIC*); and LB 103 MAN^b on tablet KN B 799v.3 (redrawn after *CoMIK* I).

Since Evans (1909, 181), CH 001 ☿ has been identified as a crouched or seated human figure, compared with logogram LB 103 MAN^b, a sitting man (Fig. 3). In this light, the shape of the sign on the medallion would be quite different from the two secure attestations of CH 001 on seals, and closer to a LB sign, centuries

older. Conversely, if we take as a single sign what was read as ●-001 in *CHIC*, then that sign is best identified as CH 040 (boat) ⚓. This reading is supported by many shared traits with other instances of CH 040 and boat motifs on contemporary MM seals (Fig. 4). With the new reading of the sign on #041.b, the crouching human graph classed as CH 001 is only attested on seal faces so far.

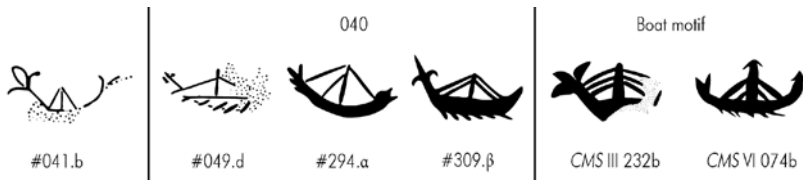


Fig. 4: Comparison between the alleged instance of CH 001 on #041.b and several examples of sign CH 040 and Protopalatial boat motifs. Signs on #041.b, #049.d, #294.α, and #309.β are redrawn after *CHIC*, whereas motifs are redrawn after *CMS* III 232b and VI 074b.

3.2 CH 015 as a variant of CH 012

Three signs in *CHIC* seem to depict a bovine's head in profile: CH 012 ⚓, 013 ⚓, and 015 ⚓ (Fig. 5). Nevertheless, two facts combined make it probable that CH 015 is not a separate sign: it is a hapax (#079.a) and it is very similar to the widely attested CH 012 and CH 013. Both CH 012 and 013 have a muzzle similar to that of CH 015, and they both have at least once a variant without neck and with the profile open on the back, again, just like CH 015 (CH 012 on #080.a and CH 013 on #076.a).







Fig. 5: Comparison between hapax shape CH 015 and variants of CH 012 and 013 (redrawn after *CHIC*).

What seems to distinguish CH 012 from 013, then, is the presence of a horn, most of the time in addition to an ear (#80.a, #236.α, #271.α, #302.γ). *CHIC* also lists under CH 013 one variant that has one horn in addition to the ear ⚓ (#065.c),

but they flag it as problematic. Perhaps, it can be better understood as another instance of CH 012. Bovine signs in this group seem to be never represented by a single line, so the diagnostic trait in CH 015 could be the stroke on the top of the head representing a horn. For this reason, the hapax CH 015 could be a variant of CH 012.

3.3 Comparison of hapax CH 030 and 181 with CH 029

The status of CH 030  and 181  as distinct signs can be questioned, as they are both hapax and very similar to CH 029  (Fig. 6). CH 030 is a plant-shaped sign with three branches. CH 030 might be argued to look also like CH 031 , but the three upward features of the latter are more consistent with the stamina of a flower than with branches.¹ Conversely, the three branches of CH 030 are so similar to the two branches of CH 029 that we can envisage that the two signs had the same plant as physical referent. Therefore, we suggest interpreting signs CH 029 and 030 as variants of the same sign.

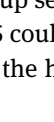










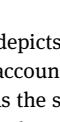


030	029						181
#083.a	#023.y	#038.a	#057.a	#057.d	#059.bA	#066.b	
							
	#200	#245.y	#285.α	#295.β			#305.δ
							

Fig. 6: Selection of paleographic variants of sign CH 029 on clay documents (above) and seals (below) compared to signs CH 030 and 181 (after *CHIC*, 396 and 429).

CH 181 is only attested on seal #305.δ (= *CMS* IV, 136) and its shape is reflected in a motif attested on earlier seals *CMS* II.1 126b, 391D (= #315), and 392a (Fig. 7).

¹ Nosch and Ulanowska (2021, 83–84) suggest that CH 031 depicts flax, but they do not provide coeval depictions of the plant to support this. One way to account for the graphic similarity of CH 031 and 032 is to assume that their physical referent was the same, and it may be the plant engraved on *CMS* II.2 248. The comparison with EH M15  and M16  (see Gardiner 1957, 481 for these signs), and the plant carved on the Egyptian scarab found at MM IA Agia Triada (*CMS* II.1 095, Phillips 2010, 313, fig. 3) rather suggests a clump of papyrus.

The physical referent may be *Acanthus* or *Lupinus* flowers, and therefore not the same referent as CH 029 (possibly the branch of a tree or shrub). Although the shapes are comparable to an extent, the bottom part of CH 181 is curved rather than angular, and its ‘branches’ are horizontal rather than oblique lines. These two traits make it closer to the motif mentioned above than to CH 029.

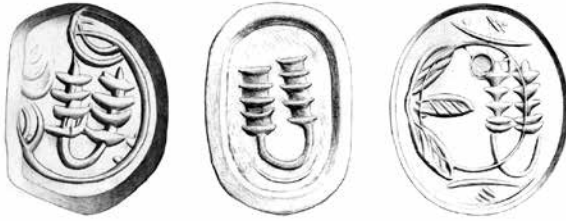


Fig. 7: Seal-faces CMS II.1 126b (left), 391D (middle), and 392a (right). Courtesy of the CMS Heidelberg.

3.4 CH 037, 085, and 094 as paleographic variants of the same sign

These three signs are very rare, even for the meager corpus of CH. CH 037 \hat{A} is attested three times (#042.a, #057.d, #061.b) and, if we exclude the instances deemed doubtful in *CHIC* (#110.b, #241.a, #251.y), we are left with one attestation of CH 085 \hat{A} (#041.b) and one of CH 094 **A** (#328). The single secure attestation of CH 085 can be compared to the more triangular version of CH 037 as attested on inscription #061.b. Their main difference is the lack of a second horizontal stroke in the mid portion of CH 085. CH 094 is more comparable to CH 037 in this aspect but, unlike CH 037, it does not feature a vertical stroke in its middle-low part (Fig. 8).



Fig. 8: Comparison between the instances of CH 037, 085 and 094 deemed secure in *CHIC*. CH 037 and 085 have been redrawn after *CHIC*, whereas the drawing of CH 094 is based on our autopsy of #328.

None of the three shapes coexists in any inscription and their distribution points to allography. Both 037 and 085 are used with sign CH 011, even though the sign groups in question are not identical:

X 085-011-040 (#041.b, following the new reading proposed above)

X 037-011-029 (#042.a, 061.b)

X 011-029-037 (#057.d)

The fact that CH 037 and 085 never occur in identical sequences might have weighed in the decision to keep them separate in *CHIC*. However, the evidence is inconclusive.

The notion that CH 085 and 094 are each a variant of CH 037 rather than distinct signs is reinforced by the evidence that their doubtful instances represent other signs. The sign on #110.b, whose correct orientation is unknown given the poor state of preservation, preserves traits that suggest it has to be read as CH 057 rather than CH 085 Δ (Fig. 9).

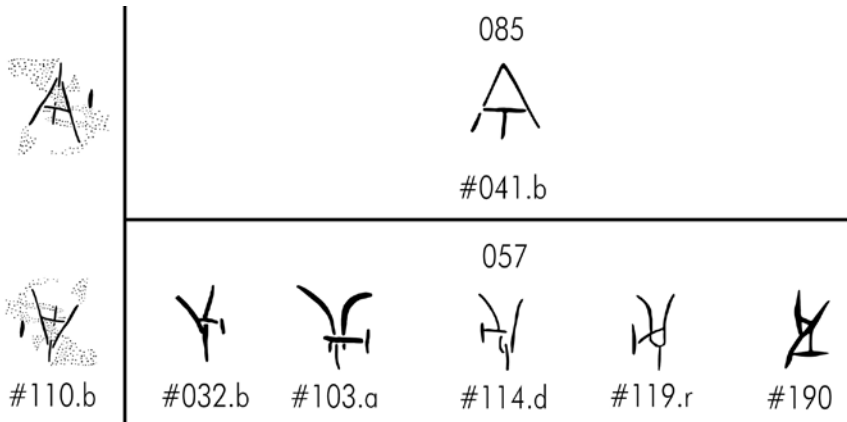


Fig. 9: Comparison between the doubtful sign on #110.b (top left) and CH 085 on #041.b (top right), and between the same doubtful sign turned upside down (bottom left) and various instances of CH 057 (bottom right). Redrawn after *CHIC*.

CH 094 presents a similar situation. By rotating it by 180° the doubtful instance on inscribed seal #241.a becomes comparable with CH 011 ∇ (Fig. 10).

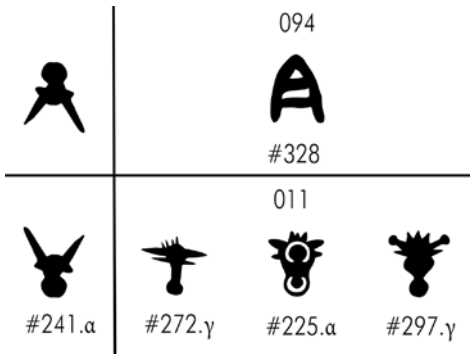


Fig. 10: Comparison between the doubtful sign on seal #241.α (top left) and the only certain instance of CH 094 (top right), and between the same doubtful sign turned upside down (bottom left) and various instances of CH 011 on seals (bottom right). Signs on seals have been redrawn after *CMS* VI 096a, IX D021b, XII 093a, VI 101c. The drawing of CH 094 is based on our autopsy of inscription #328.

On seal face #251.γ (Fig. 11), *CHIC* transcribes the sequence as 094-038 AB (not attested elsewhere), whereas Kenna (1960, 101) and Jasink (2009, 106) read the first sign as 057 V . Yet another possible reading is 019-038 VB , which occurs in the inscription on clay nodule #004, to be read as either 019-038-059 (*CHIC*, 69) or 019-038-302.



Fig. 11: Photograph and drawing of seal face #251.γ / *CMS* VI 014a (courtesy of the *CMS* Heidelberg).

The notion that CH 085 and 094 are not distinct signs is reinforced by the reclassification of these doubtful instances. Our conclusion, therefore, is that all shapes collected in Fig. 8 are allographs.

3.5 CH 048 and 089 as possible allographs

Sign CH 048 V is a hapax on seal face #236.α and clearly represents a bow with an arrow, whereas CH 089 L occurs twice on clay documents (#047.a and #065.b)

but is more difficult to recognize in terms of what it depicts. However, both shapes display a curved contour cut by a horizontal stroke (Fig. 12).

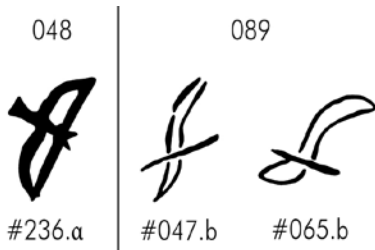


Fig. 12: Comparison between signs CH 048 and 089 (redrawn after *CMS* II.2 078a and *CHIC*, 96 and 118).

As suggested by Jasink (2009, 104), signs CH 048 and CH 089 might be variants of the same sign since they are found in complementary distribution (CH 048 only on a seal and CH 089 only on clay documents), and the shape of CH 089 is consistent with what we would expect of a simplified version of CH 048 if incised on clay. However, we prefer keeping them separate and postulate this as a hypothesis to check against possible future evidence for intermediate stages between the bow-like CH 048 and CH 089 comes to light. Another point to bear in mind is that it has been hypothesized that sign LA 305 ξ (e.g. PH 10, KH 7.4, and ZA 6a.1), is derived from CH 048 𐀄 (Ferrara, Montecchi, Valério forthcoming 2022). If this hypothesis were correct, then CH 089 𐀅 would become less likely as the clay-incised variant of CH 048, as its instances would not represent the same kind of compressed shape of the bow as shown in LA 305.

3.6 CH 066 as a possible stiktogram

This sign (𐀆) is classified as a syllabogram in *CHIC*, but, as suggested by Younger (2000–2021), both its shape, identical to the double-stroke stiktogram placed between two signs on seal #305.δ, and its occurrence between one sign and other two signs (#095.a and #305.α) suggest that it may be a divider (Fig. 13). Significantly, in two cases (#095.a and #305.α) CH 066 isolates CH 042 𐀂 from the rest of the inscription, and this is precisely the same sign that is often separated by means of other devices, such as rotation (Ferrara 2018, 97–99).



Fig. 13: Comparison between sign CH 066 as attested on inscriptions #095.a and #305.α and the stroke stiktogram attested on #305.δ. The drawing on #095.a and below transcriptions have been adapted from *CHIC*, 146–147 and 285. Photographs of seal faces #305.α,δ are due to the courtesy of the *CMS* Heidelberg. Not to scale.

However, its attestation on #059.aB is less encouraging,² as it may suggest that the sign is used as part of a sign group specifically followed by a numerical notation (Fig. 14). This is, however, the only attestation that skews the evidence thus, at least on present evidence, we should favor a divider hypothesis.



Fig. 14: Drawing and transcription of inscription #059.a (adapted from *CHIC*, 112–113). Note that it has been oriented according to the orientation of iconic signs like CH 028 “wing”, CH 049 “arrow”, and CH 044 “stamp seal” or “chisel”, therefore the line labelled as #059.aB in *CHIC* happens to be at the top.

² A fourth attestation, on #204.α, is broken and, therefore, doubtful.

3.7 CH 067 and 086 as paleographic variants of CH 068







Sign CH 068 is attested twelve times³ and is known in a wide range of paleographic variants: from the most iconic, which, if compared to EH F30 , might recall a water-skin (#225.α, #272), to the most schematic, where the shape is reduced to two parallel or converging lines with four short strokes on each side (e.g. #002.γ, 086.α, #322). Conversely, CH 067  and 086  are very rare. The first is a hapax on #027.γ and its shape, two parallel lines with three dots each, is similar to the most schematic variants of CH 068 . The second is only attested twice (#035.b and PE Hh 016.b) and its shape might be considered a middle ground stage between the most iconic and the most schematic variants of CH 068  (Fig. 15).



Fig. 15: Comparison among several examples of signs CH 067, 068, and 086. All examples have been redrawn after *CHIC*, with the exception of CH 086, which has been redrawn after Tsiopoulou and Hallager 2010, 70.

In addition to providing new instances that emphasize the similarity between CH 068 and 086, the material from Petras reinforces the notion that the two are allo-graphs in yet another way. There, the two shapes alternate in a similar sequence: 039-070-**068** (PE Ha 003.β) and X 039-070-**086** (PE Hh 016.b) (Tsiopoulou and Hallager 2010).

3.8 CH 074 and 075 as paleographic variants of CH 077

Sign CH 077  is a very frequent sign (17 or 18 attestations in *CHIC*⁴ plus PE S (1/1) 01) and it is, therefore, known under a wide range of paleographic variants:

³ Documents #002.γ, #030.a, #040.b2, #044.a, #079.a, #085.a, #086.a, #119.v., #225.α, #272.γ, #322, and PE Ha 003.β. Another possible attestation might be on #282.α (Younger 1996–1997, 399).

⁴ The sign read as a doubtful CH 077 on #164 might be an instance of CH 034.

from the most iconic, which recall two fruits or berries connected by the twig (e.g. #294.γ and #095.a),⁵ to the most compressed, where the sign is reduced to a circular shape with dots and a crossing stroke (e.g. #047.a and #079.a) (Fig. 16).

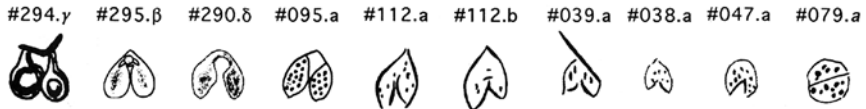


Fig. 16: Range of paleographic variation of CH 077 (adapted from *CHIC*, 417).

Signs CH 074 ☉ and 075 ☽ are hapax attested on the same document: #053.c (Fig. 17). They are shaped as circles with a different number of dots, very similar to the most schematic variants of CH 077 ☽.



Fig. 17: Photograph of inscription #053.c (courtesy of the Heraklion Archaeological Museum and the Greek Ministry of Culture and Sport, Archaeological Resources Fund), transcribed as |● X 016-057-013-074-075 in *CHIC*, 105.

Younger (2000–2021) suggested that CH 074 and 075 function as sets of numbers, 20 and 30 respectively. Indeed, they are smaller than the other signs on the inscription, they are placed next to one another, and they follow a possible commodity logogram (perhaps CH 013/152 ☽). In any case, grouping numbers in circles is not attested elsewhere and, on the same inscription, we find the standard way of writing tens in CH using cumulative dots (*CHIC*, 104–105). If CH 074 and 075 are not numerical signs, then their different number of dots can hardly

⁵ Among the fruits of common Mediterranean plants, one can compare those of the strawberry tree (*Arbutus unedo*).

be considered a diagnostic trait. As a typological parallel, the number of inner dots (or strokes) for the similar-looking sign AB 78 can vary even within the same document or hand (Fig. 18). Considering this, we suggest that CH 074 ☉ and 075 ☉ are two schematic variants of CH 077 ☉.

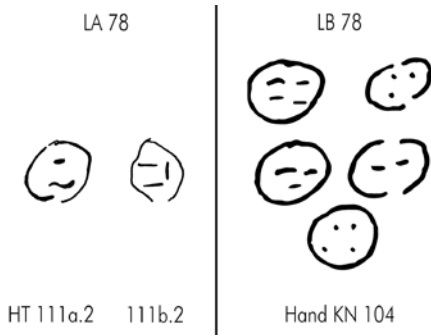


Fig. 18: Selected variants of AB 078 showing different numbers of dots and strokes (redrawn after *GORILA I*, 180 and Driessen 2000, pl. 93).



3.9 CH 079 as a paleographic variant of CH 008

CH 079 is a hapax on #057 (Fig. 19 on the left). The standard orientation in *CHIC* is ⚡, but it might equally be oriented following the orientation of the sign next to it (CH 032). If flipped vertically, CH 079 † shows the same traits of sign CH 008 † as attested on document #128 (Fig. 19 on the right). Thus, we suggest that the sign currently classified as CH 079 is rather a schematic variant of CH 008.



Fig. 19: Left: Photograph of inscription #057.b. Right: Photograph of #128/CMS II.6 182 (courtesy of the Heraklion Archaeological Museum and the Greek Ministry of Culture and Sport, Archaeological Resources Fund). Not to scale.

3.10 CH 080 and 087 as paleographic variants of CH 046

CH 080  (#092.a) and 087  (#319) are both hapax on clay documents. Tsipopoulou and Hallager (2010, 72, 162) tentatively read another instance of CH 080 in PE Hh 017.a, but this is problematic (Fig. 20).

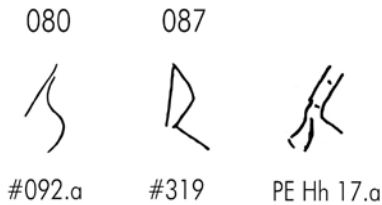







Fig. 20: Comparison among CH 080, CH 087, and the uncertain sign on PE Hh 017.a we rule out as a second instance of CH 080.⁶

Olivier and Godart (*CHIC*, 145) entertained two alternative interpretations of the single instance of CH 080, namely that it is an incomplete CH 057  or, more likely, an instance of CH 046 . This is a clue worth following. While the best-preserved instances of CH 046 are carved on seals and prove to be very pictorial, so that the physical referent can be recognized in a hindleg of a quadruped animal tied to a stick (Fig. 21, esp. #301.y),⁷ CH 080 and 087 have both the same basic traits of it: a straight stroke to the left and a curving line to the right. Therefore, we suggest that CH 080 and 087 are variants of sign CH 046.

3.11 CH 082 and 083 as allographs

CH 082  and 083  have been classified as distinct signs in *CHIC*, despite the undoubted similarity and the fact that they are hapax both attested on medallions from the same context (*Malia Quartier Mu*) (Fig. 22). In *CHIC* two alternative hypotheses are offered: 1) that CH 083 might be a schematic variant of CH 011 (followed by Younger 2000-2021), 2) that CH 082 and 083 are allographs (*CHIC*, 133).

⁶ A tentative suggestion for the reading of this problematic sign is CH 069 , assuming it was poorly executed. The sequence in PE Hh 017.a could read as [+]-069-057-070, which is at least reminiscent of the sequence X 057-069-070 attested on #038.b.

⁷ *Contra* Evans 1909, 189 no. 21, where the sign is identified as “adze with handle of an Egyptizing form”. It must be noticed that the hindlegs of a quadruped appear as a motif on seal CMS III 156a (MM IIB).

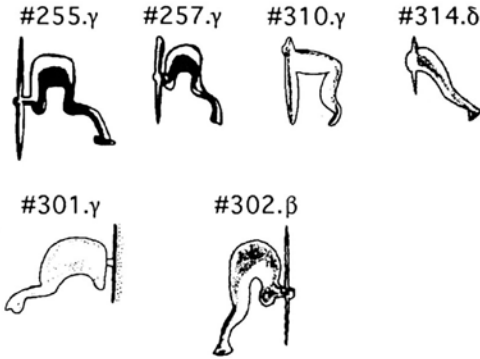


Fig. 21: Selection of the best-preserved instances of CH 046 which allow to recognize its physical referent: a hindleg on a stick, oriented either to the right (above) or to the left (below). Adapted from *CHIC*, 405.



Fig. 22: Left: Photograph of inscription #078.a, transcribed as 083-047-019-●[× in *CHIC*, 132. Right: Photograph of inscription #080.a, transcribed as 012-031-82 × in *CHIC*, 132 (courtesy of the Heraklion Archaeological Museum and the Greek Ministry of Culture and Sport, Archaeological Resources Fund). Not to scale.

After the autopsy of the documents, CH 082 and 083 seem the same shape, but inscribed by two different hands. CH 083 is made up of three contiguous traits, whereas in CH 082 the three traits are compressed in a unique curved trait. In both cases the shape is completed by a horizontal inner trait. The two additional

short and thin strokes in CH 083 could be either optional or unintentional projections. We, therefore, suggest they are allographs.⁸

3.12 CH 091 as a possible ghost sign

This sign ($\text{^{\text{^^}}}$) would be only attested on a missing Chamaizi pot, known through a drawing published by Evans (1909, 12, fig. 6) and reproduced in *CHIC* (#331). Moreover, this inscription would show the only instance of the double axe without any trace of the shaft. We wonder, therefore, how accurate the drawing is and whether what is catalogued as a single sign (CH 091) might be in reality two, for example CH 034-049 $\text{^{\text{^^}}\uparrow}$ (the sequence CH 042-034-049 is attested on #062a), or three signs, for example 072-049-049 $\text{^{\text{^^}}\uparrow\text{^{\text{^^}}\uparrow}$ (double 049 is well attested). Ultimately, as CH 091 is only attested on a missing document, we decide to remove it from the current sign list.

3.13 CH 093 as a paleographic variant of CH 049

The damaged sign incised on the clay vessel #317 has been given a separate entry as CH 093 $\text{^{\wedge}}$ in *CHIC*, 295. Nevertheless, in the commentary Olivier and Godart suggest the sign might equally be a variant of CH 031 $\text{^{\text{Y}}}$ or 049 $\text{^{\uparrow}}$. If rotated, it might be compared with some stemless variants of CH 031 (e.g. #077.a and #080.a), but these still differ in that they show dots at the edges. Conversely, the match with instances of CH 049 lacking dots at the end of each stroke is very convincing (Fig. 23).

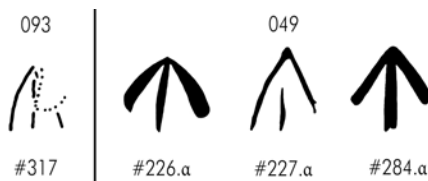








Fig. 23: Comparison between the damaged sign classified as CH 093 and some instances of CH 049 (redrawn after *CHIC*).

⁸ One possibility we considered is that CH 082 and 083 are ‘compressed’ versions of CH 011, a sign shaped like the frontal head of an ox (cf. especially the similarity of the horns of the latter as attested on #072.a and the two curved lines of the former). However, we lack variants sharing enough traits with the three sign shapes so as to support this idea.

3.14 CH 154 as a possible variant of LA 122

Sign CH 154  is so far only attested four times. Two instances are from documents considered uncertain CH or LA (#068.r.B, #122.r.1, 2) and another (#068.r.B) is badly damaged. If we exclude them, we are left with a hapax on nodule #006.y. In this inscription, however, CH 154 is isolated, which means there are no other signs that would firmly diagnose it as CH. Moreover, its shape is comparable to the stemless variants of AB 122  (OLIVES). Finally, three other fragmentary nodules of the same type (#010, #014, and #019) are also *dubitanda* (CHIC, 18). These facts show that we have no evidence to maintain CH 154 as an independent CH sign. Rather, its four attestations and the inscriptions they occur on may be LA, and CH 023/159bis  may be the true CH counterpart of AB 122 . We therefore propose to remove CH 154 from the repertoire.

3.15 CH 158 and 171 as allographs

Signs CH 158  and 171  may both be described as curved lines with multiple protuberances shaped like “teeth” or “leaves” and are only attested on clay records of commodities followed by numerals. We only have one secure instance of CH 158 on #065.d, while CH 171 is attested on three documents, #067.a, #118.a, and SY Hf 01 (Fig. 24). Here we hypothesize that they are the same sign representing the same commodity.

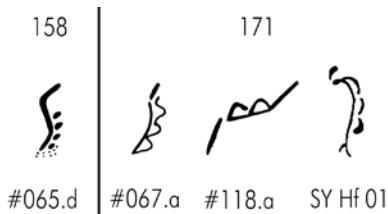



Fig. 24: Comparison between signs CH 158 and CH 171 oriented as they appear on the documents (redrawn after CHIC and Lebessi, Muhly, Olivier 1995, 64, fig. 1).

If rotated, CH 158/171 becomes comparable with the saw-like sign CH 045 , because of the curved line facing the same direction as the “teeth”. CH 045 is attested with certainty only on two seals (#125 and #298.β), even though CHIC also includes two doubtful instances from clay documents (#023.y and #058.d) as part of sign sequences, therefore classified as a syllabogram. CH 158 and 171 might be schematized variants of CH 045 used on clay documents to indicate a

certain commodity. Nevertheless, there is no independent evidence that the different orientation of signs CH 045 and 158/171 was meaningless and, therefore, the two will be kept separated in our sign-list.

3.16 CH 161 and 162 as allographs





Both shapes depict a two-handle vessel with a branch, are attested on clay bars, and are used as commodity logograms. CH 161  is attested on two bars from Knossos (#065.b and #066.d), where it features a square foot, and on a bar from Malia (#118.d), where it features a pointed foot. This little difference does not seem diagnostic. CH 162  is attested only once on #118.d, next to CH 161, where both logograms display the same pointed foot (Fig. 25).



Fig. 25: Photograph of inscription #118.d (courtesy of the Heraklion Archaeological Museum and the Greek Ministry of Culture and Sport, Archaeological Resources Fund).

The only difference between the two signs is the taller vessel and shorter branch in CH 161, as opposed to the shorter vessel and longer branch in CH 162. In addition, the handles are more accurately traced in CH 161. These slight differences can be explained as mere paleographic variation. A similar tendency can be seen for CH 016 on #112.a.b. The fact that CH 162 is attested next to CH 161 is also not sufficient reason for distinguishing it as an independent sign, since two different entries of CH 161 are recorded continuously also on #065b.

3.17 CH 164 and 165 as LA signs

Signs CH 164  and 165  are attested only on document #048, which may represent LA rather than CH (*CHIC*, 18). They appear to be ligatures of a commodity

logogram with a fraction: the cross-shaped CH 307/Σ + or LA 702/B † in the case of 164, and a triangular sign similar to the poorly attested LA 709/L 𐀓⁹ in the case of 165. Two inscriptions published in the corpus of LA, MA 4 and 6, feature very similar ligatures and texts (Karnava 2000, 19; Petrakis 2017, 81–83). They are horizontal tablets from MM III contexts at Malia. Significantly, MA 4 contains distinctive LA syllabograms: AB 08/a 𐀈 and 59/ta 𐀉. The logogram component of the ligatures is classified as AB 180 𐀊 in *GORILA*, with possible further attestations on other LA tablets from Phaistos (PH 10, 12a, 13a, 15b). *GORILA* (V, xxv) also catalogues the ‘complex’ Linear A signs 180 ‘B’ and 180 ‘L’ from MA 4 as LA 602 and 603, respectively. This strongly implies that all the three documents (Fig. 26) are early LA inscriptions (as suggested by Karnava and Petrakis) and, as a result, for now it seems warranted to remove CH 164 and 165 from the sign-list of CH. We would like to stress, however, that a counterpart of LA 180 may still come to light one day as a sign of the CH script. Should this occur, then the new sign ought to be included as a new entry, with a new number, in the inventory.
































Fig. 26: Photographs of documents #048, MA 4, and MA 6 (courtesy of the Heraklion Archaeological Museum and the Greek Ministry of Culture and Sport, Archaeological Resources Fund).


⁹ For a recent reappraisal of this problematic sign, see Corazza et al. 2020.

Having conducted our sign-by-sign analysis and concluding, in almost each case, with suggestions for structural adjustments, it is now time to take stock and summarize the implications for the number of signs entered in the inventory of CH.

4 Conclusions









We carried out a comparative paleographic analysis of low-frequency CH signs with the aim of assessing their identification. We can now sum up the results by grouping them into five categories: mergers, new readings, reassessment of sign function (CH 066 as a stiktogram), reassessment of the sign classification as LA (CH 164 and 165 as LA 180 ligatured with fractions), and suppression of a sign only attested on a missing document (CH 091). As far as mergers are concerned, we have proposed to assimilate:

CH 008  and 079 ;
 CH 012  and 015 ;
 CH 029  and 030 ;
 CH 037 , 085 , and 094 ;
 CH 046 , 080 , and 087 ;
 CH 049   and 093 ;
 CH 067 , 068   and 086 ;
 CH 074 , 075 , 077  ;
 CH 082  and 083 ;
 CH 158  and 171 ;
 CH 161  and 162 .

We have also discussed the insightful hypothesis put forward by Jasink (2009, 104) that CH 048  and CH 089 are allographs but, as we lack evidence of paleographic variants that help ‘bridging’ the differences between the two shapes, we eventually decided not to merge them. Thus, our results suggest that the 144 signs catalogued as syllabograms or logograms in *CHIC* might represent as few as 98 individual signs, if all our hypotheses were correct. At the same time, the number of hapax would be reduced to as few as 18, which is significantly fewer than the 33 in the current inventory.

The following new readings of particular shapes have been also suggested as sporadic improvements to the readings in the corpus of *CHIC*: the damaged sign incised on #041.b, read as CH 001 since Evans (1909), is here reinterpreted as CH 040; the damaged shape on #110.b, tentatively read as CH 085, is here interpreted as CH 057; the shape on #241.α, treated as a doubtful CH 094 in *CHIC* is here read

as CH 011; another doubtful instance of CH 094 on #251.γ is here tentatively read as CH 019. Likewise, the sign suggested as an instance of CH 080 on PE Hh 017.a by Tsipopoulou and Hallager (2010, 72) might be CH 069 instead. Such reassessments affect only the tiniest portion of the corpus, but that does not mean they cannot be meaningful: as far as CH 094 is concerned, they highlighted the fact that the shape was attested only once, which in turn made stronger the case for redressing it as an allograph.

The final output is the rationalized list of CH signs as shown in Table 1. To be noted is that the following signs are so far attested uniquely on seals: CH 001 , 014 , 048  (unless it is the counterpart of CH 089 ) , 076 , 095 , and 181 . These signs are therefore in the same basic situation as several other graphs not included in the *CHIC* sign-list, one of which is the cat face  (Evans' no. SM 74, commonly called 'cat mask'), which many authors now agree is probably a proper script sign (Younger 1996–1997, 387; Jasink 2009, 140, 160, 190; Ferrara, Weingarten, and Cadogan 2016, 88–89).

We conclude with an open-ended question which will require much more investigation and a modicum of cooperation across the scholarly platform. At present, it remains a point of contention to ascertain what potential methods should be applied to discern if a graph only attested on seals is part-and-parcel of the CH writing system (i.e., a high productive and language dependent graphic code), an emblem (i.e. a low productive and language independent graphic code),¹⁰ a semasiograph (defined as a language independent symbol, whose productivity varies upon context) or a mere decorative motif. As scholars have approached this problem differently (cf. Evans 1909, 181–231, 260, 268–271; *CHIC*, 13-14; Jasink 2009; Civitillo 2016; Decorte 2017), there is further scope for analysis. We, therefore, set in our future agenda a reappraisal of graphs found only on seals with coherent criteria to evaluate whether there should be additions (and how many) of graphs – such as, *inter alia*, sign LA 80 'the cat mask' – to the sign-list as presented in Table 1.

¹⁰ Definitions after Morin, Kelly, and Winters 2020.

001	027	053	088
002	028	054 = 160	089 (= 048)
003 (= 002 + 026?)	029 = 030	055	090
004	031 = 174	056	092
005	032	057	095
006	033	058	096
007	034	059	153
008 = 079	035	060	156
009	036	061	157
010	037 = 085 = 094	062 = 177	158 = 171
011	038	063	161 = 162
012 = 015	039	064	163
013 (= 152)	040	065	166
014	041	068 = 067 = 086	167 (= 061 + 072?)
016	042 = 175	069	168
017	043	070	169
018	044	071	170 (= 070 + 028?)
019	045	072	172
020	046 = 080 = 087	073	173
021	047	076	179
022	048 (= 089)	077 = 178 = 074 = 075	180
023 = 159bis	049 = 093	078	181
024 = 155	050 = 176	081	182
025	051	082 = 083	
026	052	084	

Table 1: Rationalized list of CH signs, resulting from our reassessment. Numerical and punctuation signs are not included.

Abbreviations

- ARACHNE** = online database of the German Archaeological Institute and the University of Cologne: [https://arachne.uni-koeln.de/arachne/index.php?view\[section\]=objekt&view\[layout\]=search_form_category](https://arachne.uni-koeln.de/arachne/index.php?view[section]=objekt&view[layout]=search_form_category) (last access August 2021).
- CHIC** = Olivier J.-P. and Godart L., *Corpus Hieroglyphicarum Inscriptionum Cretae*, Études crétoises 31, Athens – Rome, 1996.
- CoMIK** = Chadwick J., Godart L., Killen J.T., Olivier J.-P., Sacconi A., and Sakellarakis I. (eds.), *Corpus of Mycenaean Inscriptions from Knossos*, *Incunabula Graeca* 88, Cambridge – Pisa – Rome, vol. I–IV, 1986–1998.
- CMS** = Pini I. et al., *Corpus der minoischen und mykenischen Siegel*, Berlin, vol. I–XIII, 1964–2009.
- GORILA** = Godart L. and Olivier J.-P., *Recueil des inscriptions en linéaire A*, Études crétoises 21, Paris, vol. I–V, 1976–1985.

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