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Signatures

(Essais en) Sémiotique de l'écriture

(Studies in the) Semiotics of Writing

Dossier dirigé par
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The Functions and Toposyntax of Ancient Egyptian Hieroglyphs: Exploring the Iconicity and Spatiality of Pictorial Graphemes*

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The hieroglyphic writing system figures prominently in many general descriptions of world writing systems[1] for at least three main reasons. First, it is one of few original (and one of the most ancient) writing systems, and its origin and development can be described quite precisely based on a sizeable quantity of written evidence.[2] Second, there is a 'unity of art and writing'[3] in ancient Egypt, and the figurative dimension of the hieroglyphic signs as well as the essential relationship between the pictorial and linguistic forms of expression are of paramount interest for linguists, art historians, and semioticians alike.[4] Finally, the functions of the hieroglyphic

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1. See *e.g.* Rogers (2005, pp. 97–114), Coulmas (2006, pp. 138–142).

2. A fundamental analysis is Schott (1951). See now Morenz (2004), Regulski (2016) and Vernus (2016b), with references to previous studies. An accessible introduction to the question is found in Winand (2013).

3. As Fischer (1977c, pp. 3–4) puts it. Note that a single Egyptian verb *sš* (written with a representation of the scribal equipment ) means both 'to write' and 'to draw' or 'to paint' (*Wb.* III, 475,6-476,8). The same kind of polysemy is observed in other languages with figurative writing systems, such as Nahualt *icuiloa* 'to write, to paint, to draw, to embroider, etc.' (Thouvenot, 2008, p. 91).

4. Cf. Fischer (1986).

signs—that range from purely semographic to strictly phonographic—provide a deep insight into the potentialities of writing systems from a typological point of view.[5]

However, two aspects of the hieroglyphic writing systems, which are fairly well studied and understood within Egyptological circles, have failed to attract broader attention: the significant functional flexibility of the hieroglyphic signs as well as the impressive richness and great subtlety of their toposyntax.[6] The aim of this paper is accordingly threefold. The first goal is to provide a systematic description of the glossic functions of the hieroglyphic grapheme,[7] paying special attention to the formal plasticity of graphemes that can activate both linguistic and iconic significations. Secondly, the main principles that underlie the syntagmatic organization of graphemes within hieroglyphic inscriptions are explored, with the aim of showing how the linear and spatial syntaxes constantly interact within this writing system. Capitalizing on this semiotic account, the third objective is to make suggestions regarding the encoding of hieroglyphs in Unicode, in an effort to bridge the gap between a theoretical account and the practical development of an encoding scheme for this complex writing system. Since the description provided in this paper is an effort to analyze an empirical continuum of visual representations, it cannot not be emphasized enough that exceptions and borderline cases are only to be expected; they are the results of the categories that one needs for intelligibility.

The paper is structured as follows. In Section 1, background information about the hieroglyphic writing system is presented. Although many principles also apply to the ancient Egyptian cursive scripts (so-called cursive hieroglyphic and the hieratic scripts[8]), the focus here will be on the pictorial hieroglyphic script (Fischer, 1977a). The multifunctionality of the hieroglyphic signs is discussed in Section 2. Section 3 is devoted to a description of the spatial arrangement of hieroglyphs within a line, while Section 4 focuses on the various text orientations. The consequences of the syntactic account provided here as regards Unicode encoding are outlined in Section 5. Section 6 concludes with a discussion of the types of relationships between the linguistic and iconic signifieds within the hieroglyphic system.

5. See for instance Coulmas (2002, pp. 170–176) about Egyptian as a mixed system.

6. See especially Fischer (1977b, 1977c), Vernus (2015, pp. 148–150), Meeks (2017). For the central concept of 'toposyntax' (as opposed to 'chronosyntax'), see Klinkenberg (1996).

7. Throughout this paper, I endorse the definitions provided by Klinkenberg & Polis (this volume) for the technical terms pertaining to the semiotic analysis of writing systems.

8. See already Champollion (1824, pp. 353–355). A recent and thorough state-of-the art contribution is Verhoeven (2015).

1. The hieroglyphic writing system: background information

The hieroglyphic script arose independently in Egypt around 3250 BC (Allen, 2014, p. 2), evolving from a restricted semography[9] to a fully-fledged writing system (Vernus, 2016b), and was used down to the Roman period (4th century AD). The hieroglyphic graphemes—informally called 'signs'—are figurative (Vernus, 2016a, pp. 1–3), a characteristic shared with a small number of other writing systems (Beaux, 2009b). This means that the Egyptian hieroglyphs are fundamentally pictures with cross-culturally (more or less easily recognizable) referents.[10] For instance, besides being hieroglyphic signs with specific functions, the following graphemes can be identified as a 'man steadying basket'  [11] (A9)[12], a 'branch'  (M3), or the 'sun with rays of sunshine'  (N8). As images, the hieroglyphic signs obey the same rules of representation as the ones governing other artistic forms in ancient Egypt (Lacau, 1954, p. 9; Schäfer, 1986). As such, their figurativity can be straightforward for an Egyptian eye, but quite problematic for modern ones.[13] It is indeed not directly obvious that the sign (U15) represents a 'sledge'[14] and that (O49) is a schematic plan of a 'town' or 'village' (with cross-roads).

Three main features distinguish pictorial representations from hieroglyphic signs, which Vernus encompasses under the principle of 'ordinatio' (Lacau, 1954, pp. 9–11; Vernus, 1982, pp. 105–112, 1985, pp. 45–51, 2015, pp. 146–148, 2016a, pp. 3–5):[15]

9. In the Egyptological literature, see also Kammerzell (2009) who suggested the label 'system of graphic information processing (SGIP).'

10. The notions of figurativity and iconicity are further discussed in §6. On 'iconicity' as a fundamental 'function' of the hieroglyphic signs, see Assmann (2002, pp. 35–45).

11. If not mentioned otherwise, the standard hieroglyphic signs of this paper are generated with JSesh (see Rosmorduc, 2014; http://jsesh.qenherkhopeshef.org).

12. In order to allow the interested reader to check and investigate further the value of individual signs, the hieroglyphs of this paper are systematically accompanied by the so-called Gardiner code, *i.e.* the code assigned to individual hieroglyphs in his *Catalogue of the Egyptian Hieroglyphic printing type* (Gardiner, 1928), which are discussed and commented extensively in the sign-list of his *Egyptian Grammar* (1957, pp. 438–548). The letter of this code refers to the conceptual category to which the hieroglyphic sign belongs (A = 'Man and his occupations,' B = 'Woman and her occupations,' C = 'Anthropomorphic deities,' etc.); these categories have been usefully revised by Meeks (2004, pp. XIX–XXII). Additional codes that are not included in Gardiner's sign-list can be found in the so-called *Manuel de Codage* (Buurman, Grimal, Hainsworth, Hallof, & van der Plas, 1988).

13. The visual referent of several hieroglyphic signs is still problematic nowadays (see the 'Aa' category in Gardiner's sign-list [cf. n. 12] and the equivalent category 'ZZ' in the series *Paléographie hiéroglyphique*). Even very frequent graphemes like  (phonogram *ḥ*), have not been identified with complete certainty (Meeks, 2004, p. 232).

14. The hieroglyphic graphemes, like the other ancient Egyptian visual representations, can combine different perspectives; see the remarks in Hornung (1988, p. 412).

15. A convenient synthesis of these principles is found in Schenkel (2005, pp. 53–57) under the heading 'Kalligraphie'.

(1) The hieroglyphic signs are *calibrated*. In the artistic representations of ancient Egypt, the proportions are respected (imitating more or less the proportions of the referents), or depend on hierarchical relationships.[16] In hieroglyphic inscriptions, on the other hand, graphemes can occupy a similar space within the written line even if the size of their iconic referents differs considerably: a 'cormorant' 𓅬 (G35), an 'elephant' 𓃰 (E26), and a 'scarab' 𓆣 (L1) will have approximately the same size in a given inscription. Every hieroglyph can be conveniently described as having one of four basic shapes (Allen, 2014, p. 5, §1.7.; Gardiner, 1957, pp. 547–548; Hannig, 2006, p. 20–22; Kaplony, 1973, p. 4; Werning, 2015, p. 5), which can be visualized using a virtual square[17] within the written line—labeled 'quadrat (block)' by Egyptologists:

(a) *Tall and broad signs*, *i.e.* occupying roughly the full quadrat, such as *e.g.* the 'vulture' 𓅝 (G14), the 'night-sky' 𓇼 (N2), the 'bird-trap' 𓋴 (T26), or the 'water-pots in a rack' 𓏏 (W17).

(b) *Tall and narrow*, *i.e.* occupying roughly a vertical half quadrat, such as *e.g.* the 'wall' 𓉔 (O36), the 'mast' 𓊽 (P6), the 'divine standard' 𓌂 (R8), or the 'knotted fabric'[18] 𓋹 (S34).

(c) *Low and broad*, *i.e.* occupying roughly an horizontal half quadrat block, such as *e.g.* the 'mouth' 𓂋 (D21), the 'sky' 𓇽 (N1), the 'arrow' 𓄤 (T11), or the 'wickerwork basket, with handle' 𓎛 (V31).

(d) *Low and narrow*, *i.e.* occupying roughly a quarter quadrat block, such as *e.g.* the 'sun' 𓇳 (N5), the 'irrigation canal' 𓌹 (N23), the 'stool (of read matting)' 𓋔 (Q3), or the 'ring-stand (for jars)' 𓍿 (W11).

16. As a rule, Pharaoh is taller than his subjects, masters are taller than their servants, etc. On canon and proportion in Egyptian art, see Iversen (1975).

17. These ideal units are rarely materialized, except in the rare 'crosswords' where it facilitates the reading (see §4.3.2. below).

18. See Fischer (1972), with Meeks (2004, pp. 206, §563, n. 1) for later references.

Such a description is admittedly influenced by the standardized font types and by the typographic habits of modern Egyptological editions. In actual inscriptions, the size of signs can indeed vary quite significantly from one line to another in order to best fit into the writing space—compare the size of the 'owl' G17 at the top of the first column and at the bottom of the second one in Fig. 1—, and some signs can be taller or bigger than the virtual and ideal quadratic unit (Hannig, 2006, p. 29); see in this respect the 'man with both arms raised' A28 in the two columns of Fig. 1, which is much taller than any other tall signs.[19] Finally, some tall and narrow signs, like the 'wick of twisted flax' V28, can stand alone within a column. The goal is indeed always to get the most pleasing visual effect, striving to balance the lines as harmoniously as possible. Accordingly, quadrats vary in size and shape (more or less square or rectangular) within a single inscription.

Fig. 1. Inscr. Louvre C. 9, l. 10-11 (XIIIth dynasty, Abydos; Barbotin, 2005, p. 88).[19]

(2) The hieroglyphic signs are *oriented*. Unlike in artistic representations, in which the positioning of the characters and realia reflects the orientation of their referents, the hieroglyphic signs are oriented in a strict fashion. Several hieroglyphic signs are symmetrical about the *y*-axis (*i.e.* vertically)—such as the 'mace (with pear head)' T3, the '(beer) jug' W22, or the 'papyrus rolled up' Y1—, but a sizeable quantity of hieroglyphs is oriented intrinsically (being asymmetric about the *y*-axis). This point is particularly straightforward with signs depicting animate entities, such as the 'seated man' A1, the seated woman B1, the 'head (in profile)' D1, or the 'bull' E1. In the examples above, the signs are all facing left (they 'look' towards the left), which is conventionally noted by an arrow pointing left ←.[20] These signs could also be oriented rightwards →. When appearing in the same part of an inscription, the signs must, as a rule, be oriented in the same direction.[21] This orientation points to the reading order: if the hieroglyphs are facing right (→), the text reads from right to left (RTL, which is the dominant and unmarked reading order in ancient Egypt), if the signs are facing left (←), the text reads from left to right (LTR – a marked reading order, see Section 4 below).

19. This it to be distinguished from cases where an hieroglyph is made much bigger (*i.e.*, not respecting the 'calibration' principle) in order to function both as an image and as a grapheme. See *e.g.* Fischer (1976, pp. 35–37), or Vernus (2016a, pp. 5–8).

20. Despite the clear case made by Fischer (2005, 53–57) for using the arrows exclusively to refer to the direction of signs (← for 'signs facing left' and → for 'signs facing right'), many studies continue to use these arrows to refer to the direction of reading (← for 'read from right to left' and → for 'read from left to right'), which can be highly confusing, especially with the so-called 'retrograde' inscriptions (see §4.3.3. below).

21. See Section 4 below for a discussion of exceptions to this principle.

(3) The hieroglyphic signs are *organized* both linearly and spatially. From a linear point of view, the hieroglyphs follow each others in columns (Fig. 2a) or in rows (Fig. 2b), most often with regular delimiting lines[22] that structure the writing space (as opposed to pictorial representation).

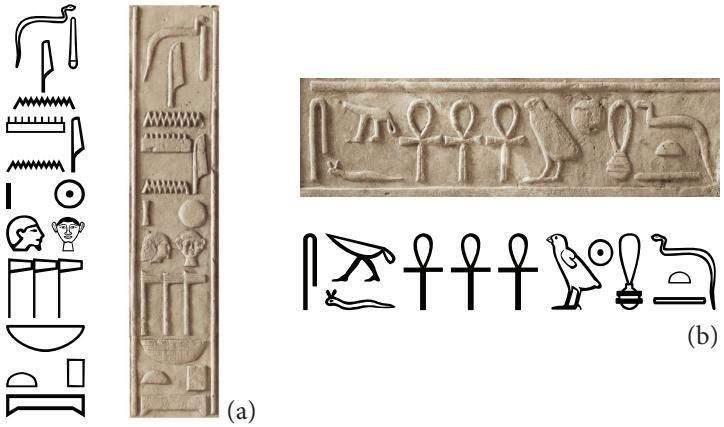


Fig. 2. White chapel of Senusret I (Karnak – 12th dynasty), pillar 8.n (KIU 1047),[23] (a) column 7 and (b) line 16, with standardized transcriptions.

However, inheriting from the two-dimensional potential of figurative representations (Vernus, 1985), the hieroglyphic signs further undergo specific spatial arrangements within the line. The goal of an esthetically pleasing effect is met through (a) *density* (Vernus, 1982, p. 106) and (b) *regularity* in the organization of individual signs. As such, the hieroglyphs that would not completely fill in the writing-line are grouped together (and possibly scaled down) in order not to leave empty spaces and to ensure the best possible readability and esthetics of the text (what would be referred to as 'type color' in modern typographical terms). The basic way of putting signs together is by grouping them horizontally and vertically (Fig. 3), creating *quadrats* (see above).

22. The signs are usually not in contact with these formatting devices. For hieroglyphic signs expressly laid on the dividing lines, as if they were understood as images on their ground line, see however the Old Kingdom examples discussed by Collombert (2016). Regarding the addition of a ground-line to hieroglyphic signs as an ANIMACY/AGENCY marker, see Lacau (1954, pp. 11–12).

23. Throughout this paper, examples from the temple of Karnak have been favored, first and foremost because detailed pictures and facsimiles are available online (http://sith.huma-num.fr/karnak), and can easily be checked by the interested reader using the KIU numbers ('Karnak Identifiant Unique'). I am much grateful to the team of the *Karnak* project and to its director, Sébastien Biston-Moulin, for making such a tool available online.

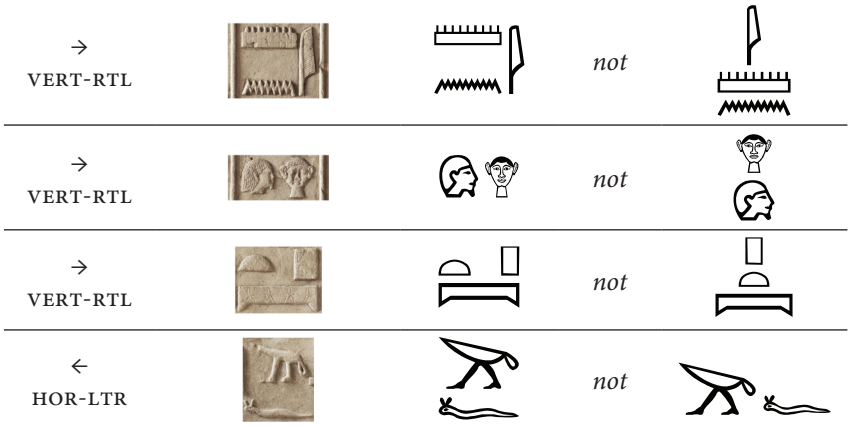


Fig. 3. Examples of simple quadrats (from the inscriptions of Fig. 2).

As shown by the examples of Fig. 1, the quadrats are one basic way of organizing the hieroglyphic signs inside columns or rows (see §3.1.-3.). However, this combination of signs is not mandatory (Schenkel, 2005, pp. 54–55): if a sign fills in a column horizontally (like 𓋴 in Fig. 2a) or a line vertically (like 𓊪 or 𓋹 or 𓇋, in Fig. 2b), it does not need to combine with any other sign. Furthermore, strategies other than these simple tabulated arrangements were developed for combining signs; they are the topic of Section 3 below.

The three above-mentioned principles delineate the graphemic realm as having distinct properties from the broader ancient Egyptian pictorial universe. However, as Gardiner puts it (1957, p. 438), 'the hieroglyphic writing always remained a system of pictorial representation as well as a script,' and the Egyptians never ceased to use the iconic potential of their writing system in order to strengthen, precise or enrich the glossic meaning conveyed by hieroglyphs.[24] An example should suffice to illustrate this point. The word *jw3* 𓇋𓅱𓄿𓃒 (*j-w3-*^{3}-BIG_CATTLE)[25], which means 'ox, steer'[26] and is especially common in offering contexts (*Wb.* I, 9-10), is usually classified with the hieroglyph 𓃒 'bull' (E1), signaling that the lexeme belongs to the semantic category [BIG_CATTLE] (Fig. 4a).

24. The literature on the figurative potential of the hieroglyphs is enormous. Recent contributions on the topic include Seidlmayer (2012), Vernus (2016a). Some hieroglyphs and cursive hieroglyphs can be described as 'ambimodal' (Lapčić, 2014), as they cannot be unambiguously assigned to the written or pictorial mode.

25. The hieroglyphs are followed by an analysis of the spelling (when needed for the discussion), see *e.g.* Lincke & Kammerzell (2012), Kammerzell (2015), Werning (2015). The signified of each hieroglyph is separated by a dash '-', following the linear order. The phonographic values are rendered in Egyptological transliteration, while the semographic values are expressed with Roman small capitals. The non-autonomous uses of graphemes (see below §2.4.-2.6.) are signaled as exponent.

26. See Meeks (2012, p. 525, n. 68) for the etymology and precise meaning of this term.

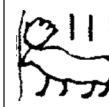
		 
*j-wꜣ-*BIG_CATTLE-PLURAL	*j-wꜣ-*BIG_FAT_CATTLE-PLURAL	*jwꜣ*/BIG_FAT_ADORNED_CATTLE-PLURAL
jwꜣ.w 'oxen'	*jwꜣ.w* '(fat ?castrated?) oxen'	*jwꜣ.w* '(fat adorned) oxen'
(a) *Annals of Thutmose III* (Karnak, VI[th] pylon – 18[th] Dynasty), KIU 3475, col. 4	(b) *Peristyle hall of Thutmose IV* (Karnak – 18[th] Dynasty), KIU 2940, *Title*, col. 4	(c) *Hypostyle hall* (Karnak – 19[th] Dynasty), KIU 616, *Title*, col. 1

Fig. 4. Three spellings of *jꜣw.w* 'oxen' with contrastive iconic features.[27]

Now, in the context of the scene of great offering (*ꜥꜣb.t ꜥꜣ.t*) to the god Amun represented in the peristyle hall of Thutmose IV (Karnak), the generic classifier is clearly adapted and replaced by a sign depicting a fat ox (Fig. 4b). This hieroglyph inherits from iconic features typical of the fat oxen in ancient Egypt (Leclant, 1956)—such as the ones appearing in the neighboring procession (Fig. 5)—, but also displays a peculiar feature, namely a bent front horn (Leclant, 1956, pp. 131–132, n. 5; Letellier, 1994, pp. 471–474). This characteristic might indexically point to the fact that these oxen were castrated, as is made visually clear (see Fig. 5) in the pictorial representation nearby (Chevrier, 1951, p. 551), but would have been hardly visible at the scale of a hieroglyphic sign. Indeed, the deformation of horns of castrated oxen is not uncommon in East Africa (Hofmann, 1975, col. 1005).[28]

Fig. 5. Two fat oxen of the *Peristyle hall of Thutmose IV* (Karnak – 18[th] Dynasty), KIU 2940, second register of offerings.

27. The line drawing for the fat oxen of Fig. 3b and Fig 3c are respectively from Letellier (1994, fig. 1) and from Nelson (1981, pl. 27).

28. This explanation is arguably better than a process of graphic dissimilation (see §2.2.). Even if this type of dissimilation is well attested for fat oxen in pictorial representations (Leclant, 1956, pp. 130–131), it would not make much sense in the context of the title of this scene.

Borrowing yet other traditional features of pictorial representations (Fig. 6), the logogram of Fig. 4c for *jꜣw.w* 'oxen' is a fat ox adorned with vegetal elements between his horns, an iconographic motif that occurs typically in artistic contexts when the oxen are brought as offerings (Leclant, 1956). Since this spelling also occurs in the title of a scene of great offering (*ꜥꜣb.t ꜥꜣ.t*), the logogram signals immediately to the reader that it is not just any type of oxen that is being offered, but the ones that are most likely to satisfy the gods.

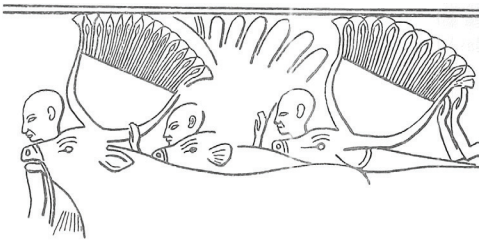


Fig. 6. Fat oxen adorned with vegetal elements (Louxor, *Beautiful feast of Opet*), from Wreszinski (1935, pl. 202).

This simple example should suffice to show how the figurative nature[29] of the hieroglyphic script could be used in order to enrich the glossic meaning with additional pieces of semographic information that relate to the referent of the linguistic sign.[30]

As images, the individual hieroglyphic signs were further believed to have some kind of magical independence (because images were thought to be efficient realities). This explains the fact that, in some—mostly funerary—contexts, signs with a potential negative agentivity were avoided (Fig. 7a), replaced (Fig. 7b), mutilated (Fig. 7c-d) or modified in various ways (Fig. 7e) in order to avoid unwanted consequences for the deceased.[31] These cases fall into the category of 'negative iconicity' coined by Schenkel (2011, pp. 134–145).

29. An additional characteristic shared by pictorial representations (Davies, 2001) and hieroglyphic signs is the use of colors (Lacau, 1954, pp. 12–14). General studies are missing; some remarks can already be found in Champollion (1836, pp. 6–11), or more recently in Davies (1958, pp. 16–17), Staehelin (1974), and Hornung (1988, pp. 415–417). Analyses of specific corpora (or of particular signs) include Staehelin, 'Zu den Farben der Hieroglyphen' (in Hornung, 1990, Chapter 8), Kahl (1997) and Myśliwiec (2006).

30. Assmann (1994, p. 17) makes a distinction between the 'semanticity' and the 'materiality' of the hieroglyphic sign and argues that 'world reference' is achieved through the latter only.

31. See the fundamental studies of Lacau (1913b, 1926), as well as Firth & Gunn (1926, pp. 171–177), Beaux (2009a, pp. 249–253), and Miniaci (2010). For the mutilation of anthropomorphic hieroglyphs in the *Pyramid Texts*, see Lincke (2011, pp. 131–149).

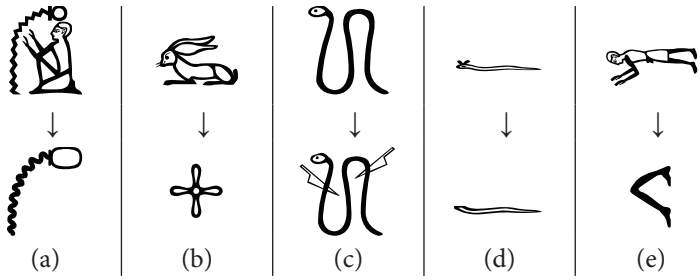


Fig. 7. Some 'mutilated' hieroglyphic signs.

From the observations above ensues that the actual number of hieroglyphs is very hard to evaluate for any period. Indeed, the repertoire is historically finite, but theoretically infinite (Collombert, 2007; Hornung, 1988, pp. 412–413; Meeks, 2013, pp. 32–33), since existing signs can be modified (Fig. 4) or combined (Section 3) in different ways[32]—*modifiability*—and new signs can be added to the repertoire—*extendability*[33] (Vernus, 1982, pp. 101–105). An illustration of this last point is the creation of a sign  'horse' (E6) during the early New Kingdom (Goldwasser, 2017a, pp. 45–55; Vernus, 1985, p. 46)—with the earliest example dating back to the reign of Ahmosis, c. 1550 BCE (Meeks, 2005; Vernus, 2009, pp. 26–29)—, after horses had been introduced to Egypt by the Hyksos during the Second Intermediate Period some 150 years earlier (Meeks, 2005, p. 51). A rough estimate, however, is that, depending on the period, between 1500 and 2500 hieroglyphic graphemes (*i.e.,* signs meaningfully distinguished by phonographic or semographic features[34]) were concurrently employed,[35] correlating the higher estimate with 'late' Ptolemaic and Roman inscriptions.[36] Among those, some 600 signs are frequently attested for all the periods and corpora (Collombert, 2007, p. 25).

32. The visual shape or general appearance of some hieroglyphs can be intentionally updated by scribes so as to be more in tune with contemporary implements, clothes, etc. See especially Fischer (1976, p. 34, 1986, pp. 35–39).

33. See Assmann (1994, pp. 28–31), who stresses the fact that '[t]he systemic openness of hieroglyphic writing is related to its world reference as well as to the fact that this is a world of direct signification,' a world that reveals the sensorial and divine in inexhaustible forms.

34. See Collombert (2007) and Polis & Rosmorduc (2013) for a discussion of the features that may be taken into account for discriminating hieroglyphic signs from one another.

35. If one includes variants distinguished by meaningful iconic features, Meeks (2013, p. 33) estimates that more than 10,000 hieroglyphic signs could be distinguished for the inscriptions of all periods and corpora.

36. This estimate could be significantly reassessed after the completion of paleographic projects such as the *Paléographie hiéroglyphique* of the French Archeological Institute — see the presentation in Meeks (2002, 2007a, 2007b) and the seven volumes published so far (Collombert, 2010; Enany, 2007; Engsheden, 2014; Haring, 2006; Lenzo, 2015; Meeks, 2004; Servajean, 2011) — and of electronic sign-lists, such as the *Thot Sign-List* (Polis *et al.*, Forthcoming).

2. The multifunctionality of the hieroglyphic signs

The hieroglyphs are able to fulfill several glossic functions, which can be distinguished using three key features: ±semographic, ±phonographic and ±autonomous (Polis & Rosmorduc, 2015; Klinkenberg & Polis, this volume). Combining these paradigmatic and syntagmatic features, six core functions are identified for the hieroglyphic signs.[37] They may behave as pictograms, logograms, phonograms, classifiers, morphograms or interpretants (Fig. 8).

	+ semographic		−semographic
autonomous	Pictogram	Logogram	Phonogram
non-autonomous	Classifier	Morphogram	Interpretant
	− phonographic	+phonographic	

Fig. 8. A taxonomy of the hieroglyphic sign functions (adapted from Polis & Rosmorduc, 2015, pp. 157–158, Fig. 10).

It should be stressed that these notions "refer to possible functions fulfilled by the tokens of particular graphemes according to their distribution and do not define inherent qualities of the signs" (Lincke & Kammerzell, 2012, p. 59)[38]. In order to determine the function of a hieroglyph in a given syntagmatic environment,[39] three basic questions should accordingly be answered: (1) does the hieroglyphic sign (as graphemic signifier) express some content [+semographic] or not [−semographic] (first articulation)? (2) does it refer to some linguistic form [+phonographic] or not [−phonographic] (second articulation)?[40] (3) does this

37. Schweitzer (2005, pp. 23–98) suggested an alternative model for the classification of the hieroglyphic graphemes based exclusively on syntagmatic properties of the hieroglyphs, his goal being to define classes (crucially not *functions*) of written hieroglyphic signs.

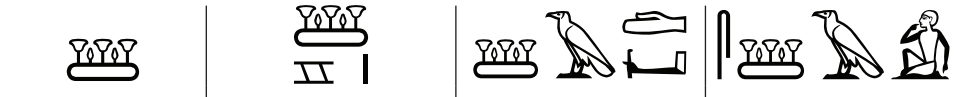
38. See already Schenkel (1984).

39. The complex history of some hieroglyphic signs, as well as the general evolution of the hieroglyphic writing system, makes it sometimes difficult to determine unambiguously the actual function of a grapheme, see Vernus (2003), Lincke & Kammerzell (2012, p. 59), Polis & Rosmorduc (2015, pp. 158–169). On the use of red ink (rubric) to signal an additional, extra-contextual, function of some hieroglyphic signs, see Olette-Pelletier (2016).

40. See the discussion in Loprieno (2003a) who provides examples highlighting how the ancient Egyptian writing system allows one to play with the two articulations of the language, with individual graphemes playing on both levels at once. It is interesting to note that the two modes of signification of the hieroglyphs (semographic and phonographic) are probably acknowledged by the Egyptians themselves in the *Memphite Theology*, which can be read as a metalinguistic comment when asserting that "all hieroglyphs originated from that which was thought up by the heart and commanded by the tongue"; see the observations about this text by Assmann (2007, pp. 25–29).

sign function autonomously [+AUTONOMOUS] in the written word, or does it make sense only *in relation* to other graphemes or signifieds [–AUTONOMOUS]?[41]

The multifunctionality of the hieroglyphic graphemes can be illustrated with an example of two different functions of the hieroglyph 𓊪 'lotus pool' (M8).[42] It is used as an autonomous logogram for the word *šꜣ* 'meadow' (*Wb.* IV, 399,7-400,5, cf. Fig. 9a), which is regularly classified as a PIECE OF IRRIGATED LAND, using the hieroglyph 𓌻 'irrigation canal' (N23), and signaled as being automonous with the vertical stroke 𓏏 (Z1), cf. Fig. 9b. This sign may also be used as a simple phonogram, with the value *šꜣ*—originally inherited from the aforementioned logogram following the famous *rebus principle* (Allen, 2014, p. 3)— in words such as *šꜣd* 'to dig (out)' (*Wb.* IV, 414,11-415,4), Fig. 9c, or *sšꜣ* 'to beseech'(*Wb.* IV, 281,2-3), Fig. 9d.



šꜣ/MEADOW	*šꜣ*/MEADOW-IRR.-AUTON.	*šꜣ-ꜣ-d-*ACTION_STRENGTH	*s-šꜣ-ꜣ-*ACTION_MOUTH
šꜣ 'meadow'	*šꜣ* 'meadow'	*šꜣd* 'to dig'	*sšꜣ* 'to beseech'
(a) LOGOGRAM	(b) LOGOGRAM	(c) PHONOGRAM	(d) PHONOGRAM

Fig. 9. Examples of the hieroglyph 𓊪 (N8) used as logogram and phonogram.

In the following sections (§2.1.-2.6.), examples of the six functions are provided. Interesting cases in which the emic 'iconocentrism' characteristic of the ancient Egyptian culture (Loprieno, 2003a) mediates between the semographic and phonographic realms (Derchain, 1991, p. 245; te Velde, 1986), blurring the boundaries of the modern etic classification of Fig. 8, have been favored. It should however be kept in mind that the majority of signs had first and foremost a phonographic function in hieroglyphic texts, an observation which holds all the more true for texts written in the cursive scripts (Schenkel, 2011).

2.1. *Pictograms*

[+SEMOGRAPHIC], [–PHONOGRAPHIC], [+AUTONOMOUS]

Pictograms — namely autonomous signs that point to some linguistic signified, but are not conventionally associated with a specific phonemic signifier—are not discussed in this section because of the pictographic origin of the hieroglyphic

41. Schenkel (1971, pp. 91–92, 1984, cols. 718–719, 2003, pp. 29–38, 2005, pp. 41–51) systematically drew attention to this syntagmatic dimension resulting from the spatial configuration of the script. Note that, if one does not take into account the distinction ±AUTONOMOUS, this taxonomy can be reduced to the three core functions—classifier, logogram and phonogram—that are usually acknowledged in the Egyptological literature and beyond (see Nederhof & Rahman, 2017).

42. Other uses of this sign linked to the root *ꜣḫ* are not discussed here for the sake of simplicity.

writing system (see above n. 2) or because of the existence of several non-textual pictographic systems in Egypt (Andrássy, Budka, & Kammerzell, 2009; Budka, Kammerzell, & Rzepka, 2015; Haring & Kaper, 2009). Rather the goal here is to show that pictograms, even if admittedly not frequent, can be directly integrated in hieroglyphic texts (Polis & Rosmorduc, 2015, pp. 158–161). Following the saying that a picture is worth a thousand words, the scribe of the Manshîyet eṣ-Ṣadr stela (St. Cairo CG 34504 = K*RI* II, 361,11) puts the sentence of Fig. 10 in the mouth of Ramses II.

mḥ-ABTRACT-*j*/I-*pr*/TEMPLE-*Rᶜ*/RE-*m*-*špsw*_*ᶜnḫ*/SPHINX-PL-*ḳ*-*n*-ABTRACT-PL-*m*-*t*-*w*-*t*-STATUE_PL-*ḥr*-AUTON.-**X**-PL-*ḥr*-AUTON.-Y-PL

mḥ-j	*pr-Rᶜ*	*m*	*špsw-ᶜnḫ*	*ḳn-w*	*m*	*tw-w-t*	*ḥr*	**X**	*ḥr*	**Y**
fill:PST-1SG	temple-Re	with	sphinxes	numerous-PL	with	statue-PL-F	on	**X**	on	**Y**

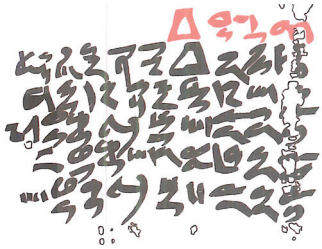
'I filled the temple of Re with numerous sphinxes, with statues (of the king) that are **prostrate offering a vase of myrrh** and that are **kneeling making offering**' (adapted from K*RITA* II, 194)

Fig. 10. St. Cairo CG 34504, l. 7-8 (Hamada, 1938, pl. XXX).

In the translation, the signs  and  are paraphrased respectively by 'prostrate offering a vase of myrrh' and 'kneeling making offering', but this is of course just a verbal description of the positions and actions—respectively *šms ᶜntjw* and *f3j jḫ.t* (Hamada, 1938, p. 226, nn. 6–7)—that are performed by the statues of the King depicted by the two hieroglyphs. The fact that modern translators are condemned to use paraphrases is no final proof that the signs had no precise phonetic rendering, but both the complexity of their stance and the quantity of details suggest that a precise reality was meant, for which some kind of circumlocution is likely. It is noticeable that these signs appear fully integrated in the writing system, since they are 'calibrated' (§1.) and the plural classifier (𓏺𓏺𓏺) is used after both of them. These observations should be correlated with the fact that the hieroglyphic script was not used only (or primarily) to record verbal speech: such texts were not meant to be performed orally, since performativity is realized through their very inscription.

In practice, the demarcation between the pictographic and logographic uses of some signs is not always easy (or even possible) to make, since this distinction heavily depends on our modern encyclopedic knowledge of the existence (or not) of a conventionalized reading for these signs. Consider the following example taken from problem n° 14 of the Moscow mathematical papyrus (Struve, 1930). In this problem written in hieratic (Fig. 11)—which gives a method for calculating the volume of a truncated pyramid with a square base—, the sign used to refer to the truncated pyramid appears twice (l. 1 & 2):  (?O194?)[43].

43. The sign O194 is classified in the category 'obelisk' in Buurman *et al.* (1988, p. 160).



tp/METHOD-AUTON.-*n*-*jr*-*t*-TRUNCATED_PYRAMID

tp	*n*	*ir-t*	TRUNCATED_PYRAMID
method	of	do-INF	TRUNCATED_PYRAMID

'method for calculating (lit. doing) a truncated pyramid'

Fig. 11. First part of the problem nº 14 of the Moscow mathematical papyrus (Michel, 2014, p. 396), with hieroglyphic transcription, graphemic analysis, transliteration, glossing and translation of l. 1.

Because of the lack of interpretants and given the virtual absence of parallels for the grapheme  , several readings can be suggested (Gunn & Peet, 1929, pp. 177–178), but we do not know for sure whether this sign was conventionally associated with a single word or phrase (and therefore falls within the category LOGOGRAM), or whether the sign is here a mere pictogram open to several paraphrases, such as 'frustum of a pyramid' or 'truncated pyramid' in English.[44]

2.2. *Logograms*

[+SEMOGRAPHIC], [+PHONOGRAPHIC], [+AUTONOMOUS]

Logograms are signs that are used for referring to entire 'words' (λόγος)[45]—one should probably say more accurately '(free) morphemes': they are linked simultaneously to a linguistic signified (first articulation) and to a linguistic signifier (second articulation).[46] Analyzed as semiotic signs, the logograms can be seen as icons, indexes, or symbols[47] (Derchain, 1991, pp. 245–247).

44. The absence of the vertical stroke (Z1), which is usually used to index the autonomous use of logograms (see its use after *tp* 'method' in l. 1), might be taken as indicative of this pictographic status.

45. The term ideogram is admittedly much more common in the Egyptological literature, and goes back to Champollion himself. However, the French scholar chose this word quite early in his decipherment process, at a time when he was of the opinion that no phonemic value was attached to logograms; see *e.g.* Champollion (1824, p. XIV). The label ideogram, with the sense 'idea/concept writing' [+SEMOGRAPHIC & –PHONOGRAPHIC], was therefore appropriate. In his grammar (Champollion, 1836, p. 48, §68-70), he changed his view—acknowledging the fact that the ideograms also refer to linguistic signifiers—but not the label.

46. See the comments of Depuydt (1994, p. 19, 1995, p. 3).

47. Based on these three relations between the figurative graphemes and the linguistic signified, some scholars operate a distinction between ideograms (for icons, and sometimes indexes) and logograms (for symbols, and sometimes indexes), while others, *e.g.* Meltzer (1980, p. 43), use 'ideograms' as a cover term for both 'logograms' and 'classifiers.' I stick here to the view clearly expressed by Coulmas (2006, p. 309): "[t]he term [*i.e.* logogram] is often used interchangeably with 'ideogram' (…), although the two should be carefully distinguished. Ideograms in the strict sense of the term are non-linguistic symbols which express concepts such as numbers. By contrast, logograms are signs which express units of a language."

Icons. Some of the hieroglyphs used as logograms have a direct iconic link with the linguistic sign, such as  (F16) in the writing of the lexeme *ꜥb* 'horn,' or  (E22) for *mɜj* 'lion.' Tokens of iconic logograms range on a scale from greater standardization to greater variation. In the latter case, the logogram can represent quite realistically the visual referent.

Fig. 12a. Offering formula, bottom of the limestone slab of Iry and Inet, 4th Dynasty (James, 1961, pl. 3).

An early such example has been pointed out by Fischer (1963, pp. 23–24). Despite the fact that the Egyptians favoured the physical ideal of vigorous youth when representing themselves in their tombs (with male figures that can be decidedly obese, pointing to the ideal of sedentary and well-fed ease), the logogram  (A19) for *iɜw* '(be) old' in the funerary formula of Fig. 12a is actually drawn as a partly bald and emaciated individual, with starkly projecting clavicles and ribs (Fig. 12b), which is reminiscent of *Ptahhotep*'s famous incipit 'old age has arrived, infirmity has descended, misery has drawn nigh, and weakness increases' (Simpson, 2003, p. 130). This contrasts strongly with the usual (standard) occurrences of this hieroglyph that conform to the ideal type of representation. The scribe very apparently wished to underline the chiasm between reality and ideality (and to index his mastery) by using the full pictorial potential of such a logogram, and aligned the visual sign with the linguistic signified.

Fig. 12b. Details of the logogram *iɜw* '(be) old', visible with strong raking light (Fischer, 1963, p. 23).

Indices. In other cases, the logographic value is rooted in cultural and cognitive processes[48] that have been conventionalized in the hieroglyphic writing system. Examples of such logograms include for instance the pod from carob tree  (M29) for *nḏm* '(be) sweet' (OBJECT > PROPERTY > QUALITY), the bovine ear  (F21) for *sḏm* 'to hear' (ORGAN > FUNCTION > ACTION), a pair of half-loaves of bread  (X7:X7) for *wnm* 'to eat' (often in combination with the classifier  ACTION_MOUTH A2; OBJECT > FUNCTION > ACTION), the man building a wall  (A35) for *ḳd* 'to build' (AGENT & UNDERGOER > ACTION), the sail  (P5) for *ṯɜw* 'wind' (OBJECT > PROPERTY

48. Borghouts (2010, p. 48) provides a convenient list of the main types of relations between semograms and their referents. For a detailed discussion, see Lincke & Kutscher (2012).

> cause), or the pot of milk  (W20) for its content *irṯ.t* 'milk' (container > content). Lacau (1954, pp. 54–61) showed that tilting a sign can have the effect of modifying the value of a logogram, which can be understood as switching from an icon to an indice.[49] For example, the logogram  (T3) iconically refers to the substantive *ḥḏ* 'mace,' whereas  (T2) is an indice of the action performed with this mace, *sḳr* 'to strike.' Additionally, some signs have apparently been integrated in the hieroglyphic writing system because of differential features (Stauder, this volume), and can be interpreted (originally, at least) as indices. For example, the one-barbed harpoon  (T21) stands for *wʿ* 'one' (and related meanings) while the two-barbed harpoon  (T22) stands for *sn* 'two' (and related meanings).

Symbols. Some signs used as logograms have no apparent relationship with their linguistic value (at least synchronically). This is for instance the case of the pintail duck  (G39) for the word *sꜣ* 'son.' In this case, the original phonogrammatic writing of 'son' with  *s*(*ꜣ*) (derived from the logogram  *s*(*.t*) 'pintail duck') became conventionalized as a logogram  , as indicated by the vertical stroke that signals autonomous (logographic) uses. The duck was then able to become a general symbol for filial relationships.[50]

The examples above suffice to show that logographic use are not defined by the fact that the form of a given sign resembles, in one way or another, or is visually related to the notion it refers to: it is enough for a sign in context to refer to the two dimensions of a lexeme, namely to both a signifier and signified simultaneously, in order to meet the definition of logogram.

At this point, it is important to stress that there is an *n*-to-*n* relationship between hieroglyphic signs functioning as logograms and lexemes. Some logograms can indeed refer to multiple words (the polyvalency of logographic sign[51]). The hieroglyph of the 'old man'  (A19) discussed above, for example, can be a logogram for *iꜣw* '(be) old,' *šmsw* 'eldest,' or *wr* 'great one, chief.' Some linguistic units, on the other hand, can be represented by the combination of several 'atomic' signs (see above the case of a pair of half-loaves of bread for *wnm* 'eat'). Originally, for instance, the group  (the seated man [A1] + the seated woman [B1]) could be used as a logogram for the single lexeme *rmṯ* 'people' (*e.g. Urk.* I, 57,15 & 16, cf. Lacau 1913, 7–11; tomb of *Sšm-nfr*, late 5th dynasty).

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49. The distinction between the semiotic categories 'index' and 'indice' (Klinkenberg, 1996) is blurred in English. The French label 'indice' is used here in order to avoid any confusion.

50. See Vernus (2003, pp. 196, 212–213) who states that in such a case, "*un rapport, originellement inexistant, est établi secondairement entre ce que représente un signe et ce qu'il signifie. Le canard devient ainsi le symbole de la relation filiale*". See further Goldwasser (1995, pp. 75–76) for the metaphoric relationship between the word *sꜣ* 'son' and the duck, which likely yielded the use of the egg sign (F8) for 'son' (the egg being the source of all 'sons' of the duck).

51. This has sometimes been called 'the flexibility of the ideographic signs.' See the discussion in Schenkel (2003, pp. 13–18).

This principle is to be compared with the repetition of logograms in the spellings of duals, such as  EYE/*ỉr*-EYE/*ỉr* = *ỉr-tj* (eye-F.DU) 'the (two) eyes'—which can be figuratively arranged as  EYE/*ỉr*-EYE/*ỉr-t* = *ỉr-t(j)* (eye-F.DU) 'the (two) eyes' (*Pyr.* §551)—, and of plurals built with three occurrences[52] of the same logogram (Fig. 13a), which is one of the common ways of expressing plurality (with the so-called 'plural strokes' ||| [Z2]).

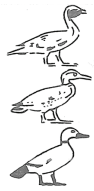
ȝpd/BIRD-*ȝpd*/BIRD-*ȝpd*/BIRD

ȝpd-w

bird-PL

'birds'

Fig. 13a. Temple of Opet (Karnak, Roman period), KIU 4233, Title, l. 2.



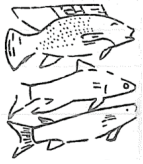
BIRD$^{\text{SPECIES A}}$-BIRD$^{\text{SPECIES B}}$-BIRD$^{\text{SPECIES C}}$

ȝpd-w

bird-PL

'birds'

Fig. 13b. Tomb of Pepiankh, Title of a scene (Meir, 6th Dyn.); Blackman (1924, pl. VIII).



FISH$^{\text{SPECIES A}}$-FISH$^{\text{SPECIES B}}$-FISH$^{\text{SPECIES C}}$

rm-w

fish-PL

'fishes'

Fig. 13c. Tomb of Pepiankh, Title of a scene (Meir, 6th Dyn.); Blackman (1924, pl. VIII).

Interesting to note here is the phenomenon known as 'graphic dissimilation'[53] in Fig. 13b-c, which is attested for the semograms (logograms and classifiers alike): instead of repeating the same hieroglyph three times in order to express plurality (as in Fig. 13a), the scribe draws three different types (here, species) belonging to the category expressed by the lexeme (Fig. 13c). The diversity implied by the plural is thereby expressed figuratively. This phenomenon is characteristic of (but definitely not limited to) the formative periods and Old Kingdom, and concerns mostly animates (both humans and animals) as well as all sorts of goods and offerings (quite obviously frequently occurring in the tomb inscriptions of the time).[54]

52. On triplication in the process of sign formation in general, see Lacau (1954, pp. 24–54).

53. The label 'dissimilation graphique' was coined by Posener (1934) and subsequently studied by Drioton (1949), van de Walle (1955), and Thuault (2017). See further Fischer (1977a, p. 1191, 1986, pp. 33–34) and Lincke (2011, pp. 32–34). The phenomenon was of course known and studied before, see *e.g.* Lacau (1913a, pp. 60–61): "[*p*]*our écrire le nom d'une collectivité formée d'éléments différents, on dessinait à l'origine trois éléments qui la composent*."

54. Note that—probably mostly for esthetic rather than symbolic reasons—the principle of 'dissimilation' can be applied not to the shape, but to the colors of the hieroglyphs; see already Lacau (1954, pp. 13–14).

2.3. *Phonogram*

[–SEMOGRAPHIC], [+PHONOGRAPHIC], [+AUTONOMOUS]

In ancient Egyptian, phonograms are graphemes that represent between one and three—on exception four—consonantal (or semi-consonantal) phonemes (the vowels are normally not written in Egyptian), namely graphemes that refer to distinctive units [+PHONOGRAPHIC] and not to meaningful units [–SEMOGRAPHIC]. The preposition *ḥnꜥ* 'with,' for instance, is written  , with three mono-consonantal signs (called 'uniliteral' hieroglyphs): the wick of twisted flax (V28) = *ḥ*, the ripple of water (N35) = *n*, and the forearm (D36) = ꜥ. Each of these phonograms is graphematically autonomous, which means that <*ḥ*> + <*n*> + <ꜥ> = <*ḥnꜥ*> 'with,' which is analogous to <b> + <e> + <d> = <bed> (= /bɛd/) in English. Depending on the period, there are about 28 uniliteral signs for 25 consonants,[55] since some (semi-)consonants can be represented by two different signs (a phenomenon known as 'polygraphy'): the ripple of water (N35) and the red crown of Lower Egypt  (S3), for example, can both be used for <*n*> (even if the latter is rare before the New Kingdom, c. 1450 BCE, and will remain much less frequent). Note that polygraphy can be used as a mean to disambiguate between two otherwise homographic lexemes. The sign representing the female sex organ  (N42) and the club  (U36)[56] can both be used as phonograms for <*ḥm*>, but one will occur in  *ḥm-t-*WOMAN 'woman' (probably inheriting from its figurative origin), while the other is rather used for *ḥm-t-*WOMAN 'maid-servant' (Fischer, 1977a, p. 1190). These kinds of word associations are of course trends (or strong tendencies), but no absolute orthographical rules.

The uniliterals seem to have all been derived pretty early (Kahl, 1994) from (putative) logograms by 'weak acrophony' (Quack, 2010a, p. 237; Vernus, 2015, pp. 153–159), namely ignoring (at most) a weak semi-consonant or a feminine ending from the phonemic shape of the said-logogram[57] (Fischer, 1977a, p. 1190). An example shall suffice to illustrate this point. The sign of the horned viper (I9) is the uniliteral phonogram *f*. This value can be explained by applying the 'weak acrophony' principle to the onomatopoeic name of the horned viper (*fy*/HORNED_VIPER): (1) the signifier of the logographic sign is kept (*fy*), while the signified is dismissed (~~HORNED_VIPER~~); in a second step *fy* is reduced to *f*, with loss of the semi-consonantal *yod* (Vernus, 2015, p. 156). It should be stressed that already

55. Note that the consonant *l*, whose phonemic status is unclear in Egyptian, is not rendered by a single and unique hieroglyphic sign, but by polygrams (Quack, 2010a, p. 242).

56. See Beaux (2009a, p. 254).

57. Acrophony is used abundantly in the so-called cryptographic inscriptions, where uniliterals are derived from longer roots; see already Drioton (1933, pp. 10–11), who distinguishes between '*acrophonie syllabique*' and '*acrophonie consonnantique*' (Drioton, 1933, p. 31), and the later analysis by Sauneron (1982, Chapter IV) who puts forward the principle of 'dominant articulation.'

during the old Kingdom, words or even sentences could be written entirely with uniliteral signs in specific ritual or funerary contexts (Schenkel, 2011; Schweitzer, 2003), which entails that some sort of 'alphabet' (or rather abjad) had already been 'invented' pretty early in ancient Egypt, but—*pace* the teleological views of some scholars (Gelb, 1963)—never surpassed the intrinsically polyfunctional hieroglyphic system (Goldwasser, 1995, pp. 77–78).[58]

Phonograms are defined here strictly as non-semographic [-SEMOGRAPHIC], which is a feature that can be tested empirically: signs that function as phonograms should occur in unrelated words, *i.e.*, words that do not share the same root (and hence, without common semantic components). Although this holds true for most uses of the uniliteral signs (*i.e.*, when they are not used as logograms), the point is sometimes more difficult to assess for biliteral signs (and all the more for triliteral signs). As a prototypical example of a biliteral phonogram, one can quote the grapheme  *mi* (a milk jug carried in a net; W19): it can appear in unrelated words like *mi* 'as,' *miw* 'cat,' or *dmi* 'town,' which shows quite clearly that it has no other value there than a phonographic one. The scribe's equipment  (Y3), on the other hand, is probably not merely a phonogram for *sš*, since it always occurs in words that have to do, in one way or another, with [WRITING] (hence it rather qualifies as a radicogram, see §2.5.). As can be observed, the actual uses of signs bring some empirical gradience between the clear-cut categories of semograms and phonograms.[59] This observation is to be considered in relation to the origin of the phonographic functions of the hieroglyphic signs, which can be described as the result of a process of 'de-iconization'[60] (also labeled 'abstraction du référent'[61] or 'phonetic metaphor'[62]) through which the graphemic sign progressively loses its semantic link to the entity depicted and becomes available for representing a phonemic shape. The famous *rebus* principle at stake does not impede some graphemes used as phonograms from keeping semantic features associated with the depicted hieroglyph.[63]

Note that, in the New Kingdom (perhaps under the influence of cuneiform), one observes a significant development of a kind of syllabic script, the so-called

58. See the comments below about syllabic orthography.

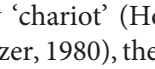
59. See especially Schenkel (2003, pp. 20–29).

60. See Goldwasser (1995) and Loprieno (2003b, pp. 126–128).

61. Vernus (2003, p. 197).

62. Goldwasser (1995, pp. 71–74). Since some signs are admittedly more iconic than others (compare the 'milk jug in a net' with the 'scribal outfit' above), a hypothesis to investigate would be that some hieroglyphs were more difficult to de-iconize than others. Furthermore, it should be kept in mind that some phonological combinations are more frequent than others. Here again, the phonological sequence *mj* of the milk-jug is assuredly more frequent than the one noted by the scribal outfit. I am grateful to Jean Winand for fruitful suggestions on the topic.

63. See the numerous examples discussed in Vernus (2003, pp. 200–212).

'syllabic orthography' (or 'group-writing'):[64] the words are entirely written with uni- and with biliterals (with their interpretants) in groups whose second consonant is a semi-vowel. From the traditional Egyptian orthography, these words only preserve classifiers at the end, such as for instance in  *ma=_r=ka=ba=ta-*WOOD *mrkbt* 'chariot' (Hoch, 1994, pp. 145–147). However, the mnemonic dimension (Meltzer, 1980), the disambiguating orthographic tradition (Gunn, 1943, p. 56), and the figurative potential of the hieroglyphic script apparently impeded the greater development of this kind of spellings, which remained virtually limited to foreign words and native lexemes that recently entered the scribal repertoire, *i.e.*, words without orthographic traditions within the hieroglyphic system (Winand, 2017).

2.4. *Classifier*

[+SEMOGRAPHIC], [–PHONOGRAPHIC], [–AUTONOMOUS]

Signs that qualify as classifiers are (written) morphemes that occur syntagmatically at the end of a word [–AUTONOMOUS] and provide information about the semantic classification of a lexeme [+SEMOGRAPHIC], without referring to elements belonging to the second articulation of language [–PHONOGRAPHIC]. For descriptive and comparative purposes, hieroglyphs functioning as such are better called 'classifiers' than the traditional Egyptological label of 'determinatives,' since they behave analogously to classifiers in classifier languages.[65]

The categorization by classifiers can operate at two levels:[66] 'lexeme classification,' when the linguistic signified is categorized, and of 'referent classification,' when the classifier points to the referent in context.[67] This distinction between lexeme and referent classification can be illustrated by considering different instances of the word *twt* 'statue, image' (*Wb*. V, 255,8-256,20). This word is commonly written with three uniliteral signs (*t-w-t*) and can be classified with the hieroglyph representing the statue of a man with stick and scepter (A22)—  *t-w-t-*STATUE—or with the mummy upright (A53)— *t-w-t-*IMAGE (cf. Fig. 14a). Such classifiers indicate that the sequence of phonograms *t-w-t* refer to a lexeme semantically associated with the notions of STATUE/IMAGE (lexeme classification).

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64. See the recent synthesis of Quack (2010b). The vocalic dimension of this syllabic orthography is still disputed between specialists.

65. See Goldwasser (2002, 2006, 2009a); Goldwasser & Grinevald (2012); Kammerzell (2015, pp. 1396–1399); Lincke (2011); Lincke & Kammerzell (2012). Note that the term 'classifier' has recently been applied to the Sumerian cuneiform script; see Selz *et al.* (2017).

66. On the types of relations (taxonomic, schematic, meronymic) between the classifier and the classified, see Goldwasser (1995, pp. 85–99, 2002) and Lincke (2011, pp. 25–43). For verbal lexemes, see Kammerzell (2015) and Lincke (2015).

67. On this distinction, see Lincke (2011, pp. 93–110) and Lincke & Kammerzell (2012, pp. 88–98), with the discussion by Loprieno (2003a, pp. 246–248) of the intensional vs extensional meaning of classifiers.

*t-w-t-*STATUE/IMAGE

Fig. 14a. Hypostyle hall (Karnak, Seti I), KIU 795, Title, l. 1.

*t-w-t-*IMAGE_OF_ITHYPHALLIC_GOD_AMUN-MIN_WITH_FLAIL-SCEPTER

Fig. 14b. Annals of Thutmose III (Karnak), KIU 7208, col. 21 (Gabolde & Gabolde, 2015, p. 69).

However, the classifier can be adapted to the context of use in order to provide information about (extra-linguistic) features of the referent.[68] On the south internal wall of the room of the Annals of Thutmose III, for instance, a specific spelling for the word *twt* 'image' appears (Fig. 14b). In this text, the king narrates the many monuments he erected for his 'father' the god Amun. When describing the door of the seventh pylon (Gabolde & Gabolde, 2015, pp. 68–69, 94), the text specifies that there is a divine figure on it, that consists of a *twt nḫw* (*n*) *nṯr pn* 'a protecting image of this god' (namely Amun). From a strictly linguistic point of view, the text does not say anything else. However, the highly detailed classifier used in this context allows the reader to understand immediately that the said image is, in this context, the prophylactic figure of the ithyphallic god Amun-Min, particularly well suited for this kind of architectural element. The classifier is evidently based on the canonical artistic representations of the god, but is configured as a statue and calibrated as a writing sign.

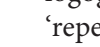
Diachronically, a likely scenario for the development of the classifier function within the hieroglyphic writing system can be sketched roughly as follows. In a first step, logograms are accompanied by interpretants (§2.6.) that facilitate their reading (Lacau, 1954, pp. 88–107). A simple example is the spelling of *mr* 'canal':  *mr-mr*/WATER_CANAL. In this spelling, the logogram  (*mr*/WATER_CANAL, N36) is preceded by the phonogram *mr* (U7) that makes the reading of the logogram explicit. From the Old Kingdom onwards, an evolution of the system (Collombert, 2007, pp. 23–24), probably culminating during the Ramesside period (Chantrain, 2014), can be observed: specific logograms with (preceding) interpretants are progressively replaced by phonograms with generic classifiers.[69] The word-final position of logograms, such as (N36) in the example above, paves the way for their use as classifiers thanks to what I would call the 'inverse rebus' principle (or 'abstraction du signifiant'[70]): the phonographic value of the

68. For the plural *twt-w* 'statues' classified by three different types of statues ('graphic dissimilation', cf. §2.2.), see van de Walle (1955, p. 370).

69. One can note a possible influence of the cursive (esp. hieratic) script here, which tends to harmonize and simplify the hieroglyphic signary.

70. To echo Vernus' 'abstraction du référent' (cf. *supra* §2.3.).

logogram is dropped (~~*mr*~~), while the semographic value is kept (WATER_CANAL) and generalized (WATER_LOCATION). Consequently, a sign like  (N36) becomes available for classifying different lexemes, such *w3ḏ-wr* 'the sea' (lit. the great green)' ( *w3ḏ*/GREEN-*wr*-WATER_LOCATION) or *ḥp* 'the inundation' ( *ḥ-p*-WATER_LOCATION).

Consequently, it is not always possible (and does not always make sense) to distinguish between logograms (preceded by interpretants) and classifiers (preceded by phonograms): as there is a continuum of uses between the word-specific logograms and classifiers. Consider for instance the so-called 'echo classifiers' or 'repeaters',[71] which stem quite directly from logographic uses. Consider the spelling  (*m3-3-i*-LION) *m3i* 'lion.' In abstracto,  can legitimately be analyzed as a logogram (*m3-3-i*-LION) or as a repeater (*m3-[3]-i*-[LION]). However, when considering this spelling in a synchronic paradigmatic series such as  (*m3-[3]-i*-[LION]),  (*m3-[3]-i*-[QUADRUPEDE]), etc., the substitution mechanism would rather point to an analysis of the sign  as a repeater.

2.5. *Morphogram*

[+SEMOGRAPHIC], [+PHONOGRAPHIC], [−AUTONOMOUS]

Morphograms are graphemes that refer simultaneously to some form [+PHONOGRAPHIC] and some content [+SEMOGRAPHIC]—just like logograms—, but are not autonomous: they are accompanied by other autonomous or non-autonomous graphemes that specify the meaning (classifiers) or phonemic shape (interpretants) of the written lexeme.

Graphemes that are used in such a way in the hieroglyphic system can refer to ancient Egyptian *roots*,[72] and are then labeled *radicograms*.[73] The hieroglyph of the lizard  (I1), can be used to illustrate this function, as it occurs, with the reading *ꜥš3* and the basic meaning [(BE) NUMEROUS], in a series of lexemes sharing the same root, such as *ꜥš3* '(be) numerous' ( *ꜥš3*-[PLURAL]), *ꜥš3w* 'quantity' (*ꜥš3-[3]*-[PLURAL]), *ꜥš3-t* 'the multitude' ( *ꜥš3-[3]-t*-[MAN-WOMAN-PLURAL]), etc. The value of this sign could derive from the proliferation of lizards or geckos in Egypt (Collombert, 2010, p. 75), and the very name of the animal is possibly[74] based on this very observation. Indeed, as noted by Vernus (2003, pp. 210–211):

> *Beaucoup d'êtres ou d'objets susceptibles d'être promus référents d'un hiéroglyphe étaient désignés en égyptien à partir d'une épithète dénotant la qualité ou l'action dont l'être ou l'objet était considéré comme le parangon, le prototype, ou*

71. See *e.g.* Goldwasser (2002, p. 15) and Goldwasser & Grinevald (2012, p. 20).

72. On 'morphograms' in general, see Klinkenberg & Polis (this volume, §3 and §3.2.).

73. See Meeks (2004: XXIV) and Schenkel (1971, 1984, 2003).

74. The lexeme *ꜥš3* 'lizard' is not attested before the Middle Kingdom (Collombert, 2010, p. 75), but this might be purely accidental given the nature of the older corpora.

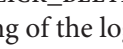
une illustration topique. Ces noms étaient entrés dans la langue avant l'écriture. Au fur et à mesure que l'écriture se mettait en place, les hiéroglyphes représentant ces êtres et objets étaient utilisés comme phonogrammes pour écrire le verbe exprimant la qualité ou l'action en question et les mots qui en dérivaient, que l'étymologie fût encore plus ou moins consciente ou qu'elle ait été oubliée.

Similarly, the red flamingo  *dšr* (G27) occurs in the spellings of words associated with the notion [(BE) RED]: this icon might indeed have been chosen as a grapheme, precisely because this bird was called or nicknamed 'the red one.' Other types of morphograms, like inflectional graphemes, affixes, etc. are more widespread across writing systems (Klinkenberg & Polis, this volume).

2.6. *Interpretant*

[−SEMOGRAPHIC], [+PHONOGRAPHIC], [−AUTONOMOUS]

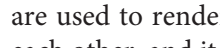
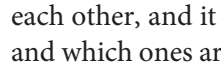
Interpretants are usually labeled 'phonetic complements' in the Egyptological literature.[75] They are non-autonomous graphemes that interpret—and thereby facilitate the reading of—the phonemic signified of other logograms, radicograms or phonograms. The most usual interpretants are the uniliteral signs, *e.g.* in groups like  *ḏb* (*ḏb-*^{b}),  *mn* (*mn-*^{n}), or  *ȝb* (*ȝb-*^{b}). In the last case, the interpretant raises an ambiguity regarding the value of the biliteral sign , here *ȝb* and not *mr*,[76] another possible reading of this sign that would be triggered by the use of other interpretants, such as  *m* and  *r* in (*mr-*$^{m\text{-}r}$). But other phonograms (bi- or triliterals) can also be used as interpretants. In the spelling  'click beetle'[77] (*ꜥnḫ-ꜥnḫ*/CLICK_BEETLE), for example, the triliteral phonogram  (*ꜥnḫ*) provides the full reading of the logogram *ꜥnḫ*/CLICK_SCARAB (Lacau, 1954, p. 92).

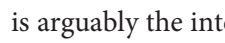
It can be noticed that interpretants can themselves be interpreted, which is to be linked to the tension between economy and readability in the hieroglyphic writing system. A straightforward example is the verb *wbȝ* 'to open up' that can be spelled  *wbȝ-*$^{bȝ\text{-}ȝ\text{-ABSTRACT}}$, with the radicogram *wbȝ* (hand drill, U26), interpreted by the biliteral  *bȝ*, itself interpreted by the uniliteral *ȝ*, and followed by the 'abstract' classifier  (papyrus roll, Y1). The frontier between phonograms and interpretants can be blurred almost completely in cases such as

75. Kammerzell & Lincke (2012, p. 59, n. 7): "[t]his term should be avoided because of the danger of its wrong implications: These elements do not hint at any phonetic (as opposed to *phonological*) properties and the element hosting an alleged complement is not in any way incomplete without it. Therefore, it seems more reasonable to name such an element according to what it actually does: (partially) interpret a phonogram or logogram." For the semiotic notion of *interpretant* in Egyptology, see already Kammerzell (1993, p. 243). Note that the label 'metalinguistic informant' is used in te Velde (1988).

76. On the ongoing debate regarding the reading of this grapheme as *mr* or *mḥr*, see Schweizer (2011, pp. 142–144), with previous literature.

77. To be more precise, this insect is probably the *Lanelater notodonta* (Meeks, 2010, pp. 288–289).

šs3-t 'nightfall,'  *š-s-s3-3-šs3-t-*NIGHT, where five phonographic hieroglyphs are used to render three consonants:[78] the signs somehow appear to all interpret each other, and it seems difficult to determine which ones are used autonomously and which ones are not. As a matter of fact, the triliteral  *šs3* (head of bubalis, F5) is arguably the interpretant of the preceding uni- and biliterals (and not the other way around). Such interpretants are known as 'phonetic determinatives' in the Egyptological literature, and were recently termed 'phono-repeaters' by Werning (2015, §13). Let's take an additional example (Goldwasser, 1995, pp. 45–46). In the word  *jb* (*j-b-*^{jb}-WATER-MOUTH) 'thirst,' it would be misleading to analyze *j* and *b* as the interpretants of a phonogram *jb*, since the syntax of hieroglyphic system rather works the other way around: the use of *jb* is triggered by the phonograms *j* and *b*. As Gardiner (1957, p. 50, §54) puts it, "the entire word  *jb* (*j-b-*KID) 'kid' enters bodily into the writing of the etymologically unrelated word for 'thirst'."

As hinted at in the previous paragraph, the interpretants contribute significantly to the readability of hieroglyphic texts, so that titles or sentences that lack such elements completely (*e.g.*,  (*s*)*ḥ-pr*/HOUSE-*wr-*SHRINE (*s*)*ḥ pr-wr* 'erecting the Great-House, *i.e.* the national shrine of Upper Egypt'[79]) are usually seen as archaic or abbreviated spellings after the Old Kingdom.

The preceding discussion of the functions of the hieroglyphic graphemes highlights the importance of the graphemic notion of 'autonomy' for analyzing the precise value of hieroglyphic signs in context. In the next two sections, we turn to the visual syntax of the hieroglyphic graphemes, first focusing on the spatial arrangement of the hieroglyphic signs within a line (Section 3), and then examining the various text orientations (Section 4).

3. The spatiality of pictorial graphemes

In Section 1, the spatial and linear organization of the hieroglyphic graphemes has already been briefly touched upon. The basic principles can be summarized as follows.

- In terms of *spatiality*, the hieroglyphs are grouped together and arranged following recurring principles (*regularity*) in such a way that as few blank spaces as possible are left within the written lines (*density* of the inscription).
- In terms of *linearity*, the hieroglyphs follow each other in columns (Fig. 2a) or in rows (Fig. 2b) and are oriented toward the right (→, the text reads from right to left, the unmarked reading order) or towards the left (←, the text reads from left to right).

78. On the syntagmatics of the interpretants, see Schenkel (2005, pp. 47–49).

79. Cf. Lacau (1954, pp. 87–88).

The esthetic effect resulting from (and targeted by) the spatial organization of the inscription is rather self-evident, but is not the only goal, since several cases of grouping are visually motivated (see §3.6., below). Before proceeding with the presentation of the main types of spatial arrangements attested in hieroglyphic Egyptian, it should be noticed that, much like in modern typography, *kerning* can play a significant role in the layout of hieroglyphic inscriptions.[80] In Fig. 15, one can observe that some signs are markedly kerned, both when the text is written in horizontal lines and in columns—grey zones in the standardized transcription refer to kerning. In (a), for instance, the cormorant sign (G25) is kerned both to the left and to the right, with its beak over the back of the owl (G17) and its tail protruding into the next quadrat ( ). Similarly in (b), the sign (N28) is kerned downwards in order to fill in the blank space available on top of the forearm hieroglyph (D36), and the same applies for the bread sign (X1) on top of the swallow (G36).

Fig. 15. White chapel of Senusret I (Karnak – 12th dynasty), (a) pillar 1.n (KIU 1098), line 11 and (b) pillar 2.s (KIU 1103), line 5, with standardized transcriptions.

As can be seen in Fig. 15, the spatial organization of the graphemes within a line is pervasive in hieroglyphic inscriptions, with different kinds of regular patterns attested. The most common of these is assuredly the simple type of quadrat (see §1 above), in which the signs are *tabulated* horizontally and/or vertically in order to fill in the writing space best. In Fig. 15a, examples of this pattern are numerous: from the sequence , from the sequence (‘half-quadrat’), from the sequence , from the sequence , from the sequence , and from the sequence . Among the other (less frequent) patterns, one also finds the *insertion*, such as in the group in Fig. 15b, where (X1) is inserted in the space available on top of (the back of) the owl (G17), with the resulting group standing for the sequence + .

80. See Nederhof *et al.* (2017, p. 9); Glass *et al.* (2017, pp. 19–20).

In the following sections, the term 'group(ing)' will be used in order to refer to any kind of spatial organization of the hieroglyphic signs within a row or column; the discussion is purposely limited to the grouping of hieroglyphs that are attested independently, and does not include the creation of new hieroglyphs by addition, subtraction, or replacement of figurative elements that are not themselves part of the signary[81] (on this aspect, see §1 above about the *modifiability* of the signs and *expandability* of the repertoire). Five basic operations are identified for grouping hieroglyphs:

Operation	Example		graphemes
– tabulating		<	
– inserting		<	
– stacking		<	
– connecting		<	
– combining		<	

Table 1. Basic operations for grouping hieroglyphs.

In Tab. 1, the operations are listed according to the degree of visual fusion (and semiotic interaction) between the components of the resulting group, from the lowest (tabulating) to the highest (combining). It should be stressed that these operations are not mutually exclusive: they can combine in various ways so as to create more complex types of groups. It can further be noted that, unlike with Maya or Chinese graphemes, the combination of hieroglyphic signs does not lead to the use of allographs: the degree of iconicity of the graphemes is not affected by their arrangement in groups. The five operations are succinctly presented below (§3.1.-3.5.), before a discussion of the compositional vs non-compositional reading of the different types of groups (§3.6.).

3.1. *Tabulating*

Groups that result from tabulation, understood here as a cover-term for both vertical and horizontal grouping, are by far the most common for all periods and all corpora. As illustrated by Fig. 2 or Fig. 15, this organization of the hieroglyphic graphemes might imply no (or very limited) size reduction of the individual signs when compared to their independent use (see above, §1): it is then a way to organize the (tall, low, broad or narrow) signs in the most elegant way within the

81. Meeks (2017, pp. 2–3) refers to these glyphs as 'complex hieroglyphs'.

space of the written line. The resulting quadrats read from top to bottom and from right to left (when the graphemes are facing right), or from left to right (when the graphemes are facing left):[82]

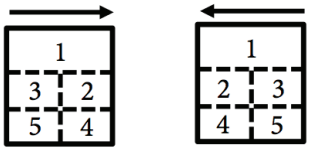


Fig. 16. The reading order of tabulated groups.

Although diachronic studies on this aspect of the writing system are currently missing, it seems that one observes, from the First Intermediate Period onwards (c. 2100 BCE), a progressive increase in the number of signs per quadrat in certain (mostly horizontal) hieroglyphic inscriptions, which led to much denser lines.

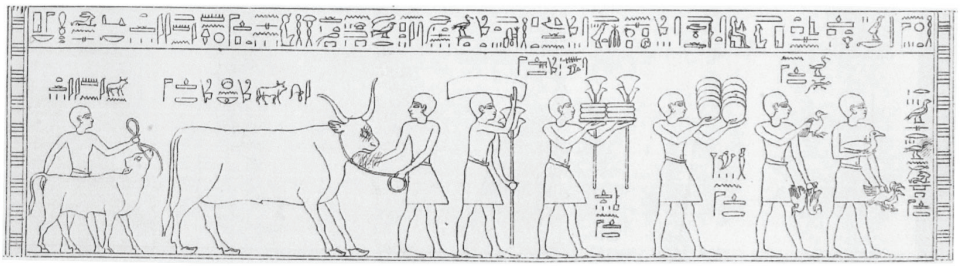


Fig. 17. Procession with bandeau-text in court A of Ramesses II's temple of Abydos; interior – south wall (Mariette, 1880, pl. 9).

Fig. 18 is a normalized hieroglyphic transcription of a section of this text, which reads '(the gods) reposing in their place in my august temple, in their form of the primeval time of their birth, which Ptah created following the writings of Thot about their physical appearance (that are found) in the great register which is in the House of Books (*i.e.*, library).' The numbers on top refer to 'quadrats' (the limits between some of which are admittedly quite arbitrary, such as 4, 6, 9 and 13-14).

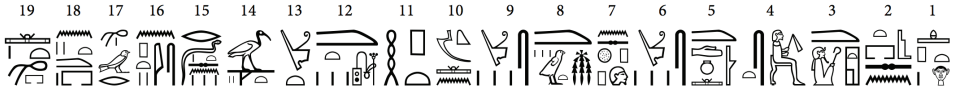


Fig. 18. Normalized hieroglyphic transcription of a section of Fig. 17 (see K*RI* II, 532,1-2).

First, it should be noted that the tabulated groups are not necessarily 'squares,' as the term 'quadrats' would seem to imply. The goal is indeed to fill in the writing space best, and some groups (*e.g.*, 3, 8) can be larger than others (*e.g.*, 11, 13). Second, the number of possible tabulated patterns is not endless, but very varied.

82. The basic reading order of the compound glyphs in Maya is similar, cf. Coe & Van Stone (2005, pp. 17–19).

Fig. 19 shows that among the 16 tabulated groups of Fig. 18, there are 14 different tabular organizations.

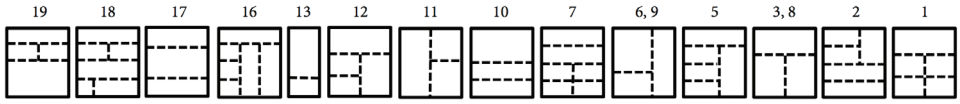


Fig. 19. The 14 tabulated patterns of Fig. 18.

This spatial organization was occasionally used in order to avoid the repetition of some graphemes. The family stela of the priest Qemnen and his wife Henenti provides an example of such a case in a horizontal line (Fig. 20). The phrase *ḥm-t-f mr-t-f wife*-F-3SG.M beloved-F-3SG.M 'his wife, his beloved one,' is indeed written as a single quadrat and the sign of the horned viper—the phonogram *f* that stands for the third person masculine singular suffix pronoun—, has to be read twice, namely after *ḥm-t* wife-F and *mr-t* beloved-F[83]. This principle of factorization is more commonly applied in texts with a vertical layout (such as in *Coffin Texts*).

Fig. 20. From Stela Turin Cat. 1513 (11th dynasty, c. 1950 BCE) (Donadoni Roveri, 1987, p. 109, figs. 139–140).

3.2. *Inserting*

Insertion is the second most common way of creating groups. The basic principle is to insert a hieroglyph—or a group of hieroglyphs—within an empty space of the virtual bounding box surrounding another sign.[84] Fig. 18 provides examples of the two main types of insertion, namely (1) *corner* insertion and (2) *center* insertion.[85]

Corner insertion is illustrated in five different quadrats of Fig. 18. A single sign can be placed in the empty space of another one (Fig. 21a-b): inserted in (top-right),  inserted in  (bottom-right). A single sign can host hieroglyphs in

83. See §4.1. below for similar *apo-koinou* graphemic constructions.

84. Egyptologists never made the distinction, often found in the literature about Maya hieroglyphs (Coe & van Stone, 2005, pp. 17–18), between main signs and smaller ones that are termed 'affixes.'

85. See Nederhof *et al.* (2017, pp. 4–5). The description provided here differs from (but is not incompatible with) the typology provided by Meeks (2017, pp. 4–6). Note that the relationship between the host-sign and the inserted sign(s) is not functionally limited: phonograms, logograms, classifiers, etc. can combine without restrictions.

different corners, such as 𓊃 (bottom-right) and 𓏺𓏺𓏺 (top-left) in 𓅱 (Fig. 21c) or 𓈖 (bottom-right) and 𓏺𓏺 (bottom-left) in 𓅓 (Fig. 21d).

(a) (b) (c) (d) (e)

Fig. 21. Different types of corner insertion.

Groups created with other operations, like tabulation (§3.1.), can be inserted into corners. This is illustrated in Fig. 21e: the tabulated group 𓏏𓏛 is scaled down and integrated in the empty space at the bottom-right of the cobra sign 𓆓 (I10). Conversely, groups resulting from insertions can be used as building units for other operations—see for instance the tabulated quadrats 8, 10, 15 and 19 above, in which groups involving corner insertions are tabulated as simple hieroglyphs.

In terms of reading order, two principles can apply: what I would call (1) the two-dimensional (or directional) reading order and (2) the three-dimensional (or salient) reading order. The two-dimensional reading order obtains when the basic reading order of (tabulated) quadrats (Fig. 16 above) is respected: signs are read as a sequence starting at the top-right and finishing at the bottom-left (when the signs are oriented rightwards). Fig. 21a (𓂝𓃀), for example, is read *ḳmȝ* from 𓎛 <*ḳ*> and 𓄿 <*mȝ*>, the three consonants of the verb *ḳmȝ* 'to create.' The three-dimensional reading order means that the bigger sign is read first and that the smaller ones follow, which implies some kind of spatial 'zoom-in' from the bigger to the smaller sign(s), which breaks the linearity of the two dimensional reading order. In Fig. 21c (𓅱𓏺𓏺𓏺), for example, the quail chick 𓅱 (G43) reads first as <*w*>, before the bread sign 𓊃 (X1)—which functions as a phonogram with the value <*t*>—, and finally the plural classifier 𓏺𓏺𓏺 (Z2). The whole group is the plural feminine ending <-*wt*> of the word *ms-wt* 'births.' Note that a single type of insertion, such as 𓅱𓊃 built with 𓊃 <*t*> and 𓅱 <*w*>, can be read both as <*tw*> (directional reading order) and as <*wt*> (salient reading order). It is fair to acknowledge the fact that, with complex cases of insertions, different logics apply at the same time as regards the reading order, which would consequently be difficult to determine in a context-free environment. Fig. 22 is such a case. The phrase *jr ȝḫ-w* 'to perform rites' is rendered as a triple corner insertion within the *ȝḫ-bird* (𓅞), and its basic linear rendering would be: 𓂋 (*jr*/MAKE) 𓅞𓎛𓏺𓏺𓏺 (*ȝḫ-ʰ-w-*PLURAL 'rites').

Fig. 22. Relief Turin S. 6136/01-02, col. 6 (= CGT 50246) – Inscription of Amenmose, 19th Dynasty (Sethy II, c. 1200 BCE) – Tosi & Roccati (1972, p. 202–203; 305).

Center insertion is less frequent in terms of tokens, but equally productive as a means of building groups (Fischer, 1977b, pp. 5–6; Lacau, 1954, pp. 105–107). It is useful to distinguish between *full* center insertion and *partial* center insertion. The group  in quadrat 3 of Fig. 18 is a case of full center insertion, in which the interpretant <*t*> is completely integrated inside the logogram  <*ḥw-t*/TEMPLE>; the enclosing sign fully contains the inserted glyph.[86] Full center insertion also frequently occurs with hieroglyphic signs that are (more or less) open on one of their sides. In Fig. 23a, the tabulated group  , built with the radicogram <*wsḫ*/BE_LARGE> and with the phonogram <*t*>, is inserted into the logogram <*wsḫ-t*/BROAD_HALL> and functions as interpretant providing the full reading of the logogram. In Fig. 23b, the pair of arms  (D32) is embracing the logogram *ꜣḫ*/SPIRIT (that is fully inserted into the matrix sign); the resulting group reads *snḫw-ꜣḫ* '(who) embraces the spirit' (title of a funerary priest). In this second case, one can observe that the insertion is also visually motivated and meaningful, since the arms are indeed 'embracing' the logogram *ꜣḫ*/SPIRIT.

Fig. 23a. Red chapel of Hatshepsut (Karnak – 18th dynasty), North face, 4th register (KIU 1372), line 16

Fig. 23b. A Dynasty II example of center insertion (Fischer, 1977b, p. 5)

As illustrated by spellings of the goddesses Hathor and Nephthys, the reading order can be: host first, inserted sign(s) second—  *Ḥwt-Ḥr* 'Hathor', literally 'House of Horus,' from *ḥwt*  'House' and *Ḥr*  'Horus'—or inserted sign(s) first and host second—  *Nbt-ḥwt* 'Nephthys,' literally 'Lady of the House,' from  *nbt* 'lady' and  *ḥwt* 'house'.

Center insertion can also be *partial*, which obviously refers to signs that are not entirely inserted into other ones. There is some gradience as regards partial insertion. Fig. 24, for instance, shows several occurrences of the title *ḥm-kꜣ* 'ka-servant' (*i.e.*, a kind of funerary priest) on the same wall of the tomb of Inty, and a great degree of variation obtains as regards the degree of insertion of the club  (U36), which reads *ḥm* 'servant,' into the pair of arms (D32), which reads *kꜣ*. In all the cases, however, the insertion remains partial and the degree of insertion of the glyph does not affect the meaning of the groups.

86. The most famous cases of center insertion are assuredly the so-called 'serekh' and 'cartouche,' namely the 'palace-facade' sign  (O33) and the round cartouche  that enclose names of the king. However these insertions, if visually identical, differ inasmuch as the 'serekh' and 'cartouche' are not read.

Fig. 24. Offering bearers in the tomb of Inty (6th Dynasty, c. 2300 BCE; Abusir); Bárta & Frouz (2010, p. 49, Fig. 20).

Partial center insertion is attested with host signs that open up in any direction. If the most common are assuredly the center-bottom (Fig. 25a) and center-top (Fig. 25b), partial center insertion is also attested for signs that are open on one of their lateral sides (Fig. 25c).

(a) (b) (c)

Fig 25. Examples of partial center insertion.

The example of Fig. 25c (stela of Paser the Elder [Louvre C 65, l. 7]; 18th dynasty)[87] is particularly interesting, since this 'sportive' or 'cryptographic' spelling of the verb *prj* 'to go out' combines the phonogram *pr* (𓉐 = O1) that is usually used in the spelling of this verb, with the viper 𓆑 (I9), which is figuratively 'going out' of the house/hole represented by the phonogram, thereby creating a complex interaction between phonographic and semographic elements: the hieroglyph 𓉐 is both a phonogram and, once rotated counter-clockwise, an element of the complex semographic group 𓂋.

It is important to stress that both corner and (partial) center insertions are akin to (and cannot always be distinguished from) kerning (§3, above), since they rely on the same overarching principle (namely avoiding empty spaces). Fig. 26a provides quite a clear case of kerning (rather than insertion) within a quadrat: the sign 𓈎 (X1) is engraved perfectly between the hieroglyphs 𓎛 (O28) and 𓅱 (G14). In other cases, kerning and insertion combines. The hieroglyph of the arm 𓂝 (D36) in Fig. 26b is both inserted on top of the back of the quail chick (𓃀) and kerned towards the tail of the goose (𓅱).

87. Cf. Drioton (1933, pl. 5).

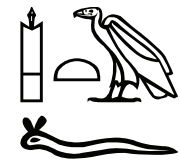


Fig. 26a. White chapel of Senusret I (Karnak – 12th dynasty), pillar 1.n (KIU 1098), line 8.

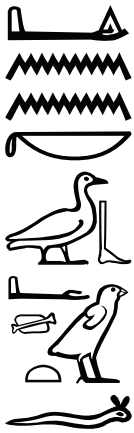


Fig. 26b. White chapel of Senusret I (Karnak – 12th dynasty), pillar 6.n (KIU 1068), line 6.

3.3. *Stacking*

Stacking refers to the superimposition of a sign—or of a group of signs—over another sign—or group of signs (Fischer termed this arrangement the 'transverse pattern'). This principle of combination is attested from the 3rd Dynasty onwards (and could derive from center insertion with broad signs, which encroached on the borders), but did not become frequent before the Middle Kingdom (Fischer, 1977b, pp. 8–11). This pattern grew in use until the New Kingdom, when visually and functionally unrelated signs could be stacked (Fischer, 1986, pp. 45–46). Stacking is usually resorted to in order to combine tall-narrow and low-broad hieroglyphic signs, without having to scale them down (Fig. 27a, from and). As shown by the comparison of Fig. 27b and Fig. 27c (on and vice versa), both from the *Annals* of Thutmose III (carved in limestone), the order of elements (tall on broad or broad on tall) can alternate, and is not meaningful from a linguistic point of view.[88]

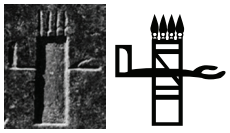
(a) 

Fig. 27a. Red chapel of Hatshepsut (Karnak – 18th dynasty), Soubassement 16 (KIU 1409), line 1.

(b) 

Fig. 27b. Annals of Thutmose III (VIth pylon, Karnak – 18th dynasty), (KIU 3475), line 18.

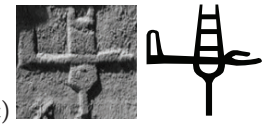
(c) 

Fig. 27c. Annals of Thutmose III (VIth pylon, Karnak – 18th dynasty), (KIU 3479), line 9.

88. To the best of my knowledge, the point has never been made that examples such as Fig. 27b should read *ʿḥʿ-ʿ* (with the interpretant read second, since visually behind), while examples like Fig. 27a should read *ʿ-ʿḥʿ* (with the interpretant read first, since visually above).

Even if most of the signs in stacked groups are centered (Fig. 27a-c), examples of low (Fig. 28a) and high transverse patterns (Fig. 28b) are not unusual (Fischer, 1977b, pp. 8–15). They do often appear to be motivated by figurative considerations, namely the non-interference between meaningful iconic details of the stacked signs (and can be an alternative to corner insertion, cf. Fig. 28a), or are preferred in order to allow additional types of spatial organization within individual quadrats to take place (such as the insertion of ⌓ and // in the lower corners of Fig. 28b).

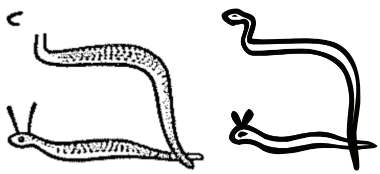
(a) 

Fig. 28a. Meir, Tomb-Chapel C, nº 1 (Blackman & Apted, 1954, pl. 18).

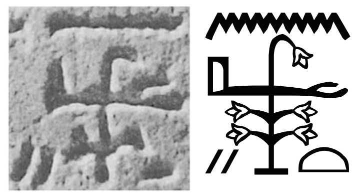
(b) 

Fig. 28b. Sandstone stela of ʿAmarah West (Fairman, 1938, pl. XI).

Fig. 28b further makes it clear that stacked groups can be tabulated just like any other hieroglyphic signs. Finally, it can be observed that signs are sometimes stacked over tabulated groups (Fig. 29a, in the word *ꜥbb* 'harpoon'), and even groups over other groups (Fig. 29b, in the word *gbgb* 'to slay'). This organization device appears to be especially productive during the Late and Ptolemaic Periods (Fairman, 1945, pp. 117–118; Meeks, 2017, p. 7; Nederhof *et al.*, 2017, pp. 6–7).

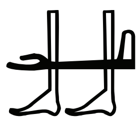
(a) 

Fig. 29a. Temple of Edfu (Chassinat, 1931, p. 87, 2).

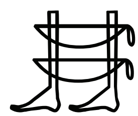
(b) 

Fig. 29b. Temple of Edfu (Chassinat, 1932, p. 292, 12).

Just as for tabulation and insertion, there are virtually no limitations as regards the respective functions of the stacked signs: phonogram(s) with phonogram(s) (Figs. 28a & 29a-b), phonogram(s) with interpretant(s) (Figs. 27b-c, 28b), logogram with interpretant(s) (Fig. 27a), but also classifier with classifier (= M1A), compounds (like *ḥw.t ꜥꜣ.t* 'Great House' = O8), etc.

3.4. *Connecting*

Connection is a spatial organization of the signs[2] that was productive during the formative periods of the hieroglyphic writing system (down to the Old Kingdom), but—opposite to what happened with the transverse pattern (§3.3.)—this strategy fell progressively out of use after the Middle Kingdom (Fischer, 1977b, 1986, pp. 44–46; Lacau, 1954, pp. 102–105), except for the signs that are simply put on the flat surface of another sign below, especially on the wickerwork baskets 𓎛, V30, and 𓏏, V31 (Meeks, 2004, p. 93).

Fig. 30. White chapel of Senusret I (Karnak – 12th dynasty), pillar 6.s (KIU 1065), line 6.

Fig. 30 provides an example of this practice, with the logograms 𓋹 *ʿnḫ* 'life,' 𓊽 *ḏd* 'stability,' and 𓌀 *wꜣs* 'power' standing on the quantifier 𓎛 *nb* 'all, any,' in a formulaic expression reading 'I [namely, the god] grant all life, stability and power to the king.'[90] Such connections are visually motivated since, according the Egyptian rules of representation, the emblems of life, stability and power are here contained in the basket represented by the hieroglyphic sign for *nb* 'all.'

It is useful to distinguish here between horizontal and vertical connections. Horizontal connections (which are called 'agglutinative patterns' by Meeks) appear to be virtually limited to signs that are identical, like 𓇋𓇋 *nṯr.w* 'gods' from 𓇋 *nṯr* 'god' (R8). When the signs are different (or exceptionally when the signs are identical, but hardly connectable)[91], one does rarely find a ligature (connecting line); see for instance the connection between the sign *wḏ* 𓂋 (V24) and its interpretant 𓅱 *w* (G43) in 𓂋𓅱 *wḏ* 'order' (Fischer, 1977b, p. 11).

The vertical connection of signs (which are called 'abutted composites' by Fischer), on the other hand, suffers no limitations. Interestingly, this process led to the emergence of several new graphemes, through a process that I venture to label 'graphemization' and define as a diachronic process by which two originally independent graphemes merge into a single, functionally non-ambiguous, grapheme. Vertical connection between hieroglyphs obtains with logogram and interpretant—*e.g.*, 𓎛𓏏 *ḥḳꜣ.t* 'bushel (a corn measure),' from the logogram 𓎛𓏏 *ḥḳꜣ.t* 'bushel' (U10) and the interpretant 𓁷 *ḥḳꜣ* (S38) (Lacau, 1954, p. 103); with phonogram and interpretant—*e.g.*, the phonogram 𓂝, which reads *tr* or *rnp*, and becomes

89. I do not include in the discussion here the hieroglyphic signs that are connected to the base line in horizontal inscriptions (cf. n. 22). Even if formally related, these connections are not linked to the spatial organization of signs within a line dealt with in this section.

90. On these three signs as 'travelling symbols' in the cultures of the ancient Levant and beyond, see Goldwasser (2017b, pp. 186–187).

91. See the example of 𓎛𓎛𓎛 *kꜣ.w* 'kas,' quoted by Meeks (2017, p. 7), in which the individual 𓎛 signs are indirectly connected.

unambiguous with the connection to the interpretant 𓊃 *t* in 𓐍 *tr* (M5), of 𓂋 *r* in 𓐍 *tr* (M6), or of 𓊪 *p* in 𓉐 *rnp* (M7); or with phonogram and classifier—*e.g.*, the graphemes combining a phonogram with the classifier of the moving legs (D54), which graphemized already during the Old Kingdom (probably based on the model of 𓃀 *jnj* 'to bring')[92] into logograms such as *šmj* 'to go' (from 𓈙 *š* and 𓂝), *jṯj* 'to take' (from 𓍿 *ṯ* and 𓂝), or *šsmj* 'to guide' (from 𓋴 *šsm* and 𓂝). Vertical connections are also used for entire phrases, such as *inr ḥḏ* 'white stone' (Fig. 31a, from 𓃀 *inr* 'stone' and 𓇋 *ḥḏ* 'white') or *ḳbḥ nm.t* 'butcher of the slaughterhouse' (Fig. 31b, from the jar that reads *ḳbḥ* and the chopping block with basin *nm.t*).

Fig. 31a. From Fischer (1977b, p. 13, Fig. 9b).

Fig. 31b. Facsimile based on Fischer (1960, p. 171b).

Interestingly enough, the example of Fig. 31b shows that connection can interact with other spatial strategies, since the interpretant 𓈖 *nm* (T35) and 𓊃 *t* are inserted at the center of the chopping block that reads *nm.t*.

3.5. *Combining*

Empirically, the border between connection and combination is fuzzy. This observation is easily demonstrated by the example of the verb *jwj* 'to come,' which is written with the hieroglyph 𓇍 (M18)—and additional graphemes—for specific inflections (Winand, 1991). This sign is quite obviously the combination (and not just the connection) of the phonogram 𓇋 <*j*> (M17) and of the moving legs classifier 𓂝 <MOTION>. As discussed in the previous section (§3.4.), this is exactly the same strategy as the one used for other motion events (namely, the use of a phonogram with the moving-legs classifier), but the specific shape of the phonogram 𓇋 <*j*> (M17) leads to a combination rather than a simple connection; the bottom part of the reed is modified in order to accommodate the legs: 𓇍 (M18).

I discuss three types of combinations: horizontal, vertical and complex combinations. Horizontal and vertical combinations characteristically do not imply the resizing of the hieroglyphs, while complex combinations do. Horizontal combinations of two (Fig. 32a) or three (Fig. 32b) hieroglyphs are common with graphemes that are identical or very similar (Fig. 32c, especially birds and mammals), and are directly guided by the rules for combining animates in other types of visual representations in ancient Egypt.

92. See the comments by Goldwasser (1995, p. 21) and Servajean (2016, p. 22).

(a) 

Fig. 32a. Combination of two owls 𓅭 (Paksi, 2017, p. 128, l. 6).

(b) 

Fig. 32b. Combination of three jabirus 𓅰 (White chapel of Senusret I, Karnak – 12th dynasty, pillar 1.s, KIU 1096, l. 3).

(c) 

Fig. 32c. Combination of a hartebeest, an antelope and a bouquetin (Meeks, 2012, p. 525 & n. 68).

The overlapping between signs that occurs with horizontal combinations is not attested with vertical ones; rather, the latter often imply the replacement of a figurative element of the main grapheme by a hieroglyphic sign that functions as interpretant of the new group. In Fig. 33a, for instance, the basket on top of the head of the classifier 𓀀 <CARRY> (A9) is replaced by the viper 𓆑 (I9) used as a phonogram <*f*>, and the compound thereby becomes a complex logogram for *fꜣy* 'to lift (up), carry,' in which the viper points to the reading of the initial consonant (Collombert, 2010, p. 16). In Fig. 33b, the combination takes place below and not above: in the hieroglyph 𓀁, the baby of the woman giving birth is replaced by the phonogram 𓋴 <*ms*> (F31). This results in a complex logogram reading *msi* 'to give birth,' with the sign 𓋴 indicating the reading of the strong consonants (Goldwasser, 1995, p. 20).

(a) 

Fig. 33a. The combination *fꜣi* 'to lift up, to carry' (Collombert, 2010, p. 179).

(b) 

Fig. 33b. The combination *msi* 'to give birth' (Fischer, 1977b, p. 9, Fig. 4d).

Under the label 'complex combination' fall the groups that involve size reduction, sign rotation and, more broadly, complex interactions between graphemes. The example of Fig. 34a is a rather straightforward instance of complex combination. This sign is a semogram (classifier or logogram) for the verb *ḥwi* 'to strike,' a regular spelling of which is 𓎛𓅱𓂝. It results from a combination of the phonogram 𓎛 <*ḥ*> (V28), which is the first consonant of the verb, together with the classifier 𓂝 <(MANUAL) ACTION> (A24). The man here strikes the phonogram,[93] depicting figuratively the event referred to by the verb *ḥwj*, and thereby aligning the visual signified with the linguistic signified. (Note that whether or not the man touches the phonogram with the stick is irrelevant here: the reduced size of 𓎛 V28 argues for a complex combination.)

93. On the gradient of size reduction of the 𓎛 <*ḥ*> in this complex group and the degree of integration of this sign under the stick, which both illustrate the blurred boundaries between 'connection' and 'combination' (cf. *supra*), see Collombert (2010, pp. 10–11).

(a) 

Fig. 34a. The combination *ḥwi* 'to strike' (Paget, 1898, pl. XXXIII).

(b) 

Fig. 34b. The combination *ḫbȝ* 'to hack' (Fischer, 1977b, p. 9, Fig. 4h).

A similar alignment between the visual and linguistic signified is observed in the complex group of Fig. 34b, used for the verb *ḫbȝ* 'to hack, to destroy' (Fischer, 1977b, p. 10; Lacau, 1954, p. 101). A regular spelling of this verb would be  <*ḫ*-^{b}-*bȝ*-^{ȝ}-HOE-ACTION> (*Wb*. III, 253,2-11). Here, however, the jabiru stork (phonogram <*bȝ*>) is hacking with the hoe (functioning as a classifier) the phonogram *ḫ* (), which is visually reinterpreted as a hole resulting from the action of the bird. To sum up, the graphemes needed for writing the verb *ḫbȝ* are present (*ḫ*-*bȝ*-HOE), but instead of occurring linearly, they are combined in such a way that they visually encode the same signified as the linguistic sign and, thereby, complement it. Such complex combination could be designated as 'conjunction of the signifieds' (see §6. Fig. 56-57).

3.6. *Towards a taxonomy: independence of the signs and compositionality of the groups*

The examples quoted in the preceding Sections (§3.1-5.) show that, whatever kinds of spatial arrangements undergone by the graphemes, they are independent from the linguistic dimension and depend solely on the written performance. To put it otherwise, groups can refer to all kinds of linguistic units—from phonemes and grammatical morphemes to lexemes, compounds, or entire phrases—and the boundaries between quadrats do not have to respect the boundaries between morphemes (even if they obviously can, and often do). Consequently a categorization of the groups based on their relationship with linguistic units is not of primary interest as far as their distribution in broader categories is concerned, since many-to-many relationships obtain.[94]

Taxonomy of the groups is however useful, not least for clarifying the current unsteady terminology: 'compound,' 'composite,' 'monogram,' 'quadrat,' and similar terms are indeed found in the literature, but they are rarely defined, and often used indistinctively. In my view, two features allow us to categorize the different types of hieroglyphic groups: the independence of the signs within groups [±INDEPENDENT] and the compositionality of the reading (of the resulting group) [±COMPOSITIONAL] (Fig. 35).

94. *Pace* Meeks (2017, p. 2), who suggests making a distinction between quadrats and composites on this basis.

	+INDEPENDENT **polygram**			– INDEPENDENT **monogram**	
	tabulation	*insertion*	*stacking*	*connection*	*combination*
+COMPOSITIONAL	**quadrat**			**compound**	**composite**
–COMPOSITIONAL	**cryptogram**				

Fig. 35. Taxonomy of the hieroglyphic groups.

The feature of independence refers to the fact that the hieroglyphs that are grouped can be visually independent—when tabulated, inserted or stacked—, or can undergo some sort of (visual or conceptual) fusion and lose their independence—when connected or combined. I suggest to use the term 'polygram' for the groups that are [+INDEPENDENT], and 'monogram' for the ones that are [–INDEPENDENT][95]. The term 'polygram' has, to the best of my knowledge, not been used in the Egyptological literature so far, but seems perfectly suited from an etymological point of view (as opposed to 'monogram') and is currently attested in order to refer to 'groups of characters' in cryptography[96] (especially as regards 'polygraphic substitution'), as well as in semiotic accounts about figurative writing systems (Pottier, 2009, p. 393). Monograms can obviously be members of polygrams, as both compounds and composites are free to occur in quadrats,[97] and—conversely—quadrats can occur in monograms (see Fig. 31).

The second feature has to do with the compositionality of the groups: can the resulting group be read when applying the basic principles of the hieroglyphic writing system (discussed in Section 1 and 2), or should special rules and codes be used in order to get to the reading and meaning of the group?[98] For the compositional polygrams, which are productively constructed during the entire history of hieroglyphic Egyptian, the generic term 'quadrat' is fitting, while for monograms, a distinction can be made between 'compounds' (when signs are connected together) and 'composites' (when signs are combined in more complex ways). The non-compositional groups are all called 'cryptograms,' following the Egyptological practice (Darnell, 2004, pp. 1–34), even if the original intention was most of the time not at all cryptographic, but rather to *signify* at as many levels as possible—

95. The term 'monogram' is used by some scholars to refer to a broader category, which includes for instance 'stacking' (Schenkel, 2005, p. 56), or to all the hieroglyphic groups that are divisible into smaller units corresponding to hieroglyphic graphemes (Meeks, 2017, pp. 2–3).

96. The term does not appear to be widely used in the study of writing systems (Coulmas, 2002, 2006), but could turn out to be a useful comparative concept, *e.g.* for Luwian and Maya hieroglyphs as well as Chinese.

97. See the nice early (Old Kingdom) example of a composite sign with corner insertion discussed by Drioton (1935b).

98. I am discussing specifically the 'groups' here and not the spelling of entire words. See in this respect the difference between alienated and cryptographic spellings made by Werning (2016, pp. 3–6).

what Morenz (2008) dubbed 'visual poetry.' Cryptograms can result from any type of spatial arrangement,[99] such as tabulation (Fig. 36a), insertion (see above Fig. 25c and Fig. 36b), stacking[100] or combination (Fig. 36c).

Fig. 36a. Cryptogram of Ptah, with tabulation (Ptolemaic) (Darnell, 2004, p. 14).

Fig. 36b. Cryptogram of Amun, with insertion (see Fig. 46a).

Fig. 36c. Cryptogram of Mentuemhat, with combination (Drioton, 1935a, p. 133).

Fig. 36a is a cryptogram of the god Ptah, a 'graphie théologique' as Yoyotte puts it (Yoyotte, 1955). The reading is non-compositional since it implies both strong acrophony—  = <*p*> from the logogram *pt* 'sky',  = <*ḥ*> from the logogram *ḥḥ* 'million,' and  = <*t*> from the logogram *tȝ* 'earth'—and an unconventional reading sequence (top-bottom-middle) in order to express the three consonants <*p*>+<*t*>+<*ḥ*> of the name *Ptḥ* 'Ptah.' At the same time, this tabulated group creates a tableau, expressing visually the demiurgic nature of the god, who (as a substitute of Shu) is seen as the creator separating heaven and earth.[101] Accordingly, the cryptogram is also a meaningful visual sign.

The example of Fig. 36b is a cryptogram for the name *Ỉmn* 'Amun.' It uses the frequent ancient Egyptian cryptographic principle 'read what you see first (and then what is written)'.[102] Here, we see some water  (N35) in an oval circle  (N18), which represents an island in the hieroglyphic repertoire; in short ' in '. As the meaning [in] is expressed by the preposition *m* in Egyptian, we get to: ' <m> '. Now, if we read the two hieroglyphic signs as phonograms, we get to '<*n*> <*m*> <*i*(*w*)>', which is *Ỉmn* 'Amun' when read from right to left. The example is again clearly non-compositional and involves center insertion—and the resulting tableau could make reference to the water emerging from the primordial island (even if this remains speculative).

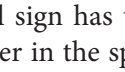
Finally, non-compositional monograms are illustrated by Fig. 36c, a cryptogram for the proper name *Mnṯw-m-ḥȝ.t* 'Montuemhat' appearing on top of the block Statue Cairo CG 646. On this document, the name is otherwise spelt  *mn-ⁿ-ṯ-w-m-ḥȝt-ᵗ-*AUT, lit. 'Montu is at the beginning,' as expected. In Fig. 36c, the image

99. Interesting examples are discussed by Vernus (1981, pp. 24–32).

100. See *e.g.* Fairman (1945, p. 106).

101. Cf. Derchain (1991, p. 254): "*la disposition même des signes peut servir à former des images complexes, dans lesquelles les hiéroglyphes, qui constituent dès l'origine une sorte d'inventaire restrictif de la réalité physique entourant l'Égyptien, représentent diversement*." See also the comments by Morenz (2008, pp. 47–48).

102. I follow here the explanation provided by Van Rinsveld (1993), but previous explanations (like the one offered by Sethe) would work along the same lines.

of the hawk-headed god Montu holds the sign  (P5). As originally suggested by Spiegelberg and confirmed, with additional evidence, by Černý (1951, pp. 442–443), the sail sign has to be read *mḫy.t* here. This value ensues from the use of as classifier in the spelling of the word  *mḫy.t* <*mḥ-ʰ-y-t-*WIND> 'North wind.' However, *mḫy.t* is not a phonographic value of : the sign is used here as an abbreviation, equivalent to *m-ḫ3.t*, if one only takes into account the strong consonants.[103] Accordingly, the combination *Mntw-mḫy.t* is non-compositional and stands for *Mnṯw-m-ḫ3.t* 'Montuemhat.'

To conclude, it should be stressed that all the kinds of grouping surveyed in Section 3, namely both the polygrams and monograms, compositional (Fig. 34b) or not (Fig. 36a), can convey a visual signified complementary or additional to the graphemic signified: grouping does not only obey aesthetic principles, but is not infrequently used as a way to extend the signification of the graphemes. This obviously relates directly to the concept of writing in ancient Egypt, which posits an ontological relationship between the reality described and its written transcription.

4. The linearity of pictorial graphemes: orientation and reading order

Hieroglyphic inscriptions are first and foremost monumental. As Vernus (1990, p. 36) puts it, "*la sémiotique où l'écriture hiéroglyphique prend place* [*est*] *celle de l'investissement de l'espace et de la dialectique entre texte et image*". As such, the hieroglyphic texts interact constantly with the visual representations and, more generally, with the (architectural) environment that surrounds them: their orientation obeys a basic principle of integration within the monumental sphere, ultimately dictated by the unity of hieroglyphic writing and art in ancient Egypt (Fischer, 1986).

Accordingly, even if the preferred (unmarked) reading order is from right to left (RTL), with hieroglyphs oriented rightwards (→) both when the text is written in lines and in columns, leftwards orientation of the signs (←)—and texts consequently reading from left to right (LTR)—is common in hieroglyphic inscriptions.[104] Assmann (2002, p. 35) envisions this flexibility as one of the fundamental functions (because the orientation is meaningful) of the hieroglyphic script. In his masterful analyses of the orientation of the Egyptian hieroglyphs, Fischer (1977c, 1986, pp. 51–142 & pl. 5-44) identifies three factors that are responsible for the reversal

103. See the parallel case of the hieroglyph  reading *jn s(j)* '(who) brings it' and hence *n(j)-sw* 'he belongs to' (De Meulenaere, 1954, pp. 75–82).

104. The cursive scripts (cursive hieroglyphs and hieratic alike) are almost never written from left to right, and when they should (in order to obey the principles described in this section), other strategies are used (like retrograde writing; see below §4.3.3.). As stated by Fischer (1977c, p. 16), "the more cursive the signs were, the greater was the resistance to reversing their direction." Note that some signs tend to keep their rightwards orientation, even when the other hieroglyphs are oriented ← (Fischer, 1986, pp. 69–70).

of the preferred reading order: symmetry, concordance, and confrontation. All the cases that Fischer discusses under the heading 'confrontation' can actually be explained by the (more fundamental) principles of *symmetry* and *concordance*, which will guide the discussion below.[105]

I first explain how considerations relating to symmetry (§4.1.) and concordance (§4.2.) influence the orientation of hieroglyphic texts. In a second step (§4.3.), complex cases of text layout are examined including rare cases of acrostics and crosswords, as well as so-called 'retrograde' and 'boustrophedon' compositions, which all illustrate the far-reaching potentialities of this writing system in terms of spatial organization.

4.1. *Symmetry*

The most straightforward examples of the symmetrical factors influencing the direction of writing are certainly the cases of inscriptions associated with symmetrical architectural elements, such as doorways or niches. A typical illustration of this phenomenon is Fig. 37 below, the lintel of a sandstone door of Ptolemy III Euergetes in Karnak. On both sides of the symmetrical *ankh*-sign 𓋹 (S34), one finds two names belonging to the titulary of this king: his name of 'King of Upper and Lower Egypt' (on the left, oriented rightwards and introduced by the graphemes 𓇳𓆎→ 'king of Upper and Lower Egypt') and his name of 'Son of Ra' (on the right, oriented leftwards and introduced by ←𓇋𓇳 *s3-Rˁ* 'son of Ra').

Fig. 37. Fragmentary door of Ptolemy III (Karnak – Ptolemaic period), lintel (KIU 2185), line 2.

Thanks to the symmetrical arrangement, the two names are facing each other, forming a closed and coherent unit[106] around the *ankh*-sign 𓋹 (S34), which stands in the middle and is to be read before each name (a frequent kind of *apo-koinou* construction[107] in hieroglyphic inscriptions): 'Long live (*ankh*) the King of Upper and Lower Egypt NAME, long live (*ankh*) the Son of Ra NAME.'

105. This actually seems to be in agreement with the view of Fischer himself in later publications, see *e.g.* Fischer (1986, pp. 66–68).

106. On the inversion of the order of some graphemes (esp. birds with other signs) so as to form a '*gechlossenes Gesamtbild*,' see Kahl (1994, pp. 43–44), Schenkel (2005, p. 55).

107. For related cases in which a single column or row is split in two (or more) different lines, see Grapow's (1936, pp. 40–42) '*Spaltung der Kolumne*,' with Fischer (1986, pp. 127–130).

Fig. 38. Statue MMA 54.116, after Fischer (1977c, p. 31, fig. 32).

As we just saw, among the effects of symmetry is the creation of coherent units. Direction reversals can accordingly obtain in cases independent of symmetrical architectural elements or scenes, where the goal is precisely to strengthen the unity of the composition and to reinforce its self-standing status, which is achieved thanks to signs facing each other.

The front-side of the statue MMA 54.116 (Fig. 38) nicely illustrates this point. On the base of this statue, one sees the beginning of two offering formulas facing each other, following the symmetry principle just described (→←). The inscription on the long loincloth is, as expected (unmarked), oriented rightwards (→), while the hieroglyphs on the staff (representing the falcon divinity Horus) are facing the man who holds it and oriented leftwards (←). One cannot speak of symmetry strictly speaking here, but the effect resulting from the two inscriptions facing each other is clear: it reinforces visually the independent character of the statue.

This practice is well attested from the earliest period onwards, especially for elements of the royal protocol,[108] in which one part of the name mirrors the other. The intended effect is similar: the inscription of Fig. 39 appears on a wooden tag, and the facing columns underline its self-standing status.

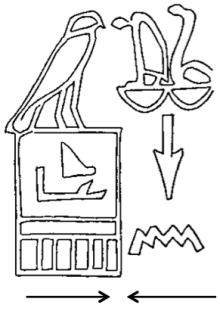


Fig. 39. Royal protocol on wooden tag, after Fischer (1977c, p. 10, fig. 4).

108. Such cases were categorized as 'confrontation' by Fischer (1977c, pp. 9–13).

From the Old Kingdom onwards (Fischer, 1977c, p. 11), the principle of symmetry is also attested within a single cartouche, a practice which became more common only during the second part of the 18th dynasty, as illustrated by the cartouche of Amenhotep III (Fig. 40). In this cartouche, the entire epithet *mr*(*j*)-*ỉmn-Rᶜ* 'beloved of Amun-Ra' faces the name of the pharaoh *Nb-Mɜᶜ.t-Rᶜ* 'The lord of justice is Ra' (Good, 1992). This kind of full-name reversal, in which the names of deities face each other, is likely to be the origin of single sign reversal in cartouches (which became frequent during the Ramesside period): the logographic sign of a deity—𓇋 *ỉmn*/Amun (C32) in Fig. 41 below—is oriented backwards in order to create a little tableau with gods interacting within a single cartouche. The figurative potential of the script is here resorted to so as to enrich the basic linguistic reading of the name with visual information pointing to the proximity between Ra and Amun (𓇋𓇋); writing and representation are one.

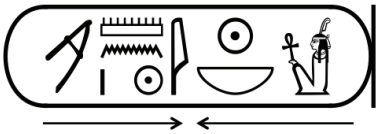


Fig. 40. Cartouche of Amenhotep III.

Fig. 41. Cartouche of Ptolemy III Euergetes (from Fig. 37).

The creation of such little tableaux within the royal cartouches is likely to have authorized (if not motivated) the change of orientation of the name of the god *Jtn* 'Aton' (𓇋𓏏*j-t-n-*ˢᵘⁿ) in the long name of the famous queen Nefertiti (Meltzer, 1980, p. 51; Tawfik, 1973, pp. 82–86). Let's consider an example from an inscription in an Amarna tomb (Fig. 42), in which the signs read in columns from right to left (and are accordingly oriented rightwards). In this inscription, the name of the god Aton is oriented leftwards. The intention here is most certainly to create a visual interaction between the graphemes of the name of the god (that belong to the epithet *nfr-nfr.w-Ỉtn* 'The beauties of Aton are (truly) beautiful') and the name of Nefertiti: much like in the iconic representations nearby where the sun-disk hands Nefertiti the emblems of life, the queen faces the god Aton who stands above her. Such cases are therefore perhaps based more on the principle of concordance (§4.2. below) than on the principle of symmetry.

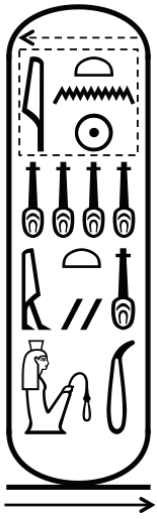


Fig. 42. Cartouche of Nefertiti (N. de G. Davies, 1903, vol. II, pl. 10).

In the words of Schenkel (1976, p. 6), they are 'exploitation[s] of the script's pictorial character in order to convey pictorial information additional to the linguistic text.'

4.2. *Concordance*

Since visual representations and written inscriptions are conceptualized as a single semiotic realm, the principle of concordance simply states that the hieroglyphic graphemes are, as a rule, oriented in the same direction as the larger figures to which they are attached.[109]

A scene from the mastaba of Ti (a high-ranking official of the 5th dynasty) in Saqqara shows how the concordance factor affects the direction of writing in two-dimensional representations (Fig. 43). In this scene, two sculptors are polishing a stone-statue (Eaton-Krauss, 1984). Over this statue, one reads the word  *t-w-t* 'statue.' This word, just like the statue, is oriented rightwards according to this concordance principle. One can further note that the expected classifier for the word statue (see §2.4.) is missing: the lexeme is written with phonograms only, since the semographic information provided by the classifier is supplied by the accompanying pictorial representation (Firth & Gunn, 1926, p. 171, n. 2; Fischer, 1977c, pp. 3–4, 1986, pp. 26–29).

Fig. 43. Tomb of Ti (Old Kingdom): two craftsmen polishing a statue (Wild, 1966, pl. 173).

Above the heads of the two sculptors, one finds the same sequence of hieroglyphs in columns ( *s-n-ꜥ-ꜥ-j-n-ḳs-ḳs*); the sentence is written entirely with phonograms (for the reasons just described) and reads *snꜥ jn ḳstj* 'polishing by the sculptor.' As expected, the column above sculptor A is oriented rightwards (→) and the one above sculptor B leftwards (←), so that the texts referring to the event (*snꜥ* 'to polish') and agent (*ḳstj* 'sculptor') are oriented in the same direction as the figures performing the action in the scene. It is further interesting to note that the lexeme *twt* 'statue' is not a mere legend above the depiction of the statue, but functions as the direct object of the verb *snꜥ* 'to polish' in both sentences,[110] which consequently read *snꜥ twt jn ḳstj* 'polishing the statue by the sculptor.' In terms of reading order this leads to a quite complex pattern since one has to begin the reading in one column before picking the complement in the next one (with direction reversal in the case of sculptor B) and then finish with the text above the representation of the sculptor ('by the sculptor').

109. The respect of this principle sometimes leads to puzzling orientations of the inscriptions on some artifacts, like statues; the texts can indeed be oriented according to the actual position that the artifact had in a sacred building (which must be reconstructed). For the retention of rightwards orientation with figures facing left and the link with cursive writing, see Fischer (1977c, p. 16); for individual signs keeping their rightwards orientation in inscriptions oriented leftwards, see Fischer (1986, p. 69), who argues that the orientation of such hieroglyphs (tools, cloths, etc.) is mostly a matter of convention, and therefore not intuitive for the scribes.

110. On the *apo-koinou* construction, see above under §3.1.

One can note that this kind of sign reversal aimed at conforming to the orientation of neighbouring figures is not restricted to (potentially) less formal types of inscriptions, such as the ones accompanying the daily-life scene above. Indeed, in the example of Fig. 44, coming from the White Chapel of Senusret I in Karnak, the same principle applies (Fischer, 1986, pp. 86–89). In the title of the scene, the text reads *dwꜣ ỉmn ḥr ḫtjw, jr=f dw ꜥnḫ* 'adoring Amun on the dais, he (namely, the king) acts endowed with life.' The spelling of the verb (*dwꜣ* 'to adore') is oriented leftwards, like the king who performs this action, but the hieroglyphs referring to the object (*ỉmn ḥr ḫtjw* 'Amun on the dais') are oriented rightwards, just as the figure of the god on his podium, while the end of the column, referring to Pharaoh, is again oriented leftwards.

Fig. 44. White chapel of Senusret I (Karnak – 12th dynasty), pillar 6.s (KIU 1065), Title.

4.3. *Complex layouts of hieroglyphic texts: Combining text orientations and coping with conflicting factors*

So far, sign orientations have been envisioned mostly at the level of a single column or row of hieroglyphs. In this section, I broaden the perspective, and investigate phenomena that belong more generally to layouts of hieroglyphic texts. From a semiotic perspective, it is indeed interesting to observe that scribes took advantage of the two possible types of linear arrangements (horizontal and vertical) of hieroglyphs (§4.3.1.) in order to create acrostics as well as highly elaborate crosswords (§4.3.2.), and that they played with the two parameters 'orientation' and 'reading order' in order to accommodate conflicting needs (§4.3.3.).

4.3.1. *Orientation of the signs and reading order: Four basic layouts* — In regular inscriptions (which represent, of course, the overwhelming majority of the cases), the orientation of the hieroglyphic signs also indicate the reading order (Fig. 45): texts in columns are read from top to bottom and from right to left (when the signs face rightwards) or from left to right (when the signs face leftwards); texts in lines are read from right to left (with signs facing right) or from left to right (with signs facing left), and in both cases from top to bottom. This leads to four basic layouts for hieroglyphic texts.

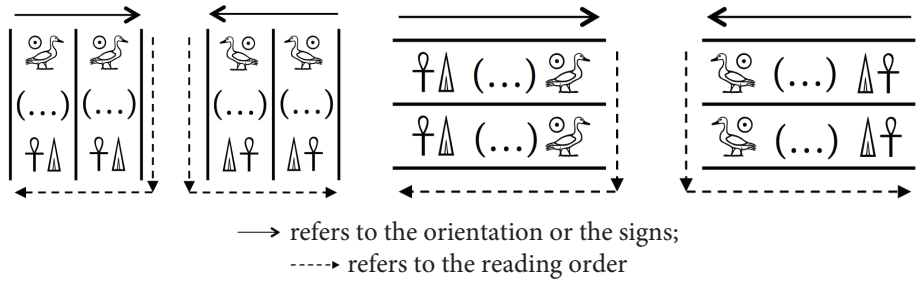


Fig. 45. The four basic layouts of hieroglyphic texts.

4.3.2. Combining line and columns: acrostics and crosswords in hieroglyphic scripts — Some scribes of the New Kingdom and of the early Third Intermediate Period (c. 1350-900 BCE) took advantage of the standard vertical and horizontal layouts, and combined them within a single inscription.[111] The virtual quadrat units that pattern the grouping of signs within each line (Section 3) facilitated the creation of acrostics and are visually materialized in examples like Fig. 46a and 47.

In the Stela of the Musées Royaux d'Art et d'Histoire (Brussels) the hymn that reads horizontally (from right to left) is interrupted (three times on the fragment; probably five times when intact) by vertical columns (marked, within the inscription, by two vertical lines on their right and one on their left). These columns are read vertically from top to bottom, as expected, and provide the names and titles of the owner of this stela (a priest of Amun-Ra) and of the members of his family (son, mother, etc.). The hieroglyphic groups belonging to these columns therefore read from right to left, both horizontally (main hymn) and vertically (name and titles).

111. We are dealing here with the combination of vertical and horizontal reading order for the same hieroglyphic groups, not with the alternation between horizontal and vertical layout in a single text, which is common—often with a demarcative function (Vernus 1982, 110) or as an index of text genre.

Fig. 46a. Multiple acrostics on Stela Bruxelles MRAH E. 6823 (Limme, 1979, p. 36).

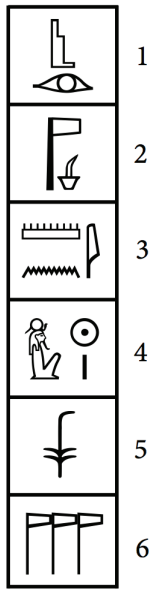


Fig. 46b. First column of the inscription.

As can be observed in Fig. 46b (which reads *wsjr, jt-nṯr ỉmn-rꜣ nswt-nṯr.w* 'The Osiris [*i.e.*, the deceased], priest of Amun-Ra the king of the gods […]'), the scribe took advantage of the flexibility of the organization of the graphemes in quadrats in order to reach his goal: quadrats are sometimes built with up to three signs (l. 3: *ỉmn* 'Amun'; l. 4 *Rᶜ* 'Ra'; l. 6: *nṯr.w* 'gods'), while in other places a single (vertical) sign is used (l. 5: (*n*)*sw*(*t*) 'king'), even if the principle of 'density' (Section 3) suffers a bit from this choice.

Some learned scribes rendered the exercise even more difficult, creating complete crosswords with the whole text in a grid that reads both horizontally and vertically.[112] The first occurrence of this practice is found in the Theban tomb of Kheruef (TT192),[113] during the reign of Amenhotep IV (c. 1350 BC), and the most impressive example—even though the document is badly damaged—is certainly the so-called 'crossword stela' of Paser (20th dynasty, c. 1150 BC), with an incised frieze of deities along the top and a hymn to Mut that reads both horizontally and vertically[114] in a grid which is (as it stands) 67 squares wide and 80 squares deep (maybe 80 by 80, originally).

112. On acrostics and crosswords, see Clère (1938), Zandee (1966), and Stewart (1971).

113. See Wente in (Epigraphic Survey, 1980, pp. 35–37 & pl. 14-15*), with (Murnane, 1999, pp. 308–314).

114. The line just below the frieze actually states that the text is to be read 'three times.' The only additional possibility would be to read it around the outer edge (Parkinson, 1999, p. 84; Stewart, 1971, pp. 88–89), but the stela is too damaged to ascertain this hypothesis. On this stela, see further Troy (1997) and Hawary (2016).

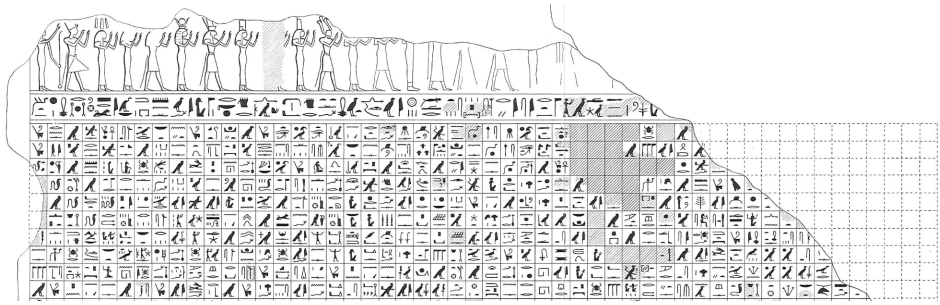


Fig. 47. Hymn to Mut of Stela BM EA 194 (top section), line 1-10 (Stewart, 1971, pl. XXV).

In order to achieve this scribal performance, the formal and functional plasticity of the hieroglyphic script has been maximally exploited: the number of signs per quadrat varies in order to create coherent units (from entire lexemes, or even phrases, to single signs), and the functions of isolated signs are not fixed (a sign can for instance be used as a logogram vertically and as a classifier horizontally).

Fig. 48. Offering list of *Dbḥ.n.j* (5th dynasty) (Barta, 1963, p. 181).

In terms of format, it can be noted that there is a long tradition of using tables in ancient Egypt. From the Old Kingdom onward, various sorts of lists, inventories and catalogs,[115] belonging to both the administrative and to the monumental (sacralized) spheres, were organized in tabular format. Examples like Fig. 48 illustrate this practice and are especially interesting inasmuch as they yield an analysis of the script. Indeed, in this offering list, the spellings of the goods are set apart from their classifiers and from their quantity (ranging from 1 to 4), each piece of information being inscribed in a different cell of the table. At the end of line 3, for instance, the names of three different kinds of goose can be read (which are

115. See recently Hoffmann (2015), Pommerening (2015), and Quack (2015).

written with uniliterals and read *sr*, *ṯrp*, and *zt*); they are followed, in a independent cell underneath, by a common classifier 𓃬—the trussed goose (G54)—, and then by the quantity (1 unit for each). This shows that the kind of textual layouts and mastery of the script needed in order to produce the monumental compositions known as 'crosswords' (which should rather be termed 'crosstexts') were available at an early stage, and that learned scribes of the New Kingdom systematized and enlarged potentialities of the script that were somehow part of the written tradition.

4.3.3. *When 'orientation' and 'reading order' do not match: Coping with conflicting factors* — A highly interesting—but unique—fragment of the Museo de Bellas Artes (Caracas, previously Metropolitan Museum of Art) will bridge the gap between the previous and the current section. On this fragment, a vertical acrostic similar to the ones of Fig. 46a can be observed. It runs: […] *ḫpr*, *jn sꜣ=f sʿnḫ* […] '[…] became, his son is the one who makes [his heart] live.'

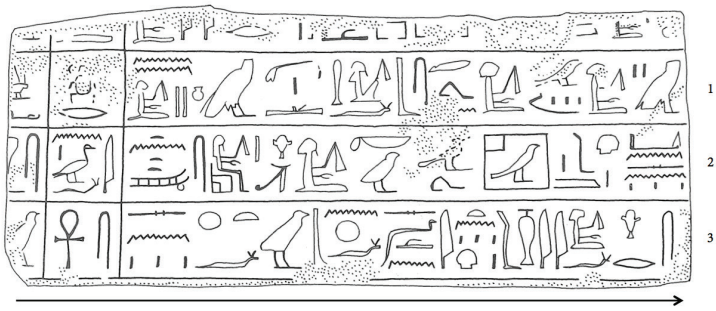


Fig. 49. Frag. Museo de Bellas Artes, Caracas (Fischer, 1986, pp. 126–127).

Besides this acrostic, one can see that the graphemes of the horizontal lines are all oriented rightwards, which would normally imply a right to left reading order. However, lines 1 and 3 make no sense when read in this direction: they are to be deciphered from left to right. This phenomenon is known in the Egyptological literature as 'retrograde writing'[116] (as opposed to 'prograde'), *i.e.* writing in which the individual hieroglyphs face towards the end of the texts, instead of towards its beginning. Consequently the fragment of Fig. 49 can be characterized as a boustrophedon[117] retrograde composition with acrostic, which is—even by Egyptian standards—fairly extreme in terms of text layout and composition.

116. See the fundamental studies of Fischer (1977c, pp. 49–62, 1986, pp. 105–128), with Mauric-Barbério (2003), Angenot (2010), and Simpson (2017).

117. Boustrophedon compositions are not uncommon in the artistic domain, see especially the logical sequence of scenes in tombs as described *e.g.* in Angenot (1996, 2010) or Fischer-Elfert (2000), but exceptional in hieroglyphic inscriptions, with only a handful of examples (Giveon, 1979, pp. 135–136). When a text is boustrophedon, the hieroglyphs of each line can face alternatively from right to left and from left to right, and involve a change of orientation (Munro, 1989, p. 135), or all the signs can be oriented in the same direction with retrograde

Retrograde writing is mostly used with texts in columns.[118] It is usually resorted to in order to adapt writing to the *sense* of a scene[119] (or even to indicate the *sense* of a scene). I intentionally use the polysemic word 'sense' here to refer both to the 'meaning' and to the 'direction' or 'dynamics' of a given scene. As regards 'meaning,' the concordance principle is targeted (Section 4.2.): the hieroglyphic graphemes must be *meaningfully* oriented, namely oriented in the same direction as the larger figures to which they relate. This is the first requirement. However, the meaningful orientation of the signs can lead to a reading order that is opposite to the direction or to the dynamics of the scene. That is where retrograde writing kicks in, solving potential semiotic conflicts between the dynamics of the scene and the reading order.

Fig. 50a. Scene of the tomb of Sennefer (TT96a, 18th dynasty), MANT/ULiège©.

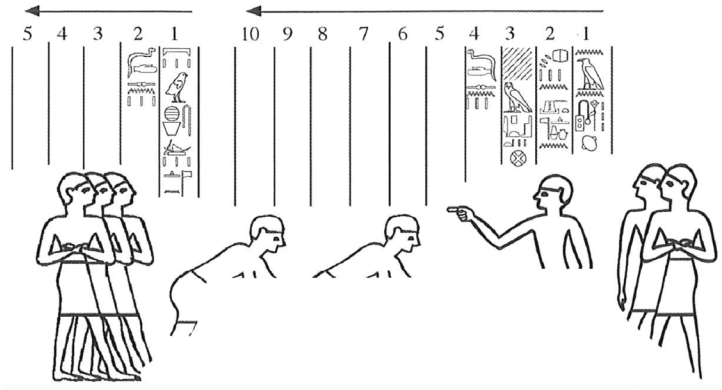


Fig. 50b. Schematic drawing of the scene (Angenot, 2010, p. 15).

reading every second line, just like in Fig. 49 (Rosati, 2003; Scamuzzi, 1942). I am not aware of boustrophedon compositions in columns.

118. For the use of retrograde writing in religious texts on papyrus, see Altenmüller (1969); this tradition is likely to derive from the retrograde inscriptions on coffins (the so-called *Coffin Texts*), whose organization was conditioned by the position of the mummy within the coffin (Fischer, 1973, p. 22, 1986, pp. 116–121).

119. Somehow paraphrasing Assmann (1994, p. 20).

The example of Fig. 50 should make this point clear. In a scene of the tomb of Sennefer (Thebes), the (badly damaged) text above the scribes monitoring the grain count and addressing the workers with a direct speech is oriented leftwards (following the principle of concordance between the orientation of the text and the orientation of the figures). Yet it reads from right to left—it is retrograde (see the numbering of the columns). As stated by Angenot (2010, p. 14), "*l'emploi de l'écriture rétrograde se justifie essentiellement par la volonté d'indiquer un sens de lecture ; et dans ce cas précis, de faire coïncider le sens de lecture du texte avec celui de l'image*". To put it otherwise, the speech of the scribes runs in the direction of the addressees within the scene, and the reading orders of the text and of the scene are consequently harmonic. The same principle applies to other interesting cases, such as retrograde writing in the underworld books that are inscribed in the royal tombs of the New Kingdom, in which the text flows in the same direction as the representation of the bark of the sun-god (Mauric-Barbério, 2003). Likewise retrograde writing in some witnesses of the so-called royal sunrise text (Simpson, 2017), in which retrograde writing allows the name of the king (or tomb owner) and the name of the sun-god to stand—much like captions—next to their representation, with the descriptive text acting as some sort of bridge leading from the king (or tomb owner) to the sun-god. Interestingly enough, this kind of retrograde writing is also used in 'vocative' or 'dative' situations between the main figure in a scene and a virtual 'reader' of this scene,[120] so that the hieroglyphic statement proceeds from the mouth of the speaker to the ear of the addressee, which is not necessarily represented figuratively, but implied by the disposition of the text itself.

The principle of symmetry may also lead one to resort to retrograde writing. This applies especially in cases of intrinsically symmetrical artifacts, such as tables of offerings (Fischer, 1986, pp. 122–124). The comparison of two similar tables from the Sinai (Serâbîṭ el-Khâdim, Middle Kingdom, c. 1800 BCE), belonging to great intendants of the Treasury, is enlightening. In both cases, the hieroglyphic texts run around the tables, with two offering formulas on each table, which start at the top (middle) of the monument and face each other symmetrically. On both documents the texts read continuously on the left- and right-hand side (dashed arrows). In Fig. 51b, the scribe reversed the orientation of the hieroglyphs for the bottom section (arrow pointing leftwards), as expected, so that the orientation of the graphemes fits the reading order: the figures face the beginning of the line. In the more elaborate composition of Fig. 51a, on the other hand, all the hieroglyphs are oriented towards the center of the table, *i.e.*, where the offerings are made, without orientation reversal for the bottom horizontal lines. Consequently, retrograde writing had to be used for these bottom sections of the text. It is further noticeable the very last hieroglyphs of each offering formula (), which end the filiation of the owner of the offering table, are themselves reversed (and hence have

120. For text orientation reversals in such cases, see Fischer (1977c, pp. 49–62).

the 'expected' orientation like in Fig. 51b), in order to visually stress the fact that the whole offering formula is meant for the deceased (Fischer, 1986, p. 124), who is the beneficiary or receiver both linguistically and visually.

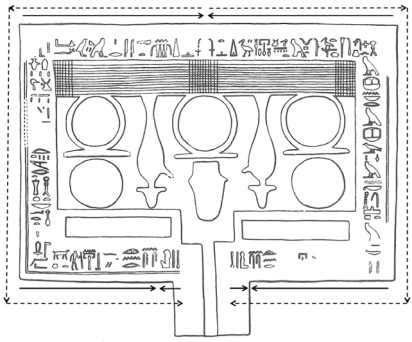


Fig. 51a. Offering table of Djafy (Gardiner *et al.*, 1952, pl. XLV, n. 122).

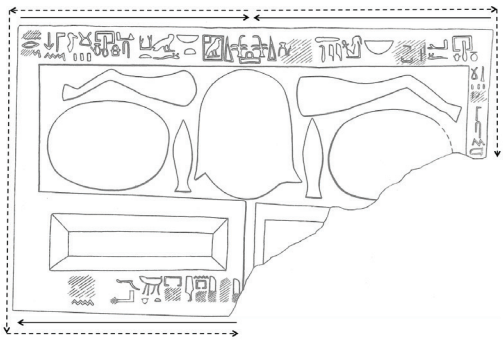


Fig. 51b. Offering table of A[men]y (Gardiner *et al.*, 1952, pl. LIV, n. 166).

As can be observed in the examples above, retrograde writing was primarily used when the principle of symmetry and the principle of concordance (§4.1.) required the hieroglyphs to be oriented in such a way that the reading sequence would have been contrary to the *sense* of a given scene (Fig. 50) or artifact (Fig. 51a). As such, it was devised first and foremost as a way to mediate conflicts between the basic principles of hieroglyphic text orientation and the meaning associated with the spatial organization of the texts. Later on, this strategy[121] was used for secondary indexical values, which are mostly: (1) providing a marked reading order to a whole sequence of scenes,[122] and, (2) marking certain knowledge-related compositions (especially religious and funerary texts) as mysterious, enigmatic or cryptic.[123]

5. From theoretical semiotics to practical implementations

The semiotic account of the hieroglyphic writing system provided above has direct implications as regards the encoding of hieroglyphs in Unicode. The present situation as regards Egyptian and Unicode can be roughly summarized as follows.

1. 1071 Egyptian hieroglyphs were added to the Unicode Standard in October 2009 (release of version 5.2) in the block 'Egyptian Hieroglyphs' (U+13000-U+1242F)[124]. It is only fair to say that, among these hiero-

121. Which, as argued by Fischer (1986, pp. 105–107), originates (at least formally) in honorific transpositions.

122. See for example the case of the tomb of Rekhmira quoted by Angenot (2010, p. 14, n. 21).

123. This value probably ensues from the use of retrograde writing on coffins (see n. 118).

124. http://www.unicode.org/charts/PDF/U13000.pdf.

glyphs, one finds a little bit of everything: (simple) hieroglyphic signs, (palaeographic) variants, quadrats of all sorts (involving tabulation, insertion and stacking), as well as compounds and composites (see §3.6.). The inclusion of such a variety of glyphs led to sound criticisms and warnings,[125] but was adopted as such.

2. On Tuesday, May 9, 2017 (http://www.unicode.org/L2/L2017/17103.htm), based on the proposal L2/17-112R (Glass *et al.*, 2017), the Unicode Technical Committee (UTC) recommended a set of eight control characters for representing quadrats in Unicode.[126] These controls are now in the standardization approval pipeline and are on track to be included in Unicode 12 (which is expected to be released in March/April 2019).[127]

𓍰	U+13430	EGYPTIAN HIEROGLYPH VERTICAL JOINER
𓍱	U+13431	EGYPTIAN HIEROGLYPH HORIZONTAL JOINER
𓍲	U+13432	EGYPTIAN HIEROGLYPH INSERT TOP START
𓍳	U+13433	EGYPTIAN HIEROGLYPH INSERT BOTTOM START
𓍴	U+13434	EGYPTIAN HIEROGLYPH INSERT TOP END
𓍵	U+13435	EGYPTIAN HIEROGLYPH INSERT BOTTOM END
𓍷	U+13437	EGYPTIAN HIEROGLYPH SEGMENT START
𓍸	U+13438	EGYPTIAN HIEROGLYPH SEGMENT END

Fig. 52a. 8 control characters first approved by the UTC.

3. In addition to these 8 controls, the 9th control character proposed in Glass *et al.* (2017, pp. 10–12) was approved by the UTC on August 4, 2017.

𓏹	U+13436	EGYPTIAN HIEROGLYPH OVERLAY MIDDLE

Fig. 52b. Additional control character approved by the UTC.

Despite the inconsistencies among the 'characters' that are encoded in the 'Egyptian Hieroglyphs' block, this means that, starting with Unicode 12, one will be able to use these 'characters' in order to build ad libitum:

1. 'tabulated' groups (§3.1.), using the 'vertical' (𓍰) and 'horizontal' (𓍱) joiners;
2. 'inserted' groups (§3.2.), using the four controls for corner insertion: 'top start' (𓍲), 'bottom start' (𓍳), 'top end' (𓍴), and 'bottom end' (𓍵);
3. 'stacked' groups (§3.3.), using the 'overlay middle' control (𓏹).

Furthermore, these spatial arrangements can combine and the resulting quadrats can be of any level of complexity: the control 'segment start' (𓍷) and 'segment

125. See the comments by Schenkel (https://www.unicode.org/L2/L1999/99223.pdf).

126. http://www.unicode.org/L2/L2017/17103.htm.

127. A convenient overview of the process is available on Bob Richmond's blog about the encoding of Egyptian hieroglyphs in Unicode (http://hieroglyphseverywhere.blogspot.be).

end' () allow users to deal with the recursive nature of the spatial organization of the hieroglyphs (Nederhof *et al.*, 2017) and to include groups within groups within groups, etc.

Now what is the way forward? In the description of Section 3, a distinction was made between polygrams (fully productive and visually not-fused) and monograms (less productive and visually fused). In the forthcoming developments of Unicode, I suggest that the polygrams should be encoded with control characters (because new polygrams will inevitably pop up in any new text[128]), while the monograms could receive individual code points. In order to apply this principle systematically, additional controls are needed. I consider three of them—all having to do with center insertion (total or partial, see §3.2.)— especially urgent given their frequency. These control characters were already suggested in Nederhof *et al.* (2016, p. 4):

1. Insert center (cf. Fig. 23)
2. Insert center-bottom (cf. Fig. 24-25a)
3. Insert center-top (cf. Fig. 25b)

Three additional controls would be equally useful, even if admittedly less frequent:

4. Insert center-start (cf. Fig. 23c)[129]
5. Overlay high (cf. Fig. 28a)
6. Overlay low (cf. Fig. 28b)

Offset stacks are certainly rarer than centered stacks (), but in my opinion should not be assigned to the font level.[130] Indeed, they are productively and intentionally constructed as such (Fischer, 1977b), and meaningful variants obtain with the same signs; offset stacking can be in complementary distribution with insertion (cf. Fig. 28a:  vs) and stacked signs can be purposely positioned high or low in order to allow other types of grouping (like the insertion of Fig. 28b:  , while the  is usually centered, despite what the normalized fonts represent). These arguments are in my view amply sufficient to recommend these six controls for rapid adoption in Unicode. These additional controls would indeed allow users to build all the types of polygrams that are frequently encountered in the ancient Egyptian inscriptions and would avoid the unwarranted addition of many such groups in Unicode (Suignard, 2017).

Besides these control characters, the examples of Section 3 and Section 4 should have made it clear that the horizontal vs vertical layout of the original text has a significant impact on the kinds of groups that are used, and that the orientation of the signs can change within a single line of text. As such, specific characters

128. See the argument in Nederhof *et al.* (2017)

129. Examples of polygrams requiring the addition of the control 'insert center-end' are not forthcoming, for at least two reasons: (1) hieroglyphic signs that open up towards the end are relatively rare, (2) the signs that do can usually be treated as 'insert top end' or 'insert bottom end.'

130. As suggested in Glass *et al.* (2017, pp. 11–12).

would be needed in order to inform the users and applications about the direction of the encoding (Nederhof *et al.*, 2017, p. 11): signs facing right – horizontal (⟼), signs facing left – horizontal (⟻), signs facing right – vertical (⮡), signs facing left – vertical (⮢). Additionally, as already suggested by Fischer (1986, p. 124),[131] the reading order could be specified with the addition of 'N' (Normal) or 'R' (Retrograde) on top of the symbols indicating the direction of the signs.

6. Conclusions

The overview presented in this paper shows that the hieroglyphic script—as all other writing systems, but to a degree which is hardly paralleled—involves much more than language reference (Assmann, 1994, p. 18; in general, see Klinkenberg, 2005). Semiotic analyses of the hieroglyphic signs (Goldwasser, 1995, 2009b; Werning, Forthcoming, pp. 25–37) clearly identify two main types of semiosis, linguistic and visual, where they model respectively the relationships between a single written signifier and (1) elements of the linguistic sign (signifier, signified, or both) as well as (2) a pictorial signified. Correlatively, studies about the complementarity between the linguistic and visual signifieds of the hieroglyphs have brought up an impressive amount of fascinating cases (Morenz, 2008). As stressed by Beaux (2009a, p. 249), "[*l*]*e signe, même purement phonétique, possède un réservoir sémantique inhérent à sa qualité d'image, réservoir auquel le scribe est toujours libre d'accéder*". A peculiarity of this writing system is that the hieroglyphs have *constant* potential to co-signify at the linguistic and visual levels.

From a semiotic viewpoint, further progress can be made by taking into account a crucial distinction in visual semiotics between the figurative (Greimas, 1984) or iconic (Groupe μ, 1992, pp. 113–123) sign and the plastic sign. These two dimensions of the visual sign were insightfully mentioned *en passant* by Vernus (1982, pp. 111–112) when stating that "[*l*]*es deux propriétés de l'écriture,* vertu iconique et plasticité formelle*, lui ouvrent un domaine de signification spécifique où est sans cesse transgressée la linéarité du langage*," but the consequences of this observation have not been systematized in the semiotic descriptions, which all refer to a unique 'pictorial' (or 'graphic') signified. Fig. 53 is a more analytical (if not more accurate) representation of the components of the written sign than the existing models.[132]

131. "*On peut formuler les deux facteurs en mettant un « N » ou un « R » sur la flèche qui indique la direction des signes, et on y verra encore l'utilité de tourner la flèche dans la direction des signes et non pas comme on les lit.*"

132. Assuming a tetradic model of the semiotic sign (Klinkenberg, 1996), but excluding (temporarily) the referent(s).

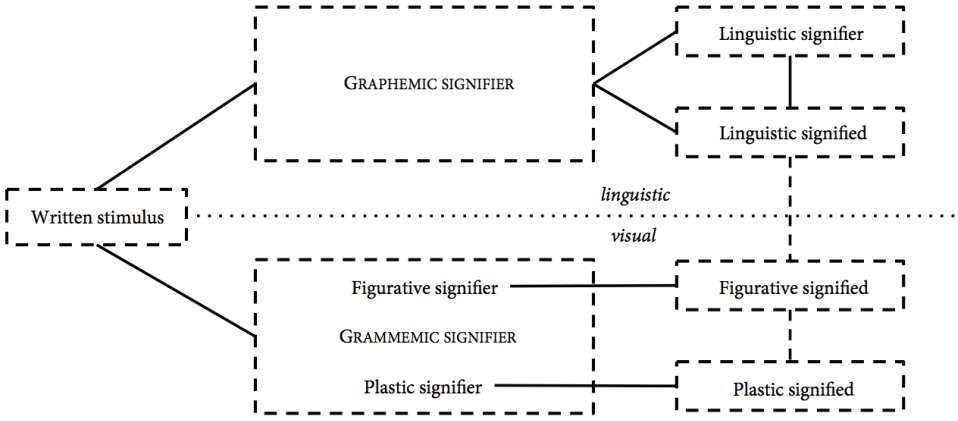


Fig. 53. A basic model of the written sign.

The higher part of Fig. 53 is uncontroversial: a written stimulus can be interpreted as a GRAPHEMIC SIGNIFIER (*i.e.*, a grapheme) of a given writing system, and any grapheme can refer to a linguistic signifier (phonogram) and/or signified (semogram). The two owls of Fig. 54a and 54b are occurrences of the ideal grapheme <owl> in the hieroglyphic script, represented by the standardized glyph of Fig. 54c, and they function as phonogram *m* (in both cases used as a preposition with the meaning 'in').

Fig. 54a. White chapel of Senusret I, Karnak – 12th dynasty, pillar 7.s, KIU 1036, l. 5.

Fig. 54b. Pedestal for the boat, Amenemhat IV, Karnak – 12th dynasty, KIU 14, l. 3.

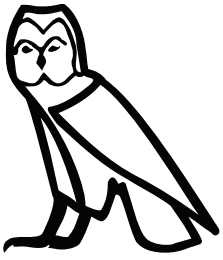


Fig. 54c. Hieroglyph of the owl (standardized glyph – JSesh).

The lower part of Fig. 53 is less canonical in semiotic descriptions of writing systems: inspired from a traditional distinction in visual semiotics (Groupe μ, 1992), it suggests that, when interpreted (according to a given writing norm) as a visual sign, the written stimulus is stabilized as a GRAMMEMIC SIGNIFIER (Klinkenberg & Polis, this volume), which can in turn be analyzed into two inter-dependent, but autonomous, units: the *figurative signifier* and the *plastic signifier* (both having their own signified). In studies about scripts, it is noticeable that, when the visual dimension of the written sign is at stake, the so-called figurative writing systems are often analyzed figuratively—focusing on the relationships between the iconic

expression and the visual referent—, while the non-figurative ones are mostly envisioned plastically (focusing on the qualities and effects of the glyphs and of their organization, which is an essential dimension of modern typography). The schema of Fig. 53 visualizes the fact that both aspects of the GRAMMEMIC SIGNIFIER can be (de)activated in any writing system. The interaction between the figurative and plastic signifiers is quite obvious when comparing Fig. 54a with Fig. 54b and shall not detain us much longer here.[133] It should be stressed that this holds true for figurative as well as for more abstract writing systems (see the name 'calypso' of Fig. 55, referring to a mermaid in a movie).

Fig. 55. The name 'calypso' written with mermaids in *Calypso* (Cosey, Futuropolis, 2017, p. 21).

Among the world's writing systems, the degree of figurativity of the hieroglyphic graphemes is definitely high (Goldwasser, 2009b, p. 338), leaning more towards the iconic than towards the abstract pole. However, this high level of figurativity is not specific to the hieroglyphic writing system: if one accepts that figurativity is a culturally dependent mode of semiosis,[134] Egyptian hieroglyphs are not more (or less) figurative than Mayan hieroglyphs, for instance.[135] What seems to be more exceptional with Egyptian hieroglyphs is *the system(at)ic interaction between the figurative and linguistic signified*.

This interaction can be described by two main types of relationships between the signifieds: *disjunction* or *conjunction*.[136] Disjunction and conjunction can result from paradigmatic—a single grapheme is formally modified—or syntagmatic strategies—the interaction results from a specific arrangement of the hieroglyphs (Fig. 56).

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133. The plastic signifiers and their associated meanings are almost entirely unexplored in the Egyptological literature and would deserve book-length studies that fall outside the scope of this paper. Similarly the links between the plastic signified and the figurative or linguistic signified must be left to future studies.

134. According to Greimas (1984, p. 9), figurativity is "*une grille de lecture* […] *soumise au relativisme culturel,* […] l*argement — mais non infiniment — variable dans le temps et l'espace. Dès lors, chaque culture étant dotée d'une "vision du monde" qui lui est propre, elle pose aussi des conditions variables à la reconnaissance des objets et, du même coup, à l'identification des figures visuelles comme "représentant" les objets du monde* […]."

135. See further the discussion in Beaux (2009b).

136. Here and below is a reformulation of the semantic relations analyzed by Klinkenberg (2008, §4), as 'redundancy,' 'difference,' and 'opposition.' Vernus (1981, pp. 28–32) discusses different types of relationships between the linguistic and figurative signifieds in polygrams and monograms.

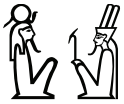
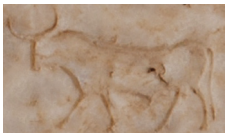
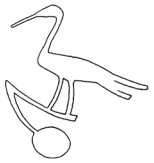
	Paradigmatic	Syntagmatic
Disjunction	 (a) Mutilated sign (see Fig. 7d)	 (b) Facing signs (see Fig. 41)
Conjunction	 (c) The logogram *kꜣ* 'bull' (calcite chapel of Thutmose IV, Karnak – 18th dyn, KIU 3234, l. 5)	 (d) The combination *ḥbꜣ* 'to hack' (see Fig. 34b)

Fig. 56. Main types of relationships between graphemic and figurative signifieds.

Conjunction between signifieds implies co-reference—the bull depicted in Fig. 56c corresponds to the linguistic signified 'bull,' and the action performed by the bird of Fig. 56d is similar to the meaning of the verb *ḥbꜣ* 'to hack'—, while disjunction does not (Fig. 56a-b): there is no relationship between the linguistic signified <*f*> (uniliteral) of the horned viper  and its beheaded (*i.e.*, magically annihilated) representation (Winand & Angenot, 2016, pp. 164–165), nor between the name of the gods Amun and Ra (appearing in the name of king Ptolemy III Euergetes) and their visual interaction in Fig. 56b.

I further suggest that three main types of conjunction can be observed: *correlation*, *coordination* and *subordination*. Correlation obtains when the graphemic and figurative signified can be equated (see Fig. 56a, above). A paradigmatic example of correlation is given in Fig. 56a, and Fig. 57a provides a syntagmatic instance: the lexeme *ꜥꜣ.t* 'stone vessel' ( *ꜥꜣ-t-*MINERAL) is classified with three different types of stone vessels (), visually expressing the variety of artifacts belonging to the category denoted by the lexeme *ꜥꜣ.t*. As shown by this example, correlation is never perfect—the linguistic and figurative signified remains autonomous, even when closely interconnected.

Correlation	Coordination	Subordination
(a)  (Morenz, 2008, p. 53)	(b)  (see Fig. 36a)	(c)  (see Fig. 4c)

Fig. 57. Three types of conjunction between the graphemic and figurative signifieds.

Coordination refers to linguistic and figurative signifieds that are complementary: while having the same referent, they point to different aspects that are coordinated in a single expression. Fig. 57b is a good example of syntagmatic coordination: the graphemes express the three strong consonants *Ptḥ* of the name Ptah, while the god is visually shown as the demiurge separating heaven from earth. Finally, one signified can be subordinated to another. If the figurative signified is most often subordinated to the linguistic one (as expected for a writing system), the opposite type of subordination can also occur. In Fig. 57c, for instance, the fat and adorned ox depicted is much more precise than the subordinated graphemic meaning *jw3* 'ox' of the logogram.

The hieroglyphic writing system is acordingly an excellent example of syncretic semiotics or rather of '*discours pluricode*' (Klinkenberg, 2008, §0.2), with a single substance that can be read simultaneously as a linguistic, figurative and plastic sign. Writing is not just about language: it is a *meta*-language, of course, as it provides an analysis of the language, but also a *para*-language (pointing to—sometimes highly complex and ideologically elaborated—referents that are not expressed linguistically) and an *epi*-language (in the sense of Culioli), namely a spontaneous (and unconscious) visual gloss about the linguistic meaning.

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