

A Detailed Study about Egyptian-Coptic and Software Engineering

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Abstract The ancient Egyptian is one of the world's oldest attested languages, with the hieroglyphic script demonstrating its existence since the 33rd century BC. Its final stage, the Coptic language, began in the 1st century AD, with Old Coptic, and extends until the 16th century AD, creating a continuous of written sources in Egyptian language of almost 5000 years. The transliteration of Egyptian-Coptic starts with the alphabetization of written Egyptian on the basis of the Greek script and it is one of the greatest proofs of the cultural interaction between the two cultures. Coptic was the language of the monks and the gospels, the scriptures, the letters and other transactions, leaving us a written wealth. Another proof of the unsurpassed cultural relationship between the two populations is the large number of Coptic texts and objects on display or at archives in Greek museums and libraries. It is also noteworthy that Coptic survives today as the liturgical language of the Coptic Orthodox Church. However, the lack of interactive computational tools in Greek makes it difficult for Greek scholars to study the language in depth and allows various misinterpretations. In this present work we try to present Coptic material that exists in Greece, the huge volume and the undisputable value of the Coptic language in the diachronic history of languages, but also the incapacity of digital resources to meet the needs of researchers and scholars of Coptic in Greece. This will highlight the need to create a software tool that will fill in the gaps and the weaknesses of other tools, a software application that will make it easier for the user to study and learn Coptic, and finally an application that will help to preserve this language over the centuries. This software tool will be based on a pre-existing model of ancient languages processing, which was successfully implemented in the case of Linear B, aiming at both educational and research use for any kind of Coptic artefact.

Keywords Coptic, Greek, Software

1. Introduction

From the pre-dynastic period, ancient Egypt has been a generative force of civilization that extends from artistic representations and is sealed with script. It is clear that intellectual and cultural development is intertwined with the economic and social prosperity of the Ancient Egyptians as well as with the various changes (social, religious, political, economic) that took place in their region. The Egyptian language - that appeared around 3,200 BC and remained active until the 11th century AD - did not remain unaffected by all these changes. The interaction between Egyptians and the peoples of the Mediterranean, the attempts of foreign invasion at Egypt and the conquest of Egypt by the Greeks,

its conversion into a Roman province, all these create various evolutionary stages in the Egyptian language and mainly in the Egyptian script with Coptic being the final phase of this long-standing language.

2. Concise Periodization

The Egyptian language appeared around the 33rd century BC and remained active until the 11th century AD, when it slowly began to be replaced by the Arabs, after the Muslim conquest of Egypt (639-642 AD). Along with Sumerian, Greek and Chinese, it is one of the oldest and longest lasting languages of the world. It belongs to the Afro-Asian language family (Afro-Asiatic languages are also referred to as Hamito-Semitic languages). In the present study we briefly present the evolutionary stages of Egyptian language, so that the reader can understand better the historical context of Coptic language. This periodization that follows (sections 2.1-5) is based on the studies of Allen [1] and Kousoulis [2].

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2.1. Old Egyptian (2600-2100 BC)

Although the Ancient Egyptian script was invented around 3200 BC, Old or Archaic Egyptian refers to the monumental inscription language of the Ancient Kingdom. The body of texts consists of names and labels. The Texts of the Pyramids have been written in this language.

2.2. Middle or Classical Egyptian (ca. 2100-1300 BC)

They are directly related to the ancient Egyptian and mark the classical phase of the language. They survived as a spoken language for about 500 years, but continued to be the standard hieroglyphic language. Their appearance corresponds in time to the development of the structural features of the language and the flourishing of the literature during the Middle Kingdom. It is characterized as the period of linguistic prosperity with a multifaceted way of expression and use: monumental, epigraphic, religious, funeral, literary [2].

2.3. Late Egyptian (ca. 1300-600 BC)

They began to replace the Middle Egyptian as a spoken language from 1600 BC. Although they are descendants of the two previous phases of language, they differ particularly in grammar. At this stage of the language, additions of many linguistic loans of Semitic, Hittite and African origin appear. Although there are writing seeds in earlier centuries, they appear as a complete written language after 1300 BC.

2.4. Demotic Egyptian (ca. 650 BC - 300 AD)

They render the language of the Late and Greco-Roman period, in which there are significant changes in the structural function of the language from foreign linguistic influences. They got its name because of the great impact they had on all social classes. Texts of this writing system are found in papyri, libraries, books, houses, but mainly in temples and tombs where the dead are accompanied by readings for eternal life. From 332 BC, when Egypt was conquered by Alexander the Great, government and legal documents were written in the language of the conqueror, that is, in Greek, and to a lesser extent in Egyptian.

2.5. Coptic (300 BC - 1500 AD)

It is the last phase of the language and the evolution of the vernacular language with the simultaneous use of the Greek alphabet. They generally retained the grammatical rules of the Late Egyptian and an important part of the Egyptian vocabulary. It is the language in which the Christian religious texts were written by the Coptic monks, it is the language of the Gospels; it is the language of the letters, but also the financial archives and other administrative texts. Today it survives as the liturgical language of the Coptic Orthodox Church. It contains Greek and foreign words of Pharaonic origin and is written in an alphabetical script.

3. The Writing System

The first attempts of linguistic recording appear in ancient Egypt in the third millennium BC. Then the propitious environmental and geographical conditions of Upper Egypt, the rich deposits and raw materials of the subsoil, combined with the easier control of trade routes, allowed the development of local hegemony and specific ideological characteristics. In this way, the smooth transition to the dynasty of Egypt and the emergence of a long-standing civilization was facilitated.

The first three stages of the language, Old, Middle and Late Egyptian, developed two writing systems, with a parallel appearance and function: hieroglyphic and hieratic script, while the last stage, the Coptic, followed its own distinct development. A brief presentation of the writing system follows below (sections 3.1-4).

3.1. Hieroglyphics

The word *Hieroglyphics* comes from the ancient Greek words, "sanctuary + glyph", meaning sacred reliefs. The ancient Egyptians used the phrase "writing the words of God" for this scripture. They appear around 3200 BC. The hieroglyphics go hand in hand with Egypt's unified emerging culture, eradicate the older fragmentary systems of written communication, and codify the new palace tradition to be consolidated to the detriment of the older ones. Hieroglyphic script is the monumental writing of the works of art of ancient Egypt and is integrated at the paintings and relief surfaces by the priest-scribes. Hieroglyphics are written horizontal and vertical from left to right and vice versa.

3.2. Hieratic

Hieratic is used contemporaneously with hieroglyphics and it's a simpler form of hieroglyphics. Each hierarchical symbol has its counterpart in hieroglyphic script. This writing system got its name from the ancient Greek "ἱερατικός" (i.e., priest) as in the Greco-Roman period it was the usual way of writing used by priests. Its form followed an evolutionary process and varies depending on the writer, whose graphic character we are often able to recognize. We find it written with a cane on papyrus, leather or wood, in red or black ink. It follows a course from right to left and usually the religious texts were written in columns while the rest in rows. Also, in some texts we find small dots in order to express independent semantic units [3]. In contrast to Hieroglyphics, the Hieratic are found mainly in informal, more temporary texts, such as documents and accounts. Late Egyptian is mostly written in Hieratic script.

3.3. Demotic

Corresponding to the Demotic Egyptian language comes the writing system that is the evolution of the Hieratic, it appeared around 650 BC and gradually sidelined the Hieratic.

The term "Demotic", which means popular, was first used by Herodotus to distinguish it from hieroglyphics. This script, which is read from right to left, has been used for more than a thousand years and during this period various developmental stages appeared. During the last three centuries of its existence, it coexisted with Coptic, creating two different written representations of the same language. Tomas Young, in his attempt to decipher hieroglyphics, was the first to conclude that vernacular script is a "mixture" of hieroglyphic and alphabetic symbols [4].

3.4. Coptic

The portion of Egyptians who followed Christianity seemed reluctant to write their sacred texts in the Demotic Egyptian language, as it had a direct connection to the former pagan religion. Thus, they used the letters of the Greek alphabet to write the Egyptian language, creating the Coptic, which until the 5th century AD achieved to be the dominant way of writing for secular and sacred texts.

4. The Coptic Context

The terms "Copt" and "Coptic" were first used by the French to distinguish the Egyptian people from the numerous Arabs who had come from Asia. The Arabs themselves used the word "qubṭ / qibt" for the natives, that is, they Arabicized the Greek word "Egyptian" [5].

4.1. Language

The Greek influence was decisive in the creation of the Coptic language, which is evidenced by the number of Greek loans. For example, there are 8,000 Egyptian-Coptic entries and 3,250 Egyptian-Greek entries in the Freie Universität Berlin database [6].

From the earliest years, Coptic was associated with Christianity in Egypt. The Coptic texts include a wide range of documentary texts from the later Roman, Byzantine, and early Islamic periods. They constitute an extensive and rich corpus of original and translated Christian literature (of particular importance for the early history of Christian monasticism) and are considered excellent witnesses of great Gnostic, Manichaean and Hermetic texts [7]. Coptic was eventually replaced by Arabic as the language of daily life in Egypt, but it continues to be used today as a functional language in the Christian communities of Egypt and the expatriate Coptic communities around the world.

4.2. Dialects

Before Coptic, the data for separate dialects in Egypt is scanty. Nevertheless, morphological and grammatical features show that Old and Late Egyptian are two phases of the same dialect, probably from the north, while Middle represent a separate dialect from the South; at least Allen [3], Funk [8] and Kasser [9] come to this conclusion. However, dialectal distinctions in the pre-Coptic phase of language

are "invisible".

On the contrary, Coptic displays six distinct dialects (sections 4.2.1-6) and many more sub-dialects. Each dialect consists of a corpus of texts with separate linguistic features, but also in some cases separate thematic features. These can place a dialect in specific geographical areas, but not with precise boundaries for each one.

4.2.1. Sahidic Dialect

Sahidic is one of the main dialects of Coptic, also known as the former Thebaic or "dialect of Upper Egypt", as it was the colloquial language of the region south of Delta. The oldest Sahidic manuscript is placed in the 3rd century AD, while the most recent ones date back to the 14th century, when Sahidic was already an almost dead dialect that artificially survived in the ecclesiastical environment of some communities of Upper Egypt that still strongly resisted the influence of Bohairic (section 4.2.2). Sahidic holds a special place among the Coptic dialects as it is the most "neutral"; it is a "middle" dialect with the least distinctive features, while on the contrary it shares the most common features with the others. In addition, it raises several discussions about its place of origin, while the fact that its "typical" literary background is the translation of the Bible helps the suppression of its discreet linguistic phenomena [10]. However, it touches more on Akhmimic (section 4.2.4) and Lycopolitan (section 4.2.5). Unlike other Coptic dialects, which are mainly translations of Greek literary and religious texts, Sahidic is the only dialect with a significant corpus of original literary and non-literary texts. For this reason, it created a wide range of well-known texts and it is generally the dialect studied by Coptic scholars, especially those outside the Coptic Church.

4.2.2. Bohairic Dialect

Also known as the "Memphitic" or "dialect of Lower Egypt", Bohairic is the first dialect with which Egyptologists became acquainted. It was probably the local dialect on the west side of Delta. During the 8th - 9th century AD it managed to break the monopoly of Sahidic and completing its evolutionary process until the 11th century AD, to become the dominant idiom of Coptic, the official ecclesiastical language, the language of Scriptures and official texts. Bohairic surpassed its local boundaries and became a "super-local" language, as it allowed the inhabitants of the various parts of Delta - where everyone spoke their local dialect - to understand each other. Fewer textual fragments of biblical content from the 4th and 5th century have been preserved in Bohairic, while the largest volume of manuscripts is placed from the 9th century onwards, with texts of the Scriptures, preaching, interpretive, hagiographic, liturgical, etc.

4.2.3. Fayyumic Dialect

Unlike most dialects, Fayyumic (sometimes Bashmuric) dialect can be placed with greater geographical accuracy in

the area of the ancient oasis of Fayum, west of the Nile valley. Although witnessed from the 3rd to the 10th century AD, Fayyumic is difficult to study due to its texts found throughout Egypt, as well as its complexity, its multiple characteristics and its variety of sub-dialects.

4.2.4. Akhmimic Dialect

It was the dialect of the area around the city of Akhmim of the ancient Greek Panopolis. It flourished, in parallel with Sahidic, during the 4th and 5th centuries, after which written texts are not certified. It is probably the most archaic of the Coptic dialects.

4.2.5. Lycopolitan Dialect

As evidenced by its second name of "Subakhmimic", it is a dialect that is closely related to Akhmimic in terms of when and where it is certified. The third name of "Assiutic" reveals that the manuscripts written in the Lycopolitan dialect tend to come from the area of Asyut. In fact, these two names declare the geographical origin, as in Greco-Roman Egypt the city of Assiut was called Lykopolis or Lykon Polis. The main differences between the two dialects seem to be in the writing patterns. The vast majority of texts in the Lycopolitan dialect belong to literature -Biblical, Occult, Manichaeic and Gnostic-, while there is a non-literary one [11], dating to around 330-340 AD.

4.2.6. Oxyrhynchite Dialect

It is also called Mesokemic and is one of the smaller idioms that probably flourished only for a while in the early period of the Coptic language (4th and 5th century AD), but nevertheless evolved during this period into a highly standardized written dialect. It derives from Oxyrhynchus in Upper Egypt, a town which even today, through excavations, constantly gives us new artefacts.

4.3. Writing System

As already mentioned, Coptic script is the final stage of the written Egyptian language. Hieroglyphics, Hieratic and Demotic precede chronologically (section 3), without their boundaries being always tight. Coptic in its essence is not exactly an evolution or simplification of the previous writing systems, as the Egyptians at this stage of linguistic depiction adopt the Greek alphabet. The influence of Greek vocabulary in Coptic began with the conquest of Egypt in 332 BC by Alexander the Great, which led to the adoption of Greek terminology in administrative affairs. Thus, government officials learned the Greek language, as did the same the majority of social classes in Lower Egypt. This led to the progressive integration of Greek words into the demotic and it is culminated by establishing the Old Coptic. This means that the spoken Egyptian is written in Greek characters. The oldest Coptic texts date to about the 1st to 2nd century AD, while the Coptic alphabet that reflects the phonological values of the Greek prototype belongs at the latest to the 3rd

century AD [3], revealing that the tradition of writing the Egyptian language in alphabetical characters is at least three centuries older than the first confirmed old Coptic texts. However, the Coptic script does not consolidate until the 3rd century AD.

The writing system reflects the phonological and phonetic system of a language. Therefore, in Coptic with its six basic dialects and numerous sub-dialects we could identify a common substrate to represent its writing system. Obviously, it is a reduction to a common alphabet of all dialects, a "theoretical" construction but at the same time so useful for scholars of this language, that it could be characterized as "Common Coptic". The alphabet, therefore, used for these six common dialects is Greek, enriched with eight more Egyptian characters to represent the consonants that the Greek language does not have. In this way, a system of 32 characters corresponding to 26 distinctive sounds is formed for the six large dialects (Table 1).

Table 1. The 32 letters of the Coptic alphabet and their Greek equivalents

Letter	Letter Name	Transliteration	Greek equivalent	Pronunciation
Α α	ΑΑΦΑ	a	A, α	a
Β β	ΒΗΤΑ	b	B, β	b in beginning of the word v in the in the middle or the end of the w
Γ γ	ΓΑΜΜΑ	g	Γ, γ	g g ^h ng if there are two consecutive γ
Δ δ	ΔΕΛΤΑ	d	Δ, δ	th d in names
Ε ε	ΕΙ	e	E, ε	e / i
Ϛ ϛ	ϚΟ	st	ς	only used as the numeral 6
Ζ ζ	ΖΗΤΑ	z	Z, ζ	z
Η η	ΗΤΑ	aa, ê	H, η	ee
Θ θ	ΘΗΤΑ	th	Θ, θ	t ^h t
Ι ι	ΙΟΥΤΑ	i	I, ι	i y
Κ κ	ΚΑΡΕΑ	k	K, κ	k
Λ λ	ΛΟΛΑ	l	Λ, λ	l
Μ μ	ΜΕ	m	M, μ	m
Ν ν	ΝΕ	n	N, ν	n
Ξ ξ	ΞΙ	ks	Ξ, ξ	ks
Ο ο	Ο	o	O, ο	o (short)
Π π	ΠΙ	p	Π, π	p
Ρ ρ	ΡΟ	r	P, ρ	r
Ϛ ϛ	ϚΗΤΑ	s	Σ, σ, ϛ	s
Τ τ	ΤΑΒ	t	T, τ	t d if preceded by the letter η
Υ υ	ΕΠΙΧΛΟΝ	u	Υ, υ	v if follows an λ or ε u if follows the letter ο y in all other cases
Φ φ	ΦΙ	ph	Φ, φ	f
Χ χ	ΧΕ	kh	Χ, χ	k ^h
Ψ ψ	ΕΨΙ	ps	Ψ, ψ	ps
Ω ω	ΩΥ	ô	Ω, ω	ô /oo
Ϙ ϙ	ϘΑΙ	š /sh	-	s ^h /j
Ϛ ϛ	ϚΑΙ	f	Ϛ	f
Ϝ ϝ	ϜΑΙ	kh / x	-	x
Ϟ ϟ	ϞΑΙ	h	-	h
Ϡ ϡ	ϠΑΙ	j	-	j, dzh
Ϣ ϣ	ϢΑΙ	c / ch	-	tsh / q
Ϥ ϥ	ϤΑΙ	ti	-	ti / de

4.4. Artefacts in Greece

The relations between Greece and Egypt have been known since antiquity. The various artifacts found in Mycenae and Minoan Crete testify diplomatic and trade relations since the Late Bronze Age. The Greek element in Egypt is present and indisputable and the Coptic - using the Greek alphabet - if it cannot be described as a peak, can at least seal the cultural osmosis of the two populations.

The Coptic element is also present in modern Greece. Museums and institutions manage to preserve some evidence of this mostly "dead" language and art that represents an amazing patchwork of cultures; it is a unique transition from paganism to Christianity and finally to Islam and it brings together the old with the new, creating in this way an amazing, distinct, holistic identity.

Specifically, the *Byzantine and Christian Museum of Athens* seems to present the largest and most diverse collection, which exhibits 44 works of Coptic Egypt, with 4 bearing written symbols. In the Museum namely, there are 19 limestone artifacts dating from the 4th to the 7th century AD, 1 wooden cross with engraved inscription, 14 fabric sections of wool, linen or silk, 3 pairs of shoes, 4 ivory objects from the 5th to the 8th century AD and 3 clay blessings from the temple of the Saint Minas in Egypt dated from the 7th century AD. There are also two tombstones that are not currently on display in the Museum, with one bearing Coptic inscription, bringing the number of works of that period to 46 in total, with 5 of them bearing Coptic script.

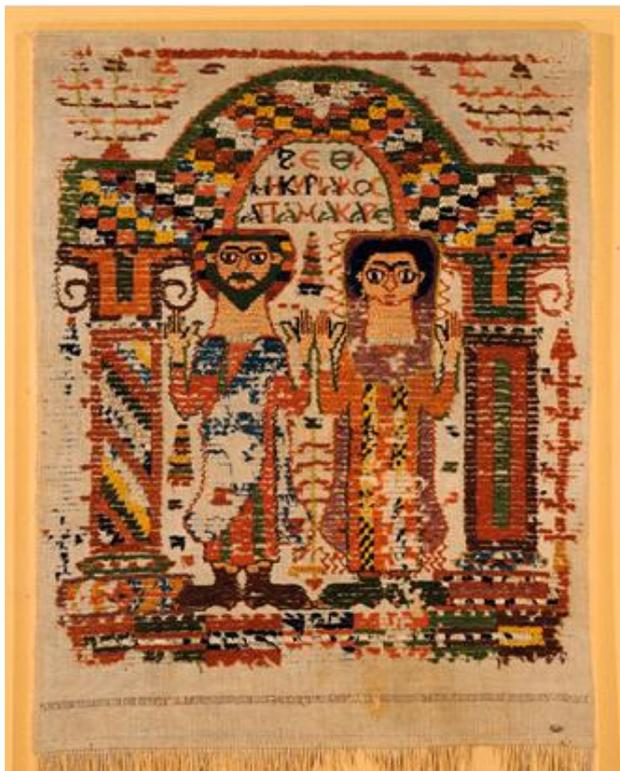


Figure 1. Linen curtain, veil, with woven representation of a couple tied under an arch and a Coptic inscription in Greek letters; it comes from a monastery of Antioe in Egypt and dates back to the 5th-6th century (Dimensions 1,05 x 0,86 m)

In addition, in the *Benaki Museum* at Athens there is an excellent collection of Coptic fabrics from linen, wool, silk and other materials including tippets, tunics, embroidered vests, embroidered medals etc., with themes from ancient Greek mythology (for example, scenes from the mythological circles of Hercules or Dionysus lifting the veil of Ariadne) to Christianity (such as the bust of the apostle Mark or a representation of the Crucifixion and the twelve Apostles), while there are parts of cloth with scenes from everyday life and a cloth Coptic doll, just like those found around the world before the industrialization of children toys. Of the 18 works in the collection, one also has a written inscription, thus combining the virtual decoration with the script of the time (Figure 1).

The *Museum of Modern Greek Culture* at Athens managed to include in its collection at least 3 parts of Coptic fabrics, while outside the prefecture of Attica, the *Peloponnesian Folklore Foundation "B. Papantoniou"*, based in Nafplion, did not remain unmoved towards the Coptic textile industry and presents 4 artefacts.

Moreover, Greece can display not only artistic wealth, but writing too. The *National Library of Greece* (Athens) keeps 3 Coptic manuscripts:

- *Codex 3549*: 15th century AD. Contents: (a) Psalm of the month Koiak: according to the Coptic Orthodox Church; (b) Twelve psalms (*troparions*) of the Archangel Michael, one for each month.
- *Codex 3550*: Consists of fragments of five different manuscripts, four Coptic and one Arabic.
 - (a) 17th century AD. Coptic with Arabic notes. Psalms, Stories.
 - (b) 17th century AD. Coptic. Praxapostolos.
 - (c) 17th century AD. Coptic with Arabic inscriptions. Apostle, Stories.
 - (d) 17th century AD. Coptic. Old Testament Readings, Gospels, Apostle, Stories.
 - (e) Arabic.
- *Codex 2894*: Not specified in the Library catalogue.

There are 3 manuscripts in the Benaki Museum:

- *Codex 84*: 19th century AD. Coptic and Arabic. Rites of Holy Week except the passages of the Gospels and the Prophecies.
- *Codex 85*: 18th century AD. Coptic and notes in Arabic. Troparions and rules for the whole year.
- *Codex 86*: 18th century AD. Coptic and notes in Arabic. Blessings, Vespers Rites, Matins Rites, Divine Liturgy of St. Basil.

In the *Holy Monastery of Iveron*, on Mount Athos, there is 1:

- *Codex $\chi.a.$ 23*: 16th century AD. Coptic, Greek and Arabic. Psalm of the month "Koiak".

Moreover, in the National Library of Greece of the four papyri from Egypt, a Coptic sheet of papyrus was found (*Codex: $\chi\phi$ EB 177/'933*), but without a more detailed description in the catalogues.

Grouping the Coptic findings, Coptic script is likely to be found in harder materials but also of milder durability: rocks (such as limestone), ivory, wood, clay, fabric (silk, linen, wool), papyri.

5. Conclusions

Coptic is considered a "dead" language, without natural speakers but its revival efforts keep the interest in it undiminished. In Greece, the richness of Coptic art and the plethora of materials in which Coptic script is found are great, but the theoretical background for Coptic is poor, while the tools related to Greek for this language are obsolete. Under the auspices of the University of Athens, it was deemed necessary to implement a similar tool, according to the standards of other tools related to non-spoken languages and more specifically the existing Dictionary of Linear B, which was implemented by Kontogianni Argyro in her master's thesis [12]. The software will be based on the existing methodology, as already announced in previous studies [13,14], adapted in such a way as to meet the complex needs of the Coptic language. This software system introduces a new digital platform for deciphering and interpreting existing ancient texts, digitizing them, and teaching rendered languages [15]. It is, therefore, a promising tool for the digitization of cultural heritage works, a model of computer-aided deciphering for findings of other ancient languages and an aid not only for the researcher but also the scholar of the Coptic language. This software will also facilitate the work of archaeologists, linguists and other researchers; it will modify their methodology and will accelerate the results of their research not only in our country but also abroad, complementary to the points that the international Coptic community is considered to "suffer" or presents deficiencies.

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