A Writing System for the Ancient Egyptian Hieroglyphs

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Abstract

The writing system for the ancient Egyptian hieroglyphs in the computer can be considered a simplified Japanese input system. By using the analogy to the Japanese writing method, the fluent writing system for hieroglyphs can be constructed. Such a computer aided writing system for hieroglyphs could revive the ancient Egyptian arts of typographies without pain that the ancient Egyptian secretaries had felt. Many ancient Egyptian enthusiasts could use that system, so that the ancient Egyptian languages could be widely recognized as a world cultural heritage.

1. Analogies to Japanese writing systems

1.1. Japan has also own megalith civilization

From outside of Japan, Japanese potential fevers on the megalith civilizations including ancient Egypt, Sumer (Mesopotamia), Indus and Maya are not aware by the foreigners. Many books on the ancient civilizations have been published in Japan. Own association on the oriental civilizations has been organized locally and a famous Egyptian professor appears frequently in the mass media such as the televisions and the popular magazines.

One reason of the fever is explained by the ancient huge tumuli civilization in Japan. Many huge tumuli for the ancient emperors had been mounded in the 3-7th centuries. In such tumuli, the many megaliths were included for constructing stone huts. The largest tumulus is known as the mound for the *Nintoku* emperor. This tumulus was constructed in the middle of the 5th century. The length of the tumulus is 487 meters, the height of its mound is 33 meters, and its area is 464,124 square meters. The shape of the mound seems a keyhole viewing from the considerable height in the sky. The base of the pyramid of the pharaoh Khufu could be just mapped to the head part of the mound.

1.2. Writing system based on ideographs

The aspect of the history of writing system in Japan could also explain the other reason of such fevers. The character systems of many megalith civilizations such as the ancient Egypt, and the Maya are similar to the Chinese Kanji character system. Namely, all character systems of those are *ideographs*.

Japanese has been introduced Kanji character since 6th century. Besides the ancient Egyptian hieroglyphs, the Mayan characters, and the Kanji characters, the early Sumer characters are also ideographic and also some kinds of logogram. Kanji character has been investigated in Japan as same as has been done in China. The recent Japanese language researcher has proposed precise investigations of the origin of Kanji Characters. Quite recently, the remarkable results of investigations on the ancient Kanji Characters have been published as a series of Kanji dictionaries in Japan [1]. The writing systems on ideographs in the megalith civilizations have much in common.

While introducing the Kanji characters as ideographs, ancestors of Japanese produced the notation of the original phonetic symbols. Such symbols are called *Kana*. Before the 19th century, the official documents were noted of only Kanji characters. Such phonetic symbols had been used in demotic notations. However, the mixture of phonetic symbols and ideographs make improved readability. Therefore, the mixture became the standard Japanese. The ancient Egyptian also used

the mixture of phonetic symbols and ideographs from the beginning of the civilization. Why the ancient Egyptian could make such an advanced usage of character is still in the mystery.

1.3. The Kanji Characters with Huge glyphs

For western researchers who have not had experiences on the Kanji Characters, various glyphs seem to be defined in the ancient Egyptian hieroglyph. However, for the citizens using Kanji Characters, the number of the glyphs is considerably lesser than the number of the glyphs of the Kanji Characters.

The most canonical Kanji Dictionary (named *Kāngxī Zìdiǎn* in Chinese) compiled by a China emperor's order and published in 1716 has 49,030 characters. The Unicode has been contained 27,484 Kanji ideograph characters in the usual code areas (BMP: basic multilingual plane) since version 1.0. Those Kanji characters have been selected under the reference to that canonical dictionary. Though the number of Kanji Characters designated for daily use in Japan defined by the government is only 1,945, most citizens using Kanji Characters can recognize over 4,000 glyphs at least. The Unicode 5.2 defines only ordered 1,071 glyphs for the ancient Egyptian hieroglyphs [2]. Those could be easily processed comparing with the Kanji Characters.

1.4. The Kanji writing system for Japanese

For Japanese, many Kanji Dictionaries are computerized and used by the computer when inputting sentences of Japanese language in accordance with the translation from the Japanese phonetic syllabary, *Kana*. Japanese syllabary Kana has only 100 kinds of syllables and one word of traditional Japanese has usually 2~5 syllables. Namely, there are potentially many homonyms in Japanese when using Kanji Characters. Therefore, the Japanese writer should select one Kanji compound word from many candidates having the same homophone described in Kana. Such a selection is called a *Kana-Kanji translation*.

Over 30 million of people use this input system when using computer system in Japan. Chinese also developed own several kinds of Roman-Kanji translation systems by referring to Japanese developments. The similar translation system can be applicable to selecting the target ancient Egyptian hieroglyphs.

In addition to the translation system, the many Japanese use the Latin (Roman) alphabet characters in order to specify one Kana syllable character. Since the missionaries had introduced the Roman alphabet in 17th century, the syllables of Kana had been described in *modern Latin spelling* (modern Latin is called *Roman* in Japan). This spelling method has been taught in the elementary school. Therefore, Japanese people use the two phases of translation system for writing the language: the *Roman-Kana translation* and the *Kana-Kanji translation*. The ancient hieroglyphs require the one translating system that converts from alphabets to target hieroglyphs directly, so that the translation would be implemented easier than the Japanese usual translation used in the writing sentences.

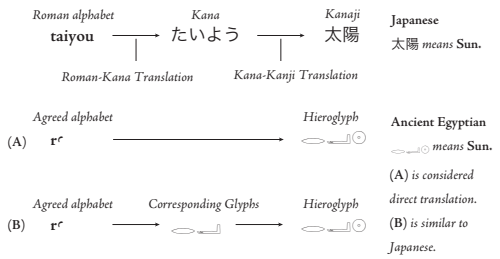

Figure 1. Translation Methods for Japanese and Ancient Egyptian

1.5. Requirement for a glyph dictionary

When selecting target characters, there is another problem, *Polyphone* - multiple and different readings of the identical sequence of characters. One sequence of Kanji characters has multiple readings in China by historical transitions, and also has multiple Japanese readings. Many the ancient Egyptian hieroglyphs have the different readings because one symbol could be used for phoneme and also for meaning. In addition to those aspects, historical transitions could make changes of meaning on a symbol of glyph. Therefore, the compound writing systems dealing with the huge kinds of glyphs have been developed in Japanese.

A usual Kana-Kanji translation system uses some kind of *Kanji-Japanese Dictionary* (means Kanji Character Glyph Dictionary). By defining a glyph

dictionary for the Hieroglyphs, the helpful writing system can be established. Recent Japanese writing systems in computer can automatically display the corresponding entries of the dictionary for the target translation for reference.

2. Front-End Processor

The computer aided writing systems for Japanese language are usually called *front-end processors*, so that the same name is adopted for calling this writing system in this paper.

2.1. Keyboard layout for phonemes

In contrast with the Kanji writing systems, the language of ancient Egypt itself has entirely different phonological system from the one of Japanese. The similarities on phonology of the ancient Egyptian language to the Aramaic, the Hebrew, and then the Arabic languages have been pointed out [3]. The ancient Egyptian language mainly bases on the consonants and the uses of vowels are limited. Those characteristics are common feature in the above languages. Therefore, in the design of keyboard layout for the input system, only pure 26 alphabets representing the phonology are used for keyboard input.

In the traditional convention for the ancient Egypt hieroglyphs, the virtual vowel “e” is inserted between the spellings consists of only consonants. This convention has been used for pronunciation. In the writing system, such conventional vowel is not required. The writing language must not be equal to the spoken language. Especially, the accurate pronunciation of the ancient Egyptian language has been unknown. Therefore, one of the important features of this input system is in the exclusion of conventional vowels. For example, in order to input the name of the famous Pharaoh of the old dynasty, one should input “Śnfrw”, not “Śneferw”, with this input system.

In the design of the layout of the keyboard, each key is considered in accordance with the original QWERTY layout. Each key top is based on the agreed alphabets for describing the ancient Egyptian literature. Referring to the Adolf Erman’s alphabets, the consonant “s” is divided into two key tops: “s” and “ś” because the different glyphs are used in the hieroglyph [4].

Figure 2. Keyboard Layout of Input System

The upper cases translated by shift modifier key are reserved for writing the proper nouns such as pharaohs, dynasties, gods, and places. Other frequently used symbols and the Bi-literal signs and the Tri-literal signs would be supported in this keyboard layout with the option modifier key. This modifier key is considered the ALT (alternate) key in Windows. This key has been familiar to the Macintosh users who use the modern Romance languages besides English, such as French and German, since 1984.

2.2. Alphabet-Hieroglyph Translation

As shown figure 1, there could be two methods for translating the inputs from the alphabets to the hieroglyphs. One method is considered an indirect translation. In this translation method, the alphabets are once translated to the alphabet symbols in the hieroglyphs automatically. When the writer inputs the SPACE key, the candidates of the target hieroglyphs would appear including the automatically translated hieroglyphs.

In all Japanese front-end processors, this method is included in their several input methods. The users can choice the preferred input methods. The reason of this indirect method is in the existence of the Kana syllables. In the keyboard of the Japanese versions of personal computers, each glyph of Kana is allocated in each key top besides the alphabet. The user who masters the Kana keyboard layout can directly input Kana without this automatic translation from the Roman alphabets to the Kana syllables.

Because there is no own syllable system in the ancient Egyptian hieroglyphs, this method seems to be complicated to the writers for the hieroglyphs. Therefore, the direct translation method from the alphabets to the hieroglyphs is adopted in this writing system. When the writer inputs a sequence of alphabets and then types the SPACE key, the

candidates of the hieroglyphs would appear and the writer could choice the target using the SPACE key by inputting repeatedly. The writer should type the Return/Enter key in order to confirm the target hieroglyphs. Without typing the SPACE key, the writer can confirm the alphabet just as it is by the typing Return/Enter key.

There are many homonyms in the ancient Egyptian hieroglyphs like the Japanese language [5]. The hieroglyphs also have *determinatives* for deciding the meanings of literals from the same phonetic spellings.

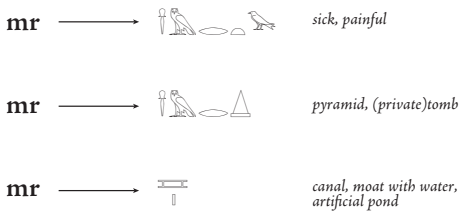

Figure 3. Homonyms in Ancient Egyptian

Arabic numerical digits are also required to input usual decimal notations. Though those are input in the form of modern digit notation, the front-end processor converts those to the hieroglyphic notation. Such conversion is usually supported in the front-end processors for Japanese. For example, if one inputs 3045, the number would be converted to the corresponding notation in the hieroglyphs.

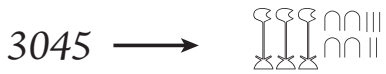

Figure 4. Numerical Translation

2.3. Conversion at Layout

The working group of Unicode organized the coding system and the glyph systems [2, 6]. In the base of this coding system, Geouge Douroh designed the *Aegyptus* font and the *Gardiner* font limited to the Unicode standard [7]. However, the several layout problems should be considered for the reproduce the original texts of Hieroglyphics. To begin with, the vertical layout and the reverse (from the right to the left) horizontal layout should be also realized. Because this proposal system is mainly for writing and not the layout, those layouts are not implemented. Though adopting only the normal horizontal layout, several kinds of layout problems that are inherent in the ancient Egyptian hieroglyphs are left.

The ligatures of small glyphs

Usually, the small glyphs in a word are combined to one ligature ignoring the order of the phonetic spelling of the word. Therefore, many sorts of ligatures should also be realized for reproducing the text in the orthography. However, the usual writing editor does not support such ligature layout and a lot of the combination of the small hieroglyphs could be noted. This frond-end processor produces the hieroglyphs in a uniform layout only. The secretaries of the ancient Egyptian would become angry if they would look at the text written in this system.

Cartouches and Dynasties

Though the several cartouche glyphs (identifying Pharaoh name) and dynasty glyphs (called Horus name) are defined in the Unicode and the font of the ancient Egyptian hieroglyphs has those glyphs, those glyphs are used like quotation marks and the words are parenthesized by those glyphs as shown figure 5. This cartouche and dynasty represent the hieroglyphs for the pharaoh "*Ḫwfw*" of the old Egyptian dynasty. In accordance with the conventional notations, a cartouche is represented by two parentheses representing the both side of the cartouche and a name of dynasty is represented as the name with the parentheses.

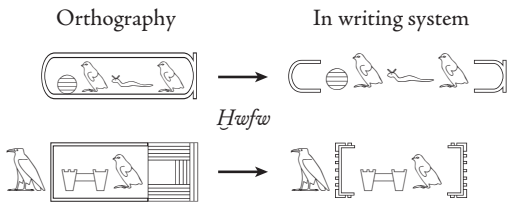

Figure 5. Cartouche and Dynasty

2.4. Dictionaries

For translating the alphabetical spells to the hieroglyphs, the simple dictionary that used only

for the translation is currently realized. Though this dictionary is currently very small, using this front-end processor itself would increase its size. In the course of the implementing the front-end processor, I felt the following three sorts of dictionaries would be required in order to make up more fluent writing systems.

(A) Glyph Dictionary

The *Aegyptus* font has many glyphs, and then the *Gardiner* font has only glyphs defined in Unicode [7]. Many glyphs represent their inherent meanings and some of the glyphs have the sounds. It is hard work to find the target hieroglyph with only code chart tables. Several glyphs are considered typeface variations of a single glyph, or conveniences for representation such as parentheses of a cartouche. Those differences and identifications should be explained in the usage. Especially, one glyph could be used for either the pronunciation or the meaning in the hieroglyphs.

This sort of information is classified in the Kanji-Japanese Dictionary. This dictionary classifies the glyphs into the some kinds of groups by the radicals of Kanji. One glyph of Kanji is explained both aspects from phonetics and meanings. The typeface variations are also cited. In addition to such information, several words using that glyph are enumerated. The similar dictionary is also required for writing the texts in the ancient Egyptian language. Alan H. Gardiner classified the hieroglyphs in accordance with the shape of the glyphs in his *Catalogue of the Egyptian Hieroglyphic printing type* [8], and Gardiner also compiled the standard glyph dictionary in his *Egyptian Grammar* [9]. James P. Allen also edited the revised glyph dictionary in his *Middle Egyptian* [10]. Wolfgang Helck compiled the encyclopedia of the ancient Egyptian hieroglyphs [11]. Based on such a catalogue and dictionaries, the glyph dictionary could be also edited by using this front-end processor.

(B) Dictionaries of Translation

The identical word could be represented with several candidates in the hieroglyphics. The main reason of those variations is explained by the dynasties. The total period of the Egyptian dynasties was wide over the two thousands of years. Looking back our current civilizations, many languages have been metamorphosed in such a long period. In the dictionaries of translation, such the transitions of spelling the words should be also enumerated.

I have been mainly using the Japanese-Hieroglyph dictionary [12, 13]. The dictionary is very useful but the shape of each glyph is too simplified and not so distinguishable against the varieties of a glyph in the *Aegyptus* font. Then I myself require the dictionary of translation with the precise shapes. For the many researchers and learners, both the reading dictionary from Hieroglyphs to English and the translating dictionary from English to Hieroglyphs are required.

(C) Learning Dictionary

For travelers to the foreign countries, some small types of *travelers' dictionaries* are prepared. Words in the target language are grouped to the aspects of activities of the typical travelers. Such convenient learning dictionary is also required in order to increase the population of the writers of the ancient Egyptian hieroglyphs. This sort of dictionary is similar to one sort of learning dictionaries. The words are classified in accordance with an aspect of dairy life. Some notable words are grouped for reading the existent texts of Hieroglyphics. This sort of dictionary is quite useful, if one would understand the virtual ancient Egyptian community, or if one would encounter the text written in the ancient Egyptian hieroglyphs. Most Japanese books on the hieroglyphs are considered inadequate learning dictionaries.

3. Implementation

The front-end system is realized on Macintosh. Apple Computer has been supporting the multilingual texts since the classic system of the Macintosh. In the modern operating system Mac OS X, the ATSUI (Apple Type Services for Unicode Imaging) library has been established and this front-end system is based on the MLTE (Multilingual Text Engine) library [14]. The translation of this front-end processor is implemented by using a simple dictionary written in text format. Though a keyboard layout could be implemented separately by writing translation table

in XML format [15], I started with the MLTE programming that realized the keyboard layout.

The MLTE library is implemented both on the Carbon library, that is the inherent Macintosh library from the classic system written in C programming language, and also on the Cocoa library, that is the successor of the *NeXTstep* written in Objective-C programming language. I implemented this front-end processor with the Carbon library and write it in C programming language. By using the front-end processor, many applications including the *TextEdit* and the *Word*, that is the common editor in Mac OS X, can handle the ancient Egyptian hieroglyphs.

4. Evaluation

By comparing with the workflow in which the writer should search out the target hieroglyph from the vast glyph table, the typing is considerably convenient with this front-end processor. Because the current translation dictionary is poor, the writer should struggle with the code table frequently.

The problem of layout, that is inherent in the ancient Egyptian hieroglyph pointed out above in this paper, is still left in this system. Publishing layout systems such as the *Adobe InDesign* applications should implement the vertical layout and the reverse horizontal layout and various ligatures of the hieroglyphs for the orthographic reproduction of the original texts. I made a simple application to demonstrate the vertical layout. However, it is possible to encode the existing many texts of Hieroglyphics by using this front-end processor. The significance of this front-end processor is to encode the original texts and publish them online.

5. Conclusion and Future Works

By using the proposed front-end processor, a writer of the ancient Egyptian hieroglyphs is able to input the original texts into the computer. All text is encoded by the Unicode standard. Therefore, texts in the computer could be the targets to retrieve. Online texts with the standard code will assist the researches and the learners on the ancient Egyptian hieroglyphs. The language systems and their literatures of the ancient civilizations could be shared widely as cultural heritages.

For the convenience to the writers, the entries of the dictionary of translation in the proposed front-end processor should be increased. When completing the classification on the sorts of ligature with small hieroglyphs, the ligatures could be implemented. The library of MLTE itself has the ability of reverse layout of glyphs, because the characters of Arabic writing system are noted from the right to the left. Then, it is possible to implement reverse horizontal layout of the ancient Egyptian hieroglyph if the horizontal mirroring of glyphs are drawn.

On the vertical layout, the application supporting that feature is required separately. In addition to the vertical layouts of Chinese and Japanese, Mongolian traditional script is described just vertically. In order to the vertical layout, there are several technical hazards faced on the localization of computer.

The proposed system is inherent to the Mac OS X. If I use the modern Cocoa library, it is possible to port this system to iPod touch or iPhone. For the Windows users, I also plan to implement the front-end processor with Java. By using the Java language, it is possible to port this system to Android OS. In a portable device, such as iPhone or Android, one would not write the text of the ancient Egyptian hieroglyphs. However, the texts encoded by this system could be readable in the device by preparing the appropriate application.

The reason why I decide to develop the front-end processor is in the elegance of the ancient Egyptian hieroglyphics, and in the analogy to the Japanese writing system in the computer. The cultures of calligraphy have grown in the Arabic, the Chinese Kanji and the Japanese Kana besides the calligraphy of the Latin. Those cultures of calligraphy commonly pursue the elegance of glyphs as the ancient Egyptian secretaries done.

Cuneiform used in *Akkadian* and *Babylonian* are difficult to read and too complicated. For encoding the vast texts written by Mesopotamians online, some front-end processor for cuneiform is required. I prefer the simplified usages of cuneiform by the Ugarit and the ancient Persia. The early Sumerian glyphs are similar to the ancient Egyptian

hieroglyphs [16]. I also plan to implement the front-end processor for those glyphs.

References

[1] Shizuka Shirakawa, *Jitou revised edition* and *Jikun revised edition*, Heibon Publisher, Tokyo, 2004-2005 (printed in Japanese).
[2] *Unicode 5.2 Character Code Chart*, http://www.unicode.org/charts/, for Egyptian Hieroglyphs, http://www.unicode.org/charts/PDF/U13000.pdf, reviewed in 2009.
[3] Messod Sabbah and Roger Sabbah, *Les secrets de l'xode*, Jean-Cyrille Godefroy, Paris, 2000 (translated to Japanese).
[4] Adolf Erman and Hermann Grapow , Wörtebuch der ägyptischen Sprache, Berlin and Leipzig, 1926-1971.
[5] Shin'ichi Akiyama, *An encyclopedia for reading Ancient Egyptian Characters*, Tokyodo Publisher, Tokyo, 2003 (printed in Japanese).
[6] *Sources for the encoding of Egyptian Hieroglyphs*, Working Group Document, ISO/IEC JTC1/SC2/WG2 N3182, 2006.
[7] George Douros, *Aegyptus font version 3.11 and Gardiner font version 3.11*, Unicode Fonts for Ancient Scripts, http://users.teilar.gr/~g1951d/, reviewed in 2010 (The *Gardiner* font is based on Alan Gardiner, *Catalogue of Egyptian Hieroglyphic Printing Type*, Oxford University Press, London, 1928).
[8] Alan H. Gardiner, *Catalogue of the Egyptian Hieroglyphic printing type*, Oxford University Press, London, 1928.
[9] Alan H. Gardiner, *Egyptian Grammar 3rd edition*, Oxford University Press, London, 1957-1979.
[10] James P. Allen, *Middle Egyptian – An Introduction to the Language and Culture of Hieroglyphs*, Cambridge University Press, London, 1999-2000 (will be revised in 2010).
[11] Wolfgang Helck and Wolfhart Westerdorf, *Lexikon der Ägyptologie*, Bände 1-7, Wiesbaden, 1975-92.
[12] Yoko Nishimura, (*A Basic Dictionary of*) *Ancient Egyptian Hieroglyphs*, Heibon Publisher, Tokyo, 1998 (printed in Japanese).
[13] Bridget McDermott, *Decoding Egyptian Hieroglyphs*, Duncan Baird Publishers, London, 2001 (translated to Japanese).
[14] *Multilingual Text Engine Reference*, Apple Computer Inc., CA, 2006.
[15] *Installable Keyboard Layouts*, Technical Note TN2056, Apple Computer Inc., CA, Revised in 2009.
[16] L. A. Waddell, *Egyptian civilization its Sumerian origin & real chronology and Sumerian origin of Egyptian hieroglyphs*, Luzac & Co., London, 1930.