THE CIPHERED AUTOBIOGRAPHY OF A 19^{th} CENTURY EGYPTOLOGIST

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ABSTRACT: Simeone Levi was an Italian Egyptologist who lived in Turin during the second half of the 19th century. His major work is an eight volume hieroglyphic dictionary. He left a ciphered autobiography which remained a mistery for about three generations in his family. We present here the procedure used to decipher the text and the structure of the code invented by Simeone Levi.

KEYWORDS: Simeone Levi, Italian, Turin, Egyptology, hieroglyphic dictionary, ciphered autobiography.

Simeone Levi was an Italian Egyptologist who lived in Turin during the second half of the 19th century. His major work is the eight volume hieroglyphic dictionary [1] for which, in 1886, he was awarded the prize of the Royal Academy of Lincei. He was the brother of the mother of my great-grandfather, and I first heard about him when my grandmother gave her copy of the dictionary to my father. The dictionary is a lithographic copy of his handwritten manuscript and its aim was to compare the hieroglyphic words with the corresponding Coptic and Hebrew words, in an attempt to demonstrate their derivation from hieroglyphic.

Born in 1843 in the Jewish ghetto of Carmagnola near Turin to a poor family, Simeone Levi was the seventh of the 10 children of a goldsmith. Struck by a paralysis at two, he remained disabled all his life, sufferering the limitations imposed by his handicap. After getting a degree in mathematics, he earned his living at first by teaching mathematics. His interest in Egyptology started only at 33, after he attended a series of lectures by Professor Francesco Rossi, vicedirector of the Egyptian Museum of Turin. His only other classmate was Ernesto Schiaparelli, who was to become famous for discovering Queen Nefertari's tomb. From that moment he entirely devoted himself to papyrology, having Professor Rossi as his guide and maintaining a competitive attitude towards Schiaparelli.

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Figure 1. The cover page: *S. Levi / Autobiografia / 1843-1900*

Figure 2. The title page: *La vita / di / Simeone Levi / narrata / da lui medesimo* (The life / of / Simeone Levi / told / by himself)

Last year my grandaunt Giorgina Levi (Simeone's grandgrandniece) decided to find out more about the life of her famous ancestor [2] and initiated an historical research. Through the documents, she got in touch with the lineal descendants of Simeone, Ettora and Massimo Levi. They had several papers, books and letters of their grandfather and among them a manuscript written in an unknown alphabet. They also reported that Simeone had imposed upon his sons the duty of interpreting and reading the 355-page manuscript. But all attempts to decode the mysterious text failed, even though it was given to fairly expert, but possibly not very motivated, people to examine.

When I heard this story from my aunt, I could not resist my ancestor's challenge. At first I was given only photocopies of the front cover, the title page and the first page (Figures 1–3). That proved insufficient to decipher the text, but it gave some hints and an idea of the difficulties to overcome: *i)* an apparently very large character set, possibly due to the varying shape of the characters because of the handwriting; *ii)* uncertainty of the language used by such a polyglot.

At a first glance the characters all look pretty much the same: some appear like calligraphic characters of the Latin alphabet, both minuscule and majuscule, some others of the Greek alphabet. Punctuation seems totally absent; accents occasionally appear, but only on the last character of some words, supporting the hypothesis that the language was indeed Italian, as suggested by the fact that Simeone had expressed his wish that his descendants interpret and read the text. On the assumption that the language was Italian, the word length statistics of the first page strongly indicated that he had not used a monoalphabetic key, since the words appeared shorter than the average word length in Italian. Of course Simeone could have also split up the words with some strange rule.

Handwriting is usually hard to interpret at a first reading. Copying the entire page a few times helped me become more familiar with the signs. This enabled me to complete an approximate table of the different signs. Their large number was a clear hint that the same Latin characters might be represented by different ciphered symbols depending on their context within the word. It was also possible to identify some equal strings of characters and this induced me to believe that each word had the same ciphering, independently of the neighboring words.

Study of the cover page (Figure 1) and title page (Figure 2) seemed to lead nowhere, since nothing appeared to have the pattern of Simeone's name. The signs on these pages are written in a fancy variant of the standard font used in the first page and throughout the text. In fact the same word appears twice in the second line of the cover (Figure 1) and as the first word of the title of the first page (Figure 3). The only line I was able to decipher was the last one on the cover (Figure 1), where the signs looked different from the others in the page. I

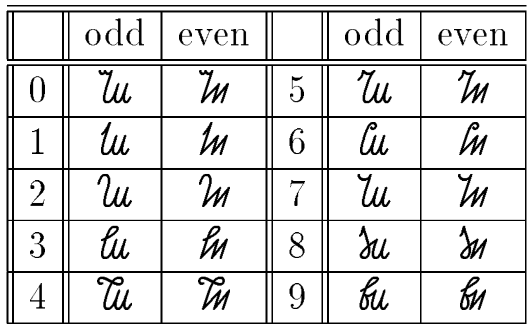

Table 1. The digits: *odd* position is for units and hundreds and *even* position is for tens and thousands.

assumed that they were numbers, and on the hypothesis that the text was his diary, they could indicate the year range 18??-1900 (the last two equal characters had to be "00", because they were different from the first "1" and Simeone died in 1913). The two unknown digits could have been "43", the year of Simeone's birth, but I could not go any further.

I was going to give up when I received the photocopies of the entire manuscript. Some new essential elements became available. All the pages after the first one were numbered and the signs for the digits could be easily derived. The sign representing a particular digit differs according to its position within the number. The upper left part of the character is constant but is followed by a sort of calligraphic *u*, if the digit is in odd position starting from right (units), or by a calligraphic *n*, when in even position within the number (see Table 1). For instance the number 5555 is ciphered as . This enabled me to establish without any doubt that the cover contained the year range 1843-1900 and confirmed the hypothesis that the manuscript could be Simeone's autobiography. The next step was to search through the entire text for all the occurrences of numbers possibly corresponding to dates or amounts of money.

The only way I could proceed then was by guessing some complete words. The historical research carried out by my aunt turned out to be valuable, since she could associate some facts in the life of Simeone with some of the years. Unfortunately the precise date of these facts, including day and month, was never available.

Still the breakthrough came from the analysis of the dates. I collected all the words around the dates on the assumption that some of them represented

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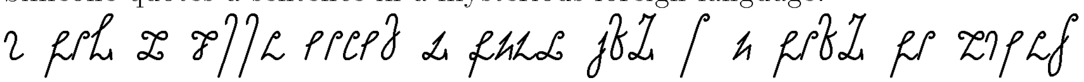
Figure 3. The first page (see Appendix)

articles, prepositions or names of months or seasons. The first words I could guess were *nel* (in) usually preceding a year and *di* (of) preceding the possible name of a month. Then came all the variants *nell'* , *nella* , *del* , *dell'* , *della* , for the two genders and for the words beginning with vowels. I was lucky to find four different months with the same last two signs, which corresponded to: *settembre* , *ottobre* , *novembre* , *dicembre* . I also found which was preceded by *nella*, indicating a feminine word starting with a consonant. Since all months are masculine in Italian it could only be the season *primavera* (spring). The other seasons *autunno* (fall), *inverno* (winter) and *estate* (summer) would be preceeded by *nell'* since they begin with a vowel. Then I recognized the words *anno* (year), *il* (the), *fine* (end) and *fino* (until), also related to the dates.

This set of words was sufficient to break the cryptosystem. From the four months and from *primavera* containing the strings *ra*, *re* and *ri*, it became clear that a basic character representing *r* was altered in the upper part according to the vowel which was following it (see Table 2). Similarly from *novembre* and *nel* it was possible to derive the signs for *n* and *o*. With the above words the signs for the vowels *a, e, i, o* and some consonants became clear. With these few signs I started translating the first page. Guessing some other words, I gradually completed the set of signs. This representation of the vowels as diacritical signs (or sign alterations) attached to consonants was certainly inspired in Simeone by his knowledge of Sanscrit.

The first meaningful sentences appeared. Simeone was writing his autobiography, telling us about all his good and bad actions, his successes and failures, his friends and enemies, his loves and betrayals.

A further puzzle is posed by the third line of the first page (Figure 3) where Simeone quotes a sentence in a mysterious foreign language:



(*Ma pecuglie ri sifafanu cecumucela o queanru ytagno fu a pecutagno pecu nicagenu.*)

I consulted various linguists in Ancient Egyptian, Sanskrit, Coptic and Hebrew, but the language of this sentence still remains a mystery. I leave it as a challenge for the interested readers.

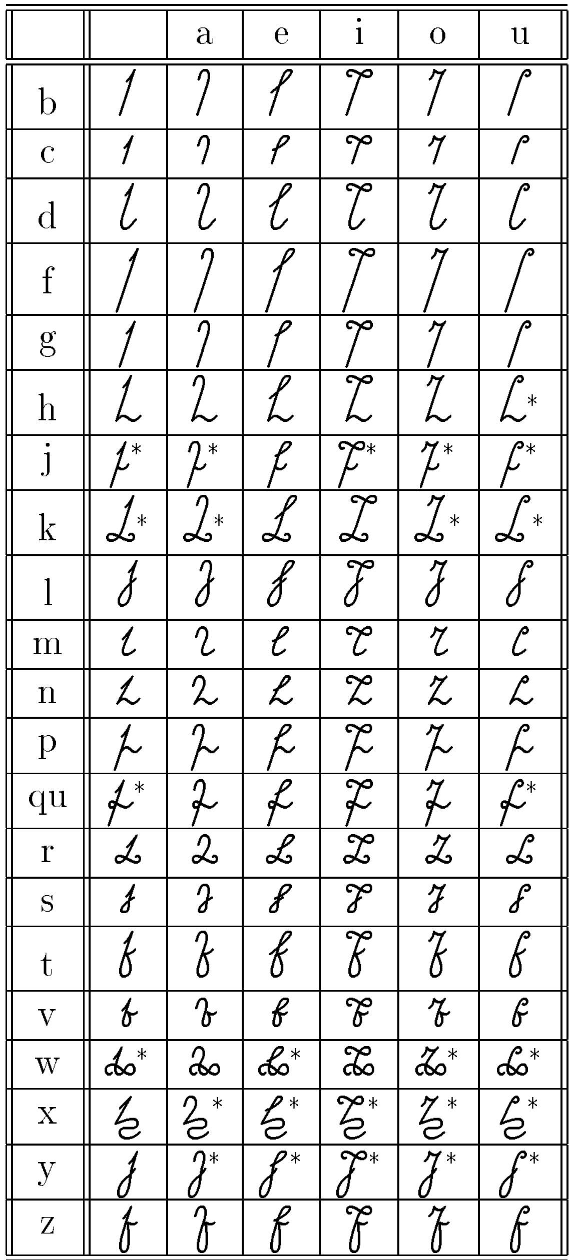


Table 2. The consonants.

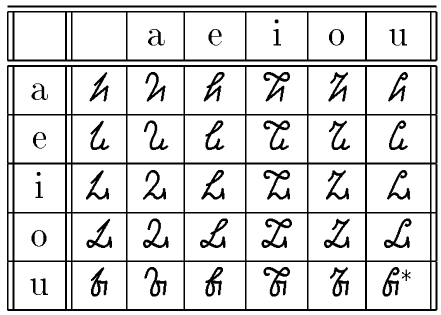


Table 3. The vowels.

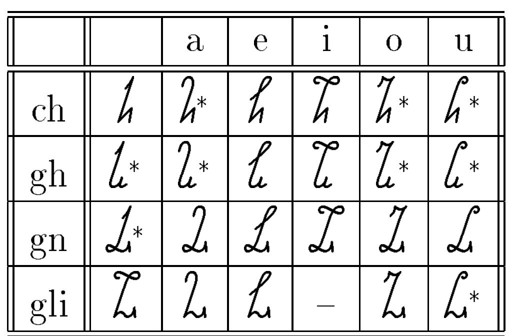


Table 4. Some special consonant pairs.

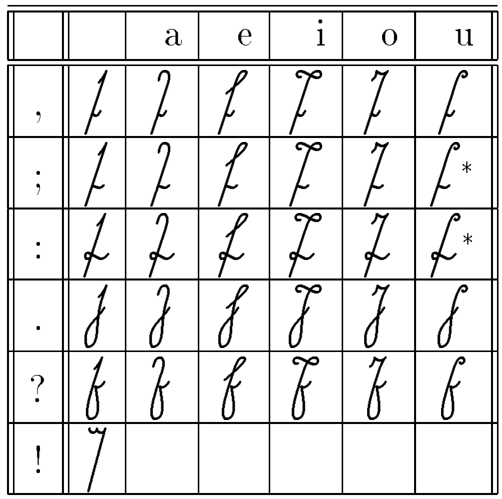
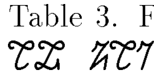


Table 5. The punctuation.

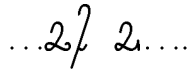
Further work unveiled all the tricks Simeone had used for ciphering.

1. Consonants followed by other consonants or at the end of a word take on the basic sign in the first column of Table 2.

2. The most important trick, which makes the code resist a simple statistical cryptanalysis is the way the vowels are enciphered. As already mentioned, when one follows a consonant it is added at the top of the consonants sign (first column of Table 2). When one follows another vowel, either in the same or in the previous word (an exception to my first guess that the code memory did not extend across neighboring words), then it takes on the basic vowel sign for the lower part, while the upper part corresponds to the sign of the preceding vowel (see Table 3). This makes the signs for the vowels position dependent. Vowels at the beginning of a word following a word ending with a consonant take on the basic vowel sign in the first column of Table 3. For example the words *mio amico* (my friend) are enciphered as .

3. The signs for the punctuation marks are also position dependent. They change according to the last character in the preceding word, as do the vowels (see Table 5). Punctuation does not break the memory for the vowels of Table 3. For example a word ending with *ra* followed by a comma, then

followed by another word starting with an *o* would be encrypted as



4. There are no capital letters.

5. Apostrophes, accents and hyphens are not encrypted, but no sign is used for word hyphenation.

6. Some pairs of consonants that are typical of the Italian language, *ch, gh, gn, gli*, are encrypted with a special sign, following the rules of the consonants (see Table 4).

7. The *qu* is a single sign, in which the *u* is omitted as redundant.

8. Occasionally some words are accidentally misspelled (less than one error per page on average).

9. The spacing between words is not always well defined probably on purpose. This trick can be observed on the third line of the title page (Figure 2) where his name is written as *simeonele vi*.

The complete set of signs is given in Tables 1–5. The letters *j,k,x,y,w* do not belong to the standard Italian alphabet and appear very rarely in the text - only in some foreign words or names. These were among the last to be recovered. All combinations of characters not allowed in the Italian language are only reported for completeness and are marked with an asterisk.

In the last pages of the manuscript Simeone tells us that he wrote the entire manuscript between February and March 1900, while he was already immobilized at home by his paralysis. Simeone Levi died in 1913.

While creating the entire ciphered font with Metafont [3], in order to typeset this paper, a new interesting feature of the signs became clear: whenever a sign is ascending or descending this corresponds to an ascending or descending character in a common calligraphic alphabet. This property is a very helpful reminder when writing the ciphered signs and enables *real-time* ciphering once the basic rules are known.

The Metafont character set for use within LaTeX can be obtained at web-site `http://www1.tlc.polito.it/~viterbo`.

ACKNOWLEDGEMENTS

The greatest incentive came from my grandaunt Giorgina Levi, who at the age of 88 gave me all the support and encouragement to carry out this work. I thank Professor Ezio Biglieri for carefully reading the translated manuscript and pointing me out two words containing the letter k, which was still missing to complete the alphabet. I would also like to acknowledge Professor Michele Elia for introducing me to cryptography and for his helpful advice.

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APPENDIX: TRANSLATION OF THE FIRST PAGE

Autobiografia di Simeone Levi

Perché narrare i propri dolori è lenire i tormenti? Io credo che l'effetto sia prodotto dalla stessa causa per cui uno stesso rumore continuato finisce per conciliare il sonno. Ma pecuglie ri sifafanu cecumucela o queanru ytagno fu a pecutagno pecu nicagenu. Eppure si preferisce raccontare le felicità godute piuttosto che le disgrazie sofferte, perché nel più delle volte la gente invidia le vittorie altrui e schernisce le altrui sofferenze e ben di rado altri si compiace del nostro bene e compiange le nostre sofferenze. Ma io dirò il bene e il male, i miei meriti e i demeriti, le mie ragioni e i miei torti, i miei trionfi e le mie sconfitte, le mie felicità e le mie sventure, le mie buone azioni e le cattive.

Autobiography of Simeone Levi

Why does telling about one's own sorrows soothe one's torments? I believe the effect is produced by the same thing which causes a continuous noise to end up inducing sleep. *Ma pecuglie ri sifafanu cecumucela o queanru ytagno fu a pecutagno pecu nicagenu.* Nevertheless, people prefer telling about their enjoyed happiness rather than about their suffered sorrows, because most of the times people envie other people's victories and mock other people's sufferings, and seldom does someone else show contentment for our good and feel sympathy for our pains. But I will tell about the good and the bad, my merits and my faults, when I was right and when I was wrong, my triumphs and my failures, my good deeds and my bad deeds.

BIOGRAPHICAL SKETCH

Emanuele Viterbo was born in Turin in 1966. He received his degree in 1989 in Electrical Engineering from the Politecnico of Turin, Italy. From 1990 to 1992, he was with the European Patent Office, The Hague, Holland, as a patent examiner in the field of dynamic recording and in particular in the field of error-control coding. In 1995 he received his Ph.D. in Electrical Engineering from the Politecnico of Turin. After graduating he held a 2 year post-doctoral fellowship at the Politecnico di Turin, Italy. He is currently a visiting researcher in the Information Sciences Research Department of AT&T Research, Florham Park, NJ. His research interests are in the field of wireless digital communications, algebraic coding theory and cryptography.