Decipherment of Hieroglyph and Cuneiform as a Case Study of the Process of Learning

Yoshinobu Kakiuchi and Fumihiko Shinohara

1. Introduction

As a part of our project for the research on the process of learning,[1] we have made rather an extensive study of decipherment of ancient characters, the results of which are described in the following. The process of decipherment involves many important aspects of problem solving in science in general. The logical consistency of our assignment of consonants and vowels to yet undeciphered characters should be followed on one hand, and also such assignment should be useful in representing appropriate phones of the words which is supposed to be reasonable from certain historical evidences or other. There could be strong parallelism between this and the scientific investigation of the phenomena in nature as well as in society. Through observations of these phenomena, we have to draw some picture of the image or the concept, which might be of use in understanding what we observe, and those pictures should above all consistent with each other. However, if we are too enthusiatic in drawing too many pictures, without paying much attention to how such pictures are correlated closely with what we actually observed, the issues out of the scrupulous arguments would be useful for the description of the phenomena in objective world, even if the procedure of logical inference is perfect. We always need tremendous precautions in order not to deviate from reality, by paying full attention to what we preceived through our senses and feelings. We shall call the consistency between

pictures we draw the *internal consistency*, and call the compatibility of that picture with reality the *external consistency*. Both internal or logical consistency, and the external or empirical consistency should keep pace together, in order for our pictures to be a fair description of our external world. The following results of our survey shows how actually difficult is for the learner to realize the way we would manage to find the reasonable balance between internal and external consistency of our pictures.

2. Hieroglyph in Rosetta Stone[2]

First we shall concern with the case of Hieroglyph. Hieroglyph has orignally been an ideogram, but during the course of history, it has also been adapted to the role as the phonetic sign. The adaptation of the ideogram for the purpose of represneting syllables or phones is fairly common in the history of language as has been observed not only in Egypt, but also in Sumer as well as in Japan. It would be of some interest to note that the phoneticalization of the ideogram has often found its place in its use in the process of representing foreign language. With increasing communication over the surface of the Mediterranian, the need for writing foreign names with native language would certainly become important around these areas, and it is natural to find the similar situation between China, Korea and Japan. Such situation has been particularly useful in deciphering Hieroglyph. Napoleon Bonaparto brought back from Egypt so called Rosetta stone, which was soon found to carry sentences written in three different languages. The first one was written in Hieroglyph, the second in the character called demotic, and the last was in Greek character. These sentenses seemed to descrbe the same text in three languages. Greek is the well known language, and the stone should be an useful dictionary in decipherment of Hieroglyph. When Champollion made his first approach to the problem, he focused his attention to the proper nouns, the names of well known persons in history, which

he could identify with Cleopatra and Ptolemy in Greek text. He also found that both these names in Hieroglyph were surrounded by the elongated closed curve, which later called cartouche. The result of these investigations would be summarized in the following figures.

Fig. 1.

Our task is to find proper assignment of the phone to each Hieroglyph, on the basis of the foregoing data. We may assume

(1) each hieroglyph corresponds to a single phone, which we assume to represented by certain appropriate roman character.

(2) the same hieroglyph always correspond to the same soman character, and the different one to the different.

(3) allocation of appropriate phone to the hieroglyph should mean the one such as to result the maximum resemblance to the pronounciation we can imagine. It should however be noted that the Egyptian way of pronouncing these two names could vary considerably from that in Greek.

It may be of interest to note that first two of these are essentially logical in character, hence concerned with the formal aspect

of the problem. The third one on the contrary depends upon the way ancient Egyptian pronounced the name of kings and queens, and we do not know the exact answer as yet. We have to try all sorts of possibilities and select most sensible answers. The result may not be unique, because the number of keys available is still too small and there remain number of alternatives.

What we did actually in the class was to present two names in hieroglyph together with their Greek counterparts, and asked the students to give romanized version of the text in mark reader card following given instructions. The result was fed into computor memories, and also the answer for individual is printed out on a paper strip. The strip was returned to the student, together with certain comments which is not entirely individualized but rather categorical in character, sometimes remain to be quite general remarks such as the guide line for finding out possible faults. The student was required to revise previous answer after reading those comments, and the similar process were iterated several times, until the result fairly converged.

For the sake of convenience, hieroglyphs are numbered as indicated in the figure. The most primitive and simple attempt for assignment is to correspond one the roman character

C L E O P A T R A

to hieroglyphs from 1 to 9, which seems to be very much rewarding, because 6 and 9 correspond to A in roman character and to the same figure of the hawk in hieroglyph also. 28% of the student succeeded to proceed thus far, but the assignment for number 10 and 11 is rather difficult and still remains to be reinvestigated.

Turning to the Ptolemy for a moment, the difficulty is whether we assume PTOLEMY or PTOLEMAIOS, the assignment does not seem therefore to be made so easily as we did in case of CLEO-PATRA. Leaving Cleopatra as

1	2	3	4	5	6	7	8	9	10	11
C	L	E	O	P	A	T	R	A	—	—

we shall try the following assignment:

12	13	14	15	16	17	18	19
P	T	O	L	E	M	Y	—

As is obvious, 12, 14 and 15 are consistent with 5, 4 and 2 respec-
tively, but the difficulty is in the above assignment 17 and 18
correspond to different roman alphabet, whereas both to the same
hieroglyph. It should be justified 13 should be read as T, because
it is located between P and O, and if it is to be the case 10 would
also be T. Having these in mind, the tentative solution could be

C L E O P A T R A T *

and

P T O L * E E *,

the asterisk * being to be determined. Either of 16 and 19 should
be M, and PTOLMEES which reflects certain flavour of Greek
sound PTOLEMAIOS seems to be more likely, compared with
PTOL*EEM, because in the latter case the assignment for the
hieroglyph numberd 15 remains still very much difficult.

Our tentative solution at this moment would be

C L E O P A T R A T *

and

P T O L M E E S.

It would be of some value to note that the letters underlined are
subjected to cross checking, in a sense that the assignment of
roman character is confirmed to be consistent in more than two
cases. The assignment for hieroglyphs not underlined is entirely
free from internal consistency, and has to be made so as to result
maximum possible reflection of the names of the king and the
queen. Hieroglyph number 7 is supposed to be read as T in the
above, but the figure is entirely different from 10 and 13. There-
fore, we may assign T to number 7 with some reservation,
which might be justified by assuming certain sound similar to but
somewhat different from T, for instance the sound such as "th"
and the like. The first hieroglyph may also be assigned to K

instead of C obviously.

3. Behaviours of the Student toward the Question

Question attatched in the Appendix I were presented to the students of non science major. The size of the class has been approximately 60. As for Cleopatra, 28% of them read first nine figures without any difficulty with certain variations such as K for C, R for L or vice versa. Another 16% went up to

C L E O P A * * A
(K)(R)

As for Ptolemy, 51% assigned first four figures

P T O L

correctly, but only 5 % went down further to give

P T O L * E E *

which should have been done, if due attention has been paid to the fact 3, 16 and 17 are the same. It should be added that in the first presention of the problem, the hieroglyph number 16 has erroneously been dropped off, which caused certain confusion in the mind of the students. This was corrected in the second presentation.

In the second trial, certain suggestion listed in the Appendix were given to the student together with the answer he or she gave in the first trial, which has been printed out on the strip of paper. The example of which is shown in the following :

```
KS  M  SS          DATE              ANSWERS
--------------------------------------------------------
                  12/17/75      KLEOPA  A  PTOLE
```

Fig. 2

The result of the second challenge of the student seemed to be somewhat encouraging, showing the increase in number of the answers of the type

C L E O P A T R A
(K)(R)   (L)

from 28% in the first trial to 37%, in the second one.

Also those who gave

P T O L

increased up to 67% as compared with the figure 51% for the first version.

In spite of such obvious improvements, it seemed to be rather obvious that more than half of the class mainly concerned with mere distribution of the alphabet among 19 sites so as to result something which resemble the names of Cleopatra and Ptolemy, without any careful allocation of the alphabet to the hieroglyph on rigorus logical basis.

The last and the third revision has been required through presentation of the second note, shown in the Appendix. Roughly more than 25% reached to the perfect answer eventually. It should also be noted that approximately 10% of the total answer seemed to reflect tremendous lack of feeling of the resemblance between the phones of the words presented *and* the name of Cleopatra and Ptolemy, although the strict logical consistency were in most cases followed rather carefully. One of the typical examples might be

K E Q L P A O R A T P T L E M Q Q Z

which is almost perfect in logical consistency, except the seventh figure. The same would be true for another example which runs

M L A T E P S O P O I E O T L - A A C

The latter also has higher logical consistency, but is even more poor in representing the sounds of Cleopatra and Ptolemy.

4. Evaluation of the Results

Our evaluation of the results would be two folds, namely the internal consistency on one hand and the external consistency on the other The measure of the internal consistency has been defind as follows. Namely, when two equal hieroglyph were assigned to two diffenrent Roman characters, one is assumed to be correct and only one point is counted for the wrong assignment. If three

figures of the same shape in hieroglyph are assigned two similar and one different Roman characters such as A A B, the ones belong to the majority in number are counted to be correc t and the numbers of the minority are counted to be wrong, irrespective of the appropriateness in the assignment in its representing phones of the original language. As for the hieroglyph, which appears only once, any assignment is assumed to be sound, whatever Roman character is supposed to correspond to it, in so far as the character is different from the ones used to represent other hieroglyph appeared in the texts.

For the evaluation of the external consistency, the following criteria has been established. Namely, in

CLEOPATRAT PTOLMEES

C may be replaced by K and L may well be replaced by R, without further destroying internal consistency of the assignment. In PTOLMEES, E E is allowed to be substituted by I I, and S might be assigned to Z as well. In case E is substituted by I in PTOLMEES, the third figure in CLEOPATRA should obviously be read as I rather than E. The total number of external inconsistencies as defined in the above were listed, and added to the internal incons- istencies. The total numbers of inconsistencies thus obtained is normalized by the numbers of the figures assigned, and this ratio would be used as the measure of the inadequecy of the solution. Our task has been to investigate, how this parameter would be improved by successive presentation of suggestions as shown in Appendix I.

5. Deciphering Cuneiform[2]

Asimilar attempt has been made on decipherment of cuneiforms, which is a little more complicated as compared with that of hier- oglyph. The texts used were the old Persian inscription of Darius I and of Xerxes, discovered at Persepolis. Through detailed in- vestigations, it has turned out to be the group of sentences written

in three different languages. It has already been made clear that the old Sassanian language (Pehlevi) are closely related to the old Persian, the former being already deciphered out through comparative studies with Greek. Grotenfeld has paid his attention to the usual patterns of the inscriptions which runs something like "*the king, the king of kings, ···the son of B, the king*", and has assumed that these inscriptions are concerned with the descriptions of the kings. If it is to be the case, our task could begin in finding out the word which means the "king" through detailed analysis of the formal structure analysis of the text. This had actually been the first half of the process of decipherment.

A simple glance at the inscription would reveal that there is seen a frequent use of the oblique line running from upper left to lower right, and the figure seems to play the role of seperating two words. Taken it for granted, each word in the inscriptions shown in the text is numbered in order, as shown in the figure. (See Appendix II). Judging from the numbers of the cuneiforms used for representing individual word, the cuneiform seems to be the phonetic sign rather than the ideogram.

We have suggested the student the machinery which may be useful to work out the structural pattern of the sentences as in the following. Suppose we name the first sentence a, and the second one b. There are 14 words in a, and 9 in b. We shall label each word a 1, a 2,..... as well as b 1, b 2,..... We shall assign Roman capitals A, B,.... to each of those words in order, and use the same capital to exactly the same or nearly the same word. We gave the Question I in Appendix II to the students, and the answers were automatically typed out on data sheet. As for the first six words, some 38% of the class gave

$$A \ B \ C \ B \ D \ B \qquad\qquad (1)$$

and 45% gave

$$A \ B \ C \ B \ B \ B \qquad\qquad (2)$$

Only the remaining 17% gave answers different from these two. (1)

differs from (2) only in the assignment of the fifth word, but this difference causes tremendous troubles because it results shifts in the way we label words. The seventh word is assigned to E in case of (1), whereas it correspond to D in case of (2). However, in view of the fact that the percentage of these two types of answers are fairly high, we thought it appropriate to assume both of them are tentatively admitted to be the right answer.

But it should be noted that there exsists a striking resemblance between B and D in (1). To state it more explicitly, D runs

Fig. 3

and B consists of first seven characters of D only. If we use the different characters B and D, the similarity between them would completely be dropped off. This seems to be unfair, and the last four characters in D may rather be recognized as the suffix to the word B. In order to restore unduely neglected similarities between differently labelled words, we presented the note to the class and asked for the revision of their first answer.

Among 25 students who gave the nearly complete answer of the type (1) in their first responce to the question, 18 pointed out the close relation between B and D. Among 21 those who gave nearly perfect answer (2) in their first trial, 14 gave perfect answer in the second trial which runs

. A B C B B B D E F G H I J K L B C B B A B F G. (*)
The perfect solution of the type (1) is

A B C B D B E F G H I J K L M B C B D A D G H. (**)
Both (*) and (**) are supposed to be correct, and they correspond to nearly half of the total student.

It seems to be obvious that the presentation of the comments after the first trial is very much useful in the analysis of the structural patterns of the given sentences.

6. Cuneiforms, their Assignment to Roman Characters

Our next task is to assign each cuneiform to Roman character exactly as we did in case of hieroglyph. In order to do this, we need further information. Sussose we should tentatively pay our attention to the answer of the type (2), which runs

A B C B B B D E F G H I J K| L B C B B A B F G,

where the vertical line seperates two sentences a and b of the inscriptions. Comparison between a and b would reveal the basic structure

A B C B B .... B D E F G .... for a (i)

and

L B C B B .... A B F G .... for b. (ii)

What is common between the two is the pattern like

X B C B B ...... F G (iii)

where

X = A or L . (iv)

No further progress would not be expected in so far as the formal structure is concerned. We need certain concrete evidences which concern with the factual contents of the text.

The essential clue for the solution suggested by Grotefend[2] was to identify the pattern described by (iii) and (iv) with

.,,., the king, the king of kings .... the son of ....

This would suggest that B means "the king", and F G means "the son of..", and also A and L correspond to the names of the king.

Once this scheme is accepted, careful examination of (i) and (ii) would reveal that the two sentences in the inscriptions describes that

A, the king, the king of kings ... E, the son of ...

(A   B   C B   B   E   F G   )

and similarly

L, the king, the king of kings. . . . A, the king, the son of. .

(L   B   C B   B . . . A   B   F G . . .)

To sum up, these seem to indicate that

The king A is the son of E   (i)

The king L is the son of the king A   (ii)

It became clear that the king L is the son of the king A, who is the son of E, and what is important here is that it is not mentioned that E is the king.

Persepolis has been supposed to be the old Palace of Darius I, and therefore it would be almost certain that either of the three names L, A and E would be Darius. If we consult the original text of Herodotus' History,[3] we would easily find in the early part of Volume Seven that King Xerxses is the son of the king Darius, who is the son of Hystaspes who was not the king. Therefore we may conclude that

    E = Hystaspes

    A = Dareios

    L = Xerxses.

We shall apply these results to the assignment of Roman alphabets to cuneiforms.

Our last problem is to try to find out the correspondence between cuneiform and its phone, which might well be represented by Roman alphabet. The Question is shown in Appendix II. The student's first responce to the Question shows that 24% of them kept fairly reasonable logical consistency in the assignment, and some 70% of which gave reasonable external consistency. Simple observation would reveal that the following four cuneiforms are subjected to cross checking in the assignment of the alphabet, and the final assignment would be

A   R   E   S

Fig. 4

Nearly 76% of the total student did not however succeed to put the problem on the basis of logical analysis, but simply try to distribute phones over the sites represented by a number of cuneiforms. It entirely loses the target, and the answer thus conjectured would be of no use for further application to read unknown words written in cuneiform.

We therefore designed the problem which might stimulate student's own evaluation of the internal consistency of their answer, as shown in the Appendix, but the result was lamentably poor. The following examples would show how this attempt failed. It seems to be more desirable to encourage the student to evaluate their own achievement.

self-evaluation of logical inconsistency	numbers of rea inconsistencies
0	3
8	11
3	1
0	4
6	15
3	17
...	...

7. Conclusion

In the above analysis of the results of our investigations, we have been able to get some general features of the development of our knowledge of the external world. It is almost obvious that we cannot do two things at the same time, and to seperate the activity of getting internal consistency from the one for getting external consistency is the necessary stop toward the solution of the problem. Logical analysis is thus of geat importance in the process of learning, but it is not the whole story. In order to put things on calculable basis, it is required to ignore minor differences and to draw rough picture of the things we observe. The logical analysis

should then be followed. Logical frame work thus established is in general in contradiction to our experiences in many respects, and therefore should be revised. In order to do this, simple formal logic is of no use. We need intuition and imagination, which centre around our image of the objects we are concerned. The present report might give some concrete evidences for the justification of the ideas above described. We hope our succeeding reports would be able to add further informations of the detailed structure of our process of learning.

References

1) Y. Kakiuchi : The Process of Learning. LERP Report No. 3 (1975)
2) E. Doblehofer : The Voice in Stone (1959)
3) Herodotus : History, Vol. 7

Appendix I Hieroglyph

(a) Question

Decipher the hieroglyph, using codes indicated underneath in Greek. Shown in Fig. 1 of the text. Recapitulated as Fig. 5.

(1) Pay attention to the consonant and vowel structures of each word.

(2) Compare the results for both words and check consistency.

(3) Indicate corresponding Roman alphabet for each hieroglyph numbered 1 to 19.

Fig. 5

(b) Comment I

Revise your answers by taking following instructions into consideration.

(1) The same hieroglyph always corresponds to the same Roman character?

(2) Roman character assigned to hieroglyph does at the same time reasonably reflect the greek sounds ΚΛΕΟΠΑΤΡΑ and ΠΤΟΛΕΜΑΙΟΣ?

130

(3) Have you already succeeded in assigning properly the sound expreseed by the Roman character "a"? If not, try to identify the hieroglyph, which represents "a", by paying attention to the arrangements of vowel sounds and ignoring for the moment the detailed distribution of consonants.

Comment II

Revise your result by the following instructions.

(1) Do not stick too rigidly to the Greek sound ΠΤΟΛΕΜΑΙΟΣ or English Ptolemy, but try to find other variation?

(2) Select from all possible assignments the appropriate variation of the name Ptolemy which at the same time fit strictly with the rule that the same alphabet should be assigned to the same hieroglyph.

(3) Note that the assignment of Roman character to the hieroglyph applicable to the ΚΛΕΟΠΑΤΡΑ should be consistent with

	FIRST ANSWER	SECOND ANSWER	FINAL ANSWER
19.	I	I	I
18.	I	I*********	I*******************
17.	I*****	I********	I********
16.	I**	I********	I*******
15.	I**********	I*****	I********
14.	I********	I******	I***
13.	I******	I*****	I*****
12.	I*******	I***	I*
11.	I*****	I*	I
10.	I****	I	I
9.	I	I	I
8.	I***	I*	I
7.	I*	I	I
6.	I*	I*	I
5.	I*	I	I*
4.	I*	I	I
3.	I*	I	I
2.	I*	I	I*
1.	I	I	I
0.	I	I	I

SIZE	55	50	53
MEAN	12.44	15.18	15.77
S.D.	3.35	2.57	3.01

Table I   Distribution of Internal Consistency Index
Note : asterisk shows numbers of population and I's on the left of asterisks shows base lines.

```
          FIRST ANSWER      SECOND ANSWER      FINAL ANSWER

19.   I                 I*                 I**
18.   I                 I*******·          I*****************
17.   I*                I**                I***
16.   I*                I*********          I*****
15.   I*****             I****               I******
14.   I****              I****               I*
13.   I*******           I***                I***
12.   I***               I*****              I****
11.   I******            I**                 I**
10.   I**                I**                 I****
 9.   I*                 I***                I*
 8.   I***               I**                 I
 7.   I*****             I*                  I*
 6.   I*                 I**                 I*
 5.   I****              I                   I
 4.   I*                 I*                  I*
 3.   I**                I                   I
 2.   I                  I.                  I
 1.   I*                 I                   I
 0.   I********          I**                 I**

SIZE       55                50                 53
MEAN       8.09              12.72              13.79
S.D.       6.66              5.17               6.18
```

Table II   Distribution of External Consistency Index

```
          FIRST ANSWER      SECOND ANSWER      FINAL ANSWER

19.   I                 I                  I
18.   I                 I********          I*******************
17.   I*                I******            I****
16.   I***              I*****             I*****
15.   I********          I*********          I******
14.   I***********        I*****             I********
13.   I***               I****               I**
12.   I******            I****               I****
11.   I*******           I******             I***
10.   I**                I                   I
 9.   I****              I*                  I*
 8.   I**                I                   I
 7.   I**                I*                  I
 6.   I*                 I*                  I
 5.   I*                 I                   I
 4.   I*                 I                   I*
 3.   I                  I                   I
 2.   I                  I                   I*
 1.   I*                 I                   I
 0.   I*                 I                   I

SIZE       55                50                 53
MEAN       11.69             14.38              15.02
S.D.       3.66              2.88               3.39
```

Table III   Distribution of total Consistency Index

the one used for ΠΤΟΛΕΜΑΙΟΣ.

(c) The Result of the Analysis

   i) Internal Consistency Index (Table I)

   ii) External Consistency Index (Table II)

   iii) Total Consistency Index   (Table III)

Appendix II   Cuneiform

(a)   Question I

Fig. 6

There are two sentences a (above) and b (below).

The symbol is used to separate a word from another. Words are numbered as a 1 to a 14 in the sentence a, and b 1 to b 9 in the sentence b.

(1) Identify groups of words exactly the same or ones having common major constituent parts and name them A, B, C, ... as indicated by the following example.

(2) Express these sentences, using symbols A, B, C, , .. above defined.

Example	Answer
A a 1	A
B a 2, a 4, b 2	B
C a 3,	C
·	D
·	E
·	F
·	·
·	·
·	·
(a4 and b2 are found to be equal to a2, and so on.)	

```
                    ABCBBB                          ABCBDB
              FIRST           SECOND          FIRST           SECOND

   23.   I                 I               I**             I******
   22.   I*************    I********        I**             I****
   21.   I*               I***             I********        I**************
   20.   I****            I                I******          I**
   19.   I**              I                I*              I*
   18.   I                I                I**             I**
   17.   I                I**              I*              I*
   16.   I                I                I               I
   15.   I                I                I*              I
   14.   I                I                I               I*
   13.   I                I                I*              I
   12.   I                I                I               I
   11.   I                I                I               I
   10.   I                I                I*              I
    9.   I                I                I               I
    8.   I*               I*               I               I
    7.   I                I                I               I
    6.   I                I                I               I
    5.   I                I                I               I*
    4.   I                I                I               I
    3.   I                I                I               I
    2.   I                I                I               I
    1.   I                I                I               I
    0.   I                I                I               I

SIZE        21              14              25              32
MEAN      20.62           20.07           19.12           20.34
S.D.       3.02            3.75            2.99            3.35
```

Table IV   Distribution of Internal Consistency Index

Note : ABCBBB and ABCBDB means two types of answers.

For example the initial part of the upper sentence a would be ABCB...

(b)   Comment I

	FIRST	SECOND
23.	I**	I******
22.	I**************	I***********
21.	I*********	I****************
20.	I**********	I**
19.	I***	I*
18.	I**	I**
17.	I*	I***
16.	I	I
15.	I*	I
14.	I	I*
13.	I*	I
12.	I	I
11.	I	I
10.	I*	I
9.	I	I
8.	I*	I*
7.	I	I
6.	I	I
5.	I	I*
4.	I	I
3.	I	I
2.	I	I
1.	I	I
0.	I	I

SIZE	46	46
MEAN	20.02	20.26
S.D.	3.04	3.48

Table V Distribution of Total Consistency Index

Revise your answers by taking instructions given underneath into consideration.

(1) Did you label alphabet properly to each word, following conventions described in the question ?

(2) In case certain words have more than 50% common constituents, and still you with to use different alphabet to discriminate one from the other, indicate their interrelationship.

(c) The result of the Analysis

　i) Consisteny index

Internal (Table Ⅳ)

External (Table V)

(a) Question II

According to the comparative analysis with Pehlvi inscriptions, together with kowledges of Persian history, names of the Kings in

the texts of Persian inscription were found to be

| a 1= b 6=Dareios |
| b 1=Xerxes |
| a 8=Histaspes |

Following similar approaches with the ones we took in case of deciphering hieroglyphs, identify each cuneiform with Roman character, which are numbered as in the following.

a 1	1	2	3	4	5	6	7
b 1	8	9	10	11	12	13	14
a 8	15	16	17	18	19	20	21	22	23	24

Cunieform Alphabets and their codes	1	2	3	· · ·	24
A 1					
B 2					
C 3					
D 4					
E 5					
·					
·					
·					
Z 24					

(b) Comment I : The comment for Self-Evaluation of Internal Consistency

(1) Evaluate your result yourself following the principle as indicated :

1) count wrong assignment   point—1

2) count no assignment   point—1

3) when two equal cuneiforms are assigned to two different Roman characters count point —1 for one of them.
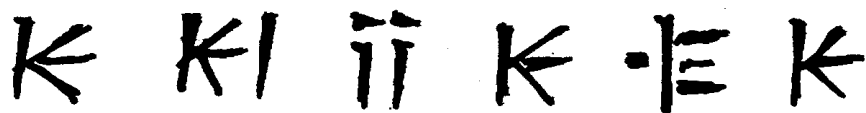
Example :

Fig. 6

There are three ĸ's in the above word. Suppose you assign to these the Roman alphabets

AAB.

A appears here twice and B only once. Assume A is correct (i. e. the principle of simple majority) and count point −1 for the wrong assignment B.

(2) Revise your assignment, taking the result of your self-evaluation into account.

Comment II

(1) Write the revised answer by taking into consideration the result of your self-evaluation.

(2) Even if your assignments are logically consistent, the results are not at all unique.

Example: As far as the logical consistency is concerned, the following two answers are equivalent.

Fig. 6

A	B	C	A	D	A
E	Q	R	E	S	E

Considering possible variations of the sound represented by the names, Dareios, Xerxses and Histaspes, try to once more find better answer, by selecting more appropriate assignment among the logically possible ones so as to fit these sounds to the maximum possible extent.

Comment III

(1) Those who have already filled up the third line of the answer column, try to further improve the answer. This should be your final answer.

(2) Those who did not filled the third line as yet, give answer, following instructions given before. This should be your final answer.

(3) Those who have asterisk * on the extreme left of the paper slip, *pay particular attention to item* (2) in the instruction sheet.

(c) The last Comment attatched to the final answer, printed out from Computor, when returned to the Student

(1) You may notice that it is not necessarily useful to try to do two things at a time. Before actually complete your decipherment, it is instructive to clarify the formal structure of the words given, namely for instance how often and in what sites among the arrangememt of cuneiforms the same character appears.

There are four different characters, which for the purpose of simplicity are represented by the symbols

    ♯   &   *   ?

appearing in the above more than twice.

(2) We can easily allocate these symbols to the numbers, which are indicated in the printed out results of your previous answers.

```
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4
  ♯                   ♯             ♯           ♯
      &   &       &       &
  *               *
      ?       ?                           ?
```

(3) In the next step, a simple consideration would be sufficient to conclude that plausible assignment would be

♯   A

&   S

*   R

?   E or Y

(4) Leaving other cuneiforms undetermined, and representing them by °, the partial solution will be something like :

    °ARE°°S°SEARSA°°S°A°°°EA

or

°ARY°°S°SYARSA°°S°A°°°YA.

(5) Further consideration might help you in guessing the overall answer, which sounds like

DAREIOSKSEARSAHYSTASPSEA

or

DARYVUSXSYARSAV̄ISTASPHYA

(c) The result of the analysis

   i) Internal consistency index for the Second Question (Table VI)

   ii) External Consistency Index   (Table VII)

   iii) Total Consistency Index   (Table VIII)

	FIRST	SECOND	THIRD	FINAL ANS.
23.	I	I	I**	I**
22.	I**	I***	I*******	I************
21.	I*****	I***	I************	I***************
20.	I******	I*****	I***********	I********
19.	I****	I*	I***	I****
18.	I**	I*	I***	I***
17.	I***	I*	I***	I**
16.	I*	I	I***	I*
15.	I****	I	I	I***
14.	I****	I	I*****	I*****
13.	I*	I*	I**	I
12.	I**	I*	I	I*
11.	I***	I*	I**	I*
10.	I*****	I**	I**	I*
9.	I*****	I	I	I
8.	I*****	I*	I	I
7.	I*****	I*	I	I
6.	I*****	I*	I	I
5.	I**	I*	I*	I
4.	I	I	I*	I
3.	I	I	I	I
2.	I*	I*	I	I*
1.	I	I	I	I
0.	I	I	I	I
SIZE	55	24	60	61
MEAN	13.80	15.29	18.20	19.03
S.D.	5.47	6.29	4.24	3.59

Table VI Distribution of Internal Consistency Index

	FIRST	SECOND	THIRD	FINAL ANS.
23.	I**	I*	I****	I****
22.	I	I	I***	I******
21.	I***	I*	I***	I****
20.	I*	I	I******	I*********
19.	I*	I**	I**	I****
18.	I**	I*	I	I**
17.	I	I	I**	I**
16.	I	I	I**	I**
15.	I*	I	I	I
14.	I***	I*	I***	I*****
13.	I***	I*	I**	I***
12.	I***	I	I******	I
11.	I**	I*	I*****	I*
10.	I**	I***	I***	I*****
9.	I***	I	I**	I
8.	I	I*	I**	I*
7.	I*	I	I	I**
6.	I***	I*	I*	I*****
5.	I******	I**	I*	I*
4.	I*	I*	I****	I
3.	I*******	I**	I	I***
2.	I******	I****	I****	I**
1.	I***	I*	I***	I
0.	I**	I*	I***	I
SIZE	55	24	60	61
MEAN	8.73	8.79	12.37	14.92
S.D.	6.68	6.92	7.14	6.39

Table VII Distribution of External Consistency Index

	FIRST	SECOND	THIRD	FINAL ANS.
23.	I	I	I**	I**
22.	I	I	I	I***
21.	I*****	I**	I********	I********
20.	I*	I*	I*****	I**********
19.	I	I*	I***	I******
18.	I****	I**	I****	I****
17.	I***	I*	I*****	I**
16.	I*	I	I****	I****
15.	I***	I*	I**	I**
14.	I*	I	I*****	I******
13.	I**	I**	I***	I**
12.	I***	I***	I******	I*
11.	I*****	I*	I**	I***
10.	I	I*	I**	I*
9.	I*******	I**	I***	I***
8.	I	I*	I**	I
7.	I*****	I	I*	I**
6.	I******	I***	I	I
5.	I**	I	I	I
4.	I****	I*	I**	I
3.	I*	I	I	I
2.	I**	I*	I*	I*
1.	I	I*	I	I
0.	I	I	I	I
SIZE	55	24	60	61
MEAN	11.04	11.79	15.08	16.68
S.D.	5.61	5.82	4.97	4.48

Table VIII Distribution of Total Consistency Index