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INTERPRETATION OF MAYA HIEROGLYPHS BY THEIR PHONETIC ELEMENTS.—I.

BY HILBORNE T. CRESSON, A. M., M. D.

THE intent of this article is to demonstrate, as briefly as possible, the method pursued in my endeavor to analyze the Maya hieratic and demotic script by the phonetic elements of which it is composed. So far as the work has progressed the indications are that the Maya graphic system, like that of other early peoples, is based upon a primitive ideographism, most of its elements being derived from motives suggested by organic or inorganic nature and objects invented by man for his necessities. The symbols were gradually given phonetic significance, and had advanced to that stage which Dr. D. G. Brinton has designated the *ikonomatic*. The Maya script, like the ancient Mexican, is largely of this character. There are indications that the Maya script had begun to enter a stage even more advanced than that of the ikonomatic. At times sounds even so meaningless as that of a single letter are to be remarked; this is very rare. It is not my intent to advocate that they had arrived at a stage where each sound was indicated by a certain element or sign. They had, however, reached a point in their progression toward an alphabetic method where we find ideographic suggestions, phonetic characters and phonetic additions, intermingled. Particular attention is called to the assertion "begun to enter a more advanced stage" for the ikonomatic method prevailing, in the majority of cases, it is evident that the advance into another stage was but in process of transition.

The consonant sounds are indicated by the characters, yet syllabic characters frequently appear. Vowel fluctuation is one of the most important factors in Maya script, and the various combinations produced by the Maya scribes require careful and especial study. The sign v-s is proposed for this peculiarity where it occurs. For instance, Fig. 122 is a genuine syllabic character, the guttural consonant k, whose variants play an important part in Maya script. Its phonetic values seem to be kan, ka v-s, an v-s, k. Where ka v-s is indicated it is meant that this element and its variants may have any of the phonetic values, ka, ke, ki, ko; ak, ek, ik, ok, and that an v-s may = an, en, in, on; na, ne, ni, no. It is to be remarked that this method of using a syllable and portions of a syllable is quite common in Maya script. The element ban, Fig. 135, has the phonetic value of ban, ba v-s, an v-s. The syllable cab is represented by Fig. 125; it has the phonetic value of cab, ca v-s, ba v-s, and also the additional phonetic value of Ma v-s. The character of the Maya language explains these peculiarities, most of its roots being monosyllables or dissyllables, and, as in all languages, largely monosyllabic, there are many significations attached to a single word. Cab, for instance, has twelve or more different meanings. The face glyphs and drawings that accompany demotic script, and the sculptured representations that appear with hieratic script, it is my opinion, are composites of phonetic elements and ideographic suggestion, and it is an important question whether the peculiar ornamentations or decorations of the ancient Mayan structures of southern Mexico are not closely allied to these composites. This has already been suggested by me in other publications.

The plates accompanying this article, from Fig. 1 to Fig. 192, give a series of elements to which certain phonetic values have been assigned, these having been frequently repeated in new combinations with probable results, corresponding in some cases with the interpretations of De Rosny, De Charency and Thomas. They are now offered for consideration to Maya students, and as a basis for future progress in the work, subject to further alteration and change. An interesting fact is their resemblance to many of the phonetic elements of the day signs of the Chilan Balam of Kaua, which is a demotic form of the script that can readily be traced to that of the older codices. Most of the phonetic elements obtained by me and given in this article are derived from analyses of the day signs of Landa and a few of the month signs; from analyses of the hieratic script of Palenque, the Yucatec stone of the Leyden Museum and a vase in the Peabody Museum, Harvard University, found at Kabahr by Mr. Edward Thompson, United States Consul to Merida, Yucatan. The inscription on this vase is, in the opinion of Dr. D. G. Brinton and myself, a beautiful example of the demotic form of hieratic script. Variants of some of the phonetic elements on this vase may be seen in Figs. 1, 3, 4, 8, 10, 19, 22, 27, 43, 84, 85, 92, 122. Especial attention is called to the fact that many variants exist of the phonetic elements given in my list, and to use them one must habituate himself to these variations. Vowel fluctuation is the only method, in my opinion, that can explain some of the combinations used by the scribes in forming their glyphs. Especially is this puzzling in more demotic forms of script, yet I venture to say that there are but few of the day signs of the Chilan Balam of Kaua that cannot be analyzed by my method, and their evolution from those of Landa demonstrated. Space will not permit further discussion of this interesting subject.

It is to be remarked before beginning our list of values assigned phonetic elements that the consonant x or sh is interchangeable with that of ch.

Figs. 1, 2, 3, 4 = Ha v-s, a, kan v-s, ka v-s, an v-s.
Figs. 7, 8, 9, 10 = Cab, ca v-s, ba v-s, ma v-s, m.
Figs. 11, 154, a, b = Ka v-s, za v-s, composed of Fig. 6 and Fig. 1; see Fig. 154, a, b.
Figs. 12 to 22 = Man, ma v-s, an v-s.
Fig. 23 to 26 = Na v-s. Fig. 26, variant of element in day signs, Chuen and Akbal. The day sign Akbal is probably akanbal = bal, "object" or "thing," acaan = "set up"; is allied to Fig. 162, the chak glyph, composed of ideo-phonetic elements suggesting akaan-tun or "stones set up," symbols of

the chaks or bacabs and of Haa = water descending to fertilize the earth. To these perpendicular symbols we have assigned the phonetic values Ha v-s, a, kan, an v-s derived from Haa = water and akaan = "set up." They are among the most primitive elements in the Maya graphic system, and their values have been repeated so often in new combinations that there is little doubt in my mind of their truth. Combining Figs. 1, 79, 9 and 6, an ideograph of sky, water and earth is obtained, Fig. 193. Take Figs. 2 and 4 (adding black color = ik or eek) and the symbol of the four bacabs or chaks supporting the sky is apparent. Combine Figs. 1 and 6 and the chak, bacab, or "wind symbol," Fig. 154 is obtained—the so-called "cross." There is more method than accident in these combinations, a strong proof that the elements composing the glyphs are phonetic, as they stand for the sound of the name of the thing represented = ikonomatic.

Figs. 27, 28, 29, 30 = Ka v-s, a. Especially allied to á sounds; probably a vowel element. Is used as a phonetic addition in certain glyphs, e. g., Fig. 100, day sign kan.

Figs. 31, 33 = Xo v-s or sho v-s, cho v-s.

Figs. 32, 34, 35, 35[a] kan v-s, ka v-s, an v-s.

Fig. 36 = hun, un.

Figs. 37, 38, 39, 40 = ki v-s (often used as a phonetic addition).

Fig. 41 = Xi v-s.

Fig. 42 = X.

Figs. 43, 45 = i, o, u (vowel?)

Fig. 44 = ich, ik v-s, i.

Fig. 46 = hun, un, ho v-s

Figs. 47, 48 = Ca v-s, ich, ik.

Fig. 49 = Xo v-s, sho, cho v-s.

Fig. 53 = hun, un, i.

Fig. 54 = Ca v-s, ich, ik.

Figs. 55 to 59 = Xo v-s, sho v-s, cho v-s.

Figs. 60, 61, 62 = Xo v-s, sho v-s, cho v-s, Ho v-s (dotted aspirate circle).

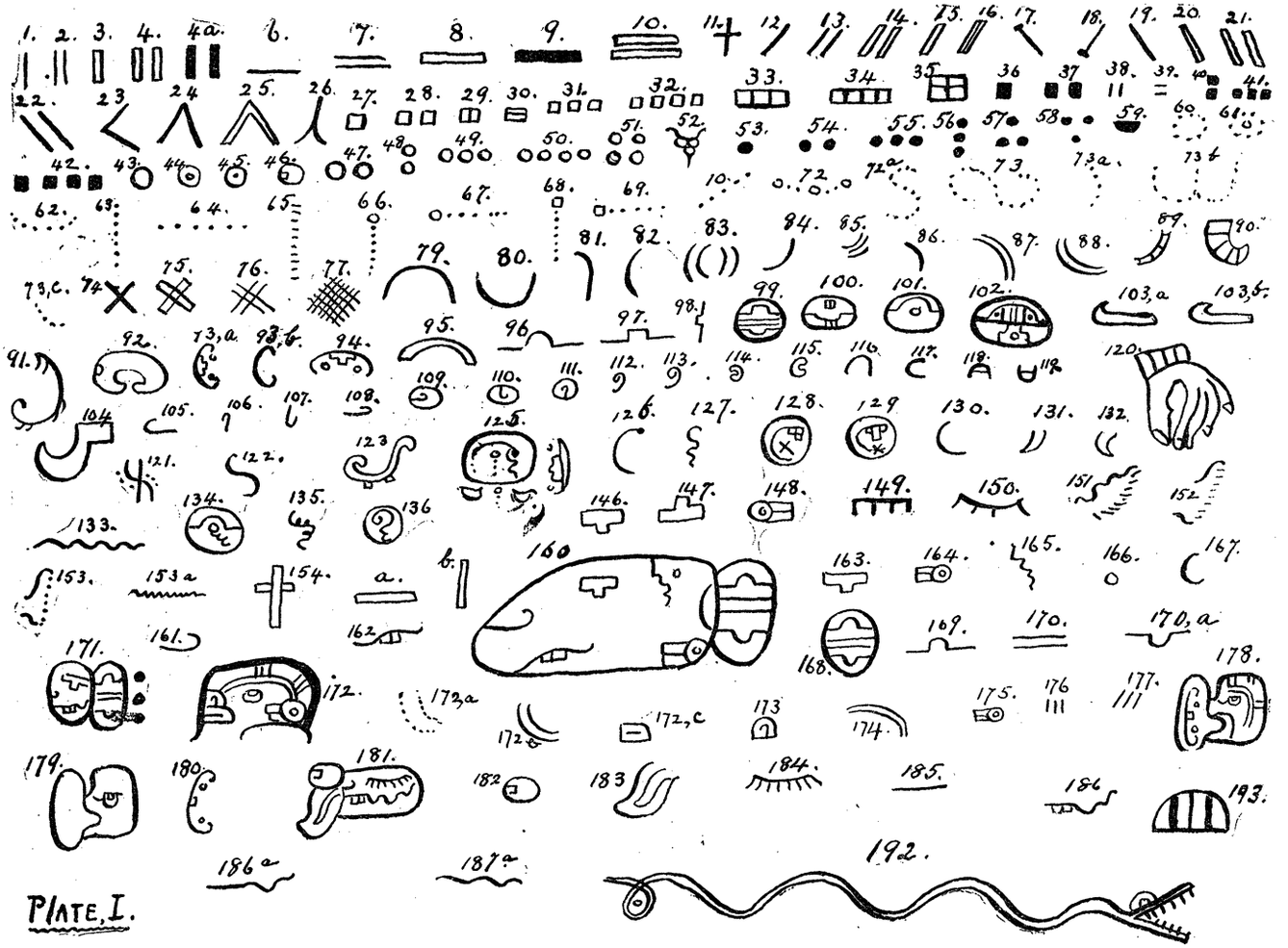


PLATE I.

Figs. 63 to 69 = Xa v-s, sha v-s, cha v-s, Ha v-s (aspirate line with phonetic addition). Figs. 27 and 43.

Fig. 70 = Xan, Xa v-s, shan, chan, cha v-s, Ha v-s.

Fig. 72 = Xo v-s, sho v-s, zo v-s, cho v-s, Ho v-s.

Figs. 72[a], 73 = Xan, Xa v-s, an v-s, chan v-s, Ha v-s, cha v-s, Ha v-s.

Figs. 73[a], 73[c] = Xan, Xa v-s, an, cha v-s, Ha v-s.

Fig. 73[b] = Xo v-s, cho v-s, Ho v-s.

Figs. 74 to 78 = Xan, shan, chan, zhan, Xa v-s, cha v-s, an v-s, Ha v-s.

Figs. 79 to 80 = Kan, chan, ka v-s, cha v-s, an v-s. (Motive derived from the life line of the serpent kan; see Fig. 192).

Figs. 81 to 86 = Man, Ma v-s, an v-s.

Figs. 87 to 88 = Cha v-s, Xa v-s, sha v-s.

Figs. 89 to 91 = Cha v-s, Xa v-s, sha v-s. (From Chilan Balam of Kaua).

Fig. 92 = Cha v-s (ch'i glyph from ch'i to bite, pinch, cling to; phonetic addition in this case indicates its value to = i; see Fig. 43).

Fig. 93 = Cha v-s.

Figs. 93[a], 94 = Ah, u (Generally used as a prefix; its phonetic elements are a variant of Figs. 92 and 93[a], Fig. 48 and Fig 163, expressing cha v-s, Ha v-s, from which ah is obtained. Its u value is suggested by chu from cha v-s).

Figs. 95 to 98 = Cha v-s, chan, an v-s, Ha v-s. Fig. 99 shows this element combined in a circle, see Fig. 171, glyph of kukulkan; see also day signs Muluc, kan, cib, akbal and their variants. See Figs. 100, 101. In Fig. 102 it appears in the well-known chak glyph of the Peresianus, whose phonetic elements express the words chak-ik = "God of Wind." See also this element as it appears in Troano 22*, an upper row of glyphs.

Figs. 103[a], 103[b] = Cha v-s, chan. Variant of Figs. 92, 105, 108; frequently appears with face glyph of the so-called "Long-Nosed God," or kukulkan.

Fig. 104 = Cha v-s, chan, an v-s; derived from Figs. 92 and 8; see sculptured representation of the "Long-Nosed God," left wing of Palace at Chi-chen-itza; see also sculptures of Labna and Kabah, etc.

Figs. 105 to 111 = Chan, cha v-s, an v-s, Ha v-s; variants of 92, 93, 103.

Figs. 112, 113 = Ca v-s, combined with the twisted line, as in the day sign cib. See Figs. 134, 135, 136, 137; it expresses ciban from which cib is derived. See also day signs caban and the cabil or honey glyph, Fig. 125; see also variants of this glyph in Codices.

Figs. 114 to 119 = Cha v-s, Ha v-s.

Fig. 120 = Cha v-s. The "pinching hand," with crustacean-like thumb, suggesting by its action ch'i = "to bite, pinch"; see Plate 24, Troano.

Fig. 121 = Xan, chan, shan, cha v-s (variants derived from the serpent motive, Fig. 192).

Fig. 122 = Kan, chan, ka v-s, an v-s, n (variant of Fig. 192; see Landa's n, representing the final letter of the word kan. The letters of Landa's alphabet, viz: a, b, c, e, k, n, ka, ku, x, are all derived from kan elements, and are attempts of a Maya scribe, or Landa himself (?), to approximate to the sounds of the Castilian alphabet such as ah, bay, thay, é or a, ain-nay, aikeys; k does not exist in the Spanish alphabet, but is represented in Maya script, not only by variants of the serpent line, Fig. 192, but also by a face glyph, which is a composite of phonetic elements having the values of kan, ka v-s, cha v-s; see Figs. 172 to 177. It is not only ikonomatic recalling ku = "a god," but is used with the phonetic value of kan, ka v-s. The addition of the hissing aspirate, half circle, Fig. 172[a], gives it the phonetic value of x or sh, also of ch.

Fig. 123 = Ca v-s, cha v-s; is a variant of Figs. 192 and 122. See face glyph of kukulkan (so-called Long-Nosed God) in Codices and hieratic script.

Figs. 125 to 127 = Glyph expressing cabil = "honey."

Fig. 126 = "L curve."

Fig. 123 = Kab or cab, honey glyph (see Peresianus, Plate 23) composite of Fig. 127 = ca and the twisted line ban, Fig. 135, 137; see variants of the day signs cib and caban in codices. The dotted aspirate line also appears as one of its components, Figs. 63 and 66 = cha. From the element, Fig. 113 and Fig. 127, we obtain the word caban, suggesting cab, and this prefixed to the il curve, Fig. 126, gives cabil = "honey." The glyphs underneath this compound glyph are variants of Figs. 118 and 119 and = cha. The element placed between is a variant of Fig. 63, with the vowel element = a above; one of its phonetic values is also cha. The glyph to the right is the prefix Fig. 93 = in this case, u. We, therefore, obtain the suggestion u-cabil = "honey" or "sweets." Cha. is repeated several times. In certain glyphs we frequently find repetitions of certain sounds as if the scribe desired to prevent any mistake in the meaning of the glyph, or else considered their addition as phonetic elements improved the appearance of the glyph. It cannot be denied that the arrangement of the phonetic elements composing these glyphs has a high degree of artistic excellence. The l curve, Fig. 126, in the glyph just analyzed, is combined with Fig. 53, one of whose values is i. We see given in glyphs Figs. 128 and 129 (refer to Plate 22* Troano) appearing in connection with the representation of an armadillo caught beneath a trap. On the top of the wooden bars composing the trap are three glyphs shown in my Fig 136. It has for component parts three small squares, variants of Fig. 35[a], one of whose values = cha. Joined to it is the l curve, see Figs. 126 and 130, giving chal. The element Fig. 74 is represented = cha v-s or xa v-s, cha v-s, from which we obtain by vowel fluctuation che or xe; suffixing this to chal or xal we obtain chalche. The glyphs, Figs. 128 and 129, either represent pieces of calcareous rock, chalche, placed upon the bars of the trap, or else the word is used to recall the word che = "wood." The glyph itself may represent round bars of wood calche that have been sawed across and laid on top of the trap or cage drawn by the scribe. If the interpretation "wooden bar" be accepted it coincides with and proves the interpretation of Dr. Thomas to be correct. The method herein set forth, in fact, coincides in its results with many of the interpretations made by my colleague of the Bureau of Ethnology, Dr. Thomas, and one method of procedure is, in fact, but a check upon the other.

Figs. 131 and 132 = Co or ku v-s, chu v-s (see day sign chuen). In the day sign akbal these same elements appear placed in a perpendicular position. Its value, instead of being ku or chu, as in chuen, is ak or ach, derived

from ku v-s or chu v-s, thus: ka, ke, ki, ko; ak, ek, ik, ok. It is an excellent example of how the same elements appear in new combinations with different phonetic values, these being influenced by vowel fluctuation.

Figs. 146, 147 = Uch v-s.
Fig. 148 = Ka v-s.
Figs. 149, 150 = Kan, ka v-s, an v-s.
Fig. 151 = Yox, iax, yosh, iash, sh, h, xa v-s. The value of this element will be demonstrated in Part II. of this article.

The phonetic values assigned a series of elements having been given, let me proceed to apply some of them to certain glyphs beginning with Fig. 160. This glyph, and variants of it, is frequently found in the codices in connection with a figure which has been designated, for the sake of convenience, "The Long-Nosed God," whom there is good reason to think is kukulkan. A glance at this glyph shows it to be a representation of an elongated reptile-like head, an ideographic suggestion of the serpent god. In the nose we have the elements, Fig. 105 = cha, curved around into a loop-like end, Fig. 161. The mouth line must not be confounded with the parallel earth line. At times small tooth-like squares (Figs. 28, 29, 30) are attached to it—similar to those shown in our Figs. 31 and 34. They seem like phonetic additions placed to indicate the especial phonetic value of the element to which they are attached. In this case there are two squares attached = ca. As chi = "mout" we accept the suggestion as cha or kha (c = k in Maya). It will be observed that the end of the mouth line is somewhat curved upward (see Fig. 162). It might at first be thought the result of accident but an examination of other glyphs (Figs. 171 and 181) shows that this is not the case. Figs. 181, 186, 187, show the mouth element, Fig. 185, connected with a curved line, a motive derived from the life line of the serpent kan, Fig. 192. This line, Fig. 187 a and Fig. 133 has the phonetic value of kan, ka v-s, an v-s. Chan is the evident phonetic value represented by our element, Fig. 162. We shall see it repeated with like value in other face glyphs yet to be analyzed. Fig. 163 we have assigned the phonetic value of uch v-s, and by vowel fluctuation we obtain cha (see values assigned Figs. 146, 147). The element Fig. 167 = cha or kha or ka. The element shown in Fig. 165 is composed of the perpendicular line, Fig. 1 = ka, and the twisted line, Fig. 135 and Fig. 153^a = ban v-s, ba v-s an, b; its value an is here used, which, placed after ka, = kan or kaan. Fig. 165 by reference to the list at Fig. 45 = o or u. Fig. 166 = cha; it is a variant of the ch'i glyph, Figs. 92 and 93, 114, 115, 116, 117. The Fig. 168 has a like value, as our element Fig. 99 = chan or kan. The components, Figs. 169, 170, 170^a, by reference to Figs. 7, 8, will be seen to have the value of ka or ca. All of the elements composing this glyph are kan elements recalling "chu-cha-chan" or kukakan.

Fig. 171 from the Codex Cortesianus is composed of a similar series of kan elements, the three perpendicular black dots to the right of it repeating xo (= three) or chu; so is Fig. 181 with its components, Figs. 182, 183, 184, 185, 187; all kan elements arranged into a face glyph.

In Fig. 172 we have another important face glyph which is a composite of kan elements. Curving upward around the mouth (= ch'i) Fig. 172^c is the an curve, Fig. 84, recalling chan. The element in the nose position, Fig. 173, = cha; see Figs. 109, 110, 111. The curved line, Fig. 174, = cha. It is a variant of Figs. 87 and 88 of my list and appears in many different combinations with this value. Some of them will be demonstrated in Part II. of this article. Fig. 175 has already been used, as cha v-s in Fig. 160. The same phonetic value is represented here. Fig. 176 is a series of Figs. 1 and 2 = ka, and Fig. 177 are variants of Figs. 12 and 13, 14 = an, giving kan. All the elements in this face glyph are kan elements. Where the dotted line Fig. 172^a is prefixed to the glyph it gives the hissing sound of x, sh, or ch and the glyph becomes xan or chan.

Fig. 178 has as one of its components a variant of the kan glyph, Fig. 172. The face or head is represented in the act of sucking the nipple of a breast. Hoobnelil, Fig. 179. Inside of the outline of the breast, Fig. 179, is the ah prefix, Fig. 180. We have thus recalled by the prefix ah, by the representation of a breast, hoobnil, and by the glyph, a variant of Fig. 172, = kan, the name of the bacab or chak, who represents the cardinal point south, = ah-Hoobnil-kan. The glyph is taken from the series, Codex Troano, Plate 25*, and proves the assignment made by De Rosny to be correct. It is an excellent example of the ikonomatic method of writing used by the ancient Mayas, a similar method being used by the ancient Mexicans, and to use the words of Dr. D. G. Brinton in a letter received by me from that distinguished Americanist, "hence it probably obtained in the Maya."

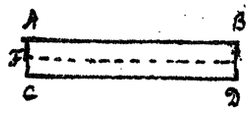
[*To be continued.*]

DOUBLE SURFACES.

BY HENRY I. COAR, CAMBRIDGE, MASS.

THE double surface was discovered by Moebius, probably about 1858, and he called attention to some of the peculiarities of the surface as he constructed it, and which has been called after his name, "Blatt des Móebius." Since his time this surface has been studied to some extent, especially by German mathematicians, and many forms of the double surface have been found beside that of Moebius. The most recent work on the subject is by F. Dingledey—"Topologische Studien über die aus ringförmig geschlossenen Bändern durch gewisse Schnitte erzeugbaren Gebilde" (Leipzig, 1890). In this work Dingledey gives a pretty complete bibliography of the subject. The existence of these surfaces is, however, little known, and it may be of interest to describe the simplest form, aside from any mathematical interest which may be attached to the subject.

The simplest form of a double surface may be constructed as follows: Take a strip of paper, whose edges we will denote as in the figure by AB and CD, and bend it imto a ring, at the same time revolving one end through 180°, so that B will fall on C and D fall on A. Now glue



the two ends together. We shall then obtain a band, which has the distinctive properties that it is bounded by only one edge and has only one surface. In other words, we can pass from any point in the surface of the paper to the corresponding point on the other side of the paper without crossing the edge. This is the simplest form of a double surface.

If, now, we cut our band along the line marked EF in the figure, it will drop apart into a new band of twice the length of the former band, but the new band will no longer be a double surface. The reason for this is obvious.