KEY TO THE MAYA HIEROGLYPHS.

BY CYRUS THOMAS, PH.D.

I GIVE here in as limited space as possible a list of the Maya letter 'glyphs so far as I have determined them, together with the corresponding phonetic equivalents; and some examples of my attempts at deciphering the written characters of the Codices.

It is necessary to explain that the letter-equivalent given to each is to be understood as only the chief phonetic element of the character represented, for, in most cases, more than this chief or prominent element is included in the one symbol. The consonant sounds are those chiefly represented, but the character, as a rule, combines therewith a vowel and sometimes even a subordinate consonant sound. Hence it happens that the same consonant sound is represented by several different characters depending upon the subordinate phonetic elements combined with it. A change, however, in the character does not necessarily follow from a change in the order of the phonetic elements it represents; thus, what denotes *ci* as a prefix may stand for *ic* or *c* at the end.

The examples given of the added vowel and subordinate consonant elements, are intended only as asserting that such combinations have been discovered; there may be, and probably are, others. As it would require too much space and too many illustrations to give full explanations of the steps by which I have reached the conclusions given, I must take for granted that those interested in the subject will be able to test these from what is presented.

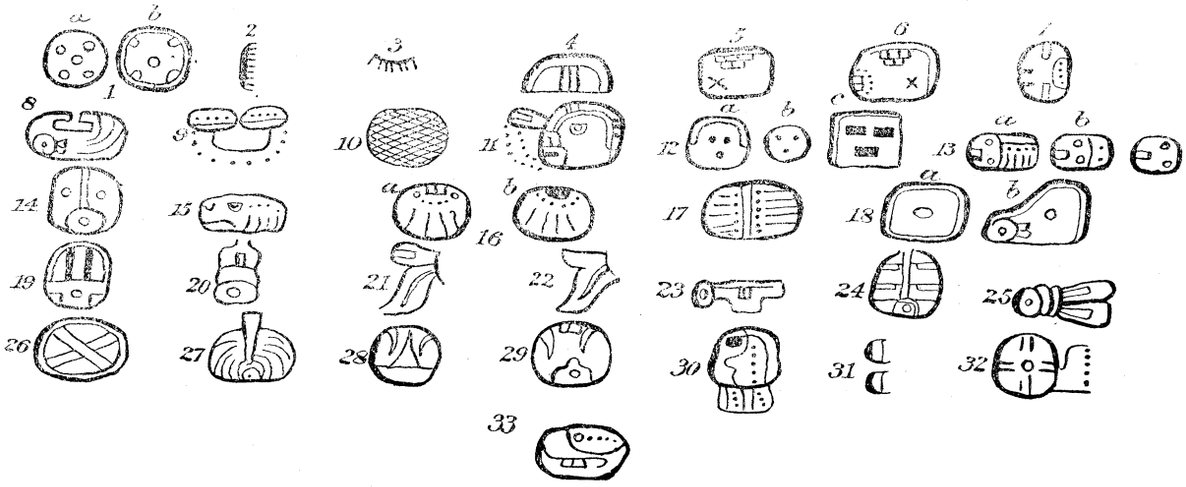

FIG. 1.

Letter Symbols (Fig. 1).

1 (a, b). *B'*.—I find no marks or rule by which to determine from the symbol alone the combined phonetic elements. This is Landa's character for *b* with a dot added.

2. *Ca.*—As a prefix, sometimes *ka* in the Cortesian Codex; *c* hard or *k* as final. Landa's character.

3. *C'*.—This is generally found in place of an eye where it denotes *cim*, *cin*, or *ci*.

4. *C'*.—*Ci* as a prefix, *ic*, *ich*, or *c* as a suffix or final.

5. *C'* or *K.*
6. *CH'* —The characters 5 and 6 are quite variable and often difficult to determine because the complete form intended is not always given. In some instances the little dot-surrounded character at the left of 6 is solid, then a slightly different rendering appears to be demarded. Landa's *k* appears to be a combination of Nos. 3 and 5. The latter sometimes contains the dotted portion seen in 6. No. 6 is frequently found where it must be interpreted *che*, "wood," yet occurs without the dot-surrounded portion where it has the same signification. Other variants are found in the Dresden Codex.

7. *K'*.—Found as *ke* and *ek*, also as *Ce*.

8. *Ch'*.—Sometimes *chi*, as in the symbol for *Chikin*, "west;" *'Ch'* as final. Landa's first *x* appears to be an attempt to give this character which is the partially closed hand.

9. *KU'*.—Landa's symbol. This does not appear to be subject to any variations that affect its phonetic value.

10. *X'*.—Cross-hatching usually indicates *x* (sh) as the leading phonetic element; however, it is sometimes rendered by *ch'*, as is evident from its appearance in the symbol for the day Chicchan if we consider it phonetic. However, the day symbols cannot always be relied upon in this respect, as will be seen by what follows.

11. *X'*.—Landa's second *x* is substantially the same as this character. But he has taken two characters for one, as in this the *x* is represented by the dotted lines alone; the little loop at the forehead, or rather the little parallelogram, in it is *a*; the face character *n*. The whole character appears to be properly rendered by *xan*, "slowly, leisurely, gently." The chief variation in the combination is found in the loop at the forehead, which may be a vowel or consonant. This form of *x* is seldom found except in combination with *n*.

12 (a, b, c). *E* and *Ee.*—The variations are shown in 12b and 12c.

13 (a, b, c). *L'*.—This is Landa's first *l*. The variations are shown in 13b and 13c. Found in combination with different vowels, as *le*, *ol*, etc.

14. *L'*.—If Landa's second *l* be turned round it will be found to be a rude imitation of this character, which is the symbol for the day *Ahau*. *Li*, in the symbol for *Likin*, East; follows *ku*, etc.

15. *M'*,-*Me.*—Symbol for the day *Men*.

16 (a, b). *M'*.—Varies in having the little loops at the top, sometimes solid, as in 16b. The dot-surrounded portion of 16b is used alone in one series of the Cortesian Codex for this letter followed by *e*. The combinations have not been traced.

17. *M'*.—This appears to be another form of *m*, or *m*

doubled, or combined with *n*. Not satisfactorily tested as yet, though *m* is certainly the chief phonetic element.

18 (a, b). *M'* (?).— Although not thoroughly traced, I am satisfied that this character, which is the symbol of the day *Muluc*, has *m* as its chief phonetic element, generally with *o* or *u*. The part representing the *c* is omitted from the day symbol, but is found in the little ring and loops in 18b. The form of the contour of a character is generally of no significance as it may be round, square, or deeply notched without any change in its meaning.

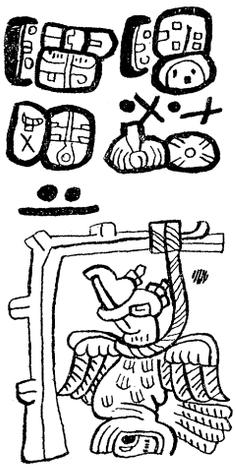

FIG. 2.

19. *P* or *Pp* (?).— Although I have not tested this satisfactorily, I am certain from my examinations that its phonetic equivalent is *p* usually *pp*. There are some variations found chiefly in the lower portion. The *p* and *b* appear to be interchangeable in the Codices even in the same word; for example in the Dresden Codex 48c, we find the *b* character in the symbol for the month *Pop*, while on 50b it is replaced in the same month symbol by our No. 19.

20, 21, 22. *T'*.—These characters (20, 21 and 22) appear to have *t* as their chief phonetic element, varied according to the markings in the upper portion. No. 20 is also varied by the marks in the lower or middle circle.

23. *Th'*.— Is followed by *e* and *i*.

24. *Tz'*.— I am also inclined to believe that the two streamers or lines which extend upward in characters, as in the symbol for the month *Tzec*, indicate the presence of this sound.

25. *Z'*, *Za*.—Varied according to the markings in the wings and circle.

26. ꝯ (dz).— Sometimes *z*.

27. *Y'*.— The index to the variations in the signification if there be any, which is doubtful, will probably be found in the length and form of the stem.

28. *Bal* or *bil* (?).—This is the symbol for the day Acbal.

29. *Ch* (?).— Usually followed by *o* or *u* when not terminal. Is the symbol for the day *Chuen*.

30. *Cab*.— The signification of the appendage so often found attached below this symbol has not been ascertained.

31. *H'*.— Sign of aspiration, the open ends always turned toward the character with which it is connected.

32. *Kin*.— Sometimes without the wing. The latter appears to be used for *n*, the circle for *ki*.

33. *Kal*.— If the separate elements are represented, it is probable the section with the dotted line stands for the *k* and the curved line with the two little teeth for the *l*.

Having submitted samples of my interpretation to Dr. H. T. Cresson of Philadelphia subsequent to the first notice, in *Science*, of my discovery, I am much pleased to learn that he has reached a similar determination as to some of these letter symbols by an independent method. As I was not aware until the publication of the article mentioned, that he was at work on the Maya characters, this agreement in our conclusions is highly gratifying, and serves to strengthen both in the conviction that we are making genuine progress in the solution of this difficult problem.

I give here a few interpretations of groups of compound characters to illustrate the combinations of the letter symbols.

Fig. 2 represents a group of four compound characters in the upper division of Pl. XXII* Codex Troano, to be read in this order: upper left, upper right, lower left, lower right; which we will number in the order given 1, 2, 3, 4.

The following is probably a substantially correct translation: (1) *U-Zabal*, (2) *U-le*, (3) *Cutz*, (4) *2-yaxkin*: "Set (or literally do the setting of) the snare for the turkey on the second day of Yaxkin." I can give no explanation of the little crosses above the symbol for Yaxkin. The prefix to No. 1 and to No. 2 is the character for *u;* the upper character in No. 1 appears to be the symbol for *z* reversed; the band across the lower character the *b* (possibly interchangeable with *p*). The figure below agrees very well with this interpretation.

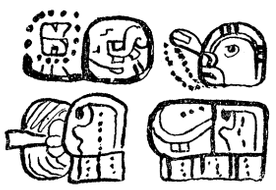

FIG. 3.

The group shown in Fig. 3 is found in the lower division of plate 26 Cortesian Codex. The characters are taken and numbered in the same order as in Fig. 2. No. 1 is supposed with good reason to be a deity symbol, the name however undetermined. Assuming this to be correct, I translate the group as follows: (Deity) *xan yalcab kal-cab*, "As" or "in the name of (the deity) slowly gather the swarm of bees and inclose them in a hive."

The figure below shows a priest wearing the mask of the supposed deity hence we say "as."

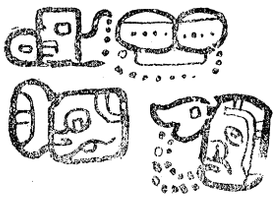

FIG. 4.

Fig. 4 is a group from the middle division of plate XXXII* Codex Troano. The characters are numbered in the same order as the preceding and are translated as follows: *Mulcin ku ci-* (god of death) *xaan;* "Collect together for the temple of the holy god of death palm wood." The picture below represents individuals bearing in their hands what appear to be blocks of wood on each of which is the symbol for *che* "wood."

The little character at the forehead in No. 4 is the symbol

for *aa* which is found in other combinations where it has the same signification.

So far I have found no marks indicating the plural; this may be represented by duplications.

OSTEOLOGICAL NOTES.

BY D. D. SLADE.

THE jugal arch is present in all of the order Rodentia, and is generally complete, although it exhibits many modifications in its composition. Three bones form the arch, which is straight or slightly curved horizontally, while it almost invariably presents a curvature downwards. The position of the jugal therein serves as a determining character in grouping the various families of the order.

The temporal fossa is often little developed, showing feeble energy in the action of the temporal muscle. On the contrary, the pterygoid plates and fossæ are often largely increased in relation to the enlarged development of the muscular insertions. In close connection with these conditions, the coronoid process of the mandible is small, and even rudimentary, while the parts about the angle are largely expanded. The condyle is little elevated and presents, with few exceptions, an antero-posterior articulating surface.

Post-orbital processes of the frontals exist in a few of the families, but there is in no case a corresponding process from the arch. The orbit is never separated from the temporal fossa.

In many of the rodents there is present a more or less extensive dilatation of the infra-orbital foramen, through which passes, in addition to the nerve, that portion of the masseter muscle which has its insertion upon the maxilla. This extends around the back of the jugal process of the maxilla in a pulley-like manner, to an insertion just below the socket of the mandibular præmolar, and thus co-operates with the temporal in moving the mandible in a vertical direction. This attachment of a head of the masseter is peculiar to the order, and explains the use of the vacuity in the maxilla which is oftentimes of vast relative proportions.

Assuming the present classification, all existing Rodentia may be brought into two groups, the Simplicidentata and the Duplicidentata. The first embraces the Sciuromorpha, Hystricomorpha, Myomorpha, and the second, the Lagomorpha.

In the Sciuromorpha, the jugal forms the greater part of the arch, extending forward to the lacrymal, and posteriorly to the glenoid cavity, of which it forms the outer wall, and it is not supported below by a continuation backwards of the process of the maxilla. In the more typical forms there is no enlargement of the infra-orbital opening, while the post-orbital processes of the frontals are characteristic of the family Sciuridæ. The external pterygoid plate is entirely wanting, and there is no fossa.

The jugal arch in the Myomorpha is for the most part slender, and the jugal, which does not extend far forward, is supported by the continuation below of the maxillary process. The zygomatic process of the squamosal is short. No post-orbital process of the frontal exists. The infra-orbital opening varies. In the family Muridæ, especially in the typical forms, this opening is perpendicular, wide above and narrow below, while the lower root of the zygomatic process of the maxilla is flattened into a thin perpendicular plate. Very much the same condition exists in the Myoxidæ, while in the Dipodidæ the foramen is as large as the orbit, rounded, and has a separate canal for the nerve. The malar ascends to the lacrymal in a flattened plate. In close connections with these conditions the coronoid process of the mandible is small and rudimenary, while the parts around the angle of the ramus are much developed.

In the Hystricomorpha the arch is stout. The jugal is not supported by the continuation of the maxillary process, and generally does not advance far forward. The infra-orbital vacuity is large, and is either triangular or oval. The coronary process and the condyle are but slightly elevated above the dental series.

In the Chinchillidæ the jugal extends forward to the lacrymal. In the Dasyproctidæ, Cælogenys is characterized by the extraordinary development of the jugal arch, which presents an enormous vertical curvature, two-thirds of the anterior portion of which, constituting the maxilla, is hollowed out into a cavity which communicates with the mouth. The nerve passes through a separate canal, adjacent to the infra-orbital opening.

In the sub-order Duplicidentata, the jugal arch is well developed. In the family Leporidæ there are large wing-like, post-orbital processes, while the jugal, but feebly supported by the maxillary process, continues posteriorly to aid in the formation of the outer side of the glenoid articular surface, passing beneath the process of the squamosal.

In the Lagomyidæ there are no post-orbital processes, and the posterier angle of the jugal is carried backward nearly to the auditory meatus. The infra-orbital opening in the Duplicidentata is of the usual size. The angle of the jaw is rounded and the coronoid process much produced upwards.

In considering the significance of the jugal arch in the Rodentia, the peculiar vertical curvature downwards, which has already been noted, and which is a decided manifestation of weakness, must be taken into account. This condition is compensated in some of the families by the unusual arrangement made in the distribution of the muscular insertions of the masseter through the infra-orbital opening, by which increased energy is imparted to the powers of mastication, and whereby the action of the mandible is rendered fully equal to the demand upon its efforts.

In those families where the above condition does not exist it is evident that the strength of the arch is still sufficient for the antero-posterior movement of the articulation so peculiar to the Rodentia and so characteristic of the act of gnawing.

The relation of the arch to the neighboring parts must also be remarked. For example, the ascending ramus of the mandible differs according to the food. Elevated in the Leporidæ, it is short in the Sciuridæ, and still shorter in the Muridæ.

In the first the coronoid is broad, projects but slightly, is near the condyle, and far distant from the molar series, while the angle of the jaw is broad and well rounded, as in the Lagomyidæ.

In the other two families, squirrels and rats, the coronoid is feeble, pointed, and placed at equal distances between the condyle and the last molar; thus the masseter does not possess a leverage as advantageous as in the hare. This muscle, however, in the rats has its maxillary attachments much developed, while few fibres spring from the arch — a condition correlative with the feebleness of this last.

Cambridge, June 21.