THE

NUMERATION, CALENDAR SYSTEMS

AND

ASTRONOMICAL KNOWLEDGE

OF

THE MAYAS

BY

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PREFACE

THIS volume is issued with the intention of offering to the student of Maya life and customs a statement of the knowledge which we possess of the numeration, calendar, and astronomical attainments of this wonderful people, of the method which has been used in obtaining this knowledge, of the probability — and in most cases the certainty — that our opinions are correct, and of the problems which offer themselves to the student for solution; but with no purpose of writing a history of the Maya people or of their customs, their monuments, or their hieroglyphics, and with no purpose of furnishing a bibliography of sources from which such a history can be gleaned. There are, without doubt, many parts of the codices and inscriptions which refer to other matters than those connected with numeration, the calendar, and astronomy, but I make no attempt to decipher them. Others have made their guesses as to the meaning of these passages, — generally on insufficient evidence, — and, though some of these guesses may be correct, I have not thought it wise to enter into this branch of the subject, especially as it is seldom that two commentators agree in their judgment.

I have not thought it necessary, in writing this volume, to award to this or that modern writer credit for individual discoveries. Students in Maya research, however, will always regard Dr. Ernst Förstemann as the leader who blazed out the path which they are glad to follow, recognizing his clear insight and remarkable advances in the study of the meaning of the hieroglyphs and in the elucidation of the Maya system of numeration, their calendar, and their astronomical knowledge. I wish also to add my testimony to the scientific accuracy of Dr. Schellhas's researches, the stimulus to studies in Maya literature which Dr. Brinton has given by his publications, the brilliancy and marvellous fecundity of Dr. Seler in his various works on Mexican and Maya subjects, the admirable comparisons and astute deductions of Cyrus Thomas, and the most helpful suggestions and tables of J. T. Goodman. To all of these learned writers I tender my most sincere thanks for their assistance. I claim for myself but little else than a close following in the footsteps of these eminent leaders, and a wish to do all that I can to excite the attention of young men to the attractive paths of Maya studies.

Although this volume contains many illustrations of the Maya signs, it will be necessary for the student to have ready access to the reproductions of the codices and to the drawings and photographs of the inscriptions contained in Biologia Centrali-Americana, Archaeology, by Alfred P. Maudslay[1] and J. T. Goodman, and in the Memoirs of the Peabody Museum of Harvard University.

In publishing this volume I have received invaluable aid from Dr. Alfred M. Tozzer, Instructor in Harvard College. He has taken great interest in my work and has given me the benefit of his advice both in the method and phraseology of the book, — knowing well, from his position as a teacher, what points especially need elucidation, so that they may be clear to the mind of the student who approaches the subject for the first time.

I am also greatly indebted to Mrs. Alberta M. Trethewey for the skill which she has shown in drawing the Maya glyphs and for superintending the making of the blocks for the illustrations, which are nearly all from her hand.

[1] Maudslay, in addition to his photographs, publishes also drawings of the inscriptions. These drawings can, in almost every instance, be relied upon as correct, on account of the care exercised in their reproduction and of the great experience which he and Miss Hunter, who executed the drawings, have had in their investigation of the Maya glyphs.

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ABBREVIATIONS

Alt.	Altar.
An.	Animal.
A. P. M.	A. P. Maudslay. His method of notation is sometimes used instead of the usual method.
bot.	Bottom.
C. B.	Books of Chilan Balam.
Chin.	Chinikihá.
Cop.	Copan.
Dr.	Dresden Codex.
(e)	East side of a Stela or monument.
(e. l.)	East lower side of a Stela or monument.
(e. u.)	East upper side of a Stela or monument.
fr. bot.	From bottom.
Ins.	Inscription.
Lin.	Lintel.
(n)	North side of a Stela or monument.
Nar.	Naranjo.
Pal.	Palenque.
P. N.	Piedras Negras.
Qu.	Quirigua.
(s)	South side of a Stela or monument.
Seib.	Seibal.
St.	Stela.
Stair.	Stairway.
T. C.	Temple of the Cross at Palenque.
T. F. C.	Temple of the Foliated Cross at Palenque.
T. I. (60), (61), (62)	Temple of Inscriptions at Palenque, Plate 60, 61 or 62 of Maudslay.
Tik.	Tikal.
Tro-Cor.	Tro-Cortesianus Codex.
T. S.	Temple of the Sun at Palenque.
(w)	West side of a Stela or monument.
(w. l.)	West lower side of a Stela or monument.
(w. u.)	West upper side of a Stela or monument.
Yax.	Yaxchilan.

CHAPTER I

INTRODUCTORY

THE two main sources from which we can gain a knowledge of the progress of the Maya people[1] in numeration, astronomy, and in the use of the calendar are:

1. The records of the Mayas themselves.
2. The writings of Spaniards and others about the Mayas.

The first of these sources may be divided into three parts, viz.:

I. The Books of Chilan Balam.
II. The Codices.
III. The Inscriptions in stone or on wood or stucco, — those on stucco being few in number and of but little importance.[2]

The Books of Chilan Balam. — These books are written in the Maya language, but in Spanish script. The actual writing therefore was done after the Conquest (placed by Dr. Brinton in

[1] The term "Maya people" is intended to include the Mayas, properly so called, who at the present time occupy practically the whole of Yucatan, together with all the tribes which were closely allied to the Mayas in language, numeration, calendar, astronomical knowledge, and religious customs. This classification, roughly stated, includes the tribes between the upper Cordilleras and the sea, taking in the states of Chiapas and Tabasco in Mexico on the north, and the northern part of Honduras on the south, thus including a large part of Guatemala and corresponding in a general way with the localities in which, as will be seen hereafter, the hieroglyphic inscriptions on stone are found. There are one or two sporadic groups of the Maya kindred outside of the localities here mentioned, but, as far as I know, we possess no knowledge of their attainments either from their writings, pictures, or inscriptions.

[2] In addition to these sources, many characters are found upon vases and sherds, but none of these have as yet added to the knowledge of the subjects of which this volume treats.

A. D. 1541), but the records contained in them very often antedate the Conquest by many years. Dr. Brinton, who possessed copies of many of these books, refers to them thus:

"There were at one time a large number of these records. They are referred to by Cogolludo, Sanchez Aguilar, and other early historians. Probably nearly every village had one, which in time became to be regarded with superstitious veneration.

"Wherever written, each of these books bore the same name; it was always referred to as 'The Book of Chilan Balam.' To distinguish them apart, the name of the village where one was composed was added. Thus we still have preserved to us, in whole or in fragments, the Book of Chilan Balam of Chumayel, of Kaua, of Nabula, etc.; in all, it is said, about sixteen.

"'Chilan Balam' was the designation of a class of priests. 'Chilan,' says Bishop Landa, 'was the name of their priests, whose duty it was to teach the sciences, to appoint holy days, to treat the sick, to offer sacrifices, and especially to utter the oracles of the gods. They were so highly honored by the people that usually they were carried on litters on the shoulders of the devotees.'[1] Strictly speaking, in Maya, **Chilan** means 'interpreter,' 'mouth-piece,' from **Chij**, 'the mouth,' and in this ordinary sense frequently occurs in other writings. The word **Balam** — literally 'tiger' — was also applied to a class of priests, and is still in use among the natives of Yucatan as the designation of the protective spirits of fields and towns, as I have shown in a study of the word as it occurs in the native myths of Guatemala.[2] '**Chilan Balam**' therefore is not a proper name, but a title, and in ancient times designated the priest who announced the will of the gods and explained the sacred oracles. This accounts for the universality of the name and the sacredness of its associations.

"The dates of the books which have come down to us are various. One of them, 'The Book of Chilan Balam of Mani,' was undoubtedly composed not later than 1595, as is proved by internal evidence. Various passages in the works of Landa, Lizana, Sanchez Aguilar, and Cogolludo — all early historians of Yucatan — prove that many of these native manu-

[1] Relacion de las cosas de Yucatan, p. 160.

[2] The names of the Gods in the Kiche Myths of Central America. Proceedings of the American Philosophical Society, Vol. XIX, 1881. The terminal letter in both these words — **Chilan, Balam** — may be either "n" or "m," the change being one of dialect and local pronunciation. I have followed the older authorities in writing "Chilan Balam," the modern preferring "Chilam Balam."

scripts existed in the sixteenth century. Several rescripts date from the seventeenth century, — most from the latter half of the eighteenth.

"The names of the writers are generally not given, probably because the books, as we have them, are all copies of older manuscripts, with merely the occasional addition of current items of note by the copyist; as, for instance, a malignant epidemic which prevailed in the peninsula in 1673 is mentioned as a present occurrence by the copyist of 'The Book of Chilan Balam of Nabula.'

"These 'Books of Chilan Balam' are the principal sources from which Señor Pio Perez derived his knowledge of the ancient Maya system of computing time, and also drew what he published concerning the history of the Mayas before the Conquest, and from them also are taken the various chronicles which I present in the present volume.

"That I am enabled to do so is due to the untiring researches of Dr. Carl Hermann Berendt, who visited Yucatan four times, in order to study the native language, to examine the antiquities of the peninsula, and to take accurate copies, often in facsimile, of as many ancient manuscripts as he could discover. After his death, his collection came into my hands." [1]

Dr. Brinton also states that the contents consist of astrological and prophetic matters, including prophecies which probably antedate the coming of Christianity to America, ancient chronology and history, medical recipes and directions, later history and Christian teachings.[2] To these should be added astronomical matters.

The Codices. — Ponce tells us that the Mayas had characters or letters with which they wrote their histories and ceremonies, the order of their sacrifices, and their calendar, in books made of the bark of a tree. These books were made in long strips folded so that they appeared like a quarto volume. They were only understood by the priests (**Ah-kines**) and by chiefs. Afterwards some of the Spanish priests came to understand them and to write them.[3]

[1] Brinton, 1882, pp. 68 *et seq.* In this volume Dr. Brinton has printed the original and translation of several of the Books of Chilan Balam. The translation is not always accurate.

[2] Brinton, 1882 a, p. 8. Also Brinton, 1890, pp. 255 *et seq.*

[3] "Son alabadas de tres cosas entre todos los demas de la Nueva España, la una de que en su antiguedad tenian caracteres y letras, con que escribian sus historias y las ceremonias y orden de los sacrificios de sus idolos y su calendario, en libros hechos de corteza de cierto arbol, los quales eran unas tiras muy largas de quarta o tercia en ancho, que se doblaban y recogian, y venia á queder á manera de un libro encuardenada en cuar-

Landa says that the Mayas wrote their books on a long shee doubled in folds, all of which was enclosed between two decoratec slabs of wood; that they wrote on both sides of this sheet, in columns on the folded leaves, and that they made their paper fron the roots of a tree and gave it a white coating on which they could write easily.[1]

Other Spanish authors have also described these books. The description is such that it is easy to recognize them when we examine the only three codices which are known. Brinton has alsc described them as follows:

"These books consisted of one long sheet of a kind of paper made by macerating and beating together the leaves of the maguey, and afterwards sizing the surface with a durable white varnish. The sheet was foldec like a screen, forming pages about 9 by 5 inches. Both sides were covered with figures and characters painted in various brilliant colors. On the outer pages boards were fastened, for protection, so that the completec volume had the appearance of a bound book of large octavo size.

"Instead of this paper, parchment was sometimes used. This was made from deerskins, thoroughly cured and also smoked, so that they should be less liable to the attacks of insects. A very durable substance was thus obtained, which would resist most agents of destruction, even in a tropical climate. Twenty-seven rolls of such parchment, covered witl hieroglyphics, were among the articles burned by Bishop Landa, at Mani in 1562, in a general destruction of everything which related to the ancien life of the nation. He himself says that he burned all that he could lay his hands upon, to the great distress of the natives." (Relacion de la cosas de Yucatan, p. 316.)[2]

tilla, poco mas ó menos. Estas letras y caracteres no las entendian, sino los sacerdote de los idolos, (que en aquella lengua se llaman 'ah-kines'), y algun indio principa Despues las entendieron y supieron léer algunos frailes nuestros y aun las escribien. (Relacion Breve y Verdadera de Algunas Cosas de las Muchas que Sucedieron al Padr Fray Alonso Ponce, Comisario-General en las Provincias de la Nueva España, p. 392. Brinton, 1882, p. 63. This quotation is found in Vol. II, p. 392, of Ponce.

[1] "Que escrivian sus libros en una hoja larga doblada con pliegues que se venia cerrar toda entre dos tablas que hazian muy galanas y que escrivian de una parte de otra a colunas segun eran los pliegues, y que esta papel hazian de raizes de u arbol, y que le davan un lustre blanco en que se podia bien escrivir." (Landa, 186 p. 44.)

[2] Brinton, 1882, pp. 64, 65. In this volume parts of several Books of Chila Balam are published, with a translation.

With such a disposition on the part of the Spaniards to destroy the native records, it is fortunate indeed that we have preserved to us three Maya codices. These are —

A. The Codex Dresdensis, or Dresden Codex, in the Royal Library in Dresden. This is the best preserved of the codices and is very carefully and delicately drawn. The subjects of which it treats are broader in scope than are found in the others, since not only the offerings to the gods, the ceremonies, sacrifices, and domestic avocations are set forth, but many of its pages are devoted to astronomical and numerical computations.[1]

B. The Codex Tro-Cortesianus. This is now in the Museo Arqueologico Nacional of Madrid. It was found in two parts, — one in the Library, and the other in the possession of Don Juan de Tro y Ortolano, of Madrid, Spain. The two pieces were found to be complements of each other. This codex is much coarser in its style than either of the others, and treats chiefly of offerings, ceremonies, sacrifices, and domestic avocations, — usually set forth as occurring in or regulated by the familiar period of 260 days.[2]

C. The Codex Peresianus, in the Librairie National in Paris. This is more imperfect than either of the others, but its workmanship is of a very fine character. Less has been accomplished in deciphering the meaning of this codex than in the case of the Dresden or the Tro-Cortesianus.[3]

The subjects treated of in the pages of these codices at times occupy the whole of the page, while in other cases the pages are divided into two, three, or four sections. The hieroglyphs are usually placed in vertical columns and in horizontal rows. When

[1] This Codex was reproduced in colors by Lord Kingsborough in Vol. III of his great work, "Antiquities of Mexico," and again by Dr. Ernst Förstemann in 1880. A second edition was issued by Dr. Förstemann in 1892.

[2] The part of this Codex which belonged to Señor Tro (called the Codex Troano) was reproduced in colors by Brasseur de Bourbourg under the title "Manuscrit Troano, Étude sur le système graphique et la langue des Mayas," 2 vols., Paris, 1869, 1870. The other part (called the Codex Cortesianus) was reproduced by Léon de Rosny in black and white, Paris, 1883, and by Rada y Delgado in colors, Madrid, 1892. The two parts forming one Codex are known under the name "Tro-Cortesianus," and the pages are numbered consecutively.

[3] This Codex was reproduced in colors by Léon de Rosny, Paris, 1887, and a second edition in black and white was issued in 1888.

it is desired to refer to a particular glyph,[1] it will be designated as occurring on a particular page, in a section marked "a," "b," "c," or "d," running from the top downward, and in a column marked 1, 2, 3, etc. from left to right, and numbered in the column from top to bottom. Thus Dr. 30b, col. 4. 1, and Tro-Cor. 36a, col. 4. 2, both refer to the glyph, Fig. 1.

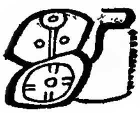


Fig. 1.

The Inscriptions. — Scattered all over the northerly and easterly slopes of the Cordilleras, as they run through the State of Chiapas in Mexico and through the Republic of Guatemala into Honduras, in the fertile valleys of the rivers which take their rise in this great chain of mountains, and in the whole extent of the peninsula of Yucatan, are the remains of great buildings with ornamental façades, and of large monoliths of various shapes and sizes. Within the buildings carvings are often found, representing human figures either by themselves or in connection with hieroglyphs, while there are many tablets, lintels, and other parts of the buildings on which hieroglyphs appear in columns and rows without figures. The monoliths may be roughly divided into two kinds, according to their shape. One kind (called *stela*, plural *stelae*) is tall, measuring in one case twenty-eight feet in height, while they are not over four feet in width or depth. The others are low and take various forms, being square, oblong, or round as a rule, though some are carved in the shape of an uncouth animal. These have been called altars, though without deciding whether sacrifices were ever offered upon them or not. These altars often stand in close proximity to the stelae.

The stelae usually have a human form carved upon the front or back, or upon both, while two or more sides are covered with hieroglyphs arranged in rows and columns. The altars are often adorned with figures and hieroglyphs in rows and columns, but are sometimes without hieroglyphs or figures.

[1] A liberty has been taken in the use of the word "glyph," which in its strict sense means a carved figure or character. I use it with this meaning in the inscriptions, but I also give this name to the characters which, drawn in square or roundish forms, are found in the codices, usually arranged in a regular order. These characters have been called by various authors "katounic," "calculiform," etc.

The inscriptions are usually carved upon the solid stone, though in a few cases, as at Palenque, there are some which are moulded in stucco. In Tikal many of the inscriptions are carved on wood.

When it is desired to designate a particular glyph on any of the inscriptions, it is stated as occurring in a column marked "A," "B," "C," "D," etc., from left to right, and in a row marked 1, 2, 3, etc., from top to bottom. In some places a glyph extends over two columns or over two rows, while in others a glyph is subdivided into two or more parts. In the first case the glyph will be designated by two letters or by two numbers, or by both two letters and two numbers; in the last case the part of the glyph will be designated by the small letters "a," "b," "c," "d," placed after the number. As a rule the glyphs are read from top to bottom across two columns at a time.

The Writings of Spaniards and others about the Mayas. — Under this second head there are but few writers whose observations and writings are based on personal knowledge. The greater number of Spanish authors wrote from hearsay, or copied, more or less accurately, the statements of earlier writers. The following authors, however, are of great value to Maya students:

I. Bishop Diego de Landa was born in Spain in 1524, became a Franciscan friar in 1541, and was appointed Bishop of Yucatan in 1573. He died in 1579. He wrote the "Relacion de las cosas de Yucatan."[1]

Three editions of Landa have been published, as follows:

1. By the Abbé Brasseur de Bourbourg, with a French translation, Paris, 1864, to which all references will hereafter be made.
2. By Juan de Dios de la Rada y Delgado, Madrid, 1881, as an Appendix to his "Ensayo sobre la interpretacion de la escritura hieratica," — a translation into Spanish of the work of Léon de Rosny.
3. In "Colección de Documentos Inéditos relativos al descubrimiento, conquista y organización de las antiguas posesiones Españolas de Ultramar." Segunda serie, publicada por la Real Academia de la Historia, Tomo Num. 13, Relaciones de Yucatan, II. Madrid, 1900.

II. Fray Alonso Ponce came to Mexico as Chief Commissioner in 1584. The account of his journey of over two thousand miles through the provinces of New Spain, entitled "Relacion breve y verdadera de algunas cosas de las muchas que sucedieron al padre Fray Alonso Ponce en las provincias de la Nueva España, siendo Comisario General de aquellas partes,"[1] was written, not by himself, but by two secretaries, one of whom came with him from Spain, and the other went with him on his journey in the provinces.

III. Fray Bernardo de Lizana was born in Spain, went to Yucatan in 1606, became Provincial of Yucatan, and died in Mexico in 1631. He wrote "Historia de la Provincia de Yucatan y su conquista espiritual," which was published in Valladolid in 1633.[2]

IV. Doctor Don Pedro Sanchez de Aguilar was born in Valladolid in Yucatan, and received the degree of Doctor in 1588. In 1613 he wrote "Informe contra Idolorum cultores," which was published in Madrid in 1639.[3]

V. Fray Diego Cogolludo was born in Spain, joined the Franciscans in 1629, and became Provincial of Yucatan. He wrote the "Historia de Yucatan," which was published in Madrid in 1688.[4]

VI. Reports sent to Spain by order of the King, giving an account of all matters concerning the natives which might be of interest.[5]

It may be proper to select from the modern writers four who have had access to Maya writings which are not now known or which are not readily accessible, either from their being deposited in distant libraries or from their not having been translated from the Maya or Spanish languages. These are —

[1] Published in "Colección de Documentos Ineditos para la Historia de España," Madrid, 1872, vols. 57, 58.

[2] An edition was published in Mexico in 1893 by the Museo Nacional under the title of "Historia de Yucatan."

[3] A new edition was published in 1892 in the "Anales del Museo Nacional de Mexico," Tomo VI, pp. 13 *et seq.*

[4] An edition was published in Merida, in 1842, and another in 1867–1868.

[5] These reports are found in "Colección de Documentos Inéditos relativos al descubrimiento, conquista y organización de las antiguas posesiones Españolas de Ultramar." Segunda serie, publicada por la Real Academia de la Historia, Tomos 11 and 13, Relaciones de Yucatan. Madrid, 1900.

VII. Don Juan Pio Perez.
VIII. Don Crescencio Carrillo y Ancona.
IX. Dr. Carl H. Berendt.
X. Dr. Daniel G. Brinton.

Though several of the Spanish authors are of assistance to the student of Maya culture by giving information on the customs, habits, modes of life, and in some cases on the calendar, of the Mayas, none of them has described the Mayas in such detail as has Bishop Landa. It is to him above all others that we are indebted for our knowledge of this intelligent people.

Brasseur de Bourbourg informs us that Landa was of noble race, that he was born in Cifuentes de l'Alcarria in Spain in 1524, and that he took the habit of St. Francis in 1541 at the convent of San Juan de los Reyes in Toledo. He was one of the earliest and most zealous of the Franciscans who entered Yucatan, — so zealous, indeed, that he was charged with usurping higher functions than belonged to him in conducting an *auto-da-fé*, in which, though no human life was sacrificed, he burned many of the books and idols of the natives. He was, however, absolved from this charge, and in 1573 was appointed the second bishop of Merida. He died there in 1579 at the age of fifty-four.[1]

Brasseur de Bourbourg also expresses his views of Bishop Landa's character, and in such well-chosen words that I cannot do better than to reproduce them here. He says:

"Landa has in turn been considered a saint and an odious persecutor. According to Cogolludo, his first biographer, he died in the odor of sanctity, and according to another biography, inserted as an appendix to the second edition of the work of Cogolludo, published at Campêche in 1842, he is stigmatized as a fanatical, extravagant, and cruel man. But if circumstances and the times make men, it is often the circumstances and the times which also make their reputation. Of the two biographers of Landa, one exaggerates the virtues which belonged to his times and to a Spanish bishop; while the other exaggerates his faults, which shock us of this age and especially the liberal writers of Yucatan, but which, nevertheless, were virtues in the eyes of Spaniards of earlier times. In order to appreciate

[1] Landa, 1864, preface, p. vii.

Landa's true character, it is only necessary to run through what he accomplished. His was a strenuous character, but an investigating one, wiser than one would think, and sincerely friendly to the natives, whom he protected constantly from the violent acts of the conquerors. From the point of view in which he placed himself, he may well be excused for having delivered to the flames so many statues and valuable documents, a fact which he acknowledges most ingenuously (p. 316). In doing this he was no more culpable than Zumarraga in Mexico and Las Casas in Guatemala. But in the midst of this excess of zeal, which we deplore so much to-day, Landa rendered an immense service to historical science in compiling the precious information which we publish here, and in preserving the characters of the Maya alphabet. His book wipes out over and over again his faults, which were those of his century; for it is the key of American inscriptions; without it they would have remained an enigma, perhaps forever, like the hieroglyphs of Egypt before the discovery of the Rosetta stone and the splendid work of Champollion."[1]

Of the four men whom I have mentioned as having had access to Maya documents which have not been at the service of others, Pio Perez is perhaps the most important. He has given a very full account of the Maya days, months, years, and other divisions

[1] "Landa a passé tour à tour pour un saint et pour un odieux persécuteur. Suivant Cogolludo, son premier biographe, il mourut en odeur de sainteté, et, d'après une autre biographie, insérée comme appendice à la seconde édition de l'ouvrage de Cogolludo, publiée à Campêche, en 1842, il est stigmatisé comme un homme fanatique, extravagant et cruel. Mais si les circonstances et les temps font les hommes, les circonstances et le temps sont bien souvent aussi ce qui fait leur réputation. Les deux biographes de Landa exagérèrent, le premier, des vertus qui étaient de son époque et d'un évêque espagnol; le second, ses défauts, choquants, surtout, pour les écrivains libéraux du Yucatan, dans notre siècle, défauts qui étaient encore eux-mêmes des vertus aux yeux des Espagnols d'autrefois. Il suffit de parcourir l'ouvrage de Landa, pour apprécier son véritable caractère. C'était un esprit violent, mais curieux, plus sage qu'on ne pourrait le croire, et sincèrement ami des indigènes qu'il protégea constamment contre les violences des conquérants. Au le point de vue où il se plaçait, il peut paraitre excusable d'avoir livré aux flammes tant de statues et de documents précieux, ce qu'il avoue lui-même ingénument (p. 316) : en cela, il ne fut pas plus coupable que Zumarraga à Mexico, que Las Casas au Guatémala. Mais, au milieu de ces excès de zèle, que nous déplorons si vivement aujourd'hui, Landa rendit un immense service aux sciences historiques, en compilant les renseignements précieux qui suivent, et en nous conservant les caractères de l'alphabet maya. Son livre efface outre mesure ses fautes qui furent celles de son siècle; car, il est la clef des inscriptions américaines : sans lui, elles fussent demeurées une énigme peut-être pour toujours, comme les hiéroglyphes égyptiens, avant la découverte de la pierre de Rosette et les magnifiques travaux de Champollion." (Landa, 1864, Avant-propos, pp. vii and viii.)

of time. But as he does not give any authorities in support of his views except that they were founded on "varios documentos antiguos," and as some of his statements are apparently at variance with the codices and with the books of Chilan Balam (the latter being probably the chief source of his information), we need not give, as I think, to the views of Perez any greater force than belongs to the opinions of any intelligent, honest searcher who has had original documents before him to which he has given hard study. A similar view must be taken of the opinions of the three others whom I have named. Perez also wrote a valuable Maya-Spanish dictionary, which has been printed.

Dr. Brinton is the only one of the four who has published the results of his studies to any great extent. He was fortunate in being the possessor of the collection of Dr. Berendt, who had travelled for many years in Yucatan, Mexico, and Central America, studying the native languages, examining the antiquities of the country, and taking accurate copies, often in facsimile, of as many ancient manuscripts as he could discover. This collection now forms part of the Library of the Free Museum of Science and Art of the University of Pennsylvania.

In treating of the subject of Maya calculations I shall follow the order of the successive steps which have led us to our present knowledge, gaining a secure foothold on one step before moving to the next. This course will prevent my finishing the discussion of each point by itself, but is the only course consistent with setting forth clearly the means which have been made use of in gaining our knowledge and with establishing a confidence in the results of our inquiries.

Therefore confining our attention at first to the codices, I shall treat of the Maya days, their names and signs. Then I shall take up the numerals (usually red) attached to the days and thus forming the Tonalamatl. Next I shall take up the black numerals in the codices, carrying the numeration through the fourth term (including the katun, tun, uinal, and kin) and showing various signs for certain numbers. I shall then discuss the Maya months, their names, signs, and the numbers attached to them. This will bring us naturally to the consideration of the Maya year, leading us to the fifty-two-year period or Calendar round and the one-hundred-and-four-year period. A chapter will follow on the longer numeration found in the codices, carrying us to the sixth term (including cycle and grand cycle) in connection with the count by days and months.

I shall then take up the inscriptions, showing the similarity of the forms of the days and months with those found in the codices, together with the glyphs representing the different periods, both normal and face glyphs, and the normal forms of numbers used in connection with the days, months, and periods. This will include the "long count," so called, as found in the Initial series (counting from a date far in the past which usually does not appear), and the distance numbers, which express the distance from one given date to another given date. It will also be shown that the codices, as well as the inscriptions, contain glyphs representing some of the periods. Glyphs in the form of heads will then be discussed, representing numbers from 1 to 19, followed by the explanation of two other methods used by the Mayas for fixing a date besides that of the long count. This will be followed by a discussion of other points connected with the codices and inscriptions.

It is very possible that the other systems of numeration and calendar which were adopted by neighboring and cognate people might be of use in studying the Maya system. So little is known however of these related systems, except that employed by the Mexicans, and the native evidence in regard to them is so slight, that I have not thought it wise to extend the limits of this volume in order to enter upon this subject. I give, however, in an Appendix a table showing the names of the days in a number of the related systems. The Mexican system of numeration and calendar is very like that of the Mayas, but it was not carried to the perfection which is found in the latter.

CHAPTER II

THE DAY SIGNS IN THE CODICES AND THEIR IDENTIFICATION

Days as given by Landa. — Landa states that the Mayas had months consisting of 20 days each. These were called **Uinal-hun-ekeh.** The year was composed of 18 of these months, and, in addition, 5 days and 6 hours. He states that for the 20 days contained in 18 months, making 360 days in all, they had 20 letters or characters, one for each of the 20 days of the month. He gives a table as follows, the order of reading being in horizontal rows:

Kan	**Chicchan**	**Cimi**	**Manik**	**Lamat**
Muluc	**Oc**	**Chuen**	**Eb**	**Ben**
Ix	**Men**	**Cib**	**Caban**	**Eznab**
Cauac	**Ahau**	**Ymix**	**Ik**	**Akbal**[1]

Later on[2] Landa says that the Mayas gave names to the days of the month, and that they formed a kind of calendar from all the months taken together. The first day of their calendar was called

[1] "Tienen su año perfecto como el nuestro de CCC y LXV dias y VI horas. Dividenlo en dos maneras de meses, los unos de a XXX dias que se llaman U, que quiere dezir luna, la qual contavan desde que salia nueva hasta que no parecia.

"Otra manera de meses tenian de a XX dias, a los quales llaman **Uinal-hun-ekeh**: destos tenia el año entero XVIII y mas los cinco dias y seis horas. . . . Para estos CCCLX dias tienen XX letras o carateres con que los nombran, dexando de poner nombre a los demas cinco, porque los tenian por aciagos y malos. Las letras son las que siguen y llevara cada una su nombre en cima . . ." (Landa, 1864, pp. 202 *et seq.*). Then follows the forms of the day signs with the names over them.

[2] "Ponian a los dias de sus meses nombres, y de todos juntos los meses hazian un modo de calendario, con el qual se reglan assi para sus fiestas como para sus cuentos y tratos y negocios, como nosotros nos regimos con el nuestro, salva que no començavan el primero dia de su calendario en el primero dia de su año, sino muy adelante. . . . las letras y dias para sus meses son XX." (Ibid. p. 234.)

Hun-ymix (see Plate I, **YMIX** 1).[1] This day, however, was not the first day of the month, and consequently of the year, but it occurred much farther along in the year than the first day.

Beginning with **Ymix**, the order of the days runs thus:[2]

Ymix
Ik
Akbal
Kan
Chicchan
Cimi
Manik
Lamat
Muluc
Oc
Chuen
Eb
Ben
Ix
Men
Cib
Caban
Eznab
Cauac
Ahau

Landa also gives the names and forms of the twenty days[3] extending through the European year, beginning with January 1st, and making the Maya day **Ben** correspond with that day of our month.[4] In giving this calendar he repeats the Maya day names and forms eighteen times, once for each month. Five of the days, but not the forms, are repeated once more, making the year con-

[1] "el caracter o letra de que començava su cuenta de los dias o kalendario se llama **Hun-ymix** y es este." (Landa, 1864, p. 236.) Then follows the day sign **Ymix**. On p. 246, against the date January 29, Landa says, "Aqui comiença la cuenta del Kalendario de los indios, diziendo en su lengua Hun Ymix."

[2] For the meaning of these names see Appendix I.

[3] Ibid. pp. 240–310.

[4] It will be more convenient in studying the Maya system to arrange the year calendar according to the Maya method, that is, beginning the year with the month **Pop**. All that will be necessary to do will be to place that part of the calendar, as given by Landa, which extends from January 1st through July 15th (pp. 240–276), after the part which ends on page 310. "Pero aunque ellos començian su año en Julio, yo no porne aqui su Kalendario sino por la orden del nuestro y junto con el nuestro." (Ibid. p. 236.)

sist of 365 days (20 × 18 + 5). These forms are given on Plates I, II, III, and IV as No. 1 of each day.

Days as given by Perez. — Don Juan Pio Perez[1] says the day was called **Kin**,[2] and that they were twenty in number, and arranged thus, the reading being downwards in columns:

Primera quinterna	Segunda	Tercera	Quarta
Kan	**Muluc**	**Gix** (o **Hix**)	**Cauac**
Chicchan	**Oc**	**Men**	**Ajau** (o **Ahau**)
Quimij (o **Cimij**)	**Chuen**	**Quib** (o **Cib**)	**Ymix**
Manik	**Eb**	**Caban**	**Yk**
Lamat	**Been**	**Edznab** (o **Eonab**)	**Akbal**[3]

It will be noted that the names and the order of the twenty days are the same in the last list given by Landa (p. 14) and in that given by Perez, although the lists do not begin with the same day. The first table given by Landa (p. 13) begins with **Kan**, and runs in the same order as that of Perez.

[1] "Codice Perez, p. 92, MS. This is a series of extracts from various ancient Maya manuscripts obtained by the late distinguished Yucatecan antiquary, Don Juan Pio Perez, and named from him by Canon Crescencio Carrillo and other linguists. A copy of it is in my collection. It is in quarto, p. 258." (Brinton, 1882, p. 48.)

[2] This is the word usually employed among the Mayas at the present time, meaning "day." It also means "sun," as stated by Perez.

[3] "Al dia llamaban **Kin**, es decir sol, y en esto se parecen à otras naciones que cuentan los dias por soles : lo dividian en dos partes naturales, à saber la noche y el tiempo en que aquel astro está sobre el orizonte. En este distinguian la parte que antecede al nacimiento del sol, expresándola con las palabras **hach hatzcab**, muy de mañana, ó con la de **malih-okoc kin**, antes que salga el sol, ó con la de **pot akab** que señala la madrugada. Con la palabra **hatzcab** designaban el tiempo que corre de la salida del sol al media dia, á este lo llamaban **chunkin** que es contraccion de **chumuc-kin**, centro del dia ó medio dia; aunque en la actualidad designan con esta palabra las horas que se acercan al media dia. **Tzelep-kin** llamaban la hora en que el sol declina en el arco diurno aparentemente, esto es, á las tres de la tarde. **Oc-na-kin** es la entrada de la noche ó puesta del sol. Para significar la tarde, dicen que cuando refresca el sol y lo espresan diciendo **cu ziztal kin**. La noche es **akab**: su mitad ó media es **chumuk-akab**, y para señalar el tanto del dia ó de la noche intermedio á los puntos dichos, señalan en el arco diurno del sol lo que este habia corrido ó correrá, y por la noche la salida ó estado de alguna estrella ó planeta conocida.

"Los dias son veinte que por lo regular se dividen de cinco en cinco, . . ." (Perez, 1864, pp. 368 *et seq.*)

Brasseur de Bourbourg adds notes as follows: "**Chumuc**, moitié, milieu, et **kin**, soleil, jour, exactement midi." "Ce partage de cinq en cinq réglait aussi l'ordre des marchés, qui avaient lieu tous les cinq jours et qu'on appelait **tianquiz** ou **tianquiztli**, en langue mexicaine, et **kinic** en maya."

Days as given in Codices.—We are thus furnished with the names of the twenty days and their order, and a type or example of one form at least of each day.

On Tro-Cor. 13–18 we find four rows of hieroglyphs, many of which are the same as the day forms of Landa. Selecting only those which are practically the same as the Landa forms, we can make the following comparison:

Landa	**Ymix**	**Ik**	**Akbal**	**Kan**	**Chicchan**	**Cimi**	**Manik**	**Lamat**	**Muluc**	
T. C. 1st row	**Ymix**	**Ik**	**Akbal**			**Cimi**	**Manik**			
2d "	**Ymix**	**Ik**				**Cimi**	**Manik**	**Lamat**	**Muluc**	
3d "	**Ymix**	**Ik**				**Cimi**	**Manik**		**Muluc**	

Landa	**Oc**	**Chuen**	**Eb**	**Ben**	**Ix**	**Men**	**Cib**	**Caban**	**Eznab**	**Cauac**	**Ahau**
T. C. 1st row	**Oc**	**Chuen**	**Eb**	**Ben**	**Ix**		**Cib**		**Eznab**		**Ahau**
2d "	**Oc**		**Eb**		**Ix**				**Eznab**		**Ahau**
3d "	**Oc**			**Ben**	**Ix**				**Eznab**		**Ahau**

Looking over the first three rows we see that the only days in the Tro-Cortesianus which we have not recognized by their similarity to the forms as given by Landa, are **Kan**, **Chicchan**, **Men**, **Caban** and **Cauac**. All the rest are either identical with the day forms of Landa, or so closely resembling them that it is impossible to mistake them. These forms, when recognized, all run in the same order as the similar forms given by Landa.

It is therefore a safe inference that Tro-Cor. 13–18 record a full list of the Maya day signs in their regular order, each row repeating the twenty days with twelve additional days at the end, and that all the day signs, including those which cannot be recognized by their resemblance to those given by Landa, can be considered as types from which other day signs resembling them may be recognized. As a further proof of the meaning of this series, it may be noticed that, if we write down the twenty days in four sets of five days each, beginning with **Ymix**, the day given by Landa as the first of the calendar, they will run thus, the reading being downwards in columns:

Ymix	**Cimi**	**Chuen**	**Cib**
Ik	**Manik**	**Eb**	**Caban**
Akbal	**Lamat**	**Ben**	**Eznab**
Kan	**Muluc**	**Ix**	**Cauac**
Chicchan	**Oc**	**Men**	**Ahau**

The columns of five days begin with **Ymix**, **Cimi**, **Chuen** and **Cib**, respectively, these being the days with which the four rows on Tro-Cor. 13–18 also begin.

Again, on Tro-Cor. 65–73, we find another long series of day forms. We recognize most of these from their similarity to the Landa forms, while the days **Kan**, **Chicchan**, **Men**, **Caban** and **Cauac**, which we have not so recognized, are practically the same forms which we found in relatively the same places in Tro-Cor. 13–18. In both of these long series we find that the order of days as given by Landa is followed exactly, as far as we can recognize the day forms. It is therefore probable that the forms which we do not recognize (and these are but a small part of the whole) are the day forms of the days which belong in the spaces where they stand, and we can therefore consider these forms to be types from which we can recognize the same or similar forms when we find them elsewhere.

Again, on Tro-Cor. 75, 76, the so-called Tableau des Bacabs, many of the days are given in the regular order, the days not given being indicated by black dots. On Dr. 22a is a regular series of twenty days, beginning with **Cauac** at the left hand of the lowest row and running through that row to the right, then to the left of the row next above, and so on.

In all these cases, then, we are able to recognize the forms of all the days, many of the days showing forms which are radically the same wherever found, such as **Kan**, **Manik**, **Lamat**, **Muluc**, **Ymix**, etc., while others, like **Cimi**, show a great variety of forms, some of which are not at all like the usual form of this day.[1]

In addition to the series already described, there are in both the Tro-Cor. and the Dr. very many columns of day forms, of which the days are separated by regular distances[2] of 4, 5, 6 or 12 days, and sometimes by some other number of days. Thus on

[1] See Plate II, **CIMI**, Nos. 22–24.

[2] I use the word "distance" as meaning a count between two dates, in which one of the dates and not both are reckoned in; and the word "interval" as meaning a count between two dates, in which neither of the dates is reckoned in. Thus the distance from the 6th of August to the 21st of August is 15 days, the 6th being omitted from the count and the 21st being reckoned in. The interval between these dates is 14 days.

2

Dr. 13b we find the series of **Ahau, Eb, Kan, Cib, Lamat,** and on Dr. 16b there is a series of **Muluc, Ymix, Ben, Chicchan, Caban,** each day being distant 12 days from the preceding day and the first day 12 days distant from the last. If then we should find a similar series in which one or two of the day forms are unknown or partially erased, and if we should find that the distance from one day to another in the case of the known days is 12 or a multiple of 12, according to the position of the days, we should be justified in considering that the unknown or partially erased forms are the days which should be reached in the regular course of the series after the proper distance. Such a decision would also be justifiable in the case of a series where the distance from one day to the next is 4 days, 5 days, 6 days, etc.

Thus on Tro-Cor. 51c, where the first column of days runs thus: **Ahau, Cimi, Eb, ?, Kan,** the distance from the first day to the second, and of the second day from the third, is 6, while the distance from the third day to the fifth is double this, or 12. The natural supposition would be that the regular distance is 6, and that the fourth day is six days after the third and six days before the fifth. The only day which fulfills this requirement is **Eznab,** and we shall be justified in calling the form in the fourth place **Eznab** (see Plate IV, **EZNAB** 8), although the glyph differs from the other forms of this day.

On pages 46–50 of the Dresden Codex there are twenty columns of day signs, which contain the days **Cib, Cimi, Kan, Ahau, Oc, Lamat, Ix, Eb, Eznab** and **Ik.** Each column contained originally thirteen glyphs of the same day,[1] and in one or more cases these glyphs are enough like those of Landa (except possibly **Ix**) to be easily recognized. These pages show many variations of the same day sign, and also afford an opportunity to see what freedom of design and what carelessness of execution the Maya artist allowed himself when there was no danger of the meaning of his work being misunderstood.

[1] This is apparent by mere inspection in most cases, though many of the glyphs in the upper row are erased. Further proof of the fact by calculation will be given in Chapter III.

Thus there are two ways by which we can identify the day signs: first, by their resemblance to the forms given by Landa; and, second, by their relative position in a sequence, in relation to the signs preceding or following. By this latter method we can restore signs which are partially or wholly illegible, and recognize unknown forms of days.

From these and other sources[1] we get most of the forms given on Plates I to IV, and we have thus made a sure interpretation of practically all the day forms of the codices, provided Bishop Landa can be trusted. And even if we did not have the knowledge given us by Landa, a guess that these forms referred to the Maya days would be confirmed by every part of the codices where they are found. The meaning of the forms given on Plates I to IV can therefore be considered as settled.

Landa also shows us that in reckoning time the day series was a continuous one, the first day following the last when the end of a series was reached. This is an important point to bear in mind throughout the study of the Maya hieroglyphs, — the continuity of the day series. One should keep in mind a circle divided into twenty parts, each part representing a day. The order is always the same, the first day following the last in every case, with no break in the series. Any given day is therefore always a certain distance from another given day. The same continuity is also found to be true when we reach the larger units of time.

I have given a large number of variants of the day forms, so that it may be seen that great differences in form may occur in the day signs without altering their meaning, with a probable corollary that equal differences may occur in other hieroglyphs without their meaning being altered.

[1] The forms from the Books of Chilan Balam are not taken from the original manuscript, but from the pages of The Books of Chilan Balam, published by Dr. Daniel G. Brinton, Phil., 1882. These forms often differ greatly from those of the codices, and this difference may well be due to the different periods at which the Books of Chilan Balam and the codices were written.

CHAPTER III

THE USE OF LINES AND DOTS IN MAYA NUMERATION

THERE will be shown in this chapter the use made by the Mayas of the line and dot system of numeration in their combination of twenty days with thirteen numbers, by which they formed a series in which the same day with the same number cannot appear a second time until after the lapse of $20 \times 13 = 260$ days. There will also be shown the method by which the Mayas reached very large numbers in their calculations by giving different values to the small numbers of which the large numbers are composed, these values being dependent on the relative positions occupied by the small numbers.

Red Day Numbers, One to Thirteen. — Dr. Brinton quotes a statement from "the pen of a native writer" which he translates as follows:

"They (our ancestors) used (for numerals in their calendars) dots and lines back of them; one dot for one year, two dots for two years, three dots for three, four dots for four, and so on; in addition to these they used a line; one line meant five years, two lines ten years; if one line and above it one dot, six years; if two dots above the line, seven years; if three dots above, eight; if four dots above the line, nine; a dot above two lines, eleven; if two dots, twelve; if three dots, thirteen."[1]

Although this statement refers only to the marking of the years, and though I know of no case in the codices where the years are so marked, we do see lines and dots used with the day signs

[1] "Yantac thun yetel paiche tu pachob, he hunppel thune hunppel bin haabe, uaix cappele cappel bin haabe, uaix oxppel thuun, ua canppel thuune, canppel binbe, uaix oxppel thuun baixan; he paichee yan yokol xane, ua hunppel paichee, hoppel haab bin; ua cappel paichee lahunppiz bin; uaix hunppel paichee yan yokol xane, ua yan hunppel thuune uacppel bin be; uaix cappel thuune yan yokol paichee uucppel bin be; ua oxppel thuun yan yokole, uaxppel binbe; uaixcanppel thun yan yokole paichee (bolonppel binbe): yanix thun yokol (cappel) paichee buluc piz; uaix cappel thune lahcapiz; ua oxppel thuun, oxlahunpiz." (Brinton, 1882, pp. 47, 48.)

throughout the codices, and it will be well to see how well this method of using numbers will apply to the red marks which we so frequently meet with. The significant point is that a dot means 1 and a line means 5.

Bishop Landa also tells us that the Indians counted by fives, and that from four fives they made twenty.[1] Landa also states that though the days were twenty in number, they did not count them above 13, but when they reached 13 they began again.[2] Although this statement might have been clearer, it can hardly mean anything else than that they counted the numbers which were attached to the days from 1 to 13, considering the explanations of Landa and of Perez.[3]

Explaining what he means, Landa begins his year on page 240 with January 1, against which he places the day **Ben**, and attaches the number 12 to it. January 2d is **13 Ix**, January 3d is **1 Men**, January 4th is **2 Cib**, and so on, January 29th being **1 Ymix**. In each case the numbers attached to the days run up to 13, and then begin again with 1, in the very method of which the text speaks.

In Tro-Cor. 65–73, as has been shown, the days run on in their regular order. Beginning with **Ymix** on 65a, and running along the top of the "a" division of that and the following pages to **Cib** on 72a, the series then returns to the top of 65b with **Caban**, and runs through the top of the "b" division of pages 65–72 to **Eb** on 72b. Thence the series returns to the second line of 65a with **Ben**, and

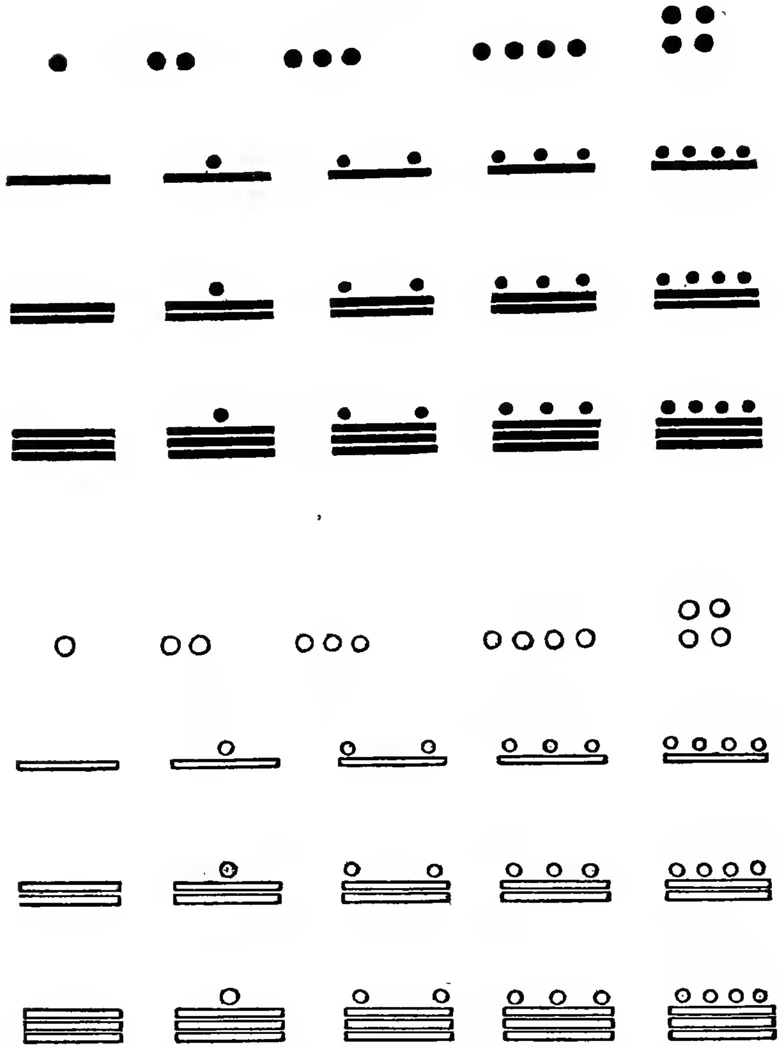
1 "El modo de contar de los indios es de cinco en cinco, y de cuatro cincos hazen veinte." (Landa, 1864, p. 206.)

2 "Porque aunque las letras y dias para sus meses son XX tienen en costumbre de contarlas desde una hasta XIII. Tornan a començar de una despues de las XIII, y assi reparten los dias del año in XXVII trezes y IX dias sin los aciagos." (Landa, 1864, p. 234.)

3 Perez speaks of the set of thirteen days which he calls "semana" as follows: "Aquella era el curso periodico de trece numeros que se aplicaban indistintamente a los veinte dias del mes, segun su orden numerico." "El año se componia de veinte y ocho semanas y un dia." (Ibid. p. 374.) These sets of 13 days are called by some authors "trecenas," or "trezes," or "treces." (Ibid. p. 236.)

It will be seen later that the sets of thirteen played a very important part in the life of the Mayas. There are two hundred or more divisions into which the first forty-five pages of the Dresden and practically the whole of the Tro-Cortesianus are divided, and in forty-five of these the time recorded in the divisions is divided into periods of thirteen days or of some multiple of thirteen.

TABLE I



so on, through 72b, the last day form given there being **Cib**,—while the last four days are carried over to 73b, and the series ends with **Ahau**,—there being 13 × 20 days given, each day being repeated thirteen times, thus producing 260 days in all. Although some of the day forms are partly erased, the large majority of them are very clear.

But over each day form (unless where erasure has taken place) there are red marks, consisting of from one to four red dots, or of one or two red lines, or of a combination of these. (In the two upper day forms of 73b these red marks are on the left side of the glyph instead of being over it.[1]) If now we give the value of 1 to each dot and of 5 to each line found connected with the day signs, as suggested by the "native writer," the numbers and days agree with the Landa list of days, beginning with **1 Ymix** on January 29th. In spite of the erasures we find the following numbered days very easy to discern:

1 Ymix	**— Caban**	**— Ben**	**10 Muluc**
. . .	**5 Eznab**	**— Ix**	**— Oc**
— Akbal	**6 Cauac**	**— Men**	**12 Chuen**
4 Kan	**7 Ahau**	**10 Cib**	**13 Eb**
. . .	**8 Ymix**	. . .	**1 Ben**
6 Cimi	**9 Ik**	**12 Eznab**	**2 Ix**
— Manik	**10 Akbal**	**13 Cauac**	**3 Men**
8 Lamat	**11 Kan**	**1 Ahau**	**4 Cib**
. . .	. . .	**— Ymix**	**5 Caban**
10 Oc	**— Cimi**	**3 Ik**	**6 Eznab**
— Chuen	**1 Manik**	**4 Akbal**	**7 Cauac**
12 Eb	**2 Lamat**	**5 Kan**	**8 Ahau**
— Ben	**3 Muluc**	**— Chicchan**	**9 Ymix**
1 Ix	**4 Oc**	**7 Cimi**	**10 Ix**
— Men	**5 Chuen**	**8 Manik**	**11 Akbal**
3 Cib	**6 Eb**	**9 Lamat**	**12 Kan**

and many others.

Owing to the fact that the upper parts of all the pages and the left-hand part of pp. 65 and 69 are somewhat rubbed, there are various erasures in the list; but the sequence of the numbers in connection with the sequence of the days is so clear that it needs no farther proof to decide that the pages of Tro-Cor. coincide as far as the Maya days and their numbers are concerned with that part of Landa's list which begins with January 29th, and it is shown that with the series of the twenty days, they counted the

[1] In the following pages the solid black numerals will be used to represent the black numbers of the codices, and the numerals in outline will be used for the red numbers of the codices. (See Table I.)

numbers 1 to 13, returning to 1 after reaching each 13. In the continuous series of days it will thus happen that each of the twenty days will be accompanied by each of the thirteen numbers, before a day with a given name has the same number a second time. This is mathematically demonstrable since 13 and 20 have no common divisor, and it is actually proved by experiment in the pages of Landa and of the Tro-Cortesianus. We thus have a

TABLE II

TABLE OF 260 DAYS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ymix . . .	1	8	2	9	3	10	4	11	5	12	6	13	7	1
Ik	2	9	3	10	4	11	5	12	6	13	7	1	8	2
Akbal . .	3	10	4	11	5	12	6	13	7	1	8	2	9	3
Kan	4	11	5	12	6	13	7	1	8	2	9	3	10	4
Chicchan .	5	12	6	13	7	1	8	2	9	3	10	4	11	5
Cimi . . .	6	13	7	1	8	2	9	3	10	4	11	5	12	6
Manik . .	7	1	8	2	9	3	10	4	11	5	12	6	13	7
Lamat . .	8	2	9	3	10	4	11	5	12	6	13	7	1	8
Muluc . .	9	3	10	4	11	5	12	6	13	7	1	8	2	9
Oc	10	4	11	5	12	6	13	7	1	8	2	9	3	10
Chuen . .	11	5	12	6	13	7	1	8	2	9	3	10	4	11
Eb	12	6	13	7	1	8	2	9	3	10	4	11	5	12
Ben	13	7	1	8	2	9	3	10	4	11	5	12	6	13
Ix	1	8	2	9	3	10	4	11	5	12	6	13	7	1
Men . . .	2	9	3	10	4	11	5	12	6	13	7	1	8	2
Cib	3	10	4	11	5	12	6	13	7	1	8	2	9	3
Caban . . .	4	11	5	12	6	13	7	1	8	2	9	3	10	4
Eznab . . .	5	12	6	13	7	1	8	2	9	3	10	4	11	5
Cauac . .	6	13	7	1	8	2	9	3	10	4	11	5	12	6
Ahau . . .	7	1	8	2	9	3	10	4	11	5	12	6	13	7

series of days and numbers amounting to $13 \times 20 = 260$ in all, and the 261st day will be the same numbered day as the 1st.[1]

We have thus found two methods for differentiating one day from another:

1. By giving different names to twenty days in sequence, returning on the twenty-first day to the name given to the first day and then repeating

[1] This period of 260 days is a very important one. While we do not know the name which the Mayas gave to it, the Nahuas called it "Tonalamatl," and it will be referred to in this volume by this name. (See Appendix II.)

the sequence. This would distinguish the twenty days from each other, but would afford no means for distinguishing the days in longer periods.

2. By affixing the numbers 1 to 13 in succession to the days, thus making it possible to mark the days in the longer period of 13 × 20 = 260 days.

A condensed table is given above (Table II), with an additional column showing how the series of days with numbers attached returns into itself.

It will be noted that **Ymix** has the number 1 attached to it in the beginning, and again, 260 (20 × 13) days later, at the top of the column 14.

The examination of Tro-Cor. 65–73 shows that the red numbers found there never rise above (13), and that they are always used in connection with the day signs. Is this the case throughout the codices?

Red Numbers over Columns of Day Signs. — Confining our attention to the Dresden and Tro-Cortesianus, we find very many places where the red numbers occur. One class of cases consists of day signs, — sometimes five, sometimes four, sometimes ten distributed in one or two columns. Over each column is usually a red number, and, judging from what we have found in the pages of the Tro-Cor. which we have just examined, this number would naturally belong to the days below it. But does it belong to all the days in the column, or only to the one immediately below it? If only to the latter, it would be difficult to see what relation a day with a number could have to one without a number. It would be much the same as if we tried to calculate a mathematical problem by treating units, tens, etc., as of one class. Let us experiment with the question on the supposition that the number belongs in turn to all the days of the column, and if this method brings out an accurate and well-ordered result, it will give some evidence of our supposition being correct, and this will be further confirmed if the evidence so obtained is supported by other facts.

We have already used these columns as a means of distinguishing the unknown day signs, and in so doing we have shown the distances between the different signs (often 5, 6, 4, and 12) as they stand in the series of twenty days. But though a day sign by itself is one out of twenty, when the day sign has a number (from 1 to 13) attached to it, it becomes, as has been seen, one out of two hundred and sixty. Thus in the Table which has been given it will be seen that **Eb** is 12 days from **Ahau**, but that **6 Eb** in column 2 is 52 days from **6 Ahau** in column 12. Taking a specific case, and turning to Dr. 13b, we find a column of days which runs as follows: **Ahau, Eb, Kan, Cib, Lamat,** with a red **6** over it. The days are 12 days apart in the series of twenty days, and the first day is 12 days from the last, the column thus re-entering into itself. But let us suppose that the **6** refers to each of the days in the column over which it stands. Then the days with the number attached become 52 days apart in the series of 260 days, as will be seen in the Table. And as there are five days and five intervals, including the interval from the last to the first day, the number of days passed over in going through the whole circuit of the column and in returning into itself will be $5 \times 52 = 260$, or exactly one full series as given in Table II.

So on Dr. 13c we have a day series in two columns as follows: **Men, Ymix, Manik, Ben, Cauac, Chicchan, Chuen, Caban, Akbal, Muluc,** — over which series are two red numbers **2,** — one over each column. These days are 6 days apart in the series of twenty days, or 26 days apart when each is combined with the number 2 in the series of 260 days. And as there are ten terms and ten intervals, the whole circuit will be $10 \times 26 = 260$, — again the full series of days as given in Table II.

So in Tro-Cor. 27c we find a column with **Muluc, Ix, Cauac, Kan, Muluc,**[1] with a red **13** over the column. These days are 5 days apart in series of twenty days, but when each day sign has a number 13 attached to it the distances are 65 days; and as there are four days and four intervals, the whole circuit will be $4 \times 65 = 260$ once more.

[1] The second **Muluc** is apparently merely a repetition of the first day of the series, which returns into itself.

There are over two hundred of these day columns in the two codices in a more or less good state of preservation. Of these the majority show a uniform distance between the days of the column, and this distance, multiplied by the number of intervals required to bring the column back into itself, gives the number 260, and completes one round of Table II, or of a similar table beginning with a different day. This is also the number of days which we find in the long series on Tro-Cor. 65–73.

This is certainly a very remarkable result, and gives strong evidence that we were right in supposing that the red number over the column belongs to each day in turn. This supposition will be supported by further evidence when we come to treat of the black numbers.

With such evidence before us we may consider it at least a good working theory —

A. That the straight line = 5 and that the dot = 1.

B. That the red numbers when found with the day signs (whether above or on one side) belong to the day signs, and give them a meaning in the series of 260 days which they did not have in the series of 20 days.

C. That a red number over a column of day signs belongs to each of the day signs in turn.

Proceeding on this theory, we shall consider that the day signs and the red numbers found in connection with them throughout the two codices designate the days in the Tonalamatl, or series of 260 days.

Red Numbers attached to Days, and Black Numbers Meaning Distances, in the Tonalamatl. — But there are many red numbers which have no apparent connection with day signs. These will now be considered.

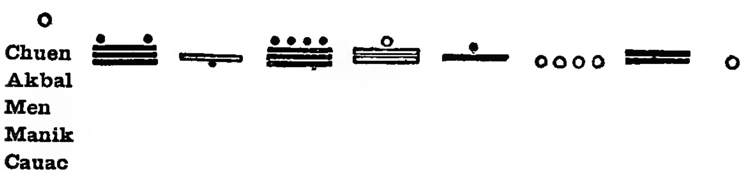
1. There is very often found on the right of the day column a series of black and red numbers. These may be in a horizontal line running below the hieroglyphs (this is usually the case) or in two horizontal lines, as in Dr. 4b–5b, or in two columns, as in Dr. 8c and 9c, or they may be scattered about the division of the page, as on Dr. 3a,

Tro-Cor. 44, etc. In all these cases no other day signs appear other than those found in the day columns.

2. These horizontal rows may appear by themselves unattached to any day column, as in Dr. 65–69.

In all these cases it will be shown that the red numbers really refer to one or more days. When no column of days precedes, the following red number refers to the single day to which it is attached; but where there is a column of days, it will be found that the following red numbers refer to as many days as there are days in the column, though not, as a rule, to the same days as those which are given in the column. And in none of these cases does the red number rise above 13, except in one instance in Tro-Cor., and this is probably an error.

Taking up the cases in 1, we will select a very common type. On Dr. 6c to 7c we find a day column which runs thus: **Chuen, Akbal, Men, Manik, Cauac.** A red **1** stands over the column. Then follows a row of numbers, the red numbers of which are here given in outline and the black numbers in solid black.[1]



What first strikes us in this row is that it begins and ends with a red **1**, and as we have already found that the column of days returns into itself, it is at once apparent that possibly the horizontal row of numbers does the same thing. In this case, as the first red number belongs to the day signs, the last red number would also belong to a day sign. The next thing which strikes us is that while the red numbers are all below 13, two of the black numbers are **17** and **19** respectively. What function do the black numbers perform? They cannot be parts of day signs, as the numbers

[1] It will be noted that of these horizontal rows there are five cases in the Dresden and forty cases in the Tro-Cor., where the black numbers are composed of thirteens or of multiples of thirteen.

attached to day signs never run over **13**, as far as we have observed. Let us see what the total of the black numbers adds up to. $17 + 19 + 6 + 10 = 52$. But turning to Table II we find that the distance from **1 Chuen** to **1 Akbal**, the first and second days of the day column, is 52 days, and that the distance from the **1** over the column to the red **1** at the end of the row may be 52 days, — a multiple of 13, — exactly the sum of the black numbers between the two red **1**'s. It would seem as if each of the black numbers might express the distance between certain days, since their total expresses the distance between the first and last red numbers, and between the first and second days of the column. Let us try this. Counting forward 17 days from **1 Chuen**, we should reach the day **Lamat**, which is not given here. In order to find the number attached to **Lamat** (17 days from **1 Chuen**), we start from the **1** of **1 Chuen** and count through 13, which will exhaust 12 of the 17 days which we have to pass in order to reach **Lamat**. Beginning with **1** once more, we count forward the remainder (17 minus 12), which will be 5, and this is the number which would be attached to **Lamat**. We actually find ═══ as the next red number. Counting forward from 5, the amount of the next black number, 19, we exhaust the 13 and have 11 left over on the next 13, and we find $\overset{\circ}{\equiv}$ as the third red number. **6** is the third black number, which by the same method brings us to **4** as the fourth red number, and 10 more brings us to **1**, and we find oooo and o as the fourth and fifth red numbers. The intermediate days would be **Lamat**, **Manik**, and **Ben**; but these are not given, — and for a very good reason, as will be shown hereafter. The full statement of the days found would be as follows: Starting with **1 Chuen** we get in succession **5 Lamat**, **11 Manik**, **4 Ben** and **1 Akbal**, the last one being the second day in the column. The numbers in the horizontal row can now be used again, and counting from **1 Akbal**, the second day, we read **5 Ahau**, **11 Cauac**, **4 Chicchan** and **1 Men**, the last mentioned being the third day in the column. Proceeding in the same way and counting from the other days of the column in succession, we should have the following set of days:

	+ 17		+ 19		+ 6		+ 10	
(1 **Chuen**		**5 Lamat**		**11 Manik**		**4 Ben**		**1 Akbal**
Akbal		**Ahau**		**Cauac**		**Chicchan**		**Men**
Men		**Eb**		**Chuen**		**Caban**		**Manik**
Manik		**Kan**		**Akbal**		**Muluc**		**Cauac**
Cauac		**Cib**		**Men**		**Ymix**		**Chuen**

In other words, twenty days are selected out of the 260, the last column being the same as the first in an advanced order, and it is very evident why no day sign was given with the red numbers **5**, **11**, **4**, and **1**, since each of these numbers was to apply not to one day but to five.

A strong proof that this is correct reasoning is afforded by Dr. 33c, etc. A series of days with the distance of 117 days ends on Dr. 33c and a new series begins, but with no day column. The black numbers are given in a horizontal row, and as in the absence of a day column there is but one day to be designated by each red number of this row, both the day signs and the red numbers are set down. Thus counting forward the amount of any black number (in the whole series of Dr. 33c–39c) from the next preceding day, we reach the next following day. Thus on Dr. 34c we find the black number = following **1 Ahau**. Counting forward 10 from **1 Ahau** we reach **11 Oc**, which is the next following day. Then comes a black ≡, and counting forward fifteen days from **11 Oc** we reach **13 Chicchan**, which is given. In this case the black distance numbers and the red day numbers are given, and the day signs are added to the latter, apparently because but one day is assigned to each red number. Similar results will follow in almost all the cases where we find a day column followed by a horizontal row of numbers.

Sometimes we find two of the days misplaced in a day column, but it is not often, and it is most unusual to find a wrong day interpolated in a series. Also in some cases the sum of the black numbers does not add up the exact sum needed to represent the distance from the first to the last red number, and consequently from one day of the column to the next. This distance is usually

26, 52, or 65.[1] On Dr. 29c the black number  is given four times, making 64 in all, when the distance between the days of the column is 65. These differences almost never exceed one day and are not very frequent. Whether they should be ascribed to error or have a meaning which we do not know, they are not numerous enough to upset the rule which we have laid down.

Other distances than 26, 52, or 65 are found. For instance, on Dr. 30c–33c the black numbers add up 117, which is the distance between **11 Ahau** and **11 Caban**, **11 Caban** and **11 Ix**, and so on through the whole twenty days of the four columns. This would indicate a total space of time of $20 \times 117 = 2340 = 9 \times 260$ days. On Dr. 38b–41b the black numbers add up 104, and as there are five days and five intervals in the day column, the total number of days shown is $5 \times 104 = 520 = 2 \times 260$. In both these cases the sums are multiples of 260.

The horizontal row on Dr. 32a–39a, where the black numbers add up 208 or 209, is as yet unexplained.

We may therefore consider that another step has been gained in our path, namely, that the horizontal rows of red and black numbers designate certain days in the space of 260 days or of a multiple thereof, that the days have numbers attached to them as shown by the red numerals, and that the distance in days of one day to the next succeeding day is denoted by the black numerals, — the names of the days to be obtained by calculation, except in the few instances where there is no day column and where, therefore, the day signs are given.

It is to be noticed that the reading of all the day and number series has been from left to right and from top to bottom, the series in all cases counting forward by addition. It is true that the same result would be obtained by reading from right to left and counting from bottom to top, the series in such case counting backwards by subtraction. But the former plan is undoubtedly the correct

[1] Though these columns represent the period of 260 days, it can be noted that seven of the 52-day periods or fourteen of the 26-day periods equal 364 days, — one day less than the solar year; while nine of the 65-day periods equal 585 days, one day more than the synodical revolution of Venus. It is doubtful, however, whether these are anything more than coincidences.

one, since in the case of the vertical columns of days which are followed by a horizontal row of black and red numbers any other course would not give any day to start with. Moreover, the starting point of the two series of Tro-Cor. on the left-hand upper corner of the series is **1 Ymix**, which Landa has told us is the beginning day of the Maya calendar. More than this, a forward count is much more natural than a backward one,—addition rather than subtraction,—unless there appears to be good reason for the latter.

But we sometimes find columns instead of horizontal rows of numbers, as in Dr. 8c. Here the day column is **3 Cib, 3 Lamat, 3 Ahau, 3 Eb, 3 Kan,** and the red and black numbers are written thus:

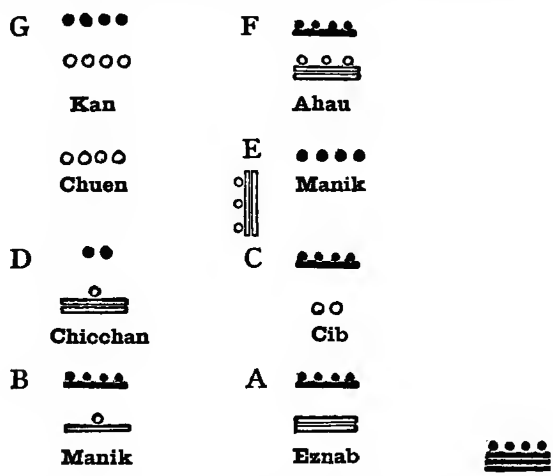
The black numbers add up as follows: 9 + 9 + 9 + 9 + 9 + 7 = 52, which is the distance between the days in the day column, and are to be read from top downward, first taking a number on the left and then one on the right, or as given in the figure,—A, B, C, D, E, F.

The days reached are as follows:

	+ 9	+ 9	+ 9	+ 9	+ 9	+ 7
3 Cib	**12 Chicchan**	**8 Ix**	**4 Akbal**	**13 Eb**	**9 Ymix**	**3 Lamat**
Lamat	**Caban**	**Cimi**	**Men**	**Kan**	**Ben**	**Ahau**
Ahau	**Muluc**	**Eznab**	**Manik**	**Cib**	**Chicchan**	**Eb**
Eb	**Ymix**	**Oc**	**Cauac**	**Lamat**	**Caban**	**Kan**
Kan	**Ben**	**Ik**	**Chuen**	**Ahau**	**Muluc**	**Cib**

Apparently the only advantage that this arrangement has over the horizontal row is the saving of space, and against this is the loss of space for the hieroglyphs.

As we found in Dr. 33c a horizontal row where both the day signs and red numbers were given, with intermediate black numbers (there being no day column), so Dr. 32b shows a similar case, with columns of numbers instead of a horizontal row. Dr. 32b is really a part of a series beginning with 31b, but as 31b is not complete we will begin with 32b. The columns run thus:



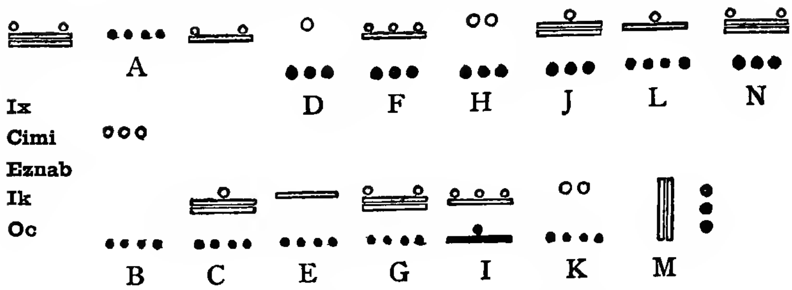
The black numbers add up as follows: 9 + 9 + 9 + 2 + 4 + 9 + 4 + 19 = 65 (the 19 and the **Akbal** being found on 33b in the lower part of the picture), or as shown in the figure, A, B, C, D, E, F, G. The **Akbal** on 33b has attached to it instead of . This is with but little doubt an error. 10 is needed in order to reach the following red **6** by the addition of a black 9.

The whole series will then run thus:

10 Eznab + 9 = **6 Manik** + 9 = **2 Cib** + 9 = **11 Chicchan** + **2** = **13 Manik** + 4 = **4 Chuen** + 9 = **13 Ahau** + 4 = **4 Kan** + 19 = **10 Akbal.**

The series includes the four sets of columns on Dr. 31b–34b, each containing 65 days, or 260 days in all, — the 19 on 31b being omitted unless it is to be faintly seen above the staff of the figure.

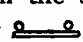
On Dr. 4b–5b the red and black numbers run in two horizontal rows above and below the dragon figure thus:

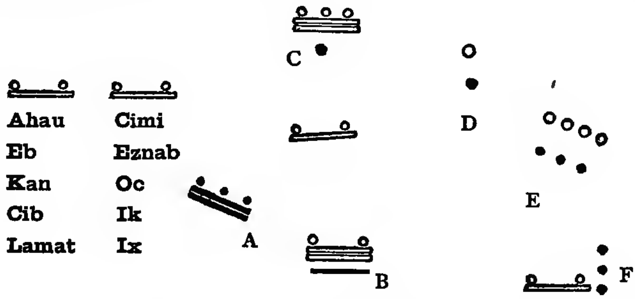


This is one of the few cases where it would seem that a correction would have to be made, or else there is a deeper meaning than appears on the surface. The day column runs thus:

12 Ix
Cimi
Eznab
Ik
Oc

The regular order of a day column which begins with **Ix** is **Ix**, **Cimi**, **Eznab**, **Oc**, **Ik**, but here **Oc** and **Ik** change places. Here, too, is a discrepancy in the numbers, for the black numbers add up $4+4+4+3+4+3+4+3+6+3+4+4+3+3=52$, but after adding  (L) we reach **6 Ahau**. Then adding  (M) we reach **9 Akbal**, but the red number is . It would seem as if this number should be , for **9** is needed when we add the black  (N) in order to reach the last red number , which is the number needed for **12 Cimi**, the second day of the day column. If the black number M were 4, the red **10** would be correct; but in that case the black number N would have to be 2 instead of 3 in order to bring the final red number **12**.

Often the numbers are scattered about the page, especially in the Tro-Cortesianus. Here on 49b we have a double column which is to be read by beginning at the top of the first column, reading then the top of the second column, then the second day of the first column, and so on. The red number  is given over each column, and the distance of one day to the next is 26. The black numbers are 13 + 5 + 1 + 1 + 3 + 3 = 26. We thus have the series: **7 Ahau** + 13 = **7 Ben** + 5 = **12 Eznab** + 1 = **13 Cauac** + 1 = **1 Ahau** + 3 = **4 Akbal** + 3 = **7 Cimi**, which is the first day on the second column. The numbers are scattered round the page somewhat thus:



We find, therefore, that whether the black and red numbers appear in rows, columns, or scattered over the page, —

First. That the sum of the black numbers gives the distance from one day to the next in the day column and from the last day to the first day in the column, except in a few cases.

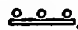
Second. That each black number gives the distance from a preceding red number which represents a day to the following red number which also represents a day.

Third. That these days are given in cases where there are no day columns, and are found by calculation where there is a day column and where consequently the red number is to be assigned to more than one day.

Fourth. That where a day column is given, the sum of the black numbers is as a rule such a number that, multiplied by the number of separate days in the column (or, what comes to the same thing, the number of intervals, including the interval between the last and the first day), the number 260 or a multiple thereof is produced.

On page 28 I have called attention to Dr. 65–69. Here are horizontal rows of black and red numbers, and though no day is given from which to begin the count (though **3 Chicchan** and **13 Akbal** are probably the days referred to), the sequence of the red and black numbers follows as in the other rows. Thus in the lowest row of Dr. 65 the first red number is . Add the following black number and we exhaust the 13 and have 1 left over, and the second red number is o. And so on with the rest. This case thus confirms our rules as laid down above.

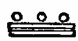
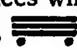
Sign for Twenty. — With this solid basis to rest on we can now prove the meaning of a form which we often find in connection with the black numbers, which is neither a line nor a dot, which from its position seems to have a numerical value and which is not referred to by any of the earlier writers.

One of the simplest cases where this form appears is on Dr. 8b, where the red number over the column is . Then follows this black sign  , followed by a red ; by this other black sign , and by a final red . The distance between the days of the column is 52, and as the black numbers the sum of which equals this distance are but two (each in two parts) and are alike, each must mean 26, and since in each case the 6 is of the usual form, and since, as far as we know, the parts which form a number are added together[1] to make up the total, the black  would naturally mean 20. A trial will prove this to be the case, for treating this series as we have treated the others we find that we obtain the following result:

	+ 26		+ 26	
8 Manik		**8 Ben**		**8 Cauac**
Cauac		**Chicchan**		**Chuen**
Chuen		**Caban**		**Akbal**
Akbal		**Muluc**		**Men**
Men		**Ymix**		**Manik**

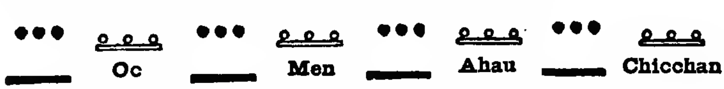
[1] The two parts cannot be factors of 26, for 6 does not go into 26 without a remainder.

This new sign may then be considered as meaning 20, and this meaning will be found to agree with other computations where this sign appears. Plate XVIII shows variants of this sign.

Numeration by Position.—A further use of this line and dot system was made by the Mayas. Leaving the red numbers for a while, we will now take the black numbers into consideration. Thus far addition has been the only means of calculation. Four dots were placed together to mean 4; one line meaning 5 and two dots meaning 2 were added together to mean 7; three lines and four dots added together meant 19, and one twenty-form, one line and one dot were added together to mean 26. In this addition the number forms might hold any position towards each other. Thus on Tro-Cor. 40a four is made thus: ; on Dr. 8b, 26 in one case has the 6 over the twenty-form, and in the other case it has it on one side; 13 may be written  as in Dr. 31a, or  as on Dr. 8c, and there are a few places where the dots are placed below the lines, as in Tro-Cor. 23d, . In all these cases, especially with the lines and dots, there is a close propinquity of the parts which make up the numbers.

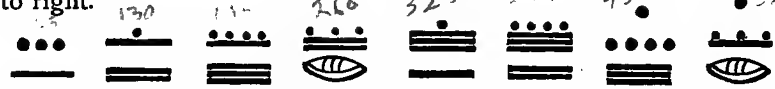
But there are numbers in which the parts do not lie thus close together. Our experience with the black numbers is that they marked distances from one day to another. Thus on Dr. 33c–39c each black number marked the distance from the day preceding the black number to the day following.

On Dr. 30b–31b we find the following series:



At first sight we should say that we had four black 8's marking the distances between 8 Chicchan, 8 Oc, 8 Men, 8 Ahau, and 8 Chicchan again. But on making the trial we find that 8 Oc + 8 = 3 Eznab and not 8 Men, while 8 Men + 8 = 3 Akbal and not 8 Ahau: and so with the other two dates. This method will not work. What next? A reference to Table II shows that the distance from **8 Oc** to **8 Men** is 65 days, and from what we have found on Dr. 33c–39c and elsewhere we should infer that the black ••• would signify this distance 65. Looking at the number carefully, we see that the black dots are very much farther from the black line than are the parts of the red numbers. It is possible that this has some definite meaning. As the days are 65 days apart (see Table II), and as the lower black line by itself means 5, what is left should mean 65 — 5, or 60. As there are three dots in the upper part of the number, this would give to each dot the meaning of 20. If this holds good elsewhere, the inference would be that a numeral, placed so far above the lower one as to prevent its being considered a part of the lower one, has a different value, and that, when there are two numerals, one above the other, the one occupying the lower place has the meaning of so many units, the one occupying the upper place has the meaning of so many twenties, and that the whole number is the sum of these two. This certainly seems a valid theory in the present case. Let us see how it works in other places.

On Dr. 71–73 in the "b" and "c" divisions are a series of numbers running thus, beginning on the right of 73b. I have reversed the order to conform to our custom of reading from left to right.



4 Caban **4 Ik** **4 Manik** **4 Eb** **4 Caban** **4 Ik** **4 Manik** **4 Eb**

In the first number given here we find the identical number found in Dr. 30b to which we have given the value of 65. Between the different days on Dr. 72b–73b we find that the same distance prevails. **4 Ik** is 65 days from **4 Caban**, **4 Manik** is 65 days from **4 Ik**, and so on through twenty-eight day terms moving to the left through 73b, 72b, 71b, 73c, 72c, 71c, and ending with 5.1.0., **4 Eb**.[1] This being so, and since the numbers on Dr. 30b gave

[1] In writing out the Maya system of numeration in Arabic numerals, the unit will be written in the first place on the right, the next higher Maya term will be the next Arabic numeral on the left, and so on, the numerals representing the different terms being separated by periods.

the distance from one day to another, we should expect that the numbers here would show the difference from one day to another as well. But the second term, , cannot mean 65 if the first one, , means 65. In fact, if , the lower number, means units and the upper number, , means twenties, the second term will mean 6 × 20 + 10 × 1 = 130. But 130 is twice 65. Can it be that this is a sort of multiplication table, each number giving the distance of the day set down under it from some past day? If so, **4 Caban** is 65 days from **4 Eb**, and **4 Ik** is 130 days from the same **4 Eb**. This seems to work satisfactorily. The third term is , which would mean, if calculated like the others, 9 × 20 = 180 + 15 × 1 = 15, or 195 in all. Now 195 is three times 65. This is the distance from **4 Eb** to **4 Manik**, which is found below. In other words, we have a table of 1 × 65, 2 × 65, 3 × 65, as can be seen by actually multiplying the terms. Twice the 3 of the first term gives the 6 of the second, and twice the 5 gives 10; while three times these numbers gives the 9 and 15 which we find in the twenty and unit places of the third term. If this is the case, the fourth term should be 4 × 65, or 260, which is equal to 13 × 20, and here sure enough we find 13 in the twenty place of the fourth term and we find under the number **4 Eb**, as the day which is just 260 days from the **4 Eb** from which we have made our other calculations. Let us try what multiplying the first term by 4 will bring. Four times 5 (the unit) equals 20 units and four times 3 (in the twenty place) makes 12 twenties. But 20 units equals one of the twenties, and so we can eliminate all units and add one to the twenties. Adding 1 to the 12 twenties which we already have gives us 13 twenties as is given in the codex. This would then tend to prove that the curious red figure  means zero. This meaning is sustained by all other places in the codices where it is found and where the calculation is clear.

The fifth term would be naturally 5 × 65, or 325, which counted from **4 Eb** would bring us to **4 Caban**, the day actually found here, while the 16 twenties and 5 units also found here equal 325. Or by multiplying  by 5 in our own manner, we should say, "Five times 5 units is 25 units, put down the 5 and carry the 1 to the twenties; five times 3 is 15 and 1 added makes 16." The answer is  as given.

So far we have worked out our problem unaided; but Landa will sanction our method, for he tells us that the Mayas counted by fives up to 20, by twenties up to 100, by hundreds up to 400, and by four hundreds up to 8000.[1]

This can surely mean nothing else than that when in their count by the use of fives they reached 20, they began to count by twenties, and when they reached 100 (i. e., five of the new count of twenty) they used that form until they reached 20 twenties, or 400, when they began with 400 as a third step. This statement is carried out to a certain extent by the series which we are discussing, for in no case do we find any number denoting units or the higher places carried higher than 19; that is, three lines and four dots.

It might be a question whether the upper row might not represent the units and the lower row the twenties. In this case the first term would consist of 5 twenties and 3 units, or 103, while the second term would consist of 10 twenties and 6 units, or 206. But **4 Caban** is 103 days from **5 Ix**, while **4 Ik** is 206 days from **6 Cib**. By this method there would be no common starting point, and neither would any day be distant from the next preceding day by the number denoted by the black numbers, as, for instance, in Dr. 30b–31b. Moreover, while the first, second and third terms in Dr. 71–73 would be in sequence, namely, 103, 206, 309, the fifth term would be 116. Such irregularity would lead us to choose the former method as the correct one. For by the former method we have a series of 65, 130, 195, 260, 325, while the sixth term would be 6 ×

[1] "Que su cuenta es de V en V hasta XX, de XX en XX hasta C y de C en C hasta 400, y de CCCC en CCCC hasta VIII mil. Y desta cuenta se servian mucho para la contratacion de caçao." (Landa, 1864, p. 134.)

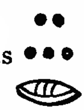
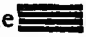
"Ya e dicho que el modo de contar de los indios es de cinco en cinco y de cuatros cincos hazen veinte." (Ibid. p. 206.)

65 = 390, and the number given is 19 twenties and 10 units, or 390 days, which is the distance from **4 Eb** to **4 Manik**, the day found below.

Considering that it is settled that 20 of the first place equal one of the second, we go on without any trouble to the seventh term, which should be 7 × 65 = 455. But here we find a third place, which is occupied by a ●. If we follow Landa this place would represent 400, and we should have a number equal to the sum of its three constituent parts, namely, 1 × 400 + 4 × 20 + 15 × 1. This equals 495 instead of 455. This is the first time that the codex is in antagonism with Landa. Let us see what, by process of subtraction, this third place must represent. The number should be, from the position which it holds, 7 × 65 = 455
The lowest place is filled with ≡, which equals 15 × 1 or 15
Deduct this from 455 and we have 440
The second place is filled with ●●●●, which equals 4 × 20 or 80
Deduct this and we have 360
for the ● in the third place. But this is only 18 × 20 instead of 20 × 20. Referring again to Landa we note that he says that this count (speaking of the 400 count) is used in transacting the trade in cacao. It may be that in the count of days or of time the Mayas used 18 of the second place, and not 20, to make one of the third place. This may be supported by the fact that such a method would bring the units of the third place to be very nearly equal in number to the number of days in a year. Moreover, Landa tells us that they made use of months of 20 days each, and that the year (*el año entero*) was made up of 18 of these months, with 5 days and 6 hours added.[1] What more natural than in counting time they should use a method by which 18 of the second place should equal 1 of the third place? At all events, it is found that throughout the codices and inscriptions this method holds good, and the cases are so very numerous that there is no doubt about its correctness. The sixth term of this series is ●●●● ≡, and might seem to contradict this method, for it might well

[1] Page 13.

be objected that if 18 of the second place were equal to 1 of the third place, this sixth term should have been . The only answer is that, while we cannot tell decisively why this was done, we do the same thing ourselves. It is not uncommon for us to speak of twelve hundred instead of one thousand two hundred, and in speaking of the year of grace we almost always say "nineteen hundred and nine" instead of "one thousand, nine hundred and nine." So the Mayas may have occasionally written (for it is but seldom that this is seen) "nineteen twenties" instead of "one three hundred and sixty, and one twenty."

Following up the series until we reach the eleventh term we find there this number, , or $1 \times 360 + 17 \times 20 + 15 \times 1 = 715 = 11 \times 65$. By adding the regular difference or  to this we ought to get 780, or 12×65, for the twelfth term. If we make the addition in our own method we should say, "15 and 5 make 20, put down zero and carry 1; 17 and 3 are 20, and 1 is 21; deduct the 18, put down the 3 and carry 1, which, added to the 1 of the third place, makes 2." This gives us , which we actually find in the twelfth term. Finally, in the twenty-eighth term we should expect to find $28 \times 65 = 1820$, and in the twenty-eighth term we do find on 71c , which, read in the usual way, gives us $5 \times 360 + 1 \times 20 + 0 \times 1 = 1820$. And as $1820 = 7 \times 260$, and as each 260 brings us back to a day of the same name and number as the one counted from, we should expect to find **4 Eb** here also. This is what we do find; and, moreover, this **4 Eb** is 65 days from **4 Manik**, the next preceding day. Here the difference between the terms changes, for a mere glance at the twenty-ninth and thirtieth terms shows them to be twice and three times the twenty-eighth term respectively, namely,  and , or 2 × 1820 and 3 × 1820, with the day 4 Eb, as we should expect, since each of these numbers is a multiple of 260. The thirty-first term would naturally be 4 × 1820 = 7280, which, being four times , might be written thus: , multiplying each of the numbers in the first, second and third places by 4. But if the vigesimal method is used, the  of the third place would probably be written as 1 of a higher place, and the whole number might be written thus, . But for some reason this term is omitted and twice the expected term, or , equal to 2 × 7280, or 14,560, is found as the thirty-first term. The next term, however (the thirty-second), is , or three times 7280, and it is distant , or 7280 from the thirty-first term. In other words, though 1.0.4.0., or 7280, does not appear as one of the numbers given, it is used as a difference between the numbers which are given. The above demonstration proves the correctness of our calculation. Moreover, since the thirty-first term is , and since we know the value of the three lowest places to be 0 × 360 + 8 × 20 + 0 × 1 = 160, and since the value of the whole number is probably 14,560, the value of the fourth place will be 14,560 − 160 = 14,400, and as the fourth place has the number 2, or two dots, each dot will equal one-half of 14,400, or 7200, which is twenty times the value of a dot in the third place.

Again, turning to Dr. 24, at the lowest right-hand corner we find , which we now know means $8 \times 360 + 2 \times 20 + 0 \times 1 = 2920$, with the day **9 Ahau.** The day from which this 2920 is counted in order to reach **9 Ahau** is **1 Ahau.** The second term is , or twice the first, as can be seen by multiplying the numbers in the three places, and the day is **4 Ahau**, just $2 \times 2920 = 5840$ days from **1 Ahau.** The third term would naturally be three times the first, or 8760. We find here . If this means, as we should suspect from what we have already found, $1 \times 7200 + 4 \times 360 + 6 \times 20 + 0 \times 0$, it is exactly 8760, and this number of days brings us to **12 Ahau**, which we find just below, if counted from **1 Ahau** as we have done before.

We can then make this rule for the Maya method of calculating time, namely:

20 of 1st	place (**Kin**)	= 1 of the 2d	place (**Uinal**)	=	20 days	
18 of 2d	" (**Uinal**)	= 1 of the 3d	" (**Tun**)	=	360 "	
20 of 3d	" (**Tun**)	= 1 of the 4th	" (**Katun**)	=	7200 "	[1]

This method of calculation by the addition of the products obtained by multiplying the value given to each term according to its position, by the number given in that position, is similar to our own method of Arabic notation. The Arabic system marks the increase of values of the successive terms of a number by the position of each digit from right to left, — units on the right, followed towards the left by tens, hundreds, etc. Any number so formed

[1] For the evidence of the propriety of using these Maya names for these periods of time see Appendix III.

can be regarded as the sum of the products of the number representing each of the decimal places by the number found in that place. Thus the number 3951 is formed by the addition of 3 × 1000 + 9 × 100 + 5 × 10 + 1 × 1.

It will be seen that the order in which the series which we have been considering is read is from right to left, the opposite of that which we have found in the day series which were discussed in the early part of this chapter. We do not know the reason for this change of order, though here, as in the previous cases, the order is always forward and not backward. The order is, moreover, the same as in our Arabic system of notation, as distinguished from the order in which we read words. Thus the Mayas had reached a point in their calculations analogous to that reached by us, that is, they gave a different value to their numbers according to their position; but whereas in the Arabic notation the value of a figure increases from right to left by tens, in the Maya notation it increases from bottom to top by twenties, except in rising from the second to the third place.

The numerical values are not, however, always marked merely by position, for there are glyphs which specifically mean the numbers 1, 20, 360, and 7200, and possibly other values, as will be seen later in discussing the forms found on the inscriptions. Dresden 61 and 69 show several of these numerical glyphs.[1]

Unfortunately the terms of these series which we have been discussing, which contain the fifth place, are so injured that the same kind of proof which we have heretofore made use of cannot be used beyond the fourth place; but we may anticipate the proof which will be produced later by saying that in the codices, at least, twenty of the fourth place equal one of the fifth, and twenty of the fifth equal one of the sixth, though there is good reason to believe that in the stone inscriptions thirteen of the fifth place equal one of the sixth. But this proof can be made much more clear when we have examined the month signs and have become conversant with the reckoning of the Maya term of 52 years.

[1] See Plate XIV. KATUN, Nos. 7, 8. TUN, No. 5. UINAL, No. 4. KIN, Nos. 5, 6.

The red zero which we have already met frequently is replaced on Dr. 24 by a variant.[1] The first zero in the fifth term of the series is an example. This term would naturally be 5 × 2920 = 14,600, taking the Maya form in the codex of . To perform the multiplication we should say, "Five times zero units give no units; put down the zero; five times 2 twenties give 10 twenties; put down the 10; five times 8 three-hundred-and-sixties give 40; but this is the same as 2 of the fourth place, with none left of the third place; therefore put down zero in the third place and 2 in the fourth place, as shown in the codex." The day in the codex is 2 **Ahau**, which is 14,600 days from 1 **Ahau**, the starting point of the series. The curious red form in the tun place must therefore mean zero.

Other variants of the red zero are found in Dr. 54b, 63c and 64c,[2] the last two in a day and number series, with a difference of 91. This difference, which is also the first term, is written . The fourth term would be 4 × 91 = 364, and the eighth term would be 8 × 91 = 728. In performing the multiplication we should say "four times 11 units give 44, put down the 4 and carry the 2; four times 4 twenties give 16, add the 2 and we have 18; put down the zero in the twenty place and carry the 1 to the third place, since 18 of the second place equal 1 of the third place." In the same way the proof of the meaning of the zero form in the eighth term can be made.

The reason why this form of zero was used can only be a matter of conjecture. It may have been done in order to call attention to the passage of well-known periods of time, for the terms on Dr. 63c and 64c represent almost exactly one and two years respectively, — 364 and 728 days, — while the term which contains this form on Dr. 24 records exactly forty years of 365 days each.

[1] See Plate XVIII. ZERO, No. 40.

[2] See Plate XVIII. ZERO, Nos. 43, 41, and 42, respectively.

On the other hand, the term on Dr. 54b, where we find this ornamental form, records 8651 days, — a number which does not appear to have any significance.

Plate XVIII shows variants of this sign.[1]

The Long Numerical Series of the Codices. — Besides the long numerical series found on Dr. 24 and Dr. 71–73, there are eight other such series found in the Dresden codex. These series may have been multiplication tables, which could be used for division by the method of subtraction. The close connection between Dr. 24 and Dr. 46–50 would seem to show that Dr. 24 was used to determine how often eight solar revolutions or five synodical revolutions of Venus occurred in any given period of days.[2]

A complete list of these series as found in the codices (all, as far as known, being in the Dresden codex) is here given with a short explanation of each.

Dr. 24.	With a difference of	2,920.	Starting point	**1 Ahau.**
31a–32a.	"	91.	"	**13 Akbal.**
43b–44b.	"	78.	"	**3 Lamat.**
45a.	"	364.	"	**13 Oc.**
51a–52a.	"	11,960.	"	**12 Lamat**, etc.
59.	"	78.	"	**13 Muluc.**[3]
62–64.	"	91.	"	**13 Akbal**, etc.
71a–73a.	"	54.	"	**9 Ix.**
70a–71b, 73a.	"	702.	"	**9 Ix.**[4]
70c–73b.	"	65.	"	**4 Eb.**

[1] Goodman gives to this form the meaning of twenty, or a completed term, but in his calculations he treats it as zero. But this meaning of twenty is negatived completely in Dr. 46–50, where eight days are recorded in the red number at the bottom of the fourth column of each page by this notation . Here, as has been well shown by Cyrus Thomas, there is no question of the completion of a uinal. Only eight days are needed here, and the red  in the uinal place is apparently added for the sake of uniformity, since all the other red numbers at the bottom of each of the five pages consist of two places.

[2] See my pamphlet entitled "A Suggestive Maya Inscription," Cambridge, 1903, p. 16.

[3] **13 Muluc** is distant 101 days from **3 Lamat**, which begins the other series with a difference of 78 days, while **3 Lamat** is distant 159 days from **13 Muluc**.

[4] The two series starting from **9 Ix** are really one continuous series, though they are recorded in a different manner.

It will be well to take up each of these series in turn and to explain the method of their arrangement, without going into the discussion of the erasures and possible errors which occur, although in so doing we shall be obliged to anticipate the proof of the value of the numbers in the fifth place in the Maya numeration. This will be taken up in Chapter VI.

On Dr. 24 we find a series which starts from the day 1 Ahau (this day not appearing on the page),[1] and has a difference of 8.2.0., or 2920. This difference is used for thirteen terms, when probably 5.5.8.0., or 37,960, is reached. The latter number is probably used as a difference for three terms, when 1.1.1.14.0., or 151,840, is reached. This is equal to 52 times 2920, or 416 solar years of 365 days each.

On Dr. 31a–32a we find a series which has 13 Akbal as a starting point and has a difference of 4.11., or 91. This difference is used for twelve terms, when 3.0.12., or 1092, is reached. The difference then becomes 1.0.4., or 364 for two terms, reaching 5.1.0., or 1820, which is 20 times 91. The difference then becomes 5.1.0. (the number of the last term), for three terms, when 1.0.4.0., or 7280, is reached. This number equals 80 times 91. Though the erasures are frequent after this through the series, it is probable that this last term is used as a difference for three more terms, the series ending with 4.0.16.0., or 29,120, which equals 320 times 91.

On Dr. 43b–44b we have a series which starts from 3 Lamat, with a difference of 3.18., or 78. The series runs on with this difference for ten terms, when 2.3.0., or 780, is reached, this number, which is 3 times 260, being used for a difference for four more terms, when 10.15.0., or 3900, is reached. This number equals 5 times 780, or 15 times 260. Thereafter the series continues for eight more terms with various differences, all but one however being a multiple of 260, though several are not multiples of 780.

On Dr. 45a we find a series in which the starting point is 13 Oc and the difference is 1.0.4., or 364, though the first term is 2.0.8., or

[1] The date from which the series starts is never given. The first date which is given is, except in one case, distant from the date of the starting point by a number of days equal to the first number of the series.

twice 364. The difference 1.0.4. is used for three more terms till 5.1.0., or 5 × 364 = 1820, is reached. Then 5.1.0. is used as a difference for three terms till 1.0.4.0., or 20 × 364 = 7280, is reached, the last number being then probably used for three terms as a difference till 4.0.16.0., or 80 × 364 = 29,120, is recorded. The other numbers are not clear enough to be deciphered with any certainty.

On Dr. 51a–52a we find a short series of large numbers which run as follows, the starting points being the five days, **12 Lamat, 1 Akbal, 3 Eznab, 5 Ben** and **7 Lamat**:

1st term	1.18. 5.0.	or			11,960 plus 1820
2d "	3. 6. 8.0.	or	2	times	11,960
3d "	4.19.12.0.	or	3	"	11,960
4th "	6.12.16.0.	or	4	"	11,960
5th "	8. 6. 2.0.	or	5	"	11,960
6th "	9.19.12.0.	or	6	"	11,960 plus 120

The following run up into the cycle place, but they are given here in order to complete the table:

7th term	1. 6.11.10.0.	or	16	times	11,960
8th "	1. 8. 4.14.0.	or	17	"	11,960
9th "	1. 9.18. 0.0.	or	18	"	11,960
10th "	2.11.10.11.0.	or	31	"	11,960 plus 260
11th "	3. 4.15.12.0.	or	39	"	11,960

The series shows some irregularity which further study may explain, but the continual reappearance of the difference of 1.13.4.0., or 11,960, is very striking.

On Dr. 59 we find a series occupying the whole page, of which the starting point is **13 Muluc**. It begins with the difference 3.18., or 78, and runs along fo[illegible]ten terms with this difference till 2.3.0., or 780, is reached, when the latter number is used as a difference for eighteen terms (with one exception) when 2.1.3.0., or 14,820, is reached. This number is equal to 190 times 78 or 19 times 780, and is used in its turn (with one exception where twice this number is used) for seven more terms when 18.10.9.0., or 133,380, is reached. This number equals 1710 times 78, or 171 times 780, or 9 times 14,820. Three other terms follow with various intervals, but the numbers are too much erased to make it possible to decide definitely upon their meaning. Indeed all the numbers above 6.3.9.0., or 44,460, are not to be considered as certainly deciphered.

Another series of days, starting from **9 Ik** is found interposed in the middle of the page, with the same difference of 78. This difference was also found in the series on Dr. 43b–44b.

On Dr. 63–64 we find a series with the difference of 4.11., or 91 (as on Dr. 31a–32a), and with the same starting point, **13 Akbal**. This difference is used for twenty terms when 5.1.0., or 1820, is reached. Then this latter number becomes the difference for three terms, when 1.0.4.0., or 7280, is reached. This number equals 80 times 91, and is used in turn as the difference for four terms, when probably 5.1.2.0., or 36,400, is reached. This is equal to 400 times 91, and it is probable that this number constitutes the difference for three more terms, when finally 1.0.4.8.0., or 145,600, is reached. This number equals 1600 times 91, or 80 times 1820, or 20 times 7280, or 4 times 36,400.

On Dr. 71a–73a and c, we find a series with a difference of 2.14., or 54, and with **9 Ix** as a starting point. The series runs along for thirteen terms with this difference, reaching 1.17.2., or 702. This series has the peculiarity that it runs from left to right and that no day signs are given except in the last term, their numbers, however (in black instead of red), being given, each number being enclosed in a red circle tied in a knot.

On Dr. 70–73 this series is continued, the number 702 being repeated on Dr. 71b, column 5, and continues with this difference for nine more terms, when 19.9.0., or 7020, is reached. This latter number is used as a difference for one term, when 1.19.0.0., or 14,040, is found on Dr. 73a. Then 14,040 is probably used as a difference for nine terms, reaching 19.10.0.0., or 140,400. It is possible that this large number is used as a difference for one term, reaching 1.19.0.0.0., or 280,800, and that this latter number is used as a difference for one term, reaching 3.18.0.0.0., or 561,600. This number equals 10,400 times 54, 800 times 702, 40 times 14,040, or 4 times 140,400.

On the same pages is a series with a difference of 3.5., or 65, and with **4 Eb** as a starting point. This difference is used for twenty-eight terms, when 5.1.0., or 1820, is reached. The latter number is then used as a difference for two terms, reaching 15.3.0., or 5460. This number equals 3 times 1820, and we should have expected to find next to it a term 1.0.4.0., or 7280, equal to 4 times 1820, since this number or its multiple is used as a difference for twelve terms more, but no such number appears. The twelfth term is 15.3.6.0., or 109,200, which equals 1680 times 65, or 60 times 1820, or 15 times 7280. Another term follows which may be 20 times 7280, but it is too doubtful to decide upon with certainty.

In many of these series the highest terms cannot be accurately decided upon, but it is clear that they are all calculated upon a similar plan. Starting with a day fixed, a number of days is counted forward with a difference given in the first term, until some higher number is reached, which in turn serves as a difference. This plan is continued in some cases till there are three or more differences used.

Red Numbers not belonging to Day Signs. — The red numbers are at times used where no day sign is attached or referred to, as far as can be seen, although the numbers may in many cases mark the distance from one day to another. Thus,

1. On Dresden 46c–50c it will be seen later that the red numbers are used for the same purpose as the black ones, namely, for counters.
2. Columns of red numbers are often used mingled with columns of black numbers, where it is probable that the two columns (black and red) are of the same character but that a distinction is meant to be marked between the two columns, and, there being no space to place the two columns side by side, color afforded an easy means of distinguishing them. See Dr. 51a, 52a, 63, etc.
3. On Tro-Cort. 77–78 (the so-called title-page) the meaning of many of the red numbers is uncertain.

In these cases the red numbers run up as high as 19, that is, they may consist of three lines and four dots.

The red numbers at the bottom of Dr. 46c–50c, which apparently do not designate days, but are used as counters like the black numbers and show the distance from one day to another, occupy two places in numeration, — those of units and tens.

On these pages, in the upper parts, are columns of day signs (all the days in each column being the same with some variation in form), with different red numbers attached. From the appearance of Dr. 48 and 49 it would seem as if there were 13 days in each column, though there is room for an additional row at the top, but what is left of the glyphs seem to show that this was not a row of day signs.

Many of the day signs are partly or wholly erased, but the red numbers attached to the days of column 4 Dr. 50 are perhaps as plain as any. Supposing that there are thirteen rows, these numbers read from the top downward thus: ?, ?, 12, 7, 2, 10, 5, 13, 8, 3, 11, 6, 1. These numbers differ from each other by 8; that is, $12 + 8 = 20$, which after subtracting 13 gives 7, the next number. So $7 + 8 = 15$, which after subtracting 13 leaves 2, the next number. And so on with the others. If the upper two numbers are filled in on the same plan they would be 9, 4. The numbers in the other columns hold the same relation to each other as far as can be seen, and from these we can safely decide that the columns of days run as in Table III (page 53).

In the centre of Dr. 46–50 there runs a series of black numbers as follows: 11. 16.; 16. 6.; 1. 10. 16.; 1. 11. 4.; 2. 5. 0.; 2. 9. 10.; 3. 4. 0.; 3. 4. 8.; 3. 16. 4.; 4. 2. 14.; 4. 15. 4.; 4. 15. 12.; 5. 9. 8.; 5. 13. 18.; 6. 8. 8.; 6. 8. 16.; 7. 2. 12.; 7. 7. 2.; 8. 1. 12.; 8. 2. 0.; or in our notation,— on page 46, 236, 326, 576, 584; on page 47, 820, 910, 1160, 1168; on page 48, 1404, 1494, 1744, 1752; on page 49, 1988, 2078, 2328, 2336; on page 50, 2572, 2662, 2912, 2920.

The fact that 2920 equal 8 years of 365 days each would tend to show that these pages refer to a continuous period of time.

It will be seen that, starting from zero on page 46, the numbers on each page are distant from the next preceding number by the following numbers: 236, 90, 250 and 8, the sum of which is 584. On looking at the bottom of Dr. 49 and 50 we see these very numbers set forth in red as follows: 11. 16.; 4. 10.; 12. 10.; 8., while the numbers in a similar place on the other three pages show clearly that these numbers have been written on each of

TABLE III

Dr. 48				Dr. 47				Dr. 48				Dr. 49				Dr. 50			
Cib;	Cimi;	Cib;	Kan.	Ahau;	Oc;	Ahau;	Lam.	Kan;	Ix;	Kan;	Eb.	Lam.;	Ezn.;	Lam.;	Cib.	Eb;	Ik;	Eb;	Ahau.
3	2	5	13	2	1	4	12	1	13	3	11	13	12	2	10	12	11	1	9
11	10	13	8	10	9	12	7	9	8	11	6	8	7	10	5	7	6	9	4
6	5	8	3	5	4	7	2	4	3	6	1	3	2	5	13	2	1	4	12
1	13	3	11	13	12	2	10	12	11	1	9	11	10	13	8	10	9	12	7
9	8	11	6	8	7	10	5	7	6	9	4	6	5	8	3	5	4	7	2
4	3	6	1	3	2	5	13	2	1	4	12	1	13	3	11	13	12	2	10
12	11	1	9	11	10	13	8	10	9	12	7	9	8	11	6	8	7	10	5
7	6	9	4	6	5	8	3	5	4	7	2	4	3	6	1	3	2	5	13
2	1	4	12	1	13	3	11	13	12	2	10	12	11	1	9	11	10	13	8
10	9	12	7	9	8	11	6	8	7	10	5	7	6	9	4	6	5	8	3
5	4	7	2	4	3	6	1	3	2	5	13	2	1	4	12	1	13	3	11
13	12	2	10	12	11	1	9	11	10	13	8	10	9	12	7	9	8	11	6
8	7	10	5	7	6	9	4	6	5	8	3	5	4	7	2	4	3	6	1

It is to be noted that, beginning with **Kan**, every second day of the twenty days appears in Table III.

In using this table, the day over each column is to be used with each of the numbers in the column. The calculation runs from left to right in horizontal rows and from top to bottom.

these pages also. In other words, the first black number on Dr. 46 is the same as the first red number on that page, or is the sum of the addition of zero and of that number, while each of the other black numbers is the sum of the next preceding black number and the red number which stands immediately below the black number which represents the sum of the two.

If now we select the lowest row of day signs on Dr. 49–50, this row being the clearest, we find by Table II that **4 Eb** in the first column of page 50 is 236 days from **2 Cib** on the last column of page 49; that **3 Ik** is 90 days from **4 Eb**; that **6 Eb** is 250 days from **3 Ik** and that **1 Ahau** is 8 days from **6 Eb**. Wherever the numbers and days are clear in all these five pages, it will be seen that any day in the first column of any page is 236 days distant from the day in the same row of the last column of the preceding page; that any day in the second column of any page is 90 days distant from the day of the same row in the first column; that any day in the third column of any page is 250 days distant from the day of the same row in the second column, and that any day in the fourth column of any page is 8 days distant from the day in the same row in the third column of that page.

From the fact that this is found to be the rule in all the cases where the days and numbers are clear, it may be safely assumed that it is true in all cases, for the cases where the glyphs are clear are very many. If this is the case, it is also clear that any day in any column of any page is $236 + 90 + 250 + 8 = 584$ days distant from the day of the same row of the same column of the next preceding page. It is unfortunate that Dr. 46 is so injured, but there is little doubt that the same rule can be applied to this page as to the other pages. Take the third day from the bottom of the fourth column of Dr. 46, which is clearly **2 Kan**. Count forward from **2 Kan**, 584 days (or what is the same thing as far as the days and numbers is concerned, 584 less twice 260, namely, 64), and we reach **1 Lamat**, which we find on a similar place on Dr. 47. Again counting forward 584 or 64 days we reach **13 Eb**, which we find on a similar place on Dr. 48; and proceeding in the same way farther still, we find **12 Cib** on Dr. 49

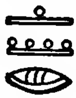
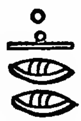
and **11 Ahau** on Dr. 50. Thus from **2 Kan** on Dr. 46 to **11 Ahau** on Dr. 50 is 4 × 584 = 2336 days. If Dr. 46 is made up on the same plan as 47–50, **2 Kan** in the fourth column is 90 + 250 + 8 = 348 days from the day standing third from the bottom of its first column. Counting back from **2 Kan** 348 days we should reach **5 Cib**, which is probably the day there given. If so, what is the point from which this day **5 Cib** is counted? We have seen that in all cases where the days and numbers are clear, that the first number in any row on a page is 236 days from the last day of the same row on the next preceding page. But there is no page of this series preceding Dr. 46. But let us count back from **5 Cib** 236 days and see what day we shall reach. Using Table II we find that by counting back 236 days from **5 Cib** we reach **3 Ahau**, which is the day in the fourth column of Dr. 50 in the row immediately above that in which **5 Cib** occurs. That is, from **3 Ahau** in the fourth row from the bottom in the fourth column of Dr. 50 to **5 Cib** in the third row from the bottom of the first row of Dr. 46 is 236 days, and from this **5 Cib** to **11 Ahau** of the same row of the fourth column of Dr. 50 is, as we have seen, the sum of 4 × 584 = 2336, and 250 + 90 + 8, or 2684 in all. Adding 2684 and 236 together we have 2920, the number found in black in the centre of the fourth column of Dr. 50. In this case 2920 should be the distance from **3 Ahau** to **11 Ahau**. Deducting all the 260's from 2920 leaves 60, and Table II shows that this is the distance from **3 Ahau** to **11 Ahau**. The same thing will be found to be true in all other similar cases where the days and numbers are clear enough to be made out; namely, that any day in any column is 2920 days from the next preceding day in the same column. This could only be true if the series of days ran over from the last day of the row running through the five pages to the first of the next following row. Although Dr. 46 is defaced, the fact that this result is such an orderly one would be very strong proof that the method is correct, even if the page, as far as it can be made out, did not give additional evidence. Now 2920 = 5 × 584 = 8 × 365. But 583.92 days is the length of the synodical revolution of the planet Venus, and 365.25 days is the length of the solar revolution of the earth.

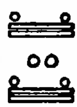
But there are thirteen rows of the day signs, and each row has been shown to cover 2920 days, or 8 years. The whole thirteen rows will then cover 13 × 2920 days, or 37,960 days, or 8 × 13 = 104 years of 365 days, or 65 synodical revolutions of Venus, from the starting point 236 days before **3 Cib**, the first day given.

But we may go a step farther to show to what an extent the Mayas carried their mathematical calculations. **1 Ahau** is seen to be the last day of the fourth column of Dr. 50. In our other series, both of the 260-day periods and in the longer series, as on Dr. 70–73 for instance, it is seen that the day counted from is the day reached as the consummation of the series. Thus the 65-day series on Dr. 73b is counted from **4 Eb**, and this is the day reached and constantly repeated at the end of the series. In Table II we found by calculation that the first day in the first column of Dr. 46 must be **3 Cib**. This, if the whole calculation is an orderly one, should be 236 days from the zero point of the calculation. Counting back 236 days from **3 Cib** we reach **1 Ahau**, the last day of the whole series as well as the zero point of the series, thus showing that the whole series returns into itself, as far as the day and number are concerned.

I have said[1] that red numbers appear in columns among the black numbers, with apparently the same meaning as the black numbers. Thus on Dr. 59, where the regular difference between the terms is , or 78, the fifth term is , or 5 × 78 = 390. The ninth term is , or 9 × 78 = 702, while the tenth term would naturally be a black , or 10 × 78 = 780. But the black number is really , just three times what we should expect, while the red numbers of  are inserted in the same

[1] Page 51.

column as the black numbers and interspersed among them. In the same way between the black numbers of the next term, the red numbers  are interspersed, and this is merely the repetition of the black numbers of the preceding term. In the seventeenth term ( = 780 having become the difference) we have  = 10 × 780 = 7800 in black, while in the eighteenth term we have in the same column not only the black  = 11 × 780 = 8580, but the red  = 12 × 780 = 9360, and the nineteenth term is  = 13 × 780 = 10,140 in black.

So in Dr. 71c the red numbers  and the black numbers  in the same column both probably require a zero beneath them. If this is supplied, the black number is 10 × 7280 = 72,800, while the red number is twelve times the same number, or 87,360, 7280 being the regular difference at this point of the calculation.

The results reached may be summed up as follows:

1. In the Maya system of numeration by lines and dots each dot equals 1 and each line equals 5.
2. The highest number used in this system in any term is 19, consisting of three lines and four dots.
3. The meaning of the twenty and zero forms have been settled.
4. Numbers of a red color, except zero, usually refer to days, being either attached to day forms, or referring to more than one day, when not so attached. In either case the number never rises above 13.
5. The black numbers are used to show the distance from one day to

another, and occasionally the red numbers are used in the same way. When so used the red numbers may rise to 19.

6. To express higher numbers the Mayas used the vigesimal system up to the katun and beyond, as will be explained later, except in the second term. Thus,

20 kins = 1 uinal.
18 uinals = 1 tun.
20 tuns = 1 katun.

This method of counting by katuns, tuns, uinals and kins (to which will be added later, cycles and possibly grand cycles) I shall hereafter call the "long count" in distinction from the year count, and the 52-year count, to the latter of which the name "calendar round" has been given.

CHAPTER IV

UINAL OR MONTH SIGNS IN THE CODICES

It will be shown in this chapter,

1. That Uinals or months of twenty days each were used by the Mayas.
2. That each month had its own name or sign.
3. That the combination of eighteen months and five additional days made up the Maya year.
4. That the days followed one another in a continuous series from one month to another, and that the months followed each other in the same way from one year to another, except that the five additional days followed the month **Cumhu**.

Names of the Maya Months. — As has been seen[1] Landa states that the Mayas not only had names and forms to designate their days, but they used months made up of twenty days each, and formed a kind of calendar from these months, making a year of eighteen months with five days and six hours in addition. Let us see what the early writers have to say in regard to these months.

In addition to the statements quoted on page 13, Landa states that the Mayas divided their twenty day characters into four sets of five days each, and used the first day of each set, as we use dominical letters, for the first days of their months, which consist of twenty days each,[2] and he then gives the four day signs, **Kan**, **Muluc**, **Ix** and **Cauac**,[3] these being the first days of the four sets.

[1] Page 13, note.

[2] "En estos sus carateres que son XX sacan los primeros de los quatro cincos de los XX y estos sirven cada uno dellos un año de lo que nos sirven a nosotros nuestras letras dominicales para començar todos los primeros dias de los meses de a XX dias, **Kan, Muluc, Ix, Cauac.**" (Landa, 1864, p. 206.)

[3] These days are called by Perez "year-bearers." "El titular con que daba principio el año y que los indios llamaron **Cuch haab** (cargador del año)." (Perez, 1864, p. 376.)

Landa also calls attention[1] to the facility with which the Mayas made their calculations in their calendars, and to the fact that the day which is the "dominical" comes always as the first day of the year, and that these days were also used in the calculation of their longer periods, and for other purposes.

Moreover, Landa also gives, as has been said,[2] the Maya days of one whole year, and illustrates them not only with the forms of the days but with those of the months also, giving the names of the months and showing on what days of our months the first days of the Maya months fall.[3] His table also shows that the months succeed each other in a continuous circle, the first month following the five **Uayeb** days over and over again, just as the days were shown to do in their successive periods of twenty days. Landa tells us that the first month was **Pop** and that the last full month was **Cumhu**, followed by the five days of **Uayeb**. When these five days had passed he shows on p. 276 that **Pop** begins again. He gives no forms for the five additional days, called **Uayeb**.[4] The month forms as given by Landa appear as the first examples under each month on Plates VII and VIII.

Cogolludo tells us that the Mayas had a year of 365 days, which was divided into months of 20 days each, that the days of the month had each its own name, and that the five days needed

1 "Con las letras de los indios . . . ponian a los dias de sus meses nombres, y de todos juntos los meses hazian un modo de calendario, con el qual se reglan assi para sus fiestas como para sus cuentas y tratos y negocios, como nosotros nos regimos con el nuestro, salvo que no ccmençavan el primero dia de su calendario en el primero dia de su año, sino muy adelante; lo qual hazian por la dificultad con que contavan los dias de los meses todos juntos, como se vera en el propio kalendario que aqui porne; porque aunque las letras y dias para sus meses son XX, tienen en costumbre de contarlas desde una hasta XIII. Tornan a començar de una despues de las XIII, y assi reparten los dias del año en XXVII trezes y IX dias sin los aciagos.

Con estos retruecanos y embaraçosa cuenta es cosa de ver la liberalidad con que los que saben cuentan y se entienden, y mucho de notar que salga siempre la letra que es dominical en el primero dia de su año, sin errar ni faltar, ni venir a salir otra de las XX alli. Usavan tambien deste modo de contar para sacar destas letras cierto modo de contar que tenian para las edades y otras cosas que aunque son para ellos curiosas, no nos hazen aqui mucho al proposito." (Landa, 1864, p. 234.)

2 Page 14.

3 See Table V.

4 For discussion of this period, see Appendix IV.

to fill out the year were called "days without name."[1] He also gives the names of the months, with the corresponding days of our calendar.

Aguilar gives the names of the months, with the corresponding days of our calendar.

Perez says that the Mayas called the month **U**, which means moon, and infers from this that the Mayas made their computations with a lunar calendar and then advanced to a solar calendar. He says, however, that the manuscripts called each month of the eighteen, **Uinal**,[2] the plural **Uinalob** being applied to the eighteen together.[3]

Table IV (page 62) shows the names of the months[4] as given by Landa, Perez, Aguilar and Cogolludo, with the days of our calendar, with which the first day of each Maya month corresponded, according to Landa.

Perez gives the same dates for the beginning of each month as Landa does, and Cogolludo gives the same dates as Landa with a slight difference after **Pop**, but he says that **Xul**, **Yaaxkin** and **Mool** fall in October, November and December respectively, and that **Cheen** "*terminaba en onze de Enero.*" Aguilar gives the same dates as Landa and Cogolludo through **Uayeab**, but after that he gives a date for the beginning of each month one day later than Landa and Perez through **Mol**. In spite of this, he gives the date

[1] "Contaban los años con trecientos sesenta y cinco dias, divididos por meses de á veinte dias, correspondiente a los nuestros por este orden. A doce de Enero llamaban Yaax, etc.

"Los cinco dias que faltaban para cumplir los trecientos y sesenta y cinco llamábanlos los dias sin nombre."

"Todos los dias de el mes tenian su nombre propio." (Cogolludo, 1867, Vol. I, pp. 297, 298.)

[2] For the sake of clearness, I shall use the term **Uinal** for the period of twenty days, and the word "month," meaning the separate months, **Pop**, **Uo**, etc.

[3] El mes en lengua yucateca se llamaba **U**, que tambien significa luna, corroborando este la presuncion de que los indios pasaron del computo de las lunaciones ó neomenias, como por escala para fijar el curso solar, llamando luna á los meses; pero en los manuscritos antiguos se le dá el nombre de **Uinal** en singular y **Uinalob** en plural á los diez y ocho meses del año, haciendose estensiva esta denominacion ó palabra á la série, y á cada uno de los nombres particulares que señalan los veinte dias que componen el mes. (Perez, 1864, p. 376. See also pp. 378, 380.)

[4] For the meaning of the names of the months, see Appendix V.

TABLE IV

		Landa[1]	Perez[2]	Aguilar[3]	Cogolludo[4]
January	12 . . .	**Yax**	**Yax**	**Yaax**	**Yaax**
February	1 . . .	**Zac**	**Zac**	**Zac**	**Zac**
	21 . . .	**Ceh**	**Queh** or **Ceh**	**Ceh**	**Ceh**
March	13	**Mac**	**Mac**	**Mac**	**Mac**
April	2 . . .	**Kankin**	**Kankin**	**Kankin**	**Kan kin**
	22 . . .	**Muan**	**Moan**	**Muan**	**Muan**
May	12 . . .	**Pax**	**Páx**	**Paax**	**Paax**
June	1 . . .	**Kayab**	**Kayab**	**Kayab**	**Kayab**
	21 . . .	**Cumhu**	**Cumkú**	**Cumku**	**Cum ku**
July	11 . . .	**Uayeyab**		**Vayeab**	**Vayeab**
				Utuzkin	**Utuz kin**
				Ulubolkin	**Ulubol kin**
	16 . . .	**Pop**	**Pop**	**Poop**	**Poop**
August	5 . . .	**Uo**	**Uo**	**Voo**	**Voo**
	25 . . .	**Zip**	**Zip**	**Zip**	**Cijp**
September	14 . . .	**Tzoz**	**Zodz** or **Zoc**		
October	4 . . .	**Tzec**	**Zeec**	**Zec**	**Zeec**
	24 . . .	**Xul**	**Xul**	**Xul**	**Xul**
November	13 . . .	**Yaxkin**	**Dzéyaxkin**	**Yaaxkin**	**Yax kin**
December	3 . . .	**Mol**	**Mol**	**Mool**	**Mool**
	23 . . .	**Chen**	**Chen**	**Cheen**	**Cheen**

for the beginning of **Cheen** as December 23, as Landa and Perez do. Although Aguilar and Cogolludo do not state it explicitly, it is evident that in giving these dates they refer to the beginning or the first day of the Maya months, as do Landa and Perez.

TABLE V

MAYA MONTHS IN CONNECTION WITH OUR OWN

Beginning day of	**Pop**	16 July	Beginning day of	**Zac**	1 February
"	**Uo**	5 August	"	**Ceh**	21 February
"	**Zip**	25 August	"	**Mac**	13 March
"	**Zotz**	14 September	"	**Kankin**	2 April
"	**Tzec**	4 October	"	**Muan**	22 April
"	**Xul**	24 October	"	**Pax**	12 May
"	**Yaxkin**	13 November	"	**Kayab**	1 June
"	**Mol**	3 December	"	**Cumku**	21 June
"	**Chen**	23 December	"	**Uayeb**	11 July
"	**Yax**	12 January	Last day of	**Uayeb**	15 July

These authorities then practically agree with each other, though there are some small differences between them. Thus the month

[1] Landa, 1864, pp. 240–310.

[2] Perez, 1864, pp. 378, 380.

[3] Aguilar, p. 95.

[4] Cogolludo, 1867, Vol. I, p. 298.

is not spelled exactly in the same way, **Pop** in one and **Poop** in another; also **Chen** and **Cheen**, **Mol** and **Mool**, etc. Aguilar, whom Cogolludo must have followed, says that there are six supplementary days instead of five. This throws the beginning of the year to the 17th of July instead of to the 16th, as stated by Landa and Perez, but of course five days is the correct number, except in leap years. The beginnings of some of the other months is thus also thrown over one day too far, but these discrepancies do not affect the question before us. Landa gives the whole count of the year in detail, and as his statement is the fullest, the most regular and the earliest of the three, it will be well to follow him. All agree that the supplementary days came after **Cumhu**, and that the beginning day of the first month **Pop** fell in the middle of July.[1] Perez tells us that the 16th of July was chosen as the beginning of the new year, as it was the day when the sun crossed the zenith in its southward journey — this calculation being within forty-eight hours of the true time.[2]

Month Signs in the Codices. — Referring again to Dr. 46–50, we have seen that the red numbers at the bottom of the pages run 236, 90, 250, 8, that in the row of black numbers in the centre of the pages each black number equals the sum of the red number directly below it and the next preceding black number, or, in other words, that each red number is the difference between the black number over it and the preceding black number. We have also seen that each red number at the bottom is the distance which any day sign in the column of day signs over this number lies from the day sign immediately preceding it in the same row.

[1] "El primero dia del año desta gente era siempre a XVI dias de nuestro mes de julio y primero de su mes de **Popp**." (Landa, 1864, p. 236.)

[2] Perez says, "Hasta el presente llaman los indios al año **Haab** (háb) y en su gentiládad comenzaba el diez y seis de julio, siendo digno de notarse que habiendo querido sus progenitores fijar el principio del año en el dia en que el sol pasa por el zenit de esta peninsula para ir á las regiones australes; sin mas instrumentos astronómicos para sus observaciones que la simple vista, solo se hayan eqivocardo en 48 horas de adelante. Esta pequeña differencia prueba ciertamente, que procuraron fijar sino con la mayo exactitud, al menos con la mayor aproximacion, el dia en que el astro regulador del tiempo pasa por el punto mas culminante de nuestra esfera, y que conocian el uso y resultados del gnomon en los dias mas tempestuosos de las lluvias." (Perez, 1864, p. 382.)

There are, however, three rows of glyphs, each with a number attached, which hold the following positions on these pages:

1. Immediately below the thirteen rows of day signs.
2. Immediately below the row of black numbers.
3. Immediately above the row of red numbers.

These glyphs might very well have a time meaning, and, on comparing them with the month signs as given by Landa, we have no difficulty in recognizing very many of them. Among those so recognized are the following; the first number referring to the page, the second to the column, and the third number to the place in the column counting from the top of the page:

46.2.14., **14 Zac**; 47.1.14., **3 Cumhu**; 47.2.14., **8 Zotz**; 48.1.14., **17 Yax**; 48.4.14., **? Yax**; 49.1.14., **11 Zip**; 49.2.14., **1 Mol**; 49.4.14., **14 Uo.**

Let us see how far apart these signs and numbers should be if they have a time value and follow the distances given in the case of the days, or, what is the same thing, of the black numbers in the centre of the pages, remembering that the days follow one another in regular order in the passage of the months, and that the months follow one another in regular order in the passage of the years. The distance from 46.2.14., **14 Zac** to 47.1.14., **3 Cumhu** can be obtained thus: Under 47.1.14. is the black number  = 820, and under 46.2.14. is the number  = 326. Subtracting the latter from the former leaves , or 494, which is the sum of the three red numbers, 250 + 8 + 236, found at the bottom of the third and fourth columns of page 46 and of the first column of page 47. Now counting forward 494 days (or one year of 365 days and 129 days) from **14 Zac**, we find that one year, or 365 days, brings us to **14 Zac** again, while 129 days further reaches **3 Cumhu**, the day given.

In making these calculations it will be convenient to use Goodman's Archaic Annual Calendar (Part VIII of Biologia Centrali-

Americana, Archaeology), since the sequence of the months and of the numbered days of the month is the only question before us at present, and Goodman gives us this sequence for a period of fifty-two years. As we have merely to decide upon the distance of one month-day to another month-day, it will not be necessary to consider the day signs with their numbers in our calculations. Selecting any year, say the 6th year of the Archaic Annual Calendar, we find **14 Zac** in the 13th column. By counting forward 494 days from this day, we reach the day **3 Cumhu** of the 7th year,[1] and **3 Cumhu** is the day given. The labor of counting such a large number of days as 494 days can be shortened by dividing the 494 days into two portions, — 365 days (or one year) and 129 days. One year from **14 Zac** of the 6th year takes us to **14 Zac** of the 7th year, and 129 days further carries us to **3 Cumhu**.[2]

From 47.1.14. to 47.2.14., or from **3 Cumhu** to **8 Zotz**, should be 90 days if this line is a line of month-days and progresses as the day signs and the black numbers do. Following the rule of Landa that the five **Uayeb** days follow **Cumhu**, and counting forward 90 days we find that 17 days are taken up in passing through **Cumhu** and 5 more for the **Uayeb** days, or $17 + 5 = 22$ days are needed to end the year. This leaves 68 of the 90 days for the new year,

[1] Hereafter, when a date is declared to be found in any year of the Archaic Annual Calendar, this will be designated by placing the number of the year enclosed in a small circle at the right of and a little above the date. Thus **4 Ahau 8 Cumhu**⑦ will mean that this date is found in the 7th year of Goodman's Tables.

[2] The question as to the purpose which the numbers attached to the month glyphs serve is to be considered. We have so far found that the black numbers, as well as a few series of red numbers, serve to decide how many of certain periods (katuns, tuns, uinals and kins) are to be counted, in the same way that our digits serve to decide how many units, tens, hundreds, thousands, etc., are to be counted. But when a red number is attached to a day form, it does not mean that so many of that day are to be counted. In fact, it has no relation to the day itself, except to differentiate it from twelve other days of the same name which occur in a Tonalamatl. When, however, a number is found attached to a month form, it will be found that the number serves neither of the purposes which it serves when attached to a day form or when standing in a period place in a series of numbers. It neither serves to differentiate the month from other months, nor does it declare that so many of that month are to be counted. It will be found that the number attached to a month form records a particular day in that month, though there may still be a question whether the beginning day of a month is numbered 0 or 1. (See Appendix VI.)

which will use up three whole months, taking us through **Zip**, and will bring us to **8 Zotz**. The same result is reached by counting forward 90 days from **3 Cumhu** of the 7th year of Goodman's Tables, this count bringing us to **8 Zotz** of the 8th year. On 48.1.14. we have recognized **17 Yax**. The black numbers show the distance to this day from 47.2.14. to be 250 + 8 + 236 = 494 = 365 + 129 as in the first case. Counting forward from **8 Zotz**, 494 days, or (which is the same thing as far as the day of the month is concerned) 129 days, we reach **17 Yax**.

We will omit from our calculations the month sign which we have recognized as **Yax** on 48.4.14., since there is some doubt about the value of the number attached to it, and proceed to the month sign on 49.1.14. The distance from the month-day on 48.1.14. to that of 49.1.14. is, as has been shown, 584 days, or 1 year and 219 days. Omitting the 365 days, we need, in counting forward from **17 Yax**, 168 of the 219 days to finish out the year, and have 51 left to be counted in the new year. This will use up two whole months, and will carry us to the eleventh day of the third month, **Zip**, giving us **11 Zip**, which is found on 49.1.14. The same result follows if we count 584 days forward from **17 Yax** on Goodman's Tables.

Here then in every case the distance of the month-days from each other are regulated by the red numbers below, just as the black numbers in the centre and the rows of day signs above are regulated. Similar experiments in the second and third rows of month signs and month numbers bring the same result.

Is it too much then to decide that, recognizing the larger part of these glyphs and numbers as month dates from their resemblance to the Landa forms, and finding that all that we thus know are regulated by the red numbers below, the intermediate glyphs and numbers which we do not know are really month dates and are regulated in the same way? In this way we shall be able to recognize variants of the month signs differing from those of Landa, but which will be as certainly proved by their position as they could be by their similarity to those given by him. The month signs and numbers in the three rows of Dr. 46–50, as well as the distances from one to the other, as shown in the red numbers, at the bottom of the page, will be as given in Table VI.[1]

TABLE VI

		Column 1		Column 2		Column 3		Column 4
Page 46		236	90		250		8	
Row	14.	**4 Yaxkin**		**14 Zac**		**19 Tzec**		**7 Xul**
"	21.	**8 Zac** [2]		**18 Muan** [2]		**4 Yax**		**12 Yax**
"	26.	**19 Kayab**		**4 Zotz**		**14 Pax**		**2 Kayab**
Page 47		236	90		250		8	
Row	14.	**3 Cumhu**		**8 Zotz**		**18 Pax**		**6 Kayab**
"	22.	**3 Zotz**		**13 Mol**		**18 Uo**		**6 Zip**
"	26.	**13 Yax**		**3 Muan**		**8 Chen**		**16 Chen**
Page 48		236	90		250		8	
Row	14.	**17 Yax**		**7 Muan**		**12 Chen**		**0 Yax** [3]
"	22.	**2 Muan**		**7 Pop**		**17 Mac**		**5 Kankin**
"	26.	**7 Zip**		**17 Yaxkin**		**2 Uo**		**10 Uo**
Page 49		236	90		250		8	
Row	14.	**11 Zip**		**1 Mol**		**6 Uo**		**14 Uo**
"	22.	**16 Yaxkin**		**6 Ceh**		**11 Xul**		**19 Xul**
"	27.	**6 Kankin**		**16 Cumhu**		**1 Mac**		**9 Mac**
Page 50		236	90		250		8	
Row	14.	**10 Kankin**		**0 Uayeb**		**5 Mac**		**13 Mac**
"	22.	**15 Cumhu**		**0 Tzec**		**10 Kayab**		**18 Kayab**
"	27.	**0 Xul** [4]		**10 Zac**		**15 Tzec**		**3 Xul** [5]

[1] The only cases where the month numbers do not agree with the rule adopted are 46.1.21. and 46.2.21., where the numbers should be respectively 9 and 19 in order to agree with the other numbers of this row and also in order to agree with the day signs over them. For it will be shown later that **Cib** can never be the 8th day of a month nor **Cimi** the 18th; but they must in each case be the 4th, 9th, 14th or the 19th of a month. The month forms are correct throughout the table.

[2] These dates should probably be **9 Zac** and **19 Muan**, as otherwise they do not agree with the days and numbers which follow. Moreover, the days which stand over them can never be the 8th or 18th days of the month. **Cib** and **Cimi** must be the 4th, 9th, 14th or 19th day of a month.

[3] I shall consider for the present that the number form attached to this month is zero, and that similar forms found elsewhere also mean zero. The proof of this will appear later. See Appendix VI.

[4] This should be either **20 Xul** or **0 Yaxkin** according as the days run from 1 to 20 or from 0 to 19. The "**Xul**" is possibly an error.

[5] The zero point of row 14 is **1 Ahau 13 Mac** (34), and therefore the first day of the

The signs for **Yaxkin**, **Yax** and **Ceh** in the codex differ chiefly from the forms given by Landa in being without a wing. The signs for **Chen**, **Mac** and **Kankin** are quite unlike those of Landa, but they are proved by their position, while **Kayab** has a form which requires some imagination to identify it with that of Landa.

The month signs as found in the codices are given on Plates VII and VIII, the forms given by Landa appearing as No. 1 under each month. It will be seen that **Uo** and **Zip** have a cross in the body of the glyph, and are to be distinguished from each other by the superfix. In the same way **Chen**, **Yax**, **Zac** and **Ceh** all have the so-called **Cauac** sign in the body of the glyph, while the superfixes differ from each other.

One further trial should be made, namely, to determine whether the first row of month signs is directly connected with the others in any way. As counting forward 236 days from **1 Ahau**, the last day of the last row of day signs, brought us to **3 Cib**, the first day of the first row of day signs, so the month date which we shall reach by counting forward 236 days from **13 Mac** in 50.4.14. is **4 Yaxkin**, of which the month is clearly seen on 46.1.14., the month number being erased. But both this month and this number are reached by counting back 90 days from the next following number. So in the second row of month signs, by counting forward 236 days from **18 Kayab**, the last month date of that row, we reach **9 Zac**. 46.1.21. has **8 Zac**, which is probably an error, as shown in a preceding note. In the last row, 236 days brings us to **19 Kayab**, which is given in 46.1.26. Thus it is shown that each row returns into itself and does not connect directly with either of the other rows.

As we have found that throughout the eight years of each continuous row of month signs the month-day can only be reached by counting the **Uayeb** days at the end of the month **Cumhu**, and by counting **Pop** as the beginning of the following year, we may safely decide —

series is **2 Ymix 14 Mac**(34). The zero point of row 21–2 is **1 Ahau 18 Kayab**(1), and the first day of the series is **2 Ymix 19 Kayab**(1). The zero point of row 26–7 is **1 Ahau 3 Xul**(28), and the first day of the series is **2 Ymix 4 Xul**(28).

1. That the Maya years consisted of 365 days and were calculated continuously one after the other, counting the five days of **Uayeb** after **Cumhu.** (See Archaic Annual Calendar, by J. T. Goodman.)

2. That pages 46–50 show a continuous series in each row of month-days.

The difference between the Tro-Cor. and the Dresden codices is marked by the absence of month signs in the former and by their frequent appearance in the latter. This is probably owing to the fact that the Tro-Cor. does not treat of long periods of time as far as is known, while the Dresden contains numbers which extend over many years. The only case which I know of where a month sign is given in the Tro-Cor. is on 73b, where the last day sign, **13 Ahau**, in the period of 260 days is written with the month-day **13 Cumhu**, which, as will be explained later, fixes the date in a period of 52 years, and lies in the year 50 of Goodman's numbering, or in the year **13 Muluc**, as Dr. Förstemann prefers to call it.[1] But many month signs appear in the Dresden besides those on pages 46–50. For instance, Dr. 24 has **18 Kayab, 18 Uo** and **8 Cumhu**, the latter associated with the day **4 Ahau.** Dr. 31a has **4 Ahau 8 Cumhu,** while in the second part of the Dresden on pages 58, 61–63, and 69, there are many examples of month signs. Where any of these signs are variants from those which we have already found, they appear on Plates VII and VIII.[2]

Day Numbers of Beginning Days of Successive Months. — It is to be noted that as the month consists of 20 days, and as there are 20 named days, whatever day the first month begins with will be the beginning day of all the months. This is seen in Landa's list (pages 240–310), where all the months begin with **Kan.** But as the numbers attached to the days run from 1 to 13 and then begin again with 1, the numbers of the days which begin each month will vary. Thus if the first month begins with **1 Kan**, the fourteenth

[1] This proves that the days are connected with the same month-days in the Tro-Cortesianus as they are in the Dresden.

[2] In Dr. 61 the **Yaxkin** has the wing; on Dr. 62 the sign for **Pax** has the comb underneath which makes it similar to **Tzec**, which it resembles in other respects; while the sign for **Uo** resembles the Landa form more closely than do its fellows of the codex.

named day, **Caban**, will again have the number 1 attached to it, and the twentieth named day, **Akbal**, will have the number 7 attached to it. The beginning day of the second month will be **Kan**, but it will have the number 8 attached to it, and the beginning day of each successive month will have a number attached to it, seven numbers in advance of the beginning day of the preceding month, until the beginning day and the last day of the thirteenth month will have the numbers 7 and 13 respectively. The beginning day of the fourteenth month will then have the number succeeding 13, or 1, attached to it, and as the day must be **Kan**, we shall have **1 Kan** again, as we should expect after the passing of 13 months or $13 \times 20 = 260$ days.

The numbers of the beginning days of the first and succeeding months will be as follows: 1, 8, 2, 9, 3, 10, 4, 11, 5, 12, 6, 13, 7, 1, 8, 2, 9, 3, 10, etc. Each first month in the years must begin with one of these numbers, and the succeeding months will begin with the other numbers in order.

Perez explains this as follows:

"Como los nombres de los dias son tantos cuantos eran los del mes, resultaba que sabido el titular con que daba principio el año y que los indios llamaron **Cuch haab** (cargador del año), se sabia ya el primero de todos los meses siguientes: distinguiendose solamente en que al contarlos se les añadia el número de la semana en que pasaban. Mas siendo esta de trece numeros era preciso que el mes constare de una semana y siete numeros mas para completar los veinte dias de que se formaban; de modo que si el mes principiaba por el número primero, terminaba por el septimo de la siguiente, y el segundo mes por consecuencia en el numero ocho. Ahora para saber los numeros ó tanto de la semana en que debian comenzar los meses, inventaron la regla que llamaban **Bukxoc** ó cuenta general que es la siguiente."

1	Hun in uaxac	de	1	á	8		12	Lahca in uac	de	12	á	6
8	Uaxac in ca	de	8	á	2		6	Uac te oxlahun	de	6	á	13
2	Ca in bolon	de	2	á	9		13	Oxlahun te uuc	de	13	á	7
9	Bolon te ox	de	9	á	3		7	Uuc in hun	de	7	á	1
3	Ox te lahun	de	3	á	10		1	Hun in uaxac	de	1	á	8
10	Lahun te can	de	10	á	4		8	Uaxac in ca	de	8	á	2
4	Can in buluc	de	4	á	11		2	Ca in bolon	de	2	á	9
11	Buluc te hó	de	11	á	5		9	Bolon te ox	de	9	á	3
5	Hó in lahca	de	5	á	12		3	Ox te lahun	de	3	á	10

"Los diez y ocho numeros 1, 8, 2, 9, 3, 10, 4, 11, 5, 12, 6, 13, 7, 1, 8, 2, 9, 3, son otros tantos principios de meses, de tal suerte dispuestos que debiendo comenzar el año por uno de ellos, los diez y siete restantes van de sucesiva, cada uno siendo precisamente el numero con que deben principiar los demas meses del año señalado, yá sea pasado, presente ó venidero." (Cronologia antigua by Juan Pio Perez in "Relacion de las cosas de Yucatan," by Diego de Landa, pp. 376, 378.)

Thus if the number and name of the beginning day of any month is known, the numbers and names of all the beginning days of the other months can be known. Thus the number and name of the first day of the first month, and therefore of the year, can easily be found.

CHAPTER V

THE YEAR (MAYA, HAAB) AND THE CALENDAR ROUND

In this chapter it will be shown —

1. That, by joining the day signs and their numbers with the month-days, a period of fifty-two years, or calendar round, elapsed before the same day with the same number fell upon the same month-day.
2. That a given month-day in this period was associated with but four of the twenty days, each of these four days appearing thirteen times, with a different number each time.
3. That there is a discrepancy between Landa and the Books of Chilan Balam on the one side and the Codices and Inscriptions on the other, as to which four days out of the twenty were attached to the month-days.

We have thus far seen that the Mayas in their calculation of time used the following methods:

1. By giving names to each of 20 days, they differentiated each particular day in the series of 20 from the other 19.
2. By using numbers from 1 to 13 for distinguishing the days, they differentiated each day in the series of 13 from the other 12.
3. By combining methods 1 and 2, they differentiated each day in the series of 260 from the other 259.
4. By using a year of 365 days, divided into months, and by numbering the days of the months, they differentiated each particular day from the other 364.

Fifty-two Year Period or Calendar Round. — Landa shows us in his table (pages 240–310) that the Mayas associated method 3 with method 4, at least as far as the first day of each Maya month is concerned, and in one instance he associates a day and its number with the tenth day of a Maya month. But by associating a day and its number with each day of the common year, and by associating the first day of each Maya month with a day and its number and with a day of our year, and by placing the first day of each Maya month 20 days after the first day of the preceding month, it is safe to say that Landa intended to state that each day of the Maya month was associated with a day and its number and with a day of our year.[1] It is also a legitimate inference that where in the codices a day and its number are in close relation to a month-day, the two belong together and form a date. Thus **10 Kan** is declared by Landa to be the first day of the month **Yax**, **4 Kan** to be the first day of the month **Zac**, etc., etc.; while **12 Ben** is declared to be the tenth day of the month **Chen**. Also on Dr. 61, **9 Kan 12 Kayab** are placed together as if forming a date. So **3 Chicchan 18 Xul**, **3 Chicchan 13 Yaxkin** seem to form other dates. This is also set forth on Dr. 46–50. For here we find the set of days and of month-days which have been discussed already, the former over the latter in columns.

Without at present discussing the question of which days began the month, this shows that the Mayas used the methods 3 and 4 together, and thus were able to distinguish days in a longer period than 260 or 365 days. Thus if **9 Kan** is a particular day of a period of 260 days, and **12 Kayab** is a particular day of a period of 365 days, then if we speak of the day **9 Kan** as the 12th day of the month **Kayab**, how long a period must elapse before another **9 Kan** will appear as the 12th day of another month **Kayab**? We saw in the case of **9 Kan** itself that another day of the same name and number would not reappear until the number of days represented by the least common multiple of 13 (the number of units used) and of 20 (the number of named days) or 260 days had passed. As **9 Kan** appears every 260 days and as **12 Kayab** appears every 365 days, the date **9 Kan 12 Kayab** will not reappear until a number of days represented by the least common multiple of 260 and 365 has passed. Now the only common divisor (except 1) of 260 and 365 is 5, so that the least common multiple of 260 and 365 will be $260/5 \times 365/5 \times 5$, or $52 \times 73 \times 5$, or 52×365. But

[1] "Pero aunque ellos comiençan su año in julio, yo no porne aqui su Kalendario sino por la orden del nuestro y junto con el nuestro, de manera que iran señalados nuestras letras y las suyas, nuestros meses y los suyos, y su cuenta de les trezes sobredichos, puesta en cuenta de guarismo." (Landa, 1864, p. 236.)

52 × 365 is 52 years, so that **9 Kan 12 Kayab** will not reappear until 52 solar years, or 18,980 days, have passed, and will reappear at the end of each period of 52 years.[1]

Dr. 46–50 shows a period just double this length of time, or 104 years, as has already been shown,[2] in discussing the thirteen columns of days with their numbers. But, using the days and their numbers in connection with the month-days, we find that from **1 Ahau** (236 days before **3 Cib**, the first day of the first row of days on Dr. 46) and **3 Xul** (236 days before **19 Kayab**, the first month-day of the third row of month-days on Dr. 46), forming the date **1 Ahau 3 Xul** (236 days before **3 Cib 19 Kayab**) to **9 Ahau** (the last day of the first row of days on Dr. 50[3]) and **3 Xul** (the last month-day of the third row of month-days on Dr. 50), forming the date **9 Ahau 3 Xul**, there are just 8 years of 365 days each. We have also shown that each row of days with their numbers runs into the following row and that each row of month-days runs into itself. Thus using the thirteen rows of days with their numbers in connection with the third row of month-days (any other row will bring a similar result) we shall pass over 8 × 13 = 104 years, reaching in succession **9 Ahau 3 Xul** at the end of the first row of days, **4 Ahau 3 Xul** at the end of the second row of days, and so on, and finally **1 Ahau 3 Xul** at the end of the 13th row, — this being the day from which we started. This is in accordance with the conclusion which we reached by our previous calculation, that after 52 years the same date is reached as the one with which we started, for 104 is twice 52.

Year-bearers or Dominical Days according to Landa. — The list of days and months forming the year as given by Landa, his state-

[1] This period has been called a "Calendar Round" by Goodman, a name which I have adopted. The glyph which he considers as meaning this lapse of time is given in Fig. 2. It is very like the sign which we shall hereafter find to mean a cycle, or 144,000 days, except that it has upon the top a form consisting of two spreading lines. Perez has called this period a "katun," but he gives no authority for this use of the word, and the Books of Chilan Balam, as published by Brinton, give evidence to the contrary. See Appendix III.

Fig. 2.

[2] See Ch. III.

[3] This day is found by calculation.

ment that the first day of the year was the first day of the month **Popp**,[1] and the testimony of pages 46–50 of the Dresden Codex all show that the first month of the year was **Pop**, following the **Uayeb** days of the preceding year; but it will be seen that the first day of **Pop** had a different name or number during the course of 52 years, after which the fifty-third year began with the same day and number as did the first year.

Landa gives the list of days thus:

Kan	**Chicchan**	**Cimi**	**Manik**	**Lamat**
Muluc	**Oc**	**Chuen**	**Eb**	**Ben**
Ix	**Men**	**Cib**	**Caban**	**Eznab**
Cauac	**Ahau**	**Ymix**	**Ik**	**Akbal**

He then says (page 206) that the first days of the four sets of five were used, each for a year (as we use Dominical letters[2]), for beginning the months of the year,[3] and then he repeats the days, **Kan**, **Muluc**, **Ix**, **Cauac**, — these being the days for beginning the months. On pages 240–310 he makes the months of the year, which he gives in full, begin with **Kan**, while the last day of the year, the fifth of the **Uayeb** days, is **Lamat**. The first day of the month **Pop** of the next year would then be **Muluc**, as would the first days of all the months of that year (since **Muluc** is the next day following **Lamat**), while the last day of **Uayeb** of the second year would be **Ben**. The first day of **Pop** and of all the months of the third year would then begin with **Ix**, and the last day of **Uayeb** of the third year would be **Eznab**, while the first and last days of the fourth year would be **Cauac** and **Akbal** respectively, and the first day of the fifth year would be **Kan** again. This explains Landa's statement perfectly when he says that it is worthy of note to see how the day which is the Dominical comes out on the first day of the year without mistake, and that no other of the twenty days comes

[1] "El primer dia del año desta gente era siembre . . . primero de su mes de **Popp**." (Landa, 1864, p. 236.)

[2] It is probable that what Landa means by "Dominical letters" is a method of marking the year and distinguishing it from other years. Thus a Maya chronicle says that the month **Pop** began with **4 Kan**. (Brinton, 1882, pp. 98, 103, 104.)

[3] "Porque cada uno le muda la propia cuenta y con todo esso no falta el salir la letra que viene por dominical el primero del año que se sigue." (Landa, 1864, p. 236.)

out.[1] This naturally results from the continuous use of the names of the days from one month to the other and from one year to the other. On page 208 he mentions the "Dominical letters" as **Kan**, **Muluc**, **Ix**, **Cauac**, in the same order as they have appeared above.

The same result will be obtained by mathematical calculation. If the year consisted of 18 months of 20 days each, or 360 days, the series of 20 days repeated 18 times would exactly fill up this period. If the first day of the year was **Kan**, for instance, all the months would begin with **Kan** and all would end with **Akbal**, so that the beginning of the next year and of all the months of that year would be **Kan** once more. But the year consists of 365 days, or 360 + 5, and therefore if the year begins with **Kan** and ends with **Akbal**, these additional five days will use up the first five of the set of 20 days, namely, **Kan**, **Chicchan**, **Cimi**, **Manik**, **Lamat**, so that the first day of the following year will be **Muluc**. In other words, the fact that the year consists of five days in excess of 360 makes each year begin with a day five days ahead of the first day of the preceding year. Therefore, if the first year begins with **Kan** and the next with **Muluc**, the third year will begin with **Ix** and the fourth with **Cauac**. The 18 months of the year beginning with **Cauac** will end with **Eznab**, the five **Uayeb** days will be **Cauac**, **Ahau**, **Ymix**, **Ik** and **Akbal**, and the first day of the fifth year will be **Kan** again, and the same series of "year-bearers," as these days have been called, will run on continually. We see then that each of the days **Kan**, **Muluc**, **Ix** and **Cauac** appeared as the beginning day of the year every four years, and if the years were distinguished by the days which begin them, confusion might arise unless some method for distinguishing the days of the same name from one another were adopted.

Heretofore we have been considering only the change of the name of the day which begins the year. But each day has some number from 1 to 13 attached to it. If the first day of the year is **1 Kan**, the number of the day with which the next year begins is easily settled, since the numbers run on continuously in sets of thirteen. If we count forward 365 days from **1 Kan** in sets of

[1] Page 60, note.

thirteen we shall reach the same number as if we counted forward what is left of 365 after all the thirteens are taken out. 13 goes into 365 twenty-eight times and 1 over. Then by counting forward one day, the same day number is reached as if 365 days had been counted forward in sets of thirteen. Adding 1 to the 1 of **1 Kan**, we have 2 as the number of the first day of the second year, while the name of the day with which the second year began has already been shown to be **Muluc**. Thus we have **2 Muluc** as the beginning day of the second year. In the same way it can be shown that the beginning day of the third year would be **3 Ix**, and of the fourth year **4 Cauac**, and of the fifth year **5 Kan**. This, then, shows the method by which two years both beginning with **Kan** can be distinguished from each other.[1] If we carry along such a series of years we should have a table like the following:

TABLE VII

Year.		Year.		Year.		Year.	
1	**1 Kan**	14	**1 Muluc**	27	**1 Ix**	40	**1 Cauac**
2	**2 Muluc**	15	**2 Ix**	28	**2 Cauac**	41	**2 Kan**
3	**3 Ix**	16	**3 Cauac**	29	**3 Kan**	42	**3 Muluc**
4	**4 Cauac**	17	**4 Kan**	30	**4 Muluc**	43	**4 Ix**
5	**5 Kan**	18	**5 Muluc**	31	**5 Ix**	44	**5 Cauac**
6	**6 Muluc**	19	**6 Ix**	32	**6 Cauac**	45	**6 Kan**
7	**7 Ix**	20	**7 Cauac**	33	**7 Kan**	46	**7 Muluc**
8	**8 Cauac**	21	**8 Kan**	34	**8 Muluc**	47	**8 Ix**
9	**9 Kan**	22	**9 Muluc**	35	**9 Ix**	48	**9 Cauac**
10	**10 Muluc**	23	**10 Ix**	36	**10 Cauac**	49	**10 Kan**
11	**11 Ix**	24	**11 Cauac**	37	**11 Kan**	50	**11 Muluc**
12	**12 Cauac**	25	**12 Kan**	38	**12 Muluc**	51	**12 Ix**
13	**13 Kan**	26	**13 Muluc**	39	**13 Ix**	52	**13 Cauac**

It will be seen that each set of thirteen years begins and ends with the same year-bearer, the first year of each set having the

[1] Perez confirms this when he says that the year began with the first, sixth, eleventh and sixteenth days of the series of twenty days; that is, with the days **Kan**, **Muluc**, **Ix** and **Cauac**, which were called year-bearers, following the regular order of the thirteen numbers. His words are, "Ya se dijo que para completar los 365 dias del año se tomaban los cinco dias primeros de los veinte que traía el mes, y de esto resultaba que al año siguiente comenzaba por el sexto; el tercer año por la onzeno y el cuarto por el decimo sesto, volviendo el quinto año al primer dia; rodando siempre sobre los dias **Kan**, **Muluc**, **Hix** y **Cauac** (por lo cual los llamaran cargadores de años ó **cuch haab**) y siguiendo el orden correlativo de la semana en sus trece numeros." (Perez, 1864, p. 386.)

number 1 attached to it, and that after four sets of thirteen years have passed we reach **1 Kan** again. That is, a period of 52 years brings back **1 Kan** as the first day of the fifty-third year. This is in accord with what has been already shown in another way.[1]

It will also be seen that each of the four days, **Kan**, **Muluc**, **Ix** and **Cauac** is the beginning day of thirteen years, which are distinguished from each other by the numbers 1 to 13. This is sometimes called an indiction.[2]

If **Kan**, **Muluc**, **Ix** and **Cauac** are always the days which begin the months, then when **Kan** is the first day of the month, **Muluc** will be the 6th, **Ix** the 11th and **Cauac** the 16th; when **Muluc** is the first day, **Ix** will be the 6th, **Cauac** the 11th and **Kan** the 16th; when **Ix** is the first, **Cauac** will be the 6th, **Kan** the 11th and **Muluc** the 16th, and when **Cauac** is the first, **Kan** will be the 6th, **Muluc** the 11th and **Ix** the 16th. These four days will then always be one or the other of the 1st, 6th, 11th or 16th days of the month, and the other days will take their places in accordance. We may then make the following table of the named days in relation to the month-days:

TABLE VIII

Kan	**Muluc**	**Ix**	**Cauac**	may be the	1st,	6th,	11th or	16th	of the month
Chicchan	**Oc**	**Men**	**Ahau**	"	2d,	7th,	12th or	17th	"
Cimi	**Chuen**	**Cib**	**Ymix**	"	3d,	8th,	13th or	18th	"
Manik	**Eb**	**Caban**	**Ik**	"	4th,	9th,	14th or	19th	"
Lamat	**Ben**	**Eznab**	**Akbal**	"	0th,	5th,	10th or	15th[3]	"

and this holds true in the year list as given by Landa. This is also shown to be true in the Maya chronicle already quoted, when it declares that the day **18** of the month **Zip** was **9 Ymix**.

Year-bearers in the Codices. — But this is not true of the codices. For the only date containing a month sign which we find in the

[1] A table on this plan appears on Tro-Cor. 34–37, beginning with **10 Cauac**, the sequence of the years being read across the four pages. The **Muluc** years show discrepancies which are probably due to the carelessness of the scribe. See also the wheel, in Appendix XI.

[2] Perez 1864, pp. 396 *et seq.*

[3] I assume for the present that the month-days were numbered from 0 to 19. See Appendix VI.

Tro-Cor. is **13 Ahau 13 Cumhu** (60),[1] while the following dates consisting of the days with their numbers and with the month-days appear in Dr. 46–50:

TABLE IX

Dr. 46	**Cib** with	**4 Yaxkin**	**8 Zac** [2]	**19 Kayab**	**19 Tzec**	**4 Yax**	**14 Pax**
	Cimi	**14 Zac**	**18 Muan** [2]	**4 Zotz**			
	Kan	**7 Xul**	**12 Yax**	**2 Kayab**			
47	**Ahau**	**3 Cumhu**	**3 Zotz**	**13 Yax**	**18 Pax**	**18 Uo**	**8 Chen**
	Oc	**8 Zotz**	**13 Mol**	**3 Muan**			
	Lamat	**6 Kayab**	**6 Zip**	**16 Chen**			
48	**Kan**	**17 Yax**	**2 Muan**	**7 Zip**	**12 Chen**	**17 Mac**	**2 Uo**
	Ix	**7 Muan**	**7 Pop**	**17 Yaxkin**			
	Eb	**0 Yax**	**5 Kankin**	**10 Uo**			
49	**Lamat**	**11 Zip**	**16 Yaxkin**	**6 Kankin**	**6 Uo**	**11 Xul**	**1 Mac**
	Eznab	**1 Mol**	**6 Ceh**	**16 Cumhu**			
	Cib	**14 Uo**	**19 Xul**	**9 Mac**			
50	**Eb**	**10 Kankin**	**15 Cumhu**	**0 Xul**	**5 Mac**	**10 Kayab**	**15 Tzec**
	Ik	**0 Uayeb**	**0 Tzec**	**10 Zac**			
	Ahau	**13 Mac**	**18 Kayab**	**3 Xul**			

This table shows the following days in connection with the following month-days:

Kan	with the month-days	2,	7,	12,	17
Cimi	"	4,		14,	19
Oc	"	3,	8,	13	
Eb	"	0,	5,	10,	15
Ix	"		7,		17
Cib	"	4,	9,	14,	19
Eznab	"	1,	6,		16
Ahau	"	3,	8,	13,	18
Ik	"	0,	10		

Here the only irregularity is on Dr. 46, where **Cib** appears with 8 and **Cimi** with 18, but the adjoining numbers show that 9 and 19 should be placed here, and this brings the whole of Dr. 46–50 into accord as far as the relation of the days to the month-days is concerned. But this table, as far as it goes, differs from Landa and the chronicle in making **Kan**, **Muluc**, **Ix** and **Cauac** the 2d,

[1] This date is found on Tro-Cor. 73b, and disproves Goodman's statement that the Tro-Cortesianus belongs to the Yucatec system, — a name which he gives to the calendar in which the year begins with the days **Kan**, **Muluc**, **Ix** and **Cauac**. See Part 8 of Centrali-Americana, Archaeology, p. 3.

[1] Probably errors for 9 and 19, as explained previously.

7th, 12th and 17th days of the month instead of the 1st, 6th, 11th and 16th, these with all the other days being placed one day ahead of the Landa plan. If we make a table on the Dresden Codex principle, filling up the gaps where they occur, it will run thus:

TABLE X

Kan	**Muluc**	**Ix**	**Cauac**	may be the	2d,	7th,	12th,	17th	of the month
Chicchan	**Oc**	**Men**	**Ahau**	"	3d,	8th,	13th,	18th	"
Cimi	**Chuen**	**Cib**	**Ymix**	"	4th,	9th,	14th,	19th	"
Manik	**Eb**	**Caban**	**Ik**	"	0th,	5th,	10th,	15th	"
Lamat	**Ben**	**Eznab**	**Akbal**	"	1st,	6th,	11th,	16th	"

Other dates in the Dresden run thus:

Dr. 24 **4 Ahau 8 Cumhu; 1 Ahau 18 Kayab; 1 Ahau 18 Uo.**
31a **4 Ahau 8 Cumhu.**
58 **4 Ahau 8 Cumhu.**
61 **4 Ahau 8 Cumhu; 9 Kan 12 Kayab; 3 Chicchan 18 Xul; 3 Chicchan 13 Yaxkin; 3 Chicchan 13 Pax; 3 Kan 12 Yax.**
62 **4 Ahau 8 Cumhu; 9 Kan 12 Kayab; 3 Ix 7 Tzec; 3 Cimi 14 Kayab; 3 Kan 16 Uo; 13 Akbal 1 Kankin.**
63 **4 Ahau 8 Cumhu; 13 Ymix 9 Uo; 3 Chicchan 13 Kankin; 13 Akbal 6 Cumhu.**
69 **4 Ahau 8 Cumhu; 9 Kan 12 Kayab.**
70 **4 Ahau 8 Cumhu.** (There are other dates, but they are uncertain.)

In all these cases the days agree with the month-days as set forth in Table X, except in the one case of Dr. 63, where **3 Kan** is given with **16 Pop.** It may be said that the dates of the inscriptions run as in Table X.

We must, then, admit a discrepancy between the year list of Landa and the date of the chronicle, and the dates of the codices and inscriptions. The reason for this is unknown. It may be that the latter form is the one used by the old priests, and that the former was put into use in the more modern time of Landa. But this is a surmise, and study must be given to the question before a satisfactory explanation can be reached. We certainly are not ready to accept the opinion of Goodman that the chronicle is in error.

Although **Kan, Muluc, Ix** and **Cauac** did not begin the year in the codices and inscriptions, this does not prove that they were not year-bearers or dominicals, even in the times when the books were written or the stones were carved, for it is quite possible that the year was not named after its first day. There is no evidence, however, that the year was ever described by its year-bearer either in the codices or inscriptions.[1] Indeed, we have not surely deciphered any glyph as meaning the year or the period of fifty-two years.

Goodman's plan of his Maya calendar makes the years begin, not with **Kan, Muluc, Ix, Cauac,** nor with **Lamat, Ben, Eznab, Akbal,** but with the four days **Ik, Manik, Eb** and **Caban.** If, in carrying out his plan, he has made these days the first, sixth, eleventh and sixteenth days of the months, it would not agree with the dates of the codices and inscriptions, but he avoids this by stating that the Mayas called what we designate as the first day of the month the "day 20" of that month, meaning by this that 20 days had passed of the preceding month and no days of the current month. This is the method by which we count hours, minutes and seconds. There is much to be said in support of this plan of Goodman's, but the discussion cannot be entered into here.[2]

It may be well to state here that there is no discrepancy between the statement of Landa that **Ymix** was the day which began the Maya count of their days or calendar, and the fact that the months and years, even in Landa's time, began with other days. Landa says explicitly that this day, "**Hun-Ymix**," which began the calendar, had no fixed day on which it fell,[3] and in his list of days making one year he makes **Kan** the first day of the year, thus

[1] This fact shows a marked difference between the Mexican and Maya writings. Many of the Mexican codices contain many year-signs, where the year-bearers — the days **Calli, Tochtli, Acatl** and **Tecpatl** with their numbers — are found in close connection with the year-sign. It would not be unnatural that similar signs should be found in the Maya codices and inscriptions, for the purpose of distinguishing one year from the other. One reason for the absence of the year-sign from the Maya inscriptions, and possibly from the Dresden codex, may be that in these places the lapse of long periods of time is calculated, not by years but by cycles, katuns, etc. For a comparison of Maya and Mexican days, see Appendix XII.

[2] Table X is made on Goodman's plan substituting zero for 20, as the number of the first month-day.

[3] "El caracter o letra de que començava su cuenta de los dias o kalendario se llama **Hun-Ymix** y es este el qual no tiene dia cierto ni señalado en que caiga." (Landa, 1864, p. 236.)

Fig. 3.

showing a clear distinction between the year and the calendar. **Ymix**, he says, began the calendar and **Kan** the year. It is the year which includes the months, of course, and in the months **Ymix** occupies the fourth, ninth, fourteenth and nineteenth places in the codices and inscriptions, while "**Hun-Ymix**," or **1 Ymix**, will fall in each of these places in all these eighteen months in turn, in a period of fifty-two years.

On the other hand, **1 Ymix** begins the series of days called the Tonalamatl, as we see in the Tro-Cor. 65–73, where a full Tonalamatl is given, and on Tro-Cor. 13–18, where an incomplete Tonalamatl is given beginning with **Ymix**. **Ymix** also begins the long count in the majority of cases. Most of the cases of the long count start from a day **Ahau** as the zero point, and therefore the first day of this count must be the day following **Ahau** or **Ymix**. We shall see later that this is true.

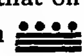
CHAPTER VI

THE HIGHER NUMBERS OF THE CODICES

In many of the number series discussed in Chapter III we have seen that the number shows the distance in days between some zero point and a day occurring below the number. We have seen in Dresden 46–50 that a month-day, in connection with a day above it in the same column, is distant from the month and day date in the same rows of the preceding column by the number of days recorded by the red number below, and is also distant from the zero point of the same row by the number given below in the row of black numbers in the centre of the page. That is, the rule seems to be that these numbers are used to mark the distance of one day from another, or of one date from another, or of either from some zero point (a day or date) to the day or date in question.

Now there are many numbers in the Dresden codex which have dates below them and are larger than those which we have been considering, and it will be well to see whether this rule holds with these higher numbers. These numbers, when they run up to four places, as we have found, are reckoned by the following rule, namely:

20 Kins = 1 Uinal
18 Uinals = 360 Kins = 1 Tun
20 Tuns = 360 Uinals = 7200 Kins = 1 Katun

When, therefore, a number is found with a fifth place in it, it would naturally be supposed, judging from what Landa has said, that it would require 20 of the fourth place to equal 1 of the fifth place, although we have found that it took only 18 uinals to make 1 tun. This supposition is strengthened by the fact that on Dr. 43 a number appears consisting of five places in which  occupies the fourth place, and it is therefore improbable that any less number than 20 katuns make 1 of the fifth place. The correctness of this supposition can be tested by experiment. Dr. 24 has the following terms in the lower left-hand corner:

9.9. 9.16.0. and under it a date **1 Ahau 18 Uo**(41).
9.9.16. 0.0. and under it a date **1 Ahau 18 Kayab**(1).
6. 2.0. and under it a date **4 Ahau 8 Cumhu**(7).

Supposing that these numbers denote the distance from some zero point to the dates given below, as has been found to be the case with the smaller numbers, it is easy to find what these zero points are by counting back each number from the date below it. As the reading of the numerical series of the page is from right to left, we will consider **4 Ahau 8 Cumhu**(7) on the extreme left of the page as the last date. Counting back 6.2.0. = 2200 kins or days from **4 Ahau 8 Cumhu**(7) (using Goodman's Tables), we reach **1 Ahau 18 Kayab**,(1) which is the next date on the right. Counting back the long number 9.9.16.0.0., which, on the supposition that 20 katuns make 1 of the fifth place, equals 1,366,560 days, from **1 Ahau 18 Kayab**,(1) we reach **1 Ahau 18 Kayab**(1) again. This would seem to show that the number 9.9.16.0.0. was a multiple of 52 years, since it takes 52 years, or a calendar round, to reach the day with the same number, which is also the same day of the month. We will test this. A calendar round is 18,980 (52 × 365) days, and if we divide 1,366,560 by 18,980 we find that it goes into it 72 times without a remainder. Or in the Maya method of reckoning, a calendar round is written thus: 2.12.13.0. If we multiply this by 72 we get 144.864.936.0., or reducing this we get 9.9.16.0.0., thus proving this large number to be a multiple of the number of days in a calendar round. Table XI gives the value of from 1 to 80 calendar rounds both in the Arabic and in the Maya reckoning.

Having reached **1 Ahau 18 Kayab**(1) again, we use the next number and count back 9.9.9.16.0. from **1 Ahau 18 Kayab**(1), and we reach **4 Ahau 8 Cumhu**(7) once more. As counting forward is easier than counting backward, we can reverse the process, and we find that by starting from some **4 Ahau 8 Cumhu**(7) far in the past, and counting forward 9.9.16.0.0., we reach **4 Ahau 8 Cumhu**(7) again, while by counting forward 9.9.9.16.0. we reach **1 Ahau 18 Kayab**(1).

TABLE XI

Calendar Rounds.	*Days.*	*Cycles, etc.*	*Calendar Rounds.*	*Days.*	*Cycles, etc.*
1	18,980	2.12.13.0.	41	778,180	5. 8. 1.11.0.
2	37,960	5. 5. 8.0.	42	797,160	5.10.14. 6.0.
3	56,940	7.18. 3.0.	43	816,140	5.13. 7. 1.0.
4	75,920	10.10.16.0.	44	835,120	5.15.19.14.0.
5	94,900	13. 3.11.0.	45	854,100	5.18.12. 9.0.
6	113,880	15.16. 6.0.	46	873,080	6. 1. 5. 4.0.
7	132,860	18. 9. 1.0.	47	892,060	6. 3.17.17.0.
8	151,840	1. 1. 1.14.0.	48	911,040	6. 6.10.12.0.
9	170,820	1. 3.14. 9.0.	49	930,020	6. 9. 3. 7.0.
10	189,800	1. 6. 7. 4.0.	50	949,000	6.11.16. 2.0.
11	208,780	1. 8.19.17.0.	51	967,980	6.14. 8.15.0.
12	227,760	1.11.12.12.0.	52	986,960	6.17. 1.10.0.
13	246,740	1.14. 5. 7.0.	53	1,005,940	6.19.14. 5.0.
14	265,720	1.16.18. 2.0.	54	1,024,920	7. 2. 7. 0.0.
15	284,700	1.19.10.15.0.	55	1,043,900	7. 4.19.13.0.
16	303,680	2. 2. 3.10.0.	56	1,062,880	7. 7.12. 8.0.
17	322,660	2. 4.16. 5.0.	57	1,081,860	7.10. 5. 3.0.
18	341,640	2. 7. 9. 0.0.	58	1,100,840	7.12.17.16.0.
19	360,620	2.10. 1.13.0.	59	1,119,820	7.15.10.11.0.
20	379,600	2.12.14. 8.0.	60	1,138,800	7.18. 3. 6.0.
21	398,580	2.15. 7. 3.0.	61	1,157,780	8. 0.16. 1.0.
22	417,560	2.17.19.16.0.	62	1,176,760	8. 3. 8.14.0.
23	436,540	3. 0.12.11.0.	63	1,195,740	8. 6. 1. 9.0.
24	455,520	3. 3. 5. 6.0.	64	1,214,720	8. 8.14. 4.0.
25	474,500	3. 5.18. 1.0.	65	1,233,700	8.11. 6.17.0.
26	493,480	3. 8.10.14.0.	66	1,252,680	8.13.19.12.0.
27	512,460	3.11. 3. 9.0.	67	1,271,660	8.16.12. 7.0.
28	531,440	3.13.16. 4.0.	68	1,290,640	8.19. 5. 2.0.
29	550,420	3.16. 8.17.0.	69	1,309,620	9. 1.17.15.0.
30	569,400	3.19. 1.12.0.	70	1,328,600	9. 4.10.10.0.
31	588,380	4. 1.14. 7.0.	71	1,347,580	9. 7. 3. 5.0.
32	607,360	4. 4. 7. 2.0.	72	1,366,560	9. 9.16. 0.0.
33	626,340	4. 6.19.15.0.	73	1,385,540	9.12. 8.13.0.
34	645,320	4. 9.12.10.0.	74	1,404,520	9.15. 1. 8.0.
35	664,300	4.12. 5. 5.0.	75	1,423,500	9.17.14. 3.0.
36	683,280	4.14.18. 0.0.	76	1,442,480	10. 0. 6.16.0.
37	702,260	4.17.10.13.0.	77	1,461,460	10. 2.19.11.0.
38	721,240	5. 0. 3. 8.0.	78	1,480,440	10. 5.12. 6.0.
39	740,220	5. 2.16. 3.0.	79	1,499,420	10. 8. 5. 1.0.
40	759,200	5. 5. 8.16.0.	80	1,518,400	10.10.17.14.0.

A further count of 6.2.0. from **1 Ahau 18 Kayab**① brings us again to **4 Ahau 8 Cumhu**⑦, while the sum of 9.9.9.16.0. and 6.2.0. gives 9.9.16.0.0.[1]

This would seem strong evidence

1. That we were right in supposing that 20 of the fourth place were equal to 1 of the fifth place.
2. That the dates at the bottom of Dr. 24 have a close relation to the numbers above them.

On Dr. 61 and 62 there are four serpents, each with two large numbers, — one in red and one in black, — among its folds. On Dr. 69 there is a single serpent similarly equipped. And underneath each number is a date, consisting of a day with its number and a month-day, though the months are nearly erased on Dr. 69. All these large numbers consist of six places, and if the vigesimal system prevails in the higher places we shall have not only,

20 of the fourth place equal 1 of the fifth place, but also
20 of the fifth place equal 1 of the sixth place.

The numbers and dates are given below; the serpents on Dr. 61, 62 being lettered A to D from right to left:

Dres.	Serpent	Number	Date given	Date reached from **9 Kan 12 Kayab** ⑮
61	D bl'k	4.6.14.13.15. 1.	**3 Chicchan 18 Xul**②	**1 Chicchan 18 Chen**⑱
	D red	4.6. 0.11. 3. 1.	**3 Chicchan 13 Pax**⑮	**5 Chicchan 13 Mac**(51)
	C bl'k	4.6. 9.16.10. 1.	**3 Chicchan 13 Yaxkin**㊴	**3 Chicchan 18 Yax**㉖
	C red	4.6. 1. 9.15. 0.	**3 Kan 12 Yax**⑲	**3 Kan 17 Uo**⑱
62	B bl'k	4.6. 7.12. 4.10.	**3 Ix 7 Pax**㉞	**3 Ix 7 Pax**㉞
	B red	4.6.11.10. 7. 2.	**3 Cimi 14 Kayab**⑦	**3 Cimi 14 Kayab**⑦
	A bl'k	4.6. 9.15.12.19.	**13 Akbal 1 Kankin**㉕	**13 Akbal 1 Kankin**㉕
	A red	4.6. 1. 9.15. 0.	**3 Kan 16 Uo**	**3 Kan 17 Uo**㉛
69	E bl'k	4.5.19.13.12. 8.	**4 Eb**	**4 Eb 5 Chen**㉞
	E red	4.6. 1. 0.13.10.	**9 Ix**	**9 Ix 12 Zip**⑨

[1] The other date, **1 Ahau 18 Uo**㊶, is reached by counting forward 1.5.14.4.0. (a number found in the second row of numbers on Dr. 24, Col. 4) from **1 Ahau 18 Kayab**①. For the method of calculating these distances see Appendix VII.

The date which is found with the red number of Serpent A, Dr. 62, is **3 Kan 16 Uo**, but, as **Kan** cannot be the 16th day of a month,[1] this is probably an error for **17**, or it is possible that the manuscript may have been copied in the later times when **Kan** had become the 1st, 6th, 11th, and 16th of the month, and the copyist for a moment forgot that he was copying an ancient document. Making this change and counting back the numbers from the dates below on the supposition that the vigesimal system prevails in the higher places, we find that all the numbers of Serpents A and B count back to **9 Kan 12 Kayab**[15] as their zero point, while the numbers in Serpents C and E count back to **9 Kan**, but to a different month-day in the case of C. The month-days of Serpent E are mostly erased, but from what can be seen of them it is probable that they are **12 Zip** and **5 Chen**, in which case the numbers above them will count back to **12 Kayab** as well as to **9 Kan.** We cannot explain why the count back of the numbers of Serpent C from its month-days does not reach **12 Kayab.** The red number of Serpent C is the same as the red number of Serpent A, and yet the date under the latter is **3 Kan 16 Uo**, probably meant for **17 Uo**, while the date under the former is **3 Kan 12 Yax**[19], a date 520 days in advance of **3 Kan 17 Uo**[15].

This leaves Serpent D as the last to be considered, and we find that in this case if we exchange the katun numbers 14 and 0 in the red and black numbers, it will bring the count correctly. Such an error might easily occur. If we suppose the black number to be 4.6.0.13.15.1., and that the copyist wrote the black number first, he would have to write the whole number in black except the zero which is always red. Then, when he came to the red number, which on my supposition was really 4.6.14.11.3.1., he would write the 4.6. in red, but finding the katun place already filled with a red number (zero), he thoughtlessly, or perhaps intentionally, wrote the 14 in black, so as not to have two red numbers together, and then finished by writing correctly the 11.3.1. in red.

If this change is made, by counting back each number except those of Serpent C from its date we reach **9 Kan 12 Kayab**[15], and

[1] See Table X.

this date is given on the tops of Dr. 61, 62 and 69 over the serpents, and is also repeated on the left-hand sides of Dr. 61 and 69. Reversing the process, we find that out of the ten large numbers probably eight of them, if counted forward from **9 Kan 12 Kayab**(15), will reach the dates given below them, and in two other cases will reach the day with its number attached. This, in connection with what we have found on Dr. 24, would seem to show that, as far as the codices are concerned,

20 of the fourth place equal 1 of the fifth place,
20 of the fifth place equal 1 of the sixth place.[1]

There are no Maya names which we know for these higher places, but it has been the custom to call them "cycles" and "grand cycles." We may therefore accept the following table as a correct one for the Maya calendar as found in the codices, namely:

				20 Kins =	1 Uinal
			18 Uinals =	360 Kins =	1 Tun
		20 Tuns =	360 Uinals =	7,200 Kins =	1 Katun
	20 Katuns =	400 Tuns =	7,200 Uinals =	144,000 Kins =	1 Cycle
20 Cycles =	400 Katuns =	8000 Tuns =	144,000 Uinals =	2,880,000 Kins =	1 Grand cycle

What we have found also is strong evidence that the numbers serve to denote the distance from some date which is the zero point of the count.

The different methods of calculating distances from one date to another will be found set forth in Appendix VII.

It will be seen that in all the above cases the kin number determines the named day sought for. It settles the day of the starting point when the day reached is known, and it settles the day to be reached when the starting point is known. This is so because the number of days included in each of the even periods higher than kin (cycle, katun, tun and uinal) is divisible by 20 without a remainder, and the 20 days are counted again and again,

[1] The evidence that 20 of the fifth place equal one of the sixth place is strengthened by the fact that on Dr. 31a the long number 19.9.9.3.0. appears. If 19 or any less number in the fifth place was made equal to 1 in the sixth place, the number here given would have extended into the sixth place instead of being composed of but five places.

and come out evenly as far as these numbers are concerned. It is the number attached to the kin which is of consequence in determining the day sought for. On Dr. 24, for instance, the zero or starting point is a day **Ahau**, and as the kin number is 0, the day reached is also **Ahau**.

So in the long numbers with six places on Dr. 61–62 and 69, where the day **Kan** is the zero point, when the kin number is 1, the day next to **Kan**, or **Chicchan**, is found; when the kin number is 2, the second day from **Kan**, or **Cimi**, is reached; when the kin number is 8, the eighth day from **Kan**, or **Eb**, appears; when the kin number is 10, we find **Ix**, and when the kin number is 19, the day **Akbal** is seen. It will be well to remember this when we discuss the inscriptions.

CHAPTER VII

THE DAY AND MONTH FORMS IN THE INSCRIPTIONS. PERIOD GLYPHS

IN this chapter it will be shown, —

1. That the same system of marking time by days with their numbers and by months, which is found in the codices, is also found in the inscriptions.
2. That the forms for the days and the months are practically the same in both, and that the line and dot method of denoting numbers is found in the inscriptions.
3. That large numbers running up to five places are found in both.
4. That in the inscriptions the periods of kins, uinals, etc., are usually recorded, not by their relative position, as in the codices, but by separate glyphs.
5. That these period glyphs are of various forms, at times being geometric, as in the so-called "normal" forms, and at times being in the form of heads or full-sized bodies of men, animals or birds.
6. That with the knowledge, gained as above, we can fill in gaps in the Initial series where glyphs have been destroyed and recognize forms, hitherto unknown, of the number, period, day and month glyphs.
7. That nearly all the Initial series record the passage of nine cycles from a date **4 Ahau 8 Cumhu**⑦ which is seldom expressed.
8. That the meaning of the large Initial glyph is yet to be decided.

Day Signs in the Inscriptions. — We have up to this time studied the Maya time glyphs as they are found in the codices, and have determined the day and month glyphs and the numerals from zero to 20 as found there. We have always found that the numbers 1 to 19 (probably zero also) appear attached to the month signs, while the numbers attached to the day signs never rise higher than 13.

On studying the inscriptions we are struck by the continual appearance of glyphs which strongly recall the day and month glyphs of the codices. Thus we find the well-known form of **Ahau** continually appearing in the inscriptions. Copan, Stela A, E2,[1] shows a glyph which is clearly **Ahau** with four dots attached to it and accompanied by a form which has a strong resemblance to the month **Muan** and which has an **18** attached to it. So, referring to Plate VI, we should have no difficulty in recognizing **Ahau** in Nos. 1–20 inclusive, all of these forms being found in the inscriptions. In all these cases we find a number attached to **Ahau** and in no instance is the number over **13**. This fact makes it clear that the day **Ahau** with its numbers appears on the inscriptions, and that therefore the notation of time is referred to; and the evidence grows stronger when we find also such similarities as appear on Plates V and VI, in the forms of the days

Ymix Nos.	1–3.
Ik	4 and probably 1–3.
Akbal	1.
Kan	1–6.
Lamat	1–3.
Muluc	1.
Ix	2.
Caban	1–6.
Eznab	1–3.

[1] The glyphs of the inscriptions, as has been pointed out in the Introduction, are usually referred to by giving letters to the columns from left to right and by numbering the rows from top to bottom. Thus if an inscription consists of several columns, as is often the case at Palenque, each space occupied by a perpendicular column receives designation by a letter, whatever the number of glyphs may be which compose the column, and each horizontal row receives designation by a number. Thus the glyph in the compartment marked by a cross in the accompanying figure (Fig. 4) will be C3. When a stela has columns on more than one side, the direction in which the side faces is often given; but when this is not done, the order of lettering will begin with the inscription on the broad side (the front or back), then to the side on the left of the observer, and then to the side on the right of the observer. In one or two instances

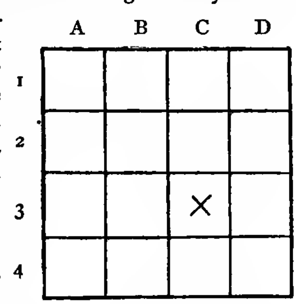


Fig. 4.

The forms of many other days show more or less similarity in the codices and inscriptions. Thus **Manik** can be seen to represent a closed hand with a small circle at the bottom; **Chicchan** has cross-hatching; the face form of **Oc** is common to both, and there is a certain similarity in the forms of **Eb** and **Ben**, as found in the inscriptions, with the codex forms of these day signs.

The forms of all the days of which there is any doubt will be proved in the discussion which follows, except those of **Chuen**, **Eb** and **Ben**. It may be stated as a general rule that, where there is any doubt in deciding whether a day form represents one day or another, it will be a help to remember that, if it is associated with a month-day, the choice is cut down to one of four days.

Chuen, **Eb** and **Ben** are then the only days which cannot be recognized with some degree of probability. **Chuen** appears on F 1 of Stela 1 of Piedras Negras, but the form is too indistinct to be determined, though it has a certain similarity to the uinal sign and to the **Chuen** sign of Landa and of the codices. That it is really a **Chuen** sign is rendered clear from the fact that its distance from the preceding and following dates is correctly given in the inscription.

Eb appears on the Palace Steps of Palenque in the date **6 Eb 10 Zip**, on Altar U of Copan, GH3 and on Stela C, base (s), of Quirigua. In these three cases the forms of the day signs are practically the same, and as the days are connected with the month-days **10**, **0** and **5** of their respective months, the day must be **Eb**, **Caban**, **Ik** or **Manik**. In no one of the three cases is the day **Caban**, **Ik** or **Manik**, and it must therefore be **Eb** by process of exclusion.

It is unfortunate that the decision as to **Ben** rests on the form found on C1 of Altar Q of Copan, where there is a doubt about the number attached to the day sign. But **Ben** is here stated to

the order of the glyphs runs from left to right round the four sides of a monolith. The above plan of designation will usually be followed, but will occasionally be deviated from when it seems best to follow Maudslay's notation. In such a case attention will be called to the deviation.

be **11 Muan**, and the form must therefore be either **Ben**, **Eznab**, **Akbal** or **Lamat**. It is not certainly any one of the last three.

Month Signs in the Inscriptions. — The month signs of the inscriptions are, if anything, more easily recognized than the day signs. (Plates IX and X.)

Pop is recognized by the so-called kin sign and knot.

Uo and **Zip**, by the cross and superfix, the latter differing in the two signs.[1]

Zotz, by its bat head.

Tzec, by the similarity of its main part, though the comb is on top in the inscriptions and underneath in the codices.

Xul, by its similarity with that found in Dr. 46 and 49.

Yaxkin, by the kin sign and superfix, and often by its beard or wing.

Mol, by its circle of dots.

Chen is more difficult to recognize.

Yax, **Zac** and **Ceh**. These all have the **Cauac** sign as their chief part, while they are distinguished from each other by their superfixes.[2] (Plate X.)

Kankin is practically the same in the codices and inscriptions.

Muan is recognized by the similarity of the heads.

Pax is practically the same in the codices and inscriptions.

Kayab. The turtle head is not as clear in the codices as in the inscriptions. The cross or kin sign is clear.

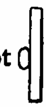
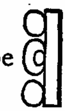
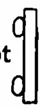
Cumhu. The **Kan** sign with its top piece is seen in all cases.

Uayeb. The lower part is the same in the inscriptions as in the codices, but the upper part in the former differs slightly from that in Dr. 50.

Bars and Dots in the Inscriptions. — All these day and month forms are accompanied by lines or bars and dots, which, from our experience with the codices, would lead us to suppose that they served the same purpose here as there, especially as in

[1] The difference in the superfixes of **Uo** and **Zip** is practically the same which we find in the superfixes of these months in the codices.

[2] The differences in the superfixes of **Chen**, **Yax**, **Zac** and **Ceh** are in many respects the same as in the superfixes of these months in the codices, though not entirely so.

connection with the day forms two lines and three dots seem to be the limit reached, while with the month forms we find as large a number as is indicated by three lines and four dots. The chief differences between these number forms in the codices and inscriptions are that in carving it is necessary to make the lines thick and to turn the dots into circles, and that the Maya sculptors disliked to leave a vacant space in their work. When a number was used which had but one or two dots in it, the sculptor was wont to fill up the spaces on the sides of the single dot or the central space between the two dots with an ornament. Thus if the number six was to be carved, he would sometimes carve it thus:  and not . Seven would be  and not . Where three or four dots were used, there was usually no space which needed to be filled up. Where the carving is not distinct, it is not always easy to distinguish the ornament from the dots, though the latter are usually complete circles while the former has a more or less curved form. (Plate XV.) The lines which mean 5 in the inscriptions are often ornamented, and when this ornament takes the form of a straight line running lengthwise through the number form, there may arise some uncertainty as to whether one or two lines are represented, that is, whether the number is 5 or 10. Plate XV shows the glyphs which express the numbers 1 to 19 by the line and dot method.[1]

Since, then, some at least of the day signs and of the month signs appear in close connection with the numbers 1 to 13 for the former and 1 to 19 (probably also zero) for the latter, and since the days with their numbers appear in close connection with the months and their numbers, thus forming dates, we can be reason-

[1] Dr. Seler, (Seler, 1902, Vol. I, p. 812) considers that the simplest form of zero is found on Stela C A5 of Copan in the cross-hatched circle on the left of the glyph. This is an error, for this circle means 1, and the number of which it forms a part gives the distance from **6 Ahau 18 Kayab** (45) on B7 A8 to **6 Ahau 13 Muan** (38) on AB9.

ably sure that time calculations which we find in the codices are also found in the inscriptions.

There are, however, a number of day forms given on Plates V and VI which cannot be recognized from their likeness to the codex forms and which must be proved in some other manner. As we proved some of the codex forms by their distance from other known forms or from a zero point, it may be possible to do the same with the forms found in the inscriptions.

Initial Series. — On looking over the inscriptions, Dr. Förstemann was struck by the fact that at the top of many of them there was a large glyph stretching across two columns, and that under this were five glyphs,[1] each with lines and dots attached to it, — these lines and dots apparently representing numbers. These five glyphs with the larger glyph have received the name "Initial series," and they will be so called hereafter. It at once occurred to him that here he had a time calculation resembling that which he had found in the codices, — numbers consisting of five places, except that in the codices the different values of the places were usually denoted merely by their position, one below the other in a vertical line, whereas in the inscriptions the different values were denoted, except in a few instances, not only by their position, but also by glyphs. He then undertook to determine whether the Initial series were really numbers like those of the Dresden codex, and whether they counted back to some zero point, as on Dr. 24 and elsewhere. Let us make the same experiment.

On Altar S, Copan,[2] we find the large initial glyph, followed by a head with the number 9 and again by a head with the number 15 (Maudslay draws it 13, but the photograph of the Peabody Museum shows it plainly as 15). Then three heads follow, each with the form shown in Fig. 5 attached to it, and then comes the date **4 Ahau 13 Yax**⑥. We will not now discuss the heads which appear to represent the periods, — cycle, katun, etc., — but will confine ourselves to the

Fig. 5.

[1] These glyphs are usually to be read in columns of two from top to bottom of the columns, reading across one row of both columns before reading the row next below.

[2] The glyphs on Altar S run in one row round the four sides of the monolith.

numbers attached to them. If these numbers correspond to the numbers consisting of five terms in the codices, the 9 will mean 9 cycles and the 15 will mean 15 katuns. These numbers 9 and 15 are clear. What is the meaning of the flaring sign? In the codices we found that the dot and line method was used, in connection with the periods, for the numbers 1 to 19, and that the only other number used was zero, which took on a variety of forms. (Plate XVIII.) We might well suppose that the flaring sign means zero, since the numbers 1 to 19 have signs of their own, and since 19 is the highest number which we have found connected with the period numbers in the codices. At all events, whatever the meaning is, it must belong to all three of the numbers connected with the tun, uinal and kin signs, since all three flaring signs are practically the same.

If, to begin with, we call this sign zero, we shall have the number 9.15.0.0.0., and if we wish to determine the starting point from which this number was counted, we shall have to count back 9.15.0.0.0. from **4 Ahau 13 Yax**⑥. Recollecting (page 88) that the kin number of a numerical series determines the starting point when we have the day reached before us, or determines the day reached when we know that of the starting point, we find that, with the kin number as zero and the day reached as **Ahau**, as happens here, the day of the starting point must also be **Ahau**. This reminds us that the starting point of the long numbers on Dr. 24 was **4 Ahau 8 Cumhu**⑦.

We start then with . . . . . **4 Ahau 13 Yax**⑥, 9.15. 0. 0.0.
Using my method[1] for obtaining the day with its number and the month-day, we must first deduct all full calendar rounds from this number, or 73 calendar rounds, amounting to . . . . 9.12. 8.13.0.
By doing this, there is left . . . . 2.11. 5.0.
Making the calculation in order to obtain the day numbers we get

$2 \times 2 + 4 \times 11 = -48.$

$5 \times 7 = +35.$ The difference is -13 or -0.

[1] See Appendix VII.

This shows that the day of the starting point and the day reached have both the same number, or **4**. The day of the zero point is then **4 Ahau**, reminding us again of the starting point of Dr. 24. Again, in order to obtain the month and its number we multiply $2 \times 100 + 5 \times 11 = -255$, while $5 \times 20 = +100$. The difference is -155. If we were counting forward *from* the starting point, we should have to deduct this difference from the month and its number, in order to reach our result, but as we are counting back *to* the starting point, we must add this number to the month-day reached, namely, **4 Ahau 13 Yax**[6], in order to find the month-day of the starting point. Counting forward 155 days from **13 Yax** we reach **8 Cumhu**, thus proving that if the flaring sign is zero (and we have no other number to give it) this date 9.15.0.0.0., **4 Ahau 13 Yax**[6], has for a zero point **4 Ahau 8 Cumhu**[7], as was the case with the long number of Dr. 24.

Goodman's Tables bring the same result, since, in what he calls the 54th grand cycle, the dates are calculated from **4 Ahau 8 Cumhu**[7], this being the grand cycle in which almost all the dates occur in the inscriptions. Goodman calls the flaring sign 20 in all places in which it is found except in connection with the uinal sign, where he gives it the meaning of 18. In other words, he considers it as meaning a "completed series"; but in all his calculations he gives to the 20 and 18 the value of zero, as has been said before.

Again, on Stela C (w) of Quirigua we find

1. The large glyph over both columns of the inscription.
2. On A3, a head with the number 9, though the 9 is somewhat defaced.
3. On B3, a head with the number 1, the two curves above and below the number 1 being evidently mere ornament.
4. On AB4, heads with the flaring form, though that of A4 is somewhat defaced. (See Plate XVII, ZERO, No. 6.)
5. On A5, two heads, the first occupying the place which numbers occupy elsewhere and having a hand across the face.
6. A glyph, B5, without a number intervenes, and then on AB6 is the undeniable date of **6 Ahau 13 Yaxkin**[42], the ornamentation of the dots and lines being apparent in the **6** of **6 Ahau**.

If, then, this long number really counts back to **4 Ahau 8 Cumhu** (7), as was the case with the long number of Dr. 24 and of Altar S of Copan, the form of the head with a hand across the face must mean zero, since the day given in A6 is **Ahau**, and any other kin number (among those which we have heretofore found in such connection) if counted from **Ahau**, either forward or backward, would bring some other day than **Ahau**. If this is the case, we have the following number, 9.1.?.?.0., **6 Ahau 13 Yaxkin** (42). The forms which we find in the tun and uinal places are alike, and are similar to those which in Altar S of Copan have been found to mean zero in all probability. If this is the meaning here we should have the number 9.1.0.0.0. This being a very simple number, we will use Goodman's Tables, since it makes no difference whether we count forward from **4 Ahau 8 Cumhu** (7) to **6 Ahau 13 Yaxkin** (42) or back from the latter date to the former. Turning to his Grand Cycle 54, Cycle 9, we find under 9.1.0. (or as he writes it, 9.1.20.) the date **6 Ahau 13 Yaxkin** (42).

On the supposition that the zero point is **4 Ahau 8 Cumhu** (7), we have found here a new form for zero, — the face with a hand across it. (See Plate XVII, ZERO, No. 21.)

If the flaring form of zero has been correctly determined, we find on Stela E (e) of Quirigua the date 9.17.0.0.0., followed on A6 by **13** with a face (Plate VI, AHAU, No. 23), and after several intervening glyphs, on A9 by **18** with a sign which resembles **Cumhu**, inasmuch as it has the **Kan** sign with a superfix. Here the ornamental curve between the two dots of the 17 in the katun number is evident. Turning again to Goodman's Tables we find under 9.17.0.0.0. (or 9.17.20.20.20. as Goodman writes it) the date **13 Ahau 18 Cumhu** (45), calculated from **4 Ahau 8 Cumhu** (7) as a zero point. The **13** and **18** and the form of the month **Cumhu** agree with what we already know, and if we have the correct zero point we have here a new form of **Ahau**, — a face looking to the left.

Again, on Stela E (w) of Quirigua we find the following date very plainly cut in the stone, 9.14.13.[1] 4.17., **12 Caban 5 Kayab** (51)

[1] This number is 12 on the inscription, but it must be an error, as will be explained later on, when the distance numbers are calculated. This date of **12 Caban 5 Kayab** (51) reappears in Quirigua on Stelæ F (w) and J and on Animal G.

(the month following after several intervening glyphs). Deducting 73 calendar rounds, or 9.12.8.13.0., we have left 2.4.9.17. Making the calculations we have $2 \times 2 + 4 \times 4 = -20$ and $9 \times 7 + 17 = +80$. The difference is $+60$, or, taking out thirteens, $+8$. Adding this to 4 of **4 Ahau**, we have **12** for the day number. The day must be 17 kins from **Ahau**, that is, **Caban**. The month-day is reached by $2 \times 100 + 4 \times 5 = -220$ and $9 \times 20 + 17 = +197$. The difference is -23. Counting this back from **8 Cumhu** we reach **5 Kayab**, thus reaching the date of the inscription **12 Caban 5 Kayab**[61], and proving that this date starts from **4 Ahau 8 Cumhu**[7] as a zero point.

Thus in these cases the count is from **4 Ahau 8 Cumhu**[7] (which, however, is not expressed)[1] as the zero point, as shown in the numbers, the day and the month-day. It is true that this result has been obtained by assigning to certain glyphs, which up to this time were unknown, a value of zero, and by considering a number 12 an error for 13. It will be well, therefore, to examine other inscriptions, so that there may be no doubt about the facts.

On Stela K in Quirigua the first three numbers are plainly 9.18.15., while the last two are the flaring sign which we have called zero. Turning to Goodman, we find that by counting 9.18.15.0.0. from **4 Ahau 8 Cumhu**[7] we reach **3 Ahau 3 Yax**[28]. The day number is **3**, and the day which we find in glyph A5 is the face which was called **Ahau** in Stela E (e). They both have the circle on the cheek. The day and its number in the inscription then agree with the day and its number in the tables. But if the adjoining glyph is **3 Yax**, both the number and the form differ from the forms with which up to this time we have been conversant. The position of the month in connection with the Initial series varies so much that we have no right yet to decide that the superfix  means **3** and that the form below means **Yax**,

[1] In the same way the zero point of our count of time, the birth of Christ, is seldom expressed, though sometimes, especially in legal documents, the letters A. D. are added to the date.

as some other glyph may be the month-day. Later, when we come to discuss the distance numbers, it will be seen that this is probably the meaning.

Stela I, Quirigua, gives the Initial series 9.18.10.0.0., **10 Ahau 8 ?**, if our identification of zero is correct, the month being clearly **Chen**, **Yax**, **Zac** or **Ceh**, — probably **Zac**. Goodman's Tables show that **10 Ahau 8 Zac**(23) is reached after the lapse of 9.18.10.0.0.

In the Initial series of Stela 1 of Copan the numbers meaning 5 are ornamented, all with straight lines and some with cross-hatching, etc. The circles or dots, meaning 1, have small circles within them, except two in the uinal number, where there are two dots with the small circles and two without, but as all are of the same size and as none of them have the curved form which we have generally found as an ornament to fill the vacant spaces, we shall be justified in calling the uinal number 14. The number of the lowest period is a glyph representing a face with a hand across it, which we have before called zero.

We therefore have the number	9.11.15.14.0.
There is no date on the front of the Stela, but on the side is the date **11 Ahau**, with a month which looks like **13 Zotz**, but which is probably **8 Zotz**, as the line in the centre of the member meaning **5** is probably ornamental, as is the case in other fives in this series. In order to see whether this number counts back to **4 Ahau 8 Cumhu**(7) from the date given, or, what is the same thing, whether this number counts forward from **4 Ahau 8 Cumhu**(7) to **11 Ahau 8 Zotz**(47), we deduct 72 calendar rounds .	9. 9.16. 0.0.
and have left	1.19.14.0.

The day number will now be reached by the following calculation, namely, $2 \times 1 + 4 \times 19 = -78$, and $7 \times 14 = +98$. The difference between $+98$ and -78 is $+20$, or (deducting 13) $+7$. This added to **4** gives **11** as the day number. The month and its day will be reached by $1 \times 100 + 19 \times 5 = -195$, and $14 \times 20 = +280$. The difference is $+85$, which, counted forward from **8 Cumhu**, brings us to **8 Zotz**, thus proving that the Initial series counts back to **4 Ahau 8 Cumhu**[7] as the starting point.

On Stela 6 of Copan we find 9.12.10.0.0., the two zeros being denoted by different signs, one by the flaring sign and the other by the head with a hand on the face. The heads which follow the numbers in the tun and uinal places are practically destroyed, but the numbers are clear. Goodman's Tables give us as the date which belongs to this number, **9 Ahau 18 Zotz**[9], if the count is from **4 Ahau 8 Cumhu**[7], and on B4 we find a **9** with a curious head enclosed in a frame, and on B6, **18 Zotz.** This gives us a new form for **Ahau.** (Plate VI, AHAU, No. 38.)

In the following examples the flaring sign and the face with a hand over the lower part are considered as zero.

We have found so far in the inscriptions that the cycle number is invariably 9, so that when we come to Stela 9 of Copan we may feel justified in restoring the four circles in the cycle place, since the line meaning 5 is clear, and the space on the left shows that there was room for a circle or circles here. This gives us 9.6.10.0.0. Goodman's Tables give as the date corresponding to this number, counting from **4 Ahau 8 Cumhu**[7], **8 Ahau 13 Pax**[46]. We find a face for **Ahau** (Plate VI, AHAU, No. 30) and a number attached which shows the **5**, though the three dots are erased but the space is there for them. Glyph B8 gives us **13 Pax.**

In Copan, Stela A, we find 9.14.19.8.0., followed by a glyph with **12** attached to a curious head in a frame, while in B9 is given a month-day, **18 Cumhu.** Deducting 73 calendar rounds, or 9.12.8.13.0., from this number, we have left 2.10.13.0., which gives us the date **12 Ahau 18 Cumhu**[5], if the zero point is **4 Ahau 8 Cumhu**[7]. (Plate VI, AHAU, No. 35.)

In Copan, Stela B, we find 9.15.0.0.0. which by Goodman's Tables gives us **4 Ahau 13 Yax**[6], which we find immediately following the number.

Copan Stela M gives us 9.16.5.0.0., **8 Ahau 8 Zotz**[31], and Goodman's Tables show us the same date, under this number.

Copan Stela N gives us 9.16.10.0.0., **1 Ahau 8 Zip**[31]. Here the day and its number and the month agree with the date found in Goodman's Tables under this number, which is **1 Ahau 3 Zip**[36]. The discrepancy in the number of the month-day is still to be explained.

Yaxchilan Lintel 21 has the date 9.0.19.2.4., **2 Kan 2 Yax**[41]. Deducting 68 calendar rounds, or 8.19.5.2.0., we have left 1.14.0.4., which, counted forward from **4 Ahau 8 Cumhu**[7], brings us to **2 Kan 2 Yax**[41]. Here the day reached is **Kan**, the kin number being 4, and **Kan** being four days from **Ahau.**

Yaxchilan Stela 11 (bot.) gives 9.16.1.0.0., **11 Ahau 8 Tzec**[27], and by referring to Goodman's Tables we find that this is the day reached from **4 Ahau 8 Cumhu**[7], after the passage of this time.

Yaxchilan Altar near structure 44 has the date 9.12.8.14.1., **12 Ymix 4 Pop**[8]. Deducting 73 calendar rounds, or 9.12.8.13.0., we have left 1.1., which, counted forward from **4 Ahau 8 Cumhu**[7], brings us to **12 Ymix 4 Pop**[8].

Piedras Negras Stela 1 gives 9.12.2.0.16., **5 ? 14 Yaxkin,** and Stela 3 has the same date. Deducting 72 calendar rounds, or 9.9.16.0.0., we have left 2.6.0.16., which, counted forward from **4 Ahau 8 Cumhu**[7], brings us to **5 Cib 14 Yaxkin**[1].

Piedras Negras Stela 25 has the date 9.8.10.6.16., **10 ? 9 Mac.** Deducting 71 calendar rounds, or 9.7.3.5.0., we have left 1.7.1.16., which, counted forward from **4 Ahau 8 Cumhu**[7], brings us to **10 Cib 9 Mac**[34].

In these last three cases the form of the day **Cib** is made known, differing somewhat from that of the codices, while the form of **Mac** is very similar to that found on Dr. 50.

Piedras Negras Stela 36 has the date 9.10.6.5.9., **8 ? 2 Zip.** Deducting 72 calendar rounds, or 9.9.16.0.0., we have left 10.5.9., which, counted forward from **4 Ahau 8 Cumhu**[7], brings us to **8 Muluc 2 Zip**[18]. The **Muluc**, though so defaced that the small circle in its centre cannot be made out, is of the same general form that we usually find in this day sign.

Naranjo Stela 8 has the date 9.18.10.0.0., **10 Ahau 8 Zac,**[23] while Stela 13 has 9.17.10.0.0., **12 Ahau 8 Pax**[3], and these dates are seen by Goodman's Tables to be the dates reached from **4 Ahau 8 Cumhu**[7] after the passage of these periods respectively.

Tikal Stela 3 has the date 9.2.13.0.0., **4 Ahau 13 Kayab**(22), which agrees with the date found in Goodman's Tables after the passage of this period from **4 Ahau 8 Cumhu**(7).

The foregoing cases are sufficient to show that one, at least, of the objects of this count by cycles, katuns, etc., is to give a number which, counted from **4 Ahau 8 Cumhu**(7), will bring us to the date given at the end of the Initial series. This decision will permit us to bring forward two other examples among the stelæ of Quirigua, which give us another form of zero.

Quirigua Stela A (e) gives an Initial series of 9.17.5.?.?., ?. ?. **13 Kayab.** The uinal and kin numbers are alike, and consist of a frame with a scroll inside, the whole supported by a hand held in much the same position as the hand is held before the face in the numbers which we have called zero. The day is a face looking towards the left, which, though it has no circle on the cheek, has a likeness to the face which we have met before in a similar position, and which in Stelæ E (e) and K of Quirigua have been considered as meaning **Ahau.** If these glyphs have these meanings, the Initial series becomes 9.17.5.0.0., **? Ahau 13 Kayab.** On turning to Goodman's Tables we find that 9.17.5.0.0. brings us to **6 Ahau 13 Kayab**(60), and later it will be seen that the head with the "hatchet eye" which precedes the **Ahau** has the meaning of **6.** This makes it clear that the hand and scroll is another form for zero. (Plate XVII, ZERO, No. 16.) This decision as to the meaning of the zero and **Ahau** is confirmed by the fact that, the uinal and kin numbers being the same, if we substitute any other number than zero in these places, **13 Kayab** will not be reached.

Again, on Stela C (e) of Quirigua there is an Initial series which has the scroll and hand sign for the kin number, and the day is the same face, looking towards the left and with a circle on the cheek, which we have considered as meaning **Ahau.** If the day is **Ahau**, the kin number must be zero, if the count is from **4 Ahau 8 Cumhu**(7). We may therefore safely consider that the scroll and hand sign means zero. (Plate XVII, ZERO, Nos. 15–18.)

In all these dates the cycle number is clearly 9, except in one case where the number is injured. We may then consider it settled that, except where we have excellent reasons to the contrary, the cycle number is 9, and this number can be supplied where, as in the case of Stela 9 of Copan, the cycle number is injured.

Again, in all these dates the flaring form, the head with a hand across the face, and the scroll and hand form, if given the value of zero, bring about the same result, — namely, of counting back to a date far in the past, **4 Ahau 8 Cumhu**⑦, — as did the long numbers of the Dresden codex in which the cycle number was 9.

Such agreement cannot be accidental, but must be intentional and in accordance with the calendar of the Mayas. We may therefore consider it settled that the flaring form, the scroll and hand form and the head with a hand across the face all mean zero, and that the starting point or zero point from which the large numbers in the cases cited are counted is **4 Ahau 8 Cumhu**⑦. This fact makes it very probable that the other large numbers which we shall find in the Initial series of the other inscriptions have the same starting point.

Moreover, all these calculations show that these large numbers refer to the number of days which have passed since the date **4 Ahau 8 Cumhu**⑦, so that in every case if we count forward from **4 Ahau 8 Cumhu**⑦, the number of days expressed by these large numbers, we reach the day and month given in the Initial series. In other words, the large numbers, as expressed in their five terms or places, all refer to the time which has elapsed and not to current time. This must be remembered in the discussion as to whether the days of the month are also numbered on this principle or not.[1] (See Appendix VI.)

If, then, these large numbers are reckoned forward from the same fixed date, **4 Ahau 8 Cumhu**⑦, it is evident that the smaller

[1] It will be more convenient, instead of speaking of a certain number of cycles, katuns, etc., having passed, to speak of a cycle, katun, etc., with the number attached. Thus, instead of speaking of nine cycles having elapsed, we can simply say that it is Cycle 9, not meaning by this, however, that it is the ninth cycle, but that nine cycles have elapsed.

TABLE XII

Altar S Copan.			Stela M Copan.			Stelæ 1 and 3 Piedras Negras.		
1. 1. 1.[1]	13 Cauac	12 Kayab (6)	1. 1.[1]	9 Cauac	7 Kayab (7)	1.16.[2]	10 Ahau	8 Kayab (7)
2. 2. 2.	9 Eznab	16 Pax (5)	2. 2.	1 Eznab	6 Pax (7)	2.16.	3 Ahau	8 Pax (7)
3. 3. 3.	5 Caban	0 Pax (4)	3. 3.	6 Caban	5 Muan (7)	3.16.	9 Ahau	8 Muan (7)
4. 4. 4.	1 Cib	4 Muan (3)	4. 4.	11 Cib	4 Kankin (7)	4.16.	2 Ahau	8 Kankin (7)
5. 5. 5.	10 Men	8 Kankin (2)	5. 5.	3 Men	3 Mac (7)	5.16.	8 Ahau	8 Mac (7)
6. 6. 6.	6 Ix	12 Mac (1)	6. 6.	8 Ix	2 Ceh (7)	6.16.	1 Ahau	8 Ceh (7)
7. 7. 7.	2 Ben	16 Ceh (52)	7. 7.	13 Ben	1 Zac (7)	7.16.	7 Ahau	8 Zac (7)
8. 8. 8.	11 Eb	0 Ceh (51)	8. 8.	5 Eb	0 Yax (7)	8.16.	13 Ahau	8 Yax (7)
9. 9. 9.	7 Chuen	4 Zac (50)	9. 9.	10 Chuen	19 Mol (7)	9.16.	6 Ahau	8 Chen (7)
10.10.10.	3 Oc	8 Yax (49)	10.10.	2 Oc	18 Yaxkin (7)	10.16.	12 Ahau	8 Mol (7)
11.11.11.	12 Muluc	12 Chen (48)	11.11.	7 Muluc	17 Xul (7)	11.16.	5 Ahau	8 Yaxkin (7)
12.12.12.	8 Lamat	16 Mol (47)	12.12.	12 Lamat	16 Tzec (7)	12.16.	11 Ahau	8 Xul (7)
13.13.13.	4 Manik	0 Mol (46)	13.13.	4 Manik	15 Zotz (7)	13.16.	4 Ahau	8 Tzec (7)
14.14.14.	13 Cimi	4 Yaxkin (45)	14.14.	9 Cimi	14 Zip (7)	14.16.	10 Ahau	8 Zotz (7)
15.15.15.	9 Chicchan	8 Xul (44)	15.15.	1 Chicchan	13 Uo (7)	15.16.	3 Ahau	8 Zip (7)
16.16.16.	5 Kan	12 Tzec (43)	16.16.	6 Kan	12 Pop (7)	16.16.	9 Ahau	8 Uo (7)
17.17.17.	1 Akbal	16 Zotz (42)	17.17.	11 Akbal	16 Cumhu (6)	17.16.	2 Ahau	8 Pop (7)
18.18.18.	10 Ik	0 Zotz (41)	18.18.	3 Ik	15 Kayab (6)	18.16.	8 Ahau	13 Cumhu (6)
19.19.19.	6 Ymix	4 Zip (40)	19.19.	8 Ymix	14 Pax (6)	19.16.	1 Ahau	13 Kayab (6)
20.20.20.	2 Ahau	8 Uo (39)	20.20.	13 Ahau	13 Muan (6)	20.16.	7 Ahau	13 Pax (6)

[1] This column shows the number assumed as the value of the flaring sign.

[2] In these stelæ the flaring sign occurs only in the uinal place, the kin number being 16 in both cases.

the number the earlier in point of time is the date which belongs to this number, and the larger the number the later in point of time is the accompanying date. Thus, though it is not possible to decide at present the connection which the Maya dates hold with those of modern chronology, it is possible to decide the relative position which the Maya dates hold among themselves.

Though it is evident that **4 Ahau 8 Cumhu**⑦ is the point uniformly reached by counting back the large numbers from the dates given, when we give the value of zero to the flaring sign and to the two forms with the hand, it may be interesting to see that no such uniformity of date is found when any other value is given to these signs. This is shown in Table XII in the case of Altar S of Copan by counting back from **4 Ahau 13 Yax**⑥ (the date at the end of the series) the different number of days which would result from giving to the flaring sign the different values from 1 to 20. There is in fact no need of calculating these values farther than 17, since 18 uinals equal 1 tun, and the number 9.15.18.18.18. would become 9.15.19.0.18., which cannot be the case, since the number glyphs of the tun, uinal and kin periods are the same. To these values are added the starting points reached under similar circumstances in Stela M of Copan and in Stelæ 1 and 3 of Piedras Negras.

It will be readily seen that in no cases are the starting points of the three dates the same, while in some cases the starting points are widely separated. Thus, where we give the value of 1 to the flaring sign, we find that **13 Cauac 12 Kayab** of Altar S is in year 6 of Goodman's Archaic Calendar, **9 Cauac 7 Kayab** of Stela M is in year 7 and **10 Ahau 8 Kayab** of Piedras Negras is in year 7. The argument from uniformity is, I think, convincing for giving the value of zero to the flaring sign. A similar proof can be given of the correctness of the decision that the face with the hand across the lower part and the scroll and hand sign also mean zero.

Table XIII gives a list of the Initial series which have been cited.

TABLE XIII

1.	Quirigua, Stela	C (w)	9. 1. 0. 0. 0.,	**6 Ahau**	**13 Yaxkin** (42)
2.		E (e)	9.17. 0. 0. 0.,	**13 Ahau**	**18 Cumhu** (45)
3.		E (w)	9.14.13. 4.17.,	**12 Caban**	**5 Kayab** (51)
4.		K	9.18.15. 0. 0.,	**3 Ahau**	**3 Yax** (28)
5.		I	9.18.10. 0. 0.,	**10 Ahau**	**8 Zac** (23)
6.	Copan, Stela	1	9.11.15.14. 0.,	**11 Ahau**	**8 Zotz** (47)
7.		6	9.12.10. 0. 0.,	**9 Ahau**	**18 Zotz** (9)
8.		9	9. 6.10. 0. 0.,	**8 Ahau**	**13 Pax** (46)
9.		A	9.14.19. 8. 0.,	**12 Ahau**	**18 Cumhu** (5)
10.		B	9.15. 0. 0. 0.,	**4 Ahau**	**13 Yax** (6)
11.		M	9.16. 5. 0. 0.,	**8 Ahau**	**8 Zotz** (31)
12.		N	9.16.10. 0. 0.,	**1 Ahau**	**3 Zip** (36)
13.	Altar	S	9.15. 0. 0. 0.,	**4 Ahau**	**13 Yax** (6)
14.	Yaxch'n, Lintel	21	9. 0.19. 2. 4.,	**2 Kan**	**2 Yax** (41)
15.	Pied. Neg. Stela	1	9.12. 2. 0.16.,	**5 Cib**	**14 Yaxkin** (1)
16.		3	9.12. 2. 0.16.,	**5 Cib**	**14 Yaxkin** (1)
17.		25	9. 8.10. 6.16.,	**10 Cib**	**9 Mac** (34)
18.	Naranjo, Stela	8	9.18.10. 0. 0.,	**10 Ahau**	**8 Zac** (23)
19.		13	9.17.10. 0. 0.,	**12 Ahau**	**8 Pax** (3)
20.	Yaxch'n, Stela	11	9.16. 1. 0. 0.,	**11 Ahau**	**8 Tzec** (27)
21.	Alt. Str.	44	9.12. 8.14. 1.,	**12 Ymix**	**4 Pop** (8)
22.	Pied. Neg. Stela	36	9.10. 6. 5. 9.,	**8 Muluc**	**2 Zip** (18)
23.	Tikal, Stela	3	9. 2.13. 0. 0.,	**4 Ahau**	**13 Kayab** (22)
24.	Quirigua, Stela	A (e)	9.17. 5. 0. 0.,	**6 Ahau**	**13 Kayab** (50)

The foregoing argument may be condensed as follows:

Referring to the table we find that the day of No. 3 is **Caban**, that of No. 14 is **Kan** and that of No. 21 is **Ymix**, and that the kin numbers of these are 17, 4 and 1 respectively. It will be found that, whatever the kin number is, this number is the remainder after eliminating all twenties from the large number, and that, as far as the day is concerned, in counting back from a given day, the zero point will be reached as well by counting back the kin number as by going through the longer process of counting back the whole number.[1] Thus by counting back 17 days from **Caban**, or 4 days from **Kan**, or 1 day from **Ymix** we reach **Ahau** as we did on page 24 of the Dresden codex. As in these four cases the count is back to **Ahau**, it is not an

[1] This is necessarily so since all the terms above the kin are multiples of 20.

improper inference that the same day may be reached by counting back in other cases, or that **Ahau** is the zero point from which the count forward is made, though this will have to be tested by experiment. If this is true, we find that in Nos. 1, 5, 6, 11, 12, 13, 18 and 20, where the day sign of **Ahau** is readily recognized, the remainder, after deducting all twenties, must be zero in order to reach **Ahau** as a starting point, since zero is the only number from 0 to 19 which will count backward or forward from **Ahau** and bring **Ahau** again. This enables us to recognize the flaring sign and the head with a hand before the face as signs for 0. And if these signs mean zero and **Ahau** is the starting point, the reverse argument is available, that when the kin number is a flaring or hand sign, the day must be **Ahau**, thus proving the new face forms of Nos. 2, 4, 7, 8, 9 and 10 to be **Ahau**. And, again, if these face forms mean the day **Ahau**, we can also recognize the face forms of No. 24 and of Stela C (e) of Quirigua, as **Ahau**, and consequently the hand and scroll form will be recognized as zero. Also, if **Ahau** is the zero point, we can recognize the days of Nos. 15, 16 and 17 as **Cib**, since the kin number is 16, and by counting forward 16 days from **Ahau** we reach **Cib**. We can also in the same way recognize the day of No. 22 as **Muluc** though the glyph is defaced.

In order to reach the day numbers (Table XIII), which, as will be remembered, can only be one of the numbers 1 to 13, we divide the whole number expressed in the count by 13 so as to eliminate all the full thirteens, and find the remainder, which alone is useful, as the day numbers run along continuously, beginning again with 1 when 13 is reached. We then subtract (as we are reckoning backward) this remainder from the number attached to the day. If, however, the number to be subtracted is larger than the number attached to the day, 13 is added to this latter number so that the subtraction may be made. As long as a full 13 is added, the result is not affected. Using this method we reach in all the twenty-four cases the number 4, except in No. 8, where the inscription is not fully legible,[1] in

[1] The injured glyph of the day sign is with little doubt **8**.

No. 3, where the tun number is 12 instead of 13 and in No. 24, where the day number is a head.

In the same way we divide the whole number expressed in the count by 365 (the number of days in a year), in order to eliminate all full years, and counting back the remainder from the month and its number as given in the different inscriptions, we find that we reach **4 Ahau 8 Cumhu**⑦ in all cases except in Nos. 8 and 3 (for the reasons already given), and in No. 4, where we do not recognize the month and its number; and this again is the strongest kind of evidence that we were right in assigning the value of zero as we did.

Thus we find that in twenty-one cases out of twenty-four we reach the date **8 Cumhu** without any doubt by giving the value of zero to the flaring face and scroll signs; in twenty-one cases we reach the number **4** attached to the day sign, and in eight cases where the day sign is known beyond a peradventure we reach the day **Ahau**; while in the cases where we have found a new day sign (as in the new **Ahau**'s and **Cib**'s) they also agree with the theory that **4 Ahau 8 Cumhu**⑦ is the zero point.

Supplementary Series. — It is to be noted that while the day and its number usually follow the kin sign immediately, the month and its number are often separated from the day sign by a number of glyphs. These glyphs have been called the "Supplementary series," and their meaning is still to be discovered. As the glyphs are usually accompanied by numerals, it is very probable that they also relate to time. The Supplementary series usually ends with a glyph of a rounded form with dots[1] which has the number 9 or 10 attached to it, and which is immediately followed by the month sign, though this is not the case in the two Naranjo stelæ which have been cited. Two bands crossing each other and forming a long St. Andrew's cross usually mark the last glyph but one in this series, and it is often possible in case of doubt to detect the month sign of an Initial series by its position in relation to these last two glyphs of the Supplementary series.

[1] See Piedras Negras, Stela 1, B2; Stela 3, A7; Quirigua, Stela F (e), A8; Animal G (e. l.), M1; Stela J, A12; Copan, Stela A, A9, etc. Goodman gives the value of 108 to this glyph.

Period Glyphs.—We have so far paid no attention to the glyphs to which the numerals of the terms of the Initial series are attached, but we have treated the numerals as if, by their position alone, they represented a certain number of cycles, katuns, tuns, uinals and kins, as did similar numbers placed in columns in the codices, the reading being from top to bottom, except when (as is the case in most instances in the inscriptions) there are two columns, when the reading is across the first row before descending to the second row, and so on across each row in succession. That is, we have considered that the number in the first place after the Initial glyph represents so many cycles or so many times 144,000 days; that of the second place, so many katuns or so many times 7200 days; that of the third place, so many tuns or so many times 360 days; that of the fourth place, so many uinals or so many times 20 days, and that of the fifth place, so many kins or so many times 1 day.

But it appears that in the inscriptions the Mayas did not leave the value of the numbers to be determined by position alone, but added glyphs to denote this value,—at least such would be the natural inference from the observation of the inscriptions which we have been considering. For since the numbers in order from the top downward need to be multiplied by 144,000, 7200, 360, 20 and 1 respectively in order to produce the results given above, it would seem to be a legitimate inference that the glyphs attached to these numbers have these numerical meanings, especially as the whole Initial series seems to have, for one object at least, the marking of the date which follows as so many days from the starting point.

On glancing over the various Initial series (see Table XIII) which we have been considering, we find that in a large majority of cases the glyphs in the five places[1] following the large Initial glyph, and attached to the numbers 1 to 19, are heads. Thus in Nos. 1–4, 8–10, 12, 13, 15–17, 21 and 22 the period glyphs are all heads, as far as can be seen. In Nos. 6 and 7 they are all heads except the kin glyph, as far as can be seen. In No. 11 they are

[1] I shall hereafter call these glyphs "Period glyphs."

all heads except the katun and kin glyphs, and in Nos. 20 and 23 they are all heads except the tun glyph.

In No. 14, however, the period glyphs are all of a geometrical pattern (which has been called the "normal form") except the kin, which is a head; and in Nos. 18 and 19 they are all normal except the cycle, which is a head, while in Nos. 5 and 24 they are all normal.

Plates XII–XIV give both the head and normal forms of the period glyphs, — most of them being taken from the Initial series, and their values being therefore settled by their position. Seler calls many of the heads "bird-heads," but I fail to see why he has given this name to them. The nose is hooked, to be sure, but often it is not especially so, and the presence of the human hand in the cycle forms and of the bone in the tun forms tend to prove most of them to be human heads with distorted features. The variations in the forms of the glyphs will strike the observer at once, but at the same time there are one or more similar points which are to be found in most of those which denote the same period of time.

The large glyph which stands at the head of the Initial series has been called by Goodman the "Grand cycle" glyph (thirteen cycles forming one grand cycle), and this name will be used hereafter. Further reference to this glyph will be postponed to the end of this chapter.

Plate XII shows the cycle head-forms. The chief distinguishing point in these glyphs is the hand across the bottom of the face, and even this is not always found, as in Nos. 23–26. As the hand forms the chief difference between the cycle and katun head-forms, it has been thought to mean 20 (the cycle being twenty times the katun), or possibly a "completed series," instead of zero, — its probable meaning in connection with the period glyphs. There is some doubt about No. 6, which may possibly be a katun form. No. 31, as well as Nos. 28 of the katun forms and 43 of the tun forms, all found on Altar L of Quirigua, should perhaps have been placed among the normal period glyphs.

Plate XII shows the katun head-forms. Here Nos. 1–5 show in the upper part of the glyph a form which is often found in the day sign **Cauac** (see Plate IV, CAUAC), and has been called the **Cauac** sign, while on each side of the **Cauac** sign is a comb-like form, which in the grand cycle glyphs often takes the likeness of a fish. This **Cauac** sign, with its adjacent combs, forms the usual top of the "normal" katun sign. The so-called fang or lolling tongue is frequent in these glyphs, but it is not constant, and it occurs often in the kin glyphs and in Nos. 1, 2, 3, 4, 36 and 37 of the tun forms on Plate XIII.

Plate XIII shows the tun head-forms. Here the so-called bone at the bottom of the face or the fleshless lower jaw is often a distinguishing mark, as in Nos. 7–17 and 20–29, but the bone becomes a hand in No. 34,[1] and is absent in many instances. The cross hatching which appears on the side of the head is not peculiar to the tun, since we find it in some of the katun forms.

Plate XIII shows the uinal head-forms. In these glyphs we find one point which is almost universal, namely, the large curve at the back of the mouth. Though it does not appear in Nos. 31 and 32, and though the bare jawbone appears in No. 33 as if it were a tun form, yet in nearly all the others the large curve is found. There are other marks which enable this glyph to be recognized when found elsewhere than in the Initial series, as, for instance, the peculiar form of the face in Nos. 1–6 and 11. Attention is called to the various forms of the suffixes of this glyph.

Plate XIV shows the kin head-forms, and these are of the most varied character. Many of them have the flowing beard which is found in the normal forms, as in Nos. 1–5. Many of them have the normal form, shown in Fig. 6, as a part of the glyph, as in Nos. 6 and 17. A head band is common to Nos. 9–12, and cross-bones, which may be a form of the normal sign for kin, occur in Nos. 31 and 32.

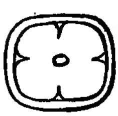


Fig. 6.

In addition to the head-forms representing the periods, there are several inscriptions, notably Animal B and Stela D of Quiri-

[1] It should be said that no case appears in the Initial series where the hand takes the place of the bone in the tun glyph. No. 34 is from Stela J, Copan, which gives a succession of tun forms from 1 tun to 16 tuns (probably to 18 tuns), and this is the only head-form, the others being in the normal form.

gua and Stela D of Copan, in which the period glyphs are represented as full-sized human beings, animals or birds. In these cases the heads, as probably giving the distinctive features of the glyphs, have been given as follows:

On Plate XII.	Cycle forms.	Nos. 27–30.
On Plate XII.	Katun forms.	Nos. 24–27.
On Plate XIII.	Tun forms.	Nos. 39–42.
On Plate XIII.	Uinal forms.	Nos. 34–37.
On Plate XIV.	Kin forms.	Nos. 16, 26–28.

It is to be noted that Nos. 35–37 of the uinal forms represent the frog **Uo.** The phonetic similarity of this word with **Uinal** or **Uo**, meaning a moon, is noticeable. It is possible that the parrot's head, No. 30 of the cycle forms, and the eagle's head, No. 27 of the katun forms, may have some relation, in their phonetic values, to the Maya names for these periods.

In fact it would appear as if the artist allowed himself great freedom in carving the period forms in the shape of heads in the Initial series, perhaps thinking that their position in the series was a sufficient indication of their values, though in many cases there are parts of the forms which are more or less constant.

The geometrical or normal forms of the period glyphs are much more uniform than the head glyphs. This is rendered necessary in all probability from their being used throughout the inscriptions in places where their position would not give a certain indication of their values. On the other hand, it may be that the reverse of this reason is the true one, and that the normal forms were so generally used throughout the inscriptions because they were so uniform. Usually in the inscriptions when a number is used to express a distance between two dates called hereafter "distance number,"[1] the order of the period glyphs as found in the Initial series is reversed, the smaller period preceding the larger ones.

Since the use of the normal forms is so general, it is very fortunate that in Yaxchilan, Stela 21, we have in the Initial series a full set of the normal forms, except the kin form, while in

[1] See Ch. VIII.

Copan, Stelæ 1 and 6, we have the normal kin form. In Copan, Stela M, we have the normal katun and kin forms, in Yaxchilan, Stela 11, we have the normal tun form, and in Quirigua, Stela I, we have a full set of normal forms, all clearly to be seen.

The cycle normal form (Plate XIV) consists of two long-shaped ovals with the **Cauac** sign in each, the whole supported by several convolutions (usually three) which at times appear like a knotted cloth.

The katun normal form (Plate XIV) is a repetition of the tun form, with a top-piece which consists of a central part, usually the form which is found in the day sign **Cauac** of the codices (see Plate IV), with a comb-like appendage on each side, though No. 6 has but one of these comb-like appendages. At times cross-hatching takes the place of the comb form. (See No. 5.) The support may be present or absent, but, when present, it usually consists of three parts.

The tun normal form (Plate XIV) is the same glyph which we find in Dr. 25–28, placed under the idols.[1] It probably there means "stone," which is the meaning of the Maya word "tun." This form usually, but not always, has a support. The support, when present, has a variety of forms, but as a general thing it consists of three parts. The body of the glyph is oval, and is usually divided by a line which is generally horizontal and straight, but is sometimes curved. The lower division has a circle, with curved lines at each end of the division, while the upper division is divided by perpendicular lines. There may be ornamentation in both the body of the glyph and in its support.

The uinal normal forms (Plate XIV) bear a more or less resemblance to the day sign **Chuen**[2] (and less so to the month sign

[1] This form is very like the main part of the month **Pax** and may have been used for this reason to represent the year of 360 days. The sixth month is given by Landa as **Xul**, which means "end" in Maya. If **Xul** ever ended the year, **Pax** would have been the tenth month, or the beginning of the second half of the year, — in fact the very centre of the year of 360 days.

[2] As the month **Pax** may have been used to represent the year of 360 days as having been the centre of that period of time, so the day **Chuen** may have been used to represent the period of 20 days, since this day was the beginning of the second half

Tzec), with or without a support. When the support is present, it takes a variety of forms, but the body of the glyph is very constant.

The kin form (Plate XIV) is very similar to the day or sun glyphs of other peoples, especially when it forms part of other glyphs, though, instead of its consisting of a circle with two cross lines or of a circle with a small circle in the centre and four radiating lines reaching to the circumference, we find that often the radiating lines take the form of indentations towards the centre of the glyph itself. The kin sign has also the beard or streamer which has been considered by some as representing the streaming light of the sun. (Plate XIV, KIN, Nos. 1–6.) The simpler kin sign also forms part of other glyphs in which the syllable kin is found, such as **Yaxkin, Kankin, Likin, Chikin**. This is one of the pieces of evidence to show that the Maya language is to some extent phonetic.

Nos. 7–12 are with but little doubt forms for kin, but as the proof of this meaning usually depends upon the further proof that the numbers, of which each forms a part, record the distance of one date from another, the decision upon this question will be postponed to the next chapter.

Goodman gives two other forms of kin, — one of which is the main part of the glyph for the month **Kankin**, — but as yet I have seen no reason for including these in my list of the kin forms.

I have not allowed my imagination much play in discussing the possible meaning of the names and of the different forms of the period glyphs. Others have done this, affording many interesting though not conclusive conjectures.

I have stated[1] that these period forms are not confined to the inscriptions. On page 69 of the Dresden codex we find in columns 3 and 4, glyphs 5 and 6 from the top (counting only the visible glyphs), forms of the katun, tun and kin signs, together with a fourth sign between the tun and kin glyphs. (Plate

of this period (when the day **Ymix** was the first day) — in fact the very centre of the twenty-day period.

[1] Page 45.

XIV, KATUN, No. 8; TUN, No. 5, KIN; No. 5.) These, as will be seen hereafter, read 1.8.16.0. = 10,400, an important number, having as factors 13, 20 and 260. On Dresden 61 the same set of glyphs occurs in columns 1 and 2, in a similar position, except that the tun form, instead of appearing alone, appears in the lower part of a glyph which has the form of a head. (Plate XIV, KATUN, No. 7, and Plate XIII, TUN, No. 5.) The number 1.8.16.0. gives the correct distance from **4 Ahau** to **4 Ahau** (as indeed it must, since it is a multiple of 260), but not from **4 Ahau 8 Cumhu**⑦ to **4 Ahau 8 Cumhu**⑦, which are dates appearing prominently on these pages. Whereas in these distance numbers the katun, tun and kin forms are given, the uinal form is found merely as a knot, joined as an affix to the number 16. (Fig. 7.)


Fig. 7.

Again, on Dresden 69, columns 3 and 4, glyphs 4 and 5 from bottom, we see the katun form with 15, the tun form with 9, the uinal with 4 (Plate XIV, UINAL, No. 4) and the kin with 4, giving 15.9.4.4. This is 111,324, which is the distance from **4 Ahau** to **9 Kan**, but not from **4 Ahau 8 Cumhu**⑦ to **9 Kan 12 Kayab**⑮, the dates found on this page.

On Dresden 61, in columns 1 and 2, in a similar position a similar series is found, reading 15.9.1.3., which equals 111,263 (Plate XIII, KIN, normal form, No. 6). This is the distance from **4 Ahau** to **13 Akbal**, a day and number appearing in these pages.

The uinal and kin forms appear in these columns on pages 61 and 69, together with other glyphs to which Dr. Förstemann assigns a numerical value, but which have not yet been definitely proved. The katun sign is also found on pages 70 and 73 together with the other signs which have just been referred to.

Initial Series partially effaced. — We have thus far proved that the Initial series show in all the cases which we have examined the distance from **4 Ahau 8 Cumhu**⑦ to a given date, and we have used this fact to enable us to decide on the meaning of day and month forms which were either unknown or about which there was more or less uncertainty, and also to decide on the forms of zero.

In investigating the Initial series as above we have taken in almost all cases the instances where the numbers of the period glyphs were distinct, though in one instance we assumed the cycle number to be 9, — a not violent supposition. We can now use our knowledge of the fact that the Initial series usually begins with 9 as far as we know, and that the count is forward from **4 Ahau 8 Cumhu**⑦ to a given date, in order to fill in the gaps in the numbers of the period glyphs, and in the day or month signs or in their numbers which are not clear, owing to injury or erosion.

Quirigua, Animal O, gives us 9.18.0.0.0., **11 Ahau 3 ?** , but the glyph beneath the **3** is quite worn away. Goodman's Tables, however, show us that the month must be **18 Mac.** This month form does not appear in the parts of the inscription as drawn by Maudslay, and as the month-day is **18**, it would seem to show that the glyph with **3** is not the month with its number, but one of the so-called "Supplementary series." (See the Initial series of Ixkun for a similar glyph belonging to the Supplementary series.)

The Turtle in Quirigua apparently has for its Initial series 9.18.5.0.0., though there may be some doubt about this interpretation. The date reached by this number from **4 Ahau 8 Cumhu**⑦ is **4 Ahau 13 Ceh**⑱, and we see plainly enough **4 Ahau** in the sixth glyph after the large glyph which heads the Initial series, while **13 Ceh** is found with but little doubt in the glyph which appears as the second of the row enclosed in a frame close to the Initial series, — this **13 Ceh** immediately following the last glyph of the Supplementary series, which is recognized by its round form and by its being accompanied by the number 9. The two zeros have the hand and scroll form.

On Stela J (w) of Copan, glyph 15 (Maudslay's notation) is by the photograph clearly 9 cycles; glyph 24 is 12 katuns; glyph 23 is 12 tuns, while glyphs 16 and 17 seem to be 0 uinal, 0 kin. This gives the number 9.12.12.0.0. and the date belonging to this is **1 Ahau 8 Zotz**⑪. Glyph 1 gives **1 Ahau**, I think, but the glyph on the opposite corner, where we should expect to find the month, is quite destroyed.

On Stela J (e) of Copan, we find the number 9.13.10.0.0., which the tables show us brings us to the date **7 Ahau 3 Cumhu**[28], but no date appears. On B11 we find 10 tuns, and on A12 appears 13 katuns or Katun 13. This may mean that by counting back 10 tuns we shall reach Katun 13, or that by counting back 13 katuns and 10 tuns, we shall reach 9.0.0.0.0., the end of Cycle 9, recording the passage of 9 cycles.

The Initial series of the Temple of Inscriptions in Palenque gives a very good example of what can be deciphered from injured glyphs. Here (Maudslay, Vol. IV, Plate 57), though many glyphs are injured, we find on A3 a cycle number which shows the straight line meaning 5 very clearly, with enough space for four dots on the left. We are justified, I think, in calling this number 9. The katun number is 4, and the tun and uinal numbers are both zero. From the fact that Katuns 5–12 are designated in the following columns, we are at liberty to consider that Katun 4 is shown here, and therefore that the kin number is zero, especially as what remains of it does not look like any other number. 9.4.0.0.0. gives as its date **13 Ahau 18 Yax**[49], and the glyphs B5 A6 do not, at least, work against this interpretation.

Stela 36 of Piedras Negras has a very clear Initial series 9.10. 6.5.9. which gives the date **8 Muluc 2 Zip**[18]. On B4 we have **8** with a sign which is much injured, and in A8 after the last glyph of the Supplementary series, we have **2** with a month which is either **Uo** or **Zip**. We may consider, therefore, that the date given here is **8 Muluc 2 Zip**[18].

Stela 23 (w) of Naranjo has 9.13.18.4.?., **8** ?, and after the last glyph of the Supplementary series a number over **15** and a month which looks like **Uo**. Now 9.13.18.4.0. brings **3 Ahau 18 Pop**[37]. The kin number is clearly over 10 and the month number is over **15**. The kin number must then be 18, 19 or 20 (if there is any number representing 20 in these series), since any less number than 18 counted from **18 Pop** would either not carry us out of the month **Pop** or would bring **15** or a smaller number than **15** for the month **Uo**. Placing these three numbers 18, 19 and 20 in the kin place, we should reach **8 Eznab 16 Uo**, **9 Cauac 17 Uo** and

10 Ahau 18 Uo respectively. As we know that the day number is **8** the only possible date must be **8 Eznab 16 Uo**[37], and the series must be 9.13.18.4.18.

Stela 30 of Naranjo has the number 9.9.?.0.0., **? Ahau ?. ?.** The tun number must be filled by a number 1, 2, 3, 4 or 5, and the day number by either **7, 9** or **10** as the photograph shows. Substituting the numbers 1 to 5 in the tun place, we have

9.9.1.0.0., **12 Ahau 18 Zip**[45]
9.9.2.0.0., **8 Ahau 13 Zip**[46]
9.9.3.0.0., **4 Ahau 8 Zip**[47]
9.9.4.0.0., **13 Ahau 3 Zip**[48]
9.9.5.0.0., **9 Ahau 18 Uo**[49]

As the day number must be **7, 9** or **10**, the last date is the only possible one.

Stela 4 of the Altar de Sacrificios has an Initial series which, though much defaced, is probably 9.10.3.17.0. Counting forward this number from **4 Ahau 8 Cumhu**[7] we reach **4 Ahau 8 Muan**[15], and this is probably found in B3 A6.

On the right-hand side of Stela 17 of Tikal there is an Initial series of 9.6.3.9.15., **10 ? ? ?**, the day and the month being invisible, but the kin number being 15, the day must be **Men**. In fact, the whole date must be **10 Men 18 Chen**[40]. Unfortunately, however, we cannot see the **Men** form. On the front of this stela are the following numbers: 9.?.3.?.15. The day number is broken off, but the day is clear, followed by a broken month form. If both the front and side of this stela record the same date, we should have here a clear form for **Men**, but we cannot be sure of this.

The Initial series of Altar K, Copan runs 9.12 (or over).16.?.8. The 8 is clear, which gives the day as **Lamat** — a new form. (Plate V, LAMAT, No. 4.)

The form on Plate V, LAMAT, No. 5, is found on Stela 20 of Yaxchilan, A3, and is joined to a month-day with the number **11**. It must therefore be either **Lamat, Ben, Eznab** or **Akbal**. It is not like either of the last three, and is quite similar to **Lamat**, No. 4, on Plate V, and may therefore be considered as **Lamat**.

The meaning of **Ahau** (Plate VI, AHAU, No. 37) is proved by its being the day of the Initial series of Stela I, Copan where the kin number is zero.

We have assumed that the cycle number is, as a rule, 9, and this is found to be a correct assumption. There is no Initial series in Copan where the cycle is other than 9; none in Quirigua, except one where the zero date, **4 Ahau 8 Cumhu**⑦, is given; none in Yaxchilan or Piedras Negras, and none in Naranjo or Tikal. That is, in the higher altitudes of Copan, Quirigua, Yaxchilan and Piedras Negras there is no Initial series which has as yet been discovered which was meant to record any earlier date than the passage of 9 cycles, except in one case where the zero date was recorded; and the same is true of the lower altitudes of Tikal and Naranjo.

Initial Series not recording 9 Cycles.—But in Palenque we find two cases of Initial series, in which dates, far in the past, are given, very close to the beginning of the grand cycle in which almost all the dates of the Initial series appear, while another Initial series at Palenque shows a date which falls in a grand cycle immediately preceding this one. In this latter case the date precedes the usual zero date, **4 Ahau 8 Cumhu**⑦, by four or five years. These dates are as follows:

Temple of the Sun	1.18. 5.3.6.,	**13 Cimi 19 Ceh**㉞
Temple of the Foliated Cross	1.18. 5.4.0.,	**1 Ahau 13 Mac**㉞
Temple of the Cross	12.19.13.4.0.,	**8 Ahau 18 Tzec**①

The probable meaning of these early dates has been treated of by me in a pamphlet entitled "The Temples of the Cross, of the Foliated Cross, and of the Sun at Palenque,"[1] in which I suggest that these dates were chosen as showing the time when just one half of a year of 365 days was needed in order to rectify the calendar, which no longer agreed with the seasons or the equinoxes, on account of the year having been counted as 365 days instead of as 365¼ days.

Initial series showing the lapse of 10 cycles are not unknown. The only case where this has occurred on a large stela is at Chichen

[1] Bowditch, 1906.

Itza, — one of the later cities of the Mayas, in which the Initial series is 10.2.9.1.9., **9 Muluc 7 Zac**[49].

Dr. Seler, however, has found in Sacchaná two stones which bear Initial series showing 10 cycles. These were not found in their original position, but bore every mark of having been made in the immediate neighborhood. One is fractured, but the cycle and katun glyphs with their numbers are clear in his drawing. These numbers are 10.2., while the tun glyph probably has 5 attached to it. The second stone bears the full Initial series 10.2.10.0.0., **2 Ahau 13 Chen**[50], with some doubt about the katun number, while the month number is slightly broken. If the first date is 10.2.5.0.0., it would bring us to **9 Ahau 18 Yax**[45], and the two would mark the raising of these records at the lapse of even periods of five tuns, one just five tuns after the other. These dates are of great interest, as Sacchaná is situated in the highlands of Guatemala near Huehuetenango.[1]

Besides these cases of Initial series with a date which shows the lapse of 10 cycles, there are other dates, not Initial series, in which the passage of 10 cycles is marked by a method which will be explained in a later chapter. These dates occur on the inscriptions of Tikal and Seibal.

One or possibly two instances occur in which the passage of 8 cycles is recorded. Neither of these occur on a stone inscription, but both are found on pieces of jade.

The first one is called the "Leyden Stone," or the "Leyden Plate." The date given on this plate is 8.14.3.1.12., **1 Eb**, while the month which appears below looks like **Yaxkin**. The date reached in the year calendar by this number is **1 Eb 0 Yaxkin**[11].[2] It has been surmised that the Yucatan year once ended with the month **Xul**, which means "end" in Maya. If this were true, the day **0 Yaxkin** would be the beginning of a new year.

The other date which may record the passage of 8 cycles is found on a nephrite image now in the possession of the National Museum in Washington. Mr. W. H. Holmes has published an account of this stone in the "American Anthropologist," New

1 Eduard Seler, 1901, p. 17. 2 Valentini, 1881, p. 15; Seler, 1902, Vol. I, p. 833.

Series, Vol. 9, No. 4. I am not convinced that this stone records an Initial series.

The Initial series of Stela C (e) of Quirigua is the only one remaining to be considered. Here 13.0.0.0.0. is given with the usual date **4 Ahau 8 Cumhu**⑦. The discussion of this date will be found in Appendix IX.[1]

The frequency with which even katun-quarters are given in the Initial series, especially in those of Quirigua, cannot fail to strike the attention of the student. A list is given in Appendix VIII,[1] with the position in which they are found. This would seem to furnish evidence that the monuments where these dates occur were erected to commemorate the passage of time at intervals of five tuns, or of five years, less one hundred days.

Initial Glyph. — We have yet to consider the great Initial glyph[2] which always appears at the head of the Initial series and which is found at times where there is no Initial series, at least none in the usual form. Thus Stela C of Copan apparently has no Initial series, and yet the Initial glyph is found on both sides of the stela, and on Stela P of Copan it appears on three sides of the stela though there is but one Initial series. (Plate XI, Nos. 2–4.)

This glyph may be said to consist of five parts, of which the tun glyph forms the main body of the whole. This part takes different forms, but they are so similar that there is no chance of error. It always has supports where a full Initial series is given, and this support usually has a trinal form, and consists either of three plain balls or legs, or of a central body with flaring forms on each side. In one case, that of Stela M of Copan, the three balls break into the lower line of the tun glyph. In Stela C of Copan, where there is no Initial series, the tun glyph has no supports, though in one case a leaf-like form breaks the continuity of the lower part of the frame of the tun sign.

On the top of the tun form there is usually a head, either of

[1] Chapter IX should be read before Appendix VIII and Appendix IX, in order to understand the subject clearly.

[2] This has been called the Grand cycle glyph, and this name has been printed at the head of Plate XI. It is not absolutely certain that this glyph designates the grand cycle.

an animal or a man, though in Stela D of Copan the upper half of a human form, in Animal B and Stela D (w) of Quirigua a whole human form, in Stela D (e) of Quirigua an entire animal form, and in two cases in Palenque a day sign, take the place of the head. The varieties of this part of the Initial glyph will be considered later.

On each side of the head is a comb-like or fish-like form with variations; but the variations are of such a character that the glyphs are readily recognized as belonging to the same standard and as serving the same purposes. It is to be noted that the comb- or fish-like glyph is at times of the same height as the head which it flanks, or at other times extends downward so as to cover the sides of both the head and its supporting tun sign, while in some cases the comb-like form on each side is divided into two, placed end to end.

Above the head and the comb-like glyphs, and occupying a space equal to the horizontal stretch of both head and combs, is a sign called by Goodman the "trinal sign." It is in three parts, — a central part and a flaring form on each side, — and often resembles the similar form found as a support to the tun-like part of the Initial glyph. The five parts of the Initial glyph are as follows:

1. The tun sign.
2. The comb-like sign.
3. The trinal sign as a support.
4. The trinal sign as a superfix.
5. The head sign.

Of these the first four are comparatively constant. This leaves the head sign, supported bv No. 1, flanked by No. 2, and with No. 4 as a superfix, as the one variable element, and this is the form which must, I think, be looked to as evidencing any difference of meaning which there may be in the different Initial glyphs.

The meaning of this Initial glyph has been much discussed and there are many different opinions on the subject.

Dr. Seler calls it the "katun sign" and says that it merely denotes "period," while he considers that the enclosed heads refer to the points of the compass, and represent the gods which belong to the different directions, as influenced by the number of katuns or by the katun-quarters, which the Initial series, given below, record.[1] He is confused, however, in attempting to assign the different heads to the different directions, since different heads are used for the same katun-quarters and the same head for different katun-quarters.

Dr. Förstemann[2] thinks that this glyph has some such meaning as "chronologic guide," "historic table," or "measure of time."

Goodman considers that this glyph is merely the sixth term of the numerical system. This system begins with kin or 1 day, and, running through the uinal or 20 days, the tun or 360 days, the katun or 7200 days and the cycle or 144,000 days, ends with the grand cycle of thirteen times 144,000 or 1,872,000 days. It would be very natural to find a sixth term in this system, especially as we find it in the Dresden codex, pages 61, 62 and 69. In the Dresden, however, the sixth term equals twenty times the fifth term and not thirteen times, as suggested by Goodman.[3]

There is also some evidence to show that the enclosed heads of the Initial glyphs may have some reference to the months recorded in the Initial series, but, on the whole, the evidence is not strong enough to support the opinion that these heads refer either to the world directions or to the months. One thing is clear, however, which is, that in three cases of pairs of Initial glyphs, namely: Copan Stela B and Altar S, Copan Stela N (e) and Quirigua Stela F (e), and Quirigua Stela E (w) and Stela F (w), the heads of each pair are practically the same, and in these cases the same date is recorded in each pair. On the other hand, while the dates of Piedras Negras, Stelæ 1 and 3, are the same, the heads are not similar. The subject is further discussed in Appendix VIII (Plate XI).

[1] Seler, 1902, Vol. I, pp. 718 *et seq.*
[2] Bulletin 28, pp. 549, 584.
[3] See Appendix IX.

CHAPTER VIII

THE DISTANCE NUMBERS AND DATES IN THE INSCRIPTIONS

It will be shown in this chapter that period glyphs with numbers attached occur throughout the inscriptions, and that these period series very often record the distance between two given dates, so that it is possible to identify glyphs which are partially or even wholly erased or which have not been previously recognized. These distance numbers and dates are at times connected with the Initial series and at times are not so connected.

Having decided upon the normal forms of the period glyphs, and remembering the values which belong to them, we can now search for similar glyphs in other parts of the inscriptions. If we find a number composed of these glyphs or of a part of them with two dates in close juxtaposition, and if we find that this number gives the exact distance from one date to the other, we are justified in believing that it was the intention of the artist to state this fact. And if, after having found this to be true in a number of cases, we find other cases where either a day or a month or even both day and month of one date are unknown, provided the day number and month-day number are clear, while the other date is known and the distance number is clear, we are justified in deciding on the name of the unknown day or month, relying on its distance from the known date. Such a decision must be subject to confirmation, for we shall find many instances where this exact proof is not forthcoming, whether this is due to our own ignorance or at times possibly to the carelessness of the sculptor. In making these calculations it is to be noted that as we ourselves say "Count from Tuesday the 6th of August 15 days forward and we shall reach August 21st," or "Count 15 days from August 6th to August 21st," or "From August 21st count backward 15 days to August

6th," so in the inscriptions we sometimes find a date, then a distance number, and then the date counted to; and sometimes we find the distance number preceding both dates, with perhaps another distance number between them; and sometimes the count is backward and not forward.

Distance Number and Dates clearly given. — Taking up the dates and distance numbers we find the following cases where both dates are known, and where the distance number is the correct distance from one date to the other.[1]

Copan Stela A, B4, B9, gives us as the date marked by the Initial series, **12 Ahau 18 Cumhu**⑤. On EF2 we find the date **4 Ahau 18 Muan**⑤. This date is just three uinals before the Initial date **12 Ahau 18 Cumhu**⑤, and in C2 we find the uinal normal form with a 3 over it and a zero on its left. As there is no kin form here, it seems possible that, as the uinal form has two numbers, one of them is meant for the uinals and the other for the kins, — the glyph meaning 3 uinals, 0 kins, which is just the distance between the two dates, the count being back from the Initial date.

Again on D11 we find the uinal form with a zero on the top and 10 on the left. If these numbers belong to the uinal and kin, which of them belongs to the uinal and which to the kin? If we follow the last case and assign the 10 to the kin, as it stands on the left of the glyph, we find that by adding 10 days to **12 Ahau** of the Initial date, we reach **9 Oc**, while by subtracting 10 days we reach **2 Oc**. If we use the **4 Ahau** of E2 as the starting point we reach **1 Oc** or **7 Oc** according as we count forward or backward. But the day given in the following date is **4 Ahau** on F11 and the month which follows in C12 is **13 Yax**. If then we call the distance number 10.0., using the 10 for the uinals and the zero for the kins, and count this distance forward from **12 Ahau 18 Cumhu**⑤, we reach **4 Ahau 13 Yax**⑥, the very date which follows. This would seem to show that when two numbers are found in connection with

[1] It is to be noted that the order of the periods in the distance numbers is usually the reverse of that in the Initial series: that is, the order of the distance numbers usually runs, kins, uinals, tuns, etc., while that of the Initial series runs, cycles, katuns, tuns, etc.

the uinal form, either one may represent the uinals and the other the kins without regard to their position.

But the Initial series showed us something more than the date **12 Ahau 18 Cumhu**⑤. It showed us the large number 9.14.19.8.0., which is the distance of this date from **4 Ahau 8 Cumhu**⑦, the starting point of the time reckoning of most of the Initial series. This distance and date may be written thus:

	9.14.19. 8. 0., **12 Ahau 18 Cumhu**⑤.
If now we count forward the distance number of D11, or	10. 0.
we reach	9.15. 0. 0. 0., **4 Ahau 13 Yax**⑥

which is found on F11 C12, while on E 12 we find a katun form with 15 before it.

In Palenque, Temple of Inscriptions (Plate 59 of Maudslay),

we find on G8	8 days [1]
and on GH9	**10 Ahau 13 Yaxkin**㊻.
Count forward eight days and we reach	**5 Lamat 1 Mol**㊻
which appears on H10.	
There is also found on L7–8 of the same Plate	6.16.17.
and on L8	**12 Ahau.**
Count forward this distance and we reach	**13 Caban**
which appears on K11.[2]	
There is found on QR6 of the same plate	**7 Caban 15 Pop**⑤
and on Q7–8	2.7.6.1.
Count this distance forward and we reach	**5 Eznab 6 Kankin**(51)
which is found on Q11. Again on R11 Q12 we find	9.11.2.
Count this forward and we reach	**9 Ahau 18 Zotz**⑨
which appears on S1.	

[1] The kin form is somewhat unusual, but as **5 Lamat 1 Mol**㊻ is actually eight days distant from **10 Ahau 13 Yaxkin**㊻, and as a form not very unlike some of the other kin forms is found in the proper position to mean a distance number, and is associated with the number 8, it is fair to presume that this form means kin.

[2] This calculation also shows that the period glyph of L7 is kin, this form being practically the same as that of No. 7 of the normal kin forms on Plate XIV, and being in the kin position in the sequence of the distance number. See page 115.

Preceding this record there is on Q3 a number 17, joined with an unfamiliar glyph, while on R3 Q4 a date appears which looks like **3 Ahau 3 Uayeb**④, though it is somewhat injured. As we find that 17 days is the distance from **3 Ahau 3 Uayeb**④ to **7 Caban 15 Pop**⑤ of QR6, it is fair to decide that the unfamiliar form is kin.

On D3 C4, Temple of the Cross at Palenque, is **4 Ahau 8 Cumhu**⑦.
This is followed on D5 C6 by 1. 9.2.
and on C13–15 by 1.18.3.12.0.
Counting forward the sum of these numbers, or 1.18.5.3.2., from **4 Ahau 8 Cumhu**⑦
we reach **9 Ik 15 Ceh**㉞
found on EF1. Again on GH1 we find **9 Akbal 6 Xul**⑳
and on K7–8 1.8.17.
which is the distance from **9 Akbal 6 Xul**⑳ to **13 Ahau 18 Kankin**㉑ of K9.

Again on PQ10 we find **11 Lamat 6 Xul**⑨
and on PQ12 13.3.9.
which is the distance from **11 Lamat 6 Xul**⑨ to **2 Caban 10 Xul**㉒ of PQ14.

If we count forward from this date the number found on P15, 6.3.
we reach the date which we find on Q17 R1 **8 Ahau 13 Ceh**㉒.

Again on C14–16 of the Temple of the Sun at Palenque, we find 9.12.18.5.16.
and on O2 N3 **4 Ahau 8 Cumhu**⑦.
Count this number forward and we reach **2 Cib 14 Mol**⑰
which is found on NO4.[1] And on O16–Q1 is found 7.6.12.3.
and on PQ2 **12 Ahau 8 Ceh**㉛.
Counting forward we reach the date found on PQ6, **9 Akbal 6 Xul**⑳.

On Altar S of Copan, the Initial date is[2] 9.15.0.0.0., **4 Ahau 13**

[1] This identifies the head with cross-bones on C14 as kin, both by its position in the distance number and by the calculation.

[2] Maudslay's drawing shows the katun number as 13, but the photograph of the Peabody Museum shows that it is 15.

Yax(6). Then 5 katuns appear on glyph 6 (Maudslay's notation). Count 5 katuns forward and we reach **7 Ahau 18 Zip**(1), bringing us to 10.0.0.0.0. The date is found on glyph 7, while glyph 8 is the cycle form with the number 10.

On Stela E (w) of Quirigua the date of the Initial series is **12 Caban 5 Kayab**(51). On B9^b–A10^a we find 6.13.3. This is the distance from the date given to **4 Ahau 13 Yax**(6), found on B10.

On AB14 of the same stela we find **11 Ymix 19 Muan**(37)
and on AB16 the number 8.4.19.[1]
Counting forward this number, we reach **13 Ahau 18 Cumhu**(45) of A17, while on B17 we find the katun form with the number 17. A reference to Goodman's Tables will show that the end of Katun 17 is **13 Ahau 18 Cumhu**(45).

On Stela F (w) of Quirigua we find on B17–A18 the number 1.16.13.3., (provided the thumb over the katun means 1),[2] on AB18 the date **12 Caban 5 Kayab**(51) and on A19 the date **1 Ahau 3 Zip**(36) (again provided that the thumb means 1 here). The number given is the distance between the two dates, and the last date is the Initial date of the other side of the stela.

On Stela J of Quirigua we find on B12, **8 Zotz** of the Initial series, and on F1 E2 the number 18.3.14. Counting this number back we reach **4 Tzec** which is on E3.

In Naranjo[2] Stairway, Inscription 6, we find
on BC1 **7 Akbal 16 Muan**(10)
on B3 1.1.17.
and on C3 **1 Ahau 8 Kayab**(11)
This is the correct count.

On the Circular Altar of Tikal[3] we find over
the figure **1 Muluc 2 Muan**(18)

[1] This case shows that though the Maya sculptor usually placed the uinal number on the top of the uinal sign in carving the distance numbers and the kin sign on the left-hand side, he sometimes reversed this order. Here it is easy to see why the uinal number, 4, is at the left side, since the kin number, 19, is too thick to occupy the narrow space on this side and since there is ample space on the top.

[2] For proof of the value of the thumb as 1, see page 167.

[3] See Memoirs of the Peabody Museum of American Archaeology and Ethnology, Harvard University, Vol. IV.

and after five glyphs the distance number 11.11.18.
and in the next two glyphs **13 Manik 0 Xul**(30).
Then after ten glyphs appears the distance number 8.9.19.
and in the next two glyphs is **11 Cimi 19 Mac**(38)
These are all correct counts.

If there should be any doubt about the day signs, it may be said that **Manik** with the closed hand can be identified in the Initial series of Stela 22 of Naranjo, where the kin number is 7, so that the day must be **Manik**. Starting from **13 Manik**, we reach **1 Muluc** by counting back 11.11.18., and **11 Cimi** is reached by counting forward 8.9.19. The form of the month **Mac** is also here proved.

Once more returning to Palenque we find in the Temple of Inscriptions, on Plate 59 (Maudslay), EF6, the date **5 Lamat 1 Mol**(46)
on EF7, the distance number 2.4.8.
and on EF8, the date **3 Ahau 3 Zotz**(44).
This is a correct count, backward from the first date.

Distance Number and Dates partially effaced. — The fact that the Mayas were in the habit of carving on their inscriptions two dates with a number declaring the distance between them has been abundantly proved by the preceding examples. A date consists of four parts, — the day, the day number, the month and the month number. When, therefore, in a combination of two dates and a distance number like those which we have just had under consideration, we find one part unknown or erased, it may be easily supplied by calculation, and even this may be possible when more than one of the parts is wanting, erased or unknown.[1]

Again in the Temple of Inscriptions in Palenque, we find on Plate 59 (Maudslay) in the KL columns the day **12 Ahau**, the number 6.16.17. and the day **13 Caban**, already spoken of. Now **12 Ahau** probably refers to the date **12 Ahau 8 Ceh**(31), which was given on Plate 58, AB2. If this is so, then if we count forward the number of days in 6.16.17. from **12 Ahau 8 Ceh**(31), we reach **13 Caban**

[1] The principle of filling up the gaps in imperfect or uncertain inscriptions may be compared to a mathematical formula like that of the triangle, where the contents or the remaining angles or sides may be found, when we know two angles and the included side or two sides and the included angle.

10 Chen(38). We find the date **13 Caban 10 ?** , with a glyph which is unknown and somewhat injured, but we shall be justified in considering it as the month **Chen**. At a later time we shall bring forward the proof of, or at least the evidence for, **12 Ahau** referring to month-day **8 Ceh**.

In the same way the **10 Ahau** of P5 with but little doubt refers to **8 Yaxkin** which has preceded it on B8 A9. Counting forward the number found on OP5, 3.6.6., from **10 Ahau 8 Yaxkin**(61) we reach **7 Cimi 19 Ceh**(2). We find on O7 the date **7 ? 19 Ceh**. We shall then be justified in considering the day form to be **Cimi**. On P7–8 we find the number 9.7.11.3.0.[1] Counting this back from **7 Cimi 19 Ceh**(2), we reach **1 Cimi 19 Pax**(46) which is found on OP10, thus giving additional proof of the glyph for **Cimi**.

On Plate 57 of the Temple of Inscriptions (Maudslay) we find on MN6 a distance number 6.14. The uinal head is identified by the large scroll behind the mouth, and the form on M6 would naturally be the head for kin. (For a similar kin form, see Plate XIV, KIN, No. 32.) On MN7 we find the date **13 Ahau 18 Mac**(41). Counting forward 6.14. from **13 Ahau 18 Mac**(41) we reach **4 Ix 7 Uo**(42), which is found on MN9. The form for **Mac** is enough like that found on the Altar at Tikal to enable us to identify it.

If objection should be made that the kin sign is unlike those which have been proved heretofore and that the month sign is not absolutely proved, the following argument may be used. We are sure of the following signs:

On MN6, 6 uinals and **14 ?** as the distance number.
On MN7, **13 Ahau 18 ?** as the date to be counted from.
On MN9, **4 Ix 7 Uo** as the date to be counted to.

No other kin number than 14 will count from **Ahau** to **Ix**, and no larger distance number than 6.14. is given. Moreover, 6.14., counted back from **7 Uo** reaches **18 Mac**, and the form of **Mac**, found here, is similar to that found on the Tikal Altar.

In the Temple of the Cross in Palenque, we find on U6 T7 the number 1.1.1. Counting this forward from **7 Kan 17 Mol**(6) which

[1] Here, and in several other cases, the period glyphs are placed in the same order as in the Initial series and not in inverse order as is usual in the distance numbers.

is seen on U10 T11, we reach **11 Chicchan 13 Chen**⑦. On TU14 we find **11 ? 13 ?** , the day and month being unknown, and we are probably justified in calling the day **Chicchan** and the month **Chen**.

In the Temple of the Sun in Palenque, we find on PQ6 (as has already been stated) the date **9 Akbal 6 Xul**⑳, and on PQ11 the number 6.2.18. Counting this backward from **9 Akbal 6 Xul**⑳ we reach **1 Chicchan 18 Zotz**⑭. But the date which we find on PQ12 is **2 Cimi 19 Zotz**⑭, just one day after the day reached by calculation. It would seem from this that there is an error in the number which, if it read 6.2.17., would, if counted back, bring the date **2 Cimi 19 Zotz**⑭, the latter being probably the last day of the month.

In the Temple of the Foliated Cross in Palenque, we find at the end of the Initial series the date **? Ahau 13 Mac**. We are not prepared to give the day number now, as it is in the form of a head, but the day itself is clear. On B12 A13 we have the number 14.19., the kin form being that found in the Temple of Inscriptions. Counting forward this number we reach **? Cauac 7 Yax**, and on B13 A14 we find **1 ? 7 Yax**. We are therefore justified in considering the day as **Cauac**. But we can go farther than this, as will be hereafter seen, for we can, by counting back the number 14.19. from the day number **1** of the **1 Cauac**, show that the head which represents the number attached to the **Ahau** of the Initial date must mean **1**.

If, then, the Initial date is **1 Ahau 13 Mac**㉞, and if we count forward from this date the number which we find in C3 D4, namely, 1.14.14.0., we reach **2 Ahau 3 Uayeb**⑯, which we find in CD8, while on D7 we see the cycle sign with the number 2. Goodman's Tables show that this date is the end of Cycle 2.

Cimi may also be recognized on Stela J of Quirigua, where on B12 we have already found **8 Zotz** in a correct calculation. Giving now the full date, except the day number, which is a head, namely, **? Ahau 8 Zotz**, and counting backward the number 18.3.14., which is seen on F1 G2, we reach **? Cimi 4 Tzec**. This date appears on E3 as **6 Cimi 4 Tzec**⑬. By counting forward 18.3.14. from the **6** of **6 Cimi**, we obtain the number **8** as the day number of **Ahau**.

On Stela K (w) of Quirigua, the Initial series is clear, and this must bring us to **3 Ahau 3 Yax**[28], though the forms are unusual. On A6 we have the number 10.10. Counting this back from **3 Ahau 3 Yax**[28], we reach **1 Oc 18 Kayab**[27], and on B6 A7 we find **1 ? 18 Kayab**. We are therefore justified in recognizing the day as **Oc**. Conversely this adds evidence that the month sign of A5 is **3 Yax**.

On the alligator's head of Quirigua (Maudslay, Plate 50) we find on AB1 the number 3.2.0. On AB2 we find **4 Ahau 13 ?** , the main part of the month sign being erased, while the top may be that of **Yax**, though it differs somewhat from some of the other forms with which we have met. If we count forward 3.2.0. from **4 Ahau 13 Yax**[6] we reach **6 Ahau 18 Zac**[9], and on AB3 we find **6 Ahau 18 ?** , with a month sign, which, though the body of the glyph is worn, has on the side the top knot of **Zac**. It will not be unsafe to call the two months **Yax** and **Zac** respectively.

On Piedras Negras, Stela 3, we have the Initial date — **5 Cib 14 Yaxkin**[1], 9.12. 2. 0.16.
On CD1 we have a number which, though defaced, is probably — 12.10. 0.
which, counted forward, brings us to — **1 Cib 14 Kankin**[13], 9.12.14.10.16.
and we find this date in CD2.
On D4 C5 we have the number — 1. 1.11.10.
which, counted forward, brings us to — **4 Cimi 14 Uo**[35], 9.13.16. 4. 6.
which we see on D5 C6.
On E1 we find the number (somewhat defaced) — 3. 8.15.
Counting this forward we reach — **11 Ymix 14 Yax**[38], 9.13.19.13. 1.
and on EF2 we recognize **11 ? 14 Yax**, and get a new form for **Ymix**.
On F6 we have the number — 4.19.
which, counted forward, brings us to — **6 Ahau 13 Muan**[38], 9.14. 0. 0. 0.

On F7–8 this date is very clear, and on F10 we find Katun 14. Goodman's Tables show that **6 Ahau 13 Muan**(38) ends Katun 14.

The completeness of this demonstration requires no comment. It not only proves its own correctness, but also the correctness of the method which we have employed.

Stela 36 of Piedras Negras gives the following dates and distance number:

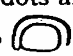
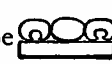
CD3	2.1.13.19.
CD4	**6 ? 19 Zotz**
D7 C8	**4 Ahau 13 Mol**(46).

Now 2.1.13.19. is the distance from **6 Ymix 19 Zotz**(5) to **4 Ahau 13 Mol**(46), and we thus recognize C4 as **Ymix**, though the glyph is much defaced.

On A5–B6 of Stela C, Copan, we find the number 11.14.5.1.0. Seler calls this 11.14.5.0.0., giving the cross-hatched circle on the left of the uinal the meaning of zero, without authority for so doing. It is really 1. The series runs thus:

A5–B6	11.14.5.1.0.
B7 A8	**6 Ahau 18 Kayab**(45)
AB9	• **6 Ahau 13 Muan**(38)

and by counting forward this number from **6 Ahau 18 Kayab**(45) we reach **6 Ahau 13 Muan**(38).

It may be objected to this that the day number of A9 is **8** and not **6**, since Stela C is broken and we have no photograph of the inscription, and must therefore rely entirely on Maudslay's drawing, which shows the number of the day as **8**. Maudslay, however, writes me as follows: "On glyph 8 (A9), the numeral consists most certainly of a bar and three dots, but the dots are much worn, and as the dots in this inscription are made thus, , section thus, , where zero is meant, it is entirely possible that the ridge is worn off the outer dots and that the numeral should be  = **6**, and, if the computation shows that the numeral should be six, I should have no hesitation in accepting it." He then makes another correction in glyph C2.

Stela 1, Copan, shows the date **11 Ahau 8 Zotz**[47] on glyphs D 1–2 on the side of the stela. The month number has the appearance of **13**, but it is probably **8** with an ornamental line. On the other side of the stela on $C5^{b}$ is the number 14 uinals. Counting 14 uinals back from **11 Ahau 8 Zotz**[47] we reach **4 Ahau 13 Mol**[46], and on C6 we find **? Ahau 13 Mol**, with an oval form over the **Ahau**. This is probably a new form for **4**. (Plate XVI, FOUR, No. 4.)

On Stela 4, Copan, we have on A6 the date **11 Ahau 18 Zac**[1], and on B6, A5 with a glyph which Goodman calls the 5-tun glyph. Counting forward 5 tuns from **11 Ahau 18 Zac**[1] we reach **4 Ahau 13 Yax**[6], which we see in A7, and which is followed in B7 by the katun sign with the number 15. We have already seen that this date appears as the date of the Initial series of Stela B of Copan as 9.15.0.0.0. The date **11 Ahau 18 Zac**[1] would then be 9.14.15.0.0.

Altar Q of Copan contains several calculations. On D6 E1 we find **6 Ahau 13 Kayab**[60] and on E5 the number 3.4. Counting this forward we reach **5 Kan 12 Uo**[61], and on E6 we find **5 Kan 13 Uo**. I think it safe to consider this an error, for **Kan** can never be the thirteenth day of a month.

Also on B3 A4 we have **8 Ahau 18 Yaxkin**[13], and on A6 we find the number 7.12. On CD1 we find probably **5 Ben 11 Muan**[13], though the sign for **5** is new, but that of **Ben** is similar to the codex form. Now the real distance from the former to the latter date is 7.13., but A6 has the number 12, the middle dot being replaced by a cross. This would seem to be an error, unless the cross has the meaning of a dot.

These two apparent errors may be explained by the fact that they both occur on the lowest row of the inscription. One is an error of 12 for 13, and the other is an error of 13 for 12. It is not at all impossible that the sculptor may have become confused and have put the 12 in the 13's place, and *vice versa*.

At times it would seem as if one of the period forms of a distance number could be omitted when none of that period is to be counted. Thus on Stela 12 of Yaxchilan (Deity side), A6, we find the tun glyph with over it and  on its left. No uinal glyph is given and the distance number is to be read 10.0.6. This number, counted back from **11 Ahau 8 Tzec**[27], which appears on CD1, brings us to **6 Ix 12 Yaxkin**[17]. On AB1 we have **6 ? 12 Yaxkin,** and we are justified in calling the day **Ix.** Here the tun glyph, as is common with the uinal glyph, has two period numbers attached to it.

Also on Stela 1 of Piedras Negras, G6–7, we find the katun glyph with 1, and the uinal glyph with 2 over it and 5 on its left. This is to be read 1.0.2.5., and is the distance from **1 Cib 14 Kankin**[13] on G3–4 to **5 Ymix 19 Zac**[33] on G8–9.

It is possible that AB13 of the Temple of the Sun at Palenque shows a similar case. There is some reason for believing that this should be read 1.0.2.11. — the similarity of the number with that of the stela in Piedras Negras being very striking.

On Stela J (e) of Copan, a distance number 13.10.0. is given on B11 A12. The kin glyph is the form found on Plate XIV, No. 8, of Normal forms which resembles the upper part of No. 7. Apparently the uinal form is omitted. If this surmise is correct, we have here the number 13.10.0.0., which is a repetition in the reverse order of the lower terms of the Initial series.

On Stela I, Copan, we have a distance number on EF6 where the uinal form has a head over it, which will hereafter be shown to mean 10, and on its left is the form given in KIN No. 9 of Plate XIV, Normal forms. On EF1 is an **Ahau** with the same head for 10 over it. On E7, **10 Lamat** is given. If the distance number is 10.8., it is the distance from **10 Ahau** to **10 Lamat.**

On Altar Z, Copan, GH1 is a probable distance number 1.8.1., containing the kin form shown on Plate XIV, No. 10 of Normal forms.

On Stela 1, Piedras Negras, we find on FG1, **9 ? 9 Kankin**, and on F3, the form given on Plate XIV, KIN, No. 11 of Normal forms. If this form means 5 days, as is probable, and if 5 days is counted forward from **9 Chuen 9 Kankin**[13], we reach **1 Cib 14 Kankin**[13], which is found on G3–4. A similar form for kin is to be seen on the base of Stela C, Quirigua.

On Plate 74 of Maudslay's Tikal, we find on glyphs 6–7 the date **6 Eb 0 Pop**[19], and on glyph 13, the form found on Plate XIV, KIN, No. 12 of Normal forms. This probably means 1 day, and on glyphs 14–15 the date **7 Ben 1 Pop**[19] is found, the latter being one day from the former date.

There are, of course, many cases where the distance number does not mark the distance between a date and the next following date; but in several of these cases it is found that the count runs from some preceding date. In other cases it is very possible that the additional number of days needed to fill out the true distance between two dates is supplied by some of the glyphs which have not yet been deciphered.

CHAPTER IX

HEADS AND FACES MEANING 1 TO 19. FORMS FOR ZERO

Face Numerals. — As has been shown in Chapter VII, we have found twenty-four cases where the Initial series are clear, together with many others where parts of the series have to be filled up by calculation. In these cases all the period glyphs are accompanied by numbers in the normal form, nearly all show a date consisting of a day with its number and a month with its number, and nearly all contain a series of glyphs (the Supplementary series) either between the day and the month or following the month. All have **4 Ahau 8 Cumhu**⑦ as the zero point, which, it will be remembered, is seldom expressed, and all record the passing of more than 9 cycles from the zero point.

It will be found that in place of the bar and dot numbers which usually occur with the different period glyphs and also with the day and month signs of the Initial series, heads or faces are sometimes used. These faces are distinct from the faces which are generally used to express the different periods, and they are used to express all the numbers from 1 to 19.

The following is a list of the inscriptions where the numbers attached to the period glyphs or to the day sign or month sign in the Initial series are expressed by faces:

Quirigua, Stela A.	Face for day number.
Stela F (w).	Faces for period numbers and for the numbers of the day and month.
Stela F (e).	do.
Stela J.	Faces for period numbers and day number.
Animal G.	do.
Piedras Negras, Lintel 2.	Faces for period numbers.
Naranjo, Stairway, Inscription 5.	do.

Palenque, Palace Steps.	Faces for period numbers and for the numbers of the day and month.
Temple of the Cross.	do.
Temple of the Foliated Cross.	Faces for period numbers and day number.
Temple of the Sun.	do.
Copan, Stela I.	Face for day number.
Stela P.	Faces for period numbers.

Heads and faces, meaning numbers, are also attached to period and other glyphs found elsewhere in the Inscriptions. These will be taken up later.

In working out the meaning of these face numerals we are aided by the fact that in a few cases the number of one of the glyphs composing the Initial series is expressed by a face, while the remaining numbers are shown in the more usual way by bars and dots.

It is my intention to work out the values of these face numbers, assuming for the time being that the Initial series with face numbers start from the same zero point as that from which the other Initial series with normal numbers start.

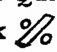
Face meaning 6. — As has been seen, Stela A of Quirigua has a large Initial glyph, followed by 9.17.5.0.0., **? Ahau 13 Kayab** (the month and its number following the last of the Supplementary series) and the place of the day number is taken by a head or face. (Plate XVI, SIX., No. 2.) Since, by turning to Goodman's Tables, or by calculation, it is found that the date **6 Ahau 13 Kayab**(60) belongs to the date 9.17.5.0.0. (counting forward from **4 Ahau 8 Cumhu**(7)), we are fully justified in deciding that the head with the hatchet eye means **6**. This decision as to the meaning of the hatchet eye is strengthened by the fact that on B10 we find **6 Ahau** in the usual form.

Face meaning 17. — In exactly the same way the face representing the number 17 can be proved on Quirigua, Stela F (w), A5[a], where the day sign is clearly **Caban**, and the face attached to the kin must be the one expressing 17 since **Caban** is the seventeenth day from **Ahau**. Unfortunately the glyph is more or less destroyed. There seems to be a fleshless bone used as the lower jaw of this face. The other face numerals on this stela will be examined later. (Plate XVII, SEVENTEEN, No. 1.)

Face meaning 1. — On Lintel 2 of Piedras Negras, the day sign is clearly **Ymix** which would make the face number attached to the kin period glyph equivalent to 1. The character of this face is rather difficult to make out. In an inscription to be taken up later, the glyph for 1 can be made out more clearly. (Plate XVI, ONE, No. 6.)

Face meaning 5. — Stela I of Copan has the Initial series, 9.12.3.14.0., ? ?, the month and its number, following the last of the Supplementary series, being undecipherable. The kin number is the form which we have decided must mean zero. The date belonging to this number is **5 Ahau 8 Uo**(3), as will be found by calculation, and as the day sign with its number usually follows the kin sign, this would seem to show that glyph B5 represents the day and its number, the right-hand part being the day **Ahau** and the left-hand part the number **5**. (See Plate VI, AHAU, No. 37, and Plate XVI, FIVE, No. 2.) The glyph meaning **5** is seen to be a head with a sign like the tun or **Pax** glyph over it. I do not know why this glyph should mean **5**, though it is interesting to note that in my method of determining the month-day of an Initial series, or after a distance number, the tun number remaining after deducting all calendar rounds must be multiplied by 5.

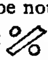
Face meaning 9. — As nearly all the cycle signs in the Initial series which we have so far found have the number 9, expressed by a line or bar and four dots, it is at least probable that the cycle glyphs of the other Initial series which have their numbers expressed by faces will also have the number 9 attached to them. Let us examine the heads which are attached to the cycle signs and which probably represent numbers, and see whether there is any similarity between them. Plate XVI, NINE, shows in No. 1 the head, probably meaning 9, attached to the cycle glyph of Stela P, Copan; in No. 8, that of the cycle glyph of Stela F (e) of Quirigua; in No. 9, that of the cycle glyph of Stela J, Quirigua, and in No. 4 that of the cycle glyph of the Palace Steps of Palenque. All of these have a collection of dots (variously distributed and called by Seler, jaguar spots) about the inner corner of the mouth, while two of them have beards. All have frontlets, which have a certain resemblance to each other. Bearing these points in view, it is easy to recognize this face number for 9, in No. 2 from Stela P, Copan, and in No. 5 from the Palace Steps of Palenque. Nos. 8 and 9 have also a similarity in the forms of the face, though they differ somewhat from the other examples. Provided, therefore, that the cycle glyph records the passage of 9 cycles, we have recognized as 9, Nos. 1, 2, 4, 5, 8 and 9, while No. 10 from Animal G of Quirigua, though defaced, is proved by its position to mean 9, besides having a certain resemblance to Nos. 8 and 9.

Faces meaning 16, 1 and 3. — In Stela F (e) of Quirigua we have 9 for the cycle number. The katun number is the face with the hatchet eye, which we should call 6 from its likeness to the head of the Initial series of Stela A of Quirigua. The tun number is unknown, but it has the **Cimi** mark  on its cheek (Plate II, CIMI, Nos. 22–24), as has the katun number also. The uinal and kin numbers are heads with hands across the faces, which we have already found to mean zero. The long number will then read 9.6.?.0.0. In B5 we find an **Ahau** on the right with an unknown head on the left, while no month sign appears before B8, where we find **Zip** with a head. The day *must* be **Ahau** if the kin number is zero, but what tun number is needed to bring about a month **Zip**?

Turning to Goodman's Tables and looking under Grand cycle 54, Cycle 9 and Katun 6, and running down the column where the different tuns are given, we find that **Zip** does not occur at all at the end of a tun; that is, where zero is the number of the uinal and kin. We feel sure that the cycle number is 9, since that is practically the number of all the cycles which we have so far found; but can the katun number be anything else than 6? Comparing the hatchet-eyed face with the similar face of Stela A, Quirigua, we see that there is a decided difference between them. That of Stela A is a perfect face, while that of Stela F has a fleshless lower jawbone and the **Cimi** mark. Can these have any meaning?[1] Glancing over Goodman's Tables we see that while Katun 6 contains no **Zip** at the end of a tun, Katun 16 has four dates in which **Zip** occurs at the end of a tun. These are

1. 9.16. 7.0.0., **13 Ahau 18 Zip** (33)
2. 9.16. 8.0.0., **9 Ahau 13 Zip** (34)
3. 9.16. 9.0.0., **5 Ahau 8 Zip** (35)
4. 9.16.10.0.0., **1 Ahau 3 Zip** (36).

Can it be that either the fleshless jawbone or the **Cimi** sign (or both) means 10 and changes the meaning of the head with the hatchet eye from 6 to 16? If so, and if the Initial series reads 9.16.?.0.0., which of the four dates shall we select as the true one? If the fleshless jawbone or the **Cimi** mark gives to a face the meaning of 10 or over, we cannot select the first date, since this date has 18 for the month number, and the face for this number has no fleshless jawbone or **Cimi** mark. Nor can we select the second or third dates, since 9 appears as the day number in the second and as the tun number in the third date, and neither of the heads representing the numbers of the day and tun has any resemblance to the heads for 9 which have already been met with. But if the fourth date is chosen, the tun number will be 10, and on looking at A4 we find both the fleshless jawbone and the **Cimi** mark on the tun number. This is rather strong evidence that one or both of these marks has a meaning of 10, and we can make a tentative decision that the Initial series is 9.16.10.0.0., **1 Ahau 3 Zip** (36), thus giving us in the left-hand parts of B5 and B8 the heads for **1** and **3** respectively.[2] (Plate XVI, ONE, No. 2; THREE, No. 1; TEN, No. 5.)

[1] It may be noted that **Cimi** means "death," and it is therefore natural to find the **Cimi** mark  on a fleshless skull or on any symbol of death.

[2] Seler gives further evidence of the value of the glyph as 16 by showing that in the Temple of Inscriptions at Palenque there are three sets of glyphs, — the first and second sets consisting of three glyphs and the last of two, two glyphs of this last set having been compressed into one. The last glyph in each set looks like kin, and is accompanied in the first case by the number  and in the other two by the head with the hatchet eye and the bare jawbone. (See Seler, 1902, Vol. I, p. 765.)

We may also decide that as a working theory the face with the fleshless jawbone either means 10, or, if this form of jawbone is found in connection with a face which has, without this fleshless jawbone, a meaning less than 10, it adds 10 to the value of the face.

Face meaning 10. — In the Initial series of Inscription 5 of the Stairway of Naranjo (Plate XVI, NINE, No. 7), all the period glyphs are clear and the beard of the cycle number gives evidence that it means 9, in addition to the fact that the cycle numbers of the other inscriptions have been found to mean 9. The fleshless jawbone of the tun number gives us a right to call it 10 (for an experiment at least), while the hands on the faces of the heads representing the uinal and kin numbers clearly mark them as zero. We then have 9.?.10.0.0. The day is **13 Ahau**, and the tables show that the only number which can belong to the katun, when the other numbers are 9.?.10.0.0. and the day is **13 Ahau**, is 10. To this interpretation the head attached to the katun lends itself easily. We have then 9.10.10.0.0., **13 Ahau 18 Kankin**(21).

This decision as to the meaning of the head (usually a skeleton) with fleshless jawbone meaning 10 is strengthened by Dr. Seler's showing that the date **6 Caban 10 Mol**(38) appears in two places with the numbers expressed by the dot and line method.[1] He also finds **6 Caban ? Mol** on the Hieroglyphic Staircase at Copan, the number of the month **Mol** being there expressed by the skeleton head with the bare jawbone.

In Stela P, Copan, we have the long number, 9.9.?.0.0., the cycle and katun numbers being 9. The tun number is unknown, and the flaring sign appears as the number for both the uinal and kin, the last two glyphs with their numbers occupying the space usually occupied by one period glyph and its number. In A5 we find a face which must be **Ahau**, though the day number is uncertain, while in B8, after the last glyph of the Supplementary series, we find a month form with **13** for its number. The cross in this month glyph gives it a resemblance to **Pop**.

[1] Seler, 1902, Vol. I, p. 758.

Turning to Goodman's Tables we find that under Grand cycle 54, Cycle 9, Katun 9, the months **Zotz, Zip, Uo, Pop, Uayeb, Cumhu** and **Kayab** occur at the end of different tuns. The month glyph cannot be any of these except **Pop**. This reduces our choice to one of the following dates, namely:

9.9. 9.0.0., **6 Ahau 18 Pop**①
9.9.10.0.0., **2 Ahau 13 Pop**②
9.9.11.0.0., **11 Ahau 8 Pop**③
9.9.12.0.0., **7 Ahau 3 Pop**④

As the month number is **13**, the second date is the only one which we can select as the Initial date, 9.9.10.0.0., **2 Ahau 13 Pop**②.[1] The day number looks like **1** or **3 Ahau**, but it is probably **2 Ahau.** This gives us another form of 10 (see Plate XVI, TEN, No. 3). The glyphs of Stela P, Copan, are the most ornate and variegated of all the inscription glyphs.

We have now possible glyphs for the numbers 1, 3, 5, 6, 9, 10, 16 and 17, the last glyph much effaced.

Face meaning 8. — In the Initial series of Stela J of Quirigua we have the cycle number 9, while the hatchet eye and fleshless jaw of the katun number enables us to fix the number as 16. The tun number has the **Pax** superfix (Plate XVI, FIVE, No. 1), which designates the number as 5, and the hands across the faces of the uinal and kin numbers fix their values as zero. We find also in B8 the day **Ahau** preceded in A8 by a head. In B12 we have **8 Zotz**, following A12, the last glyph of the Supplementary series, — this last glyph being recognized in part by its having a head attached to it which from the dots on its face can be nothing else than 9. Thus we have the long number 9.16.5.0.0., and this is found by the tables to bring us to **8 Ahau 8 Zotz**㉛, thus fixing A8 as the number **8**. (Plate XVI, EIGHT, No. 1.) In further proof of this glyph meaning **8**, it may be noted that on F2 E3 is the date

[1] Dr. Seler reads this date as 9.9.13.0.0., **3 Ahau 3 Uayeb**④, but I am quite sure that he is wrong. The month **13 Pop** is unmistakable in B8, and as this glyph follows the last glyph of the Supplementary series, we must select it as the month of the Initial series. (Seler, 1902, Vol. 1, p. 773.)

6 Cimi 4 Tzec(13), while on F1 E2 is the distance number 18.3.14. Counting forward this number from **6 Cimi 4 Tzec**(13), we reach **8 Ahau 8 Zotz**(31).

We have now a face meaning 8. It will be seen that it is very similar to the face for 1. Great care will have to be taken in order to discriminate between them. As a rule the frontlets are different, that of 1 often consisting of three lobes, while that of 8 is of a curvilinear form. This distinction is not, however, universal.

Faces meaning 15 and 17.—On Animal G (e. l.) of Quirigua we find on C1 a somewhat eroded face for 9 in the cycle number, though even here the dot behind the corner of the mouth can be seen. In C2 the face number is also injured, so that the katun number must be passed by for the present. In E1 we have the face number of the tun. This has the **Pax** superfix, meaning 5, and the fleshless jawbone to which we gave the tentative meaning of 10, making 15 in all. (Plate XVII, FIFTEEN, No. 1.) The face numbers of the uinal and kin in E2 G1 have the hand across the face, and are therefore both zero. The day number in G2 is **5** (Plate XVI, FIVE, No. 5), as evidenced by the **Pax** superfix, while the day in H2 must be **Ahau**, since the kin number is 0. (Plate VI, AHAU, No. 36, and compare with Nos. 35, 37, 38.) On N1 we find **3 Muan**, immediately following the last glyph of the Supplementary series which has a head attached to it in which the bare jawbone suggests the number 10. Thus we have the long number 9.?.15.0.0., **5 Ahau 3 Muan**(8), and on looking under Cycle 9 of Goodman's Tables we find that the only date which is here possible is 9.17.15.0.0., **5 Ahau, 3 Muan**(8). A similar result would be obtained if we use another method. We find that **? Ahau 3 Muan** occurs at the end of a tun five times in Cycle 9. Goodman's Tables show that these cases are as follows:

1. 9. 3. 3.0.0., **3 Ahau 3 Muan**(32)
2. 9. 6.16.0.0., **10 Ahau 3 Muan**(52)
3. 9.10. 9.0.0., **4 Ahau 3 Muan**(20)
4. 9.14. 2.0.0., **11 Ahau 3 Muan**(40)
5. 9.17.15.0.0., **5 Ahau 3 Muan**(8)

The first of these dates must be thrown out, since the numbers of the katun, tun, day and month are all the same, while in the inscription they are all different. The next date has the numbers 6 and 16 in the katun and tun places respectively, and we should therefore expect to find the hatchet eye in both of the corresponding glyphs; but there is nothing of the kind, and we therefore throw out the second date. The third date must suffer the same fate, since the tun number is 9 and the inscription shows a face which in no respect resembles the faces for 9 which we have heretofore found. This leaves Nos. 4 and 5. If we choose the former as the correct date, we find that the value of the fleshless jawbone as 10 must be given up, since the tun number is less than 10 and yet has the fleshless jawbone, while the day number is over 10 and no fleshless jawbone appears. In No. 5, however, the reverse is the case. The fleshless jawbone appears in the tun number with 15 and is absent in the day number with **5**. Besides this, the **Pax** sign appears with both, as should be the case with the numbers 15 and 5, judging from what has been already found.

This then gives us the face numbers for 15 and 17, and it is unfortunate that the lower part of the glyph which means 17 is so injured that we do not get a good example of this number, which is rarely met with. (Plate XVII, SEVENTEEN, No. 2.)

Faces meaning 8 and 13. — The Initial series of the Palace Steps of Palenque, as drawn by Maudslay, gives us 9 for the cycle number, 9 for the tun number, a strange glyph for the kin number, which, however, must be zero, as in A4 we find the day form **Ahau**, with an unknown head for its number, which, however, has the same frontlet as the katun number. Also the uinal number and the month number are almost exactly the same. Moreover, as the day is **Ahau**, the month number can only be **3, 8, 13** or **18.** This scanty knowledge seems to afford rather a weak basis for our work, but, such as it is, we have this part of a date, namely:

A	B	C	D	E	F	G	H	I
9	?	9	?	0	?	**Ahau**	3, 8, 13 or 18	?

Of these B and F are possibly the same, while D and H are surely the same.

The katun face number has a resemblance to the faces which mean 1 in Quirigua, Stela F (e), and 8 in Quirigua, Stela J. Let us then experiment with these two numbers: If the katun number is 1, by placing in the uinal place the numbers 1 to 17, we shall have the following table:

TABLE XIV

9.1.9. 0.0.,	**9 Ahau 8 Tzec**(51)
1.0.,	**3 Ahau 8 Xul**(51)
2.0.,	**10 Ahau 8 Yaxkin**(51)
3.0.,	**4 Ahau 8 Mol**(51)
4.0.,	**11 Ahau 8 Chen**(51)
5.0.,	**5 Ahau 8 Yax**(51)
6.0.,	**12 Ahau 8 Zac**(51)
7.0.,	**6 Ahau 8 Ceh**(51)
8.0.,	**13 Ahau 8 Mac**(51)
9.0.,	**7 Ahau 8 Kankin**(51)
10.0.,	**1 Ahau 8 Muan**(51)
11.0.,	**8 Ahau 8 Pax**(51)
12.0.,	**2 Ahau 8 Kayab**(51)
13.0.,	**9 Ahau 8 Cumhu**(51)
14.0.,	**3 Ahau 3 Pop**(52)
15.0.,	**10 Ahau 3 Uo**(52)
16.0.,	**4 Ahau 3 Zip**(52)
17.0.,	**11 Ahau 3 Zotz**(52)

As the uinal number is the same as the month number, the only date in the above list which would bring this about is 9.1.9.8.0., **13 Ahau 8 Mac**(51). Although the month glyph is injured, its form is clearly seen, and this form is different from any of the known forms of **Mac** which we find in the codices or inscriptions. Moreover the uinal number and the month number bear no resemblance to the face for 8 which we have found in Stela J, Quirigua. We must therefore extend our search.

Substituting 8 for 1 in the katun place and successively placing the numbers 1 to 17 in the uinal place, we have the following table:

TABLE XV

9.8.9.0.0.,	**8 Ahau 18 Xul**(33)
1.0.,	**2 Ahau 18 Yaxkin**(33)
2.0.,	**9 Ahau 18 Mol**(33)
3.0.,	**3 Ahau 18 Chen**(33)

TABLE XV (*continued*)

9.8.9.4.0.,	10 **Ahau 18 Yax**(33)
5.0.,	4 **Ahau 18 Zac**(33)
6.0.,	11 **Ahau 18 Ceh**(33)
7.0.,	5 **Ahau 18 Mac**(33)
8.0.,	12 **Ahau 18 Kankin**(33)
9.0.,	6 **Ahau 18 Muan**(33)
10.0.,	13 **Ahau 18 Pax**(33)
11.0.,	7 **Ahau 18 Kayab**(33)
12.0.,	1 **Ahau 18 Cumhu**(33)
13.0.,	8 **Ahau 13 Pop**(34)
14.0.,	2 **Ahau 13 Uo**(34)
15.0.,	9 **Ahau 13 Zip**(34)
16.0.,	3 **Ahau 13 Zotz**(34)
17.0.,	10 **Ahau 13 Tzec**(34)

Here the only date where the uinal number and the month number are the same is 9.8.9.13.0., **8 Ahau 13 Pop**(34). Here also the faces of the katun number and of the day number, which are somewhat similar, are both found to mean 8, and the form of the month glyph is entirely consistent with its representing **Pop**. For the present, then, we can decide upon the date being 9.8.9.13.0., **8 Ahau 13 Pop**(34). Dr. Seler reaches the same conclusion though by a different path,[1] while J. T. Goodman calls the date 55.3.18.12. 15.12., **8 Eb 15 Pop**. This seems to me inadmissible, since, in order to find this date, he has to go into the grand cycle which follows that in which all the other dates except one are found.[2]

We thus have two forms for 8, slightly differing from one another (Plate XVI, EIGHT, Nos. 3, 5) and a form for 13. (Plate XVI, THIRTEEN, Nos. 2, 3.) It will be seen that there is no bare jawbone appearing on the glyphs for 13 (unless it has been worn off), as we should expect to find on all face numbers over 10. But it may well be that the Mayas carried the individual, as opposed to the composite, glyphs through 13, and did not begin to use the composite form with 10 till they reached 14, — 13 being such an important number in their estimation. It may also be possible that they had another form for 13 in which the 10 formed part.

[1] Seler, 1902, Vol. I, pp. 771 *et seq.*

[2] J. T. Goodman, 1897, p. 139.

Faces for 11 and 2. — On Lintel 2 of Piedras Negras we will assume that the cycle number is 9 from its position, while the katun number is unknown. The hatchet eye of the tun number fixes it as 6, while the kin number must be 1 as the day (C1) is **Ymix.** This day glyph is clear, and its meaning is still further emphasized by the fact that in G1 (immediately following the last Supplementary glyph in F2, which has the number 9 attached to it) we find the month form **Ceh** with the number **19.** The day number is either **2** or **3.** The Initial series will then be 9.?.6.?.1., **2** or **3 Ymix 19 Ceh.**

Here, then, we have a complete Initial series, in which the only uncertainty exists in the katun and uinal numbers, — with a doubt whether the day number is **2** or **3.** If we call the uinal number zero for the present and substitute the numbers 0 to 19 successively in the katun number, we shall have the following result as given in Table XVI, Column 1, using Goodman's Tables in our calculation:

TABLE XVI

	Column 1.		Column 2.	Column 3.
1.	9. 0.6.0.1.,	**11 Ymix 4 Zac** (28)	1	**5 Ymix 4 Ceh** (28)
2.	9. 1.6.0.1.,	**9 Ymix 4 Xul** (48)	6	**12 Ymix 4 Ceh** (48)
3.	9. 2.6.0.1.,	**7 Ymix 4 Pop** (16)	11	**6 Ymix 4 Ceh** (16)
4.	9. 3.6.0.1.,	**5 Ymix 9 Kankin** (35)	16	**13 Ymix 4 Ceh** (36)
5.	9. 4.6.0.1.,	**3 Ymix 9 Chen** (3)	3	**11 Ymix 9 Ceh** (3)
6.	9. 5.6.0.1.,	**1 Ymix 9 Zotz** (23)	8	**5 Ymix 9 Ceh** (23)
7.	9. 6.6.0.1.,	**12 Ymix 14 Kayab** (42)	13	**12 Ymix 9 Ceh** (43)
8.	9. 7.6.0.1.,	**10 Ymix 14 Ceh** (10)	0	**10 Ymix 14 Ceh** (10)
9.	9. 8.6.0.1.,	**8 Ymix 14 Yaxkin** (30)	5	**4 Ymix 14 Ceh** (30)
10.	9. 9.6.0.1.,	**6 Ymix 14 Uo** (50)	10	**11 Ymix 14 Ceh** (50)
11.	9.10.6.0.1.,	**4 Ymix 19 Muan** (17)	15	**5 Ymix 14 Ceh** (18)
12.	9.11.6.0.1.,	**2 Ymix 19 Yax** (37)	2	**3 Ymix 19 Ceh** (37)
13.	9.12.6.0.1.,	**13 Ymix 19 Tzec** (5)	7	**10 Ymix 19 Ceh** (5)
14.	9.13.6.0.1.,	**11 Ymix 4 Uayeb** (24)	12	**4 Ymix 19 Ceh** (25)
15.	9.14.6.0.1.,	**9 Ymix 4 Kankin** (44)	17	**11 Ymix 19 Ceh** (45)
16.	9.15.6.0.1.,	**7 Ymix 4 Chen** (12)	3	**2 Ymix 4 Ceh** (12)
17.	9.16.6.0.1.,	**5 Ymix 4 Zotz** (32)	8	**9 Ymix 4 Ceh** (32)
18.	9.17.6.0.1.,	**3 Ymix 9 Kayab** (51)	13	**3 Ymix 4 Ceh** (52)
19.	9.18.6.0.1.,	**1 Ymix 9 Ceh** (19)	0	**1 Ymix 9 Ceh** (19)
20.	9.19.6.0.1.,	**12 Ymix 9 Yaxkin** (39)	5	**8 Ymix 9 Ceh** (39)

As the month-day is clearly **19 Ceh**, none of these dates agree with the date of the inscription, and therefore the uinal number cannot be zero. We could make tables in which we could substitute the numbers 1 to 17 in the uinal place of each of the series given above, but this would take a long time to accomplish and is not necessary. As in No. 1 the month is **Zac**, and as in the inscription the month is **Ceh**, it is evident that there cannot be more than 1 uinal added in order to reach the latter month, and the question is as to even uinals alone, all the other terms having been settled on. Counting 1 uinal from **4 Zac** brings us to **4 Ceh**, and the date is **19 Ceh**. Therefore the substitution of any value from 1 to 17 in the uinal place of No. 1 will not bring out the correct result, for the substitution of the number 1 brings us to the wrong day of the month, and the substitution of any other number up through 17 will bring us to the wrong month. In No. 2 the month-day is **4 Xul**, and no more nor less than 6 even uinals will bring us to the month **Ceh**, but counting forward 6 uinals from **4 Xul** brings us to **4 Ceh** and not to **19 Ceh**, while the substitution of any other number than 6 will bring us to the wrong month. This proves that No. 2 does not offer a possibility of reaching the correct date. The same course may be pursued with all the other cases of column 1, with the result given in columns 2 and 3. Column 2 gives the only number of even uinals which can be used to reach the month **Ceh**, while column 3 shows the day with its number and the month-day actually reached by counting forward this number of uinals from the date in column 1. Nos. 12 to 15 show the only cases where the month number reached is **19**, while No. 12 is the only one of these four where the day number is **2** or **3**. We thus find that the only possible combination by which the date **2** or **3 Ymix 19 Ceh** in connection with an Initial series of 9.?.6.?.1. is where the katun number is 11 and the uinal number is 2. The Initial series of Lintel 2 must be 9.11.6.2.1., **3 Ymix 19 Ceh**(37).

We have thus new face glyphs for 11 and 2. (Plate XVI, TWO and ELEVEN.)

It may be claimed that the tun number is 16 and not 6, as the lower jaw of the head is peculiar, but a comparison with the face number of the kin which has a similar lower jaw and which must be 1 and cannot therefore have the bare lower jaw, shows that the lower jaw of the tun number is not meant to be bare of flesh. And indeed it is evidently not fleshless. Moreover, if the tun number were 16, the only date which would meet the requirements of the day and month with their numbers would be 9.19.16.8.1., **2 Ymix 19 Ceh**(49). Examination shows that the katun face number has no bare lower jawbone and is not like the faces meaning 9, and that the uinal face number is unlike the other faces which mean 8. (See also my "Notes on the Report of Teobert Maler, No. 1," pages 22 to 25.)

Faces meaning 4, 12 and 14. — The only other Initial series with face numbers, except those of Palenque, is found on Stela F (w) of Quirigua. Here the period glyphs are distinct, the day is **Caban** in B5 and the month in A6 is **5 Kayab**, — the **5** being recognized by the **Pax** superfix. Knowing that the day is **Caban**, we know that the kin number is 17. In AB18 we find the date **12 Caban 5 Kayab**(51), which, as we often find the Initial date repeated, gives a suggestion at least that the Initial date may also be **12 Caban 5 Kayab**(51).[1] We now have the following: 9.?.?.?.17., **? Caban 5 Kayab**. This seems discouraging, but we find that the katun number and the uinal number are almost exactly similar, except that the former has the fleshless jawbone which shows that there is a difference of 10 between them. We have found that the numbers 11 to 13 are given in their face form without the fleshless jawbone, so that it is probable that the katun number is one of the numbers 14 to 19 inclusive; but we will make the examination as if it might be 11, 12 or 13 also.

Table XVII shows the first and last terms of ten possible series in which an Initial series of 9.?.?.?.17. can occur, provided the uinal number is ten less than the katun number. It is evident that under this condition the katun number cannot be less than 10. The first column gives the numeral part of the first and last terms of each series, the second column gives the date of each first term and column three gives the date of each last term of these

[1] This date probably occurs five times on the inscriptions in Quirigua.

series. All the other dates which occur when the tun number has intermediate values between 0 and 19 will be found, as far as the month is concerned, between the month dates of the second and third columns of each series, counting backwards. It is to be noted that if 9.11.0.1.17. reaches the month-day **5 Kankin**, the date one tun in advance of this, or 9.11.1.1.17., will reach the month-day **0 Kankin**. In the same way 9.11.2.1.17. reaches the month-day **15 Mac**. In other words, by increasing the tun number by 1, in an Initial series or other long count, we count to a month date 5 days earlier than in the date with which we started. This is necessarily the case, since a tun is 5 days shorter than a year of 365 days. If a year's count from **5 Kayab** reaches **5 Kayab** again, then by counting forward from **5 Kayab** a tun of but 360 days, we must reach **0 Kayab**.

Thus in the first series of Table XVII all the dates belonging to the Initial series of 9.10.?.0.17., when we use the numbers 0–19 in the tun place, will fall, as far as the month is concerned, between

TABLE XVII

Series.	First Column.	Second Column.	Third Column.
1.	9.10. 0.0.17.,	**5 Caban 5 Cumhu** (11)	
	9.10.19.0.17.,		**7 Caban 10 Mac** (30)
2.	9.11. 0.1.17.,	**10 Caban 5 Kankin** (31)	
	9.11.19.1.17.,		**12 Caban 10 Chen** (50)
3.	9.12. 0.2.17.,	**2 Caban 5 Yax** (51)	
	9.12.19.2.17.,		**4 Caban 10 Tzec** (18)
4.	9.13. 0.3.17.,	**7 Caban 5 Xul** (19)	
	9.13.19.3.17.,		**9 Caban 10 Pop** (38)
5.	9.14. 0.4.17.,	**12 Caban 5 Uo** (39)	
	9.14.19.4.17.,		**1 Caban 15 Muan** (5)
6.	9.15. 0.5.17.,	**4 Caban 10 Pax** (6)	
	9.15.19.5.17.,		**6 Caban 15 Zac** (25)
7.	9.16. 0.6.17.,	**9 Caban 10 Ceh** (26)	
	9.16.19.6.17.,		**11 Caban 15 Yaxkin** (45)
8.	9.17. 0.7.17.,	**1 Caban 10 Mol** (46)	
	9.17.19.7.17.,		**3 Caban 15 Zip** (13)
9.	9.18. 0.8.17.,	**6 Caban 10 Zotz** (14)	
	9.18.19.8.17.,		**8 Caban 0 Cumhu** (32)
10.	9.19. 0.9.17.,	**11 Caban 15 Cumhu** (33)	
	9.19.19.9.17.,		**13 Caban 0 Kankin** (62)

5 Cumhu and **10 Mac**, counting back from **5 Cumhu**. So in the second series of the table, all the dates belonging to the Initial series 9.11.?.1.17., when the numbers 0–19 are used in the tun place, will fall, as far as the month is concerned, between **5 Kankin** and **10 Chen**, counting back from **5 Kankin**. And so with the other series.

It will be seen that the date **5 Kayab** will not occur between the limits included in the series Nos. 2, 3, 4, 6, 7, 8 and 9, while it may occur between the limits of Nos. 1, 5 and 10, in each of which series there will be but one place where **5 Kayab** will occur. The three possible places where **5 Kayab** will occur are,

No. 1. 9.10. 4.0.17., **2 Caban 5 Kayab**(15),
No. 5. 9.14.13.4.17., **12 Caban 5 Kayab**(51),
No. 10. 9.19. 6.9.17., **13 Caban 5 Kayab**(39).

The true date is probably not the first of these three, since the uinal number is unlike any of the forms of zero which have been met with, and the katun number is not like any of the forms for 10 which have been found. The last of the three must be discarded, since there is no likeness to 9 in either the katun or uinal number faces. This leaves as the probable date 9.14.13.4.17., **12 Caban 5 Kayab**(51), which also appears as has been said on AB18. We have thus probably obtained the face numbers for 4, 12 and 14, but unfortunately the glyphs are rather indistinct. (Plate XVI, FOUR, No. 3; TWELVE, No. 2 and FOURTEEN.)

In all the foregoing cases the proof of the values of the number glyphs depends in a large degree on the assumption of the value of the cycle number as 9. The evidence of this value of the cycle number glyph depends on the facts,

First, that all the cycle numbers of the Initial series where the line and dot method is used are 9, except in one instance, where the zero date **4 Ahau 8 Cumhu**(7) is given;

Second, that, by the use of 9 as the value of the cycle face numbers, a harmonious system of face numbers has been found in all the Initial series which have been examined up to this time.

This evidence seems strong enough to support the decision that the value of the faces for 9 given on Plate XVI is correct.

We have now found face forms for all the numbers from 0 to 19, except 7, 18 and 19, and 0 in connection with a month or day glyph. We have also found that the face forms for 14, 15 and 16 are practically the same as those of 4, 5 and 6 except that the former have the bare jawbone. It may be fair to suppose therefore that the face forms of 18 and 19 will resemble those of 8 and 9 respectively, with the same exception. In our search we have examined all the Initial series that are known which have face numbers attached to the period, day or month glyphs, except those of the three buildings at Palenque, which are called Temple of the Cross, Temple of the Foliated Cross and Temple of the Sun.

Initial Series of Palenque. Face meaning 18. — Beginning with the Initial series of the Temple of the Foliated Cross, the grand cycle glyph calls for our attention. That part of the glyph which lies between the two combs is usually a head, but here it is a frame in which we find the day sign **Ik**. We are also struck with the dissimilarity of the face number of the cycle to the face number 9 which we have met with before. It looks much more like 8 or 1, the frontlet being like that of the kin face number of Lintel 2 of Piedras Negras, which is surely 1. The face number of the katun is like the face number of the katun of the Palace Steps in Palenque, which means 8, except that it has the bare jawbone. This would raise its value to 18. (Plate XVII, EIGHTEEN, No. 1.) The **Pax** superfix fixes the value of the tun face number at 5. The uinal face number is unknown, while the kin face number is shown by the hand across the face to mean zero, and we find, as we should expect, the day to be **Ahau** (B8). The face number of the day is very like the cycle face number, while the month number is **13**, and the month is **Mac**. We have then ?.18.5.?.0., **? Ahau 13 Mac**. As we have always up to this time found the cycle number to be 9, we should naturally expect to find it mean 9 here, in spite of its dissimilarity to the known forms of 9. The day number having the same face form as the cycle number, we shall have to call the day number 9 also. We then have 9.18.5.?.0., **9 Ahau 13 Mac**[42]. Giving the values of 0 to 17 successively to the uinal number, we shall get the values set forth in Table XVIII, Column No. 1. Column No. 2 shows the day and month dates, calculated by Goodman's Tables, belonging to each of the numeral dates of Column No. 1, provided that the zero point of the count is, as we have so far always found it, **4 Ahau 8 Cumhu**[7].

TABLE XVIII

Column 1.		Column 2.
9.18.5. 0.0.,	**9 Ahau 13 Mac.**	**4 Ahau 13 Ceh**[18]
9.18.5. 1.0.,	**9 Ahau 13 Mac.**	**11 Ahau 13 Mac**[18]
9.18.5. 2.0.,	**9 Ahau 13 Mac.**	**5 Ahau 13 Kankin**[18]
9.18.5. 3.0.,	**9 Ahau 13 Mac.**	**12 Ahau 13 Muan**[18]
9.18.5. 4.0.,	**9 Ahau 13 Mac.**	**6 Ahau 13 Pax**[18]
9.18.5. 5.0.,	**9 Ahau 13 Mac.**	**13 Ahau 13 Kayab**[18]
9.18.5. 6.0.,	**9 Ahau 13 Mac.**	**7 Ahau 13 Cumhu**[18]
9.18.5. 7.0.,	**9 Ahau 13 Mac.**	**1 Ahau 8 Pop**[19]
9.18.5. 8.0.,	**9 Ahau 13 Mac.**	**8 Ahau 8 Uo**[19]
9.18.5. 9.0.,	**9 Ahau 13 Mac.**	**2 Ahau 8 Zip**[19]
9.18.5.10.0.,	**9 Ahau 13 Mac.**	**9 Ahau 8 Zotz**[19]
9.18.5.11.0.,	**9 Ahau 13 Mac.**	**3 Ahau 8 Tzec**[19]
9.18.5.12.0.,	**9 Ahau 13 Mac.**	**10 Ahau 8 Xul**[19]
9.18.5.13.0.,	**9 Ahau 13 Mac.**	**4 Ahau 8 Yaxkin**[19]
9.18.5.14.0.,	**9 Ahau 13 Mac.**	**11 Ahau 8 Mol**[19]
9.18.5.15.0.,	**9 Ahau 13 Mac.**	**5 Ahau 8 Chen**[19]
9.18.5.16.0.,	**9 Ahau 13 Mac.**	**12 Ahau 8 Yax**[19]
9.18.5.17.0.,	**9 Ahau 13 Mac.**	**6 Ahau 8 Zac**[19]

If the cycle number is 9, the day number must also be **9**, since the two glyphs are practically the same. But the only place in Column 2 where the day number is **9** is in the date 9.18.5.10.0., **9 Ahau 8 Zotz**[19]. This cannot be the correct date, since the month number of the inscription is clearly **13**, the month is surely not **Zotz** and the uinal number does not look like 10. In the cases where in Column 2 the month-day is **13**, there is no case where the day **9 Ahau** appears.

This result seems to show that **9** cannot be the number attached to the day, and consequently cannot be the number attached to the cycle, — as indeed an inspection of the glyphs would like-wise show, since neither of these glyphs has any resemblance to any of the faces which have been heretofore found with the meaning of 9.

If, contrary to all our experience, we call the cycle number 8, giving the same number to the day, we should have the following columns of Table XIX, calculated as in Table XVIII:

TABLE XIX

Column 1.	Column 2.
8.18.5. 0.0., **8 Ahau 13 Mac**	**5 Ahau 3 Zip(40)**
8.18.5. 1.0., **8 Ahau 13 Mac**	**12 Ahau 3 Zotz(40)**
8.18.5. 2.0., **8 Ahau 13 Mac**	**6 Ahau 3 Tzec(40)**
8.18.5. 3.0., **8 Ahau 13 Mac**	**13 Ahau 3 Xul(40)**
8.18.5. 4.0., **8 Ahau 13 Mac**	**7 Ahau 3 Yaxkin(40)**
8.18.5. 5.0., **8 Ahau 13 Mac**	**1 Ahau 3 Mol(40)**
8.18.5. 6.0., **8 Ahau 13 Mac**	**8 Ahau 3 Chen(40)**
8.18.5. 7.0., **8 Ahau 13 Mac**	**2 Ahau 3 Yax(40)**
8.18.5. 8.0., **8 Ahau 13 Mac**	**9 Ahau 3 Zac(40)**
8.18.5. 9.0., **8 Ahau 13 Mac**	**3 Ahau 3 Ceh(40)**
8.18.5.10.0., **8 Ahau 13 Mac**	**10 Ahau 3 Mac(40)**
8.18.5.11.0., **8 Ahau 13 Mac**	**4 Ahau 3 Kankin(40)**
8.18.5.12.0., **8 Ahau 13 Mac**	**11 Ahau 3 Muan(40)**
8.18.5.13.0., **8 Ahau 13 Mac**	**5 Ahau 3 Pax(40)**
8.18.5.14.0., **8 Ahau 13 Mac**	**12 Ahau 3 Kayab(40)**
8.18.5.15.0., **8 Ahau 13 Mac**	**6 Ahau 3 Cumhu(40)**
8.18.5.16.0., **8 Ahau 13 Mac**	**13 Ahau 3 Uayeb(40)**
8.18.5.17.0., **8 Ahau 13 Mac**	**7 Ahau 18 Pop(41)**

Since no one of the months in the table has the number 13, it is evident that the true date is not found in the table, and that therefore the numbers of the cycle and day glyphs cannot be 8.

If we call the cycle and day numbers 1 (and the face has more resemblance to the glyphs for 1 which have been found before than to anything else), by giving the values of 0 to 17 to the uinal number, as before, we shall have the following columns:

TABLE XX

Column 1.	Column 2.
1.18.5.0.0., **1 Ahau 13 Mac**	**12 Ahau 13 Chen(34)**
1.18.5.1.0., **1 Ahau 13 Mac**	**6 Ahau 13 Yax(34)**
1.18.5.2.0., **1 Ahau 13 Mac**	**13 Ahau 13 Zac(34)**
1.18.5.3.0., **1 Ahau 13 Mac**	**7 Ahau 13 Ceh(34)**

TABLE XX (*continued*)

COLUMN 1.	COLUMN 2.
1.18.5. 4.0., **1 Ahau 13 Mac**	**1 Ahau 13 Mac**(34)
1.18.5. 5.0., **1 Ahau 13 Mac**	**8 Ahau 13 Kankin**(34)
1.18.5. 6.0., **1 Ahau 13 Mac**	**2 Ahau 13 Muan**(34)
1.18.5. 7.0., **1 Ahau 13 Mac**	**9 Ahau 13 Pax**(34)
1.18.5. 8.0., **1 Ahau 13 Mac**	**3 Ahau 13 Kayab**(34)
1.18.5. 9.0., **1 Ahau 13 Mac**	**10 Ahau 13 Cumhu**(34)
1.18.5.10.0., **1 Ahau 13 Mac**	**4 Ahau 8 Pop**(35)
1.18.5.11.0., **1 Ahau 13 Mac**	**11 Ahau 8 Uo**(35)
1.18.5.12.0., **1 Ahau 13 Mac**	**5 Ahau 8 Zip**(35)
1.18.5.13.0., **1 Ahau 13 Mac**	**12 Ahau 8 Zotz**(35)
1.18.5.14.0., **1 Ahau 13 Mac**	**6 Ahau 8 Tzec**(35)
1.18.5.15.0., **1 Ahau 13 Mac**	**13 Ahau 8 Xul**(35)
1.18.5.16.0., **1 Ahau 13 Mac**	**7 Ahau 8 Yaxkin**(35)
1.18.5.17.0., **1 Ahau 13 Mac**	**1 Ahau 8 Mol**(35)

Among the above dates there is but one in which the month number is **13** and the day number is **1**. This is 1.18.5.4.0., **1 Ahau 13 Mac**(34). This, therefore, is the date for which we are seeking.

If this decision is correct, and it is hard to see why it is not, we have found a face form for 4 which is not unlike the forms for 14 and 4 which were found attached to the period glyphs of Stela F (w) of Quirigua, though the glyph is more clear in this case and shows the square mark in the eye which we shall find in other glyphs of this number and which Goodman refers to as the "square irid."[1] (Plate XVI, FOUR, No. 2.) Part of the kin glyph is also found on several of the forms for 4.

To those who are seeking for evidence in support of the phonetic or partially phonetic character of the Maya glyphs, the fact that the kin sign is found on the face meaning 4 suggests the possibility that as **Kan**, **Can** and **Kin** have the same consonantal sound, one may be used to represent the other. **Kan** is the fourth day of the series of twenty days where **Ymix** is the first, as it is in the long count, and **Kan** is always the day reached when the kin number of the Initial series is 4. Since **Can** also means 4, it may be thought natural that the face number for 4 should have the kin sign.

To find a date in Cycle 1 is most unusual, and it will not be wise

[1] J. T. Goodman, 1897, p. 17.

to accept this result without further examination and the support of other dates. The date of **1 Ahau 13 Mac**(34) is proved, however, by the fact that on B12 A13 we find the distance number 14.19. But if we count 14.19. forward from **1 Ahau 13 Mac**(34) we reach **1 Cauac 7 Yax**(35), and this date we find in B13 A14. This confirms the decision arrived at, for it shows that the day number is **1**, and as the day number and cycle number are practically the same form, it gives sanction to our calling the cycle number 1 also.

Again, in the Initial series of the Temple of the Sun we find that the central part of the grand cycle glyph is a head as usual in other cases, instead of a frame with the day sign **Ik** inside it, as we found in the Temple of the Foliated Cross. The numbers of the cycle, katun and tun, are almost exactly like those of the Initial series of the Temple of the Foliated Cross. (Plate XVI, ONE, No. 4; FIVE, No. 4, and Plate XVII, EIGHTEEN, No. 2.) The uinal number is unknown and the kin number is 6, judging from the hatchet eye. The day in B8 must be **Cimi** if the kin number is 6, while the day number is like the form of 13 in the Palace Steps of Palenque. In B9 we have **19 Ceh**.

If the cycle number is 9, we shall have 9.18.5.?.6., **? Cimi 19 Ceh**. By giving in succession the values of 0 to 17 to the uinal number, we obtain the following table, calculated in the same way as were Tables XVIII to XX:

TABLE XXI

Column 1.	Column 2.
9.18.5. 0.6., **? Cimi 19 Ceh**	**10 Cimi 19 Ceh**(18)
9.18.5. 1.6., **? Cimi 19 Ceh**	**4 Cimi 19 Mac**(18)
9.18.5. 2.6., **? Cimi 19 Ceh**	**11 Cimi 19 Kankin**(18)
9.18.5. 3.6., **? Cimi 19 Ceh**	**5 Cimi 19 Muan**(18)
9.18.5. 4.6., **? Cimi 19 Ceh**	**12 Cimi 19 Pax**(18)
9.18.5. 5.6., **? Cimi 19 Ceh**	**6 Cimi 19 Kayab**(18)
9.18.5. 6.6., **? Cimi 19 Ceh**	**13 Cimi 19 Cumhu**(18)
9.18.5. 7.6., **? Cimi 19 Ceh**	**7 Cimi 14 Pop**(19)
9.18.5. 8.6., **? Cimi 19 Ceh**	**1 Cimi 14 Uo**(19)
9.18.5. 9.6., **? Cimi 19 Ceh**	**8 Cimi 14 Zip**(19)
9.18.5.10.6., **? Cimi 19 Ceh**	**2 Cimi 14 Zotz**(19)
9.18.5.11.6., **? Cimi 19 Ceh**	**9 Cimi 14 Tzec**(19)
9.18.5.12.6., **? Cimi 19 Ceh**	**3 Cimi 14 Xul**(19)

TABLE XXI (*continued*)

Column 1.	Column 2.
9.18.5.13.6., ? **Cimi 19 Ceh**	**10 Cimi 14 Yaxkin**[19]
9.18.5.14.6., ? **Cimi 19 Ceh**	**4 Cimi 14 Mol**[19]
9.18.5.15.6., ? **Cimi 19 Ceh**	**11 Cimi 14 Chen**[19]
9.18.5.16.6., ? **Cimi 19 Ceh**	**5 Cimi 14 Yax**[19]
9.18.5.17.6., ? **Cimi 19 Ceh**	**12 Cimi 14 Zac**[19]

The first date of the table, and this alone, fulfils the conditions of the day and of the month-day, but the uinal number is certainly not zero, and the day number is unlike any of the forms of 10 which have been found heretofore.

If however the cycle number is 1, we shall have the date 1.18.5.?.6., **? Cimi 19 Ceh**, and by giving the values of 0 to 17 to the uinal number, we obtain the following Table:

TABLE XXII

Column 1.	Column 2.
1.18.5. 0.6., ? **Cimi 19 Ceh**	**5 Cimi 19 Chen**[34]
1.18.5. 1.6., ? **Cimi 19 Ceh**	**12 Cimi 19 Yax**[34]
1.18.5. 2.6., ? **Cimi 19 Ceh**	**6 Cimi 19 Zac**[34]
1.18.5. 3.6., ? **Cimi 19 Ceh**	**13 Cimi 19 Ceh**[34]
1.18.5. 4.6., ? **Cimi 19 Ceh**	**7 Cimi 19 Mac**[34]
1.18.5. 5.6., ? **Cimi 19 Ceh**	**1 Cimi 19 Kankin**[34]
1.18.5. 6.6., ? **Cimi 19 Ceh**	**8 Cimi 19 Muan**[34]
1.18.5. 7.6., ? **Cimi 19 Ceh**	**2 Cimi 19 Pax**[34]
1.18.5. 8.6., ? **Cimi 19 Ceh**	**9 Cimi 19 Kayab**[34]
1.18.5. 9.6., ? **Cimi 19 Ceh**	**3 Cimi 19 Cumhu**[34]
1.18.5.10.6., ? **Cimi 19 Ceh**	**10 Cimi 14 Pop**[35]
1.18.5.11.6., ? **Cimi 19 Ceh**	**4 Cimi 14 Uo**[35]
1.18.5.12.6., ? **Cimi 19 Ceh**	**11 Cimi 14 Zip**[35]
1.18.5.13.6., ? **Cimi 19 Ceh**	**5 Cimi 14 Zotz**[35]
1.18.5.14.6., ? **Cimi 19 Ceh**	**12 Cimi 14 Tzec**[35]
1.18.5.15.6., ? **Cimi 19 Ceh**	**6 Cimi 14 Xul**[35]
1.18.5.16.6., ? **Cimi 19 Ceh**	**13 Cimi 14 Yaxkin**[35]
1.18.5.17.6., ? **Cimi 19 Ceh**	**7 Cimi 14 Mol**[35]

The fourth date here fulfils all conditions, namely, 1.18.5.3.6., **13 Cimi 19 Ceh**[34]. The uinal face number is very like the face in Quirigua, Stela F (e), which meant 3, and the day number is very similar to the faces meaning 13 on the Steps of the Palace in Palenque. Moreover, the date is just fourteen days before the date of the Initial series of the Temple of the Foliated Cross, 1.18.5.4.0., **1 Ahau 13 Mac**(34).[1] (Plate XVI, THREE, No. 2; THIRTEEN, No. 4.)

Faces meaning 12, 13 and 19. — The Initial series of the Temple of the Cross is, if we decipher it aright, entirely unique, for it falls in the grand cycle immediately preceding the grand cycle in which all the other Initial series fall, with the exception of that of Stela C (e) Quirigua, in which the date **4 Ahau 8 Cumhu**(7) is given, — the beginning of the Maya time era, — or rather, in all probability, the end of the preceding era. In the Initial series of the Temple of the Foliated Cross and of the Temple of the Sun, the period glyphs are heads, but in the Initial series of the Temple of the Cross we find the normal forms of the period glyphs. (See Plate XIV, Normal forms, No. 1 of each period.)

In the grand cycle glyph we see the **Caban** sign above the **Pax** sign, and between the combs, taking the place of the **Ik** sign in the grand cycle sign of the Temple of the Foliated Cross and of the head in that of the Temple of the Sun. If the grand cycles of the Temple of the Cross and of the Temple of the Foliated Cross are different, it may well be that the **Ik** and **Caban** signs show this, — each sign being the fourth in the sets of five days, in which the twenty days are divided when each set begins with one of Landa's "dominical days," or the second when counted from **Ymix**, **Cimi**, etc.

The face number of the cycle looks at first sight like 5, — a head with a **Pax** superfix. But a close examination will show that this is a mistake. In the examples of 5 found in Stela I, Copan, in Stela J and Animal G of Quirigua, and in the Initial series of the Temples of the Foliated Cross and of the Sun in Palenque (Plate XVI, FIVE, Nos. 1–5), the face is generally an old one with one or two projecting teeth, while the glyph which we are examining shows a young face. Again, the so-called **Pax** superfix has the upper part divided by vertical columns, and the lower part contains a circle with curved lines on each side of it. The glyph of

[1] The reading of this Initial series is further confirmed by the fact that the whole series is repeated in reverse order on C7–D8.

the cycle number of the Temple of the Cross has no vertical columns in the upper part, while the lower part has curved lines but in a different place, namely, on the lower corners, and two little circles close to the upper line. It is more like the glyph for **Tzec**.

It is easy to recognize in the katun glyph the dots and beard which usually belong to 9, while the bare jawbone adds 10, making the whole number 19. (Plate XVII, NINETEEN.)

The tun number is 10, or over 10, as shown by the bare jawbone, and the **Ik** sign over the place of the ear suggests 3. This would give 13, for which, however, we have already found an individual glyph, in which the bare jawbone does not appear.

The uinal number looks like the uinal number of the Temple of the Foliated Cross, which is 4, while the kin number is 0, as shown by the hand and scroll glyph in A7, as it must be, if the day is **Ahau**, as it plainly is.

The day number is either **1** or **8** and the month is **Tzec**, with a number which is very like the day number except that it has the bare jawbone. If the day number is **1** the month number is **11**, and if the day number is **8** the month number is **18**; but the month number cannot be **11**, as the day is **Ahau**. If we compare the month number with the katun number of the Temples of the Foliated Cross and of the Sun, it will be seen to be the same form. If, then, we have deciphered the last two series correctly, the date which we are examining is **8 Ahau 18 Tzec**①.

We then have ?.19.?.4.0., **8 Ahau 18 Tzec**①. The end of the preceding tun will be ?.19.?.0.0., **6 Ahau 18 Pop**①.

Looking through the Katuns 19 of all the cycles in which **4 Ahau 8 Cumhu**⑦ is the zero point, we find no tun ending with this date. But in the preceding grand cycle (called by Goodman 53) we find this date in Cycle 12, Katun 19, Tun 13, as the end of the tun. We then have 12.19.13.0.0., **6 Ahau 18 Pop**①, or, adding the 4 uinals, we reach 12.19.13.4.0., **8 Ahau 18 Tzec**①. The probability that the month and day dates are correct is increased by the fact that in AB16 we find the date **1 Ahau 18 Zotz**①, which would be but one uinal before **8 Ahau 18 Tzec**①, and would be 12.19.13.3.0.

It is certainly very strange to find a date so far in the past as this is, — over 3700 years before an average date like 9.9.16.0.0. But the dates of the Temples of the Foliated Cross and of the Sun are not very distant from this, and these dates, as I have shown in my pamphlet entitled "The Temples of the Cross, of the Foliated Cross and of the Sun at Palenque," may very possibly have an astronomical connection. The date 12.19.13.4.0. gives us new forms for 12 and 19. (Plate XVI, TWELVE, No. 1, and Plate XVII, NINETEEN.)

Moreover, there is evidence that a very early date is recorded here, for on D3 C4 we find **4 Ahau 8 Cumhu**⑦ (a date but 6.14.0., or 2440 days after the date which we are discussing), and on C5 this is declared to be Cycle 13. As we have always found that elapsed time is recorded, this probably means that 13 cycles of the preceding grand cycle have elapsed and that another grand cycle has begun, since up to this time in our investigations all the dates which we have found have **4 Ahau 8 Cumhu**⑦ for their zero point. If, however, we count forward 13 cycles from **4 Ahau 8 Cumhu**⑦, we reach **4 Ahau 3 Kankin**㊵, and not **4 Ahau 8 Cumhu**⑦, while if we count forward 13 cycles from **4 Ahau 8 Zotz**㉗, the zero point of the preceding cycle, we reach **4 Ahau 8 Cumhu**⑦, and if we count forward 12.19.13.4.0., from **4 Ahau 8 Zotz**㉗, we reach our date **8 Ahau 18 Tzec**①.[1]

We then have the date on D3 C4 in which the 13 will mean 13 completed cycles of the last grand cycle and will be treated as the zero point of our calculations.	13. 0.0. 0.0., **4 Ahau 8 Cumhu**⑦
On D5 C6 we find	1. 9.2.
and on D13–C15 we find (provided that the thumb means 1, as we have found it to mean heretofore)	1.18.3.12.0.
Counting forward these sums, we reach	1.18.5. 3.2., **9 Ik 15 Ceh**㉞.

[1] For further explanation of Cycle 13, see Appendix IX.

On EF1 we find this date, which is, as will be seen, 4 days before that of the Initial series of the Temple of the Sun and 18 days before that of the Temple of the Foliated Cross.

Thus, if we have interpreted these dates correctly, these three temples, standing in one group and facing a common centre, contain Initial series which record dates far in the past, two of the dates being within fourteen days of each other, while the third temple contains glyphs in close proximity to the Initial series, which record a date within a few days of the dates of the Initial series of the other two.

Moreover, large numbers are found farther on in the inscription, as if to bring forward the date of the Initial series to the then present or recent time.

Thus on E5–F6 we have	2. 1. 7.11. 2.
and on E10–F11	3. 6.10.12. 2.
and on F15–16	1. 6. 7.13.
Adding the numbers already reached, or	1.18. 5. 3. 2.
we have a total of	7. 7. 9.15.19.
We also find on D15–17 of the Temple of the Foliated Cross following **1 Ahau 13 Mac**㉞	7. 7. 7. 3.16.

In our decision that the Initial series of the Temple of the Cross is 12.19.13.4.0., **8 Ahau 18 Tzec**①, and that it lies before **4 Ahau 8 Cumhu**⑦, the zero point of the usual Maya era, everything is satisfactory as far as the face numbers are concerned, except that the face number of the cycle is unlike the face form of 12 which we found as the face number of the day **Caban** on Stela F (w) Quirigua. In this connection it is interesting to notice that the **Pax** superfix gives the value of 5 to a face number. If this is owing to the fact that **Pax** was the fifth month in some old form of the calendar in which the first month was **Ceh**, then it would be natural that a form of the month **Tzec** should mean 12, for in such a calendar **Tzec** would be the twelfth month.[1]

[1] Attention may be here called to the fact that the Initial series of Stela C (e) of Quirigua is 13.0.0.0.0., **4 Ahau 8 Cumhu**⑦.

Dr. Seler confesses himself unable to decide on the date 12.19.13.4.0., but as the

We have now recognized in the Initial series all the face numbers from 0 to 19 except 7 and 0, when applied to a month-day; but we have the face form of 17, which may be of assistance to us in recognizing that of 7, when we meet it.

The question whether the month-days were numbered from 1 to 20, or whether the numbers only ran to 19 with a day in each month preceding that numbered 1, as, for instance, whether **1 Uo** was what we call the first or second day of the month, has not been decisively settled and will be considered later. A further question arises whether, in case there is such a day preceding **1 Uo**, such day was called **0 Uo**, meaning that no days were fully completed in the month **Uo**, or **20 Uo**, meaning that twenty days had been completed in the previous month **Pop** and that the month **Uo** had begun. I shall anticipate the discussion of these questions by saying that, for the present purposes, I shall consider that the days of a month were numbered by the Mayas from **0–19**, — what we call the first day having the number **0**.[1]

Assuming this, the forms for zero, when thus used for numbering a month-day, will be found to differ from the zero forms which we have heretofore found in the codices and inscriptions, as they also differ from the forms for 20 which we have heretofore met with.

Taking up the forms for zero, when attached to a month form, we find on Dr. 48.4.14. the glyph given on Plate XVII, TWENTY or ZERO, No. 8. The preceding date is **12 Chen**. Adding 8, the red number at the bottom of Column 4, we reach **0 Yax**, which appears in 48.4.14. The next red number, at the bottom of the first column of Dr. 49, is 11.16. Counting forward this number from **0 Yax**, we reach **11 Zip**, which we find on Dr. 49.1.14., thus proving that the previous date must be **0 Yax**.

On Dr. 50.1.14. we find the date **10 Kankin**. The red number

katun number is clear and as the **Ik** on the face of the tun number suggests a 3, and as he has reached a decision as to the uinal, kin, day and month numbers, I fail to see why he is in doubt.

[1] See Appendix VI.

at the bottom of Column 2 is 4.10. Counting forward this number we reach **0 Uayeb**, and we find the form which is given on Plate XVII, TWENTY or ZERO, No. 9. The next red number at the bottom of the page is 12.10. Counting forward this number from **0 Uayeb** we reach **5 Mac**, which appears in Dr. 50.3.14.

In the Temple of the Cross at Palenque, we find on AB16 the date **1 Ahau 18 Zotz**(1), and on E5–F6 the distance number 2.1.7.11.2. Counting forward this number we reach **9 Ik 0 Yax**(37), and on EF9 we find **9 Ik** with a month which looks more like **Zac** than **Yax**, and which has a number attached to it, as given on Plate XVII, TWENTY or ZERO, No. 4. Two dates follow, one in E10–F11, 3.6.10.12.2., and one in F15–16, 1.6.7.13., making a total of 3.7.17.1.15. Counting forward this number from **9 Ik 0 Yax**(37), we reach **11 Caban 0 Pop**(24), which appears on Q2 P3, and here the zero is in the form given on Plate XVII, TWENTY or ZERO, No. 1.

Again, on R8–9 we have the distance number 1.16.7.17., and on RS10 we find the date **5 Ahau 3 Tzec**(52). Counting forward this number from this date we reach the date **5 Caban 0 Zotz**(36) of S12 R13, in which the zero has the form given on Plate XVII, TWENTY or ZERO, No. 3.

On Altar U of Copan, B1 on the top and H3 on the sides, the month signs **Pop** have the number forms given on Plate XVII, TWENTY or ZERO, Nos. 5, 6. The meaning of these forms cannot be proved here by calculation from other dates, but it is a fact that, if they mean zero, we have here the beginning day of the new year.

In Tikal (Plate 74 of Maudslay) we find on B3 A4 the date **6 Eb 0 Pop**(19), in which the zero has the form given on Plate XVII, TWENTY or ZERO, No. 7. On A7 is, with but little doubt, the sign for one day, and on B7–A8 we have the date **7 Ben 1 Pop**(19), the day following **6 Eb 0 Pop**(19).

On Dr. 50.1.27. we have the form given on Plate XVII, TWENTY or ZERO, No. 10, together with the month **Xul**, where we should expect to find **Yaxkin**. This would enforce the argument that the month-days were numbered from 1 to 20. A similar case is found in the inscriptions in connection with the forms given on Plate XVII, No. 2. But whatever decision is reached on this point, it does not invalidate the fact that this sign attached to a month means either 0 or 20.

We have now added the zero to the numbers which have been recognized.

A few cases of face numbers are found in the inscriptions, elsewhere than in the Initial series. Thus in the stucco on the eastern piers of House A of the Palace in Palenque there is a head which is 19, associated with **Pop**, but the inscription is too much worn to allow any calculations. Again, on B6[b] of the Palace Steps in Palenque is a head which is probably 1 or 8, connected with the tun sign in the distance number, 3.1 or 8.3.3. Counting forward 3.8.3.3. from **8 Ahau 13 Pop**(34), the date of the Initial series, brings us to the date **7 Akbal 1 Xul**(49), and the day and its number are probably seen in the same glyph, B6[b].

In the Temple of Inscriptions of Palenque (Plate 57, Maudslay) we have on T6 the face number 16 attached to the kin sign, while on S7 is the face number 9, but we can establish no numerical connection between the two. (Plate XVII, SIXTEEN, No. 2, and Plate XVI, NINE, No. 3.)

In the same inscription, on GH1 (Plate 58), we have a face number, then an **Ahau**, then **8** in dot and line form, and a face with a streamer beneath it, followed on G2 by the glyph "ending Katun 12."[1] Now 9.12.0.0.0. is **10 Ahau 8 Yaxkin**(51), and we thus have a face for **10** and a month form for **Yaxkin**. (Plate XVI, TEN, No. 4.)

In the same inscription on I1 (Plate 58), we find the face for 16 (Plate XVII, SIXTEEN, No. 1) and in J3 that for 6, but there is no connection that can be found with the other neighboring glyphs.

On Pier A, Palenque (Plate 53, Maudslay) in the same building we find a distance number in which face numbers are given with the tun and uinal, the uinal having two numbers as usual, the dot

[1] For further explanation, see the following chapter.

and line number 13 probably representing the uinal, and the face number 6 the kin.

On Stela E (w) of Quirigua, in the last part of A7 is the last glyph but one of the Supplementary series, and in the first part of B7 is the last glyph of the same series. This usually has attached to it the number 9 or 10, and here we find the death's head and the bare jawbone, which we have already found to mean 10.

On Stela 1 of Piedras Negras we find on C3 a katun glyph with an unknown face before it. It may be that the face is 12, denoting that **5 Cib 14 Yaxkin**① (the Initial date) is in Katun 12. On Stela 3 of the same place, on A9 we have the same face with the katun glyph, but with **Ik-Ben** over the latter. Also on C3 is a head with the katun, but we cannot give a value to either.

Stela C (e) of Copan shows on D7 a head in the right-hand part of the glyph over **Uo** which looks like a face number. If the preceding day is **Ahau** this face would be 3, 8, 13 or 18, and on D11 is a face which may be also one of these numbers. The two faces are not the same.

On Stela I, Copan, E1 has an **Ahau** with a death's head over it, which probably means **10 Ahau**, followed on F1 by **13** with a month sign which looks like **Chen**, while E6 is 8 kins and F6 is a uinal sign with another death's head over it. Counting forward 10.8. from **10 Ahau** we reach **10 Lamat**, which is found in E7. (Plate XVI, TEN, Nos. 2 and 1.)

Again, on Stela 6 in Copan the last Supplementary glyph, B6[a], has a death's head attached to it, meaning 10, while the same glyph on Stela 7 has a head with a bare jawbone attached to it, which also probably means 10.

Thumb meaning 1. — The accumulated proof as to the meaning of the thumb glyph (Plate XVI, ONE, Nos. 7, 8) may well be brought in here. Its value as 1 is shown by the following examples:

In the Temple of the Cross in Palenque we have
on D3 C4 **4 Ahau 8 Cumhu**[7],
declared by C5 to be Cycle 13, 13. 0.0. 0.0.
On D5 C6 we have the distance number 1. 9.2.
and on D13 C15 we have the distance number 1.18.3.12.0.
in which the cycle number is the thumb. Counting forward the sum of these numbers we reach **9 Ik 15 Ceh**[34], 1.18.5. 3.2.
and on EF1 we find **9 Ik 15 Ceh**[34]. (See Plate XVI, ONE, No. 8.)

On R9 we find the thumb with the katun sign in a distance number 1.16.7.17. The date **5 ? 3 Tzec** appears in RS10, the day sign being injured. Counting forward 1.16.7.17. from this date we reach **5 ? 0 Zotz**, and **5 Caban 0 Zotz**[36] is found on S12 R13. By reversing the count we find that the day of the first date is **Ahau**.

On Stela F (w) of Quirigua we find the strongest proof of the value of the thumb as 1. In B17 A18 we find the distance number ?.16.13.3. (the thumb being the katun number). Then on AB18 we have **12 Caban 5 Kayab**[61], — a repetition of the date of the Initial series. On A19 appears **? Ahau 3 Zip**, the thumb again appearing as the day number. The thumb can only mean one of the numbers from 1 to 13, since no higher number than 13 is ever attached to the day signs. Substituting these numbers in succession in both places (with the katun and the day) we find that 1 is the only number which, attached to the katun, will bring the same number for the day number; and no other number, put in both places, will reach the date **3 Zip**. (Plate XVI, ONE, No. 7.)

On Stela F (e), which has the date **1 Ahau 3 Zip**[36] (the 1 being denoted by a face) as the date of the Initial series, we find on B10 the **1 Ahau** repeated (the repetition of the day and number of the Initial series being very common), and here the **1** is denoted by the thumb.

A thumb, however, appears on B17 of Stela N Copan, between the number  and the month glyph. (Plate IX, CHEN, No. 3.) The form here is rather different from the shape of the others, but it cannot, I think, mean 1.

Initial Series with Human or Animal Forms. — There are four other Initial series, — those of Stela D of Copan, of both sides of Stela D of Quirigua and of Animal B of Quirigua, — which must now be considered. In these inscriptions the period glyphs and the numbers which go with them are no longer faces or heads, but entire or partial figures, — either human or animal. So also are most of the numbers attached to the days and months. It will be seen, however, that, though the whole figure may be given, it is the faces which, by their forms or adjuncts, enable us to detect (as far as it is possible to be sure of anything) what numbers are meant. These faces are given on the Plates in their proper positions. We will take up each of these Initial series in turn.

In Stela D of Copan the cycle and katun glyphs (Plate XII, CYCLE, No. 30; KATUN, No. 27) are both birds, the former having a hand upon the lower jaw, as in the case of the other heads which represent the cycle. The tun sign (Plate XIII, TUN, No. 40) is a nondescript animal with ribs showing, while the uinal is a frog (Plate XIII, UINAL, No. 37), — recalling the similarity of sound between **Uo**, meaning frog, and **Uinal**, meaning a month. The kin glyph (Plate XIV, KIN, No. 16) has a coarse face which reminds one of the kin glyph on the Palace Steps at Palenque, which Dr. Seler[1] thinks is meant to show diseased features.

The cycle number (Plate XVI, NINE, No. 6) is clearly 9, judging from the dots and hair on the chin. The katun number (Plate XVII, FIFTEEN, No. 2) has the **Pax** sign on the head, which gives the meaning of 5 and the bare lower jaw adds 10, enabling us to give the value of 15 to this figure with a great deal of certainty. The tun number (Plate XVI, FIVE, No. 7) has a similar

[1] Seler, 1902, Vol. I, p. 730.

headdress, but without the bare jaw, and we therefore assign the number 5 to the tun. The uinal and kin numbers (Plate XVII, ZERO, Nos. 23 and 24) both have a hand across the lower jaw, giving the value of zero to each. Here then we have the series 9.15.5.0.0. This is seen by Goodman's Tables to bring us to **10 Ahau 8 Chen**[11]. On examining the day glyph we find it is a full human figure with a coarse face not unlike the kin face of this series, but as the kin number is zero, we know it must be **Ahau.** (Plate VI, AHAU, No. 34.) The day number (Plate XVI, TEN, No. 7) is a figure, the face of which is somewhat injured, but the bare lower jaw is distinct and gives us strong evidence that the number is 10 or over 10. As we need 10, it is safe to give this value to it. The month sign on A5 bears some resemblance to the **Chen** which we have found on Stela N of Copan, both in the **Cauac** sign which is seen on the body of the glyph and in the shape of the knot over it. The month number (Plate XVI, EIGHT, No. 4), as shown by the face, is either 1 or 8, and as 8 is needed, this is undoubtedly the correct number. This settles the date as 9.15.5.0.0., **10 Ahau 8 Chen**[11]. Goodman calls the date 9.5.5.0.0., **4 Ahau 13 Zotz**[22]; but he is wrong in this, since the katun number is shown by the bare jawbone to be 10 or over 10, and the day number is also proved by the bare jawbone to be 10 or over.

In the Initial series of Quirigua, where figures are used for numbers, the period glyphs and their numbers are often so interwoven that it is difficult to tell whether any particular part belongs to the period glyph or to its number. The faces, however, are probably accurately shown on the plates. (Plates XII, XIII and XIV.)

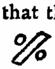
Even if we did not naturally expect 9 to be the cycle number of Animal B (glyph No. 1, Maudslay's notation), we should decide on this value on account of the long beard hanging down from the chin. (Plate XVI, NINE, No. 12.) The uinal and kin numbers on glyphs Nos. 4 and 5 (Plate XVII, ZERO, Nos. 27 and 25) both show the hand across the face, giving them both the value of zero and fixing the day as **Ahau.** This day is worn away, but its number (glyph No. 6) is clear, the face showing that it is either 1 or 8.

The tun number (Plate XVII, ZERO, No. 28) is a figure with a full face. There are six **Cimi** marks upon the figure, one on each cheek, one on each lower leg and two on the only arm which is visible. A curious form goes across the chin. The chances are, I think, in favor of the tun number being zero.[1] If this is so, we have the following date, — 9.?.0.0.0., **1** or **8 Ahau**; in other words, a date setting forth an even number of katuns with the day **1** or **8 Ahau**. On looking over Goodman's Tables the only dates in Cycle 9 which conform to these requisites are the following:

9. 0.0.0.0., **8 Ahau 13 Ceh**[22].
9.10.0.0.0., **1 Ahau 8 Kayab**[11].
9.13.0.0.0., **8 Ahau 8 Uo**[19].

The katun number has no real resemblance to the forms for 0, 10, or 13 which we have met with, but it is more like 10 or 13 than it is like zero. (Plate XVI, TEN, No. 8.)

Perhaps we can settle the question from the glyph for the month. We should naturally expect to find the month glyph immediately after the **Ahau** (that is, in glyph No. 7) or immediately after the last Supplementary glyph. Glyph No. 7 is, I think, the first of the Supplementary series. In glyph No. 10 I think that I detect the penultimate of the Supplementary series, as it contains the long cross which is very frequently found in this position. The face of the animal is also like the face which is often found in other Supplementary series in close connection with the long cross. This decision is confirmed by glyph No. 11, which has a face with a beard, meaning 9 (Plate XVI, NINE, No. 13), near a form in the centre of the glyph, that may well be the oval form with a circle inside of it, which, with the number 9 or 10, is nearly universal in the last glyph of the Supplementary series. I therefore consider glyph No. 11 as the last Supplementary glyph and glyph No. 12 to be the month sign. Here we can clearly distinguish the turtle head, or possibly parrot head, with its eye and hollow above the nose, which is the well-known form of the month

[1] Note that the forms meaning zero, attached to the uinal and kin glyphs have the **Cimi** mark  on arms and legs, and in the case of the uinal on the face.

Kayab. In the centre of glyph No. 12 is a human face which may be **8.** If this argument is correct (I acknowledge that it is not entirely satisfactory to myself), the date will be 9.10.0.0.0., **1 Ahau 8 Kayab**⑪.

Dr. Seler[1] calls this date 9.17.10.0.0., **12 Ahau 8 Pax**③. My objections to this interpretation are

1. The katun number is no more likely to be 17 than 10.
2. The tun number is more likely to be zero than 10.
3. The day number is almost surely 1 or 8.
4. There is no likeness to a **Pax** sign anywhere, while the **Kayab** head is plainly seen in glyph No. 12.

Figure meaning 7. — Taking up the Initial series of the east side of Stela D of Quirigua, we find in A3 a figure with a face which has a beard, thus fixing the cycle number (Plate XVI, NINE, No. 11) as 9. The figures on glyphs A9–10, 11–12 have faces with hands across the lower part or cheek, showing that the uinal and kin numbers (Plate XVII, ZERO, Nos. 29 and 26) are zero and that therefore the day is **Ahau.** $A17^a$ is the last of the Supplementary series with the number 10, and the month-day is **18 Pop.** We therefore have 9.?.?.0.0., **? Ahau 18 Pop.** On looking over Goodman's Tables we find that the only dates which will conform to this are

1. 9. 2. 3.0.0., **5 Ahau 18 Pop**⑬.
2. 9. 5.16.0.0., **12 Ahau 18 Pop**㉝.
3. 9. 9. 9.0.0., **6 Ahau 18 Pop**①.
4. 9.13. 2.0.0., **13 Ahau 18 Pop**㉑.
5. 9.16.15.0.0., **7 Ahau 18 Pop**㊶.

The bare jawbone forms part of the tun number, giving a value of 10 or over. This eliminates Nos. 1, 3 and 4, since in these cases the tun number is less than 10. The bare jawbone also forms part of the katun number, which eliminates No. 2 for the same reason. This leaves No. 5, and the date is therefore 9.16.15.0.0., **7 Ahau 18 Pop**㊶. The headdress of the tun number supports

[1] Seler, 1902, Vol. 1, p. 809.

this decision, but we miss the hatchet eye from the katun number, this feature being generally found with 6 and 16. The face which marks the day number (Plate XVI, SEVEN) is then the form for 7, which has not heretofore been met with.

The Initial series of the west side of Stela D of Quirigua remains to be considered. The day and the month with its number on AB13–14, A17b are pretty surely **? Caban 5 Yaxkin**, which makes the kin number 17. The day number is probably **1** or **8**. The cycle number is probably 9. We have a probable date of 9.?.?.?.17., **1** or **8 Caban 5 Yaxkin**. On looking over Goodman's Tables the only places where such a date can occur in Cycle 9 are found to be as follows:

8 Caban 5 Yaxkin(39) may be	1.	9. 0.16.16.17.
	2.	9. 3. 9.11.17.
	3.	9. 6. 2. 6.17.
	4.	9. 8.15. 1.17.
	5.	9.11. 7.14.17.
	6.	9.14. 0. 9.17.
	7.	9.16.13. 4.17.
	8.	9.19. 5.17.17.
1 Caban 5 Yaxkin(19) may be	9.	9. 2. 9. 6.17.
	10.	9. 5. 2. 1.17.
	11.	9. 7.14.14.17.
	12.	9.10. 7. 9.17.
	13.	9.13. 0. 4.17.
	14.	9.15.12.17.17.
	15.	9.18. 5.12.17.

The katun number has a bare jawbone which shows that it is 10 or over, thus excluding Nos. 1, 2, 3; 4, 9, 10 and 11. The tun number is not zero and this bars Nos. 6 and 13. The tun number probably has a bare jawbone which would bar Nos. 5, 8, 12 and 15. As the only forms for 11 and 12 which we know have no bare jawbone, we must also eliminate Nos. 5 and 14 since the katun number has one, and the tun number probably has one also. No. 7 is left which makes the date 9.16.13.4.17., **8 Caban 5 Yaxkin**(39). In support of this decision we find the 16 of the katun number not unlike the 16 of the katun number of the other side of the stela.

The 13 of the tun number is however unlike any other 13 which we have met with, but the uinal number may well be 4. Altogether the above interpretation cannot be considered as satisfactory. Dr. Seler also deciphers this Initial series with the same result.[1]

This finishes the discussion of the glyphs representing the days, the months, and the periods, together with the numbers attached to them, by means of which the Mayas fixed their dates in the 260-day count, the year, and 52-year count and in the long count from **4 Ahau 8 Cumhu**⑦.

NOTE. — It is proper that I should here state my dissent from Goodman's decision as to the meaning of certain face numbers. In his Part 8 of Centrali-Americana, Archaeology, page 48, the third face which he gives for 12 is in my opinion clearly 9, while on page 50 the first glyph which he gives for 15 is as surely 13. Whether the face glyph which he calls 11 is to be so deciphered, I do not know, since I have failed to find the glyph upon the inscriptions.

I cannot yet subscribe to the values which Goodman assigns to the days (pages 56 *et seq.*), and to the months (pages 69 *et seq.*), and to various forms, such as curves, knots, etc. (pages 64 *et seq.*). I have already called attention to the fact that there is some evidence that the day **Kan** may stand for 4, as might be considered natural, both from its being the fourth day in a series in which **Ymix** is the first day, and from its phonetic value, **Can** being "four" in Maya.

TABLE XXIII

PLACES WHERE THE PROOF OF THE FACE NUMBERS IS GIVEN

1.	Piedras Negras, Lintel 2.	T. F. C.	T. S.	Quirigua, Stela F (e).
2.	Piedras Negras, Lintel 2.			
3.	Quirigua, Stela F (e).		T. S.	
4.	Quirigua, Stela F (w).	T. F. C.		
5.	Copan, Stela I.	T. F. C.		
6.	Quirigua, Stela A.		T. S.	
7.	Quirigua, Stela D (e).			
8.	Quirigua, Stela J.	Palace Steps.		
9.	Copan, Stela P.	Palace Steps.		Quirigua, Stela F (e). Quirigua, Stela J.
10.	Copan, Stela P. See also Dr. Seler's plan.	Naranjo, Stairway.		Quirigua, Stela F (e).

[1] Seler, 1902, Vol. I, p. 811 *et seq.*

TABLE XXIII (*continued*)

11.	Piedras Negras, Lintel 2.			
12.	Quirigua, Stela F (w).	T. C.		
13.	Quirigua, Stela F (w).	T. C.	T. S.	Palace Steps.
14.	Quirigua, Stela F (w)			
15.	Quirigua, Animal G.			
16.	Quirigua, Stela F (e).			
17.	Quirigua, Stela F (w)	Quirigua, Animal G.		
18.		T. F. C.	T. S.	
19.			T. C.	

CHAPTER X

OTHER METHODS OF FIXING DATES

WE have seen that a given date, described by its day and its number as a particular day of a given month, will again appear after the lapse of 52 years, but that its place in the calendar is fixed in a period of several thousand years, when, as in the Initial series, it is declared to be a certain number of days from a date far in the past.

Thus **5 Cib 14 Yaxkin**① in the Initial series of Stelæ 1 and 3 of Piedras Negras occurs once in 52 years, but when it is declared to be 9.12.2.0.16. from **4 Ahau 8 Cumhu**⑦, its place is absolutely fixed in a period of several thousand years.

But the Mayas appear to have wished to fix the place of a date with accuracy without having recourse to the long count of the Initial series, and this was easy to accomplish in several ways.

(1) It might be stated that a given date occurred on the day on which a given number of cycles had elapsed. Thus if a given date, **2 Ahau 3 Uayeb**⑯, should be accompanied by a glyph which means that the end of 2 cycles has come, this would fix the place of this date in a period of 374,400 years, for in no less time could a date formed in this method occur on the ending day of Cycle 2 in any other grand cycle.[1]

(2) A date might be stated as occurring on a day in which a given number of katuns has elapsed. Thus if a date **8 Ahau 8 Uo**⑲ is accompanied by a glyph which means that the end of 13 katuns has come, this would fix the date in a period of 18,720 years, for in no less time could a date formed in this method occur on the ending day of any other Katun 13 in any other cycle.

(3) A date might be stated as occurring on a day on which a given number of tuns had elapsed. Thus if a date **5 Ahau 8**

[1] See Appendix X.

Kankin (23) should be accompanied by a glyph which means that the end of 12 tuns has come, this would fix the date in a period of 936 years, for in no less time could a date formed in this method occur on the ending day of any other Tun 12 of any other katun.

(4) The date could be stated as occurring after the lapse of a given number of katuns, but without specifying its exact place; that is, without stating how many days after the lapse of these katuns it occurred. This would fix the date perfectly well if the number of cycles which have passed is also known. Thus if **5 Cib 14 Yaxkin** (1) is stated as occurring after 12 katuns have passed (it being understood by this statement that no larger number of full katuns has passed), and if it is known that 9 cycles have passed, the place of the date is fixed surely as 9.12.2.0.16., since no such date as we are discussing can occur more than once in the same katun. This must be so, since a katun is less than 20 years, and since a date stated as a given day with its number and as a certain month-day will not occur a second time until after the lapse of 52 years. More than this, this date cannot occur in the cycle immediately preceding or immediately following the Cycle 9. Thus after 9 cycles and 12 katuns have passed, the period of the next katun is comprised between **10 Ahau 8 Yaxkin** of the year 51 of Goodman's Tables, and **8 Ahau 8 Uo** of the year 19, and as **5 Cib 14 Yaxkin** is in the year 1, this date is found in this katun. But after 8 cycles and 12 katuns have passed, the period of the next katun is comprised between **11 Ahau 3 Pax** of the year 20 and **9 Ahau 3 Zac** of the year 40, and **5 Cib 14 Yaxkin** of the year 1 cannot fall in this period of less than twenty years. Also after 10 cycles and 12 katuns have passed the period of the next katun is comprised between **9 Ahau 18 Pax** of the year 29 and **7 Ahau 18 Zac** of the year 49, so that our date of the year 1 will not fall within this limit. But if 7 cycles and 12 katuns have passed, the period of the next katun is comprised between **12 Ahau 13 Xul** of the year 42 and **10 Ahau 13 Pop** of the year 10, and here our date of the year 1 can occur. It will not occur, however, in the katun following the passage of 11 cycles and 12 katuns, but will occur in the katun following the passage of 12 cycles and 12 katuns. Thus a

date stated as occurring after the passage of a given number of cycles and a given number of katuns, will be fixed within the limits of at least three cycles, or nearly 1200 years. As a rule, most of the dates occur after 9 cycles have passed, and therefore we can assume that this is the case unless we have reason to believe to the contrary. It is true, however, that we find **4 Ahau 8 Cumhu**(7) accompanied by a glyph of 13 cycles (probably meaning the lapse of 13 cycles of the preceding grand cycle), and in the Temple of the Foliated Cross in Palenque the lapse of 2 cycles is recorded. A number of dates also occur after the lapse of 10 cycles, and others show calculations in the cycle following the lapse of 10 cycles.

(5) If, however, a date is stated as occurring after the lapse of any number of tuns, without specifying its place in the tun, the place of the date is not fixed in a period of such length that it would be of much more use than if the date were given alone, since the same date consisting of a day and a month with their numbers cannot occur a second time till after the lapse of 52 years.

Glyphs marking the End of a Period. Cycles. — These methods appear to have been employed by the Mayas. A period glyph is often found accompanied by a number, and a date is found in close proximity to the period glyph. This date is often the very date with which the period ends, or at least it occurs before another similar period ends. In addition, the period glyph is often accompanied by a sign which forms a part of the glyph itself, and which seems to have the meaning of "ending" (Plate XIX, prefixes and superfixes to CYCLE, KATUN and TUN forms), or, when this sign is absent, another glyph, which may have a similar meaning, takes its place (Plate XIX, HAND SIGNS).

Taking up these methods in turn, we find on R2 of the Temple of the Cross at Palenque the cycle sign preceded by 9, while on Q17 R1 is the date **8 Ahau 13 Ceh**(22). (Plate XIX, ENDING SIGNS, CYCLE, No. 1.) We find no sign which would seem to mean "ending" attached to the cycle glyph, but on S1, between the month and cycle glyphs, is a glyph, a part of which has the form which, as we shall see hereafter, would seem to have this meaning. (Plate XIX, HAND SIGNS, No. 8.) And **8 Ahau 13 Ceh**㉒ is found in 9.0.0.0.0.

Again, on the Temple of the Foliated Cross, the

Initial series gives us the date	1.18. 5. 4.0.
and on C3–D4 we find the number	1.14.14.0.
Counting forward, we reach	2. 0. 0. 0.0.

and on CD8 we find **2 Ahau 3 Uayeb**⑯, preceded on D7 by the cycle sign in the form of a head with the numeral 2. (Plate XIX, ENDING SIGNS, CYCLE, No. 9.) No ending sign is found with the cycle sign, but a glyph precedes it (Plate XIX, HAND SIGNS, No. 1), which may have that meaning. And **2 Ahau 3 Uayeb**⑯ is found in 2.0.0.0.0.

Again, on Altar S of Copan, the Initial series is

	4 Ahau 13 Yax⑥,	9.15.0.0.0.
On glyph 6ª (Maudslay's notation) is 5 katuns		5.0.0.0.
Counting forward this number, we reach	**7 Ahau 18 Zip**①,	10. 0.0.0.0.

and on glyph 7 we find the date, while on 8ª we find the cycle sign with 10, and over the whole a sign which may mean "ending." At all events **7 Ahau 18 Zip**① is found in 10.0.0.0.0. (Plate XIX, ENDING SIGNS, CYCLE, No. 2.)

On Copan, Stela 8 (s.w.), B1 is the katun sign with 3 over it and a glyph on its left which bears a strong resemblance to the so-called "ending" sign of the last example. (Plate XIX, ENDING SIGNS, KATUN, No. 1.) We might expect to find near by the date **2 Ahau 18 Muan**㉙, since this date is 9.3.0.0.0.; but on CD1 we find **13 Ahau 18 ?** , and **13 Ahau 18 Cumhu**㊺ is 9.17.0.0.0. B1 is probably a distance number, for on counting forward the 3 katuns given on B1 we reach 10.0.0.0.0., and on A2 we find the cycle sign with 10 at its left and over it an "ending" sign. (Plate XIX, ENDING SIGNS, CYCLE, No. 10.) It may be remarked here that this probably proves that Maudslay's notation, which runs thus

1 2 11 12
3 4 13 14
5 6 15 etc.

is wrong, and that the reading should be

1 2 3 4
5 6 7 8
9 etc.

On Animal G Quirigua (w. u.) we find on GH4 a date **7 ? 18 Zip,** the day being most probably **Ahau**. On F5 is the cycle sign with 10 over it and the so-called "ending" sign as a prefix. **7 Ahau 18 Zip**①, as has been seen before, is found in 10.0.0.0.0., and a similar "ending 10 cycles" is found on E10. (Plate XIX, ENDING SIGNS, CYCLE, Nos. 3, 4.)

At Seibal we find on E2, Stela 11, **7 Ahau 18 Zip**①, followed on F2[a] by a similar sign to that just spoken of. (Plate XIX, ENDING SIGNS, CYCLE, No. 5.) Again, we have a date at the end of ten cycles.

There are several places where the zero point of the long count **4 Ahau 8 Cumhu**⑦ is given, and in these cases the date is accompanied by a glyph which contains the cycle sign with the number 13, either with or without an "ending" sign. Thus in Palenque on the Temple of the Cross, we find on D3–C5 this combination, but without an "ending" sign, though between the month and cycle signs there is on D4 a sign which may have this meaning. (Plate XIX, ENDING SIGNS, CYCLE, No. 6, and HAND SIGNS, No. 2.) We find the same thing on the Round Altar of Piedras Negras. On Stela C (e) of Quirigua the Initial date is **4 Ahau 8 Cumhu**⑦, and on B14 there is a cycle form with a sign on the top of it which looks like 15, but as the upper line is very much worn, it may well be 13. No "ending" sign is found attached to the cycle, but the left-hand part of the glyph has the sign which is like that found on D4 of the Temple of the Cross. (Plate XIX, HAND SIGNS, No. 6.) On the Temple of the Sun at Palenque we find **4 Ahau 8 Cumhu**⑦ on O2 N3, and on N2 appears the glyph given on Plate XIX, ENDING SIGNS, CYCLE, No. 7, where, instead of there being two **Cauac** ovals with a knot beneath, we have the two **Cauac** ovals without any support, but on top is a third **Cauac** oval in a horizontal position and with two drooping streamers, one on each side, while over it is a glyph which is found often in the inscriptions. It is not improbable that this whole glyph means that 13 cycles have passed. The prefix may add force to this meaning. Compare the drooping streamers with the drooping frontlet of several of the heads which we have found to mean 13.

Cycles and Katuns. — We will now take up two cases where both the cycle and the katun numbers are given in order to declare the position of a date.

The Temple of Inscriptions at Palenque has an Initial series of 9.4.0.0.0., the end of 4 katuns, and the inscription proceeds to give the dates which end the following katuns as far as 12 katuns, with other dates interspersed. On Plate 57 of Maudslay's work, we find on P2 O3 the date **3 Ahau 3 Zotz**[44], and on P3 we find the katun sign with 9 before it and an "ending" sign over the 9. (Plate XIX, ENDING SIGNS, KATUN, No. 2.) A little farther on, on OP6, we find both the cycle and katun signs, each with the number 9 attached, but neither having an "ending" sign. (Plate XIX, ENDING SIGNS, CYCLE, No. 8; KATUN, No. 3.) **3 Ahau 3 Zotz**[44] is found on 9.9.0.0.0.

Katuns. — Turning now to the cases where the ends of given katuns seem to be stated, we find on ST1 of the Temple of Inscriptions at Palenque (Plate 57 of Maudslay) what appears to be a date. On T2 we have the katun glyph with 10 over it and an "ending" sign on its left. (Plate XIX, ENDING SIGNS, KATUN, No. 5.) By the Tables we find that 9.10.0.0.0 is **1 Ahau 8 Kayab**[11], and ST1, though badly injured, shows, in what is left, forms which would bear out this interpretation, the day number being a face which looks like **1**. The evidence in favor of this decision is greatly strengthened by the fact that on P2–3, **3 Ahau 3 Zotz**[44], ending Katun 9 has been recorded, as has just been shown, while on Maudslay's Plate 58, AB2 shows the date **12 Ahau 8 Ceh**[31], which ends Katun 11. On A3 is the katun glyph with 11 over it and with a sign on its left which is like the form which we found on S1 of the Temple of the Cross. (Plate XIX, ENDING SIGNS, KATUN, No. 6.)

On the same inscription we find on GH1, **? Ahau 8 Yaxkin**, the lower jaw of the face which forms the day number being injured, so that it is impossible to tell whether it is bare of flesh. On G2 (Plate XIX, ENDING SIGNS, KATUN, No. 7) is the katun sign with 12 over it, and on its left is a sign resembling that which we found on the left of the glyph meaning 11 katuns on A3. 9.12.0.0.0.

brings us to **10 Ahau 8 Yaxkin** (51), and it is therefore probable that the head means 10.

Farther on in the inscription on Plate 59 of Maudslay's work we find on CD1, **8 Ahau 8 Uo** (19), which is the end of 13 katuns after **4 Ahau 8 Cumhu** (7), though no declaration of this fact is found. But it emphasizes the intention of the artist to state the expiration of the successive katuns.

On the same inscription, P3 shows the katun glyph with 11 before it and with an "ending" sign over the number. (Plate XIX, ENDING SIGNS, KATUN, No. 8.) On OP4 we find **12 Ahau 8 Ceh** (31), which date is found in 9.11.0.0.0.

Here we see that the ends of Katuns 9, 10, 11 and 12 are shown in the way which we are discussing, while Katuns 9 and 11 are repeated. This is fair evidence that in similar places where the carving has been injured or indistinct the meaning may be similar. Thus on Plate 57, before referred to, D5 shows us **11 Ahau**, while D6 shows the glyph given on Plate XIX, ENDING SIGNS, KATUN, No. 9. As the end of 4 katuns has been shown before this in all probability, and as the end of 6 katuns probably follows, there is very little doubt that **11 Ahau 18 Tzec** (17), which is found in 9.5.0.0.0., is here declared as the end of 5 katuns.

In the Temple of the Foliated Cross on N15 we find **8 Ahau 8 Uo** (19) and on O15 we find the katun glyph with 13 before it and over the number an "ending" sign. And **8 Ahau 8 Uo** (19) is found in 9.13.0.0.0. (Plate XIX, ENDING SIGNS, KATUN, No. 10.)

On a slab in Palenque, a mould of which is in the American Museum of Natural History in New York, while another was exhibited at the Buffalo Exposition, the date **12 Ahau 8 Ceh** (31) is found, followed by the katun glyph with 11 over it, and **12 Ahau 8 Ceh** (31) is found in 9.11.0.0.0. The **Ahau** also has a snake over it.

The Initial series of Stela A, Copan, is	**12 Ahau 18 Cumhu** (5),	9.14.19. 8.0.
The distance number on D11 is 10 uinals or		10.0.
Counting forward this number we reach	**4 Ahau 13 Yax** (6),	9.15. 0. 0.0.

On F11 C12 we find this date while on E12^{a} is the katun sign preceded by 15 and by an "ending" sign. (Plate XIX, ENDING SIGNS, KATUN, No. 11.) Between the month and the katun signs is the glyph shown in Plate XIX, HAND SIGNS, No. 3.

The Initial series of Stela B, Copan, is 9.15.0.0.0., **4 Ahau 13 Yax**⑥, while on B6 is the glyph shown on Plate XIX, ENDING SIGNS, KATUN, No. 12, preceded by a glyph like that of D4 of the Temple of the Cross at Palenque.

On Stela 4, Copan, A7 shows **4 Ahau 13 Yax**⑥ and on B7 follows 15 katuns, with a strange glyph preceding, the upper part of which resembles an "ending" sign. (Plate XIX, HAND SIGNS, No. 7.) As we have seen, **4 Ahau 13 Yax**⑥ is found in 9.15.0.0.0. As additional evidence of the correctness of our supposition, we find on A6, **11 Ahau 18 Zac**①, and on B6, a glyph with 5, which probably means 5 tuns, for the latter date is 5 tuns before **4 Ahau 13 Yax**⑥.

On Stela E (w) of Quirigua, we find on A17, the date **13 Ahau 18 Cumhu**㊺, and on B17 the katun glyph with 17 over it and no "ending" glyph. But **13 Ahau 18 Cumhu**㊺ is found in 9.17.0.0.0.

One of the most complete proofs of the point which we are examining is given on page 133, where the Initial series of Stela 3 of Piedras Negras is 9.12.2.0.16., **5 Cib 14 Yaxkin**①, and where a series of distance numbers carries us forward to 9.14.0.0.0., **6 Ahau 13 Muan**㊳. After this appears a glyph like others found in similar places, and then on F10 appears the katun sign with 14 over it and on its left the "ending" sign. (Plate XIX, ENDING SIGNS, KATUN, No. 13.)

On Lintel 31 of Yaxchilan, EFGH4 give **13 Ahau 18 Cumhu**㊺ and on GH5 we have the katun sign with 17 and an "ending" sign. And **13 Ahau 18 Cumhu**㊺ is found in 9.17.0.0.0. (Plate XIX, ENDING SIGNS, KATUN, No. 14.)

On Stela 23 (e) of Naranjo, CD17 show clearly **6 Ahau 13 Muan**㊳, while on C18 appears a glyph like that of B14^{a} of Stela C (e) of Quirigua, and on D18 appears the katun sign with 14 over it and an "ending" sign on its left. (Plate XIX, ENDING SIGNS, KATUN, No. 15.) **6 Ahau 13 Muan**[38] is found on 9.14.0.0.0.

Plate 29 of the Peabody Museum, Vol. IV, No. 2, shows a fragment of a lintel from Naranjo. It is broken off through the column of glyphs which bears the month sign, but we can see that on FG2 we have here a date **1 Ahau 8 ?**, with a part of the month sign which bears a strong resemblance to **Kayab**. This date has already appeared in a part of the Escalera or Stairway. Directly below **1 Ahau** on F3 is a very clear glyph with the katun sign, having 10 over it and an "ending" sign. **1 Ahau 8 Kayab**[11] is found in 9.10.0.0.0. (Plate XIX, ENDING SIGNS, KATUN, No. 16.)

On Stela 16 (s) of Tikal, we find on A1–2 a date which may be either **8 Ahau 13 Muan**[14] or **6 Ahau 13 Muan**[38]. On A4 we find a head with 14 over it, and on the left the "ending" sign (Plate XIX, ENDING SIGNS, KATUN, No. 17), meaning that 14 katuns have passed. **6 Ahau 13 Muan**[38] is found on 9.14.0.0.0. as shown in the case of Stela 23 of Naranjo.

On Stela C (w) of Quirigua, there is found on B11–A12 the date **6 Ahau 13 Kayab**[60] and on A11 is the katun glyph with 17 and the tun glyph with 5. The above date is found in 9.17.5.0.0.

Tuns.—We will now turn to the cases where the ends of given tuns seem to be declared.

In the Temple of Inscriptions at Palenque (Plate 57 of Maudslay) on N1 M2, we find a date which is **5 Ahau 18 ?**, followed by 13 with a glyph. (Plate XIX, ENDING SIGNS, TUN, No. 1.) This may be **5 Ahau 18 Tzec**[37], as the injured month sign has the appearance of **Tzec**. This is probably 9.8.13.0.0., since **5 Ahau 3 Chen**[24], which is probably 9.8.0.0.0., has preceded it in KL6, and **3 Ahau 3 Zotz**[44], ending Katun 9, follows it on P2–3, the inscription in this part being a reckoning of katuns in their regular order. N2 would then have meaning of 13 tuns. No "ending" glyph accompanies the date, but on M1 is a glyph which may have this meaning. (Plate XIX, HAND SIGNS, No. 5.)

In the Temple of the Sun at Palenque, we find on Q14 P15, the date **13 Ahau 18 Kankin**(21), followed on Q15 by a glyph given on Plate XIX, ENDING SIGNS, TUN, No. 2. This has the number 10 attached to it with no "ending" sign and it is probable that the date is 9.10.10.0.0. (See my "The Temples of the Cross, of the Foliated Cross and of the Sun at Palenque.") [1] In this case Q15 would mean either 10 katuns or 10 tuns, — most probably the latter, if we consider its resemblance to N2 of Plate 57 of the Temple of Inscriptions.

Again, in the Temple of Inscriptions, Plate 57, on IJ10 we find **13 Ahau 18 Ceh**(9), and on I11 is a defaced glyph with 5. **7 Ahau 3 Kankin**(4) has probably just preceded on J5 I6, and there is but little doubt that **7 Ahau 3 Kankin**(4) is 9.7.0.0.0. and that **13 Ahau 18 Ceh**(9) is 9.7.5.0.0.

The Initial series of Stela 3 (e), Tikal, is 9.2.13.0.0., **4 Ahau 13 Kayab**(22) and on B8 we find the glyph given on Plate XIX, ENDING SIGNS, TUN, No. 3, which, with its "ending" sign, apparently means that 13 tuns have passed. On A7 we also find a glyph common to these dates with another "ending" sign.

On Stela 5 (e) of Tikal, AB4 is **4 Ahau 8 Yaxkin**(19), and on A5 is a glyph which seems, although the "ending" sign is somewhat effaced, to mean that 13 tuns have passed. **4 Ahau 8 Yaxkin**(19) is found on 9.15.13.0.0. (Plate XIX, ENDING SIGNS, TUN, No. 4.)

Glyphs denoting Lapse of Periods but not the Ends of Periods. — Several cases occur where an even number of periods have not elapsed and these I will give here with the reservation, that I do not feel sure that they should be quoted as evidence in the problem which is under discussion.

On Altar Q of Copan, we find on D6 E1 the date **6 Ahau 13 Kayab**(50), while on C6 we have 17 katuns. Now **6 Ahau 13 Kayab**(50) is found on 9.17.5.0.0. No "ending" sign is found here and the supposition might well be that the place of **6 Ahau 13 Kayab**(50) is here fixed at some time after 17 katuns and before 18 katuns have passed. This, as has been said, fixes the date if we are sure that the cycle is known.

[1] Bowditch, 1906.

On Stela 2 of Copan we find on F5, **13 Ahau** with a knot between the day and the number. (Plate XIX, AHAU, No. 14.) On E6 we have **8 Ceh** and on E7 we find the katun glyph with 13 and no "ending" sign. **13 Ahau 8 Ceh**[19] is 9.13.0.10.0., while on F6 is the glyph given on Plate XIX, HAND SIGNS, No. 4.

The Initial series of Stela F (w) of Quirigua has faces for the numbers of the period glyphs and has been read as 9.14.13.4.17., the same as that of Stela E (w) of Quirigua. On $B7^a$ is a glyph with the "ending" sign over it, and below this sign the number 14 and below both, a very much injured glyph, which looks more like a tun than a katun. It may mean however that the date lies at some time after 14 katuns and before 15 katuns have passed. (Plate XIX, ENDING SIGNS, TUN, No. 5.)

In one case it would seem as if Cycle 8 is referred to though most of the cases which have been cited are to be found after 9 cycles have passed. Stela N of Copan has an Initial series of which the numbers are very clear and read 9.16.10.0.0. while the date seems to read **1 Ahau 8 Zip**[31] although the day after the passage of this time is **1 Ahau 3 Zip**[36]. On B10–12 we find a number 19.10.0.0., and if we count this back from **1 Ahau 3 Zip**[36], 9.16.10.0.0., we reach **1 Ahau 8 Chen**[15], and on B16 we find **1 Ahau** and on B17, the month and its number in all probability, while on B13 is the katun sign with the number 17. But this date **1 Ahau 8 Chen**[15], thus counted back is found in 8.17.0.0.0. The unknown elements here, however, caused by the apparent error in the date of the Initial series and in the presence of a glyph which seems to mean 14 cycles, cause great uncertainty as to the meaning of this inscription.

Table XXIV contains a list of most of the foregoing cases.

In the eleven cases in which the end of the cycle is given, we find that in four cases a so-called ending sign is attached to the cycle glyph itself, while in one other case it is probably so attached. In two cases the ending sign is attached to another glyph near by, and in the three other cases there is a glyph near by which is similar to the glyph to which the ending sign is attached in some other case. In one case there is no ending sign, and in all the cases the date as given by the day and month and their

TABLE XXIV

LIST OF DATES MARKING ENDS OF PERIODS

			No. on Plate XIX.	
		CYCLE.	Ending.	Hand.
T. Cross. R2.	End sign on other glyph.	9. 0.0.0.0.	1	8
T. Fol. Cross. D7.	End sign on other glyph.	2. 0.0.0.0.	9	1
Cop. Alt. S: No. 8.	Ending sign.	10. 0.0.0.0.	2	
St. 8. A2.	Ending sign.	10. 0.0.0.0.	10	
Qu. An. G. F5.	Ending sign.	10. 0.0.0.0.	3, 4	
Seib. St. 11. F2.	Ending sign.	10. 0.0.0.0.	5	
T. Cross. C5.	Unknown glyph.	13. 0.0.0.0.	6	2
P. N. Round Altar.	Unknown glyph.	13. 0.0.0.0.		
Qu. St. C (e). B14.	Unknown glyph.	13. 0.0.0.0.		6
T. Sun N2.	Ending sign. (?)	13. 0.0.0.0.	7	
T. Ins. (Pl. 57) O6.	No ending sign.	9. 9.0.0.0.	8	
		KATUN.		
Cop. St. 8. (s.w.) B1.	Probably distance number.		1	
T. Ins. (Pl. 57) P3.	Ending sign.	9. 9.0.0.0.	2	
P6.	No ending sign.	9. 9.0.0.0.	3	
T2.	Ending sign.	9.10.0.0.0.	5	
(Pl. 58) A3.	Ending sign.	9.11.0.0.0.	6	
G2.	Ending sign.	9.12.0.0.0.	7	
(Pl. 59) P3.	Ending sign.	9.11.0.0.0.	8	
(Pl. 57) D6.	Ending sign.	9. 5.0.0.0.	9	
T. Fol. Cross O15.	Ending sign.	9.13.0.0.0.	10	
Pal. Slab.	?	9.11.0.0.0.		
Cop. St. A. E12.	Ending sign.	9.15.0.0.0.	11	3
B. B6.	Unknown glyph.	9.15.0.0.0.	12	
4. B7.	End sign on other glyph. ?	9.15.0.0.0.		7
Qu. St. E (w). A17.	No ending sign.	9.17.0.0.0.		
P. N. St. 3 F10.	Ending sign.	9.14.0.0.0.	13	
Yax. Lin. 31. GH5.	Ending sign.	9.17.0.0.0.	14	
Nar. St. 23 (e) D18.	Ending sign.	9.14.0.0.0.	15	
Frag. Lin.	Ending sign.	9.10.0.0.0.	16	
Tik. St. 16 (s). A4.	Ending sign.	9.14.0.0.0.	17	
		TUN.		
T. Ins. (Pl. 57). N1 M2.	End sign on other glyph.	9. 8.13.0.0.	1	5
T. Sun Q15.	No ending sign.	9.10.10.0.0.	2	
T. Ins. (Pl. 57) I 11.	Defaced.	9. 7. 5.0.0.		
Tik. St. 3 (e). B8.	Ending sign.	9. 2.13.0.0.	3	
5 (e). A5.	Ending sign.	9.15.13.0.0.	4	
		SUNDRY.		
Cop. Alt. Q. C6. Katun.	No ending sign.	9.17. 5.0.0.		
St. 2. F6. Katun.	Knot sign between day and number.	9.13. 0.10.0.		4
Qu. St. F. (w). B7a. Katun or Tun	Ending sign.	9.14.13. 4.17.	5	

numbers, falls on the day which ends the given cycle. In these glyphs 13 cycles (probably of the preceding grand cycle) is declared to have passed in four cases, 10 cycles in four cases, 9 cycles in two cases, while the passage of 2 cycles is mentioned in the other case.

There are 18 cases in which the katun sign (either alone or with the cycle sign) appears in connection with the day and month dates. In 13 cases an ending sign, as given in Plate XIX, appears; in one case an ending sign probably appears on a glyph near by; in one case the neighboring glyph is like the glyph which in another case has the ending sign attached to it; in one case I have not been able to verify my notes owing to the cast being at a distance, and in two cases apparently no ending sign is to be found, though in one of these last cases the ending sign has appeared with 9 katuns only a short distance back. But in all the cases the date as given by the day and month with their numbers coincides with the day which ends a given number of katuns. All these dates are in Cycle 9. One is 9.5.0.0.0.; two are 9.9.0.0.0.; two are 9.10.0.0.0.; three are 9.11.0.0.0.; one is 9.12.0.0.0.; one is 9.13.0.0.0.; three are 9.14.0.0.0.; three are 9.15.0.0.0.; and two are 9.17.0.0.0.

The cases in which a given number of tuns is declared are not as convincing as in the case of the other periods. There are five cases where tuns seem to have been used to fix a date, and of these, two cases show an ending sign attached to the glyph and one attached to a glyph near by. In one case the sign is too much defaced to use it as proof and in the last case there is no ending sign. But the fact that in all the cases the date given by the day and month with their numbers falls on the day on which not only an even number of tuns ends, but also that the number of tuns given is either an even quarter of a katun or 13 tuns shows the probability that in the case of the tuns the same method of fixing a date was used as in the case of the cycles and katuns.

An objection may be raised that in the case of the cycles there are other places in the long count where a date, given as a certain day and month with their numbers, may occur than at the end of a given cycle. This is true. If a date so given is found on 13.0.0.0.0.; it will also occur on 13. 2.12.13.0.

13. 5. 5. 8.0.
13. 7.18. 3.0.
13.10.10.16.0.
13.13. 3.11.0.
13.15.16. 6.0.
13.18. 9. 1.0.

There does not appear, however, to be any reason for marking these dates, while there is a very good reason for marking the end of even periods of time.

We can then reason from the following facts:

1. The date given always ends a certain period of time, which is recorded near by.
2. We know that the Mayas did mark the ends of katuns and quarter-katuns.[1]
3. As far as the katuns are concerned, when the end of a katun is marked, the same day and month cannot return in the same katun.
4. The signs which accompany the dates and which I have called the ending signs have a great similarity to each other and would therefore seem to have a similar purpose.

I think therefore that we may adopt the following as true:

1. The Mayas recorded a date as occurring at the end of a given number of cycles or katuns, by adding to the date the cycle or katun glyph with the number of the cycles or katuns which had passed either with or without the "ending" sign, thereby fixing the date in a period of over 18,000 years.

[1] Landa states that there were found in Mayapan seven or eight stones ten feet in length, well worked and with several rows of their characters, and that the Mayas were accustomed to raise stones like these every twenty years.

"se hallan . . . VII o VIII piedras de a X pies en largo cada una, redondas por la una parte, bien labradas, y que tienen algunos renglones de los caracteres que ellos usan." (Landa, 1864, p. 52.)

Cogolludo says that the Mayas counted the ages by twenty years, which they called katun, and that they placed one worked stone on another on the walls of their temples at the end of these periods, as he himself had seen.

"Contaban sus eras y edades que ponian en sus libros de veinte en veinte años y por lustros de cuatro en cuatro. . . . Llegando estos lustros á cinco que ajustan veinte años, llamban **Katun**, y ponian una piedra labrada sobre otra labrada, fijada con cal y arena en las paredes de sus templos," etc. (Cogolludo, 1867, Vol. I, p. 299.)

2. In a similar way they probably recorded a date as occurring at the end of a given number of tuns, thus fixing the date in a period of 936 years.
3. The sign, several forms of which are given on Plate XIX, probably has the meaning of "ending," though it is not always present and, as has been seen, it is possible that it may be connected with a date not at the end of a period, but still showing that the full number of katuns, as recorded, and no larger number, has passed.

Method of fixing Dates in Books of Chilan Balam. — Still another method of fixing a date is shown in the Books of Chilan Balam. Thus in the Book of Chilan Balam of **Tizimin** we find,[1]

Ahau 6, the land of Chakanputun was seized,
Ahau 4,
Ahau 2,
Ahau 13,
Ahau 11,
Ahau 9,
Ahau 7,
Ahau 5,
Ahau 3,
Ahau 1,
Ahau 12,
Ahau 10,
Ahau 8, Chakanputun was abandoned. For thirteen score years Chakanputun was ruled by the men of Itza, etc.

This method is used throughout the Books of Chilan Balam and is often shown in the form of a wheel. This does not mean, however, that the word **Ahau** is synonymous with katun, but that the katuns are distinguished from each other by giving to each katun a designation consisting of the day **Ahau** (with its number) with which the previous katun ends or the current katun begins, — probably the former, — thus counting current time by elapsed periods as we do our hours, minutes, and seconds. Thus, Katun **13 Ahau** or **13 Ahau** katun simply means that this katun is distinguished from the other katuns which end with **Ahau**, but with a different number. That this is the correct meaning is evident

[1] Brinton, 1882, pp. 139, 145. Brinton's translation is not followed exactly. He uses the ordinal numbers while the cardinal numbers are used in the Maya original.

from the fact that paragraph 3[1] of the Book of Chilan Balam of Chumayel states that 4 Ahau is the name of the katun, and similar phrases are to be found throughout the Books of Chilan Balam.

As a rule no attempt is made to fix a date by this method with greater exactness than is afforded by the mention of the tun in which any event occurred, and in the large majority of cases the katun alone records the date mentioned. Occasionally, however, a date is also fixed by the day and month method.

When the katun alone is mentioned, the date is recorded with but little accuracy, since it may occur anywhere in a period of nearly twenty years, although this period of twenty years is itself fixed in a period of about 256 years.

When both the katun and tun are given, the date is recorded within a period of 360 days, and this period of 360 days is itself fixed in a period of 256 years.

But if the day and month method is used and the katun alone is mentioned, the date is fixed in a period of about 256 years. Thus if 12 Ahau 13 Kankin(38), 8.5.0.0.0. is the day with which Katun 12 Ahau ends, this same date cannot occur again in that katun but will occur on 8.18.3.11.0., about three tuns after the next Katun 12 Ahau ends.

If, however, the day and month method is used and both the katun and tun are given, the date is fixed with great accuracy in a varying period of at least seven thousand years.

By this method the katuns were not numbered, as in the inscriptions, in regular order from 0 to 19, showing that so many katuns, as are represented by the numbers attached to them, have passed, but the numbers were given in the order in which the Ahaus were numbered at the end of each katun. A glance at Goodman's Archaic Chronological Calendar shows that the number of the Ahau with which a katun ends is always two less than the number of the Ahau with which the preceding katun ends and two more than the number of the Ahau with which the following katun ends. This necessarily follows from the scheme of the Maya calendar. A katun consists of 7200

[1] Brinton, 1882, pp. 178, 180.

days. If the end of a katun is marked by the day **8 Ahau**, the end of the following katun will also be marked by an **Ahau** (since the katun is exactly divisible by 20) and this **Ahau** will have a number equal to 8 + 7200 or 7208, less all even thirteens. Subtracting 554 thirteens or 7202, we have **6** for the **Ahau** number of the following katun. In like manner the number attached to the **Ahau** with which the next following katun ends will be 7200 + 6 = 7206 less 554 thirteens, or **4**. Or the same thing can be shown as follows: 7200 = 553 × 13 + 11. If then we add 11 to the **8** of **8 Ahau** with which a katun ends, it will bring the same result as if we added 7200 and eliminated all even thirteens. 8 + 11 = 19. Subtract 13 and we have **6** for the number of the **Ahau** with which the following katun ends. But if we deduct **2** from **8**, the day number, it will have the same effect as if we added 11. Therefore the numbers of the days **Ahau** with which the katuns end will run thus: **13, 11, 9, 7, 5, 3, 1, 12, 10, 8, 6, 4, 2, 13**, etc.[1]

This method of counting the katuns is not used in the codices and inscriptions as far as is known.

Glyphs connected with Ahau, and possibly thus fixing Dates. — In the inscriptions a number of cases are found where the day **Ahau** is given with its number and with a snake or waving line, or at times with a sort of knot or bouquet glyph over it, and in some cases the date referred to seems to be the end of a katun, but often of some smaller period. It is probable that these forms of **Ahau** refer to a date which has been previously mentioned and that the **Ahau**, with the accompanying number, is used to recall the date in question. A list of a number of these cases is given.

(1) In the Temple of Inscriptions at Palenque (Plate 59 of Maudslay) we find on EF8 the date **3 Ahau 3 Zotz**(44), with a snake

[1] Some have believed that a katun consisted of 24 years, of 365 days. This was the view of Pio Perez, who says that twenty years formed the body of the katun and the other four years its support. This view was strengthened by the fact that the days ending the periods of 24 years would be marked by numbers diminishing by 2. For instance if **8 Ahau** ended one period of 24 years, **6 Ahau** would end the following period of 24 years. This must be true, since 24 × 365 = 8760, which is 673 × 13 + 11, and 11 + 8 = 19, from which if we deduct 13, **6** is left. But the Books of Chilan Balam prove conclusively, in my opinion, that a katun consists of twenty periods of 360 days. (See Appendix, III and XI.)

over the **Ahau.** (Plate XIX, AHAU, No. 4.) This date is found in 9.9.0.0.0. and has been given before on Plate 57 of Maudslay, where on P2–3 it is declared to end Katun 9, or to state that 9 katuns have passed. In this inscription the katuns seem to be given in a regular order from 4 katuns onward.

(2) On the same Plate, 59, we find on L8, **12 Ahau** with a snake or undulating lines over it, which probably refers to **12 Ahau 8 Ceh**(31), 9.11.0.0.0. (Plate XIX, AHAU, No. 2.) **12 Ahau 8 Ceh**(31) also appears in the same inscription, Maudslay's Plate 58, A2–3, as ending 11 katuns; on Plate 59, P3–4, as ending 11 katuns, and on PQ2 of the Temple of the Sun, without any declaration as to its position.

(3) On a slab found near the Temple of the Foliated Cross at Palenque, there is a glyph, A7, the frame of which is clear, but the interior is effaced. It is probably a day glyph of which the number is **1**, and on the top is a snake, which would lead to the belief that the day is **Ahau.** But against this is the fact that the month-day which follows is **10 Pop.** As erasures occur in places, this number might be **8**, and if so, the date would be **1 Ahau 8 Pop**(19). But no tun or katun ends with this date after 9 cycles have passed, though **1 Ahau 13 Pop**(14) would be found in 9.2.4.0.0.

(4) In the Temple of Inscriptions, Plate 59, **Ahau** appears on P5 with the number 10 over it and over the 10 are undulating lines. (Plate XIX, AHAU, No. 3.) If this means the ending of a katun, it would be the end of 12 katuns, for **10 Ahau 8 Yaxkin**(51) is found in 9.12.0.0.0., and this would be a date which one might expect to find since 11 katuns have appeared shortly before in P3. That this **Ahau** refers to **10 Ahau 8 Yaxkin**(51) seems clear, since if we count forward the distance number of OP5, namely 3.6.6., we reach **7 Cimi 19 Ceh**(2) of O7. This date of **10 Ahau 8 Yaxkin**(51) appears in the same inscription on Plate 58, G1–2, as ending 12 katuns, and on Plate 59, B8–A9, without such designation.

(5) Again on a slab found in Palenque, a cast of which is in the American Museum of Natural History in New York, a date **12 Ahau 8 Ceh**(31) is found followed by the katun glyph with 11 over

it, while over the **Ahau** is a snake. As has been said, this date is found in 9.11.0.0.0.

(6) On Stela F (w) of Quirigua, on A15 we find **3 Ahau 3 Mol**[16] which occurs on 9.15.10.0.0. On A16[a] we find a glyph with a 10 over it, the meaning of which is probably 10 tuns. Counting back 10 tuns from **3 Ahau 3 Mol**[16], 9.15.10.0.0., we reach **4 Ahau 13 Yax**[6], 9.15.0.0.0. and on A17[a] we find this date with a knot above the **Ahau**, which may have a similar meaning to the snake in the same position. (Plate XIX, AHAU, No. 16.)

(7) On B17 A18 of the same inscription we find a distance number 1.16.13.3. followed by **12 Caban 5 Kayab**[61] (a repetition of the date of the Initial series), which would be 9.14.13.4.17. Counting forward this distance number from the date, we reach 9.16.10.0.0., **1 Ahau 3 Zip**[36], and this date is found on A19. This last date is also found as the Initial date of Stela F (e) of Quirigua, and as the Initial date of Stela N of Copan, though in the latter date there is some discrepancy in the month number. On B19 is **13 Ahau** with a partially erased glyph over it. (Plate XIX, AHAU, No. 7.) This may possibly mean Katun **13 Ahau**, and it may declare that 17 katuns have passed, since the Initial series of Stela E (e) of Quirigua is 9.17.0.0.0., **13 Ahau 18 Cumhu**[45], while **12 Caban 5 Kayab**[61] is the date of the Initial series of Stela E (w) of Quirigua.

(8) On Animal G (w. u.) of Quirigua, we find on GH4 a date **7 ? 18 Zip**, followed on F5 by 10 cycles with an "ending" sign. **7 Ahau 18 Zip**[1] is found in 10.0.0.0.0. On E10 a similar cycle sign is found with 10 and an "ending" sign. (Plate XIX, ENDING SIGNS, CYCLE, No. 4.) On H10 is **5 Ahau** with a prefix in the form of a knot. This may mean Katun **5 Ahau**, in which case it might be **5 Ahau 3 Kayab**[20], 10.1.0.0.0.

(9) On the other hand we find on T8, of the Temple of Inscriptions (Plate 59, Maudslay), the date **8 Ahau 3 Kayab**[36], in which the **Ahau** is nearly, if not quite, erased. The **8** is above the glyph and over all is the "ending" sign. This date does not end a tun or katun after 9 cycles and before 10 cycles have passed. It is found, however, ending a katun in 6.8.0.0.0. and ending a tun in 8.15.9.0.0.

(10) On the same inscription, on Plate 59, we find on R3 Q4 the date **3 Ahau 3 Uayeb**[4]. (Plate XIX, AHAU, No. 5.) The month is surely **Uayeb**, though it is somewhat injured. The date is practically proved, since Q3 is 17 days, and by counting forward 17 days from **3 Ahau 3 Uayeb**[4] we reach **7 Caban 15 Pop**[5], which is found on QR6, and this last date is proved in turn by the calculation which follows. **3 Ahau 3 Uayeb**[4] does not end a katun after 9 cycles have passed, but it is found in 9.9.13.0.0. It also ends a katun in 3.12.0.0.0. of the following grand cycle, but this date is too far away to enable us to take it into account.

(11) On the same inscription, on Plate 57, we find on M7 the the date **13 Ahau 18 Mac**[41]. (Plate XIX, AHAU, No. 1.) The month is proved by the fact that by counting forward the distance number 6.14. of MN6 from **13 Ahau 18 Mac**[41] we reach **4 Ix 7 Uo**[42] of MN9. Now **13 Ahau 18 Mac**[41] does not end a tun after 9 cycles have passed, but is found in 8.5.3.0.0. or in 10.12.12.0.0. It ends no katun in either the grand cycle in which practically all the dates of the codices and inscriptions are found, or in the grand cycle which immediately follows this one, but it is found ending a katun in the grand cycle which immediately precedes the usual one.

(12) On Stela C of Copan on B2–A3 is the date **6 Ahau 18 Kayab**[45], there being a knot or bouquet glyph between the number and the day of **Ahau**. (Plate XIX, AHAU, No. 10.) This date is repeated in B7 A8 with a slightly different glyph between the number and the **Ahau**. (Plate XIX, AHAU, No. 9.) Preceding the latter date is the distance number 11.14.5.1.0. Counting this number forward from **6 Ahau 18 Kayab**[45], we reach the date **6 Ahau**[1] **13 Muan**[38] of AB9. Here also is a knot glyph between the number and **Ahau**. (Plate XIX, AHAU, No. 8.) **6 Ahau 13 Muan**[38] may be 9.14.0.0.0., but in this case **6 Ahau 18 Kayab**[45] cannot end an even cycle, katun or tun, since, if we use the distance number given, the date reached would to be 10.19.14.17.0. of the preceding grand cycle. Or if **6 Ahau 18 Kayab**[45] is 8.8.0.0.0., **6 Ahau 13**

[1] Maudslay draws this number as **8 Ahau**, but he writes me that it is probably **6 Ahau**, as the inscription is not very distinct.

Muan㊳ would be 7.2.5.1.0. of the following grand cycle. The first glyph of the inscription is apparently 13 cycles, and in this cycle **6 Ahau 18 Kayab**㊺ has no place as ending a katun or tun. It does appear, however, as 13.2.18.0.0. of the following grand cycle, and as 13.0.19.0.0. of the preceding grand cycle.

(13) Again on D2 of the same stela we find on Maudslay's drawing **15 Ahau**; but this is an impossible date, and Maudslay writes me that it is probably **13 Ahau** or **8 Ahau**. The following month looks like **8 Cumhu**, but there is a glyph between the number and month signs. This glyph may give a different value to the month sign. There is also a knot glyph between the number and the **Ahau**. (Plate XIX, AHAU, No. 11.) If the glyph above the month sign raises the value to **18 Cumhu**, we find that **13 Ahau 18 Cumhu**㊺ is found in 9.17.0.0.0.

(14) On C7 of the same stela we find **4 Ahau** with a knot sign between the number and the day, but the month and its number cannot be surely identified. (Plate XIX, AHAU, No. 12.) If the date is **4 Ahau 13 Uo**⑩ it is found in 9.2.0.0.0.

(15) On C11 of the same stela we find **5 Ahau** with the bouquet sign between the day and number (Plate XIX, AHAU, No. 13) but we cannot make out the month.

(16) On F5 of Stela 2 of Copan we find **13 Ahau** with the knot sign between the number and the day, while E6 is **8 Ceh** and E7 is the katun sign with 13. (Plate XIX, AHAU, No. 14.) **13 Ahau 8 Ceh**⑲ may be 9.13.0.10.0.

(17) On Stela 1 of Copan, the day sign on D1 is shown as on Plate XIX, AHAU, No. 15. If the date is **11 Ahau 8 Zotz**㊼, it is probably the date 9.11.15.14.0., while if it is **11 Ahau 13 Zotz**㊷ it may be 9.8.18.0.0.

(18) On Stela F (e) of Quirigua, $B14^{a}$ shows **1 Ahau** with a knot over it. (Plate XIX, AHAU, No. 6.) This may refer to **1 Ahau**, the day of the Initial series, 9.16.10.0.0., **1 Ahau 3 Zip**㊱, or it may form with $B14^{b}$ the date of **1 Ahau 13 Mol**㉚.

Several of these cases would seem to show that the snake and knot glyphs were used to declare that a number of even katuns or tuns had passed, and might therefore be considered as evidence that the katuns were known by the number of the day **Ahau** with which they ended. But I think that a review of a whole number of cases will not support such a conclusion.

TABLE XXV

AHAU SIGNS WITH SNAKE, WAVY LINE OR KNOT SIGN

1.	9. 9. 0. 0.0., **3 Ahau 3 Zotz (44)**	Snake, Plate XIX,	No. 4.
2.	9.11. 0. 0.0., **12 Ahau 8 Ceh (31)**	Snake	No. 2.
5.	9.11. 0. 0.0., **12 Ahau 8 Ceh (31)**	Snake	
10.	9. 9.13. 0.0., **3 Ahau 3 Uayeb (4)**	Snake	No. 5.
4.	9.12. 0. 0.0., **10 Ahau 8 Yaxkin (51)**	Wavy line	No. 3.
11.	8. 5. 3. 0.0., **13 Ahau 18 Mac (41)** or 10.12.12.0.0.	Wavy line	No. 1.
9.	8.15. 9. 0.0., **8 Ahau 3 Kayab (36)**	Ending sign	
6.	9.15. 0. 0.0., **4 Ahau 13 Yax (6)**	Knot	No. 16.
7.	9.17. 0. 0.0., **13 Ahau 18 Cumhu (45)**	Knot	No. 7.
16.	9.13. 0.10.0., **13 Ahau 8 Ceh (19)**	Knot	No. 14.
17.	9.11.15.14.0., **11 Ahau 8 Zotz (47)** (Init. series)	Knot	No. 15.
18.	9.16.10. 0.0., **1 Ahau 3 Zip (36)**	Knot	No. 6.
8.	10. 1. 0. 0.0., **5 Ahau 3 Kayab (20)**	Knot	

The following are of doubtful value.

3.	**1 Ahau 8 or 13 Pop.**	Snake. Probably no tun or katun in Cycle 9.	
12.		Knot. Both of the two **Ahaus** with knot cannot end even tuns, katuns, or cycle in Cycle 9. Nos. 8–10.	
13.	9.17. 0. 0.0., **13 Ahau 18 Cumhu (45)**	Knot	No. 11.
14.	9. 2. 0. 0.0., **4 Ahau 13 Uo (10)**	Knot	No. 12.
15.	? **5 Ahau**	Knot	No. 13.

CHAPTER XI

INTERCALARY DAYS

It is evident that the Initial series of the inscriptions and the long numbers of the codices fix the position of a day with perfect certainty, the count being, except in two instances, a certain number of days from **4 Ahau 8 Cumhu**⑦, the fixed zero point. In connection with the numerical count of a certain number of days from a fixed day, the position of the day and the month in the annual calendar is often added, and this day is fixed in relation to the numerical count on the basis of there being 365 days in the year.

But with a nation which had remained in the same general area long enough to have enabled them to keep records which have as a basis a date more than 3000 years in the past, and to fix the length of the year as accurately as 365 days, and which, as is probably shown by the Dresden codex, had worked out the length of the revolutions of the moon and of the synodical revolutions of Venus,[1] the observations made by them must have been very accurate. One of the simplest methods of observing the courses of the celestial bodies would be by noting the rising and setting of these bodies in relation to one or more natural objects on the earth, as is the case among the Pueblo Indians.[2]

If such observations were used, it would be almost impossible

[1] See the following chapter.

[2] The northerly and southerly points reached by the sun in its rising and setting were marked by the Pueblo Indians, and these points served them for their directions or "world quarters," as Dr. J. W. Fewkes has designated them. Their directions, instead of being like ours, east, north, west and south, taking the form of an upright cross, corresponded more nearly to our north-east, north-west, south-east and south-west, taking the form of a Saint-Andrew's cross, thus marking the positions in which the sun rose and set at the time of the solstices. Compare the "**Ollin**" of the Mexicans.

that the Mayas should not have noticed that the rising and setting of the sun at the solstices began to occur a little later in the annual calendar than the previous records showed. In other words, they would have found that their annual calendar of 365 days did not show the exact time taken by the sun in reaching a given position from one year to another. That this observation should have been made would have seemed *a priori* probable with a nation as observant as were the Mayas; but the matter is not left to conjecture, for Bishop Landa has told us that the Mayas did recognize the want of correspondence between the annual calendar and the seasons, and rectified this error by counting an intercalary day once in each four years. Since Landa has made this statement, I think that we must accept it as a fact; but there are two points in connection with this subject upon which he does not enlighten us. These are

1. How was this day reckoned?

2. Was the intercalary day reckoned *every* four years through the whole lapse of time?

Method of Reckoning the Intercalary Days. — The answers to these questions must be sought from the records of the Mayas themselves.

As the long count gave the exact number of days which had elapsed from a day long past, it had no connection with the relation of the sun's movements to the annual calendar, except to keep an accurate record of the number of times which the sun had risen and set. There was not, nor could there be, any error in the long count; and if the movements of the sun and the annual calendar were not in agreement, the trouble must be in the calendar and not in the long count. For the purpose of correcting this error, the only part which the long count would play would be to show how many so-called years, each consisting of 365 days, had passed since the long count was begun, and thus to show further how many fractions of a day should be calculated in addition in order to bring the seasons and the calendar into unison. As far as the long count was concerned there was no error, and therefore no need of any correction.

But the annual calendar was a different matter. This was not an actual count of the exact number of times that a certain natural phenomenon occurred, but was an attempt of the priests to divide into a certain number of days and months a natural phenomenon; namely, the length of the seasons or the time taken by the sun to return to any given position as seen from the earth, —a time incapable of division into whole days. This was roughly done by dividing the nearest number of whole days in the time under consideration, namely, 365 days, into 18 months of 20 days each, and 1 month of 5 days. But if, as is done by the Pueblo Indians, the priests marked the northerly and southerly limits of the sun's rising and setting at the solstices by some natural object on the horizon or at a great distance from the observer, and if they noticed that in a given year the sun reached this limit on a day marked, for instance, as **1 Cumhu** in the annual calendar,[1] they would have seen, when **1 Cumhu** came the next year, that the sun had not quite reached this limit, and at the end of four years they would have seen that it did not reach this limit till the day **2 Cumhu**, while at the end of eighty years the sun would have been seen to rise or set at its northernmost point twenty days later, or on **1 Uayeb**. If the last day of **Kayab** had been counted twice (as the Romans counted their bissextile) every fourth year, the sun would have reached its northern limit of northern setting on **1 Cumhu** at every fourth year for a very long period of time.

If intercalary days were inserted, there are two ways in which the correction might be made.

First. The needed number of days could be reckoned back, and, from the date so reached, the days could be counted over again. Thus, if, having reached **0 Pop**, or the first day of the year, it were necessary to insert 25 days in order to bring the calendar and seasons into unison, 25 days could be reckoned back to **0 Cumhu** and the day **0 Pop** could be called **0 Cumhu**.

[1] Landa tells us that in his time the day **1 Pop** coincided with our 16th of July. If this is true, the 21st of June, the summer solstice, would have fallen on the day **1 Cumhu**.

Then all the days from **0 Cumhu** to **0 Pop** could be counted over again, so that when **0 Pop** was reached a second time 25 extra days would have been inserted. This is the same plan on which the Romans counted their bissextile days.

Second. Having reached **0 Pop,** 25 unnamed and unnumbered days could be counted, and the twenty-sixth day would be **1 Pop.**

Either of these methods would have interfered seriously with the long count, and it is not probable that any intercalation was actually made, though the first method may have been used in the calculations which were made to correct the divergence between the seasons and the calendar. That this was the case is evidenced by the following facts:

In the inscriptions, one of the earliest of the Initial series is 1.18.5.4.0., while the latest known date is 10.2.9.1.9. At the end of the numerical count the day and month are given in the terms of the annual calendar, and practically in every instance in which the glyphs are decipherable the day and month reached are the very day and the very month which would have been reached had each year consisted of exactly 365 days, one year following the preceding year without any break or addition. For instance, the day and month indicated by 1.18.5.4.0. are **1 Ahau 13 Mac**㉞. That is, by counting forward just this number of days, or 754 × 365 + 270 days, from **4 Ahau 8 Cumhu**⑦, we reach **1 Ahau 13 Mac**㉞. If now the priests had actually added one intercalary day every fourth year, then the long count would have been increased by that day, and in the course of 754 years there would have been 188 days added to the long count, which would then be 1.18.5.13.8., and this would represent **7 Lamat 16 Zotz**㉟, and not **1 Ahau 13 Mac**㉞. So in all the other cases the correspondence between the long count and the day and the month would be lost, unless indeed the long count was suspended while the intercalary days were counted. But this supposition is irreconcilable with the whole theory of the long count, which is a count of the exact number of days which have elapsed from **4 Ahau 8 Cumhu**⑦.

Dresden 46–50 also disproves the idea that an actual intercalation of days took place. Here the passage of 104 years is set forth, each eight years divided into twenty parts, and though the days and months are stated in each of the parts, no additional day is inserted anywhere in the whole passage.

Was there any need of actually making the intercalation? The long count gave the exact number of days which had passed, and if, at fixed times, a calculation was made showing the number of days needed up to that time for bringing the seasons and calendar into unison, it would always have been easy for the priests to tell the people when the proper season for ceremonies and domestic avocations had arrived. Would not this calculation have been sufficient without actually counting the day? It must be remembered that in all probability the common people regulated their affairs by the seasons and by the advice of the priests, and not by the months of the calendar. If this is so, it would have been of little concern to the people whether the month was **Pop** or **Yax**. They were sure of being told when the new year came in and when ceremonies were to be performed. The market days, which were objects of concern to them, would not depend on the exact unison of the seasons and the calendar. The priests and the ruling class were the only ones to whom this knowledge would be of value, and a simple calculation, without interfering in any way with the long count or the annual calendar, would give the required knowledge. I am therefore of the opinion that this calculation was made and that no actual intercalation occurred. This view is upheld by the facts set forth in my pamphlet on the three temples of Palenque.[1] If, then, the bringing the seasons and calendar into unison was a matter of calculation, no days being actually added, such a calculation could be also made by omitting from the number representing the intercalary days needed at any particular date all full years. The same result would be reached in either case, since, as the seasons come round each year, very nearly the same point, as far as the seasons are concerned, would be reached by counting back,—say 150 days, or 1 year and 150 days or 2 years and 150

[1] Bowditch, 1906. In "A Suggestive Maya Inscription," Cambridge, 1903, p. 12, I stated my opinion that a day was actually intercalated, but I have changed my opinion since then.

days. If, then, 950 intercalary days are needed at any particular date in order to bring the seasons and calendar into unison, it would be nearly as accurate to count back 220 days, which is equal to 950 days less 730 days, the number of days in two full years.

Basis on which Intercalary Days were Reckoned.— The question which next arises is whether the intercalary day was added or calculated for every four years during the whole period of time recorded by the long count. Landa says that the Mayas counted one day every four years, and this would be said of our own calendar by any one who was born and died within any given century, if he was guided by his own personal experience. A man born in 1810 and dying in 1890 would have had no experience at variance with such a plan, but one born in 1850 and living into the twentieth century would have found that the intercalary day was omitted in the year 1900, or, in other words, that the intercalary day was added each fourth year for 24 times and was omitted in the last year of the century. Is it possible that some plan like this was known and used by the Mayas?

Several authors assert that in Mexico, among the native races, 13 days were added every 52 years; some say that 25 days were added each 104 years; while others state that in the periods of 52 years the number of intercalary days which were added were 13 and 12 alternately. Orosco y Berra[1] thinks that each 260 years were divided into five sets of 52 years each, and that the intercalary days were added to each set of years, as follows: 13, 12, 13, 12, 13; but the Codex Borgia, to which he refers as proof of this arrangement, does not bear out his views.

No assertion that the Mayas used a plan of this kind is, as far as I know, made by any contemporaneous authority, but the records seem to give evidence in favor of the theory that the Mayas calculated 25 intercalary days for each 104 years, though it is not clear how they calculated the intercalary days for the remaining years left over after taking out all the even 104-year periods. This latter calculation may have been on the basis of 1 day for each 4 years except the last 4 of the 104-year period, or it may have

[1] Orosco y Berra, 1880, Vol. II, pp. 60 *et seq.*

been on the basis of 3 days for each even 13-year period, or they may have had some sort of calculation for the intercalary days needed in the periods called cycles, katuns, etc. It is possible that at different places or at different times all these plans may have been used.

The following cases may be cited as evidence that the Mayas had some kind of a plan for calculating the intercalary days, for it seems unlikely that in these cases the number of needed days or the date to which the count was to go back would be given with such exactness as they are given in the inscriptions merely by accident.

In Palenque, the dates shown on or near the Initial dates on the inscriptions in the Temples of the Cross, of the Foliated Cross and of the Sun, all cluster round the date 1.18.5.4.0., **1 Ahau 13 Mac**(34), which appears in the Temple of the Foliated Cross.[1] This period equals seven times 104 years plus 26 years, 270 days. If the intercalary days are calculated on the basis of 25 days for each 104 years and of 1 day for each even 4 years in the balance, the number of intercalary days would be $7 \times 25 = 175$ days

$26 \div 4 = 6$ days

or a total of 181 days

which is nearly one half-year. But if we suppose that the priests calculated the intercalary days on the same basis as above, but calculated them as so many days to the cycles, so many to the katuns, etc., as given in Table II in the pamphlet cited, we should find that there were needed for

	1 cycle,	95.50 days
	18 katuns,	85.75 days
	5 tuns,	1.25 days
or a total of		182.50 days

exactly half a year of intercalary days. According to Landa, **13 Mac** was March 26th, or very near the vernal equinox, and this calculation would have shown them that the calendar had run ahead of the season by just half a year, and that the season, instead of being the vernal equinox, was really the autumnal equinox of

[1] Bowditch, 1906.

the previous year, — a fact which must have been very apparent to a nation of agriculturists.

Again, on AB13 of the Temple of the Sun is the distance number 1.2.11., which equals 411. This is just one-third of 1233, the exact number of intercalary days needed in a grand cycle, according to the above table.

In C3 D4 of the Temple of the Foliated Cross we find the distance number 1.14.14.0. This is the exact number of intercalary days needed on the above basis for a period of time expressed by 10.2.0.0.0.0., or the end of Cycle 2 of Grand cycle 10, counting 13 cycles to a grand cycle. On CD8 we find **2 Ahau 3 Uayeb**⑯, and this date is declared by D7 to be Cycle 2. Moreover, this date of 2.0.0.0.0. is 1.14.14.0. after 1.18.5.4.0., **1 Ahau 13 Mac**㉞, the preceding Initial date. In other words, first a date is given which from the ending of the previous cycle requires just one half-year of intercalary days. Then follows a number which carries us forward to the end of Cycle 2, this number being the exact number of intercalary days needed to bring the seasons and the calendar into unison at the end of Cycle 2, counting from the beginning of Maya time, and reckoning that something over 10 grand cycles have passed.

If the theory is correct that the Mayas did really calculate the necessary intercalary days and that they used some such plan as is set forth in Table II referred to, it would seem probable that this theory was put into effect at Palenque.

In Tikal,[1] there is a date **3 Ahau 3 Mol**⑯ (the same year in the calendar round as **2 Ahau 3 Uayeb**⑯), which may be found at intervals of 2.12.13.0. during a long period of time. But as we find a date of 10.0.0.0.0. at Seibal, to the south of Tikal, and one of 10.2.9.1.9. at Chichen Itza, to the north of Tikal, and as it is probable that the migrations passed from south to north, it is in no way improbable that the date of Tikal is between the two, or 10.0.15.8.0., and an accompanying glyph gives strength to this view. On glyphs 4 and 5 we find the distance number 2.11.12., or 952 days, and by counting this number forward from 10.0.15.8.0.

[1] See Bowditch, 1903, p. 11.

we reach **6 Eb 0 Pop**⑲, the first day of the year (glyphs 6 and 7), or 10.0.18.1.12. The number of intercalary days needed for this period on the same basis which we used for Palenque, would be

for	10 cycles,	949.25 days
	18 tuns,	4.50 days
or a total of		953.75 days.

Counting this number back from **6 Eb 0 Pop**⑲ in order to bring the season and calendar into unison, we reach **1 Eznab 1 Mol**⑯,—two days before the date at the beginning of the inscription, or **3 Ahau 3 Mol**⑯. But the distance number given on glyphs 4 and 5 is 952 days, which, being counted backward from **6 Eb 0 Pop**⑲, brings us to the date given, **3 Ahau 3 Mol**⑯. It is possible that some different plan for calculating the intercalary days was used at Tikal than was used at Palenque. 10.0.18.1.12. equals $38 \times 104 + 11$ years and 17 days.[1] If the calculation was made on the basis of 25 intercalary days for each 104-year period and of 1 day for each 4 years of the balance, the number of intercalary days

would be	$38 \times 25 = 950$ days
1 day for each full 4 years,	$11 \div 4 =$ 2 days
or a total of	952 days,

the exact number of days found in the inscription, and bringing us to **6 Eb 0 Pop**⑲. Such a coincidence could hardly be accidental.

It will be noticed that the count goes to the first day of the year, **6 Eb 0 Pop**⑲ in this inscription, and this would be a very natural time to make the proper calculations in the calendar. The Books of Chilan Balam[2] speak of setting **Pop** in order. This day of **0 Pop** is also found elsewhere in a possible connection with intercalary days.

On glyphs AB1 of Altar U, Copan (top), we have the date **2 Caban 0 Pop**㉘, again the beginning day of the year. This date may be found in many places, one of which is 10.1.7.3.17. This number equals $38 \times 104 + 20$ years and 17 days,[1] and if this

[1] It may be noted that 17 is the number of days from **8 Cumhu** to **0 Pop**, the first of the year, though this is probably a mere coincidence.

[2] Brinton, 1882, pp. 138, 144, 153, 158.

inscription is concerned with intercalary days, calculated on the basis of either Tikal or Palenque, we shall find that the number of intercalary days needed will be

$38 \times 25 = 950$ days
$20 \div 4 = 5$ days

or a total of 955 days.

Counting back 955 days from **2 Caban 0 Pop**㉘, we reach **9 Ik 0 Mol**㉕, which we find recorded on D5–E1 on the side of the altar.

Again, on GH1 of Altar U, Copan, we find the well-known date **4 Ahau 13 Yax**⑥. This has appeared on the inscriptions as 9.15.0.0.0. (See Altar S, Copan.) On G2 is 13 tuns. If we count back 13 tuns from **4 Ahau 13 Yax**⑥, we reach 9.14.7.0.0., **4 Ahau 18 Mac**㊺. This number of days equals $36 \times 104 + 89$ years, 275 days. The number of intercalary days needed in this period on the basis used in Tikal would be

$36 \times 25 = 900$ days
$89 \div 4 = 22$ days

or a total of 922 days.

Counting back 922 days from **4 Ahau 13 Yax**⑥, we reach **5 Eznab 1 Pop**④, or the next to the beginning day of the year. The actual beginning day **0 Pop** would be reached if we counted the fraction of a day beyond 922 caused by the division of 89 by 4. On GH3 is the date **3 Eb 0 Pop**③, and this is just one year and one day before **5 Eznab 1 Pop**④. Or if we omit from the 922 days all even years, or 730 days, we have 192 days left. Counting back this number we reach **1 Pop**, or also counting the fraction of the day, we reach **0 Pop**, as given on H3. The coincidence in either case is striking, and at all events the beginning of the year is reached.

Again, on Q17 R1 of the Temple of the Cross at Palenque we find the date **8 Ahau 13 Ceh**㉒, which is declared by R2 to be Cycle 9. Now 9.0.0.0.0. is **8 Ahau 13 Ceh**㉒. The intercalary days needed for nine cycles or $34 \times 104 + 14$ years, 250 days, are

$34 \times 25 = 850$ days
$14 \div 4 = 3$ days

or a total of 853 days.

Counting back 853 days from **8 Ahau 13 Ceh**[22], we reach **13 Manik 10 Xul**[20], and we find **10 Xul** in Q14. But as the calculation might be merely for the purpose of determining just how far the seasons were out of unison with the calendar, it would be perfectly in order, as has been said before, to omit all even years. Dropping, then, out of the 853 days two full years, or 730 days, we have left 123 days, and counting 123 days back from **13 Ceh** we reach **10 Xul**, of Q14, while on P15 we find the distance number 6.3., or 123. It is to be noted that in Q2 P3 — a few glyphs before **8 Ahau 13 Ceh**[22] — appears the date **11 Caban 0 Pop**[24], a date 1 year and 132 days after **8 Ahau 13 Ceh**[22], or say 9.0.1.6.17., thus bringing in the beginning of the year.

Again, on Stela K of Quirigua, we find the Initial series 9.18.15.0.0., **3 Ahau 3 Yax**[28]. This number equals $37 \times 104 + 72$ years and 200 days. On the basis used at Tikal or Palenque the number of intercalary days needed would be $37 \times 25 = 925$

$$72 \div 4 = \underline{18} \qquad 943 \text{ days}$$

and counting back this number of days from **3 Ahau 3 Yax**[28] we reach **9 Caban 15 Kayab**[25], a date which we do not find, though **18 Kayab** appears on A7. If we omit as before two full years or 730 days we have 213 days left, and counting 213 days back we reach **11 Manik 15 Kayab**[27], a date which also does not appear on the inscription. But on A6 we find the distance number 10.10.=210 days, and on B6 A7 we find the date **1 Oc 18 Kayab**[27], — the distance number being just 3 days less than the 213 which we have been using, and the date just 3 days from the date **11 Manik 15 Kayab**[27], which we have reached. This is very close to the correct time and date on the basis of the Tikal and Palenque calculation.

Can it be that in Quirigua the priests used some modification of the plan used elsewhere? If the calculation of intercalary days were on the basis of 25 days for each 104 years, and of 3 days for each full 13 years in the balance, we should have for the Quirigua Initial series the following calculation: $37 \times 25 = 925$

$$72 \div 13 = 5, \text{ and } 5 \times 3 = \underline{15} \qquad 940 \text{ days}$$

or, deducting two full years or 730 days
we have left 210 days.

This is exactly the 10.10. which we find on A6, and by counting back 210 days from **3 Ahau 3 Yax**[28] we reach **1 Oc 18 Kayab**[27], which is found on B6 A7. If Landa is correct in saying that the beginning of the year, **0 Pop**, is July 16, **18 Kayab** would be June 19, — a date very near the summer solstice. The priests may well have said, as they watched the sun setting near what they had observed for years as being its northern limit, "The sun has just set at its northern point and we are counting the day **3 Yax**, — 210 days from **18 Kayab**,— which is the true date in the calendar, according to our traditions and records, for the sun to set at this point of his course."

The date 9.15.0.0.0., **4 Ahau 13 Yax**[6], is found several times in the inscriptions, and Goodman ascribes the frequent occurrence of the date to the fact that, if the grand cycle where this date is found is Grand cycle 54 in a series of 73 grand cycles, 9.15.0.0.0. would mark exactly the end of three-fourths of the number of days in 73 grand cycles. It is possible, however, that there may be another reason for the prominence of this date.

9.15.0.0.0. equals 195 katuns or 3846 years and 210 days. This is equal to 36×104 years plus 102 years and 210 days. During this period the number of intercalary days needed, in order to bring the calendar and the seasons into unison on the basis of 25 days for each 104 years and 1 day for each 4 years remaining, would be $36 \times 25 = 900$ days plus $102 \div 4 = 25$, or 925 days in all. If we omit all even years or 730 days from this number we shall have 195 remaining. But this is the same number of days as there are katuns in the date 9.15.0.0.0., so that at this date it would be necessary to add one day for each katun which had passed in order to bring the calendar and seasons into unison. Such a date, therefore, would be a good date to start from for calculating intercalary days in the future. The number 195 has a further significance as it is just three-fourths of the number of days in a Tonalamatl or 260 days.

Although the evidence here presented is not conclusive in proving that the Mayas calculated intercalary days on the basis suggested, yet the facts that Landa tells us that they made use of intercalary days, that the Books of Chilan Balam speak of **Pop** being set in order, that the beginning period of the year occurs so often in the inscriptions in connection with numbers and dates which are fitted for the purpose,— the numbers representing the days needed to bring the seasons and calendar into unison, and the dates being the days that would be reached in making the calculations for rectifying the calendar,— and that these cases are so frequent as practically to negative the idea of their being mere coincidences, — all these facts certainly tend strongly to prove that the Mayas —

1. Recognized the want of unison between the seasons and the calendar in a term of years.
2. Rectified this want of unison by calculation and not by actual addition of the intercalary days.
3. Used as a basis of rectification the calculation of 25 days for each 104 years; and probably of 1 day for each 4 years of the balance with possibly some slight modification.

CHAPTER XII

OTHER ASTRONOMICAL KNOWLEDGE OF THE MAYAS

It has already been shown that the Mayas had gained a knowledge of the length of the year as 365 days, and there is evidence to prove that they had found out how to adjust this inexact year to the seasons by a calculation of the number of days which were needed in order to bring the seasons and the calendar into unison. It will now be well to consider what other knowledge they possessed of the movements of the heavenly bodies. We will take them up in the following order:

1. The Moon and other planets.
2. The planet Venus.
3. The planet Mars.

The Moon.— The revolutions of the Moon are set forth on pages 51–58 of the Dresden codex, as has been well shown by Dr. Förstemann,[1] although he has made corrections in the reading of the manuscript which are uncalled for.

On Dresden 46–50 there is set forth, as has been shown,[2] the number 2920, — representing 8 solar revolutions, — divided into 20 subdivisions, and carried by the day columns on the upper parts of the sheets to 13 times 2920, — making a product equal to 104 solar revolutions. On Dresden 24 this number 2920 is used as a factor or difference, the page affording a kind of multiplication table up to 13 times 2920, or 5.5.8.0. This last number is then probably used as a factor or difference through $4 \times 13 \times 2920 = 1.1.1.14.0.$ or 52 times 2920, while on the left of the page is the number 9.9.16.0.0., equal to $9 \times 52 \times 2920$ or 3744 solar years.

[1] Förstemann, 1901, pp. 121 *et seq.*; 1906, pp. 200 *et seq.*
[2] Chapters III and IV.

In a similar manner on Dr. 51–58 the numbers 11,958 to 11,960 are set forth, divided into 69 subdivisions, and setting forth 405 lunar revolutions of a little more than 29 1/2 days each. No Spanish author refers to such a table of lunar revolutions, and most of the Maya hieroglyphs, apart from those relating to time and direction, are still sealed to us. We must therefore depend upon the internal evidence of the numeration on these pages to prove our statements. This number, 11,960, has also 104 and 115 for its factors, and it is curious that on pages 46–50 we find 104 solar revolutions. A natural supposition would be that the number 115 represents some astronomical phenomenon. In fact the synodical revolution of the planet Mercury requires 115.877 days, and Dr. Förstemann has therefore considered that these pages combine 405 lunar revolutions and 104 synodical revolutions of Mercury.[1] I do not agree with Dr. Förstemann in this opinion, for 877/1000 of a day is a very large variation in a revolution of 115 days for men who could calculate the revolutions of the sun and moon as accurately as the Mayas did. It will appear later that they were able to calculate the synodical revolution of Venus with great precision. An error rate of 7/8 of a day in 115 days would amount to more than 2 days in a year and to over 90 days, or nearly a whole revolution, in 104 revolutions.

Putting aside the question of Mercury and its revolutions we will turn our attention to the lunar revolutions recorded in these pages.

The first of the subdivisions occurs on the left hand of page 53a. Two horizontal lines of numbers and three lines of days run from left to right through the "a" sections of pages 53 to 58, and are continued through the "b" sections of pages 51 to 58. The lowest of the lines consisting of uinals and kins (the uinals being given in red and the kins in black) records the number of days which belong to each subdivision, while the sum of these numbers in the lowest line is recorded in the upper line of numbers, consisting of katuns, tuns, uinals and kins. Any number in this upper line is the sum of the number directly below and of all the

[1] Förstemann, 1901, pp. 121 *et seq.*; 1906, pp. 200 *et seq.*

preceding numbers of the lowest line, or, what is the same thing, is the sum of the number directly preceding in the upper line and of the number directly below in the lowest line. Thus on Dr. 53a the third upper number is 1.7.2. = 502, which is the sum of 7.8. = 148, directly below 1.7.2., plus the two preceding numbers (each of which is 8.17. = 177) in the same line. The sixth number in the upper line is 2.15.13., which is the sum of the preceding number in the upper line, 2.6.16. and 8.17., the number in the lower line below 2.15.13.

The centre rows consist of three lines of days, — the days of each column running along consecutively as, for instance, in the first column, **Kan**, **Chicchan**, **Cimi**, and in the next column, **Ymix**, **Ik** and **Akbal**. Any day in any line is distant from the preceding day in the same line by the number of days recorded in the line of numbers below, and any day in any line is distant from the zero point of that line by the number of days recorded in the upper line of numbers. Thus the zero point from which the count of the first line of days starts would be 8.17. = 177 days before **6 Kan**, the first day of the first line of days. Counting back 177 days from **6 Kan** we reach **11 Manik**, which is the zero point from which the first line of days is counted, while **12 Lamat** and **13 Muluc** are respectively the zero points from which the second and third lines are counted. We must distinguish the zero point from which the count is made from the first day of the count itself. If the zero points in these lines of days are **11 Manik**, **12 Lamat** and **13 Muluc** respectively, the first days of the count will be **12 Lamat**, **13 Muluc** and **1 Oc** respectively. It is a great advantage to have these separate lines of days and numbers, for, when any irregularity occurs in any line either of days or numbers (and there are many such), the irregularity can be corrected by reference to the other lines. Moreover, as all the days have numbers attached to them (from **1** to **13**), this furnishes a still further means of correcting any irregularity whenever found.

A good example of the regular order of the series is found on Dr. 54b. The last number in the upper line of 53b is 1.1.11.15. The first number on the lower line of 54b is 8.17., which, added to the former number, gives 1.2.2.12., found as the first number of the upper line on 54b. The second number in the lower line is 8.17., which, added to 1.2.2.12., produces 1.2.11.9., which is the second number of the upper line. Adding to this 8.17., the third number in the lower line, we have 1.3.2.6., the third number of the upper line, and again adding to this last number 7.8., the fourth number of the lower line, we have 1.3.9.14., the fourth number of the upper line.

Again, starting with **7 Akbal,**
8 Kan
9 Chicchan, the last day column of 53b, and counting forward successively the numbers found in the lower line of 54b, namely, 8.17., 8.17., 8.17. and 7.8., we reach the following days:

2 Ahau	**10 Caban**	**5 Ix**	**10 Ik**
3 Ymix	**11 Eznab**	**6 Men**	**11 Akbal**
4 Ik	**12 Cauac**	**7 Cib**	**12 Kan**, as found in

the day columns of Dr. 54b.

This is the regular order, but we will now take up some of the irregularities (without going into them all in detail), giving the reasons for the changes which are made in the table of the manuscript.

The second number in the upper line of 53a is 17.13. This in regular order should be the sum of the addition of the first and second numbers of the lower line, namely, 8.17. and 8.17. But this sum is 17.14. and not 17.13. And when we find that the kin number must be 14 in order to reach the third number of the upper line, 1.7.2., by the addition of 7.8., the third lower number of 53a, we have no hesitation in deciding that the 17.13. should be 17.14., especially as the day columns show that 8.17. is the distance from the first day column to the second.

Again, in Dr. 58a the third lower number is 8.17., and adding this to the second upper number, 13.8.2., we have 13.16.19.; but the third upper number is 13.17.0. If the upper line of numbers is correct the second lower number should be 8.18. That this correction should be made is proved by the fact that the third upper

number needs to be 13.17.0. in order that, by the addition of the fourth lower number, 8.17., we should reach the fourth upper number, 14.7.17. A further proof of this is found in the fact that from **5 Oc**
6 Chuen
7 Eb in the second column of days to **1 Lamat**
2 Muluc
3 Oc in the third column of days the distance is 8.18. and not 8.17.

Again, the fifth column of days on 54a runs **6 Cib**
7 Caban
8 Eznab. The number below this day column is 8.17., which is probably the correct count for the upper line of numbers. If 8.17. is right it must give the distance from the fourth day column to the fifth day column. The fourth day column is **11 Muluc**
12 Oc
13 Chuen, and counting forward from these days 8.17. we reach **6 Cimi**
7 Manik
8 Lamat, which are the correct days, as is proved by the fact that the distance from these days to the days of the sixth day column **1 Akbal**
2 Kan
3 Chicchan is 8.17., the sixth lower number on 54a.

Whenever then an irregularity occurs in one of the lines of numbers, days or day numbers, we have the other lines to correct it by. Making such corrections, we have the table, given on page 216, in which the first day of each day column is given, it being understood that the two next following days are to be added.

It will be seen that the number 148 appears in the 3d, 26th, 49th,
13th, 36th, 58th,
19th, 42d, 65th
places. These places in the horizontal rows are 23 places apart, except in one instance, and it would therefore seem not unnatural

TABLE XXVI

Table of Numbers and Days in Dresden 51 to 58

	Page 53a				Page 57a				Page 54b		
1.	177	177	**6 Kan**	24.	4163	177	**2 Chuen**	47.	8149	177	**10 Caban**
2.	354	177	**1 Ymix**	25.	4340	177	**10 Lamat**	48.	8326	177	**5 Ix**
3.	502	*148*	**6 Muluc**	26.	4488	*148*	**2 Cib**	49.	8474	*148*	**10 Ik**
	Picture				*Picture*				*Picture*		
					Page 58a						
4.	679	177	**1 Cimi**	27.	4665	177	**10 Ben**	50.	8651	177	**5 Cauac**
									Page 55b		
5.	856	177	**9 Akbal**	28.	4842	177	**5 Oc**	51.	8828	177	**13 Cib**
6.	1033	177	**4 Ahau**	29.	5020	*178*	**1 Lamat**	52.	9006	*178*	**9 Ix**
	Page 54a										
7.	1211	*178*	**13 Eznab**	30.	5197	177	**9 Chicchan**	53.	9183	177	**4 Chuen**
					Page 51b						
8.	1388	177	**8 Men**	31.	5374	177	**4 Ik**	54.	9360	177	**12 Lamat**
9.	1565	177	**3 Eb**	32.	5551	177	**12 Cauac**	55.	9537	177	**7 Chicchan**
10.	1742	177	**11 Muluc**	33.	5728	177	**7 Cib**	56.	9714	177	**2 Ik**
11.	1919	177	**6 Cimi**	34.	5905	177	**2 Ben**	57.	9891	177	**10 Cauac**
12.	2096	177	**1 Akbal**	35.	6082	177	**10 Oc**	58.	10039	*148*	**2 Manik**
									Page 56b		
									Picture		
13.	2244	*148*	**6 Chuen**	36.	6230	*148*	**2 Eznab**	59.	10216	177	**10 Kan**
	Page 55a				Page 52b						
	Picture				*Picture*						
14.	2422	*178*	**2 Muluc**	37.	6408	*178*	**11 Cib**	60.	10394	*178*	**6 Ik**
15.	2599	177	**10 Cimi**	38.	6585	177	**6 Ben**	61.	10571	177	**1 Cauac**
16.	2776	177	**5 Akbal**	39.	6762	177	**1 Oc**	62.	10748	177	**9 Cib**
									Page 57b		
17.	2953	177	**13 Ahau**	40.	6939	177	**9 Manik**	63.	10925	177	**4 Ben**
					Page 53b						
18.	3130	177	**8 Caban**	41.	7116	177	**4 Kan**	64.	11102	177	**12 Oc**
	Page 56a										
19.	3278	*148*	**13 Chicchan**	42.	7264	*148*	**9 Eb**	65.	11250	*148*	**4 Eznab**
	Picture				*Picture*				*Picture*		
20.	3455	177	**8 Ik**	43.	7441	177	**4 Muluc**	66.	11427	177	**12 Men**
21.	3632	177	**3 Cauac**	44.	7618	177	**12 Cimi**	67.	11604	177	**7 Eb**
									Page 58b		
22.	3809	177	**11 Cib**	45.	7795	177	**7 Akbal**	68.	11781	177	**2 Muluc**
	Page 57a				Page 54b						
23.	3986	177	**7 Ix**	46.	7972	177	**2 Ahau**	69.	11958	177	**10 Cimi**
									Picture		

to suppose that the whole series of 11,958 is divided into three parts of 3986 days each as shown in the table, the parts being separated by vertical lines. When thus placed, the number 148 appears in the third place, the thirteenth and the nineteenth in each column except the last, where it appears for the second time in the twelfth place.

When the series is arranged in this way, we see that the number 178 appears in the sixth and fourteenth places in each column, except where it appears for the first time in the first column, where it is in the seventh and not in the sixth place. Dr. Förstemann attempts to bring about perfect uniformity[1] by changing the last of the lower numbers in 53a to 178 and the first of the lower numbers in 54a to 177, but the days and their numbers and the upper numbers forbid this, as they also forbid the changing the last of the lower numbers of 55b to 177 and the first lower number of 56b to 148, which Dr. Förstemann also suggests. It may possibly be that these numbers thus placed are errors of the scribe, but the mere plea for uniformity is not sufficient to lead us to make these changes.

There are ten pictures given on these pages — one being at the end of the series. The first nine pictures show a remarkable uniformity in their position, for they appear after the 3d, 13th, and 19th numbers in each column, except in the case of the second picture in the third column, where it appears after the twelfth number, — thus exactly following the order of the number 148, a picture always appearing immediately after each number 148 throughout the series. The number of days which elapse between the pictures is as follows:

Zero point	to first	picture	502	days	Fifth	picture	to sixth	picture	1034	days
First	picture	to second	"	1742	"	Sixth	"	to seventh	"	1210	"
Second	"	to third	"	1034	"	Seventh	"	to eighth	"	1565	"
Third	"	to fourth	"	1210	"	Eighth	"	to ninth	"	1211	"
Fourth	"	to fifth	"	1742	"	Ninth	"	to end		708	"

If the second picture of the third column had been one place further on, the number of days between the pictures would have been

[1] Förstemann, 1901, p. 123; 1906, p. 203.

502		
1742	1742	1742
1034	1034	1034
1210	1210	708

The last number plus the first, or 708 + 502, equals 1210. This would seem to show that the series was to be divided into three equal parts, and that in turn each of the three equal parts was to be divided into three unequal parts, at least if we count from the first picture. Dr. Förstemann has used these same three unequal parts for dividing the three columns of 3986 days each, and, though I do not feel sure that this was intended, I have followed his example.

Such an arrangement may be defended by the fact that it brings the number 148 as the third in each smaller subdivision of the series except in the middle part of the third column, while a picture follows each number 148, and that the number 178 appears as the fourth number of the middle part of every column, and as the sixth number of the first part of each column, except the first.

Another irregularity remains to be noticed. In the first column of 57a the last of the lower numbers is 178 and the days

7 Ix
8 Men
9 Cib are 178 days from the preceding
11 Cib
12 Caban
13 Eznab as would be expected. But the preceding upper number is 10.10.9. = 3809
and the first upper number of 57a is 11. 1.6. = 3986,
which requires the lower number to be 8.17. and not 8.18.

Dr. Förstemann considers that the lower number should be 8.17. = 177, as required by the upper number. If this is so we must consider that the scribe not only erred in writing 178 in the lowest line and in counting 178 when he wrote down the days **7 Ix**
8 Men
9 Cib instead of **6 Ben**
7 Ix
8 Men,

but that he carried this error forward through the day columns of all the remaining subdivisions, — forty-six in all. It is very improbable that this is the correct view, for it is most unlikely that such an error could have been so carried along without being discovered. I think it probable that the irregularity was intentional and that the plan was that here, at the end of one-third of the series, where, as will be seen later, the number given was nearly two-thirds of a day less than the true number required by the revolutions of the moon, the calculator deliberately set the days ahead of the numbers, in order to show that there was a discrepancy between the numbers and the lunar revolutions. Perhaps the numbers were allowed to remain as they were, since the whole number (11,958) would not be divisible by 3, if it were increased by 1. It is also to be noted that this is the only case where 178 is actually set down in the lower line of numbers, although the upper line of numbers and the lines of days with their numbers prove that 178 and not 177, as given, is needed in six instances.

A proof of the carelessness of the artist in drawing the day series is shown in the case of the lowest day number of column 5 on Dr. 53a. The column consists of the days **Akbal**, **Kan** and **Chicchan**. **Akbal** has the number **9** attached to it, **Kan** has **10** and **Chicchan** should have **11**, but the number actually found with **Chicchan** is **4**. The next preceding day on the left is **3 Lamat**, and it is evident that, for the moment, the artist forgot that the day and number series ran up and down, and thought that the series ran horizontally, placing **4** with **Chicchan** as it followed the **3** of **3 Lamat**, instead of writing **11 Chicchan** as following **10 Kan**.

Taking then the table as given here with the errors corrected (if indeed they are errors and do not have some deeper signification), what good reason is there to suppose that the table relates to the lunar revolutions? The answer is that the evidence of the table itself is sufficient. If we should find a paper of figures set down in lines and columns, and if time after time these figures showed the result of addition, subtraction, multiplication or division, we should surely be justified in considering that these mathematical processes were intended to be set forth by the writer. A similar case is found here.

The correct lunar revolution is by modern calculations 29 days, 12 hours, 44 minutes, 2.87 seconds, or 29.53058877315 days. A very near approach to this would be 29.50 days. But if 29.50 days were adopted as the length of a revolution there would be an error of one day in 33 revolutions, or in a little more than two and a half years. Therefore every now and then some correction would have to be made. This could be done by waiting till the accumulated errors had reached one whole day and then add one day, or it would be possible to begin by calculating a number of revolutions as of 29.50 days each, and every now and then to calculate a number of revolutions as of a longer period. This is what is actually found in Dr. 51–58.

Table XXVII shows the upper number in each subdivision, the number required to reach the given day of the first line of days, the number of lunar revolutions and the length of each revolution in each subdivision, and the number of days which had elapsed in the given number of revolutions on the true basis of 29.53059 to each revolution.

Taking the first column of the table we find that 177 days or six revolutions of 29.50 days are used, but as at the end of 2 revolutions an error of more than one-third of a day had occurred, the third term was set down as 5 revolutions of 29.60 each, or 148 days in all. This gave a result of 17 revolutions occupying 502 days, while the true time by modern calculation is 502.02 days, — a very close approximation. Then 29.50 is used for three terms of six revolutions each, so that the end of 35 revolutions is given as 1033 days, whereas the true time is 1033.57. Thereupon the next term of six revolutions is calculated as 29⅔ days each, or 178 days in all, with the result that 41 revolutions are set down as taking place in 1211 days when the true time is 1210.75 days. Thus the calculation goes through the first part of the table, and in no case is the recorded time of the lunar revolutions distant more than 67/100 of a day from the true time. It would seem that on arriving at this point, or at the end of 135 revolutions, the calculator found that the record was nearly two-thirds of a day out of the way, and that, if the same plan of adding days were continued, at the end of a similar period of 135 revolutions the record would be more than a whole day out of the way. Wishing perhaps to keep to the rule on which they had begun in adding the 177, 178, and 148 days, and wishing to have 3986 days in each third part of the total number, the device was adopted of keeping the upper line of numbers without change, but of adding one more day to the lines of days and thus bringing the day lines very close to the truth. At all events there is no case in the second third of the table, where the end of the revolutions is as much as one day distant from the true time, if we use the lines of days as our guide. This is also true as to the third part of the table, the largest variation being in the very last number, 11,959, which is 89/100 of a day from the true time, 11,959.89. On the other hand the last number of the upper line of numbers differs from the true time by 1.89 days, while many of the other numbers of the upper line of numbers differ by more than a day from the true time. However, the accuracy of the Maya method is shown by the fact that the ends of 17, 147 and 311 revolutions are set forth by the lines of days, with an error of 2/100, 0/100 and 1/100 respectively.

With such coincidences it seems impossible to doubt that it was the intention of the calculator to record the times of the lunar revolutions.

The time recorded in these pages covers nearly 33 years. If they wished to continue the calculation, all they would have to do would be to add one more day to **10 Cimi**, the 11,959th day, reaching **11 Manik** in the second row of days as the true end of 405 revolutions,—this calculation being but 11/100 of a day ahead of the true time. That is, the last day of the first series is **11 Manik**, and the first day of the next series would be **12 Lamat**,—the same day with which the first series began. The second series would then run along in the line of the first series, except that, as 11/100 of a day belonging to the second series had been included in the first series, this 11/100 must be deducted

TABLE XXVII

Table of Lunar Revolutions on Dresden Codex, Pages 51 to 58

Dr.		Upper Number.	Number by Days.	Number and Length of Revolutions.	Revolutions with 29.53059 Days to a Revolution.	
53a.	1.	177	177	6 of 29.50	177.18+	
	2.	354	354	6 of 29.50	354.37−	
	3.	502	502	5 of 29.60	502.02	Picture 1, 17 rev'ns.
	4.	679	679	6 of 29.50	679.20+	
	5.	856	856	6 of 29.50	856.39−	
	6.	1033	1033	6 of 29.50	1033.57+	
54a.	7.	1211	1211	6 of 29⅔	1210.75+	
	8.	1388	1388	6 of 29.50	1387.94−	
	9.	1565	1565	6 of 29.50	1565.12+	
	10.	1742	1742	6 of 29.50	1742.30+	
	11.	1919	1919	6 of 29.50	1919.49−	
	12.	2096	2096	6 of 29.50	2096.67+	
	13.	2244	2244	5 of 29.60	2244.32+	Picture 2, 59 rev'ns.
55a.	14.	2422	2422	6 of 29⅔	2421.51−	
	15.	2599	2599	6 of 29.50	2598.69+	
	16.	2776	2776	6 of 29.50	2775.88−	
	17.	2953	2953	6 of 29.50	2953.06−	
	18.	3130	3130	6 of 29.50	3130.24+	
56a.	19.	3278	3278	5 of 29.60	3277.90−	Picture 3, 35 rev'ns.
	20.	3455	3455	6 of 29.50	3455.08−	
	21.	3632	3632	6 of 29.50	3632.26+	
	22.	3809	3809	6 of 29.50	3809.45−	
57a.	23.	3986	3987	6 of 29⅔	3986.63−	
	1–24.	4163	4164	6 of 29.50	4163.81	
	2–25.	4340	4341	6 of 29.50	4341.00−	
	3–26.	4488	4489	5 of 29.60	4488.65−	Picture 4, 41 rev'ns.
58a.	4–27.	4665	4666	6 of 29.50	4665.83+	
	5–28.	4842	4843	6 of 29.50	4843.02−	
	6–29.	5020	5021	6 of 29⅔	5020.20+	
	7–30.	5197	5198	6 of 29.50	5197.38+	
51b.	8–31.	5374	5375	6 of 29.50	5374.57−	
	9–32.	5551	5552	6 of 29.50	5551.75+	
	10–33.	5728	5729	6 of 29.50	5728.93+	
	11–34.	5905	5906	6 of 29.50	5906.12−	
	12–35.	6082	6083	6 of 29.50	6083.30+	
	13–36.	6230	6231	5 of 29.60	6230.95+	Picture 5, 59 rev'ns.
52b.	14–37.	6408	6409	6 of 29⅔	6408.14−	

TABLE XXVII. — *Continued*

Dr.		Upper Number.	Number by Days.	Number and Length of Revolutions.	Revolutions with 29.53059 Days to a Revolution.
52b.	15–38.	6585	6586	6 of 29.50	6585.32+
	16–39.	6762	6763	6 of 29.50	6762.51−
	17–40.	6939	6940	6 of 29.50	6939.69−
53b.	18–41.	7116	7117	6 of 29.50	7116.87+
	19–42.	7264	7265	5 of 29.60	7264.53−
					Picture 6, 35 rev'ns.
	20–43.	7441	7442	6 of 29.50	7441.71−
	21–44.	7618	7619	6 of 29.50	7618.89+
	22–45.	7795	7796	6 of 29.50	7796.08−
54b.	23–46.	7972	7973	6 of 29.50	7973.26−
	1–47.	8149	8150	6 of 29.50	8150.44+
	2–48.	8326	8327	6 of 29.50	8327.63−
	3–49.	8474	8475	5 of 29.60	8475.28−
					Picture 7, 41 rev'ns.
	4–50.	8651	8652	6 of 29.50	8652.46+
55b.	5–51.	8828	8829	6 of 29.50	8829.65−
	6–52.	9006	9007	6 of 29⅔	9006.83−
	7–53.	9183	9184	6 of 29.50	9184.01+
	8–54.	9360	9361	6 of 29.50	9361.20−
	9–55.	9537	9538	6 of 29.50	9538.38+
	10–56.	9714	9715	6 of 29.50	9715.56+
	11–57.	9891	9892	6 of 29.50	9892.75−
	12–58.	10039	10040	5 of 29.60	10040.40+
56b.					Picture 8, 53 rev'ns.
	13–59.	10216	10217	6 of 29.50	10217.58+
	14–60.	10394	10395	6 of 29⅔	10394.77−
	15–61.	10571	10572	6 of 29.50	10571.95+
	16–62.	10748	10749	6 of 29.50	10749.13+
57b.	17–63.	10925	10926	6 of 29.50	10926.32−
	18–64.	11102	11103	6 of 29.50	11103.50+
	19–65.	11250	11251	5 of 29.60	11251.15+
					Picture 9, 41 rev'ns.
	20–66.	11427	11428	6 of 29.50	11428.34−
	21–67.	11604	11605	6 of 29.50	11605.52+
58b.	22–68.	11781	11782	6 of 29.50	11782.71−
	23–69.	11958	11959	6 of 29.50	11959.89— or on exact reckoning 11959.888453125
					Picture 10, 24 rev'ns.

148 days equal 5 lunar revolutions of $29^{6}/_{10}$ days each
177 " " 6 " " " 29½ " "
178 " " 6 " " " 29⅔ " "

from the last column of the table in calculating the true elapsed time for the end of the various lunar revolutions as we count forward from the first day of the second series. Thus the first number of this column would be 177.18 — .11 = 177.07, and the second number of this column would be 354.37 — .11 = 354.26, and so on.

In this way this series could be used eight times in succession, 11/100 being taken off the numbers of the last column in each new series, until the last number of the eighth series would be 11,959.01 and the last day would be **10 Cimi**. It is true that this explanation does not account for the third line of days, since the first and second lines of days are the only ones used. It may be that three lines were adopted in order to allow the first line to represent the numbers, and the two other lines to add the two additional days needed to bring the 11,958, shown in the upper line of numbers, to 11,960, shown in the number series of Dr. 51–52.

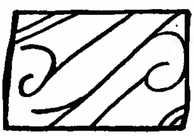
It may also be true that the third line of days was used first. This line begins with **1 Oc**. At the end of the first third of the series a day is added, and the last day of this line is **12 Lamat**. Here a day **13 Muluc** would be counted, though not given, in order to take up the 89/100 of a day by which the true count exceeds the record, and the new series would again begin with **1 Oc** as before, though 11/100 of a day which really belongs to the new series is included in the first series. This is kept up for eight series, when the error of 89/100 is eliminated and the series ends with **12 Lamat**, which coincides within 1/100 of a day with the true time of 8 × 405 lunar revolutions.

The ninth series would then begin anew with the day **13 Muluc**, which is the first day of the second line of days. The same process goes on with the second line of days as with the third line till we finish eight more series, the last day **11 Manik** coinciding with the end of another 8 × 405 lunar revolutions within 2/100 of a day. The first day of the seventeenth series would be **12 Lamat**, which is the first day of the first line of days, and eight more series can be carried through, at the end of which we reach **10 Cimi** or the last day of another 8 × 405 lunar revolutions within 3/100 of a day. Thus 3 × 8 × 405 lunar revolutions may be recorded here or 9720 revolutions covering nearly 800 years. While all this regarding the use of this series over and over again is possible, there is not enough proof as yet to enable us to assert it as a fact.

Mercury, Jupiter, Saturn. — Dr. Förstemann[1] is of the opinion that this series, besides recording the lunar revolutions, also records those of Mercury and Jupiter, and possibly those of Saturn.[2]

He in part supports this opinion by the fact that above the pictures he finds rectangles which contain forms, which he had previously recognized as representing the planets. Thus he had supposed that

Saturn was represented by



or

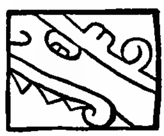
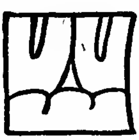


Fig. 8. Fig. 9.

Jupiter was represented by



or

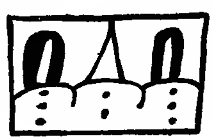
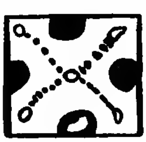


Fig. 10. Fig. 11.

Mercury was represented by



or

or

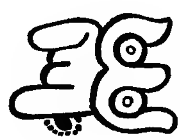


Fig. 12. Fig. 13. Fig. 14.

[1] Förstemann, 1901, pp. 125 *et seq.*; 1906, pp. 205 *et seq.*

[2] For lengths of revolutions of various planets, see Appendix XII.

15

Venus was represented by

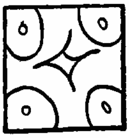


Fig. 15.

or

Fig. 16.

or

Fig. 17.

The Moon was represented by

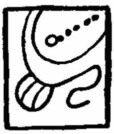


Fig. 18.

The two rectangles Figs. 19 and 20 also occur above the pictures.

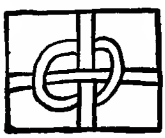


Fig. 19.

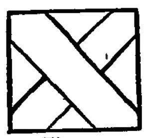


Fig. 20.

The following table shows the distribution of the planets among the pictures as recognized by Dr. Förstemann.

Picture	1.	No rectangles						Sun and Moon over
"	2.	Mercury	Saturn			Moon		Sun and Moon over
"	3.	Mercury	Saturn	Venus				Sun and Moon over
"	4.		Saturn		Jupiter			Sun and Moon over
"	5.	Mercury	Saturn					
"	6.		Saturn		Jupiter			
"	7.		Saturn		Jupiter		Fig. 19	
"	8.		Saturn	Venus		Moon		
"	9.		Saturn		Jupiter			
"	10.			Venus	Jupiter		Fig. 20	Sun and Moon over

Dr. Förstemann also suggests that the zero point, from which the revolutions of the planets are reckoned, is not the same zero point from which the lunar revolutions are reckoned, but that a new zero point is established at the first picture, this being the only picture over which no rectangles appear. This picture comes after the number 502 in the upper row of numbers. Therefore, in order to reckon the numbers from this new zero point, 502 must be deducted from the numbers given on the pages. In this way the pictures follow the following numbers according to Dr. Förstemann's calculations:

Picture	1 follows	0
"	2 follows	2244 − 502 = 1742
"	3 follows	3278 − 502 = 2776
"	4 follows	4488 − 502 = 3986
"	5 follows	6230 − 502 = 5728
"	6 follows	7264 − 502 = 6762
"	7 follows	8474 − 502 = 7972
"	8 follows	10216[1] − 502 = 9714
"	9 follows	11250 − 502 = 10748
"	10 follows	11958 − 502 = 11456

Dr. Förstemann finds the Saturn sign in all the pictures except the first (which is his zero point) and the last, which he thinks does not relate to Saturn. The only number which he suggests as recording the revolution of Saturn is connected with the ninth picture, namely, 10,748, while the sidereal revolution of Saturn occupies 10,759 days. The coincidence is indeed remarkable, but, aside from the improbability that the Mayas had discovered the Copernican theory, it is very astonishing that the other pictures should all contain the Saturn glyph and yet have no relation to either the sidereal or synodical revolutions of this planet. The variation of the numbers given above from the true synodical revolutions runs from 37 to 171 days; while none of the numbers forms any aliquot part of the sidereal revolution of 10,759 days.

This would seem to negative the suggestion that these pages have any relation to the movements of the planet Saturn. It may be, however, that the rectangular form which has been assigned to Saturn belongs to some other planet. We reach no more satisfactory result if we begin our count, not from the new zero point but from the beginning of the series, for the numbers vary from 22 to 186 days from the true time of the synodical revolutions,

[1] This picture really comes after the number 10,039.

while no number records the sidereal revolution or any aliquot part of it.

Dr. Förstemann is very sure that 104 synodical revolutions of Mercury of 115 days are recorded here. I have already explained my reasons for doubting this, and my opinion is strengthened by the fact that beginning with the zero point of the series (and it is necessary to begin here on Dr. Förstemann's own theory, since the whole number 11,960 is needed to make the 104 revolutions of 115 days each) we find no such accordance between the numbers given and the synodical revolutions of Mercury, whether such revolutions are reckoned as 115 days or as 115.88 days, as would enable us to decide that the Mercury revolutions were intended to be given here. In but one case out of the 69 numbers of the upper row is a number given which is an exact multiple of 115. This occurs on Dr. 57b, where 10,925 is equal to 95 × 115. In ten other cases only does an even multiple of 115 come within ten days of the number given in the series. And further there are but nine cases where a multiple of 115.877, the true time of the synodical revolution of Mercury, comes within ten days of the numbers given, while the variation of the other numbers from the true time runs from 11 to 57 days in both cases. And the numbers of the series do not coincide with the number of days (88) included in the sidereal revolution of Mercury.

Moreover, 115 will not divide without a remainder any one of the three unequal parts into which each third of the series is divided, namely, 1742, 1034 and 1210, nor do any of these numbers represent an even number of synodical revolutions of 115.88 days. 1034 is, however, within one day of 9 × 115.

Even the cases where the numbers given come within ten days of the true time, the numbers of the revolutions do not seem to run in regular order. Thus where 115 days are reckoned as the synodical revolution we find that the numbers of revolutions recorded, on the supposition that these cases do refer to synodical revolutions, are 3, 9, 12, 21, 30, 39, 83, 86, 92, 95, 104; while, where 115.877 is taken as the true time, the numbers of revolutions supposed to be recorded are 3, 9, 12, 15, 24, 27, 36, 51, 97.

Another suggestion may be made here which perhaps will remove many of the objections which I have made. This is that the series was written in the first place to record accurately the lunar revolutions, and that the planet signs (supposing that these signs represent the planets) were given without any intention of recording the time of the revolutions of the planets, but merely to show that these planets were visible together or by themselves at the times of the lunar revolutions recorded by the series.

Venus. — The sign, which, as will be seen hereafter, probably belongs to Venus and which is given on page 226, occurs once among the glyphs and twice at least in the rectangles. Where it occurs among the glyphs its position is above the number 679,[1] and following the number 502, the completion of one Venus synodical revolution of 584 days falling between the two. But the completion of a Venus revolution does not seem to be marked in this way in the other two cases where the sign appears in the rectangles. We should not, however, expect to find the synodical revolutions of Venus set forth here, since they are so fully treated of in Dr. 46–50. We are, therefore, not surprised when we find that none of the numbers given in the series approximates very closely to the true times of the synodical revolutions of Venus.

Mars. — Nor should we expect to find the synodical revolutions of Mars 780 days (more accurately 779.936), referred to here, since it is not improbable that the series of Dr. 59 refers to Mars, though, since $780 = 3 \times 260$, the Tonalamatl may be recorded on this page. But there is no such coincidence between the numbers of the series and the true time of the synodical revolutions of Mars as would warrant us in deciding that these revolutions were intended to be recorded in this series.

Jupiter. — But if the coincidence between the numbers of the series and the true time of planetary revolutions is evidence of the intention to record the latter, the evidence in favor of an intention to record the synodical revolutions of Jupiter is far stronger than in the case of Saturn, Mercury, Venus and Mars. The true time of the synodical revolution of Jupiter is 398.867 days. Our series

[1] Corrected from 674.

is divided into three parts of 3986 days each, which period is exactly equal to ten revolutions, reckoned at 398 3/5 days or 398.6 days. 3986 is then less than three days out of the way, — an error which would be very easily made by observers who made their observations with their unaided eyes. Thus the ends of the three parts of the series would represent respectively 10, 20, and 30 synodical revolutions of Jupiter with errors of about 3, 5, and 8 days respectively.

Again, as Dr. Förstemann shows, if we adopt the first picture as the zero point, the numbers reached at the 3d, 4th, 6th, 7th, and 9th pictures coincide very closely with the true time of the synodical revolutions of Jupiter. But Dr. Förstemann was in error in his calculations, for though the Mayas did not probably deal with decimals, yet, as they must have decided on the length of a planetary synodical revolution by the position of the planet relative to the sun and earth, it is necessary to use the true time of a revolution in calculating how many revolutions have occurred in a given number of days. Thus we must use the true time of Jupiter's synodical revolution, 398.867 instead of 398 days as used by Dr. Förstemann. By this calculation we have the following table instead of that given by Dr. Förstemann.

TABLE XXVIII

Picture.	Days from Picture 1.	Syn. Revn's by Dr. F.[1]	True time.	Real diff.
3	2776	7 × 398 = 2786	2792.07	− 16
4	3986	10 × 398 = 3980	3988.67	− 3
6	6762	17 × 398 = 6766	6780.74	− 18
7	7972	20 × 398 = 7960	7977.34	− 5
9	10748	27 × 398 = 10746	10769.41	− 21

The inference which Dr. Förstemann draws from the number immediately preceding Picture 10 cannot be supported, since Dr. Förstemann has inadvertently omitted to substract 502 from this number, as he has done from the others. If he had done this we should have the number 11,458, which is equal to 29 × 398 − 86.

[1] Förstemann, 1901, pp. 126 *et seq.*; 1906, pp. 206 *et seq.*

If we take the numbers of the series without reference to the pictures, deducting 502 as before, we find that the numbers give the following approximations to the true time of a synodical revolution:

4 Syn. Rev'ns.	= 1595.	On Dr.	54a, 6.	we have the numbers	1594,	or by day signs	1594
10 " "	= 3989.	"	57a, 4.	" " " "	3986	" " "	3987
14 " "	= 5584.	"	51b, 5.	" " " "	5580	" " "	5581
20 " "	= 7977.	"	54b, 4.	" " " "	7972	" " "	7973

The numbers of revolutions here recorded (if the series really records them) run in a regular order, which is some evidence of intention, thus, 4, 10, 14, 20.

On the whole, I am inclined to think that the synodical revolutions of Jupiter are recorded in this series, though there may be some doubt whether a new zero point is established at picture 1, as Dr. Förstemann suggests. If the count begins at the beginning of the series we have 10, 20 and 30 synodical revolutions recorded, coinciding with 135, 270, and 405 lunar revolutions respectively. This would give a reason for the selection of 11,958 to 11,960 days or 405 lunar revolutions, and for the division of this number into three sections of 3986 days each.[1] I think it very probable also that the rectangles which Dr. Förstemann has recognized as planetary signs are really such, but I do not think that he has proved that he has distributed them correctly among the planets, though at present I have no better suggestion to offer than his. I also think that the presence of the planetary signs in the pictures does not necessarily mean that a planetary revolution came to an end at that point, but it may mean merely that the planets designated were visible at the times of the lunar revolutions as recorded by the series.

Venus. — Pages 46–50 of the Dresden codex have frequently been referred to as containing a record of 13 × 8, or 104 solar years. That this is so is evident to one who examines the pages and sees

[1] This number, 11,960, is taken up on Dr. 51–52 as the difference of a number series which records 2, 3, 4 and 5 times 11,960; 6 times 11,960 + 120 is then set down, when a skip is made to 16, 17 and 18 times 11,960; after this a record is made of 31 times 11,960 + 260 and of 39 times 11,960.

that the number of days recorded on the last page is 2920, or exactly 8 × 365, and that through these pages the record of the passage of time is given in the day signs with their numbers and in the month signs with their numbers, — the same scheme which has been shown to have been devised for recording the solar year.

But by what right do we say that these pages also record the synodical revolutions of the planet Venus, excepting that it happens that eight solar years are almost exactly equal to five of such Venus revolutions, — this of course being a natural phenomenon entirely apart from the investigations of the Mayas? The reasons for reaching this decision are two in number.

1. Each 2920 days, which equal 5 synodical revolutions of Venus, is divided into five parts of 584 days each, a page being given to each part. 583.92 days form the period of the Venus synodical revolution, and here we have just this period recorded on each of the five pages, the total of which equals the exact number of eight solar years of 365 days each, as recorded by the day and month signs.

2. Each period of 584 days is divided into four parts of 236, 90, 250 and 8 days. The synodical revolution of Venus also consists of four parts, namely, the two periods when it is visible from the earth, — once as morning and once as evening star, — and two periods when it is invisible, — once at its superior and once at its inferior conjunction. The 8-day period of the codex may well represent the time of invisibility at the inferior conjunction and the 90-day period the similar time at the superior conjunction. Then the 236 days will represent the time during which it is visible from the inferior to the superior conjunction, and 250 days will represent the time of visibility after its superior conjunction. It may seem that the time of invisibility is very unevenly divided between the two conjunctions, eight for one and ninety for the other; but it is to be remembered that Venus is about six times farther from the earth at the time of its superior conjunction than it is at its inferior conjunction, and that it is therefore much less brilliant and more difficult to be seen, and that the movements

of the two planets (the earth and Venus) in the same direction, when they are on the opposite sides of the sun and at a greater distance from each other, tends to prolong the period of invisibility.

So much for the mathematical part of the question, which is set forth in the Dresden codex. We will now see what the chroniclers have to say on the subject. Frequent mention is made of the planet Venus by the Spanish writers of New Spain, but as far as the Mayas are concerned Landa is the earliest one who refers to it. Thus Landa tells us that the Mayas marked the time of night by means of Venus, of the Pleiades and of the constellation Gemini.[1]

Herrera uses almost the same words as Landa (probably showing that he copied from the latter) in regard to the Indians of Yucatan,[2] and also says that the Indians of Peru worshipped the planet Venus.

Sahagun says that when Venus appears in the east it makes four starts, shining but little in the first three, but on the fourth, coming out with all its brilliancy and proceeding on its course. From it auguries were taken.[3] He also speaks of the worship of the planet Venus in one of the buildings of the great temple of Mexico, and of the sacrifice of captives each year when it appeared anew. A picture of the planet was painted on a column.[4]

Motolinia says that after the sun, Venus received greater adoration and sacrifice than any other object, celestial or terrestrial, and that after it disappeared in the west they knew the day in which it would appear again in the east. He also says that they allotted 260 days for the time in which it was visible, though some considered that the time of its visibility in the east was 273 days. He

[1] Regian de noche para conocer la hora que era por el luzero y las cabrillas y los astilejos. Landa, 1864, p. 202.

[2] Herrera, 1726. Decade IV, p. 212, col. 1.

[3] A la estrella de Venus la llamaba esta gente **Citlalpulveycitlalin** (estrella grande ó de la alba) y decian que cuando sale por el oriente, hace cuatro arremetidas, y á las tres luce poco, y vuélvese á esconder; y á la cuarta sale con toda su claridad y procede por su curso. . . . En la primera arremetida tenianla de mal aguero, etc. Sahagun, 1829. Vol. II, p. 251.

[4] Una columna gruesa y alta, donde estaba pintada la estrella ó lucero de la mañana. Ibid. Vol. I, p. 205.

speaks of the possibility of seeing Venus in the middle of the day,[1] thus fixing the identity of the planet.

The Popol Vuh, as translated by Brasseur de Bourbourg, says that in awaiting the rising of the sun they watched the star of the morning.[2]

In the Anales de Cuauhtitlan, it is stated that when the god Quetzalcoatl disappeared, he reappeared eight days after as the planet Venus.[3] Motolinia also states that Quetzalcoatl became the planet Venus, and if this is recognized, it is at least an interesting coincidence that the time of his disappearance is fixed at eight days,— the number given on pages 46–50 of the Dresden codex as one of the periods into which the Venus revolution is divided.

Landa was the writer of Yucatan; Motolinia, Sahagun, and Herrera were writers about Mexican matters, while the Popol Vuh is a native document of the Quichés of Guatemala, found by the well-known writer on Central American subjects, Brasseur de Bourbourg. The Anales de Cuauhtitlan is an ancient Mexican document, written in the Nahuatl language. It will thus be seen that there is a general testimony to the fact that Venus was an object of observation and worship by the peoples who lived in the country occupied by the Mayas and in the adjacent territory. Venus was the most brilliant celestial object after the sun and moon, and it would seem most natural that a nation, whose priests had observed so carefully the motions of the sun and moon, should also have followed the movements of Venus with an equal care, as the Spanish chroniclers state to have been the case. When, therefore, we find a table in the codex, which practically conforms in its numerical terms to the movements of this planet, we may safely consider that such conformity was intentional and that its makers intended to record these movements.

[1] El que tiene buena vista y la sabe buscar, la verá de medio dia delante. . . . Despues del sol á esta estrella adoraban é hacian más sacrificios que á otra creatura ninguna, celestial ni terrenal. Motolinia, 1903, pp. 54–56. See also Troncoso, 1882, pp. 338 *et seq*. Also Orozco y Berra, 1880, Vol. I, pp. 33 *et seq*.

[2] Dans l'attente du lever du soleil ils contemplaient l'étoile du matin, ce grande astre, précurseur du soleil. Popol Vuh, 1861, pp. 211–213.

[3] Anales del Museo Nacional de Mexico, end of Tomo III, 1885, p. 22.

Mars. — Whether the Mayas observed the synodical revolutions of Mars is a more doubtful question. The synodical revolution of Mars takes place in 779.936 days, while on Dr. 59 there is a numerical series which begins with 3.18. or 78, and runs along with this difference till 2.3.0. or 780 (10 × 78) is reached. The last number, 2.3.0., is then used as a difference (with one exception) till 2.1.3.0. or 14,820 (19 × 780) is reached. 2.1.3.0. is again used as a difference, and the calculation probably reaches 18.10.9.0. or 133,380 (171 × 780), or over 365 years of 365 days each.

It would not be safe to decide, because the number treated of on Dr. 59 is so near to the true synodical revolution of Mars, that therefore the Mars revolution is here recorded, since we have merely the mathematical evidence of the codex, without the sustaining evidence of the Spanish writers, as we had in the case of Venus. Moreover 780 is just three times the number of days in the Tonalamatl, which might well account for the number having such prominence here.

CHAPTER XIII

POINTS TO BE INVESTIGATED

VERY little progress has been made in deciphering the Maya hieroglyphs, with the exception of those connected with numeration, the calendar, and astronomical calculations, and even in these there are many problems which are yet unsolved and which are well worthy of study. I think it very probable that many of the glyphs represent numbers, but I am unable to agree with Mr. J. T. Goodman in his identification of many of the forms. He is at times too vague and conflicting in his statements, as when he says in regard to the numerical value of the day sign **Cauac**: "So it will be seen that the sign has at least four distinct meanings, — a particular day, a day or days in the abstract, the third day or three days, ten or twenty days as the sign is single or double; and I have no doubt that still other meanings will be found to attach to it." Many of his suggestions, however, are well worthy of being studied and investigated.

The following are some of the problems which need careful study:

Repetition of the Day of the Initial Series. — In several of the inscriptions we find the day recorded by the Initial series repeated at a distance of a few glyphs from the end of the series. This repeated day is generally accompanied by a glyph which includes the **Cauac** form with a wing.

Fig. 21.

Thus on Stela E (e) of Quirigua, the Initial series is 9.17.0.0.0., **13 Ahau 18 Cumhu**[45], all the numbers being of the dot and line form. In A9 we find the **18 Cumhu** of the Initial series and on A11 is **13 Ahau** with the **Cauac** and wing glyph.

On Stela K (n) of Quirigua, the Initial series is 9.18.15.0.0., **3 Ahau 3 Yax**[28], the **3 Ahau** being on A5, while on $A6^{a}$ of the south side we find the **3 Ahau** repeated with the **Cauac** and wing glyphs on B6. All the numbers are given by the dot and line method.

On Stela A of Quirigua, the Initial series is 9.17.5.0.0., **6 Ahau 13 Kayab**[50], in which all the numbers except that of the day are given by the dot and line method. On B10, two glyphs after the month glyph, **6 Ahau** is repeated, the six being seen to be in the dot and line form though it is somewhat defaced. On B11 is the **Cauac** and wing glyph.

In the Temple of Inscriptions at Palenque (Plate 57, Maudslay), T2 shows the date of ST1 to be the end of Katun 10, so that the date must be **1 Ahau 8 Kayab**[11], **3 Ahau 3 Zotz**[44] having preceded in P2–3 as the end of Katun 9. S8 gives us **1 Ahau**, with a human head in T8, a conventional form in S9 and the **Cauac** and wing glyph in T9.

In the same Temple (Plate 58, Maudslay), we find on A2–3 the date **12 Ahau 8 Ceh**[31] ending Katun 11. On C2, **12 Ahau** is found, without an accompanying **Cauac** and wing glyph, but with a human head (like T8) in D2.

On Stela F (e) of Quirigua, where the period numbers and the day number are heads, we find the Initial series to be 9.16.10.0.0., **1 Ahau 3 Zip**[36]. On B10 we find **1 Ahau** (the **1** being given as a thumb) followed on A11 by a head with a wing, a part of the **Cauac** sign being shown on the head.

On Stela J of Quirigua, the Initial series gives 9.16.5.0.0., **8 Ahau 8 Zotz**[31], the period numbers and the day number being heads. On C3 we have **8 Ahau** with the **Cauac** and wing glyph.

In the Temple of the Foliated Cross at Palenque, the Initial series is 1.18.5.4.0., **1 Ahau 13 Mac**[34], the period numbers and the day number being heads. On D14 C15, we find **1 Ahau 13 Mac**[34], and here the numbers are given by the dot and line method. Here, perhaps, because the month is repeated, we find no **Cauac** and wing glyph.

On Stela D (e) of Quirigua, the Initial series is 9.16.15.0.0., **7 Ahau 18 Pop**[41], the period numbers and the day number being in the form of figures. On B18^a we find **7 Ahau** with the **Cauac** and wing glyph.

On Stela C (w) of Quirigua the Initial series is 9.1.0.0.0., **6 Ahau 13 Yaxkin**[42], all the numbers being given in the dot and line form. On the base of the stela, **6 Ahau** is repeated with the **Cauac** and wing glyph.

On Stela F of Copan, the **Cauac** and wing glyph follows shortly after the Initial date although the day is not repeated.

It is to be noted that most of the cases which we are considering occur in Palenque and Quirigua, and that the day which is repeated is invariably **Ahau**. It would seem that the **Cauac** and wing imply some kind of repetition and declare either that the whole Initial date is referred to or that the month is declared to be repeated. The meaning of the **Cauac** and wing glyph and the repetition of the Initial day need further study.

Glyphs with the Number 19. — In several instances there are found in the inscriptions glyphs which have the number 19 connected with them. Thus it has been seen that the Initial series of Stela E (e), of Quirigua, is 9.17.0.0.0., **13 Ahau 18 Cumhu**[45], with the day repeated on A11^b. The next date **13 Ahau 18 Yax**[49] is on B13. No distance number in the usual form occurs before A11 or between the two dates, but on B12 occurs a glyph (Fig. 22)


Fig. 22.

with 19 over it and 5 on the left side, both marked by the dot and line method. The shortest distance from the first date to the other is 1300 days or 3.11.0. We have usually found that the number on the left has meant so many kins, though at times it denotes the uinals. If the 5 means kins here, the balance of the distance number, if it be a distance number, should be a multiple of 19. But deducting 5 from 1300 leaves 1295, which is not divisible by 19 without a remainder. If, however, the 5 represents 5 uinals it would mean 100 days, and if we deduct 100 days from 1300, the remainder is 1200, which also is not divisible by 19 without a remainder. We must find some other values for this glyph, such that by multiplying one by 5 and the other by 19 the sum of the two products will be 1300. This is accomplished by considering that the 19 represents periods of 65 days while the 5 represents periods of 13 days. 19 multiplied by 65 equals 1235 and 5 times 13 is 65, the sum of the two products being 1300. This is analogous to the cases where we find two numbers connected with the uinal sign. In the case under consideration the glyph apart from the numbers would seem to mean 65, when used with the upper number and 13, when used with the left-hand number, just as the uinal number represents 20, when used with one number and 1, when used with the other. In the latter case the relation of the two values is 20 to 1, and in the former case it is 5 to 1.[1]

Another suggestion may be made here. Although 1300 is the shortest distance from **13 Ahau 18 Cumhu**[48] to **13 Ahau 18 Yax**[49], it is possible that the distance number is not meant to represent the shortest distance, and the two dates may be separated by more than 1300 days. As the same day with its number occurs on the same day of the month after the lapse of a calendar round, or 52 years, these dates may be separated by 1300 days plus one or more calendar rounds. Thus the 1300 days may be increased by 18,980 (a calendar round), or by any multiple of 18,980. If we add one calendar round we have the sum of 20,280. This sum is equal to $19 \times 1040 + 5 \times 104$. Here the values of 1040 and 104 have the relation of 10 to 1, and they are numbers often met with in the codices and inscriptions. 1040 is equal to 4 Tonalamatls and 104 is equal to two-fifths of 1 Tonalamatl. Moreover, $104 = 8 \times 13$, and it is possible that this multiplication is shown in the glyph itself. The face is similar to the face which we have often met with, meaning 8, and in this case the remainder of the body of the glyph would mean 13.

The suggestion that the distance between the two dates is really 1300 plus one calendar round is supported in some degree by other instances. Thus on Stela A (e), Quirigua, the Initial series is 9.17.5.0.0., **6 Ahau 13 Kayab**[50], — just 5 tuns later than that of Stela E (e). **6 Ahau** is repeated on B10, followed by a glyph with

[1] The following values also give 1300. $19 \times 60 + 5 \times 32$, $19 \times 55 + 5 \times 51$, $19 \times 50 + 5 \times 70$ and others all bring 1300, but the two values thus given to the body of the glyph have no significant relation to one another.

a wing, similar to that found in a like place on Stela F (e), while **6 Ahau 13 Zac**⑭ is found on Stela A (w) AB2, the inscription running from one face of the stela to the other. The only number, if it is a number, between the dates is on Stela A (w) B1, where we find 19 with a glyph consisting of the tun sign with a head above, while no number precedes the repetition of **6 Ahau**. The shortest distance from **6 Ahau 13 Kayab**㊿ to **6 Ahau 13 Zac**⑭ is 5720 days, or to this may be added one or more calendar rounds. 5720 is not divisible by 19 without a remainder. By adding one calendar round we have 24,700 = 19 × 1300 or 19 times 5 Tonalamatls.

Again on Stela F (e), Quirigua, the Initial series is 9.16.10.0.0., **1 Ahau 3 Zip**㊱, — just ten tuns before that of Stela E (e). **1 Ahau** is repeated on B10^b with a glyph on A11^a consisting of a head with a wing, and on B14 we find **1 Ahau 13 Mol**㉚. The shortest distance from **1 Ahau 3 Zip**㊱ to **1 Ahau 13 Mol**㉚ is 16,900 days. On A13^a is a head with 11 on top of it and 3 on one side. This head has the appearance of the tun sign, and the glyph may mean

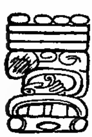


Fig. 23.

3.11., 11.3., 3.11.0. or 11.3.0., or it may represent the whole distance between the two dates. On A14^b, however, we find the number 19 attached to a glyph (Fig. 23) consisting of the same top that we found on Stela E (e), while below is a hand and at the bottom is a form which looks like the tun sign. Let us add one calendar round to 16,900, thus making 35,880. Neither of these numbers is divisible by 19 without a remainder, nor do we get any valuable result by considering that the head with 3.11. represents either of these numbers by itself. If, however, we consider that A13 means 3.11.0. or 1300, and that it is used to count part of the distance between the two dates, and that the glyph counts the remainder of this distance, we shall have to subtract 1300 from 35,880, the total distance, in order to find the number of days which is represented by the glyph with 19. This subtraction leaves the number 34,580, which is equal to 19 times 1820, and 1820 is itself equal to 7 Tonalamatls.

Thus on these three inscriptions we have the following similar results in connection with the glyphs to which the number 19 is attached.

	Stela A (e) and (w)	Stela E (e)	Stela F (e)
Initial series	**6 Ahau 13 Kayab** (50)	**13 Ahau 18 Cumhu** (45)	**1 Ahau 3 Zip** (36)
B10	**6 Ahau**	A11 **13 Ahau**	B10 **1 Ahau**
A11	glyph with wing	A11 glyph with wing	A11 glyph with wing
			A13 3.11.0.
B12[1]	19 with glyph	B12 19 with glyph	A14 19 with glyph
AB13	**6 Ahau 13 Zac** (14)	B13 **13 Ahau 18 Yax** (49)	B14 **1 Ahau 13 Mol** (30)
Shortest distance	5,720 days	1,300 days	16,900 days
Add cal. round	18,980	18,980	18,980
	24,700	20,280	35,880
Deduct A13			3.11.0 = 1,300
			34,580
Equal to	19 × 5 × 260	19 × 4 × 260 (or 19 × 1040) + 5 × 104	19 × 7 × 260

Here we have in each case the Initial series, the day with its number repeated, the sign with a wing, the number 19 with a glyph and another date. If the glyph with 19 means 5 × 260, 4 × 260, and 7 × 260 respectively, with the modification for the second number in Stela E (e), it gives the distance required in calculating the distance from the date of the Initial series to the following date.

The regularity with which these inscriptions are arranged is worth noting. The repetition of the day of the Initial series appears on B10, A11, and B10 of the respective inscriptions. The glyph with a wing appears on A11, A11, and A11; the 19-glyph on B12, B12, and A14, and the second date appears on AB13, B13, and B14. The 19-glyph and the second date are pushed forward slightly on the inscription of Stela F (e) owing to the fact that the number 3.11.0., which does not appear on the other two inscriptions, is inserted on A13.

It may also be of some interest to note that the numbers which we have been considering are based on 19 times 260, which in Maya numeration is 13.13.0. — a number made up of their prominent number 13.

[1] As the inscription on Stela A is on two sides, I number this and the following glyphs as if the inscription was continuous on one side, in order to compare it with the other inscriptions.

Stela I, Quirigua, offers evidence additional to that of the three stelæ under consideration. Here the Initial series reads 9.18.10.0.0., **10 Ahau 8 Zac**㉓, running across four columns. On A7 we find the glyph with a wing, though the initial day is not repeated. On B5 we have 19 with a glyph. (Fig. 24.) On BC9 we find **10 Ahau 18 ?** . On C6 we have two glyphs with numbers, but they are not decipherable. If we disregard these glyphs, we find that 19 × 1 × 260 is the distance from **10 Ahau 8 Zac**㉓ to **10 Ahau 18 Uo**㊲; while 19 × 4 × 260 brings us to **10 Ahau 18 Mac**㉕, 19 × 9 × 260 to **10 Ahau 18 Yaxkin**㊶, and 19 × 14 × 260 to **10 Ahau 18 Pop**⑤. C9 is not clear enough to enable us to decide upon the name of the month.

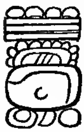


Fig. 24.

Maudslay (Plate 78) gives a drawing of a slab found near the Temple of the Foliated Cross at Palenque. Here B3 shows a glyph with 19, but the dates are too uncertain to enable us to draw any conclusions from the inscription.

Here then we have a problem which is well worthy of investigation by Maya students, including, as it does, the meaning of the forms shown in Fig. 25, which will now be taken up.

a *b* *c* *d*

Fig. 25.

Glyph which may mean 13. — The glyph (Fig. 25*a*) appears, as we have seen, in B12 of Stela E (e) of Quirigua, where it forms part of the body of a glyph which may mean 104. In this case the head might mean 8 and this glyph 13, since 8 times 13 makes 104.

On Stela F (e) of Quirigua a similar glyph forms part of A14, where the distance number 34,580 may be expressed, in which, since 19 is found on the top of the glyph, the body would represent 1820. The lower part is a tun-like form, supporting a hand which partly hides an oval form, while the glyph which we are discussing is over the hand. If this glyph is 13 and the hand is 20 it would leave the tun form meaning 7, which is improbable.

Again, on Stela E (e) of Quirigua this glyph is found on $B15^b$ (Fig. 25*b*) with the number 6 over it. The next preceding date, on B13, is **13 Ahau 18 Yax**(49), and the next following date on A16 is **13 Ahau 13 Uo**(6). The distance from the first to the second date is 3120 days. If this form expresses this distance and if our glyph means 13, the lower part must be 40 provided the numbers are factors. But there is another glyph in which this form appears in A15[b]. Does this also mean 3120? The middle and lower part of the glyph would then mean 240.

Again, on Stela E (e) of Quirigua we find a similar form on B16[b]. Below it is the zero sign with a curious centre and a death's head. There is no regular number, but the preceding date is **13 Ahau 13 Uo**(6), and the following date is **13 Ahau 18 Cumhu**(45). The distance forward is 14,560 days and backward 4420. Both these numbers are divisible by 13 without a remainder, so that if the form we are considering means 13, the zero and death's-head parts of the glyph may mean 1120 or 340. If the death's head is 10, the other part would be 112 or 34.

On O2 N3 of the Temple of the Sun in Palenque we find the beginning date **4 Ahau 8 Cumhu**(7), preceded on N2 by the normal cycle sign (Plate XIX, CYCLE, No. 7), formed by two **Cauacs** with another **Cauac** sign on top of them, and over all three signs is the form we are considering. (Fig. 25*c*.) Possibly this means that thirteen cycles have passed, our sign meaning 13.

4 Ahau 8 Cumhu(7) also occurs on D3 C4 of the Temple of the Cross in Palenque, followed on C5 by the usual form for 13 cycles, and again followed on C7 by three **Cauacs** (as on N2 of the Temple of the Sun) with the form of Fig. 25*d*. A distance number, 1.9.2., also intervenes between the two 13-cycle signs.

On Stela J (s) Copan C3 we have a similar sign in connection with the double **Cauac** sign. Goodman calls the double **Cauac** sign 20, and seems to give the value of 73 to Fig. 25. It is not impossible, however, that 13 cycles may be recorded here.

A somewhat similar form appears on D2 of Stela I Copan in connection with the number 4. This is on the top of a head which is frequently found with the number 18. If the number means 18 the lower part would be 14. But this form is somewhat different from the other forms which have been given.

Other similar forms occur on Quirigua, Stela A (w), B4 and A9, on Quirigua, Stela C (e), A14 (where the whole glyph seems to represent 13 cycles as on N2 of the Temple of the Sun, and C7 of the Temple of the Cross), and on Quirigua, Stela E (e), B14.

The Supplementary Series. — As has been said in Chapter VII, there is often found, in connection with the Initial series of various inscriptions, a number of glyphs which have been called the Supplementary series. These glyphs, usually from four to nine in number, are found either between the day and month, or following the month of the Initial series. Where they are placed between the day and the month, the month glyph generally follows immediately the last Supplementary glyph (Fig. 26), though in two stelæ in Naranjo this is not the case. The Supplementary series probably relates to time, since many of the glyphs which compose it have numbers attached to them. Goodman thinks that the Supplementary series record dates from the foundation of the city in which the monument was erected, but he gives no proof of this statement.[1] He also infers that the Initial series, with which the Supplementary series are connected, are historical. The last Supplementary glyph has usually a rounded form with dots and has the number 9 or 10 attached to it, either in the dot and line form or in the face form. This series offers one of the best opportunities for study to the Maya scholar.

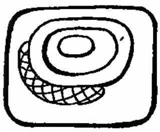


Fig. 26.

Ben-Ik. — This sign appears with very great frequency throughout the inscriptions and the codices, especially with the katun glyph. Dr. Förstemann[2] thinks that it means the moon period of 29 days, since **Ik** is 29 days from **Ben**, counting one full day round. (Fig. 27.)

Fig. 27.

It seems at times to have the meaning 13. Thus on AB8 of Stela A (w) of Quirigua there are two signs which may well be **4 Ahau 13 Zotz**㉒ if **Ben-Ik** is 13. On $A6^{a}$ is a glyph which is apparently Katun 5, and 9.5.5.0.0. is **4 Ahau 13 Zotz**㉒.

On CD3–AB4 of Lintel 31 of Yaxchilan is the date **2 Ahau 8 Uo**㊴, and on E3–G3 is the distance number 7.0.0. Counting

[1] Goodman, 1905, p. 647.

[2] Bulletin 28, p. 518.

forward 7.0.0. from **2 Ahau 8 Uo**[39], **13 Ahau 18 Cumhu**[45] is reached. This date is found on E4-H4 and is declared by GH5 to be the end of Katun 17. 9.17.0.0.0. is found by Goodman's Tables to be **13 Ahau 18 Cumhu**[45]. **2 Ahau 8 Uo**[39], being 7.0.0. before **13 Ahau 18 Cumhu**[45], would appear in 9.16.13.0.0.; and on F2, following **2 Ahau 8 Uo**[39], is the katun glyph with a 3 over it, and the **Ben-Ik** sign between the 3 and the katun. If this refers to the position of **2 Ahau 8 Uo**[39] among the katuns it would mean Katun 16, and **Ben-Ik** would seem to have the meaning of 13. Many other cases could be cited in support of this meaning.

On the other hand the Initial series of Stelæ 1 and 3 of Piedras Negras are the same, namely, 9.12.2.0.16., **5 Cib 14 Yaxkin**[1]. In each case the second glyph after the month sign is a katun glyph with the same head as a prefix; but in one case the superfix is a **Ben-Ik** sign and in the other there is no superfix. Again, the **Ben-Ik** sign seems at times to mean some other number than 13. Only careful study will determine what number this glyph records, or whether it has a numeral meaning at all.

Calendar Round. — No sign has as yet been clearly identified as the 52-year or calendar round sign, though Goodman[1] has decided that this period is represented by the double **Cauac** with a double scroll emerging from the top, the scroll being surrounded by dots. (Fig. 28.) We know that the Mexicans spoke of this period as the "tying up of years," and that they represented it in their pictures by a bundle of sticks tied together. It has occurred to me, therefore, that the Mayas may have adopted a similar sign, since we find in many places the form of a bundle of sticks tied at each end. Often two of the bundles are crossed — perhaps representing the important period of twice 52 years or 104 years, which are set forth in the Dresden codex, pages 46–50. For examples of this form see Copan, Altar Q (top), B2 and A5; Stela 11, A2; Stela B, B11; Stela J (e), A24; Quirigua, Stela F (w), B7; Stela J, D13; Yaxchilan, Lintel in House G (Plate 88 of Maudslay, Menché), No. 11, and many other places.

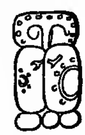
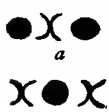


Fig. 28.

1 Goodman, 1897, p. 20.

Dots and Crosses. — Another interesting subject for investigation is the value of the signs consisting of a dot or dots with a cross or crosses in connection with them, — the cross in some cases being replaced by two curves joined at their convex surfaces.

On Dr. 49 a dot between two crosses in the lowest line of month-days has undoubtedly the meaning of 1, since it is attached to the month **Mac**, and calculation shows that **1 Mac** is the month-day to be reached by counting 250 days forward from the previous date, **16 Cumhu**, and that by counting 8 days forward from **1 Mac** we reach the next following date, **9 Mac**. On Dr. 46 we find two dots with a cross between them, which means 2, since it is attached to the month **Kayab**, and **2 Kayab** is 8 days distant from the preceding date **14 Pax**. These are, I think, the only places where the meaning of the dots and crosses is absolutely sure, and it would seem from these cases that the only purpose of the crosses is to fill up the vacant spaces, as the crescent form is used in the inscriptions for the same purpose. (Fig. 29*a*, *b*.)



a *b*

Fig. 29.

In like manner, two dots with a cross made up of two curves between them is found in Dr. 46 in connection with a glyph, of which the exact counterpart occurs in Dr. 50 with the number 10. In the first case the passage of one synodical revolution of Venus is recorded, while in the second case the passage of five of such revolutions is marked, — thus bearing the relation to one another of two to ten.

On Dr. 58b we have a dot with a cross below it in connection with the katun glyph, and as 1 katun is needed here, the cross apparently has no meaning, though Dr. Förstemann[1] thinks that the cross here shows that the dot is misplaced and belongs elsewhere, — a suggestion which I think is untenable, especially as in a similar case on Dr. 24.2.7. he attaches no meaning to the cross.

On the other hand, on Altar Q (top) of Copan we find a number on A6 which should be 13, written with two lines and two dots with a cross between them; but I prefer to consider this as an

[1] Bulletin 28, p. 472.

error of the sculptor, as on the same line a 13 is given where a 12 is needed.

It seems probable, therefore, that the crosses in connection with the dots have no particular meaning.

Copan, Stela J. — The north and south sides of Stela J of Copan offer a most interesting subject to the student. It is certain that the inscription records the tuns from one to sixteen tuns, the tun signs being in the normal form except in one instance and the numbers being carved in the line and dot method. Many other glyphs are interspersed which Goodman[1] considers record the number of days which have elapsed at the end of each tun. If this is so, the inscription affords a very valuable set of synonyms, and Goodman's explanations give very strong evidence of the truth of his supposition. This inscription will also tend to throw light on the values of the **Cauac** sign, the wing and many other frequently recurring glyphs.

Ten-tun Glyph, so called. — The glyph of which Fig. 30 is an example is called by Goodman[2] the **10-Ahau** (or 10-tun) glyph, and is said by him to be always found in connection with the end of a 10-tun period or recording a 10-tun distance. As the number which accompanies the glyph is at times 5, and at other times 10 or 15, this interpretation seems doubtful. For instances of this glyph the student is referred to Copan, Stela A, H12; Stela P (e), B7[a]; Stela F, B2; Stela 6, A7; Altar R, No. 3 (Maudslay's notation); Palenque, Temple of Inscriptions (Plate 57), S3; Quirigua, Stela P (w), A16 and B19; Tikal, Wooden lintel, etc.

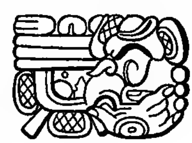


Fig. 30.

Cimi. — The day sign for **Cimi** is usually a death's head, though at times it takes the form shown on Plate II, CIMI, Nos. 22–24. The death's head is found as a numeral form in the inscriptions, meaning 10, as has been heretofore shown. The abbreviated form, consisting of a line with a dot on each side, is found on Animal B of Quirigua, No. 4 (Maudslay's notation), on the face, arm and leg of the figure attached to the uinal form, and on No.

[1] Goodman, 1897, pp. 104 *et seq.* [2] Ibid. 1897, p. 99.

5 on the arm of the figure attached to the kin form of the Initial series. In both these places the hand across the face makes it certain that each of these figures is 0 or 20. The same **Cimi** marks are found on the figure of the tun form in No. 3, though here there is no hand across the face to decide its meaning. There is, however, an unusual mark on the face below the mouth which may have the same meaning. (See Plate XVII, ZERO, No. 28.) It is a question to be considered whether the duplication of the **Cimi** marks changes the value from 10 to 0 or 20.

Burner Glyph, so called. — The form in Fig. 31 is said by Goodman[1] to be the "burner glyph" and to be associated in varied forms with the "bissextile count." By this he means that this sign is used to record the passage of a given number of years of which 4 is a factor. Thus he thinks that the day **4 Ahau 13 Yax**⑥ is the beginning or end of three bissextile counts, one of which counts a number of years in which 300 times 234 intercalary days are to be counted, making 300 × 234 × 4 or 280,800 years. Another counts the same number of years, but divides them into 270 × 260 × 4 years, while the third records 195 × 360 × 4 years. He offers but little evidence in support of his opinion, and it would seem that this sign appears often where no such number of years or even the smaller number of 4 × 360 years (a tun of bissextile years) appears to be recorded. Neither does he explain why a burner sign, belonging to a period of 260 days, should be employed to mark these periods of years. This is one of the signs which should be thoroughly investigated.

Fig. 31.

The Number 5.1.0. — The number 5.1.0., which equals 1820 or 5 periods of 364 days or 7 Tonalamatls, is of frequent occurrence in the codices and seems to be referred to in the inscriptions.

In the fourth column of Dr. 63 we find 5.1.0. as the twentieth term of a series which extends over Dr. 63 and 64 and which has a difference of 4.11. or 91, and 5.1.0. is used as a difference for three terms further.

In the sixth column of Dr. 71c the same number is found as

[1] Goodman, pp. 28 *et seq.*

the twenty-eighth term of a series which extends over Dr. 71–73 and which has a difference of 3.5. or 65, and 5.1.0. is used as a difference for two terms further.

On Dr. 51a–52a there is a series which has a difference of 1.13.4.0. or 11,960. The first number, however, of this series, given in black on Column 3 of Dr. 52a, is 1.18.5.0., which is the sum of the difference 1.13.4.0. plus 5.1.0. Five tuns and one uinal appear in the next column.

The Initial series of Stela N Copan reads 9.16.10.0.0., **1 Ahau 3 Zip**㉛, but the long number really counts to **1 Ahau 3 Zip**㊱. The latter date is 5.1.0. in advance of the former.

It is evident that, since 5.1.0. equals 7 Tonalamatls and also equals 5 years less 5 days, by counting 5.1.0. forward from any given date, a date will be reached which will have the same day and number as the given date, and a month-day 5 days before the given one.

World Direction Glyphs.—The final word has not yet been spoken as to the meaning of the four glyphs which have been assumed to be direction glyphs or points of the compass glyphs. They are usually assigned as follows:

1

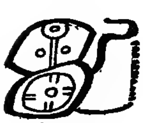


Fig. 32.

2

Fig. 33.

3

Fig. 34.

4

Fig. 35.

Goodman asserts that they are not direction glyphs at all, while Dr. Förstemann and Cyrus Thomas have had varying opinions as to the direction to be assigned to each glyph. One strong objection to the above arrangement is that it is not supported by Tro-Cor. 75 and 76. On these pages is an example of the Maya "wheel" with a sinistral circuit.[1] All other examples of the wheel which I have seen have the east at the top, and a letter from Dr. D. G. Brinton states that all the wheels of which he has knowledge

[1] For an account of Maya wheels see Appendix XI.

are formed with the east at the top, where any direction is marked. Other wheels where the direction is not marked give the upper place to **Kan**, which day is associated with the east.[1] Now the upper direction sign on pages 75–76 is No. 3 of the above list, and this is followed in sinistral circuit by Nos. 4, 1, and 2. This is evidence that No. 3 belongs to the east, No. 4 to the north, No. 1 to the west, and No. 2 to the south. These signs are always found in close connection with one another and generally in the above order, though often they seem to be used in a dextral circuit.

In connection with these signs there are other signs which are supposed to have a meaning of direction or of colors as assigned to direction.

1

Fig. 36.

2

Fig. 37.

3

Fig. 38.

4

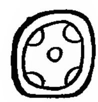


Fig. 39.

Dr. Förstemann[2] assigns these as follows:

No. 1,	East.
2,	North.
3,	West.
4,	South.

Dr. Brinton[3] thinks that the arrangement should be as follows:

No. 1,	West,	Black,	**Ek.**
2,	North,	White,	**Zac.**
3,	East,	Red,	**Chac.**
4,	South,	Yellow,	**Kan.**

The Maya words above given have the meaning of the colors beside which they are placed.

[1] In the Book of Chilan Balam of Chumayel, **Kan** is placed with **Likin** (east), **Muluc** with **Xaman** (north?), etc. (Chilan Balam II, p. 73.)

[2] Förstemann, 1901, p. 81; 1906, p. 152.

[3] Brinton, pp. 108–109.

Dr. Seler[1] assigns them as follows: —

No. 1,	West,	**Ix**,	**Ek**,	Black.
2,	North,	**Muluc**,	**Zac**,	White.
3,	East,	**Kan**,	**Chac**,	Red.
4,	South,	**Cauac**,	**Kan**,	Yellow.

In connection with these glyphs of direction and color, we often find glyphs representing a haunch of venison, a fish, an armadillo, and a turkey, although the arrangement of these latter glyphs with those of direction and with the day signs is not always the same.

A thorough investigation of the glyphs denoting direction, color, and food in their connection with the day signs would probably have important results.

Various Glyphs. — On Quirigua, Stela K, the Initial series is clearly 9.18.15.0.0. The calendar date for this number is **3 Ahau 3 Yax**(28). The **3 Ahau** appears in A5, and in the same glyph is a head which looks more like **Yaxkin** than **Yax**, and on the top of the head is this form, . Does this mean 3? It has some resemblance to the form which we have been considering as possibly meaning 13. That the date glyph is **3 Yax** is made more certain by the fact that on A6 is the distance number 10.10., and on B6 A7 is the date **1 Oc 18 Kayab**(27), which precedes **3 Ahau 3 Yax**(28) by 10.10.

The glyph, Fig. 40, may mean 9. In the Temple of Inscriptions in Palenque (Plate 57 of Maudslay), we find on OP6 the cycle and katun signs, each accompanied by the number 9. The date **3 Ahau 3 Zotz**(44) has just preceded, declared by P3 to mark the ending of 9 katuns. This date is 9.9.0.0.0. On I7 of the same plate is the cycle sign with the form here given, following the date which is probably **7 Ahau 3 Kankin**(4), 9.7.0.0.0. The same form appears in O12 and R2 of the same plate in each case next to a glyph with the number 9.

Fig. 40.

The **Kan-Ymix** sign appears frequently, and the opinion that it means "bread" is supported by Cyrus Thomas[2] by reference to

[1] Seler, 1902, Vol. I, p. 410 *et seq.*
[2] Thomas, 1882, p. 80.

Landa and the Tro-Cortesianus. Landa[1] says that the Mayas were wont to offer, as a sacrifice in the ceremonies of the New Year, dogs with bread on their backs. On Tro-Cor. 36, where the ceremonies of the New Year are clearly referred to, we see a dog with black spots with the sign of **Kan-Ymix** on its back.

The meaning of the sign, Fig. 41, needs to be investigated. Among other places it is found in the Temple of the Cross at Palenque on D15 near the date **9 Ik 15 Ceh**(34) on EF1. On the supposition that the year began on July 16, as stated by Landa,[2] this date would be March 8, or very near the vernal equinox. This glyph is also seen on Dr. 68, where Dr. Förstemann[3] thinks that it refers to the "change of the year" or to July 16.


Fig. 41.

The values of the **3 Oc** sign (Fig. 42), of the **5 Cauac** sign (Fig. 43), of the **13 Muan** sign (Fig. 44), and of the head with


Fig. 42.


Fig. 43.


Fig. 44.


Fig. 45.

the number 11 (Fig. 45), have still to be settled, although Dr. Schellhas[4] has identified Fig. 45 as God F, the god of war and human sacrifice.

Goodman[5] gives a number of signs which he thinks have a numerical meaning of from 1 to 20. He also assigns a numerical value to the month and day glyphs. There are glyphs which frequently appear in the Dresden codex, which are accompanied by numbers and which therefore may relate to time. All these numerical values will offer to the student an attractive subject for investigation.

[1] "Avian de ofrescerle perros hechos de barro con pan en las espaldas." (Landa, 1864, p. 222.)

[2] "El primer dia del año desta gente er siempre a xvi dias de nuestro mes de julio." (Ibid. p. 236.)

[3] Förstemann, 1901, p. 152; 1906, pp. 238, 239.

[4] Schellhas, 1904, pp. 21 *et seq.*; 1904a, pp. 25 *et seq.*

[5] Goodman, 1897, p. 67.

The glyphs which Dr. Förstemann calls the planet signs should be carefully studied both in the codices and inscriptions, — the so-called Venus sign being surely found in both places.

Many of the divisions of the pages of the Dresden codex have backgrounds of different colors, the explanation of which is still to be sought.

A careful study should also be made of Tro-Cor. 75 and 76, the so-called "Tableau des Bacabs," and of Tro-Cor. 77 and 78, the so-called "Title pages." Tro-Cor. 34–37 and Dr. 25–28, all relating to the ceremonies of the New Year, have been discussed by Dr. Förstemann[1] and Cyrus Thomas,[2] but neither of these writers has fully exhausted the subject.

There are many other suggestions to be found in the works of Dr. Förstemann, Dr. Seler, J. T. Goodman, and Cyrus Thomas, which are well worthy of being followed out to a conclusion.

[1] Förstemann, 1901, pp. 56 *et seq.*; 1906, pp. 120 *et seq.*; 1902, pp. 54 *et seq.*
[2] Thomas, 1882, pp. 59 *et seq.*

CHAPTER XIV

PHONETICISM, ERRORS

ALTHOUGH this book is concerned with the numeration, the calendar, and astronomical calculations of the Mayas, it will not be out of place to speak of the possible phonetic character of the glyphs and of the possible errors to be found in the codices and inscriptions.

Phonetic Character of Maya Glyphs. — Whether the Maya glyphs were phonetic in their character or not is a question which has been much debated. The statement of Landa, "*De sus letras porne aqui un a, b, c,*" followed by a table headed "*siguese su a, b, c,*" and consisting of columns of signs at the head of which stand the words "*signos — valor fonetico,*"[1] excited the greatest hopes that in this so-called alphabet lay the key to the decipherment of the Maya hieroglyphs. But such hopes were transient, since it was soon evident that this alphabet was probably merely a collection of the signs which would be used by the Mayas to recall the sounds of the words of the church service. Thus, if the priest asked them what sign would be used to recall the first syllable of the word "*Ave,*" they would draw the head of the turtle or AC.

Fantastic schemes for the interpretation of the Maya hieroglyphs have been put forth by various authors, but they have come to nothing and the idea of a phonetic alphabet must be abandoned. The phonetic use of syllables — the rebus form — called by Dr. Brinton the "ikonomatic" system, is probably the solution of the question. Dr. Brinton has finally summed up his views[2] by giving it as his opinion about the hieroglyphs, "that while chiefly ideographic, they are occasionally phonetic in the same manner as are confessedly the Aztec picture writings." While I subscribe in general to these words of the eminent Americanist, I do not think that the Aztec picture writing is on

[1] Landa, 1864, pp. 316 and 320. [2] Brinton, p. 13.

the same plane as that of the Mayas. As far as I am aware, the use of this kind of writing was confined, among the Aztecs, to the name of persons and places, while the Mayas, if they used the rebus form at all, used it also for expressing common nouns and possibly abstract ideas. The Mayas surely used picture writing and the ideographic system, but I feel confident that a large part of their hieroglyphs will be found to be made up of rebus forms and that the true line of research will be found to lie in this direction. If this is a correct view of the case, it is very important, indispensable indeed, that the student of the Maya hieroglyphs should become a thorough Maya linguist. I am also of the opinion that the consonantal sound of a syllable was of far greater importance than the vowel sound, so that a form could be used to represent a syllable, even if the vowel and consonant sounds were reversed. Thus the glyph of the month **Kayab** has always the head of the turtle **Ac** as its main component, the **Ac** apparently representing the syllable **Ka**.[1]

I give a list of the glyphs which appear to me to support the opinions which I have advanced.

Both of the signs, Figs. 46 and 47, which are supposed to represent the direction points east and west, have the kin sign as a component, and the Maya words for "east" and "west" are **Likin** and **Chikin** respectively. If Fig. 47 represents the west, it may be that the upper part, **Manik**, represents the **Chi** of **Chikin** on the principle that the **Ik** may be the representative of the reverse sound of **Ki** or **Chi**.

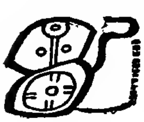


Fig. 46.

Fig. 47.

The glyph for **Yaxkin**, Fig. 48, has the kin sign also, while the upper part has the erect form of a phallus, which is used in many countries as the sign of strength, vigor, youth, etc. **Yax** in Maya signifies "vigorous, fresh, green," etc. All of the above glyphs have the kin sign as a component part. (See Plate VII, YAXKIN, No. 1.)

Fi4. 48.

[1] Recent writers have thought that the **Kayab** head is that of a parrot and not of a turtle.

Fig. 49.

The glyph for the month **Kankin**, Fig. 49 (Plate VIII, KANKIN, No. 1), as given by Landa, contains a partial sign of kin, and in the confused mass at the right it may be possible to distinguish the sign for **Kan**.

The sign shown in Fig. 50 is found under the statues erected in the ceremonies of the New Year, as shown in Dr. 25–28 and Tro-Cor. 34–37. Now **Tun** is "stone" in Maya, and Landa says that these statues were raised on a pile of stones. In the **Kan** years he says "*hazian una imagen o figura hueca de barro del demonio que llamavan* **Kan-u-Uayeyab.** *y llevavanla a los montones de piedra seca.*"[1] Again, in the Muluc years he says that they made a statue of "**Chac-u-Uayeyab.** *y la llevavanla a los montones de piedra.*"[2] Again we find this sign as meaning the period of 360 days, and the Maya **Tun** also means this period.

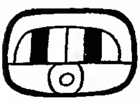


Fig. 50.

Fig. 51.

The period of 7200 days is **Katun**, and in Fig. 51 we find the "tun" or "stone" glyph, while on the top is a **Cauac** sign, which at times has a fish on each side of it. The Maya word for fish is **Cay**. Here, then, we have a double use of a phonetic syllable, for both **Cauac** and **Cay** contain the sound of **Ka** in **Katun**.

Moreover, as the katun of 7200 days is twenty times the tun of 360 days, and as the Maya word for 20 is **Kal**, we have here additional evidence of the Maya time values and of their use of phoneticism. Thus we should have

Tun = 360 days.
Katun = 7200 days = 20 × 360 = **Kal – Tun.**
= **Ca – uac – Tun.**
= **Cay – Tun.**

It is also very possible that the **Cauac** or **Cay** sign has the meaning of 20 when found elsewhere. Landa's alphabet gives the sound of **Ca** to the comb-like form found in the katun glyph.

Xaman is the Maya term for "north," and though the sign shown in Fig. 52 has been called the sign of the south by Dr.

[1] Landa, 1864, pp. 210, 212. [2] Ibid. p. 218.

Fig. 52.

Brinton and others, I have never been satisfied with this decision, since the pages 75–76 of Tro-Cor. seem to give it the meaning of "north." The testimony of phoneticism is in favor of the latter meaning, for in Landa's alphabet Fig. 53 is given as representing the sound of **Ma**, while the lower part is the form which we found in **Yax**. If my theory is correct the **Ax** of **Yax** may represent **Xa**, — the consonant being the important part of the syllable, in which case we have the sound **Xa-Ma** in this glyph.

Fig. 53.

Landa speaks of four deities in the ceremonies of the New Year, all called **Acantun** and distinguished from one another by the names **Kanal**, **Chac**, **Zac** and **Ekel**.[1] On Dr. 26 we find the glyph, Fig. 54. Of the four parts of this glyph **Kan** and **Tun** are clear. The left upper part has some resemblance to **Yax**. If it means strong, vigorous, it may well be the masculine sign of **Ah**, this being the prefix added to words to give them a masculine meaning. This would give us the word **Acantun**, and the right-hand lower part of the glyph may represent one of the words by which the deities were named in the different years. We should expect to find similar glyphs on the other pages which set forth the ceremonies of the New Year (Dr. 25, 27 and 28), but I do not find them.

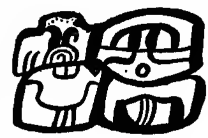


Fig. 54.

Landa speaks of a demon, **Yax-Coc-Ahmut**, in his account of the ceremonies of the **Muluc** year.[2] It is possible that the form here given, Fig. 55 (Tro-Cor. 36), may represent this deity. Here we have the sign **Yax**, and **Ah-Mut** would mean "male bird," leaving the kin sign to mean **Coc**, the Maya word for calabash.

Fig. 55.

Uo is "frog" in Maya and a "month" is **Uinal**. The uinal period of time is represented by Fig. 56 on Quirigua, Stela D (w), B9, by Fig. 57 on Quirigua, Animal B, glyph 4 (Maudslay's notation), and by Fig. 58 on Copan, Stela D, A3^b. I think that these

[1] Landa, 1864, pp. 214 *et seq.*

[2] Ibid. pp. 220 *et seq.*

figures are meant for frogs. (Plate XIII, UINAL, Nos. 35–37.) Moreover in the uinal period glyph of the Initial series of Quirigua,

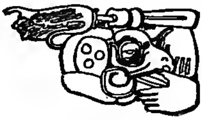


Fig. 56.

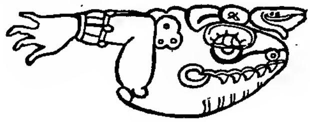


Fig. 57.

Fig. 58.

Stela D (e), the hand of the figure representing the number zero is resting on a form which is very similar to the form for the month **Uo**. (Compare Plate IX, UO, No. 4.)

The fact that the sign for kin is often found upon the head which means 4 or **Kan** (a word of similar consonantal sound) has already been referred to.[1]

Errors. — Many of the leading students of the Maya hieroglyphs have shown themselves far too ready to ascribe carelessness to the writers of the Maya manuscripts and to the sculptors of the inscriptions. They do not hesitate to change one glyph for another if their theory requires such a change.

It is true that errors do occur in the codices and inscriptions, but it is never safe to assume that such an error has been made, until every effort has been made to determine the true meaning of the glyph without assuming error, and no interpretation should be considered as settled, until it has been shown that it is supported by a like interpretation of several other similar glyphs. Evidently great liberty was allowed the scribe or sculptor in details, as may be seen in the columns of days (each column giving thirteen examples of the same day) in Dr. 46–50. This was especially true when the glyph was so well known that there was but little danger of its being misinterpreted. But no such liberty should be allowed to the investigator, and he should consider that the writing or inscription is correct till the contrary is absolutely proved. It is only when all the weight of evidence is in favor of an error having been made that such an error should be admitted. Among the cases where we are forced to admit that an error has been made are the following, —

[1] See page 157.

On Dr. 24 a series with the difference of 2920 days is given, and under each member of the series is a day with its number. This day is the day reached by counting forward from a day **1 Ahau** the number of days shown by the number above it. We have

1 × 2920 =	8.2.0.,	**9 Ahau**
2 × 2920 =	16.4.0.,	**4 Ahau**
3 × 2920 =	1.4.6.0.,	**12 Ahau**
5 × 2920 =	2.0.10.0.,	**2 Ahau**

and so on in regular order until we reach 13 × 2920 = 5.5.8.0. But the number which would naturally be 4 × 2920 or 1.12.8.0. is given as 1.12.5.0. In other words, the uinal term of this number is given as ▬ instead of •••▬. That is, three dots seem to have been omitted. If the number as given were not an error, the day under the number would undoubtedly have conformed to the change from the regular order, and we should have found **12 Ahau**, the day reached by counting forward from **1 Ahau**, 1.12.5.0. days. In reality we find **7 Ahau**, the very day which would be reached by counting forward 1.12.8.0. days. Here we have the means of rectifying the error, since the two parts of the series do not agree with each other. One of these parts is wrong, without doubt, and as the day series carries out the regular order, it is in the number series that the error must lie.

In a similar way Dr. 51–58 give a similar series, and a similar plan for deciding upon an error can be employed. In this passage we find the series divided into three parts, and one of these parts is in turn divided into three smaller parts. One or more of these parts can be used to correct the errors in the others. First we have a numerical series consisting of relatively small numbers, which show the distance of each member of the day series from the preceding member. Then we have a numerical series consisting of larger numbers, each member of which is the sum of the smaller numbers up to that point, and a day series giving the day reached from the zero point of the series after the lapse of the number of days set forth by the corresponding member of the larger numerical series. This day series consists of three days in each column, the lower two days being those immediately following the first day of the column. Here, too, we have ample means of detecting the numerous errors which occur in the series.

There are also probably errors in the inscriptions. The Initial series of Stela E (w), of Quirigua, runs 9.14.12.4.17. The calendar date for this number is **3 Caban 10 Kayab**[50]. But on B5, B7 of the inscription, we find the date **12 Caban 5 Kayab**[51] carved very clearly. This is the calendar date corresponding to 9.14.13.4.17. It would seem that the tun number should be 13 and that the ornamental form between the two circles should be replaced by a third circle. That this change should be made is rendered almost certain by the fact that on B9 A10 we find the distance number 6.13.3., which, being counted forward from 9.14.13.4.17., **12 Caban 5 Kayab**[51], brings us to 9.15.0.0.0., **4 Ahau 13 Yax**[6], which is found on B10. This evidence is strengthened by the fact that the date **12 Caban 5 Kayab**[51] is found on Stela F (w), Stela J, and on Animal G, all in Quirigua, — showing that this date was an important one in that ancient city.

The dates of the Temples of the Cross, the Foliated Cross, and of the Sun in Palenque are very closely connected, so closely, indeed, that the dates of one of the Temples may be of service in correcting any error in those of the others. Thus on PQ6 of the Temple of the Sun we find **9 Akbal 6 Xul**[20], and on PQ14 we have the distance number 1.8.12. Counting forward this number from **9 Akbal 6 Xul**[20] we reach **8 Men 13 Kankin**[21], which is nowhere to be found. But if the distance number were 1.8.17. (that is, if an additional line were added to the kin number), we should reach **13 Ahau 18 Kankin**[21] which we find in Q14 P15, and which is declared by Q15 to be Katun 10 or Tun 10. **13 Ahau 18 Kankin**[21] is found in 9.10.10.0.0. Moreover, on EF1 we find **9 Akbal 6 Xul**[20], and on GH2, **13 Ahau 18 Kankin**[21]. Also in the Temple of the Cross there is found on GH1 **9 Akbal 6 Xul**[20]

on K7–8	1.8.17.
and on K9	**13 Ahau 18 Kankin**[21]

All this seems to make it safe to assume that the 1.8.12. of the date of the Temple of the Sun is a mistake for 1.8.17.

APPENDICES

APPENDIX I

MEANING OF DAY-NAMES

THE following meanings have been given to the names of the Maya days:[1]

Kan. The cord or thread of twisted henequen. **Caan** means "heaven." (P.)

The cord of twisted henequen. Yellow. Serpent. Hammock. Clayey. Red earth. (B.)

Grain of maize. (S.) **Kan** does not mean maize at the present time.

An eye. (Seler.)

Shell pendant. Bead used for money. Abundance. (Br.)

Chicchan. Twisted threads, **chich kuch.** (Br.)

Unknown meaning. **Chichan** means "small" at the present time. (P.)

Chikan means "it appears" at the present time. (T.)

Cimi. The past tense of **cimil** meaning "to die." It thus has the meaning "he died" or "one died." (P.)

Compare Mexican **mic** or **miqui**, meaning "to die" or "dead." (B.)

Manik. **Man-Ik** would mean "the wind which passes," and then possibly "that which was." (P.)

The word is from the verb **manik** or **mansik**, and **Ik** is part of the verbal root and does not mean "wind." (T.)

The breath has passed. More strength. (B.)

A hand which grasps. **Mach** means "to grasp." (Br.)

[1] Abbreviations.
(P.) Pio Perez.
(B.) Brasseur de Bourbourg.
(Br.) Daniel G. Brinton.
(S.) Paul Schellhas.
(T.) A. M. Tozzer.

Lamat. Unknown. Given as **Lambat** by Boturini, as found in Oaxaca. (P.)

Lamal kin means "sun-setting." (Br.)

Plunged in water. (B.)

Muluc. Found also in Chiapas. Perhaps means "reunion by heaping." (P.)

May be a form of the verb of which the root is **mul** or **muul**, meaning "to pile up." (T.)

Reunited. (B).

Compare the form with that of the month **Mol.**

Oc. That which falls in the hollow of the hand, closed so as to form a shell. (P.)

Foot. This may be the same form as is found in **Okol**, meaning "to enter," as suggested by Brinton. (T).

Foot. Leg. Walk. Entrance. Handful of grain, as much as can be held in the hollow of one's hand. Suffix for counting by handfuls. To be changed or metamorphosed. (B.)

Chuen. In old times **chuenche** meant "a board." There is a tree called **zac chuenche** or "white chuenche." (P.)

Corruption of **Chouen**, called **Hun-Choven** in the Popul Vuh. He was the brother of **Batz** or **Hunbatz**, who occupies the same place in the Quiché calendar which **Chuen** does in the Yucatecan. Gourd or calabash opened by degrees. Hole filled with water. (B.)

From **chi**, "a month" or **chu**, "a calabash." (Br.)

Eb. Ladder. (P.)

Ladder. A thing which rises. (B.)

Ben or **Been.** From **Be che**, meaning a "wooden bridge." (Br.)

A Chiapas word. **Beentah** in Maya means "to spend economically." (P.)

A sloping path. Walk. (B.)

Ix, Hix or **Gix.** A Chiapas word. In Maya, **hiixtah** means "to gather all the fruit of a tree or to strip off the leaves from a branch." **Iixcay** means "the skin of a fish." **Hihixci** means "rough." (P.)

Hole. Rust. Urine. Prefix giving feminine meaning. **Hix** is found written **Iiz** or **Itz** in the Quiché calendar and there it means "a sorcerer or sorcery." (B.)

Men. A founder. Builder. (B.)
To know. One who knows. A doctor. (T.)
A workman. (P.)

Cib or Quib. Wax. Candle. Copal. (P.)
Flowing of a thick liquid. Mark of interrogation. To wish. To become. (B.)

Caban. Unknown. (P.)
That which is heaped up or overturned. **Cab** is anything which flows slowly. Poison. Honey. Aurora. Sunrise. Earth. To descend. Prefix signifying ownership or habiting. (B.)

Edznab or Eonab. Unknown. (P.)
Should be written **Eoanab** or **Eznab.** Surface of water. (B.)

Cauac. Unknown. (P.)
One that has gone out. That which has been opened or which has overflowed. (B.)

Ahau. The king. Period of twenty-four years. (P.)
Principal. Chief. (T.)
A reed or the male in a circle of water. (B.)

Ymix or Imix. Unknown. (P.)
Deep hole. Issue of the navel or breast. Written **Imox** in the calendars of Chiapas and of the Quiché. The **Cipactli** of the Mexicans. (B.)

Ik or Yk. Wind. Air. (P.)
Air. Wind. Breath. Spirit. Soul. Life. One of the symbols of **Kukulcan** or **Quetzalcoatl.** (Br.)
Spirit. Breath. Wind. (B.)

Akbal. Unknown. Written **Aghual** as one of the days of the Chiapas calendar. (P.)
An old word of the Quiché, meaning "pot" or "vase." On the verge of night. (B.)
Akbal (Aqbal) is "a black thing." **Akab (Aqab)** is "night." (T.)

APPENDIX II

THE TONALAMATL[1]

THIS period seems to play an important part in the life and customs of the Mayas. It is reached by the combination of the numbers 13 and 20, the latter being the number of named days in the uinal or month of 20 days, and the former the numbers which are attached in a series of 1–13 to the named days. As these two numbers, 13 and 20, have no common divisor, the total possible combination of the days and numbers must be $13 \times 20 = 260$, and it is not till this possible combination is exhausted (that is, till each of the 13 numbers appears attached to each of the 20 days), that, in the regular order of the days and numbers, a day with a given number will reappear.

Factors — Twenty and Thirteen. — The reason for the selection of these numbers is not settled, though it is probable that 20 shows the number of fingers and toes which a man possesses, this supposition being supported by what we find in other races and by the further fact that in the Maya language the month of 20 days is called **uinal** and a man is **uinic**. It has been supposed by some that the number 13 was selected as representing the number of days in which the moon remains visible while waxing or waning. Others have thought that thirteen was the number of the higher gods, though this is rather begging the question, for the answer would still have to be given as to why they selected thirteen gods.

The suggestion that 13 was selected as a number to be combined with 20, because 8 solar years exactly, or very nearly exactly, equals 5 synodical revolutions of Venus, and because $8 + 5 = 13$,

[1] In Mexico the series of 260 days was called the **Tonalamatl**, and was used by the priests in divinations, horoscopes, auguries, ceremonies, etc. This term may be conveniently used in our discussion of this period.

Tonalamatl is defined by Simeon, (French translation) as a book of martyrs, a book of births, a calendar founded on birth divination and appropriated to the ritual of feasts. Molina speaks of it as " martilojo " which is probably a form of " martirologio " or book of martyrs. Seler translates it as " the book of the (good and evil) days." Chavero calls it " the book of the days."

seems to be placing the cart before the horse. In the natural order of things the selection of thirteen with its various properties in connection with other numbers must have preceded by a long period the knowledge of the solar and Venus revolutions.

It has also been suggested that this number was chosen as the total of all directions. Thus a man standing on the earth or in the upper world has the four horizontal directions in his front, rear, and on either side of him, while above him is the zenith and below him is the nadir, his own position being added which makes seven. In the lower world he has the same directions as in the upper world, but refrains from counting his own position a second time. The seven upper world directions and position and the six lower world directions added together make thirteen. Cushing says that the Zunis numbered their points of direction and position in this way, and he is quoted by W. J. McGee as having stated that the Zunis called the 260-day period the "kernel of the year."[1]

I am rather inclined to think that 13 was taken as a satisfactory number to combine with 20 for the purpose of giving a number of days in which each day could be differentiated from the others, and which being less than the number of days in a tun (360 days) should not be too small to be of practical use. For this purpose it would be necessary to find a number which had no common divisor with 20. The numbers 7, 9, or 11, would have this property, but 7 and 9 would be too small for the purpose; while 13, in addition to filling the necessary conditions, had the further advantage of being a divisor of the number of days in a year with only 1 for a remainder. It may well be, however, that the choice of the numbers 13 and 260 antedated the knowledge of the length of the solar year. It is also to be noted that the number 260 approximates very closely to the length of nine lunar revolutions and to the period of human gestation.

The Tonalamatl is found in most of the Maya and Mexican codices where the calendar or ceremonies are treated of. In the Dresden it appears in more than sixty instances and occupies nearly all the pages of the first part, — pages 2–23 and 29–45. In the Tro-Cortesianus it appears on nearly every page of the codex, while there are the remains of a Tonalamatl on page 17 of the Peresianus.

[1] Thomas, 1894, p. 12.

Tonalamatl in the Tro-Cortesianus. — This period is set out in full in Tro-Cor. 65–73, divided into thirty-two sections of 8 days each with their numbers, and one section which includes the last four days, the whole beginning with **1 Ymix** and ending with **13 Ahau**, to which the month-day **13 Cumhu** is annexed, recording the date **13 Ahau 13 Cumhu**(60).

The order of reading is along the first lines of the upper section of pages 65–72, then along the upper lines of the second section of the same pages, then along the second lines of the upper section, continuing along the second lines of the second section and so on. In each section, each day with its number, except the first, is thirty-two days from the next preceding day above it.

On Tro-Cor. 13–18, it would seem as if the artist had started out to draw another complete Tonalamatl in four horizontal rows (giving the days without the numbers) of 65 days each, but that when he reached the fifty-second day, he forgot that he was not drawing a Tonalamatl in five rows like many of those found in the Mexican codices. At all events he drew but 52 days in each row, leaving some blank spaces after the last days. The four rows begin with the four days, **Ymix**, **Cimi**, **Chuen** and **Cib**, as if there were to be 65 days in each row.

Again, on Tro-Cor. 75–76, the so-called Tableau des Bacabs, we find a complete Tonalamatl, though all the days are not written out in full. Forty days with their numbers are recorded, while the intermediate days are designated by black dots. **1 Ymix** appears near the lower left-hand corner of the central frame and **13 Ahau** (the last day) is seen close by, the circuit being sinistral, that is, in the direction in which a person would walk round a circle with his left hand towards the centre.

Tonalamatl in the Codex Cospi. — The Tro-Cortesianus is the only Maya codex, in which all the days of the Tonalamatl with their numbers are given or designated, though such Tonalamatls are not uncommon in the Mexican codices. Thus in the Codex Cospi (pages 1–8, Loubat reproduction), as in several others, four double pages are given up to a complete Tonalamatl. The centres of the pages, running horizontally, are divided into 260 small squares (sixty-five squares on each double page), and in these squares the days without numbers are given in consecutive order. In the Cospi, the days are accompanied by another set of forms, nine in all, which are called "companions" or "Lords of the night," and which, being given consecutively, differentiate the days in the several sets of 20 days in the Tonalamatl. The days are also accompanied in the Cospi by footprints, which appear first on the fourth day and thereafter on the following days throughout the Tonalamatl, namely, Days 13, 22, 31, 40, 49, 58, 67, 76, 85, 92, 99, 106, 113, 120, 127, 134, 143, 152, 161, 170, 179, 188, 197, 206, 215, 222, 229, 236, 243, 250, 257, and back to 4. Thus these marks are at the following distances from each other, namely, 9, 9, 9, 9, 9, 9, 9, 9, 9, 7, 7, 7, 7, 7, 7, 7, 9, 9, 9, 9, 9, 9, 9, 9, 9, 7, 7, 7, 7, 7, 7, 7, or nine distances of 9 each, seven of 7 each, nine of 9 each, and seven of 7 each. This divides the Tonalamatl into thirty-two unequal sections. (Compare Tro-Cor. with its thirty-two equal sections covering 256 of the days of the Tonalamatl.) Above and below each perpendicular column of days is a picture set in an oblong rectangle.

The Tonalamatls of many of the Mexican codices are much more elaborate than that of the Cospi. The larger part of a page is often given up to a picture in which some figure of a god or goddess is given, and this divinity is supposed to rule the thirteen days, which border two sides of the picture. These days with their numbers are each placed in a square, and the companions or Lords of the night are either placed in the squares with the days or in separate squares of their own. In some cases a third set of squares is added, containing birds, one of which is assigned to each day.

Position of the Tonalamatl in the Years. — The position of the Mexican Tonalamatl in the year has been the subject of discussion. Mrs. Zelia Nuttall[1] thinks that it occupied the centre of each year, with 52 days before it and 53 days after it. Thus if a year began with 1 **Cipactli**, the 53d day would begin the Tonalamatl. This would be 1 **Acatl** and would give the name to the year. Dr. Förstemann[2] does not think that the evidence which she offers proves her assertion and I agree with him. Indeed, the Codex Borbonicus disproves it.

Orozco y Berra says that when one Tonalamatl is ended, another begins to unroll, and so on indefinitely.[3] This view is sup-

[1] Nuttall, 1894, pp. 7 *et seq.*

[2] Bulletin 28, p. 532.

[3] "El periodo de 260 dias es el propio del Tonalamatl; terminado uno se desarrolla

ported by the Codex Borbonicus. Tro-Cor. 73 proves conclusively that Mrs. Nuttall's view is incorrect as far as the Maya Tonalamatl is concerned. Here the last day of the Tonalamatl, which has been given in the preceding pages, is **13 Ahau 13 Cumhu**(60), showing that its 260 days extended over the period beginning with **1 Ymix 14 Tzec**(60) and ending with **13 Ahau 13 Cumhu**(60), — a period which must have been preceded in the year by 94 days and followed by 11 days.

If the "burner period," as given by Perez[1] and consisting of sixty-five days, is supposed to make up a Tonalamatl with four such periods, then the example which he gives would go to prove Orozco y Berra's statement, for, after the fourth period of 65 days is ended, the fifth period begins.

Purposes of the Tonalamatl. — The purposes which the Tonalamatl served were various. It was used in connection with ceremonies, household avocations, customs, and possibly astronomy,[2] and with astrology and divination, at least by the Mexicans. Goodman thinks that it was also used in connection with the bissextile days needed to bring the calendar and seasons into unison.[3] Orozco y Berra speaks thus of the Mexican Tonalamatl:

"Este calendario era ritual, astrológico y adivinatorio. Sólo le entendían los sacerdotes y los agoreros. Los tlamacazqui, despues de arreglar las fiestas, las anunciaban al pueblo para su cumplimiento, al principio de cada trecena, á semejanza de lo que los sacerdotes romanos practicaban

otro en el espacio de los tiempos y otro y otro indefinidamente." (Orozco y Berra, 1880, Tomo II, p. 17.)

[1] Perez, 1843, pp. 449 *et seq.*

[2] Dr. 3a relates to human sacrifice.
6b relates to the making of fire as do Tro-Cor. 38b,c.
16–23 relate to women, impregnation, pregnancy, and child-birth.
25–28 and Tro-Cor. 34–37 relate to the ceremonies of the New Year.
Tro-Cor. 44–49 relate to hunting.
108c–109c relate probably to bees and honey as do 103b,c–106b,c.
102c relates to weaving.
97b–98b, 99d, 101b, relate to carving, probably to carving idols.
95a relates to offering one's blood in sacrifice by cutting the ear.
93d–94d relates to some occupation in which carrying burdens is a part.
91a, 93a relate to trapping and snaring animals and birds.
93c relate to some sort of baptism. (See Landa, 1864, pp. 144 *et seq.*)
86b–87b relate to smoking.

[3] Goodman, 1897, pp. 28 *et seq.*

en las calendas. Las personas dedicadas á su estudio y práctica se llamaban **Tonalpouhque**, sortílego ú hombre que dice la buena ventura. El modo de proceder era casi idéntico al de los astrólogos judiciarios; con la hora del dia del nacimiento de una persona acudían al libro adivinatorio; y consultado el signo reinante, el estado que guardaban los planetas y su recíproco influjo, levantaban la figura, deducían el horóscopo, prediciendo las virtudes y vicios del individuo, los sucesos que le estaban reservados en lo futuro." (Orozco y Berra, 1880, Tomo II, p. 23.)

The Tonalamatl and the Planet Venus. — Orozco y Berra also states that in the Mexican calendar the Tonalamatl served to calculate the combined movements of the moon and the planet Venus.[1] He quotes from Motolinia that Venus was visible in the west for 260 days and in the east 260 + 13 = 273 days or 533 days in all, in addition to which they counted the 51 days in which Venus was not visible at all.

His views as to the connection with the revolution of the moon are not supported by anything with which I am cognizant in the Maya codices, but his suggestions as to the connection with the synodical revolution of Venus of 584 days (really 583.92 days) may have some support from Tro-Cor. 65–72, on which 256 days of the Tonalamatl are given and page 73 on which the other four days are shown. If we read through the whole Tonalamatl eight times and then read through it for the ninth time, omitting the last four days on page 73, we shall have passed through 2336 days, which is exactly equal to four synodical revolutions of 584 days each. Moreover, the division of the Tonalamatl into thirty-two sections seems to have a significance, when we consider that in running through two lines of these sections we pass over 64 days, and each synodical revolution contains two Tonalamatls plus 64 or twice 32 days. Thus the first revolution of Venus would consist of two full Tonalamatls and a third reading of the first two lines of sections a and b of pages 65 to 72, and would end with **12 Kan** in the last column of page 72. The second revolution would begin with **13 Chicchan** on page 65, and would run through two full Tonalamatls and the third and fourth lines of the thirty-two sections, ending with **11 Lamat** on page 72. The third would begin with **12 Muluc** on page 65, and, running

[1] Orozco y Berra, 1880, Tomo II, pp. 32–33.

through two full Tonalamatls and the fifth and sixth lines of the sections, would end with **10 Eb** on page 72. The fourth revolution would begin with **11 Ben** on page 65, and would run through two full Tonalamatls and the seventh and eighth lines of the sections, ending with **9 Cib** on page 72. If this **9 Cib** is the end of the fourth revolution it will be **9 Cib 9 Cumhu**㊿, since the fourth day following is **13 Ahau 13 Cumhu**㊿. We can then fix the dates as follows of the beginning and ending of the four revolutions:

First revolution	begins with **1 Ymix 4 Zac** ㊹		
	ends with		**12 Kan 17 Zip**㊻
Second	"	begins with **13 Chicchan 18 Zip**㊻	
		ends with	**11 Lamat 16 Kankin**㊼
Third	"	begins with **12 Muluc 17 Kankin**㊼	
		ends with	**10 Eb 10 Yaxkin**㊾
Fourth	"	begins with **11 Ben 11 Yaxkin**㊾	
		ends with	**9 Cib 9 Cumhu**㊿

If only one Tonalamatl is recorded here its beginning will be **1 Ymix 14 Tzec**㊿.

It should be said in relation to the connection between the Tonalamatl and Venus, that it would seem probable, if this connection occurs, that some of the glyphs or pictures would confirm our supposition, but the picture on page 72 is a turtle recalling the month **Kayab**, and not one of the revolutions ends with **Kayab**. **Kayab**, however, is the month in which the summer solstice occurs.

The Tonalamatl and the Burner Period. — Goodman[1] calls this 260-day period the "Burner period," because Perez,[2] in giving a year table, shows that on certain days **Ahau**, **Chicchan**, **Oc**, and **Men**, when combined with the numbers 3, 10, 4, and 11 and falling on the 2d, 7th, 12th, and 17th days of the month, some person called the "burner" does certain things. Thus on the above-named days, affected with the number 3, the burner takes or handles the fire; when these days have the number 10 attached, the fire begins or the burner begins or the fire of the burner begins or the burner ignites the fire, — all these expressions being given by Perez in his translation from the Maya; when these days are affected with 4 the burner gives the fire scope, and when 11 is the day number the burner puts out the fire. The following table shows the days of

[1] Goodman, 1897, pp. 28 *et seq.*

[2] Perez, 1843, pp. 449 *et seq.*

THE "BURNER PERIOD"

The burner —		65 days	65 days	65 days
Takes the fire			**3 Chicchan 2 Zip**	**3 Oc 7 Xul**
	20 days			
Begins the fire			**10 Chicchan 2 Zotz**	**10 Oc 7 Yaxkin**
	20 days			
Gives scope		**4 Ahau 17 Pop**	**4 Chicchan 2 Tzec**	**4 Oc 7 Mol**
	20 days			
Puts out fire		**11 Ahau 17 Uo**	**11 Chicchan 2 Xul**	**11 Oc 7 Chen**
	5 days			
Takes the fire		**3 Men 12 Chen**	**3 Ahau 17 Ceh**	**3 Chicchan 2 Pax**
	20 days			
Begins the fire		**10 Men 12 Yax**	**10 Ahau 17 Mac**	**10 Chicchan 2 Kayab**
	20 days			
Gives scope		**4 Men 12 Zac**	**4 Ahau 17 Kankin**	**4 Chicchan 2 Cumhu**
	20 days			
Puts out fire		**11 Men 12 Ceh**	**11 Ahau 17 Muan**	**11 Chicchan 2 Uayeb**
	5 days			

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the burner's work in one year, but these days must fall on different days of the month in the next and following years.

Each day in the horizontal rows is distant 65 days from the preceding day in the row, and each day in the column is distant 20 days from the preceding day in column.

It is very possible that this refers to the clearing of the fields by fire, though it is hard to think that this was done every 65 days and extended over a period of 60 days. The table is interesting, however, in showing that this division of 65 days runs uninterruptedly through the year.

I have my doubts however whether the period of the Tonalamatl should be called "the burner period" any more than that it should be called "the hunting period," because Tro-Cor. 50b gives us the days **Chuen**, **Cib**, **Ymix** and **Cimi** in a 65-day period in connection with hunting. It would seem as if the old book from which Perez took the table was simply a transcript in the Maya language and Spanish script from some older book, like one of the codices, and that in this some fire ceremonial was set down.

Dr. Förstemann sums up his opinion upon the Maya Tonalamatl as follows:[1]

"The tonalamatls of the manuscript are kinds of horoscopes which were cast by the priests for the purpose of foretelling the future lives of persons, classes or tribes, as well as future political events or natural phenomena. They may have been so employed because they approximate periods of pregnancy. Naturally, they had constant reference to the mythologic personages, but had no connection whatever with the established calendar."

[1] Bulletin 28, p. 532.

APPENDIX III

NAMES OF TIME PERIODS

THERE has been much discussion of the question as to the names which should be given to the Maya periods of time which indicate 1 day, 20 days, 360 days, 7200 days, and 144,000 days. The names which are generally used are

1 day	=	1 Kin		
20 days	=	1 Uinal	=	20 Kins
360 days	=	1 Tun	≐	18 Uinals
7200 days	=	1 Katun	=	20 Tuns
144,000 days	=	1 Cycle	=	20 Katuns

The evidence of the propriety of assigning these names to these periods of time may be summed up as follows:

Kin. — This is the word for "day" now in use among the Mayas. It was also used in the Book of Chilan Balam of Mani, where the text runs "Bolon imix u kinil laì cimci Ahpula,"[1] which Dr. Brinton translates "9 Ymix was the day on which Ahpula died."[2] Practically the same words in the original and translation occur in the Books of Chilan Balam of Tizimin[3] and of Chumayel.[4] Dr. Brinton says that the Maya year was "divided into eighteen months, *u*, (*u*, month, moon,) of twenty days *kin* (sun, day, time) each."[5] There seems, therefore, to be no reason for calling the day by any other name than "kin."

Uinal. — There is more uncertainty as to the use of the word "uinal" as meaning a period of 20 days. Uinal is the generic name for the named months. In the Books of Chilan Balam, as recorded by Pio Perez, a list is given of the numbers which should be attached to any given day (say, the first) in successive periods, thus:[6]

[1] Brinton, 1882, p. 98. [2] Ibid. p. 104. [3] Ibid. pp. 142, 149.
[4] Ibid. pp. 156, 162. [5] Ibid. pp. 50, 51.
[6] Chilan Balam I, pp. 102, 103. Page 102 is probably a copy of the Book of Chilan Balam of Mani, and page 103 is probably a copy of the Book of Chilan Balam of Káua.

PAGE 102	PAGE 103
Vinales 1, 8, 2, 9, 3, 10, 4, 11, 5, 12, 6, 13, 7,	Vinales the same list as on page 102
Katunes 13, 9, 5, 1, 10, 6, 2, 11, 7, 3, 12, 8, 4,	Vinales the same list as on page 102
Katunes 13, 11, 9, 7, 5, 3, 1, 12, 10, 8, 6, 4, 2,	Katunes the same list as on page 102

In both passages the word "Vinales" is used with the series of numbers which mark any given day (the first, for instance) of the successive months of the year. It would, therefore, seem as if Uinal were the proper designation for a month, were it not that in the following lines from the Book of Chilan Balam of Káua, the name is annexed to a list of numbers which mark any given day of successive tuns; but this is almost surely an error, for a similar list in the preceding extract from the Book of Chilan Balam of Mani has annexed to it the name Katunes, which is certainly an error.

Landa, as has been seen,[1] calls the month of twenty days, **Uinal-Hun-Ekeh.** Perez,[2] speaking of the month of twenty days, says that the word **Uinal**, in the singular and **Uinalob** in the plural, is given to the eighteen months of the year. Dr. Brinton [3] says that "Twenty days were a month, *u*, or *uinal.*" **U** has at present in Maya the meaning of a month or period of twenty days, a lunation.

Goodman has given the name **Chuen** to this period of twenty days, — apparently because the form which represents this period resembles that of the day **Chuen.** It is not at all probable however that the Mayas would have given the same name to a day and to a period with all the chances of confusion incident to such a nomenclature.

I think that the choice of name lies between **U** and **Uinal**, and in this I am confirmed by phonetic reasoning, since in Stela D of Copan the uinal period is shown in the form of a frog, — frog being **Uo** in Maya. The term "uinal" will therefore be used till a better designation is found.

Tun. Tun is used continually in the Books of Chilan Balam as the name for the subdivision of the katun. I shall give but one example out of eight which appear in the five books of Chilan

[1] See page 13, note.

[2] "En los manuscritos antiguos se le dá el nombre de *Uinal* en singular y *Uinalob* en plural á los diez y ocho meses del ano." (Perez, 1864, p. 376.)

[3] Brinton, 1882, p. 53.

Balam printed by Dr. Brinton in his "Maya Chronicles." In the Book of Chilan Balam of Mani we find the words "tu lahun Tun uaxac ahau."[1] This is translated thus: "and it was the tenth year of the eighth ahau,"[2] but the translation should read, "it was Tun 10 of **8 Ahau.**" Moreover, **tun** means in Maya not only the period of 360 days but also a stone. Landa states that the Mayas in the ceremonies of the new year placed the statue of the god which was made at this time on a heap of stones. When, therefore, we see these ceremonies referred to on Dr. 25–28 and Tro-Cor. 34–37 and find that the statue of the deity is set on a form like that of Fig. 59, and when again we find this form on the inscriptions representing the period of 360 days, it is a fair inference that the word "tun" was used to represent this period. Mr. Goodman uses the term **Ahau** and says that this period undoubtedly derives its name from the fact that it always begins with the day **Ahau.**[3] It would seem as if he had entirely overlooked the fact that the uinal, katun, and all higher periods begin (or end) with the day **Ahau.** As Goodman has adopted the name "katun" for the period of 7200 days, it is strange that he should not have adopted the word "tun" as representing the period of 360 days, since it is at the least very possible that katun is simply **kal-tun**, or twenty tuns.

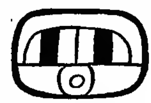

Fig. 59.

There is in my mind no doubt that the period of 360 days was called "tun" by the Mayas.[4]

In the manuscript volume which has just been referred to, immediately following the series of numbers attached to given days of successive uinals, there is a paragraph from the Book of Chilan Balam of Mani, which states that there was another number which was called **ua katun**, which served to find the katuns.[5] This statement is followed by the series of numbers which has just been given, thus: **Katunes** 13, 9, 5, 1, 10, 6, 2, 11, 7, 3, 12, 8, 4. But

[1] Brinton, 1882, p. 97. Also Bowditch, 1906a.

[2] Brinton, 1882, p. 102.

[3] Goodman, 1897, p. 23.

[4] Don Juan Martinez y Hernandez, who has most kindly given me his opinion on many points connected with the Maya language, writes me that **tun** is used very often, especially at the present time, as an adverb, meaning "indeed, then"; and that it is also used in the form **thun** as a particle for counting or a "dot."

[5] "Habia otro numero que llaman ua Katun el que servia casi como llave para hallar y asertar los Katunes y segun la orden de su movimiento cae a los dos dias de uayeb haab y da su vuelta al cabo de algunos anos." (Chilan Balam I, p. 102.)

these are exactly the numbers which would be attached to any given day in successive periods of 360 days. In the Book of Chilan Balam of Káua a similar statement is made, but the name which precedes the series of numbers is **Vinales.**[1] Thus these passages which might be expected to settle the name of the period of 360 days contain a contradiction. The Book of Mani calls these periods **Katunes** — the name given to the following series — and the Book of Káua repeats the name **Vinales** (although it has been stated in the text that the name was **Katunes**), which had already been applied to the preceding series. In each case there is probably an error, which may be that of Pio Perez, Dr. Berendt, or of the Maya scribe.

Katun. — This word was certainly used to designate some period of time, but there has been a great deal of doubt and discussion as to the exact period which it designated.

Pio Perez says that some gave the name katun to a "lustrum" of four years, while others thought that thirteen years made a katun, and still others decided that four times thirteen years, or fifty-two years, completed a katun. Perez considered that the last was the most probable solution of the matter.[2]

Cogolludo says distinctly that the katun was a period of twenty years. The year to which he refers is evidently a year of 365 days, since in the same paragraph he speaks of a "lustro" of four years, which begin successively with the days **Muluc, Ix** and **Cauac.** That he had not thoroughly informed himself of the details of the Maya calendar is evident from the fact that he calls the year which begins with **Kan,** "**Cuch-Haab,**" which is the word applied to all four year-bearers. He also places the order of the years as follows:

East,	**Cuch-haab.**
West,	**Hijx.**
South,	**Cauac.**
North,	**Muluc.**

[1] "Avia otro numero que llaman Katun el que servia casi como llave hallar y asertar los katunes," etc. (Chilan Balam I, p. 103.)

[2] "Algunos suponen que cuando terminaba el cuarto año, . . . se completaba un Katun ò lustro de cuatro años; otros que tres revoluciones de las de la rueda, con sus cuatro señales se contaban, con una mas, haziendo asi 13 años para completar el *Katun;* otros que cuatro semanas de años completas ò indicciones enteraban el *Katun;* y esto es lo mas probable." (Perez, 1864, p. 394.)

"Se dá el nombre de indiccion a cada una de las cuatro semanas de años que componen un siglo de 52, que los indios llamaban *Katun.*" (Ibid. p. 396.)

instead of following the circuit of the direction points, east, north, west, south, or east, south, west, north, as given in Books of Chilan Balam and elsewhere.[1]

Besides the fact that the katun was a period of time, it is also agreed by every one that the numbers of the day **Ahau** with which the katun ended (or began) ran in the following order,— 13, 11, 9, 7, 5, 3, 1, 12, 10, 8, 6, 4, 2.[2]

The Book of Chilan Balam of Chumayel[3] has a series of heads with a variety of ornaments, numbered 1, 2, 3, etc., to which the years are added, as follows:

Page 53	Head with 1	**Buluc Ahau, Katun.**	
Page 55	Head with 2	**Bolon Ahau, Katun.**	1560
Page 56	Head with 3	**Vuc Ahau, Katun.**	1580
Page 57	Head with 4	**Ho Ahau, Katun.**	1600
Page 58	Head with 5	**Ox Ahau, Katun.**	1620
Page 59	Head with 6	**Hun Ahau, Katun.**	1640
Page 62	Head with 7	**Lahcabil Ahau, Katun.**	1660
Page 63	Head with 8	**Lahun Ahau, Katun.**	1680
Page 64	Head with 9	**Uaxac Ahau, Katun.**	
Page 64	Head with 10	**Vac Ahau, Katun.**	1720
Page 65	Head with 11	**Can Ahau, Katun.**	1740
Page 66	Head with 12	**Cabil Ahau, Katun.**	1760
Page 66	Head with	**Oxlahun Ahau, Katun.**	1780

This shows the length of the katun very clearly as twenty years, and the Maya numbers attached to the days **Ahau** run in the prescribed order. On the other hand, on pages 82, etc., of the Book of Chilan Balam of Káua we find thirteen heads with names, numbered in the following order,— 3, 1, 12, 10, 8, 6, 4, 2, 13, 11, 9, 7, 5; and to each of these heads the words "24 años" are attached. But the Book of Chilan Balam of Káua also states that katun was the name of the period of twenty years.[4]

The Book of Chilan Balam of Mani, as translated by Brinton,

1 "Contaban sus eras y edades que ponian en sus libros de veinte en veinte años y por lustros de cuatro en cuatro. El primer año fijaban en el Oriente, llamándole *Cuchhaab*, el segundo en el Poniente llamado *Hijx;* el tercero en el Sur, *Cavac;* y el cuarto *Muluc* en el Norte y esto los servia de letra dominical. Llegando estos lustros á cinco, que ajustan veinte años llamaban *Katun*, y ponian una piedra labrada sobre otra labrada." (Cogolludo, 1867, Vol. I, p. 299.)

2 Chilan Balam I, p. 103.

3 Chilan Balam II, pp. 53 *et seq.*

4 "Katunes el numero d'espacio de una edad de 20 años." (Chilan Balam I. p. 103.)

gives in many places the length of a katun as twenty years. One of the most conclusive passages is thus translated by Dr. Brinton, the changes which should be made in the translation being indicated by brackets:[1]

"Four katuns had passed in which they journeyed when they arrived here with Holon Chantepeuh and his followers. When they set out for this country it was the eighth ahau (**8 Ahau**). The sixth ahau (**6 Ahau**), the fourth ahau (**4 Ahau**), the second ahau (**2 Ahau**) (passed), fourscore years and one year, for it was the first year (Tun 1) of the thirteenth ahau (**13 Ahau**) when they arrived here in this country; fourscore years and one year in all had passed since they departed from the land and came here to the province of Chacnouitan. These were years 81."

The Book of Chilan Balam of Tizimin begins thus, changing the translation as I have done above:

"**8 Ahau, 6 Ahau, 4 Ahau, 2 Ahau,** fourscore years and one year to Tun 1 of **13 Ahau.**"[2]

Beltran says that "katun" was used as meaning "always, forever," and that **kinkatun** was a "century" or "a very long time."[3] Landa says that the Mayas raised a stone every twenty years.[4] Dr. Förstemann says, "The katun has also been supposed to be 24 × 365 = 8760 days long (and I held this view for a long time), indeed the long period of 52 × 365 = 18,980 is also used occasionally, designated with the word."[5] He gives no authority to support these opinions.

I think that we can dismiss without further discussion the theories that the katun denoted the periods of four, thirteen, or fifty-two years. The weight of the authority of the inscriptions, codices, and the Books of Chilan Balam are all against them. Even if this were not the case, it would be sufficient to say in reply that if the

[1] Brinton, 1882, p. 100. With certain corrections of translation.

[2] Ibid. p. 144.

[3] "*Katun*, Para siempre. *Kinkatun* es el siglo ó tiempo largo." (Beltran, 1859, p. 177.)

[4] "Acostumbravan erigir de XX en XX años que es el numero que tienen de contar sus edades, una piedra." (Landa, 1864, p. 52.)

[5] "Man hat auch (und ich bin darin eine Zeitlang gefolgt) den Katun für 24 × 365 = 8760 Tage angenommen, ja es ist mit dem Worte zuweilen auch die grosse Periode von 52 × 365 = 18,980 Tagen bezeichnet." (Förstemann, 1904, p. 138.)

katun designated four years, the numbers of the days **Ahau** with which the katuns end would run as follows: 13, 4, 8, 12, 3, 7, etc., and not in the prescribed order, while, if the katun was thirteen or fifty-two years in length, the number of the days **Ahau** would always remain the same.

We are brought back then to the decision that the katun was either twenty or twenty-four years in length. If we take the word "años," which appears in the Books of Chilan Balam, as meaning years of 365 days each, we shall find that the numbers of the days **Ahau** with which the periods of twenty such years end, run as follows: 13, 7, 1, 8, 2, 9, etc. Thus if a katun ends with a day **13 Ahau**, the next katun will end with a day **Ahau** which has a number equal to $13 + 20 \times 365$. $20 \times 365 = 7300$, from which we must subtract all even thirteens leaving a remainder of 7. Counting forward 7 from 13 we reach **7** as the number of the day **Ahau** of the next katun. The following katun will end with the day **Ahau** which has for its number, $7 + 7 = 14$, or, deducting 13, the number **1**, and so on. This is not the prescribed order. If, however, the katun is supposed to consist of 24 years of 365 days each or of 8760 days, we find that after leaving out all even thirteens from 8760, there is a remainder of 11. Counting forward 11 from 13 we reach **11**, which will be the number of the day **Ahau** with which the next katun ends, while by successively adding 11 and deducting all even thirteens the numbers of the days **Ahau** with which the successive katuns end will run in the prescribed order, 13, 11, 9, 7, etc. This would seem to be conclusive were it not that the statement is made so clearly in many of the Books of Chilan Balam that twenty years only were required for the passage of a katun, and that in this the Books of Chilan Balam are supported by Landa and Cogolludo and by the inscriptions and the codices.

Dr. Seler and others have shown that these opposing views are reconciled by the suggestion that the Spanish word "años" was used, not as meaning the period of 365 days but one of 360 days, — the period of time which has been designated by the word "tun." The numbers of the days **Ahau** with which the successive periods of twenty tuns end run in the prescribed order, since $20 \times 360 = 7200$, from which if all even thirteens are deducted the remainder is 11, as is the case where the katun is considered as consisting of 24 years of 365 days each. It is exceedingly probable that the Spaniards, in speaking of this period of 360 days, would use a term which expressed such a period of time as was in their language nearly identical with the one in question, and that the native writers, after learning Spanish, would have done the same thing. This decision is supported and strengthened by the inscriptions and codices, where it is certain that twenty of the third term, denoting 360 days, equal one of the fourth term denoting 7200 days.

We can then be practically certain, in my opinion, that the katun was a period of twenty years of 360 days each or of 7200 days.

One other point is to be considered. This period of twenty years (whether of 360 or 365 days each) has been called by other names.

Beltran gives **Ahau** under the head of "Particulas para contar," and states that the word is used to count the years by twenties and that there were thirteen **Ahaues** which contained 260 years.[1]

Dr. Förstemann gives the name **Ahau** to the period of 7200 days. Such a designation would seem on first glance to be supported by the Books of Chilan Balam where the different katuns are distinguished by the days **Ahau**, thus: "**8 Ahau, 6 Ahau, 4 Ahau, 2 Ahau**, fourscore years and one year to Tun 1 of **13 Ahau**."[2] A careful reading, however, will show that these are the designations of particular katuns and not a generic name for the period of 7200 days. This is often so stated in exact terms, thus: "**4 Ahau** was the name of the katun."[3] "**11 Ahau** was the name of the katun,"[4] while **Ahau** is never used when speaking of katuns in general. Thus the Book of Chilan Balam of Mani says: "Four katuns had passed." "This is the arrangement of the katuns."[5]

Ahau not the same as Katun. — **Ahau**, then, was not a synonym of katun, but, with its number, differentiated one katun from another. Moreover, it is difficult to conceive that a nation as intelligent as

[1] "Para cuenta de veintenas de años en calendarios de los indios yucatecos, lo mismo que las indicciones nuestras, pero de mas años que estas, eran trece *ahaues* que contenian 260 años que era para ellos un siglo." (Beltran, 1859, p. 204.)

[2] Brinton, 1882, p. 144.

[3] Ibid. pp. 178, 180.

[4] Ibid. pp. 179, 181. (Wrongly translated by Dr. Brinton.)

[5] Ibid. pp. 95, 100. See also Bowditch, 1906a.

the Mayas should adopt the same name for a particular day and for a period of 7200 days, with all the chance for error which would inevitably arise from such use. If they had done so it would be natural to find a constant use of the day sign **Ahau** for the period of 7200 days, but, as far as I know, not a single instance of this occurs on the monuments or in the codices. Landa confirms the view which I have expressed in regard to the meaning of **Ahau**, since he says [1] clearly that the Mayas counted the passage of time by periods of twenty years, counting thirteen twenties with one of their letters called **Ahau**, without order, but retrograding, as shown by the wheel of which he gives a drawing, and that these periods were called katuns. The order of **Ahaus** with which they named the katuns he gives as follows: 13, 11, 9, 7, 5, 3, 1, 12, 10, 8, 6, 4, 2.

Perez attempts to reconcile the differences of opinion in regard to this period by saying that the period of twenty-four years was called **Ahau-Katun** and that this period was divided into two parts, — one of twenty years and the other of four years which served as a pedestal or support of the first part.[2] I can find no authority for this opinion or for the use of the word **Ahau-Katun** as meaning the period of twenty-four years. This mistaken use of the term has probably arisen from the fact that the Books of Chilan Balam speak of a katun as "Katun **6 Ahau**" or as "**6 Ahau** Katun," the name "**6 Ahau**" being in both cases the designation of a particular katun of 7200 days.

The word katun may be a contraction of **kal-tun, kal** meaning "twenty" in Maya. Others have thought that it was a contraction of **Cay-tun, cay** being a name for "fish" in Maya. This view is supported by the fact that a fish is sometimes carved as a portion of that part of the Initial glyph which resembles the katun.

1 "No solo tenian los indios cuenta en el año y meses, como queda dicho, y señalado atras pero tenian cierto modo de contar los tiempos y los cosas por edades, las quales hazian de veynte de veynte años, contando XIII veyntes con una de las XX letras de los meses que llaman *Ahau*, sin orden sino retruecanados como pareceran en la siguiente raya redonda; llaman les a estos en su lengua *Katunes*." (Landa, 1864, p. 312.)

2 "Cada periodo ó Ahau-Katun se dividia en dos partes; una de 20 años que era incluida en la rueda ó cuadro, por lo que los llamaban *amaytum*, *lamaitun* ó *lamaitè* y la otra de 4 años y la significaban como pedestal de la anterior, y la titulaban *chek-oc-katun* ó *lath-oc-katun*, que todo quiere decir pedestal. A estos cuatro años los consideraban como intercalares y como no existentes creyendolos aciagos." (Perez, 1864, pp. 400, 402.)

Don Juan Martinez y Hernandez writes me as follows: "It (referring to the katun) comes from **kat**, 'to ask for, to question' and **tun**, 'stone.' It was customary to go to a certain place and ask for the stone, so they called it **katun**. The Book of Chilan Balam states that the stone was sent or gone for to Colah Peten, Tijal, Euan and other distant places."

Cycle. — There is no known Maya word for this period of 144,000 days and this name has been applied as a convenient designation for the period.

Grand Cycle. — Neither is there any known Maya word for this period, which is thought by Goodman to consist of thirteen cycles, as it undoubtedly does in the inscriptions, but which in Dr. 61, 62 and 69 surely consists of twenty cycles. This name will, however, suffice till further knowledge is gained on the subject.

APPENDIX IV

UAYEB

PEREZ states that the five days needed in excess of eighteen months of 20 days each in order to make up the year of 365 days were called **Xma Kaba Kin** (days without name) or **Uayab Haab** or **Nayeb Haab** (chamber, cell, or apartment of the year), either supposing that the year took its rest in these days or that the next year came out of them as from a room. He says that they were also called **U Yail Kin** or **U Yail Haab**, the unfortunate days,[1] from the belief that during these days sudden deaths or accidents of all kinds were likely to occur.[2]

The use of the "n" in **Nayab** is probably an error for "u."

The five days which were needed to form the year, in addition to the 18 months of 20 days each, have been a source of misunderstanding in both the Maya and the Mexican calendars. Landa gives them names, but places no numbers with them. Perez says distinctly that they were called "unnamed" because they formed part of no month. It is perfectly certain that if they had no names, there would be no succession of what Landa called the dominical or beginning days of the Maya year, — **Kan, Muluc, Ix** and **Cauac**. It is easily seen that if the year began with **Kan**, the 360th day would

[1] Dr. A. M. Tozzer translates these words, "the year its misfortune" or freely "the year's misfortune."

[2] "El año constaba segun se ha dicho de diez y ocho meses y estos de veinte dias y como solo resultaba de todos ellos 360, para completar los 365 que debe tener, le agregaron cinco dias mas, que llamaron innominados ó sin nombre, por que no hacian parte de mes alguno, y esto quiere decir *xma kaba kin.*

"Tambien los llamaron *uayab* ó *nayeb haab;* mas esta denominacion tiene dos interpretaciones, por que la palabra *nayeb* puede derivarse del nombre *nay* que significa cama, celda ó aposento, presumiendo que los indios creyesen que en ellos descanse el año, ó el siguiente saliese como de un depósito, conjetura que tiene en su apoyo él que en algunos manuscritos se llamase *u ná haab,* madre del año, ó *nayab chab,* cama ó aposento de la creacion. Algunos los llamaban *u yail kin* ó *u yail haab* que se traduce lo doloroso ó trabajoso de los dias ó del año, porque creian que en ellos sobrevenian muertes repentinas, pestes; y que fuesen morbidos por animales ponzonosos ó devorados por las fieras, temiendo que si salian al campo á sus labores se les estacase algun palo, ó les sucediese cualquiera otro genero de desgracia." (Landa, 1864, pp. 382, 384.)

be **Akbal**, and if five unnamed days followed, the 366th day or the first day of the following year would be **Kan** again and not **Muluc**. Moreover, if they were not numbered or named, not only would **Kan** begin all the years and all the months, but the order of numbering the years would be thrown out of gear. Indeed, the discussion of the long numbers of the codices and of the dates of the stone inscriptions, will show that we must take as a fact the assertion of Perez that these days were called **Xma Kaba Kin**, because they formed part of no month, and not because they were not named or numbered.

The Books of Chilan Balam of Mani and Kāua, as copied by Dr. Berendt, expressly say that these days had names, though the meaning of other parts of the extracts from these books is at times rather obscure. These books state that it is to be noted that when the eighteen months are ended, there must be counted after the last day of **Cumhu** the five days of **yai haab** *by their names*, and that on the sixth number falls the **Cuch haab** or year-bearer, **2 Ix**, of the year 1595. It further states that the first day of **Cumhu**, in 1595, was **4 Ix**, and that **3 Cauac** will fall in the year 1596, followed by **4 Kan**.[1]

1 "Hace de notar que en acabandose los 18 meses y vinales despues del postremo dia de Cumku se ahan de contar los cinco dias de una yai haab por sus nombres y al sesto numero cae el cuch haab que entran y suceden como fue esto año de 1595 que fue ah cuch haab ca Hiix, que el primer dia de Cumku del año de 1595 sera can hiix, que cae el 21 de julio del dicho año del postrero dia de poop sera oxil cauac para el dicho año de 1596 y parte del año de 1597 al cual le sucedera caanil kaan succediendo por su orden los ah cuch haaber sin interpolacion de bukxooc, como parece, de maniera que aunque los dichos cinco dias se dicen valdias o ixmakaba, no se entiende en acabando al nombrarlos por sus nombres sino en quanto que no entran por algun uinal ó mes." (Chilan Balam I, pp. 102, 104.)

"Ase de notar que en acabando se los 18 meses y vinales despues del postremo dia de Cumkú se han de contar los cinco dias de una llail hab por sus nombres y al bisexto, numero cae ah cuch hab que entran y suceden como fuere bisesto al año de 796 años que fue ah cuch haab ca ix Kan, que el primer de Cumku, en el año de 1797 años sera oxil Muluc ti xaman que cae 12 de Julio del dicho año del postrero dia del Poop sera can hiix para el dicho año de 1797 y parte del año de 1798 al qual se sucederan hoil uaix hiix sucediendo por su orden los ah cuch habob sin interpolacion de bukxooc como parece pornaera que aunque los dichos cinco dias se dice guardias ò yxxmakabakin, no se entiende en acabando al Nombrarle por sus nombres S. en quanto a que no se quentan por algun uinal ò meses." (Ibid. pp. 103, 105.)

It will be seen that if **2 Ix** is **1 Pop** in any year, **4 Ix** will be **1 Cumhu** in the same year and that **3 Cauac** will be **1 Pop** of the next year, and **4 Kan** will be **1 Pop** of the following year.

APPENDIX V

MEANING OF MONTH NAMES

THE following meanings have been given to the names of the Maya months:[1]

Pop	Mat. (P.)
	Mat woven of leaves is the meaning at the present time. (T.)
	Sign for yellow, — perhaps referring to the color of a mat. (Br.)
	Ground spread with reeds. Mat. Carpet. A marsh plant. (B.)
Uo	Frog. (P.)
	A tadpole. Small frog. **Pitahaya**, a fruit. (B.)
	Uooh is a written character or letter. (Br.)
Zip	There is a tree called **Zipché**. (P.)
	Sip means "the powder of a decayed tree." (T.)
	Fault. Error. Swollen. Plump. (B.)
	From **zipik kin**, the sunset. (Br.)
Zotz, Zoo	Bat. (P.)
or **Tzoz.**	Bat. (B.)
Tzec or	Unknown. (P.)
Zeec	Discourse, or to discourse. (B. quoting Ruz.)
	Censure. Grimace. Chastisement. (B.)
	Scorpion. (Br.)
Xul	End. (P.)
	Xupic, from the same root, means "to exhaust." (T.)
	End. Finishing. Limit. To snatch. (B.)

[1] Abbreviations. (P.) Pio Perez.
(B.) Brasseur de Bourbourg.
(Br.) Daniel G. Brinton.
(S.) Paul Schellhas.
(T.) A. M. Tozzer.

Dzeyaxkin or Yaxkin. Unknown. (P.)

Ɔe means "beginning," "foundation." **Yaxkin** means "sun, or the fresh green of the summer." The whole word would mean "the beginning of summer or the dry season." Season which follows rain. (B.)

New sun or strong sun. (Br.)

Yaxkin means "the first day or the first season," and possibly "the rainy season." (T.)

Mol or Mool To bring together or collect. The claw of a bird. (P.)

Things piled one on the other. Group. Brought together. Union of claws of an animal. To conduct. To lead. (B.)

Mul is from the root meaning "to collect." **Mol** may also be from the same root, as **U** and **O** are often interchangeable. (T.)

Compare **Muluc**, which has a similar form.

Chen or Cheen A well. (P.)

A spring or well of water. (Br.)

Alone. It is the month in which the men go into the woods alone in order to renew the idols. (T.)

Solitary. Alone. A natural well. **Cheen** is the bark of a tree. **Chen** means "source." Fountain with no current. (B.)

Yax Green or blue. First. The beginning of the sun in springtime. (P.)

New. First. Fresh. Green. Vigorous. Robust. Of rapid flight. (B.)

Zac White. (P.)

White. (B.)

White. Its form consists of the sign of the North over the **Cauac** sign and white is the color assigned to the North. (Br.)

Ceh Deer. (P.)

Deer. Wild beast. (B.)

Deer. Flint knife, referring to slaughter of deer. (Br.)

Mac — To choke up. To obstruct. Lid. Cover. Measure. (P.)

This word, with a long sound, means "man," as distinguished from **winik**, which means, in Spanish, *cristiano*. (T.)

A measure of land. To close or cover. Who? Which? (B.)

Cover of a jar. (Br.)

Kankin — The yellow sun, perhaps, because in this month the air is thick with the smoke of the burning brush cleared off for sowing. (P.)

Or because at this season the fields are dry and yellow from the heat of the sun. Red sun. (B.)

Moan or **Muan** — The clouded day, with chance of occasional showers. (P.)

The sign is like the head of a bird which seems to be the *Ara*. This is **Mo** or **Moo** in Maya. (B.)

Pax — Instrument of music. (P.)

To play an instrument. To break. (B.)

Pax che means "a drum." (Br.)

A drum. (T.)

Kayab — Song. (P.)

From **Ak** or **A**, meaning "a turtle." (Br.)

Cumhu or **Cumku** — Strong explosion, like a cannon heard from a distance. Or the sound produced by the marsh lands cracking as they grow dry. The thunder in squalls. **Hum-ku** means "the sound of God." (P.)

Explosion. Thunder. Noise of storm. The vase of God. The Mayas personified the storm or hurricane. (B.)

Rebus for **cum kan**. (Br.)

Uayeb **Uayab** or **Uayeyab** — The bed or the repose of the year. (B.)

APPENDIX VI

METHODS OF MARKING THE PASSAGE OF TIME

THE question of the method used by the Mayas in counting their time periods has been much discussed. In such a discussion it is very important to remove from our minds all prejudice in favor of our own methods, so that we may judge the methods of the Mayas entirely from what we gather from the records of the Mayas themselves and from their chroniclers.

Our Methods of Counting Time. — Our own methods of counting time are inconsistent with each other. Thus with our hours, minutes and seconds we reckon by elapsed time. The hour between 12 and 1 o'clock is not called the first hour, but it is 12 o'clock until one hour has been completed; the hour from 1 to 2 is not the second hour, but it is 1 o'clock until two hours have been completed. And in the same way with all the hours, minutes and seconds. That is, at any time of the day we say that so many hours, minutes and seconds have passed since the beginning of the day or half-day, while astronomers reckon time from 0 hours through the whole twenty-four hours.

But when we come to days, years and centuries we change our method. It is the first day of the month as soon as 12 o'clock midnight of the last day of the preceding month has been reached, and it is the twentieth century as soon as 12 o'clock midnight of the last day of 1900 has been reached. It is to be noted that in these cases we use the ordinal numerals, — the *first* day of the month, the *twentieth* century. But when we count the years, although we use the same method of naming them as in the case of the days of the month and of centuries, — calling the year 1901 as soon as 12 o'clock midnight of the last day of the year 1900 has been reached, yet we use the cardinal number 1901 and not the ordinal nineteen hundred and first.

Thus we have three methods in use in counting our time periods, to which should be added a fourth, when we give a name to each current day of the week.

Long Count records Elapsed Time. — To turn now to the Mayas, it is very generally agreed that the distance numbers and the "long count," so-called, represent time which has elapsed and not time which is passing, or current time. Thus on PQ10 of the Temple of the Cross at Palenque,[1] we have the date **11 Lamat 6 Xul**⑨, and on PQ12 we find the distance number 13.3.9., or 4749 days. If now we count forward 4749 days, or, in other words, allow that time to elapse, we reach **2 Caban 10 Xul**㉒, which we find on PQ14, from which, if we again count 6.3., or 123 days of P15, we reach **8 Ahau 13 Ceh**㉒ of Q17 R1, which is declared by S1 R2 to be the end of Cycle 9. Goodman's Tables show that 9.0.0.0.0. is **8 Ahau 13 Ceh**㉒, that is, the lapse of 9 cycles from **4 Ahau 8 Cumhu**⑦ brings us to **8 Ahau 13 Ceh**㉒.

Here the 13.3.9. does not mean that the thirteenth tun is passing after 12 whole tuns have passed, nor do the 3 and 9 mean that the third uinal and ninth kin are passing after 2 whole uinals and 8 whole kins have passed. If this were the meaning it would be the same as saying that 12.2.8. days have passed; but this number counted forward from **11 Lamat 6 Xul**⑨ would bring us to **11 Cib 14 Tzec**㉑, and not to **2 Caban 10 Xul**㉒ as given in the inscription. The meaning must therefore be that 13 uinals, 3 tuns and 9 kins have actually elapsed.

Further, the Initial series of the inscriptions reach the date given at the end of the series by counting forward the number stated by the series from a date far in the past, — **4 Ahau 8 Cumhu**⑦; and this date is given several times in the inscriptions and very much oftener in the Dresden codex than are the other dates. Thus on Dr. 61–70 this date is surely recorded at least ten times. There is every reason to suppose that these larger numbers have the same function as the smaller ones, and that they count the distance from one date to another by recording the number of days which have actually passed. And even if this were not to be so inferred, it is shown as a fact not only in the Initial series but also in the black number of serpent A of Dr. 62, where we reach **13 Akbal 1 Kankin**㉕ at the bottom of the page by counting forward the long number given in this place, 4.6.9.15.12.19.,

[1] This anticipates the later discussion of the inscription dates, but as the subject of the marking of the passage of time has already arisen, I have thought it best to discuss the matter here.

from **9 Kan 12 Kayab**⑮, the date given at the top of the column. This result would not be obtained if the long number meant that current time, and not that time passed, was recorded; i.e., that the time actually passed was 3.5.8.14.11.18. And other similar instances could be given.

So in the Dresden codex, page 48, if we count forward from **17 Yaxkin** (the second date of the last row of month dates) the red distance number 12.10., or 250, given below, we reach the next following month date, **2 Uo**. Here the 12 does not mean that the twelfth uinal is passing and that eleven whole uinals have passed, nor does the 10 have a like meaning. If such were the case, the actual time which had passed would be 11.9., and the day reached would be **1 Pop**, and not **2 Uo**, as given.

I think that it may be considered as settled that the Initial series and all the cycle, katun, tun, uinal and kin numbers contained therein record time that has actually elapsed. Can the same thing be said of the dates of the 52-year period? Does, for instance, **8 Ahau 13 Ceh**㉒, which is 9.0.0.0.0. in the long count, record a day which is passing or one that has passed?

Maya Method of Numbering Month-days, which also record Elapsed Time. — This brings us to the consideration of the question of how the Mayas numbered the month-days. I have discussed this question in a pamphlet entitled "Was the Beginning of the Maya Month numbered Zero (or Twenty) or One?"[1] Without going into the detail there set forth, I will merely say that in three cases on Dr. 46–50 a number is given, which, if counted forward from the previous date, would reach a month-day with the number 20, if the days of the month were numbered from 1 to 20, but would reach a day of the next following month if the last numbered day of a month received the number 19.

Taking up one of these cases, we find on Dr. 48, 3.14., **12 Chen**, to which if we add 8 days, the fourth red number below, we should reach **20 Chen**, on 48.4.14., if the month numbers run from 1 to 20. We find attached to the month sign a prefix, which is unlike any number which we have previously met with, but which is undoubtedly a number, since in all cases we find a number attached to a month sign. (See Plate XVII, TWENTY or ZERO, No. 8.)

[1] Bowditch, 1901.

We should naturally call it 20 if the month sign were **Chen**. But the month sign is not **Chen**, but is **Yax**, the month next following **Chen**. This would seem to show that no number higher than 19 was attached to the month sign, and that when **19 Chen** appeared, the meaning would be that 19 days of the given month had elapsed and were completed. It would also show that the next day after **19 Chen** was not numbered **20 Chen**, meaning that 20 days of **Chen** had been completed, but was recognized as some day of the following month **Yax**, with a number which we have not met with before. This number is certainly none of the numbers 1 to 19, and, as it is not **20 Chen** nor **1 Yax**, it would naturally be a day of the month **Yax** preceding **1 Yax**. The only numeral preceding 1 is zero, and it would seem as if **0 Yax** was what is here meant. In speaking of what we should in our method call the first day of **Yax**, the Mayas may have said, "the 20 days of **Chen** have passed; **Yax** has come, but no days **of Yax** have been completed." If the above reasoning is correct, it would show that the numbers which the Mayas attached to their months ran from 0 to 19, and this affords strong evidence that the month-days, as well as the long count, were reckoned by elapsed time. In the same way, in the date 9.0.0.0.0., **8 Ahau 13 Ceh**(22), we may suppose the Mayas as saying, "Nine cycles have elapsed from our great epoch **4 Ahau 8 Cumhu**(7), and thirteen days of the month **Ceh** have also passed."

Two other cases in Dresden 46–50 support this view, but the fourth case is against it. On Dr. 49, **9 Mac** is the last date in the third row of months, while the first red number on Dr. 50, if counted forward from **9 Mac**, would bring us to **0 Yaxkin** if the month numbers run from 0 to 19, but to **20 Xul** if the month numbers run from 1 to 20. The month given is **Xul**, with a form attached similar to that which appears with the months in the other three cases. It is true that if the record refers to elapsed time, it makes no difference whether we say that twenty days of the month **Xul** have passed, or that no days of the month **Yaxkin** have passed, but the method of stating the fact is different from that which we find used in the other three cases. The former method states clearly that the month **Xul** has passed away, and the latter states that the month **Yaxkin** has come in, but that no days have been completed. The same day is reached in either case. Is it possible that the zero form has a double meaning, or was the month form of **Xul** written here in error?

In the inscriptions there are also four cases which bear on the point under discussion. Three out of the four cases are in favor of the contention that the month-days were numbered from 0 to 19. The fourth case can only be explained by the assumption that the wrong month was carved on the stone, or that the days of the month were numbered from 1 to 20.

The strongest proof, however, that the month-days were numbered from 0 to 19 is found on an inscription in Tikal (Vol. III, Plate 74 of Maudslay).[1] Here, by counting 2.11.12. found on B2 A3 forward from **3 Ahau 3 Mol**⑯ of AB1, we reach **6 Eb 0 Pop**⑲, if the numbering of the month-days runs from 0 to 19, but we reach **5 Uayeb** if the numbering is from 1 to 20. **5 Uayeb** is not found, however, but **6 Eb 0 Pop**⑲ appears on B3 A4. The form for zero is rather different from other zero forms of the inscriptions (Plate XVII, TWENTY or ZERO, No. 7), but it has the double curve found in the zeros of the codices. Moreover, it is surely none of the numbers 1 to 19, and it would seem that it must be either 0 or 20. But the last day of the previous month could not have had the number 20 attached to it, since the month was **Uayeb**, which consists of 5 days. Is it not a fair inference that the number is zero? Moreover, the case is made clear when we find in B7 A8 the date **7 Ben 1 Pop**⑲, the very next day after **6 Eb 0 Pop**⑲, and in A7 the dot, meaning 1, with a sign which is probably a kin sign. The two month forms are surely the same, and there can be no doubt that a day is recorded in the month **Pop** which is one day before **1 Pop**. This can be nothing else than **0 Pop**. Besides this one, there are three other cases where the date **0 Pop** is recorded, — a date which was the beginning of the new year, and well worth recording as the season of festivals and rejoicing.

Dr. Seler is of the opinion that these signs which I read zero mean "the evening before";[2] but this suggestion of his is not supported, in my opinion, by the codices or inscriptions or by the Spanish authorities.

[1] The drawing on this plate shows the number 4 attached to the tun sign; but reference to the photogravure on Plate 12 of the "Compte-rendu d'une mission scientifique en Espagne et en Portugal" par Léon de Rosny, Paris, 1882, shows that the number is 2.

[2] Seler, 1902, Vol. I, pp. 856, *et seq.*

Goodman contends that these signs mean 20 but refer to the first day of the month in exactly the same way as if zero were used. That is, he considers that the Mayas numbered the beginning days of their months with 20, following the 20 with 1, 2, 3, etc., up to 19. He supports his view by insisting that they used the number 20 in this way to show that 20 days of the previous month had passed; but this is not so where we find **0 Pop**, since only five days of **Uayeb** had just passed, and here, therefore, by Goodman's own argument, the sign which we are discussing should be considered the equivalent of 5.

I think, therefore, that, taking everything into consideration, we may safely decide that both the long count and the month count recorded elapsed time, and that when the Mayas recorded the date **3 Ahau 3 Mol**⑯ on the Tikal tablet after the passage of 10.0.15.8.0. kins or days (which I believe to be the date), and counted forward 2.11.12. to **6 Eb 0 Pop**⑲, they declared that, now that this number of days had passed, they had finished the old year, and that **Pop** had arrived, but that no days had been completed of this month, — that, in fact, it was the beginning of the new year.[1]

Days with their Numbers may record Elapsed Time. — What shall then be said of the day **6 Eb** and of similar days with their numbers which are found connected with the month-days? Were these names given to the passing day as we give the week-day names to our week days? Or was the record here also of an elapsed day? It is difficult to decide. One thing is very clear, and that is that the number attached to the day forms part of the name of the day itself. This number is apparently added to distinguish one day from another in the Tonalamatl and elsewhere. Landa,[2] however, states that the Mayas began their calendar, though not their year, with **Ymix**, in connection with the computation of cycles. In the date, therefore, 9.0.0.0.0., **8 Ahau 13 Ceh**㉒, where we have already decided that the count 9.0.0.0.0. and the month date **13 Ceh** refer to time that has elapsed, it would also be natural that the

[1] Dr. Förstemann seems to have held this opinion since he says, " The new year's day is not the first but the zero day. It is not counted." Bulletin No. 28, p. 456.

[2] " Usavan tambien deste modo de contar para sacar destas letras cierto modo de contar que tenian para las edades y otras cosas que aunque son para ellos curiosas, no nos hazen aqui mucho al proposito; y por esso se quedaran con dezir que el caracter o letra de que començava su cuenta de los dias o kalendario, se llama *Hun-Ymix* y es este el qual no tiene dia cierto ni señalado en que caiga." (Landa, 1864, pp. 234, 236.)

day **8 Ahau** should also refer to elapsed time; that is, that the day **8 Ahau** should be the last of the cycle which is declared to be finished, and that the Mayas should say, "Nine cycles have elapsed, and with them the day **8 Ahau** has also passed as well as thirteen days of the month **Ceh**." This method of reckoning makes **Ahau** the last day of the cycle and brings **Ymix** as the first day of the succeeding cycle, thus supporting the statement of Landa.

I am therefore of the opinion that the day with its number referred to elapsed time, and that when the question arose as to what day it was, the answer would be in the case of the Tikal date, "10.0.18.1.12. kins have passed since our epoch date of **4 Ahau 8 Cumhu**⑦, and **6 Eb** has also passed. The year has ended, and **Pop** has come, but no days in **Pop** have been completed."

If it be contended that by this method the current day had no name and that their yesterday was all that they referred to, it may be remarked that there would be no inconvenience in this, since we do exactly the same thing in marking the time of day. When one is asked what time it is, the reply takes cognizance only of passed time. "Twenty minutes past one" is not the name of the passing minute, but is merely a record that one hour and twenty minutes have elapsed since noon or midnight.

APPENDIX VII

METHODS OF CALCULATING TIME

In considering the methods of making the calculations which are indicated in the Maya codices and inscriptions, — that is, in calculating what day of the calendar round will be reached in a given number of days from some other day of the same or another calendar round either before or after the former, — the following facts must be borne in mind:

1. The day series of 20 days is continuous and is repeated over and over again in the calendar round.

2. The day number series from 1 to 13 is repeated over and over again, 1 following 13 when a series is finished.

3. The month series of 18 months and the 5 days of **Uayeb**, or 365 days in all, are repeated over and over again, **Pop** following **Uayeb** when a year is completed.

The following rules for making the calculations required may be deduced from the above facts:

1. To find the day, divide the whole number of days by 20 and count forward or backward the remainder from the day of the zero point. As all the time periods of the Maya notation, except the kin, are divisible by 20 without a remainder, this rule may be stated thus: Count forward or backward from the day of the zero point a number of days equal to the kin number.

2. To find the day number, divide the whole number of days by 13 and add the remainder to the day number of the zero point, deducting all thirteens until the final remainder is 13 or less.

3. To find the month-day, divide the whole number of days by 365 and count forward the remainder from the month-day of the zero point.

Dr. Förstemann's Method of Calculation. — The method of calculation which both Dr. Förstemann and Dr. Seler have adopted is accurate, as one would be sure that it would be if used by these writers, but it is very cumbersome. They take a long number like 9.9.9.16.0., and turn each figure into our decimal values thus:

9 ×	144,000 =	1,296,000	days
9 ×	7,200 =	64,800	"
9 ×	360 =	3,240	"
16 ×	20 =	320	"
0 ×	1 =	0	"
	Total	1,364,360	days

As we have found on Dr. 24, **4 Ahau 8 Cumhu**⑦ in the past is the zero point from which this date is counted in order to reach **1 Ahau 18 Kayab**①. The day number of **1 Ahau** would therefore be reached by adding to the **4** of **4 Ahau** the number 1,364,360, after taking out all the thirteens in it. This large number equals 13 × 104,950 + 10. Adding 10 to 4 and subtracting 13, we find that the remainder is 1. **1** then is the day number reached. As **Ahau** is the day counted from, the day reached must be **Ahau** also, for it is easy to see that 1,364,360 is divisible by 20 without a remainder and **Ahau** returns every 20th day. The month date depends on what remainder is left after dividing the long number by 365, for **8 Cumhu** will return (provided no allowance is made for leap years) after every 365 days. Now 1,364,360 = 365 × 3737 + 355. Therefore by counting forward 355 days from **8 Cumhu** we shall reach the month-day which we are seeking. There are seventeen days left in the year after **8 Cumhu**. Deducting this from 355 we find that there are left 338 days to be counted forward in the following year. This will use the whole of sixteen months of 20 days each, and will reach day **18** of the 17th month, which is **Kayab**. We thus prove that this number of days, counted forward from **4 Ahau 8 Cumhu**⑦, will reach **1 Ahau 18 Kayab**①.

Goodman's Tables. — Goodman's tables offer an easy means of calculating time in the Maya calendar. They are of three kinds; but the first of these, called "Perpetual Chronological Calendar," is not very often of use. The other two are, however, of the greatest assistance to the student of the Maya calendar and of Maya numeration.

Of these the "Archaic Annual Calendar" consists of a continuous arrangement of the twenty days with their numbers in a long series of 18,980 days, or 52 years. This period is separated into 52 single years which have for their beginning days the days **Ik**, **Manik**, **Eb** and **Caban**, instead of **Kan**, **Muluc**, **Ix** and **Cauac**, as described by Landa. This, however, does not prevent the accurate use of the tables, since the whole is but a series of days returning into itself, and thus it is not only very easy, but also very accurate, to calculate the distance of one day from another by using these tables.

Thus if it is desired to find the distance from **3 Ahau 18 Yaxkin** to **6 Ben 1 Kayab**, we look in the Archaic Annual Calendar and find that **3 Ahau 18 Yaxkin** is found in the 21st year and **6 Ben 1 Kayab** appears in the 23d year. We then count forward from **18 Yaxkin** of the 21st year to **18 Yaxkin** of the 23d year, this distance being, of course, just two years, or 730 days. We then count forward as large a number of full uinals as possible without reaching the day sought, and reach **18 Pax**, which is 9 uinals from **18 Yaxkin**, or 180 days. Again counting forward three days from **18 Pax** we reach **6 Ben 1 Kayab**㉓. The distance sought is then 730 + 180 + 3 = 913 days, or, in the Maya notation, 2.9.13. As the same month-day with the same day and number reappears after the lapse of a calendar round, or 52 years, this distance of 913 days may be increased by one or more calendar rounds.

The problem may also be solved by counting up the tuns, uinals and kins, thus: from **3 Ahau 18 Yaxkin** of the 21st year to **12 Ahau 13 Yaxkin** of the 22d year is just 1 tun, and to **8 Ahau 8 Yaxkin** of the 23d year is another tun. To **6 Ahau 8 Pax** we count 9 uinals, and to **6 Ben 1 Kayab**㉓ is 13 kins, giving, as before 2.9.13.

The third of the tables is called the "Archaic Chronological Calendar,"[1] and when the zero point is **4 Ahau 8 Zotz**㉗, **4 Ahau 8 Cumhu**⑦ or **4 Ahau 3 Kankin**㊵, it affords a very easy method of ascertaining the date reached after a large number of days, the number consisting of five places. Thus taking the former number, 9.9.9.16.0., if we know or have a good reason to suppose that

[1] Goodman's notation of the Maya number is peculiar. The sign which is usually called zero is called by him 20, when found with the katun, tun and kin period forms, and 18, when found with the uinal form. Thus 9.15.0.0.0. is written by him thus: 9.15.20. 18 × 20. He means by this that a complete series of the tun, uinal and kin periods has elapsed, since in all his calculations he treats the 20 and 18 as if they were zeros.

the zero point is **4 Ahau 8 Cumhu**⑦ (and the dates in which this is the case are so numerous, that we are justified in considering this to be true in most cases), we turn to what Goodman calls the 54th Grand Cycle, and under the heading of 9th Cycle we pass along the head of the page till we reach the column which has 9 over it, meaning Katun 9. Then following down the column of figures which appear on the left, right and middle of each page, till we find the number 9 (meaning Tun 9), opposite this 9 we find the date **6 Ahau 18 Pop**①. This means that **6 Ahau 18 Pop**① is distant 9 cycles, 9 katuns, 9 tuns from **4 Ahau 8 Cumhu**⑦, or, as expressed in the Maya notation, 9.9.9.0.0. The Archaic Chronological Calendar goes no further than this, but as our number is 9.9.9.16.0., we have not yet solved our problem and we must count 16 uinals more. Turning to Goodman's Archaic Annual Calendar, we seek the date **6 Ahau 18 Pop**①. We find this on the page which Goodman has assigned to what he calls the 1st year. Counting forward 16 uinals or 16 full columns to the right we reach the date **1 Ahau 18 Kayab**① as before. If the long number includes a number of kins, just so many additional days must be counted forward from the date already obtained. Thus if the long number given above had been 9.9.9.16.12., we should count forward 12 days from the date **1 Ahau 18 Kayab**①, already obtained with 9.9.9.16.0., thus reaching **13 Eb 10 Cumhu**①. This method is a great advance over that employed by Förstemann and Seler, inasmuch as it is far simpler, and therefore less liable to error, besides saving a great deal of time in the calculation.[1]

[1] In seeking any date in the Archaic Annual Calendar, it will be noted that **Ahau**, as day 18 of a month, is found in the 1st, 5th, 9th, etc. years; as day 13 of a month, is found in the 2d, 6th, 10th, etc. years; as day 8 of a month, is found in the 3d, 7th, 11th, etc. years, and as day 3 of a month, is found in the 4th, 8th, 12th, etc. years. And so with the others of the named days. The numbers attached to the day which marks the same month-day in the different years will also vary by one in each year, and by four in each fourth year, when the **Ahau** or other named day reappears on a given month-day. If **6 Ahau** is the day **18 Pop** in the 1st year, **7 Chicchan** will be the day **18 Pop** in the second year, **8 Oc** in the third year, **9 Men** in the fourth year, **10 Ahau** in the fifth year, and so on. If then **6 Ahau 18 Pop** is sought in the Archaic Annual Calendar, it will be found in one of the years 1, 5, 9, etc. In the 13th year, for instance, the month-day **18 Pop** is found in connection with the day **5 Ahau**. Is it necessary to look for **6 Ahau 18 Pop** in the following or preceding years? As the day **Ahau** will appear with the month-day **18 Pop** every fourth year following or preceding the 13th year, and as the number attached to the day **Ahau** will increase by four every fourth year if we count forward, and decrease by

Goodman's Archaic Chronological Calendar cannot be easily used except for counting from dates which have for their zero point the three dates which have been given above. For dates with other zero points the Archaic Annual Calendar can be used, but only after reducing the given number below 2.12.13.0. = 18,980 days or one calendar round, by substracting all even calendar rounds from it.

Thus if we have to count forward from **9 Kan 12 Kayab**⑮ the number	9.9.9.16.6.
we should have to subtract from this number 71 calendar rounds (see Table XI) or	9.7.3.5.0.
leaving	2.6.11.6.

Then in order to find the day number we should use the Förstemann method and turn the katuns, tuns, etc. into our own system of numeration. In this way we should have 2 × 7200 + 6 × 360 + 11 × 20 + 6 = 16,786. This is divisible by 13 with 3 for a remainder. Adding 3 to the **9** of **9 Kan**, we obtain **12** as the day number. The day will be obtained by subtracting all even twenties from the long number and counting forward the remainder. All the time periods except the kin are divisible by 20 without a remainder. It therefore follows that the kin period shows the number of days which must be counted forward in order to reach the day sought. Counting forward 6 days from **Kan** brings us to **Oc.** The day is therefore **12 Oc.**

To find the month-day we must subtract all even years from the number 2.6.11.6. 365 days are in Maya 1.0.5. Subtracting 45 years, equal to 16,425 days, or 2.5.11.5., from 2.6.11.6., there are left 1.0.1., or 361 days. This sum of 1 tun and 1 kin, if counted forward from **12 Kayab**, brings us to **8 Kayab**, the whole date being **12 Oc 8 Kayab**⑨.

four every fourth year if we count backward, we know that by going forward twelve years the number of the **Ahau** will be 5 + 12 = 17, or subtracting 13, **4 Ahau** and for the same reason by counting back twelve years this number will be 5 + 13 = 18 − 12 = **6 Ahau**, the latter being the day and number sought for. In general, then, if we find the month-day in any year connected with the right day, but with a day number different from that which is sought for, the right year can easily be reached by remembering that in 12 years forward a number 1 lower will be found attached to the day, and in 24 years forward a number 2 lower will be found. In counting 12 or 24 years back the numbers attached to the day will be 1 or 2 higher than the number started with. By remembering this regularity it will be an easy matter to find in the Archaic Annual Calendar the day which is sought for.

In such a case as this it will often be more simple to count backward than forward. Thus 1.0.1., or 361 days, is 1 year less 4 days. We can then, instead of counting forward 361 days, count backward 4 days, and by so doing we shall reach **8 Kayab** as before. This will always bring the same result as far as the month-day is concerned, but of course would not bring the same result with the days or the day numbers.

My Method of Calculation. — While both these methods are accurate and while I use Goodman's Tables constantly, especially for proving the results of my own method, I very much prefer my method for general purposes.[1] It is applicable to all time distances expressed in the Maya method and can be used in counting forward or backward from any zero point.

My method is this: Taking the zero point as before, **9 Kan 12 Kayab**⑮, and the number	9.9.9.16.6.
the first step is to deduct all even calendar rounds, using Table XI.	
In this case 71 calendar rounds can be deducted or	9.7.3. 5.0.
leaving as has been seen	2.6.11.6.

Then, to get the day number, we multiply the katun number by 2 ($2 \times 2 = 4$) and the tun number by 4 ($4 \times 6 = 24$), add the two products together ($4 + 24 = 28$) and give the sum the minus sign, thus — 28.

Then multiply the uinal number by 7 ($7 \times 11 = 77$), add the kin number (6) and give the sum the plus sign, thus	+ 83
add these two numbers together, giving the sum the proper sign, thus	+ 55
and after subtracting all thirteens or	52
count the remainder	+ 3
forward from the day number of the zero point, as the sign is plus.	$9 + 3 = 12$

which is the day number which we are seeking. If the sign had been minus we should have subtracted 3 from the day number of the zero point.

The day will depend on the kin number. If this number is zero, the day will be the same as that of the zero point, while if the

[1] For a full explanation of why this method produces correct results, see Bowditch, 1901a, and also note at the end of this Appendix.

kin number is 1, 2, 3, etc., the day sought will be 1, 2, 3, etc., in advance of that of the zero point. In the present case we use a table in which, as the day of the zero point is **Kan**, **Chicchan** will represent 1, **Cimi** will represent 2, etc. As the kin number is 6 the day will be **Oc**.

In order to find the month-day we multiply the katun number by 100 and the tun number by 5, and add the products together with the minus sign. Thus 2 × 100 = 200 and 6 × 5 = 30. 200 + 30 = 230, or — 230.

Then multiply the uinal number by 20, add the kin number and give the sum the plus sign. Thus 11 × 20 + 6 = + 226

The sum of these numbers is — 4

and we must count forward or backward from the month-day of the zero point according as the sign is plus or minus. In this case we count 4 days backward from **12 Kayab**, which brings us to **8 Kayab**, giving the date **12 Oc 8 Kayab**(9) as before.

I take another example at random. Suppose we wish to find what date will be reached by counting 8.17.11.14.13. from **9 Caban 10 Xul**(42).

Förstemann and Seler would calculate thus:

8 ×	144,000	=	1,152,000
17 ×	7,200	=	122,400
11 ×	360	=	3,960
14 ×	20	=	280
13 ×	1	=	13
Total			1,278,653

Divide this by 13 and it gives 98,357 with 12 as a remainder. Add 12 to **9** of **9 Caban** and we have 21. Subtracting 13 we have 8 left. **8** therefore is the day number of the date sought.

As the kin number is 13 we must count forward in the day list 13 days from **Caban**, which gives us **Oc**. **8 Oc** is the day sought.

To get the month-day we divide 1,278,653 by 365 and find the quotient of 3503 with a remainder of 58. Counting forward 58 days from **10 Xul** we reach **8 Chen**. The date which we are seeking is then **8 Oc 8 Chen**(9).

With Goodman's Tables we cannot use the Archaic Chrono-

logical Calendar, since the zero point is not one of the three dates already given. We must put down the whole number 8.17.11.14.13.
and using Table XI we find that the largest number of calendar rounds in this is 67, which gives 8.16.12. 7. 0.

This being deducted leaves 19. 7.13.
This being reduced to our system of notation gives 19 × 360 + 7 × 20 + 13 × 1 = 6993. This divided by 13 gives 537 with 12 for a remainder. 12 added to 9 as before brings **8** as the day number. The day is reached as before. Dividing 6993 by 365 gives 19 with a remainder of 58. Counting forward 58 days from **10 Xul** brings **8 Chen** as before.

My method would be as follows:

Writing down the Maya number, we have 8.17.11.14.13.
and deducting by Table XI all whole calendar rounds (67 in this case) 8.16.12. 7. 0.

we have left 19. 7.13.
Multiplying 19 by 4 with a minus sign to the product gives us − 76
Multiplying 7 by 7 and adding 13 with a plus sign gives us + 62.

The sum is − 14
or omitting thirteens, − 1. As we find the minus sign we must deduct **1** from the **9** of **9 Caban**, giving **8** as the day number as before.

The day is found as in the other methods, giving **Oc.**

For the month-day, multiply 19 by 5, giving it the minus sign − 95
7 × 20 = 140 + 13 = (with the plus sign), + 153

The sum is, with the plus sign, + 58
which, counted forward from **10 Xul**, gives **8 Chen** as before.

This same method can be used for counting backward by reversing the signs.

An additional advantage in the use of my method is that it tends to lead the student to use the Maya numeration as his own. To be able to think in the lines of the race whose customs one is studying cannot fail to be advantageous.

It is often useful to make a calculation by one of the foregoing methods and to prove its correctness by another. Thus we have found from Goodman's Tables that the distance from **3 Ahau 18 Yaxkin**(21) to **6 Ben 1 Kayab**(23) is 913 days, or 2.9.13. To prove that this calculation is correct, we can use the Förstemann method. To obtain the day we divide 913 by 20 and find the remainder to be 13. We then count 13 days forward from **Ahau** and reach **Ben.** To obtain the day number we divide 913 by 13 and find the remainder to be 3. Adding 3 to the **3** of **3 Ahau** we find **6** to be the day number. To obtain the month-day we divide 913 by 365 and find a remainder of 183. By counting forward 183 days from **18 Yaxkin** we reach **1 Kayab**, thus proving the correctness of the original calculation.

This can also be proved by my method as follows, using the same number, 2.9.13. To find the day we count 13 days forward from **Ahau** and reach **Ben.** To find the day number we make the following calculation:

$2 \times 4 =$	$-\ 8$
$9 \times 7 + 13 =$	$+\ 76$
The sum is	$+\ 68$
Deduct 5 thirteens or	65
The remainder is to be counted forward from the **3** of **3 Ahau** giving **6** and making the day, **6 Ben.**	$+\ 3$

To find the month-day we have the following calculation:

$2 \times 5 =$	$-\ 10$
$9 \times 20 + 13 =$	$+\ 193$
The sum	$+\ 183$

is to be counted forward from **18 Yaxkin**, reaching **1 Kayab**, and making the full date **6 Ben 1 Kayab**(23), and thus proving the correctness of the original calculation.

NOTE. — The reason why my method of finding the day reached by the Maya system of time notation brings about correct results will now be explained.

It has been seen that the named day is reached by the Förstemann method by deducting all twenties from the total number of days, and counting forward the remainder from the day of the zero point; or, since all the Maya time periods except the kin are divisible by twenty without a remainder, the day is reached by counting forward the number of the kin period from the day of the zero point. In my method this plan is also used.

It has been seen that by the Förstemann method the day number is reached by deducting all thirteens from the total number of days and counting forward the remainder from the day number of the zero point; and that the month-day is reached by deducting all three-hundred-and-sixty-fives from the total number of days and counting forward the remainder from the month-day of the zero point. It is in these last two calculations that my method saves much time and labor.

Let the question be as before to find the date reached by counting 9.9.9.16.6. from **9 Kan 12 Kayab**⑮. As the same date appears every 52 years or every 18,980 days, which in Maya notation is 2.12.13.0., or one calendar round, the same date will be reached in solving this problem if we deduct from the large sum all even calendar rounds and count forward the remainder, as would be reached if we counted forward the total number of days. By referring to Table XI it will be seen that 71 is the largest number of even calendar rounds contained in 9.9.9.16.6. Deducting then 71 calendar rounds, or 9.7.3.5.0., there is left 2.6.11.6., which is a simpler sum to deal with than is the larger one.

The kin number is 6, which must be counted forward from **Kan** in the Förstemann method as well as in my own. This gives **Oc** as the day which is sought for.

In finding the day number it makes no difference whether we deduct the thirteens from the total number of days, which, in the case of 2.6.11.6., is 16,786, or deduct the thirteens separately from the various time periods, which, when added together, make the total number of days. That is, the same result will be reached if we deduct the thirteens from 16,786 and find a remainder of 3, as if we deducted the thirteens from 2 × 7200, 6 × 360, 11 × 20 and 6 in succession, and then added the various remainders together and deducted all thirteens again. The latter method seems to be much more cumbrous than the former, but it is in reality far less cumbrous.

If then we wish to find how many thirteens there are in 2 katuns, we begin by performing the operation with 1 katun, finding that 7200 = 553 × 13 with a remainder of 11. Therefore in 2 katuns there will be a remainder of 2 × 11 = 22

We find that in 1 tun or 360 days there are 27 thirteens with a remainder of 9, and that in 6 tuns the remainder will be 6 × 9 = 54

We find that in a uinal there is 1 thirteen with a remainder of 7, while in 11 uinals there will be a remainder of 11 × 7 = 77

In 6 kins there are no thirteens and a remainder of 6

The sum of the remainders of all the periods will then be 159

or, after deducting 12 thirteens, or 156

there will be a remainder of 3

as was shown by the Förstemann method.

This operation can be much simplified, however, as follows:

Since one katun has a remainder of 11 after deducting all even thirteens, and as the series of the day numbers returns again to 1 after reaching 13, it is evident that the same day number is reached by adding 11 or subtracting 2. Thus if the day number of the zero point is 9, by counting forward 11 we reach the number 20, or after deducting 13, the number 7. The same day number is also reached by deducting 2 from 9, this operation also bringing 7. This enables us to use smaller numbers in our calculations, — 2 instead of 11 as a multiplier. Instead therefore of adding 2 × 11 = 22 to the other remainders in the problem above stated, we can subtract 2 × 2 = 4. We give the 4 the minus sign to show that it is to be deducted, − 4

We are also able to use smaller numbers in our calculations if, instead of adding 9 as the remainder of each tun, we deduct 4, which will produce the same result. In the case before us we deduct 6 × 4 = 24, giving the product the minus sign to show that it is to be deducted. − 24

This gives a total minus sum of − 28

The uinal and kin remainders will be added as before, 77 + 6 = + 83

The sum of these numbers is + 55

from which we deduct 4 thirteens or 52

and find the final remainder to be + 3

as before, the plus sign showing that the 3 is to be counted forward from the **9 of 9 Kan**, the day number of the zero point.

We have thus found the day number to be **12 Oc.**

The same principle applies to the search for the month-day. The same month-day, considered by itself, reappears at the end of every 365 days. We shall therefore reach the same month-day if we subtract all even three-hundred-and-sixty-fives from the total number of days to be counted and count forward the remainder, as we should if we counted the total number of days. Or we can deduct 365 from each period separately, add all the remainders together and count forward the sum of the remainders (after deducting 365 if necessary) from the month-day of the zero point.

Thus 2.6.11.6. equals 16,786 days. This is equal to 45 years and 361 days. Counting forward 361 days from **12 Kayab** of the zero point we reach **8 Kayab.**

If, however, we deduct the three-hundred-and-sixty-fives from each period separately, we find

that in one katun there are	19 years of 365 days + 265 days
that in one tun there are	0 years of 365 days + 360 days
that in one uinal there are	0 years of 365 days + 20 days
and that in one kin there are	0 years of 365 days + 1 day.

In 2 katuns then we shall have a remainder of

$2 \times 265 =$	530 days
In 6 tuns there will be a remainder of $6 \times 360 =$	2160 days
In 11 uinals the remainder will be $11 \times 20 =$	220 days
and in 6 kins the remainder will be $6 \times 1 =$	6 days
the total remainder will be	2916 days
Deducting $7 \times 365 =$	2555 days
the final remainder will be, as before,	361 days

This, however, can be stated in another way. As the year returns into itself after one year is finished, and as **0 Pop** comes round after **4 Uayeb** is reached, it follows that the same month-day will be reached if we count forward from a given zero point 265 days, or if we count backward $365 - 265 = 100$ days. We may therefore give a value to 1 katun of 20 years less 100 days, and to 1 tun of 1 year less 5 days, making no change in the values assigned to the uinal and kin.

This again enables us to use smaller numbers in our calculations, 100 for 365 in the case of the katuns, and 5 for 360 in the case of the tuns. Thus in the case before us, where 2 katuns are given, instead of counting forward twice 365 days from the month-

day of the zero point, we count backward 2 × 100 days or − 200
giving the product the minus sign to show that it is to be counted backward. In the case of the tuns also, instead of counting forward 6 × 360 days, we can count backward 6 × 5 days, or − 30
again giving the minus sign for the reason stated. The total number of days to be counted backward will then be − 230

We shall count forward the uinal and kin numbers as we did before, counting for the uinals 11 × 20 = + 220
and for the kins, 6 × 1 = + 6 + 226
The sum of these plus and minus numbers is − 4
Since this sum has the minus sign, we must count back 4 days. Counting back 4 days from the zero month-day, **12 Kayab**, we reach **8 Kayab** as before.

APPENDIX VIII

KATUN-QUARTERS. THE INITIAL GLYPH

Dates of Even Katun-Quarters. — Table XXIX includes the even quarter-katuns which appear both in the Initial series and elsewhere in the inscriptions. The column under the heading of "Initial Series" shows the position of the dates which are recorded by the long count, thus making their position free from any doubt. The next column shows the position of the dates which are recorded exactly, by being declared to be the end of a cycle or katun, or because they stand at a given distance from some known date. There can probably be no error in these cases. The third column gives the position of those dates where the month and day which end an even katun-quarter are given, but where it is not possible to say with certainty that the dates belong to the even quarters, since each date may occur once every 52 years. It is to be noted, however, that in many cases these dates occur at the beginning of an inscription, thus adding to the probability that they are meant to represent a katun-quarter.

Conceding that all the dates in the first two columns are exact and record even katun-quarters, the following katun-quarters are recorded:

13. 0. 0.0.0.	9.10.10.0.0.	9.16.15.0.0.
9. 0. 0.0.0.	9.11. 0.0.0.	9.17. 0.0.0.
9. 1. 0.0.0.	9.12. 0.0.0.	9.17. 5.0.0.
9. 2. 0.0.0.	9.12.10.0.0.	9.17.10.0.0.
9. 4. 0.0.0.	9.13.10.0.0.	9.17.15.0.0.
9. 5. 0.0.0.	9.14. 0.0.0.	9.18. 0.0.0.
9. 6.10.0.0.	9.15. 0.0.0.	9.18. 5.0.0.
9. 9. 0.0.0.	9.15.10.0.0.	9.18.10.0.0.
9. 9. 5.0.0.	9.15.15.0.0.	9.18.15.0.0.
9. 9.10.0.0.	9.16. 5.0.0.	10. 0. 0.0.0.
9.10. 0.0.0.	9.16.10.0.0.	10. 1. 0.0.0.

It might be deduced from this table that in early times the Mayas marked the lapse of each katun by some kind of stone

TABLE XXIX

EVEN KATUN-QUARTERS IN INSCRIPTIONS

Dates.	Initial Series.	Position marked by other Method.	Position unsettled.
13. 0. 0.0.0. 4 Ahau 8 Cumhu (7)	Quir. St. C (e).		
9. 0. 0.0.0. 8 Ahau 13 Ceh (22)		T. C. Q17 R1.	
10.0.0. 7 Ahau 3 Yax (32)			Q. St. D (e). B18ᵃ ?
15.0.0. 13 Ahau 18 Mol (37)			Nar. St. 32. (top) OP1.
9. 1. 0.0.0. 6 Ahau 13 Yaxkin (42)	Q. St. C (w).		
10.0.0. 5 Ahau 3 Tzec (52)			T. C. RS10.
9. 2. 0.0.0. 4 Ahau 13 Uo (10)	P. N. St. 6. ?		
9. 4. 0.0.0. 13 Ahau 18 Yax (49)	T. I. 57.		
15.0.0. 5 Ahau 3 Yaxkin (12)			El C. Lin. 1. EF3.
9. 5. 0.0.0. 11 Ahau 18 Tzec (17)		T. I. 57. D5–6.	
15.0.0. 3 Ahau 3 Uo (32)			Cop. Altar L.
9. 6. 0.0.0. 9 Ahau 3 Uayeb (36)			T. I. 57. F4 E5.
10.0.0. 8 Ahau 13 Pax (46)	Cop. St. 9.		
9. 7. 0.0.0. 7 Ahau 3 Kankin (4)			T. I. 57. J5 I6.
5.0.0. 13 Ahau 18 Ceh (9)			IJ10.
10.0.0. 6 Ahau 13 Zac (14)			Q. St. A (w). AB2.
9. 8. 0.0.0. 5 Ahau 3 Chen (24)			T. I. 57. KL6.
9. 9. 0.0.0. 3 Ahau 3 Zotz (44)		T. I. 57. P2 O3. 59. EF8.	
5.0.0. 9 Ahau 18 Uo (49)	Nar. St. 30. ?		
10.0.0. 2 Ahau 13 Pop (2)	Cop. St. P.		
9.10. 0.0.0. 1 Ahau 8 Kayab (11)	Q. An'l. B.		Nar. Stair. Insc. 6.
10.0.0. 13 Ahau 18 Kankin (21)	Nar. Stair. Insc. 5.	T. S. Q14–15.	T. C. K9. T. S. GH2.
9.11. 0.0.0. 12 Ahau 8 Ceh (31)		T. I. 59. P3–4. 58. A2–3.	PQ2.
15.0.0. 4 Ahau 13 Mol (46)			P. N. St. 36. D7 C8. Lin. 2. X11–W12.
9.12. 0.0.0. 10 Ahau 8 Yaxkin (51)		T. I. 58. G1–2.	T. I. 59. B8 A9.
10.0.0. 9 Ahau 18 Zotz (9)	Cop. St. 6.		S1.
9.13. 0.0.0. 8 Ahau 8 Uo (19)			CD1.
10.0.0. 7 Ahau 3 Cumhu (28)	Cop. St. J (e).		Cop. St. J (w). 31, 33.
9.14. 0.0.0. 6 Ahau 13 Muan (38)		P. N. St. 3. F7–10. Nar. St. 23 (e). A17–B18.	
10.0.0. 5 Ahau 3 Mac (48)		Cop. St. F. B1–A3.	
9.15. 0.0.0. 4 Ahau 13 Yax (6)	Cop. St. B. Alt. S.	St. A. F11–E12.	Q. St. E (w). B10. F (w). A17.
5.0.0. 10 Ahau 8 Chen (11)	St. D.		
10.0.0. 3 Ahau 3 Mol (16)			A15. Tik. Pl. 71. AB1. 78. AB1.
15.0.0. 9 Ahau 18 Xul (21)			Yax. St. 11 (n. e.). AB1.
9.16. 5.0.0. 8 Ahau 8 Zotz (31)	Cop. St. M. Q. St. J.		Lin. 3. A1–C1.
10.0.0. 1 Ahau 3 Zip (36)	Q. St. F (e). Cop. St. N.		Q. St. F (w). A19.
15.0.0. 7 Ahau 18 Pop (41)	Q. St. D (e).		Cop. Alt. G3. AB1.
9.17. 0.0.0. 13 Ahau 18 Cumhu (45)	Q. St. E (e).	Q. St. E (w). AB17. Yax. Lin. 31. E4–H5.	Alt. G3. AB2. Q. St. E (e). B19–A20. Seib. St. 7. AB1. St. 6, No. 1. B4.
5.0.0. 6 Ahau 13 Kayab (60)	Q. St. A (e).	Q. St. C (w). B11–A12. Cop. Alt. Q. C6–E1.	
10.0.0. 12 Ahau 8 Pax (3)	Nar. St. 13.		Nar. St. 19. AB1.
15.0.0. 5 Ahau 3 Muan (8)	Q. An'l. G. (e. l.).		La Mar. B7–A8.
9.18. 0.0.0. 11 Ahau 18 Mac (13)	Q. An'l. O.		Yax. Lin. 32. AB1. Nar. St. 14. CD12.
5.0.0. 4 Ahau 13 Ceh (18)	Q. Turtle P.		Cop. Alt. G2. AB1.
10.0.0. 10 Ahau 8 Zac (23)	Q. St. I. Nar. St. 8 (n).		G1(n). AB1.
15.0.0. 3 Ahau 3 Yax (28)	Q. St. K.		
9.19. 0.0.0. 9 Ahau 18 Mol (33)			Nar. St. 7 (s). AB1.
5.0.0. 2 Ahau 13 Yaxkin (38)			St. 23 (w). B17–A18.
10. 0. 0.0.0. 7 Ahau 18 Zip (1)		Cop. Altar S. 7–8. Q. An. G. (w. u.) G4–F5. Seib. St. 11. EF2.	T. I. 59. CD7.
5.0.0. 13 Ahau 13 Uo (6)			Q. St. E (e). A16.
10. 1. 0.0.0. 5 Ahau 3 Kayab (20)		Seib. St. 11. A3–4.	

record, as Bishop Landa and others report, and that, as time ran on, they made this record more often, perhaps at the end of each half-katun, and that in still later times the record was made at the end of each quarter-katun. But as the early monuments are probably more defaced than the later ones, and as a large number of monuments are found, the glyphs of which are too much worn to be identified, and as undoubtedly there are many monuments yet to be discovered, it is not at all improbable that the quarter-katuns were recorded from the beginning.

Even Katun-Quarters in Initial Series. — The Initial series which record even quarter-katuns are distributed thus: in Quirigua, 13; Copan, 9; Naranjo, 4, and in Piedras Negras and Palenque, 1 each.

The dates which are marked with certainty by being recorded as being at the end of a given cycle or katun are distributed as follows: Palenque, 6, two being recorded twice, and all being before 9.13.0.0.0.; 4 in Copan, 3 in Quirigua; 2 in Seibal; and 1 each in Naranjo, Piedras Negras and Yaxchilan. All these dates in the last-named six places are later than 9.13.0.0.0.[1] This would seem to support the general belief that Palenque was of an earlier date than the other ruins.

In the first column of Table XXX, where the day and month date forms part of the Initial series, twenty-three dates, recording even katun-quarters, are found in 27 different places, as follows: 8 recording even katun-periods, 4 recording even five-tun periods, 8 recording even ten-tun periods, and 3 even fifteen-tun periods.

If Dr. Seler's suggestion, that the quarters of the katuns and the heads contained in the Initial glyphs refer to the points of the compass, were correct, it would naturally be supposed that the heads of the Initial glyphs in each set would be the same, or at least similar.

Taking up each set in turn, we find that where an even katun is recorded in the case of the Temple of Inscriptions at Palenque the inscription is too worn, and in that of Animal O of Quirigua it is too indistinct, to enable us to decide on the form of the head of the Initial glyph, and in the latter case Maudslay does not give any

[1] It is probably true that some of these dates, especially at Palenque, are not connected with the erection of the monument on which they occur, since several of them appear on the same inscription; but they seem to be calculations, with possibly some historical value.

drawing of the glyph. In the other six, the only two heads which are similar are those found in Copan, Stela B and Altar S (Plate

TABLE XXX

INITIAL SERIES WITH EVEN QUARTER-KATUNS

13. 0. 0.0.0.	**4 Ahau**	**8 Cumhu** ⑦	Quirigua, Stela C (e).
9. 1. 0.0.0.	**6 Ahau**	**13 Yaxkin** ㊷	" Stela C (w).
9. 2. 0.0.0.	**4 Ahau**	**13 Uo** ⑩	Piedras Negras, Stela 6. ?
9. 4. 0.0.0.	**13 Ahau**	**18 Yax** ㊾	Palenque, T. I. (Too worn for use.)
9.10. 0.0.0.	**1 Ahau**	**8 Kayab** ⑪	Quirigua, Animal B.
9.15. 0.0.0.	**4 Ahau**	**13 Yax** ⑥	Copan, Stela B.
			" Altar S.
9.17. 0.0.0.	**13 Ahau**	**18 Cumhu** ㊺	Quirigua, Stela E (e).
9.18. 0.0.0.	**11 Ahau**	**(18 Mac)** ⑬	" Animal O.
9. 9. 5.0.0.	**9 Ahau**	**18 Uo** ㊾	Naranjo, Stela 30. ?
9.16. 5.0.0.	**8 Ahau**	**8 Zotz** ㉛	Quirigua, Stela J.
			Copan, Stela M.
9.17. 5.0.0.	**6 Ahau**	**13 Kayab** ㊿	Quirigua, Stela A (e).
9.18. 5.0.0.	**4 Ahau**	**13 Ceh** ⑱	" Turtle.
9. 6.10.0.0.	**8 Ahau**	**13 Pax** ㊻	Copan, Stela 9.
9. 9.10.0.0.	**2 Ahau**	**13 Pop** ②	" Stela P.
9.10.10.0.0.	**13 Ahau**	**18 Kankin** ㉑	Naranjo, Stairway, Ins. 5.
9.12.10.0.0.	**9 Ahau**	**18 Zotz** ⑨	Copan, Stela 6.
9.13.10.0.0.	**7 Ahau**	**3 Cumhu** ㉘	" Stela J (e).
9.16.10.0.0.	**1 Ahau**	**3 Zip** ㊱	" Stela N.
			Quirigua, Stela F (e).
9.17.10.0.0.	**12 Ahau**	**8 Pax** ③	Naranjo, Stela 13.
9.18.10.0.0.	**10 Ahau**	**8 Zac** ㉓	Quirigua, Stela I.
			Naranjo, Stela 8. Defaced; probably animal's head.
9.16.15.0.0.	**7 Ahau**	**18 Pop** ㊶	Quirigua, Stela D (e).
9.17.15.0.0.	**5 Ahau**	**3 Muan** ⑧	" Animal G (e. l.).
9.18.15.0.0.	**3 Ahau**	**3 Yax** ㉘	" Stela K.

XI, Nos. 16, 17), where exactly the same date, 9.15.0.0.0., is given. The other four differ from the two mentioned and from each other.

There is no similarity in the heads of the Initial glyphs in the four cases in which an even five tuns is recorded. (Plate XI, Nos. 24, 27, 28, 32.)

Out of the eight cases where an even ten tuns is recorded, the heads of the Initial glyphs of Copan, Stela N, and of Quirigua, Stela F (e) (Plate XI, Nos. 35, 36), are nearly identical, and in both these cases the date 9.16.10.0.0. is recorded. But these heads are not similar to any of the others of the set. The heads of Copan, Stela J (e) and Stela F (Nos. 39, 40), seem to have a similar outline, but they are too much defaced to allow us to found any theory upon them. The five others are unlike either of the two types just cited and are not like each other.

In the three cases where an even fifteen tuns is recorded, one of the heads is that of a man, another is a full-sized leopard in a very involved position, while the third seems to have some appearance of a head, the so-called Venus form appearing very prominently above it. (Plate XI, Nos. 52, 50, 51.)

It would seem, therefore, that we must abandon the idea that these glyphs represent katun-quarters as marking world directions. The two instances where the same date is recorded twice, and where the heads are identical, would, as far as they go, tend to show that the katuns, and not the katun-quarters, are referred to by the heads of the Initial glyphs.

But if this is the case, then Nos. 35 and 36 of Plate XI, which are alike, both designating 9.16.10.0.0., should have some resemblance to No. 50, which marks 9.16.15.0.0., and to Nos. 24 and 32, which mark 9.16.5.0.0. This is not the case, however, and moreover Nos. 24 and 32, which record the same date, are not at all similar, though perhaps No. 32 is too much defaced to enable us to form a decision.

Again, No. 18 records 9.17.0.0.0., No. 27 records 9.17.5.0.0. and No. 52 marks 9.17.15.0.0. No. 18 has no resemblance to the other two, while Nos. 27 and 52 have very different details, though both represent the human head.

Again, No. 28 records 9.18.5.0.0., No. 34 records 9.18.10.0.0. and No. 51 marks 9.18.15.0.0. The three forms are quite dissimilar.

This would show that the evidence which we possess is against the theory that the heads of the Initial glyphs, where even katun-quarters are recorded, refer to the position of the katuns or of the katun-quarters in the calendar. Neither do these heads refer, in all probability, to the cycle or grand cycle numbers, since, in all the cases which we have been considering, except one, the cycle is the same, and in all the cases the grand cycle is the same. It may be, however, that these heads refer to the grand cycle, and that the artist, knowing that there could be no mistake in regard to the grand cycle, allowed himself great freedom in carving the Initial glyph, as he did in delineating the day **Ahau**. It is equally possible that the heads which we have been discussing refer to something else than the calendar, numeration or direction.

The following list shows the total number of Initial series known in the different ruins in the region of Maya culture, and the number of these Initial series which record even katun-quarters:

Ruin.	Number of Initial series.	Number of dates recording even katun-quarters.
Quirigua	16	13
Copan	15	9
Palenque	5	1
Yaxchilan	5	0
Piedras Negras	5	1
Naranjo	8	4
Tikal	2	0
Chichen Itza	1	0
El Cayo	1	0
	58	28

Katun-Quarters of Initial Series referring to Direction. — But there are other Initial glyphs which need to be considered. Dr. Seler, in suggesting that these glyphs, where they are connected with even katun-quarters, refer to the world directions, suggested further that the Initial glyphs, although even katun-quarters are not marked, might also represent world directions. In these cases the dates from an even katun to an even five tuns would belong to the first katun-quarter; those from an even five tuns to an even ten tuns, to the second katun-quarter; those from an even ten tuns to an even fifteen tuns, to the third katun-quarter, and those from an even fifteen tuns to an even katun, to the fourth katun-quarter.

Table XXXI includes most of such known Initial series, separated into sets belonging to each katun-quarter.

TABLE XXXI

LIST OF INITIAL SERIES — NOT EVEN QUARTER-KATUNS

9.16. 0. 2.16.	**6 Cib**	**9 Mol** [26]	El Cayo, Lintel 1. (Defaced.)
9.16. 1. 0. 0.	**11 Ahau**	**8 Tzec** [27]	Yaxchilan, Stela 11, base.
9.12. 2. 0.16.	**5 Cib**	**14 Yaxkin** [1]	Piedras Negras, Stela 1.
9.12. 2. 0.16.	**5 Cib**	**14 Yaxkin** [1]	" " Stela 3.
9. 6. 3. 9.15.	**10 Men**	**18 Chen** [40]	Tikal Stela 17.?
9.12. 3.14. 0.	**5 Ahau**	**8 Uo** [3]	Copan, Stela I.
9.10. 3.17. 0.	**4 Ahau**	**8 Muan** [15]	Altar de Sacrificios, Stela 4.
1.18. 5. 3. 6.	**13 Cimi**	**19 Ceh** [34]	Palenque, Temple of the Sun.
1.18. 5. 4. 0.	**1 Ahau**	**13 Mac** [34]	" Temple of the Foliated Cross.
9.11. 6. 2. 1.	**3 Ymix**	**19 Ceh** [37]	Piedras Negras, Lintel 2.
9.10. 6. 5. 9.	**8 Muluc**	**2 Zip** [18]	" " Stela 36.
9.12. 8.14. 1.	**12 Ymix**	**4 Pop** [8]	Yaxchilan, Altar, Structure 44.
10. 2. 9. 1. 9.	**9 Muluc**	**7 Zac** [49]	Chichen Itza, Tablet.
9. 8. 9.13. 0.	**8 Ahau**	**13 Pop** [34]	Palenque, Palace Steps.
9. 8.10. 6.16.	**10 Cib**	**9 Mac** [34]	Piedras Negras, Stela 25.
9.11.12. 0. 0.	**3 Ahau**	**8 Chen** [43]	Yaxchilan, Stela 1.?
9.12.12. 0. 0.	**1 Ahau**	**8 Zotz** [11]	Copan, Stela J (w).?
9. 2.13. 0. 0.	**4 Ahau**	**13 Kayab** [22]	Tikal, Stela 3. (Defaced.)
9.16.13. 4.17.	**8 Caban**	**5 Yaxkin** [39]	Quirigua, Stela D (w).?
12.19.13. 4. 0.	**8 Ahau**	**18 Tzec** [1]	Palenque, Temple of the Cross. (Previous grand cycle.)
9.17.13. 4. ?.		**Pop** [7]	Naranjo, Stela 14 (n). (Defaced.)
9.14.13. 4.17.	**12 Caban**	**5 Kayab** [51]	Quirigua, Stela E (w).
9.14.13. 4.17.	**12 Caban**	**5 Kayab** [51]	" Stela F (w).
9.12.15.13. 7.	**9 Manik**	**0 Kayab** [14]	Naranjo, Stela 22 (w). (Defaced.)
9.11.15.14. 0.	**11 Ahau**	**8 Zotz** [47]	Copan, Stela 1.
9.12.16. 7. 8.	**3 Lamat**	**16 Yax** [15]	" Altar K.
9.13.17.12.10.	**8 Oc**	**13 Yax** [36]	Yaxchilan, Lintel 29.[1]
9.13.18. 4.18.	**8 Eznab**	**16 Uo** [37]	Naranjo, Stela 23 (w).
9. 0.19. 2. 4.	**2 Kan**	**2 Yax** [41]	Yaxchilan, Lintel 21.
9.14.19. 8. 0.	**12 Ahau**	**18 Cumhu** [5]	Copan, Stela A.

[1] We have no photograph of this inscription.

In these sets we find several cases in which the expected resemblance between the heads in the Initial glyphs occurs. Thus in the sets in which Tuns 0 to 5 are recorded a slight resemblance may be traced between the heads of Nos. 22 and 23 of Plate XI, both denoting 9.12.2.0.16. But on the other hand the head of No. 24 is very different from that of No. 32, though both record exactly the same date.

In the set in which Tuns 5 to 10 are recorded we find a resemblance between the form on top of the animal's head of No. 25 and the form above the tun form of No. 29, the former denoting 1.18.5.3.6. and the latter 9.11.6.2.1. But the face of No. 27, which denotes 9.17.5.0.0., is very similar to those of Nos. 41 and 42, which denote 9.14.13.4.17., and which are therefore in the following set in which Tuns 10 to 15 are recorded. Moreover, Nos. 25 and 30, which mark dates only fourteen days apart, are absolutely different and the leopard's head of No. 26, denoting 9.8.9.13.0., is similar to No. 50 of the later set, which denotes 9.16.15.0.0.

In the set in which Tuns 10 to 15 are recorded, Nos. 41 and 42, both denoting 9.14.13.4.17., bear a strong resemblance to Nos. 39 and 40, denoting respectively 9.13.10.0.0. and 9.14.10.0.0., but they bear a still stronger resemblance to No. 27, which denotes 9.17.5.0.0.

In the set in which Tuns 15 to an even katun are recorded, there is a striking similarity between No. 53, denoting 9.12.16.7.8., and No. 51, denoting 9.18.15.0.0., — the so-called Venus sign appearing in both. The head of the Initial glyph in Stela 23 of Naranjo, where the date is 9.13.18.4.18., may represent a leopard's head, while No. 50, denoting 9.16.15.0.0., is a full-sized leopard. But a leopard's head is very clear in No. 26 of a previous set, where the date 9.8.9.13.0. is marked. The face, too, of No. 27, denoting 9.17.5.0.0., is of the same style as the faces of Nos. 39, 40, 41, 42 and 52 (all in different sets), though with different ornamentation.

Taking the four sets together, I cannot find enough evidence to prove that the forms over the tun form and between the combs of the Initial glyph are of such a character that they can be considered as indicating anything fixed in the way of dates or of any differentiation of dates or of directions. One fact, however, stands out clearly, — namely, the pair Nos. 22 and 23 resemble each other, as do the pairs 16 and 17, 35 and 36, and 41 and 42, and the two forms of each pair belong to exactly the same date. But this is offset by the fact that Nos. 24 and 32 which also represent the same date, are not at all similar, in detail or outline.

Ik and Caban in the Initial Glyph. — The date of No. 30 is 1.18.5.4.0., with an **Ik** sign where we generally find a head. No. 46 is 12.19.13.4.0. of the previous grand cycle, and has a **Caban** sign in place of the head. If the **Ik** and **Caban** signs refer to different grand cycles the following grand cycles would be marked by **Manik** and **Eb** respectively, but we know of no instance where these grand cycles are recorded.

Why **Ik** and **Caban** should appear in the grand cycle glyphs is hard to understand. It may possibly give strength to Goodman's theory that the years begin with the days **Ik**, **Manik**, **Eb** and **Caban**, and that the first day of the first years of the calendar round in the current grand cycle began with **Ik**, while the priests of a former grand cycle may have begun the first years with **Caban**. Or it is possible that this advance of 5 days in the Initial glyph was made, as a sign that the grand cycle had changed, because the number of intercalary days needed to bring the calendar into accord with the seasons, on the basis of 25 days for each whole 104 years in a grand cycle, necessitated such an advance. Thus on the basis of 13 cycles being equal to 1 grand cycle, the latter consisted of 1,872,000 days, equal to 5128 years, 280 days, or 49 times 104 years, plus 32 years, 280 days. 25 days for each 104 years would make 1225 intercalary days. This number runs through the twenty day signs 610 times with 5 over, and if counted on from **Caban** would carry us to **Ik**; but this would take no account of the 32 additional years.

Another suggestion may not be out of place. The Initial series of the Temple of the Foliated Cross is 54. 1.18.5.4.0.
and that of the Temple of the Cross is 53.12.19.3.4.0.[1]
The distance from the one to the other is 1.19.2.0.0.

= 281,520 days
= 771 years, 105 days
= 14 calendar rounds, 43 years, 105 days
= 7 × 104 + 43 years, 105 days.

[1] I use the numbers 53 and 54 for the grand cycles, not as indicating my belief that these grand cycles had these numbers, but merely to show that the two dates are in successive grand cycles.

The intercalary days needed on the basis of 25 days for each 104 years and 1 day for each full 4 years in the remainder, would be

$$\begin{array}{lll} 7 \times 25 & \text{or} & 175 \text{ days} \\ 43 \div 4 & \text{or} & \underline{\ 10} \text{ days} \\ \text{in all} & & 185 \text{ days} = \text{one half a tun} + 5 \text{ days.} \end{array}$$

This runs through 9 sets of day signs with 5 days over. This might give a reason why the later date (especially as it is in another grand cycle) has **Ik** instead of **Caban** in the place usually occupied by a head in the Initial glyph.

Initial Glyph referring to Months. — There is some reason to believe that the enclosed heads refer to the months recorded by the Initial series. Thus a leopard is shown either in full size or in part in Quirigua, Stela D (e), and on the Palace Steps of Palenque, and the month **Pop** is common to both; the head with no lower jaw is found with the month **Zip** in Copan, Stela N, and in Quirigua, Stela F (e), and probably in Piedras Negras, Stela 36; an animal's head with serrated teeth in connection with **Zotz** is found in Copan, Stelæ 1 and 6; the animal's head shown in No. 16, Plate XI, is found in Copan, Stela B and Altar S, and in Yaxchilan, Lintel 21, etc., in connection with **Yax**. But it should also be said that in some of these cases and in other cases of similarity the dates recorded are the same, while at times the same head occurs with a different month, and the same month occurs with different heads. One of the most striking cases in support of this theory is that of Copan, Altar K, and Quirigua, Stela K, where the month **Yax** is recorded and where the so-called Venus sign is very clearly shown.

APPENDIX IX

THE NUMBER OF CYCLES IN A GRAND CYCLE

The Date 13.0.0.0.0., 4 Ahau 8 Cumhu⑦. — We have referred to the Initial series of Stela C (e) of Quirigua, where the zero date **4 Ahau 8 Cumhu⑦** is given with the long count 13.0.0.0.0. In Chapter X four cases are cited where the same date, **4 Ahau 8 Cumhu⑦**, is connected with glyphs which apparently mean the lapse of 13 cycles. How shall this date be interpreted?

Our experience with all the other Initial series (except that of the Temple of the Cross at Palenque) would lead us to suppose that the meaning of this Initial series is that **4 Ahau 8 Cumhu⑦** is to be reached by counting forward 13 cycles from the zero date of the same name. But on trying this it is found that such a count reaches, not **4 Ahau 8 Cumhu⑦**, but **4 Ahau 3 Kankin㊵**. The next supposition would naturally be that **4 Ahau 8 Cumhu⑦** is the zero date itself, and that here it is declared to be 13 cycles from some other date, which in this case would be **4 Ahau 8 Zotz㉗**, the ending date of a previous grand cycle. This is, in my opinion, the correct solution, and this view is confirmed by the four cases where this date is declared to be the end of 13 cycles.

Number of Cycles in a Grand Cycle. — But a further result is to be deduced from this decision. If **4 Ahau 8 Cumhu⑦** is the end of 13 cycles of a former grand cycle, and is the zero point of the current grand cycle (as is apparently the case, judging from all the Initial series which we know of, except the one which we are discussing and that of the Temple of the Cross at Palenque), and if it is recorded as being 13 cycles from the date **4 Ahau 8 Zotz㉗**, the evidence is strong that in the inscriptions it needed only 13 cycles to round out a grand cycle, although we have found that 20 cycles are needed to fill up a grand cycle in the Dresden codex. If this were not so, and if 20 cycles were needed to round out a grand cycle in the inscriptions, and if **4 Ahau 8 Cumhu⑦** is the end of 13 cycles, then **2 Ahau 3 Uayeb⑯**, instead of being the end of Cycle 2, as we have already found it to be in D7–8 of the Temple of the Foliated Cross, would be the end of Cycle 13 plus 2 or of Cycle 15; and all the dates of Cycle 9 would be dates in Cycle 13 plus 9 equal to 22 less 20, leaving the cycle with the number 2. That this is not so is evident.

Moreover, if we have correctly deciphered the numbers of the period glyphs of the Initial series of the three Temples of Palenque, we find that that of the Temple of the Cross is 12.19. 13.4.0., **8 Ahau 18 Tzec①**, or 6.14.0. before the date **4 Ahau 8 Cumhu⑦**. This date of **8 Ahau 18 Tzec①** is not reached by counting forward the number of the Initial series from **4 Ahau 8 Cumhu⑦**, but is reached by counting forward from **4 Ahau 8 Zotz㉗**, which as has been seen may be the end of a preceding grand cycle, from which **4 Ahau 8 Cumhu⑦** is reached by counting forward 13 cycles. This theory is further strengthened by the fact that on D3 C4 of the Temple of the Cross the date **4 Ahau 8 Cumhu⑦** is declared on C5 to be the end of Cycle 13. Moreover,

on D5 C6 there is found the distance number	1. 9.2.
and on D13–C15 another distance number appears	1.18.3.12.0.
The sum of these is	1.18.5. 3.2.
which, being counted forward from **4 Ahau 8 Cumhu⑦**	13. 0.0. 0.0.
brings us to	1.18.5. 3.2.

of the grand cycle following the Initial date, provided that 13 cycles make one grand cycle. This date is within 4 days of the Initial date of the Temple of the Sun, and within 18 days of the Initial date of the Temple of the Foliated Cross.[1]

The evidence against the theory that 13 cycles make 1 grand cycle is that on J11 of the Temple of Inscriptions at Palenque (Plate 59 of Maudslay) there is a glyph which clearly shows 14 cycles, and that B14 of Stela N of Copan may also be 14 cycles, though this is not certain. In the Temple of Inscriptions the 14 cycles cannot be connected with any other glyph, and the glyphs of the passage in Stela N, in which the 14 cycles occur, are in some respects unusual. Thus the Initial date is 9.16.10.0.0., to which the date **1 Ahau 3 Zip㊱** belongs. But on A15 the date **8 Zip** appears to be given, though the bar which means 5 is of an unusual form. On B10–12 the distance num-

[1] Bowditch, 1906.

ber 19.10.0.0. is given, while on B13 is a glyph which looks like a katun glyph, except that it has a hand across the face. On B14 appears a glyph which is very similar to that of B13, and which has 14 on its left and a partially effaced superfix. It has been assumed by some that the whole series from B10–B14 form a distance number, 14.17.19.10.0.0. If, however, we count this number forward from **1 Ahau 3 Zip**(36), we reach **10 Ahau 13 Yaxkin**(46), by counting 13 cycles to the grand cycle and **3 Ahau 18 Yaxkin**(21), by counting 20 cycles to the grand cycle. The date given on B16–17 is **1 Ahau 8 ?** . If, however, we consider that the distance number is found in the glyphs B10–12, reading 19.10.0.0., and if we count this number back from 9.16.10.0.0., **1 Ahau 3 Zip**(36) of the Initial date, we reach 8.17.0.0.0., **1 Ahau 8 Chen**(15), while Katun 17 is recorded on B13. It is true that this explanation leaves B14 unaccounted for, in the same way that Cycle 14 is unaccounted for in J11 of the Temple of Inscriptions on Plate 59 of Maudslay.

Dr. Seler, in commenting on the Initial date 13.0.0.0.0., **4 Ahau 8 Cumhu**(7), gives an explanation which I do not understand, and his conclusion that the "thirteen cycles" mean the "time periods in general," and that the Initial series means "this is a chronological record. The beginning of the calendar is **4 Ahau 8 Cumhu**," seems to me not to be supported by evidence.

APPENDIX X

PERIOD ROUNDS

THE Day round is the time which elapses from any given day to another day of the same name. This time is 20 days. If we count forward from any day, say **Ahau**, **Ymix**, etc., 20 days will bring us to another **Ahau**, **Ymix**, etc., respectively.

But as any given day in the manuscripts and codices is always accompanied by one of the numerals 1 to 13, and as the number of days is equal to the number of units in a uinal, or 20, and as 13 and 20 have no common divisor, the Uinal round will consist of 13 × 20 days, or 260 days, at the end of which time any given day with the given number will appear again, and for the same reason that has just been stated a given day with a given number occupying a given place in a uinal will again occur in the same place in a uinal. Thus **9 Ahau** occupying the place of Day 3 in a uinal will again appear as Day 3 of a uinal after the lapse of 260 days.

A Tun round will have elapsed when a given day with a given number occupying a given place in a tun will again occupy the same place in another tun. This will happen in a number of days equal to the least common multiple of 260, the number of days in a Uinal round, and 360, the number of days in a tun. This is equal to 13 × 360 or 18 × 260, or 4,680 days.

A Katun round will have elapsed when a given day with a given number occupying a given place in a katun will again occupy a like place in another katun. This will happen in a number of days equal to the least common multiple of 260, the Uinal round, and 7200 the number of days in a katun. This is equal to 360 × 260 = 13 × 7200 = 20 × 4680 = 93,600 days.

A Cycle round will in the same way be equal to 7200 × 260 = 13 × 144,000 = 20 × 93,600 = 1,872,000 days.

But these calculations are subordinate ones. For as in the inscriptions and codices the days with their numbers are almost always accompanied by a month date, it is not so important to know when a given day with its number will again occur in a given place in a uinal, tun or katun as it is to know when a given day with its number occupying a given place in a uinal, tun, etc., and also occupying a given place in a given month, will again occur in the same place in a uinal, tun, etc., and in the same place in the same month. It will be found, in the case of the uinal, that this will take place after the lapse of a number of days equal to the least common multiple of 260, the Uinal round, and 365, or 5 × 52 × 73 = 18,980 days, or 52 years. This has been called a Calendar round.

Going further, we find that a given day with its number occupying a given place in a tun and a given place in a given month will again occur in the same place in a tun and in the same place in the same month after the lapse of a number of days equal to the least common multiple of 4680, the tun round, and 365. This equals 341,640 days or 13 × 72 = 936 years, or 949 tuns. This may be called a Tun Calendar round.

A Katun Calendar round will be found to be the least common multiple of 93,600, the Katun round, and 365. This equals 5 × 73 × 18,720 = 6,832,800 days or 13 × 1440 = 18,720 years, or 949 katuns.

A Cycle Calendar round will be found to be in the same way the least common multiple of 1,872,000, the Cycle round, and 365. This is equal to 5 × 73 × 374,400 = 136,656,000 days or 374,400 years, or 949 cycles.

The following table shows the value of each round:

TABLE XXXII[1]

1 Day round	20 days	= 20 days
1 Uinal round	260 days	= 13 × 20 days
1 Tun round	4680 days	= 18 × 260 days
1 Katun round	93,600 days	= 20 × 4680 days
1 Cycle round	1,872,000 days	= 20 × 93,600 days
1 Calendar round	18,980 days	= 52 years = 949 uinals
1 Tun Calendar round	341,640 days	= 936 years = 949 tuns
1 Katun Calendar round	6,832,800 days	= 18,720 years = 949 katuns
1 Cycle Calendar round	136,656,000 days	= 374,400 years = 949 cycles

[1] Goodman, 1897, p. 27.

APPENDIX XI

CONTINUOUS SERIES. WHEELS

THE Mayas in their system of measuring time adopted many different series, each of which returned into itself, with but one exception, and repeated itself over and over again by the necessity of its formation. These are:

1. The day count, consisting of twenty named days. As soon as the twentieth day was reached the same count began over again. If the first day was **Ymix**, the twentieth day was **Ahau**, and the twenty-first was **Ymix** again, and so on.

2. The 13 number count. This began with 1, ran from 1 to 13, and was followed again by 1 to 13, and this was repeated over and over again.

3. The combination of Nos. 1 and 2, making the 260-day count. In this count each of the days was joined with each of the numbers 1 to 13 until 260 days had passed, when the 261st day was the same as the first, and the series went on repeating itself when 260 days were again completed.

4. The 18 months and the 5 additional or **Uayeb** days. The month **Pop** began this series, which ended with **Uayeb**, when **Pop** came in again, and this was repeated continuously.

5. The affixing to each of the 18 months the numbers 0 to 19 and to the **Uayeb** days the numbers 0 to 4, — thus marking the passage of 20 days in each of the former and of 5 days in the latter. This equals $18 \times 20 + 1 \times 5 = 365$ days. Therefore **0 Pop** began the year which ended with **4 Uayeb**. Then **0 Pop** came in again, and the series of 365 days went on continuously.

6. The combination of Nos. 3 and 5. In this count the days with their numbers were attached one after the other to the successive month-days. This made a long period equal to the least common multiple of 260 and 365, or 18,980 days or 52 years, before the end of the period was reached. If this period began

with **1 Ik 0 Pop**, the first year ended with **1 Cimi 4 Uayeb** and the next year began with **2 Manik 0 Pop**, the third year began with **3 Eb 0 Pop**, and so on till the 52d year began with **13 Caban 0 Pop**, and this year and the period ended with **13 Ymix 4 Uayeb**. Then **1 Ik 0 Pop** came in again with a new series, and the system continued on indefinitely.

7. The long count. This count started from some day fixed by the method explained in No. 6, went on adding one to itself for each day passed and therefore did not necessarily return into itself. This count was composed of kins, of uinals of 20 kins, of tuns of 18 uinals, of katuns of 20 tuns, of cycles of 20 katuns and of grand cycles of 13 or 20 cycles. Each of these constituent parts necessarily returned into itself except the grand cycles. Thus when 20 kins were reached, the kin record returned to zero, and 1 was added to the count of the uinals. When the uinals reached 18 the uinal count returned to zero and the tun count was increased by 1. And the same thing happened with the tuns, katuns and cycles. But there is nothing to show that there was any limit to the increase of the grand cycles. Goodman suggests that, in order to reach a consistent whole,[1] when the number of grand cycles had reached 73, the next grand cycle should be numbered 0 (or 73, which in his reckoning is the same as 0) again. It is true, if we take any date, such as **4 Ahau 13 Yax⑥**, as the beginning of time, that at the end of 73 grand cycles (assuming that it takes 13 cycles to make 1 grand cycle) **4 Ahau 13 Yax⑥** will again appear in the same position in the grand cycle which it occupied before. But there is nothing to show that the new grand cycle was numbered 0 instead of being numbered 1 in excess of the previous grand cycle. Therefore the long count cannot be said to return into itself, except that the same day with its number and the same month-day will be repeated at the end of 73 grand cycles.

8. The 13 katun count. This count recorded the katuns by the numbers of the day **Ahau** with which the previous katun ended, and ran Katun **13 Ahau**, Katun **11 Ahau**, Katun **9 Ahau**, etc.,

[1] Goodman supports his views by calling attention to the fact that **4 Ahau 13 Yax⑥** a date often found in the inscriptions, occurs at a point when three-fourths of 73 grand cycles have elapsed, if, as he supposes, the grand cycle in which most of the dates occur is Grand cycle 54. (Goodman, 1897, pp. 5 *et seq.*; 26-27.)

and when Katun **2 Ahau** ended, Katun **13 Ahau** came in again, and thus this series continued on indefinitely.

This sequence of a series can be expressed in various ways. One of the most graphic methods, and one which is very easily understood, is by the use of a wheel. In this way the series is repeated so that one can begin at any point in the series and can

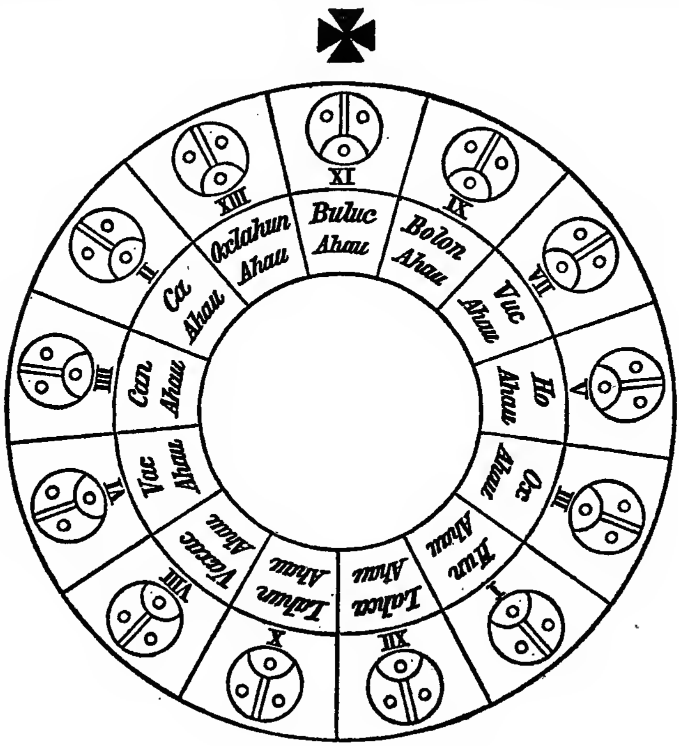

Fig. 60.

find himself returning, after the series is completed, to the same point at which he started.

Wheel given by Landa.—This method of recording time by means of a wheel is referred to by Landa. He says that the Indians had a method of counting their times and affairs by ages or katuns, which consisted of twenty years, and that they counted thirteen of these by one of their twenty letters which they called **Ahau**, not however keeping any order, but indeed reversing the order, as

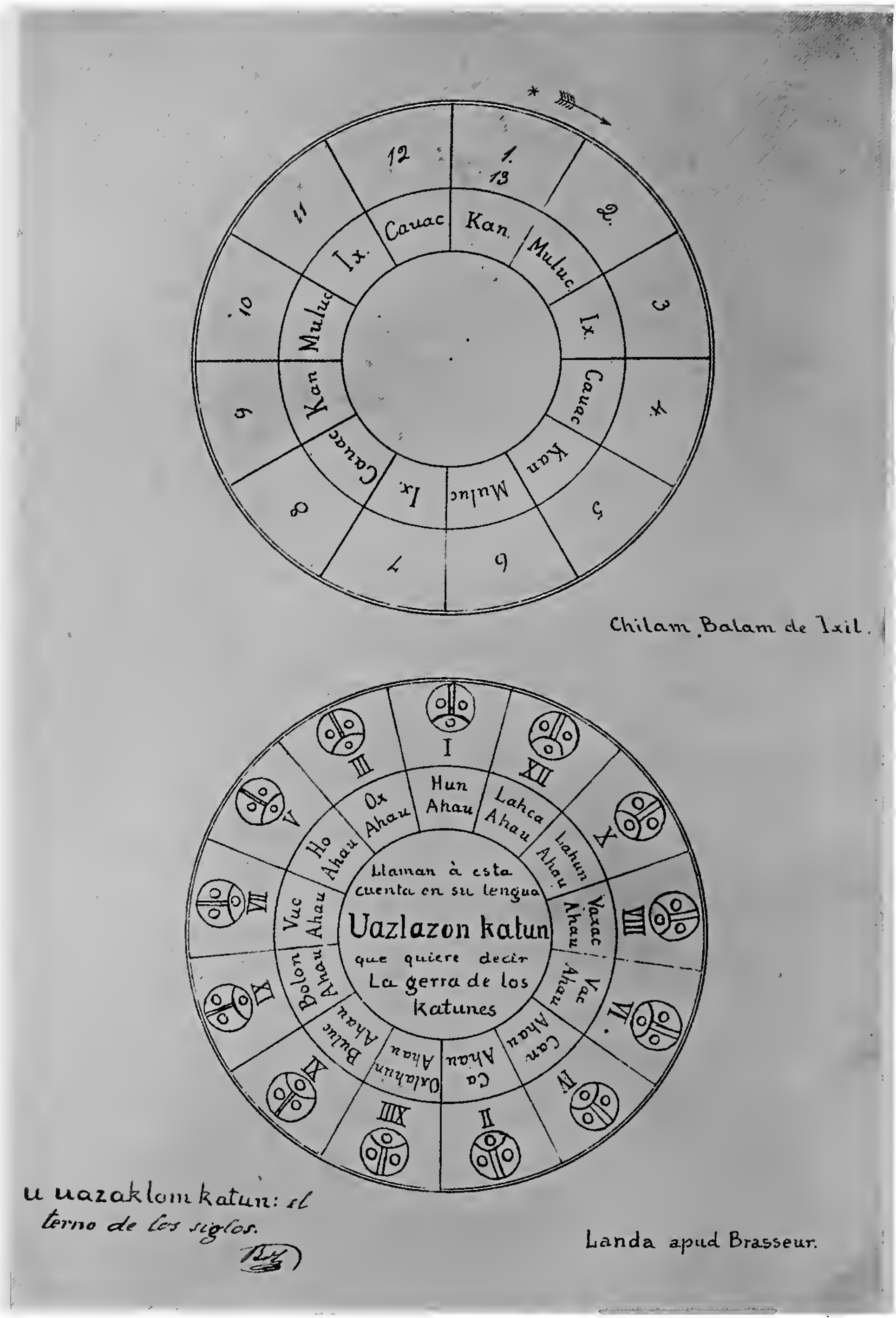
12
1.
13
2.
3
4.
5
6
7
8
9
10
11
Cauac
Kan.
Muluc
Ix.
Cauac
Kan
Muluc
Ix.
Cauac
Kan
Muluc
Ix.
Chilam Balam de Ixil.
I
XII
X
VIII
VI
IV
II
XIII
XI
IX
VII
V
III
Hun Ahau
Lahca Ahau
Lahun Ahau
Vaxac Ahau
Vac Ahau
Can Ahau
Ca Ahau
Oxlahun Ahau
Buluc Ahau
Bolon Ahau
Vuc Ahau
Ho Ahau
Ox Ahau
Llaman à esta cuenta en su lengua
Uazlazon katun
que quiere decir
La gerra de los katunes
u uazaklom katun: el terno de los siglos.
Landa apud Brasseur.

Fig. 61.

"will appear by the following round wheel."[1] He then gives a picture of the wheel, which appears in Fig. 60.

Brasseur de Bourbourg says in his translation that in the centre of the wheel were words which meant the "war of the katuns."[2] At the top of the wheel is the Katun **Buluc Ahau** (**11 Ahau**), followed in a dextral circuit by **Bolon Ahau** (**9 Ahau**), **Vuc Ahau** (**7 Ahau**), etc., until **Oxlahun Ahau** (**13 Ahau**) appears as the last katun, and then the round begins again with **Buluc Ahau.** On page 26 of Chilan Balam II is a similar wheel (Fig. 61), with the words "Landa apud Brasseur." This wheel, however, has **Hun Ahau** (**1 Ahau**) at the top, and there is no cross. Dr. Berendt translates "**Uazlazon Katun**" in the centre of the wheel as meaning "*el torno de los siglos*," or "the revolution or wheel of the katun," and not "*La gerra de los katunes*," as given in the wheel itself. In this wheel, then, the 13 katun period (No. 8) is shown in a dextral circuit.

Wheel of Book of Chilan Balam of Ixil.— Above the last-mentioned wheel there is on the same page of the manuscript volume another wheel taken from the Book of Chilan Balam of Yxil or Ixil, which represents the passage of 13 years of the 52-year period. (Fig. 61.) There is no cross over the wheel. The outer part of the wheel is divided by radial lines into 12 compartments, each of which is divided by a concentric circle into two portions. In the inner portion of each of these compartments one of the year-bearers **Kan**, **Muluc**, **Ix** and **Cauac** is placed in a dextral circuit, the series being repeated three times. In the outer parts of these compartments the numbers 1 to 13 are placed, beginning with 1 over the year-bearer **Kan** and following on in a dextral circuit until 12 is placed over **Cauac**, while 13 is placed in the same compartment as 1 in connection with **Kan**. By referring to Table VII of Chapter V, it will be seen that the years in the

[1] "No solo tenian los indios cuenta en el año y meses como queda dicho y señalado atras, pero tenian cierto modo de contar los tiempos y sus cosas por edades, las quales hazian de veynte en veynte años, contando XIII veyntes con una de las XX letras de los meses que llaman *Ahau*, sin orden sino retruecanados como pareceran en la siguiente raya redonda; llaman les a estos en su lengua *Katunes*, y con ellos tenian a maravilla cuenta con sus edades, y le fue assi facil al viejo de quien en el primero capitulo dixe avia tres cientos años acordarse dellos." (Landa, 1864, pp. 312–314.)

[2] "Llaman a esta cuenta en su lengua Uazlazon Katun que quiere dezir 'la *gerra* de los Katunes.'" (Ibid. p. 313.)

first column of the table are the same as those given in this wheel. This period of 13 years is sometimes called an indiction. It would be quite possible to use this wheel for the whole 52-year period, by imagining the outer circle, containing the numbers, to be slipped round after each 13 years have passed so as to bring the number 1 over **Muluc**, **Ix** and **Cauac** in succession.

On page 76 of this same manuscript volume is the drawing shown in Figure 62, taken from the Book of Chilan Balam of **Ixil**. The small wheel with "**Ah cuch haab**" (the year-bearers) below it contains the four year-bearers **Kan**, **Muluc**, **Ix** and **Cauac** in a sinistral circuit with the directions assigned to the four days, the east to **Kan**, the north to **Muluc**, etc., **Kan** and the east being at the top of the wheel. There are fifty-two points around the outer circle, representing the 52 years of the calendar round.

Above is a large wheel, made on the same principle as one of those which has just been described, in which the series of 13 years **1 Kan**, **2 Muluc** up to **13 Kan** are given in a sinistral circuit. In the centre is a face surrounded by rays and a circle with scallops. There are thirty of these scallops, which may show that it is the moon that is represented here. One hundred and thirty-seven points surround the outer circle. The words "**BUK XOC**" which appear between the two circles are translated by Brasseur de Bourbourg in his vocabulary as the name given to the general computation of weeks in the calendar.[1]

Just such wheels must have been before Pio Perez, when he wrote that the Indians painted a small wheel with the four hieroglyphs of the days which begin the year and with the points of direction, assigning the east to **Kan**, the north to **Muluc**, the west to **Hix** and the south to **Cauac**. He says that some suppose that when, at the end of the fourth year, **Kan** appeared again, a katun of four years had been completed, while others thought that three revolutions of the wheel with their four days and with one day more, representing 13 years in all, made a katun. Others again thought that four weeks or indictions of years made a katun, and this last opinion was that of Perez. He goes on to say that in addition to the little wheel they made another large wheel, which they also called **Buk-Xoc**, in which they placed three revolutions

[1] "Nom du comput général des semaines dane le calendrier." (Landa, 1864, p. 482.)

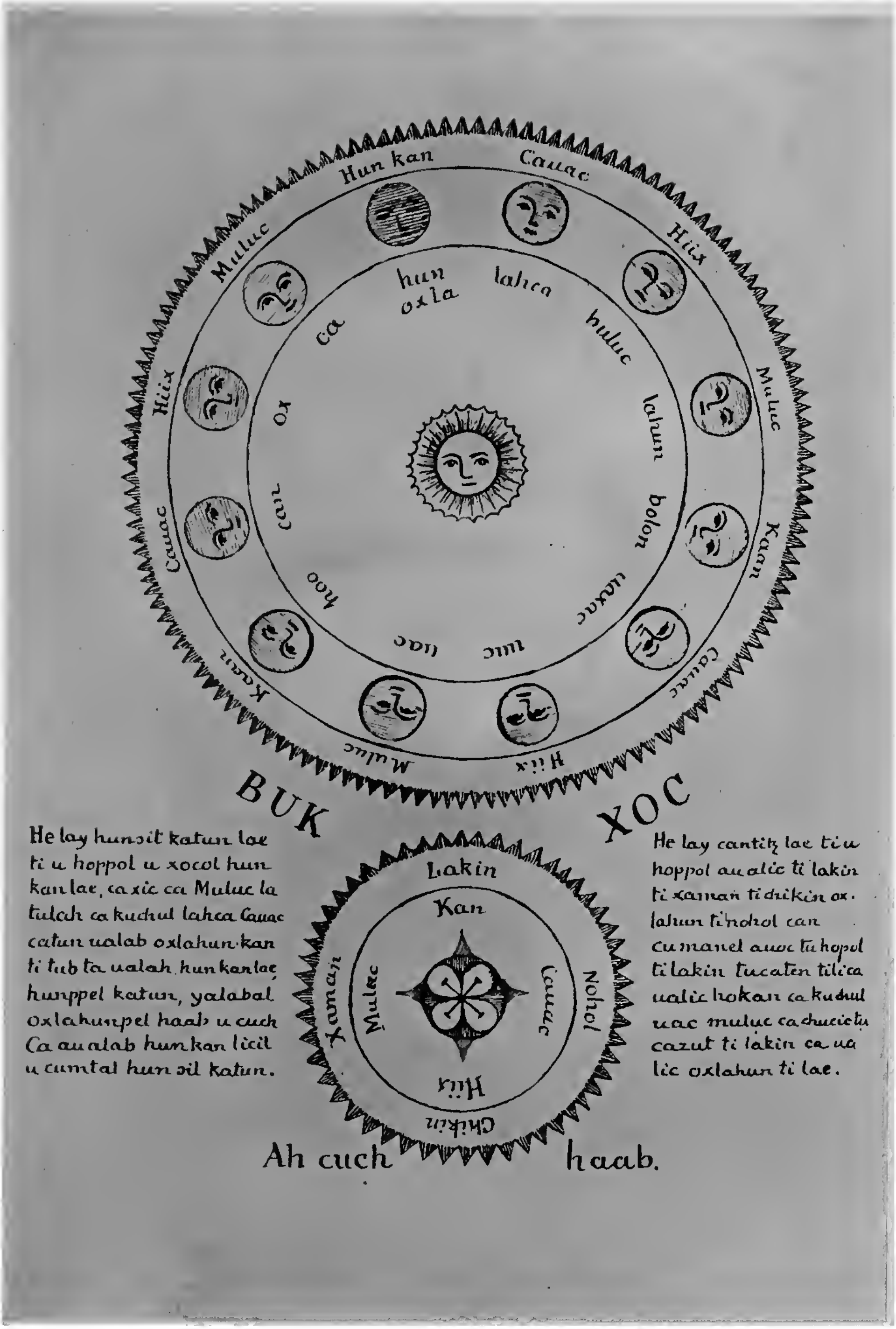
Hun kan
Cauac
Hiix
Muluc
Kaan
Cauac
Hiix
Muluc
Kaan
Cauac
Hiix
Muluc
hun
oxla
lahca
buluc
lahun
bolon
uaxac
uuc
uac
hoo
can
ox
ca
BUK
XOC
He lay hunsit katun lae ti u hoppol u xocol hun kan lae, ca xic ca Muluc la tulah ca kuchul lahca Cauac catun ualab oxlahun kan ti tub ta ualah hun kan lae, hunppel katun, yalabal oxlahunpel haab u cuch Ca aualab hun kan licil u cumtal hun sil katun.
Lakin
Kan
Xaman
Mulac
Cauac
Nohol
Hiix
Chikin
He lay cantits lae ti u hoppol a ualic ti lakin ti xaman ti chikin ox. lahun ti nohol can cu manel a uuc tu hopol ti lakin tu caten tilica ualic hokan ca kuchul uac muluc ca chucictu cazut ti lakin ca ua lic oxlahun ti lae.
Ah cuch
haab.

Fig. 62.

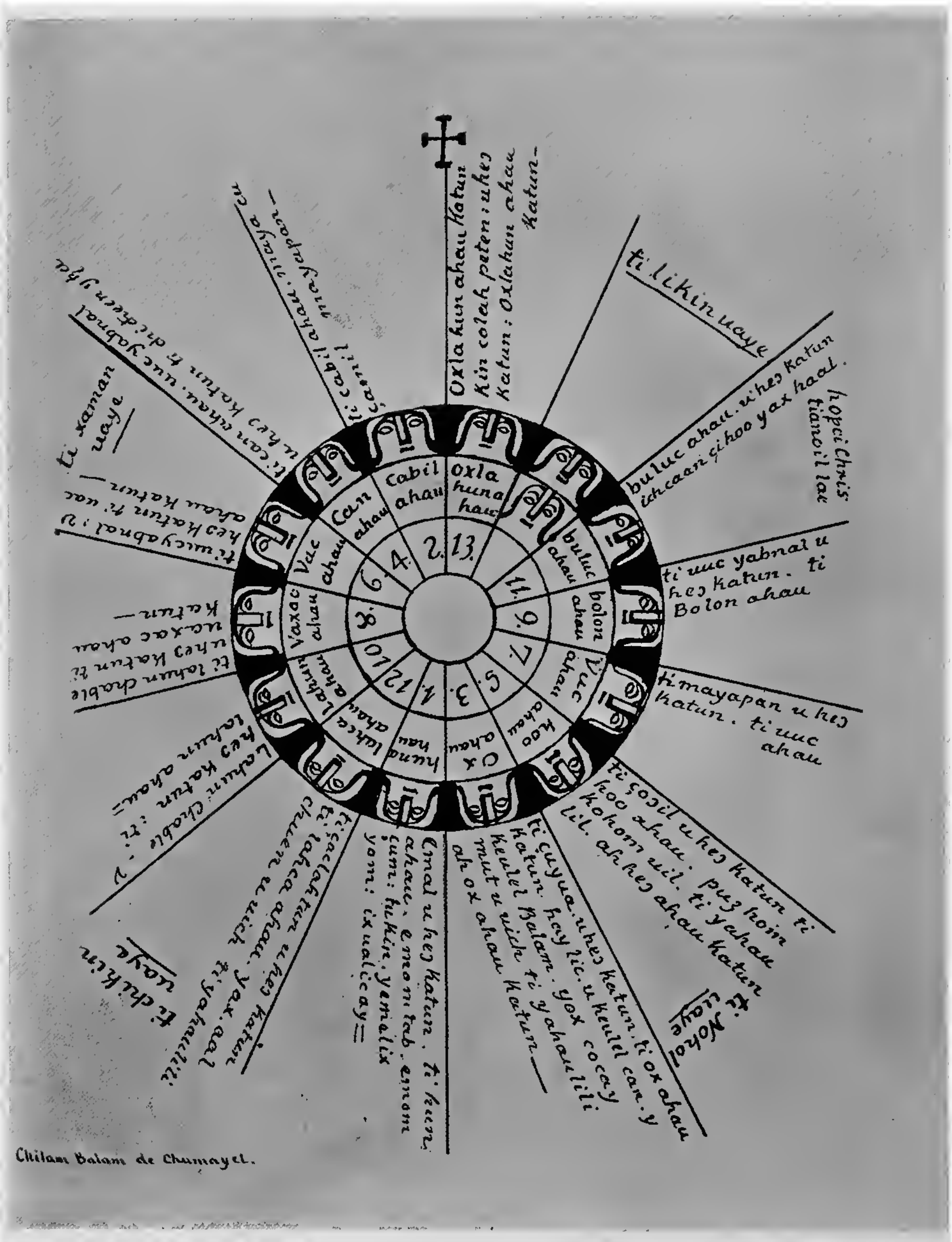
Oxla hun ahau Katun
Kin colah peten : u hes
Katun : Oxlahun ahau
Katun—
ti likin uaye
buluc ahau. u hes Katun
ich caan çihoo yax haal.
ti uuc yabnal u
hes Katun. ti
Bolon ahau
ti mayapan u hes
Katun. ti uuc
ahau
ti Nohol
uaye
ti chikin
uaye
ti xaman
uaye
Oxla
huna
hau
Cabil
ahau
Can
ahau
Vac
ahau
Vaxac
ahau
Lahun
ahau
Lahca
ahau
huna
hau
Ox
ahau
hoo
ahau
Vuc
ahau
bolon
ahau
buluc
ahau
13.
2.
4.
6.
8.
10.
12.
1.
3.
5.
7.
9.
11.
Chilam Balam de Chumayel.

Fig. 63.

of the four hieroglyphs of the smaller one, making twelve signs, to which they added **Kan** once more, making thirteen years, thus forming an indiction or week of years. Then another indiction began with **Muluc**, and finally a fourth with **Cauac** completed the katun. Except for the error of Perez in regard to the length of the katun, this is a very good description of Figure 62.[1]

Wheel of Book of Chilan Balam of Chumayel.— On page 27 of the same manuscript volume another wheel is given (Fig. 63) taken from the Book of Chilan Balam of Chumayel, in which the 13 katun period is shown. Here the wheel is divided into three concentric bands, and into fourteen compartments by radial lines. The fourteen compartments of the outer band as well as one compartment of the centre band are filled with representations of the day **Ahau** — making fifteen in all. Thirteen compartments of the centre band are occupied by the Maya words meaning **13 Ahau, 11 Ahau**, etc., in a dextral circuit, the **13** being on the top, while thirteen compartments of the inner band are occupied by the Arabic numerals 13, 11, 9, etc. (the 13 being on the top here also), the space below the fifteenth face being left vacant.

The radial lines extend beyond the circumference of the wheel, and the spaces between the lines are filled with words or sentences in the Maya language. Over the compartment which contains the fifteenth **Ahau** face there is written in the space beyond the circumference the words "**ti likin uaye**," "here is the east," **likin** or **lakin** being the Maya for "east." In the similar space beyond the compartment which contains **5 Ahau** there are written the words

[1] "Estos indios pintavan una rueda pequeña, en la cual ponian los cuatro geroglificos de los dias con que principiava el año, *Kan* al oriente, *Muluc* al norte, *Hix* al poiniente y *Cauac* al sur, para que se contasen en el mismo orden. Algunos suponen que cuando terminaba el cuarto año, habiendo vuelto otra vez el caracter *Kan*, se completaba un *Katun* ó lustro de cuatro años; otros que tres revoluciones de las de la rueda, con sus cuatro señales se contaban con una mas, haziendo asi 13 años para completar el *Katun;* otros, que cuatro semanas de años completas o indicciones enteraban el *Katun;* y esto es lo mas probable. Ademas de la rueda pequeña ya dicha, bazian otra rueda grande que llamaban tambien *buk-xoc*, en que ponian tres revoluciones de los cuatro geroglificos de la pequeña, haziendo un total de 12 signos, principiando la cuenta con el primero *Kan* y siguiendo á contarlas hasta nombrar cuatro vezes el mismo *Kan* inclusivamente, haziendo asi trece años y formando una indiccion ó semana (de años); la segunda cuenta comenzaba con *Muluc*, acabando en el mismo, y esto hazia el otro trece, y siguiendo de la misma manera llegavan a *Cauac*, y esto era un *Katun*." (Perez, 1864, pp. 394, 396.)

"ti nohol uaye," nohol being the Maya word for "south"; while the Maya words chikin (west) and xaman (north) are found in the same radial divisions of the circle as contain **12 Ahau** and **6 Ahau** respectively. In this plan the east is not exactly opposite the west, nor is the north exactly opposite the south. It is possible that this is meant to show that the points of direction with the Mayas are not what we call the cardinal points, but are the points where the sun rises and sets at the time of the summer and winter solstices. This is not certain, however, and it is possible that the circle was divided into fourteen parts merely for ease of division, and that the irregularity of the position of the directions is due to this irregular division.

Wheel of Book of Chilan Balam of Káua. — On page 98 of Chilan Balam I there is a wheel shown in Figure 64. Here the wheel is divided into two outer circular bands and into four compartments by two diameters, crossing each other at right angles and in the position of a Saint Andrew's cross. In the inner one of the outer bands the 13-katun period is represented by thirteen heads, three heads being placed in each of three compartments and four heads in the fourth. Under each head is the number of the katun (13 being at the top) in a dextral circuit. The outer of the circular bands represents the 4-year period in a sinistral circuit. In the upper division made by the diameters the first five days of the twenty are given, namely, **Kan, Chicchan, Cimi, Manik, Lamat.** These five days begin the year which has **Kan** for a year-bearer, and these five days also end it. Then comes the year which has **Muluc** for a year-bearer, and the five days, **Muluc, Oc, Chuen, Eb, Ben,** which begin and end this year, are found in the left-hand division. In the same way the five days **Ix, Men, Cib, Caban, Eznab,** which begin and end the **Ix** years, are found in the lower division, and the five days **Cauac, Ahau, Ymix, Ik, Akbal,** which begin and end the **Cauac** years, are found in the right-hand division. The directions are also marked. The east is connected with the five days of the **Kan** years, north with the five days of the **Muluc** years, west with the five days of the **Ix** year and south with the five days of the **Cauac** years.

In the centre of the wheel is a small circle, which, besides being divided by the two diameters of the large circle, is also crossed by two other diameters at right angles. This small circle has the

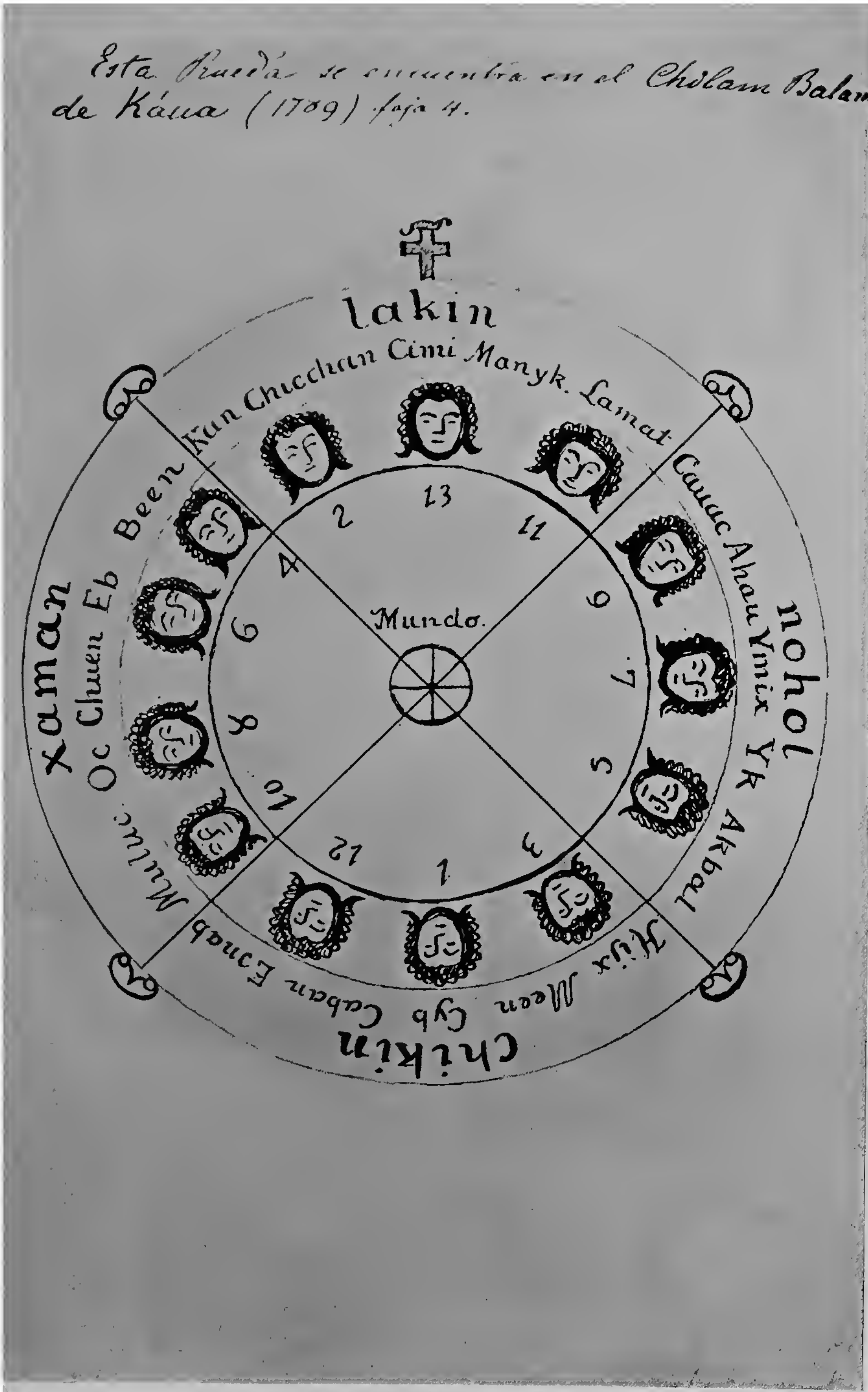
Esta Rueda se encuentra en el Chilam Balam de Kaua (1789) foja 4.
lakin
Kan Chicchan Cimi Manyk. Lamat
Cauac Ahau Ymix Yk Akbal
nohol
Hix Men Cib Caban Eznab
chikin
Muluc Oc Chuen Eb Been
xaman
Mundo.
13
11
9
7
5
3
1
12
10
8
6
4
2

Fig. 64.

word "*mundo*" over it, and represents the earth from which the directions may be supposed to be reckoned.

Wheel of Codex Tro-Cortesianus. — An example of the wheel, as representing the Tonalamatl, or 260-day period, is found in Tro-Cor. 75–76, though the wheel here takes on a squarish form. There is a smaller square or circle in the centre of the page, and the days of the Tonalamatl run forwards and backwards between the corners of the inner circle and the corners of the page, six-day forms being grouped at each corner of the page and four at each corner of the inner circle. The other 220 days of the Tonalamatl are indicated by dots connecting the day forms which are given.

At the lower left-hand corner of the inner circle is **1 Ymix**, and the days follow with intervals of 11 and 0 days in a sinistral circuit till **13 Ahau** is reached, the latter day form being placed next on the left of the day with which the series begins. Thus at the bottom of the page directly below **1 Ymix** is **13 Ben**, followed at the right by **1 Ix**; then the series runs over to the right lower corner of the page where **13 Cimi** is found, and at its right is a glyph which is probably **1 Manik**, though it is somewhat erased. Then at the right-hand lower corner of the inner circle is **13 Cauac** with **1 Ahau** on its right. Proceeding again to the right-hand lower corner of the page we find **13 Eb** with **1 Ben** above it, and again proceeding to the right-hand lower corner of the inner circle **13 Chicchan** is found, with **1 Cimi** close above it. Again, on the right-hand lower corner of the page is **13 Eznab** with **1 Cauac** above it. Thence the series runs to the upper right-hand corner of the page to **13 Chuen** with **1 Eb** above it, and thence the series runs in a sinistral circuit with the above intervals, so that the whole series appears as in the following table:

TABLE XXXIII

TRO-CORTESIANUS, 75–76

Inner circle,	lower left corner	**1 Ymix**
Page	" " "	**13 Ben**
"	" " "	**1 Ix**
"	lower right corner	**13 Cimi**
"	" " "	**1 Manik**
Inner circle	" " "	**13 Cauac**
" "	" " "	**1 Ahau**
Page	" " "	**13 Eb**
"	" " "	**1 Ben**

TABLE XXXIII (*continued*)

Inner circle, lower right corner	**13 Chicchan**
" " " " "	**1 Cimi**
Page " " "	**13 Eznab**
" " " "	**1 Cauac**
" upper right corner	**13 Chuen**
" " " "	**1 Eb**
Inner circle " " "	**13 Kan**
" " " " "	**1 Chicchan**
Page " " "	**13 Caban**
" " " "	**1 Eznab**
Inner circle " " "	**13 Oc**
" " " " "	**1 Chuen**
Page " " "	**13 Akbal**
" " " "	**1 Kan**
" upper left corner	**13 Cib**
" " " "	**1 Caban** (nearly effaced)
Inner circle " " "	**13 Muluc**
" " " " "	**1 Oc**
Page " " "	**13 Ik** (effaced)
" " " "	**1 Akbal** (effaced)
Inner circle " " "	**13 Men** (effaced)
" " " " "	**1 Cib** (partly effaced)
Page " " "	**13 Lamat**
" " " "	**1 Muluc**
" lower left corner	**13 Ymix**
" " " "	**1 Ik**
Inner circle " " "	**13 Ix**
" " " " "	**1 Men**
Page " " "	**13 Manik**
" " " "	**1 Lamat**
Inner circle " " "	**13 Ahau**

As has been said, the spaces between the day forms are filled with dots where the intervals of eleven days occur, and in each case these dots should be eleven in number. The intervals of eleven days occur twenty times, but the number of dots is irregular. There seem to be eleven dots in but four of the intervals while there are twelve dots in eleven intervals and thirteen in the other five intervals, though this count is not absolutely certain, as some of the dots may be erased. This irregularity would seem to arise from carelessness on the part of the artist.

The inner circle or square contains the twenty day forms in the following order, beginning with **Ymix** in the upper right-hand corner. The days probably run in a sinistral circuit.

Top	**Ymix**	(4)	**Chicchan**	(4)	**Muluc**	(4)	**Ben**	(19)	**Eb**	(9)[1]
Left side	**Cimi**	(16)	**Ik**	(8)	**Oc**	(4)	**Ix**	(4)	**Eznab**	(8)
Bottom	**Akbal**	(4)	**Manik**	(4)	**Chuen**	(4)	**Men**	(4)	**Cauac**	(4)
Right side	**Kan**	(4)	**Lamat**	(9)	**Caban**	(3)	**Ahau**	(16)	**Cib**	(8)

It would seem as if the artist who drew the wheel had been careless. As it stands, the five day signs at the bottom of the inner circle form a regular series in which each day is four days distant from the next preceding day, and the series returns into itself, the first day being four days from the last. There are six other cases in the other rows in which the distance between two successive days is also four. But if **Eb** on the top and **Caban** on the right-hand side were to change places so that the two series would run, **Ymix, Chicchan, Muluc, Ben** and **Caban**, and the right-hand series would run, **Kan, Lamat, Eb, Ahau** and **Cib**, the series of days on the top would show distances of four, and the series on the right would do the same, except that **Ahau** and **Cib** should change places. The left-hand series would also consist of the proper days to form a similar series, but the order of the days should run, **Cimi, Oc, Ix, Eznab, Ix**, and not **Cimi, Ix, Oc, Ix, Eznab**, as they are written.

The error of misplacing **Eb** and **Caban** can be accounted for, since both these days are fourth in the second and third columns respectively, in the list of days given by Pio Perez,[2] where the first day is **Kan**. A careless scribe might therefore have written one for the other, owing to the propinquity of the days in his list, but the misplacing of the other days is more difficult to explain. It may be that the series of the five days with distances of four from each other was so well known that it was thought immaterial in what order the forms of the days were written, provided that all the forms were given. It is also possible that there is some reason for placing the days in the given order which has not yet been discovered.

At all events we have a series on the bottom of the inner circle which shows a distance of 4 between the days. This would indicate a series which has a distance of 104 days,[3] if each day had

[1] The numbers in parentheses represent the distance (not the intervals) between the days, those after the last days in the rows representing the distance from the last day of each row to the first day of the same row.

[2] Perez, 1864, p. 370.

[3] See list of 20 days in four columns in Dr. 32a. Here each column contains five days which appear in the four series on Tro-Cor. 75–76, if the **Eb** and **Caban**

the same number attached to it as is the case with many of the day columns of the Dresden and Tro-Cortesianus codices. Five distances of 104 days equal 520 days or 2 Tonalamatls, and if a like distance is recorded on the top and two sides, we should have 4 × 520 or 2080 days, which is equal to 8 Tonalamatls.

A series of days with a distance of 4 between them would also give the days with which successive Venus synodical revolutions end. Thus if one revolution ends with **Akbal**, the next one would end with **Manik**, the next with **Chuen**, and so on. The bottom line might then represent five Venus revolutions, or 2920 days, equal to eight solar years.[1] Then the days of the whole inner circle might represent four times this length of time or 20 synodical revolutions or 32 solar years. But this would not be the case with a series of days arranged in the order of those in the inner circle (with the modification which has been made) if the same number is attached to each day, since the number of the day which ends any synodical revolution of Venus will be 12 more than the number of the day which ended the next preceding revolution, and 12 less than the number of the day which will end the next following revolution. This is due to the fact that the number of days in such a revolution contains 44 × 13 days and 12 days over. It is very probable therefore that Tro-Cor. 75–76 do not refer to the planet Venus.

The Mexicans also used in their calendar all the forms of continuous series which were used by the Mayas except the two enumerated in Nos. 7 and 8. This would naturally be expected, as the Mexican and Maya calendars were based on the same system. The Mexicans gave expression to the series in various ways, including that of wheels. But, as far as we know, the Mexicans used no method of recording time like the long count of the Mayas, built up of kins, uinals, tuns, katuns and cycles, and therefore they had no such plan of recording time as is found in the thirteen-katun count.

change places. Each column has the red number 13 over it, giving a distance of 104 days between the days, or 520 days in each column.

[1] See Dr. 46–50.

NOTE. I am indebted to the kindness of Dr. George Byron Gordon of the University of Pennsylvania, for the reproduction of Figures 61, 62, 63 and 64.

APPENDIX XII

SUNDRIES

The Days of the Maya and other Calendars

Maya.	Mexican.	Quiché and Cakchiquel.[1]	Chiapas and Soconusco.[1]
Ymix	Cipactli	Imox	Imox or Mox
Ik	Ehecatl	Ig	Igh or Ygh
Akbal	Calli	Akbal	Votan
Kan	Cuetzpalin	Qat	Chanan or Ghanan
Chicchan	Coatl	Can	Abah or Abagh
Cimi	Miquiztli	Camey	Tox
Manik	Mazatl	Quieh	Moxic
Lamat	Tochtli	Ganel	Lambat
Muluc	Atl	Toh	Molo or Mulu
Oc	Itzcuintli	Tzy	Elab or Elah
Chuen	Ozomatli	Batz	Batz
Eb	Malinalli	Ci or Balam	Evob or Enob
Ben	Acatl	Ah	Been
Ix	Ocelotl	Yiz or Itz	Hix
Men	Quauhtli	Tziquin	Tziquin
Cib	Cozcaquauhtli	Ahmak	Chabin or Chahin
Caban	Ollin	Noh	Chic or Chiue
Eznab	Tecpatl	Tihax	Chinax
Cauac	Quiahuitl	Caok	Cahogh or Cabogh
Ahau	Xochitl	Hunahpu	Aghual

Revolutions of Planets.

Venus	Synodical revolution,		583.920 days	(584)	Sidereal revolution,		224¾
Mars	"	"	779.936 "	(780)	"	"	687
Mercury	"	"	115.877 "	(116)	"	"	88
Jupiter	"	"	398.867 "	(399)	"	"	4332½
Saturn	"	"	377.750 "	(378)	"	"	10,759

[1] Bancroft, 1886, Vol. II, p. 767.

Lengths of Various Years.

Tropical Year	365 d. 5 hrs. 48 min. 46.04 sec. = 365.2421995+ days	from one tropic or equinox to the same.
Sidereal Year	365 d. 6 hrs. 9 min. 9.3 sec. = 365.25636 days	from any fixed star returning to same.
Anomalistic Year	365 d. 6 hrs. 13 min. 48 sec. = 365.2596 days	from one perihelion to another.
Intercalary Lunar Year	384 days	13 lunar months.
Lunar Astronomical Year	354 d. 8 hrs. 48 min. 36 sec. = 354.3671 days	12 lunar synodical months.

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Copan	Plates.	Volume	I.
Quirigua	"	"	II.
Ixkun	"	"	II.
Yaxchilan (Menché)	"	"	II.
Chichen Itza	"	"	III.
Tikal	"	"	III.
Palenque	"	"	IV.

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Piedras Negras	Volume	II.
Yaxchilan	"	II.
El Cayo	"	II.
La Mar	"	II.
Naranjo	"	IV.
Tikal	"	IV.
Seibal	"	IV.

PLATES

NOTE

Reference is made to the glyphs of the codices as follows:

The number of the page on which the glyph appears is given with the letter of the division (a, b, c, d) into which the page is divided, reading from top to bottom. If more accurate reference is needed, the number following that of the page designates the perpendicular column from left to right in which the glyph is found, and the third number designates the horizontal row, numbered from the top of the division. Where the page is not divided into divisions, the rows are numbered from the top of the page unless otherwise stated. On Dr. 46–50, thirteen rows of day glyphs are counted on each page above the first row of month glyphs.

Reference is made to the glyphs in the inscriptions by mentioning the ruined city and the monument where the glyph is found, with the place of the glyph accurately designated by marking the perpendicular columns of glyphs with the letters A, B, C, etc., from left to right, and by numbering the horizontal rows from top to bottom. When glyphs on different sides of the same monument are referred to, the side is often designated by the point of the compass towards which it faces, thus, (e), (w), etc. In some cases, however, where the glyphs are carved round two or more sides of a monument, the columns are marked on all the sides consecutively with letters. At times it has seemed advisable to use the system of notation used by A. P. Maudslay in Biologia Centrali-Americana, Archæology. In other cases, where the glyphs do not run at right angles with the sides of the monument, a different method of notation has been adopted.

The following list shows how the glyphs on the inscriptions are referred to in all cases except where the notation is in the regular form:

Copan.

Stela A.	Cols. A–B on North side, C–F on West side, G–H on South side.
B.	A on North side, B on South side.
C.	A–B on West side, C–D on East side.
E.	A–B on back, C on left side, D on right side.
F.	A on one side, B on the other.
H.	A–D on East side.
I.	A–D on East side, E–F on South side, G–H on North side.

Stela J. (w).	A. P. Maudslay's method.
(n), (s).	A–B on North side, C–D on South side.
(e).	A–B, following A. P. Maudslay's method as rearranged.
K.	A. P. Maudslay's method.
N.	A on East side, B on West side.
N, base.	A. P. Maudslay's method.
P.	A–B on East side, C–D on South side, E–F on North side.
Altar R.	A. P. Maudslay's method.
S.	A. P. Maudslay's method.
Z.	A–B on one side, C–F on face, G–H on the other side.
Stela 1.	A–B on West side, C on South side, D on North side.
2.	A–B on face, C–D on one side, E–F on the other side.
6.	A–B on East side, C on South side, D on West side.
7.	A–B on West side, C–D on North side, E–F on South side.
9.	A–B on face, C–D on one side, E–F on the other side.
10.	A–H running round the four sides.

Quirigua.

Animal B.	A. P. Maudslay's method.
Stela C, base.	A. P. Maudslay's method.
J.	A–D on face, E–F on one side, G–H on the other side.
Altar L.	1–12, the glyphs of the outer circle, beginning with the upper glyph on the left, and running round the circle to the upper glyph on the right. 13–22, the interior glyphs, beginning with the upper glyph on the left and running round the circle to the upper glyph on the right.

Tikal.

Round Altar.	1–31, the glyphs on the outer circle, beginning with the glyph directly over the two glyphs near the top of the inner circle of the altar, and running round the circle to the right.

INDEX OF GLYPHS ON PLATE I

DAY SIGNS — CODICES. YMIX — CHICCHAN

YMIX

1. Landa, p. 242.
2. Dr. 4a.
3. 33b.
4. 35b.
5. 56b.
6. Tro-Cor. 14b.
7. 91b.
8. C. B.[1]
9. "
10. "
11. "

IK

1. Landa, p. 242.
2. Dr. 2b.
3. 15b.
4. Tro-Cor. 71a.
5. Dr. 73b.
6. Tro-Cor. 13b.
7. 111b.
8. 10b.
9. 20a.
10. 65a.
11. 109a.
12. 99b.
13. 103a.
14. 47b.
15. 49a.
16. 51b.
17. 75.
18. C. B.
19. "
20. "
21. "

AKBAL

1. Landa, p. 242.
2. Dr. 5b.
3. Tro-Cor. 17b.
4. Dr. 5c.
5. 22b.
6. 72a.
7. Tro-Cor. 108b.
8. 63c.
9. C. B.
10. "
11. "

KAN

1. Landa, p. 242.
2. Dr. 6b.
3. 23b.
4. Tro-Cor. 45b.
5. 47c.
6. 83b.
7. 24c.
8. 104c.
9. C. B.
10. "
11. "

CHICCHAN

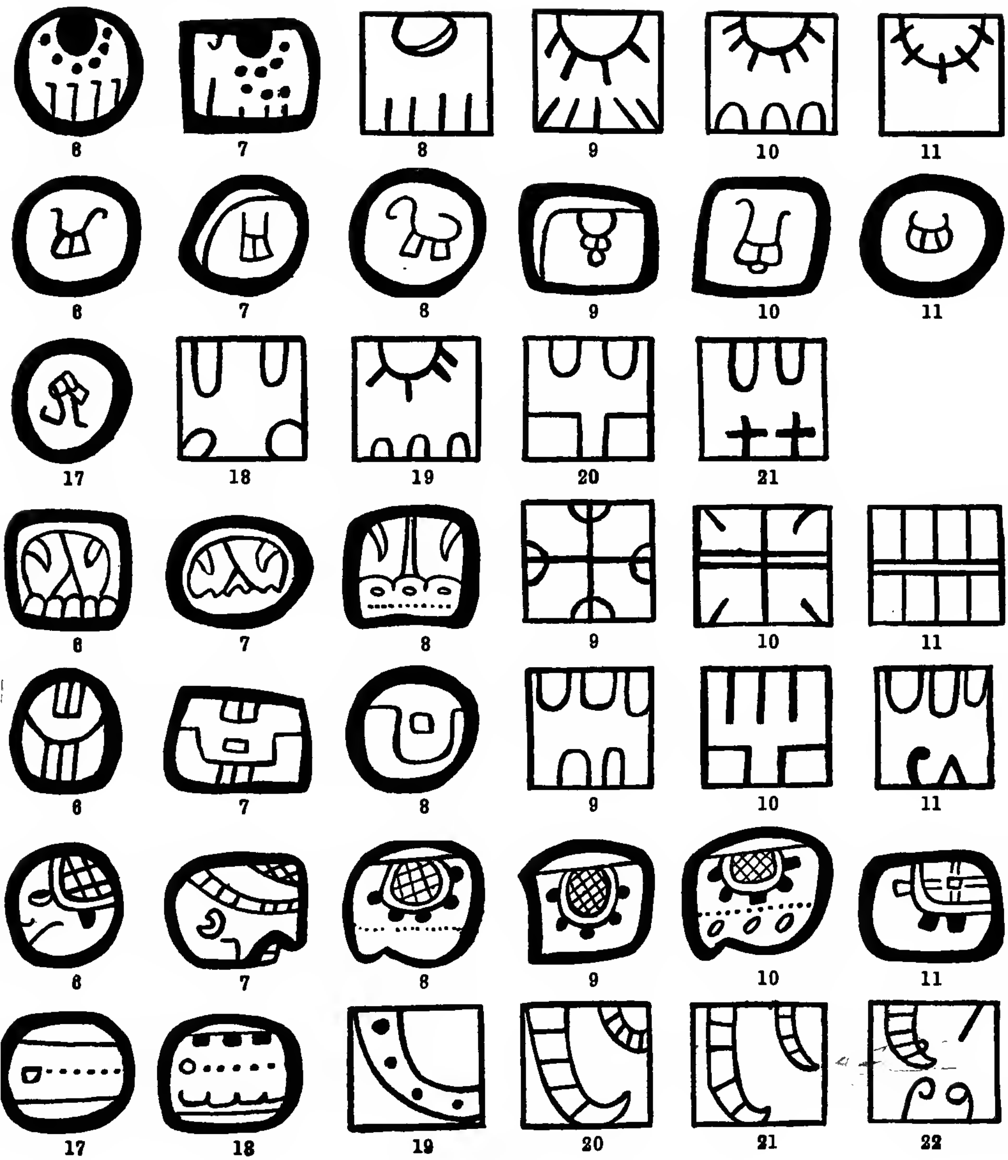
1. Landa, p. 242.
2. Tro-Cor. 20c.
3. Dr. 43c.
4. Tro-Cor. 31a.
5. 15b.
6. 16b.
7. 26d.
8. Dr. 61c.
9. 63c.
10. 63c.
11. Tro-Cor. 30b.
12. Dr. 31b.
13. Tro-Cor. 45a.
14. Dr. 64a.
15. 4a.
16. 9c.
17. Tro-Cor. 104a.
18. 107a.
19. C. B.
20. "
21. "
22. "

[1] Glyphs indexed "C. B." are taken from Brinton, 1882a, pp. 16–17.

PLATE I

DAY


YMIX
1 2 3 4 5
IK
1 2 3 4 5
12 13 14 15 16
AKBAL
1 2 3 4 5
KAN
1 2 3 4 5
CHICCHAN
1 2 3 4 5
12 13 14 15 16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21
22

INDEX OF GLYPHS ON PLATE II

DAY SIGNS — CODICES. CIMI — OC

CIMI

1. Landa, p. 242.
2. Tro-Cor. 81c.
3. 58b.
4. 47b.
5. 65a.
6. 23b.
7. 14b.
8. 108c.
9. Dr. 45a.
10. Tro-Cor. 79a.
11. 83c.
12. Dr. 63a.
13. 70b.
14. 44b.
15. 12b.
16. Tro-Cor. 82b.
17. 86c.
18. 87a.
19. 85c.
20. Dr. 12a.
21. 46a.
22. Tro-Cor. 44c.
23. Dr. 10c.
24. 58b.
25. C. B.
26. "

MANIK

1. Landa, p. 242.
2. Dr. 4c.
3. 28a.
4. 32b.
5. Tro-Cor. 21c.
6. 83a.
7. 89c.
8. 102b.
9. 97d.
10. C. B.
11. "

LAMAT

1. Landa, p. 242.
2. Dr. 47a.
3. Tro-Cor. 5a.
4. 38a.
5. Dr. 13b.
6. Tro-Cor. 38b.
7. Dr. 17c.
8. 47a.
9. 47a.
10. C. B.
11. "

MULUC

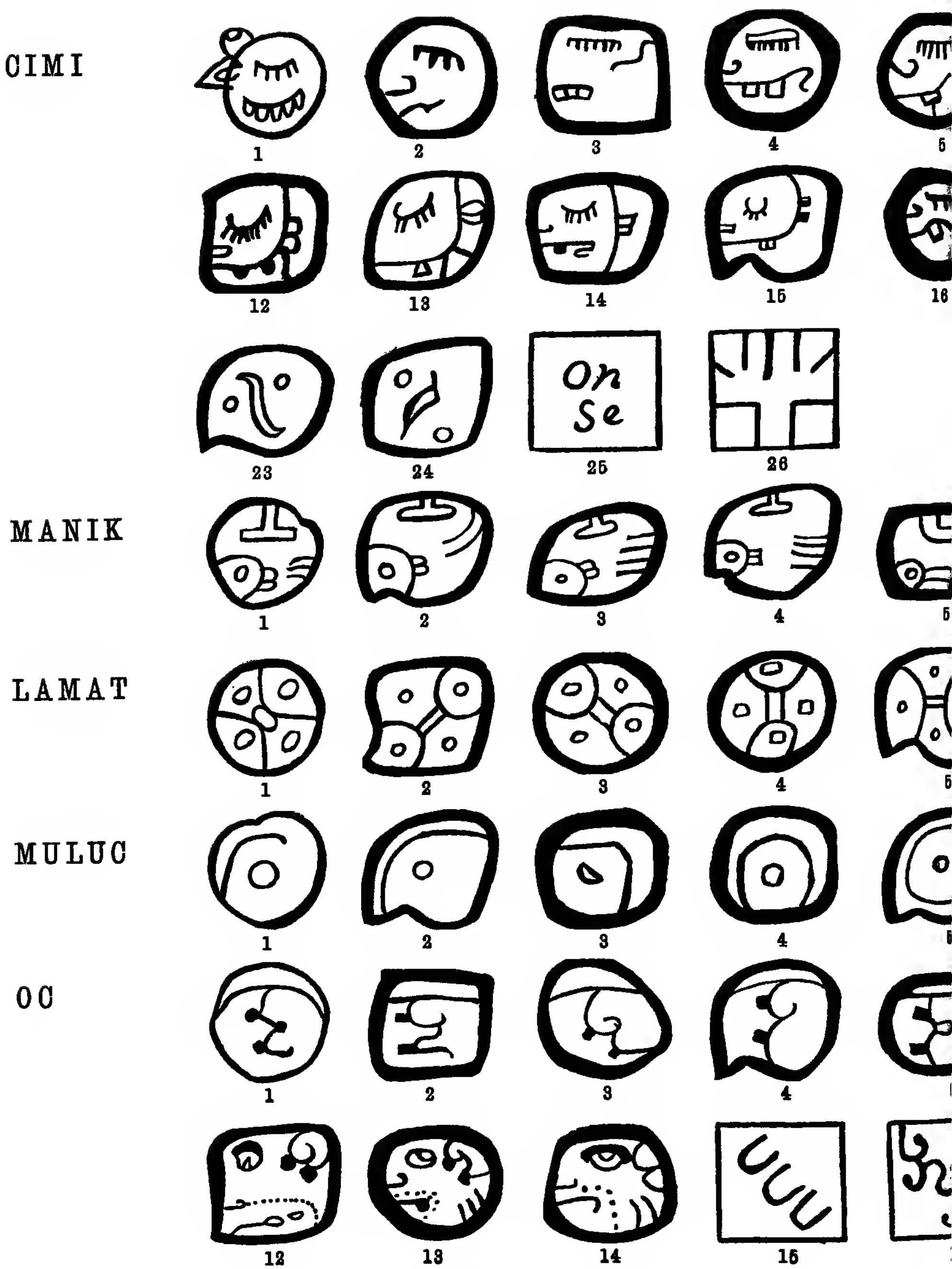
1. Landa, p. 244.
2. Dr. 13a.
3. Tro-Cor. 15b.
4. 15b.
5. Dr. 53a.
6. Tro-Cro. 99c.
7. Dr. 58a.
8. C. B.
9. "
10. "
11. "

OC

1. Landa, p. 244.
2. Tro-Cor. 49b.
3. 22d.
4. Dr. 12b.
5. Tro-Cor. 108c.
6. 32a.
7. Dr. 47a.
8. Tro-Cor. 64a.
9. Dr. 22a.
10. 58a.
11. 12a.
12. 45a.
13. Tro-Cor. 45a.
14. 45c.
15. C. B.
16. "
17. "
18. "

PLATE II

DAY



CIMI
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12
13
14
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16
23
24
On Se
25
26
MANIK
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2
3
4
5
LAMAT
1
2
3
4
5
MULUC
1
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OC
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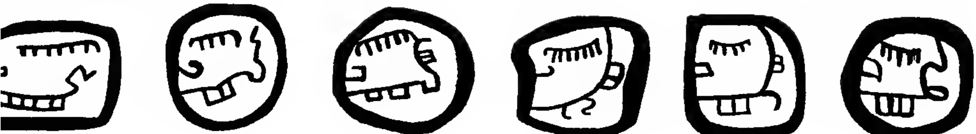

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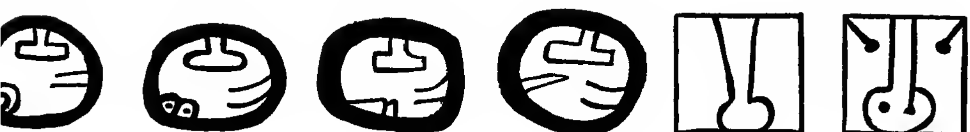

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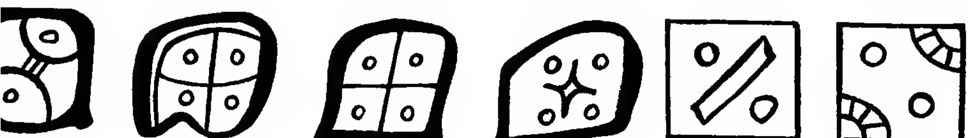

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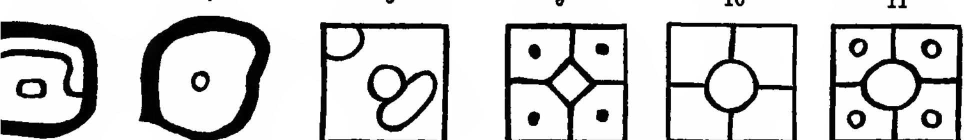
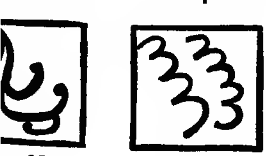


6 7 8 9 10 11

6 7 8 9 10 11



17 18

INDEX OF GLYPHS ON PLATE III

DAY SIGNS — CODICES. CHUEN — MEN

CHUEN

1. Landa, p. 244.
2. Dr. 55a.
3. Tro-Cor. 15b.
4. 50b.
5. Dr. 2a.
6. 6c.
7. 10b.
8. Tro-Cor. 89a.
9. C. B.
10. "
11. "

EB

1. Landa, p. 244.
2. Dr. 12a.
3. 71.
4. Tro-Cor. 33a.
5. 49c.
6. 111c.
7. Dr. 54a.
8. 48a.
9. Tro-Cor. 13b.
10. 15b.
11. 18b.
12. 92b.
13. 96c.
14. Dr. 42c.
15. Tro-Cor. 39b.
16. Dr. 48a.
17. Tro-Cor. 76.
18. C. B.
19. "
20. "
21. "

BEN

1. Landa, p. 244.
2. Dr. 4a.
3. 25b.
4. 32a.
5. Tro-Cor. 13b.
6. 14b.
7. 24d.
8. 67b.
9. 106b.
10. C. B.
11. "

IX

1. Landa, p. 244.
2. Tro-Cor. 23b.
3. 37.
4. 27b.
5. 14b.
6. 15b.
7. 49b.
8. Dr. 64a.
9. 4b.
10. 12b.
11. 52b.
12. 64a.
13. 44b.
14. Tro-Cor. 89a.
15. 25c.
16. 16a.
17. 81a.
18. 82a.
19. 103c.
20. 64a.

IX (*continued*)

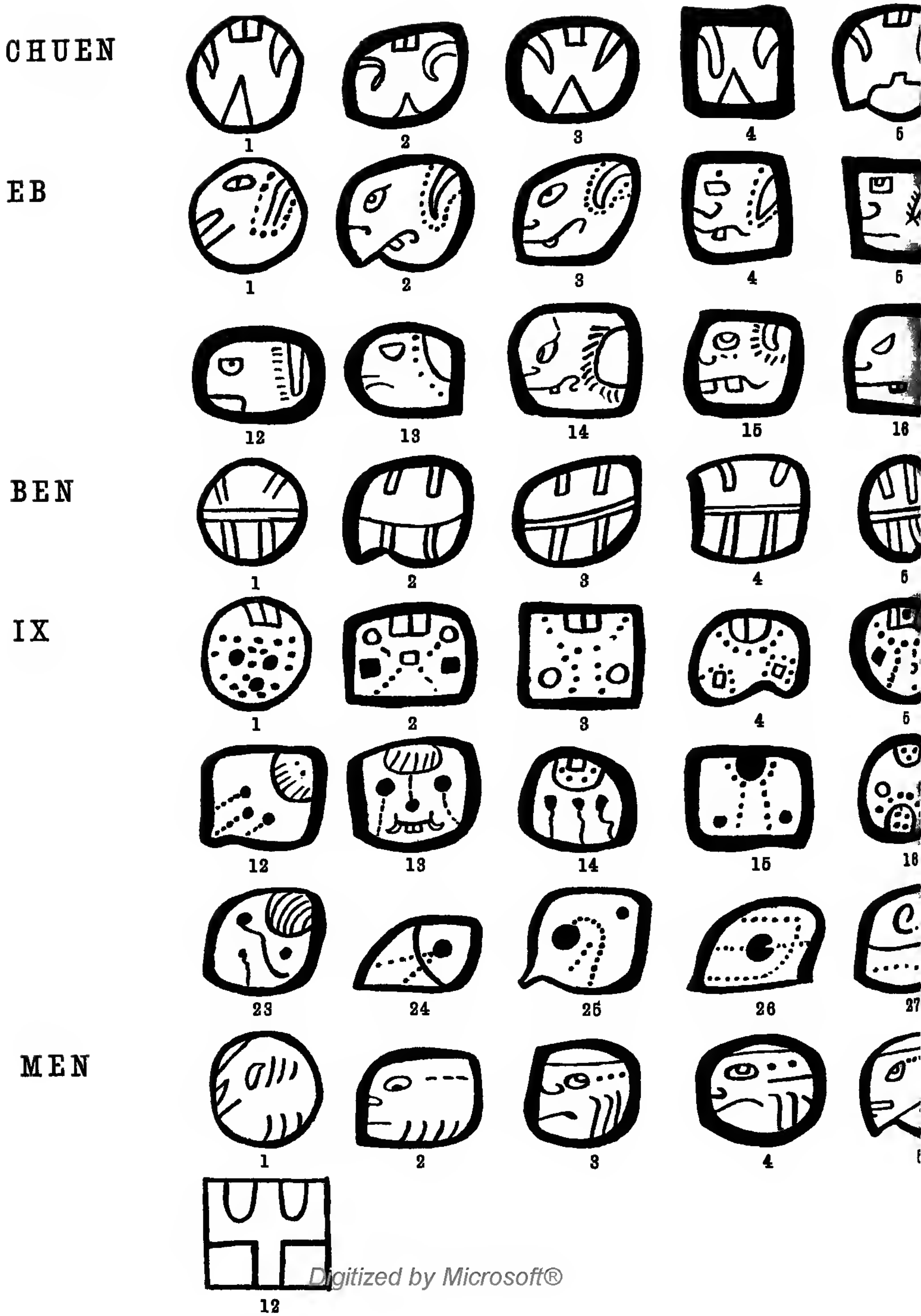
21. Dr. 35c.
22. 71a.
23. 59c.
24. 48a.
25. 48a.
26. 48a.
27. 48a.
28. Tro-Cor. 45c.
29. C. B.
30. "
31. "
32. "

MEN

1. Landa, p. 244.
2. Dr. 57b.
3. Tro-Cor. 14b.
4. 83a.
5. Dr. 5b.
6. Tro-Cor. 89a.
7. Dr. 30b.
8. 10b.
9. 36c.
10. C. B.
11. "
12. "

PLATE III

DAY


CHUEN
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EB
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12
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14
15
16
BEN
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IX
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MEN
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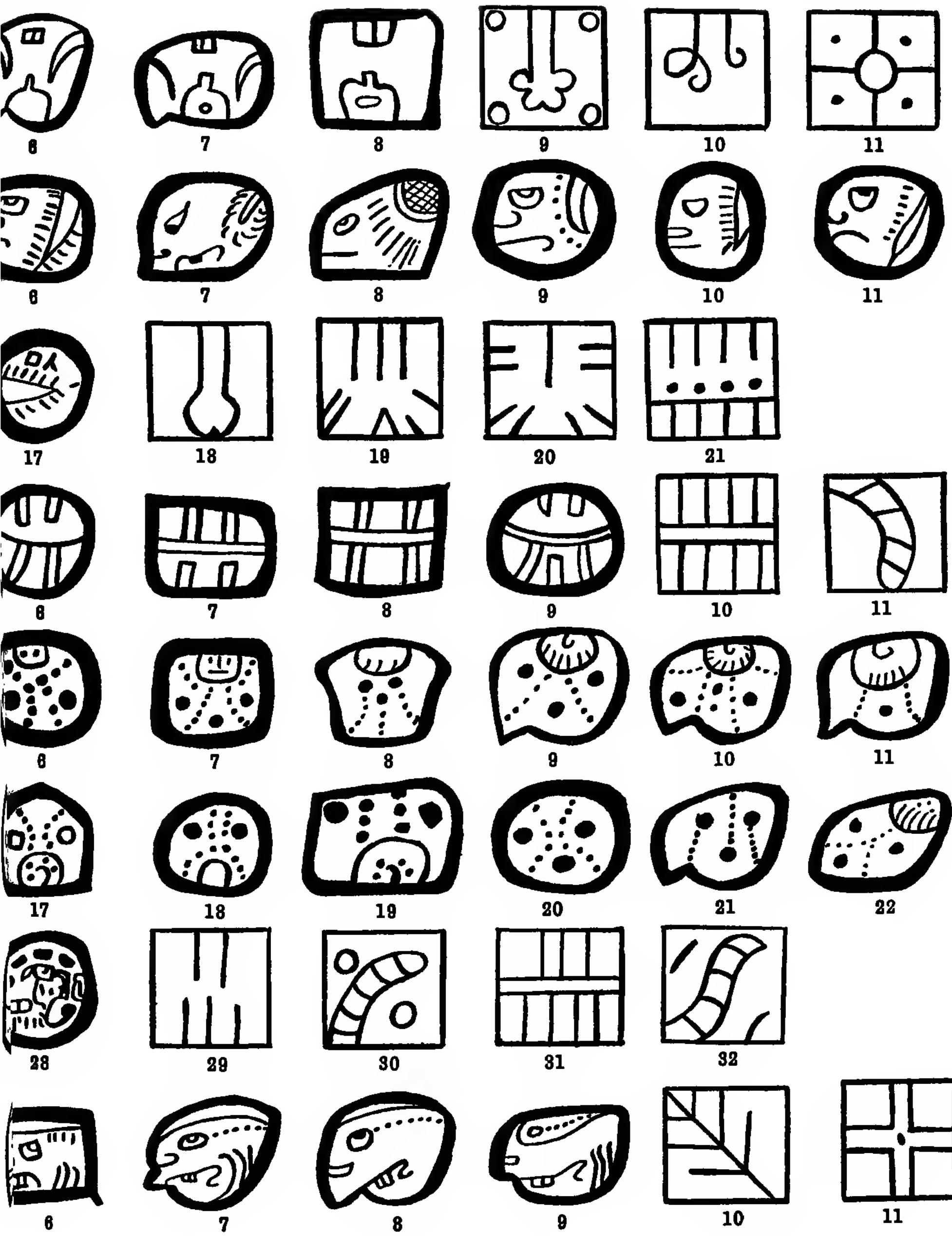
12


6 7 8 9 10 11
6 7 8 9 10 11
17 18 19 20 21
6 7 8 9 10 11
6 7 8 9 10 11
17 18 19 20 21 22
28 29 30 31 32
6 7 8 9 10 11

INDEX OF GLYPHS ON PLATE IV

DAY SIGNS — CODICES. CIB — AHAU

CIB

1. Landa, p. 244.
2. Dr. 6b.
3. 42c.
4. Tro-Cor. 14b.
5. 14b.
6. 30a.
7. Dr. 54a.
8. Tro-Cor. 101d.
9. 15a.
10. C. B.
11. "
12. "
13. "

CABAN

1. Landa, p. 244.
2. Dr. 72b.
3. 15b.
4. Tro-Cor. 71a.
5. Dr. 26.
6. 57a.
7. 54a.
8. Tro-Cor. 10b.
9. 109a.
10. C. B.
11. "

EZNAB

1. Landa, p. 244.
2. Dr. 2b.
3. 5c.
4. Tro-Cor. 13b.
5. Dr. 22c.
6. Tro-Cor. 26c.
7. 103b.
8. 51c.
9. C. B.
10. "
11. "

CAUAC

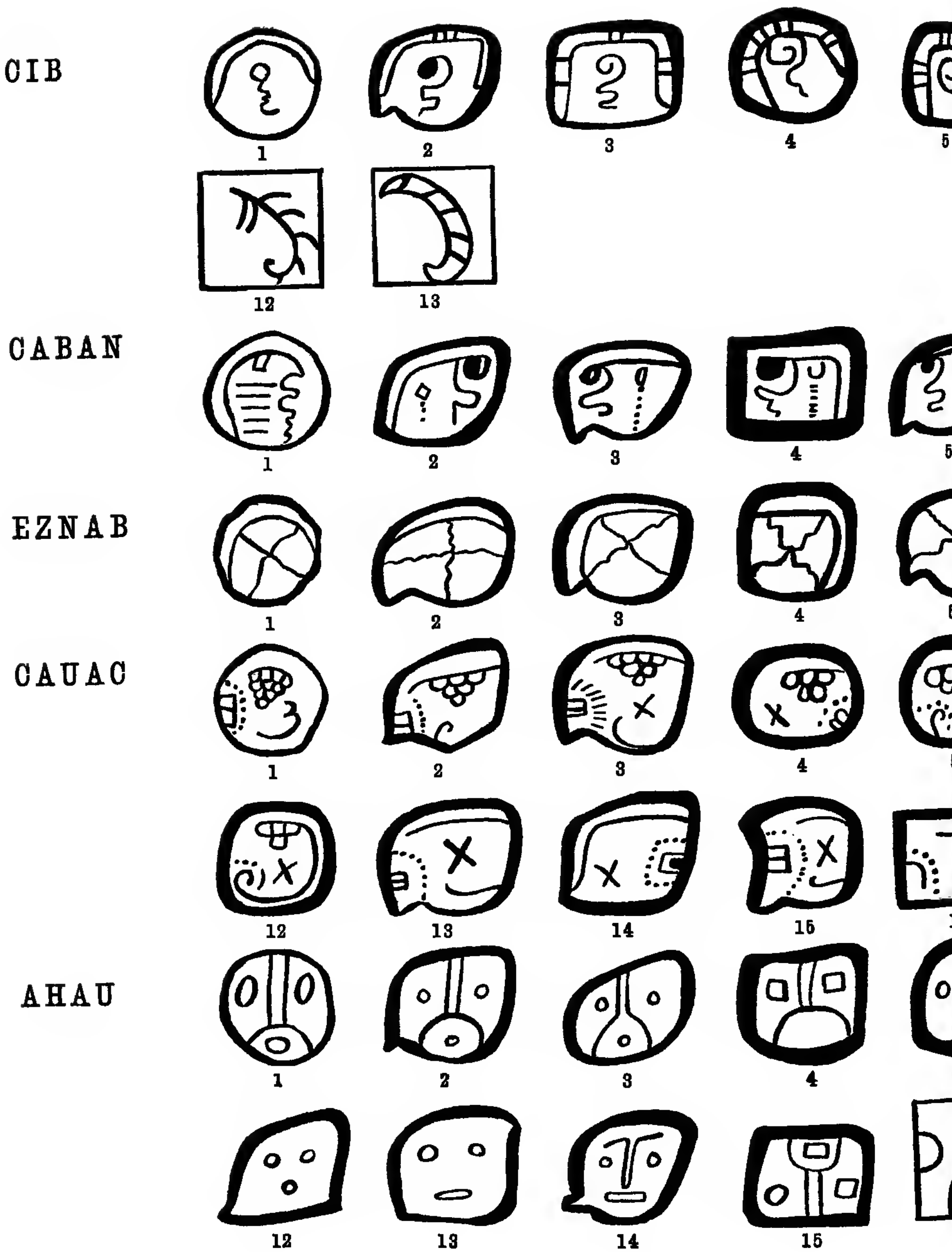
1. Landa, p. 244.
2. Dr. 36c.
3. 10b.
4. Tro-Cor. 10a.
5. 14b.
6. 15b.
7. 6b.
8. Dr. 56b.
9. Tro-Cor. 29b.
10. 24a.
11. 17b.
12. 81a.
13. Dr. 6c.
14. 56a.
15. 64c.
16. 34b.
17. 48a.
18. C. B.
19. "

AHAU

1. Landa, p. 246.
2. Dr. 24.
3. 24.
4. Tro-Cor. 48b.
5. 82a.
6. Dr. 50a.
7. Tro-Cor. 51c.
8. Dr. 17c.
9. 6b.
10. 13b.
11. 24.
12. 47a.
13. 55b.
14. 24.
15. Tro-Cor. 92c.
16. C. B.
17. "
18. "
19. "

PLATE IV

DAY


CIB
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CABAN
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EZNAB
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CAUAC
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14
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AHAU
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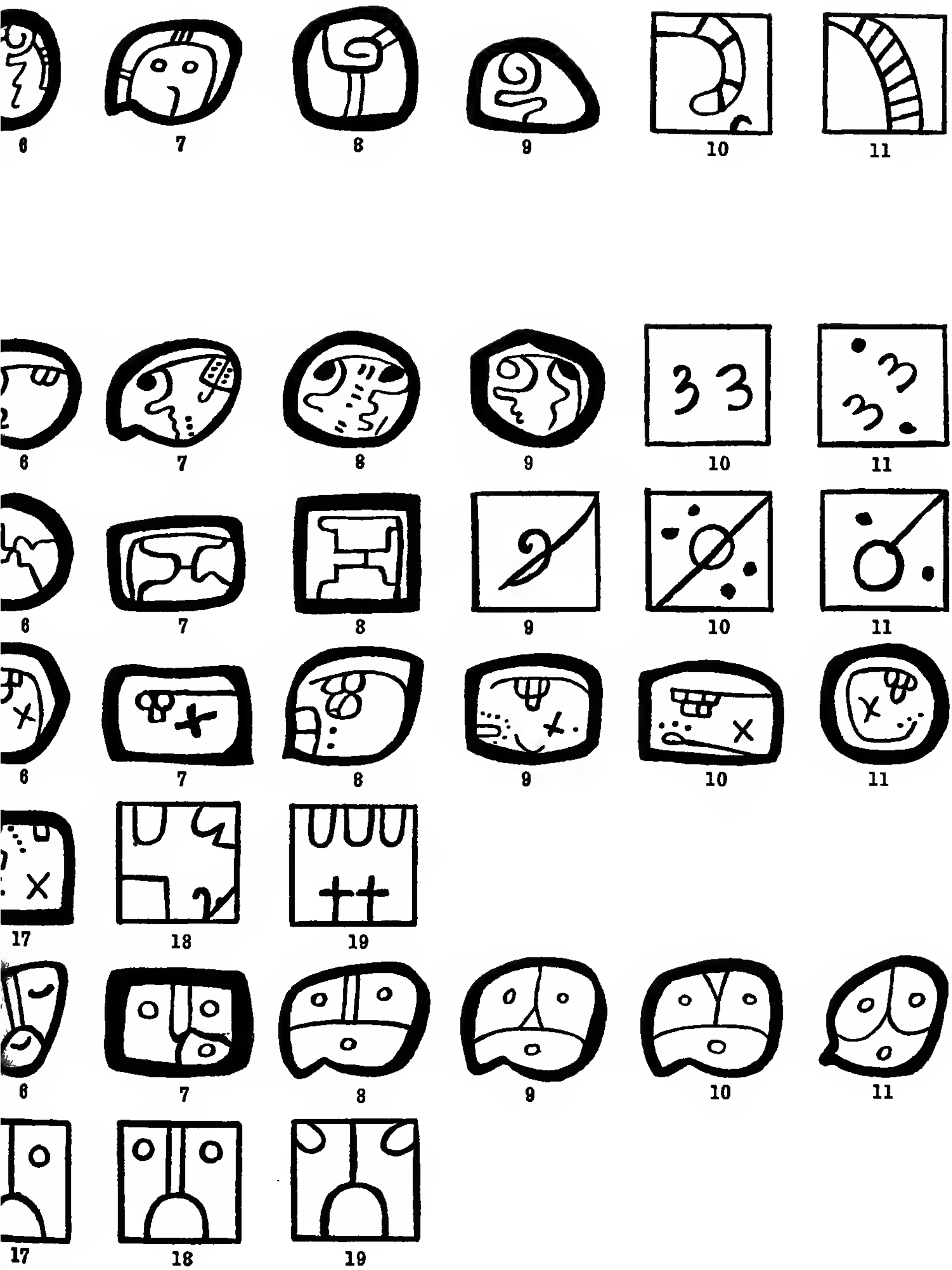
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6 7 8 9 10 11
6 7 8 9 10 11
6 7 8 9 10 11
17 18 19
6 7 8 9 10 11
17 18 19

INDEX OF GLYPHS ON PLATE V

DAY SIGNS — INSCRIPTIONS. YMIX — CIB

YMIX

1. T. C. U5.
2. Qu. St. E (w), A14b.
3. P. N. St. 1, G8.

IK

1. T. C., C9.
2. F12.
3. E1.
4. T. I., Stucco, (Pl. 55 A. P. M.).
5. Qu. An. G. (w. l.), E1.

AKBAL

1. T. S., E1.
2. P6.

KAN

1. T. C., R17.
2. Yax. Lin. 21, A4.
3. T. C., U10.
4. Pal. (A. P. M., Pl. 90) A2.
5. T. C., Q8.
6. Cop. Alt. Q, E6a.

CHICCHAN

T. C., T14.

CIMI

1. P. N. St. 3, D5.
2. Tik. Round Alt. No. 25.

MANIK

1. T. I. (62), H1.
2. G11.
3. Tik. Round Alt. No. 11.

LAMAT

1. T. I. (62), E6.
2. H6.
3. T. C., P10.
4. Cop. Alt. K, No. 6 (A. P. M.).
5. Yax. St. 20, A3.

MULUC

1. Yax. Lin. 21, C5.
2. Tik. Round Alt. No. 28.

OC

1. Qu. St. K (n), B6b.
2. T. F. C., N5.
3. E1.

EB

1. Qu. St. C, Base, A. (A. P. M.).
2. Cop. Alt. U, G3.
3. Pal. Palace, House A, Side of steps. (A. P. M.)

BEN

Cop. Alt. Q, C1.

IX

1. T. I. (62), M9.
2. Yax. St. 12, A1.

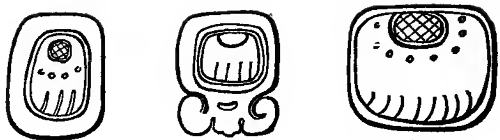
CIB

1. P. N. St. 1, A7.
2. 3, A4.
3. 25, A7.
4. T. S., N4.

PLATE V

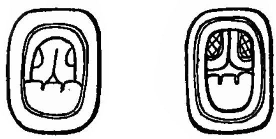
DAY

YMIX



1 2 3

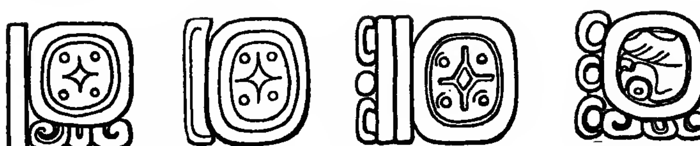
AKBAL



1 2

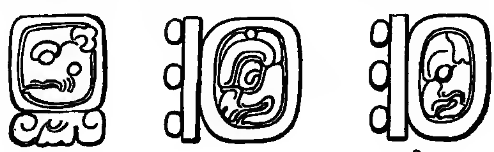
CHICCHAN

LAMAT



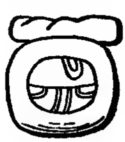
1 2 3 4

OC

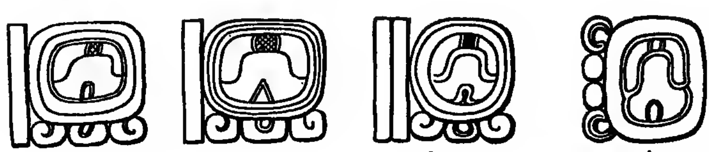


1 2 3

BEN



CIB



1 2 3 4

IK

KAN

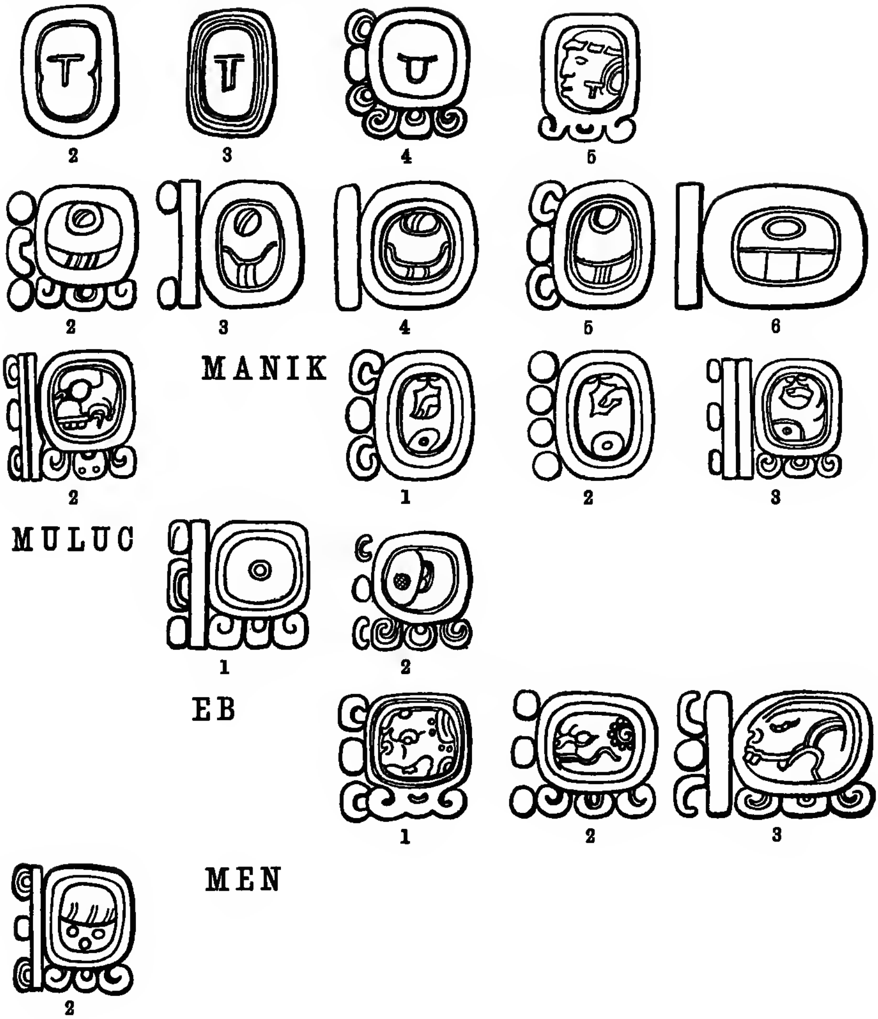
CIMI

CHU

IX

INSCRIPTIONS

PLATE V



INDEX OF GLYPHS ON PLATE VI

DAY SIGNS — INSCRIPTIONS. CABAN — AHAU

CABAN

1. Qu. St. F (w), B5b.
2. E (w), B5.
3. T. C., Q2.
4. P14.
5. S12.
6. Cop. Alt. Q, A1.
7. Qu. St. D (w), B13.

EZNAB

1. T. I. (62), Q11a.
2. T5a.
3. T. C., R7.

CAUAC

T. F. C., B13.

AHAU

1. T. C., B8.
2. T. I. (62), B8.
3. T. S., P2.
4. Cop. Alt. R, No. 20, (A. P. M.).
5. T. F. C., C8.
6. T. S., O2.
7. T. I. (60), M7.
8. Cop. St. A, F11.
9. Qu. St. G (w), A6.
10. F (e), B14a.
11. T. I. (62), E8.
12. Cop. St. C, B7.
13. M, D2.
14. N, A7.
15. I, G1.
16. Alt. S. No. 4a, (A. P. M.).
17. St. H (e), A1.
18. Qu. Alt. L, No. 8.
19. St. E (e), A16a.
20. F (w), A17a.
21. J, B8.
22. F (e), B5b.
23. E (e), A6.
24. E (w), B10a.
25. Cop. St. B, A7.
26. T. F. C., B8.
27. Qu. An. G (w. l.), B1.
28. St. C (e), B5.
29. Cop. St. C, A9.
30. 9, B5.
31. C, B2.
32. P, A5a.
33. Qu. St. D (e), B13.
34. Cop. St. D, A4b.
35. A, B4.
36. Qu. An. G (e. l.), H2.
37. Cop. St. I, B5.
38. 6, B4.

PLATE VI

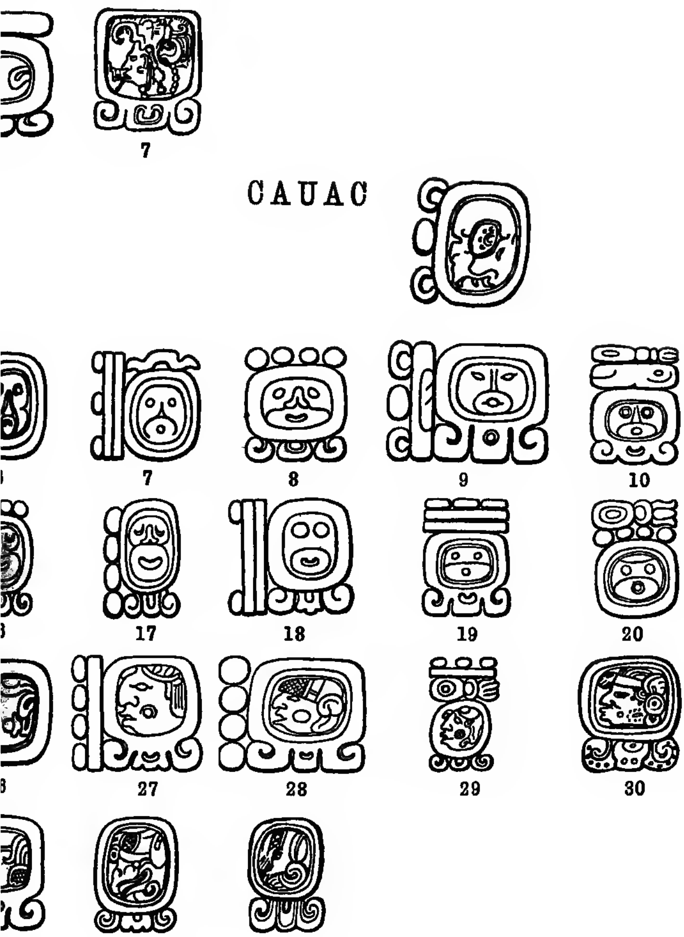
DAY

CABAN

EZNAB

AHAU

INSCRIPTIONS PLATE VI



INDEX OF GLYPHS ON PLATE VII

MONTH SIGNS — CODICES. POP — YAX

POP

1. Landa, p. 276.
2. Dr. 48.2.22.
3. 62.6. 5 fr. bot.

UO

1. Landa, p. 282.
2. Dr. 24.3.bot.
3. 49.4.14.
4. 48.3. 3 fr. bot.
5. 47.3.22.
6. 49.3.14.
7. 48.4. 3 fr. bot.
8. 62.4. 2 fr. bot.
9. 63.3. 2.

ZIP

1. Landa, p. 286.
2. Dr. 62.5. 6 fr. bot.
3. 49.1.14.
4. 47.4.22.
5. 48.1. 3 fr. bot.

ZOTZ

1. Landa, p. 292.
2. Dr. 47.2.14.
3. 1.22.
4. 46.2. 3 fr. bot.

TZEC

1. Landa, p. 296.
2. Dr. 46. 3.14.
3. 50. 3. 3 fr. bot.
4. 2.22.

XUL

1. Landa, p. 98.
2. Dr. 50.1. 3 fr. bot.
3. 46.4.14.
4. 49.3.22.
5. 4.22.
6. 50.4. 3 fr. bot.
7. 61.3. 2 fr. bot.

YAXKIN

1. Landa, p. 302.
2. Dr. 61.5. 2 fr. bot.
3. 49.1.22.
4. 46.1.14.
5. 48.2. 3 fr. bot.

MOL

1. Landa, p. 306.
2. Dr. 49.2.14.
3. 47.2.22.

CHEN

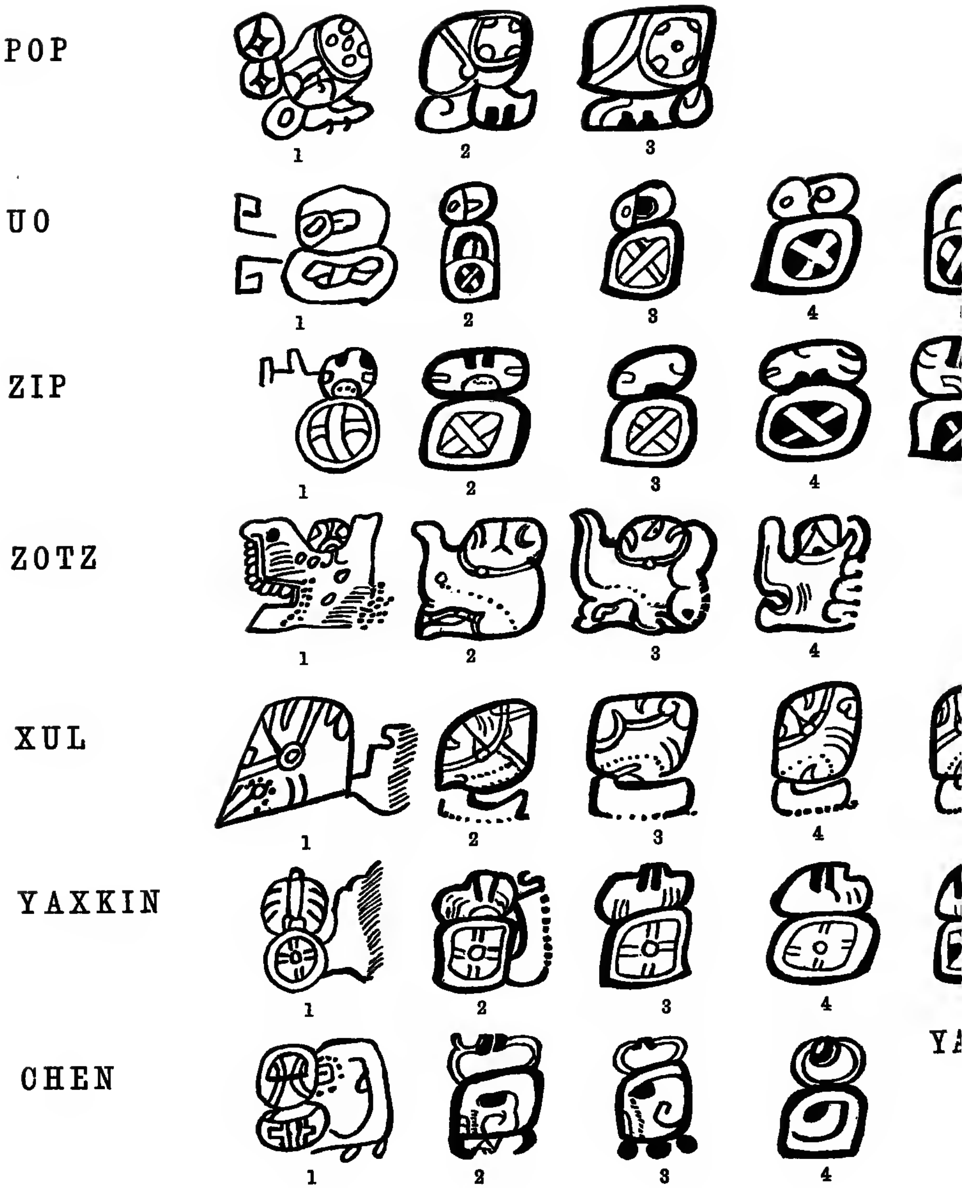
1. Landa, p. 310.
2. Dr. 47.3. 3 fr. bot.
3. 4. 3 fr. bot.
4. 48.3.14.

YAX

1. Landa, p. 242.
2. Dr. 46.3.22.
3. 4.22.
4. 48.1.14.
5. 4.14.
6. 47.1. 3 fr. bot.

PLATE VII

MONT



POP
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ZOTZ
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XUL
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YAXKIN
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YA
CHEN
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ZEC
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MOL
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INDEX OF GLYPHS ON PLATE VIII

MONTH SIGNS — CODICES. ZAC — UAYEB

ZAC

1. Landa, p. 246.
2. Dr. 46.1.21.
3. 50.2. 3 fr. bot.
4. 46.2.14.

CEH

1. Landa, p. 250.
2. Dr. 49.2.22.

MAC

1. Landa, p. 252.
2. Dr. 49.3. 3 fr. bot.
3. 4. 3 fr. bot.
4. 50.3.14.
5. 4.14.
6. 48.3.22.

KANKIN

1. Landa, p. 256.
2. Dr. 48.4.22.
3. 49.1. 3 fr. bot.
4. 50.1.14.

MUAN

1. Landa, p. 260.
2. Dr. 48.2.14.
3. 1.22.
4. 47.2. 3 fr. bot.
5. 46.2.21.

PAX

1. Landa, p. 264.
2. Dr. 61.4. 2 fr. bot.
3. 46.3. 3 fr. bot.
4. 47.3.14.

KAYAB

1. Landa, p. 268.
2. Dr. 62.2. 2 fr. bot.
3. 61.2. bot.
4. 50.3.22.
5. 46.1. 3 fr. bot.
6. 50.4.22.
7. 46.4. 3 fr. bot.
8. 47.4.14.

CUMHU

1. Landa, p. 272.
2. Dr. 47.1.14.
3. 49.2. 3 fr. bot.
4. 50.1.22.
5. 58.5. bot.
6. 62.5. bot.

UAYEB

Dr. 50.2.14.

PLATE VIII

MON

ZAC

MAC

KANKIN

PAX

KAYAB

CUMHU

UAYEB

GNS—CODICES

PLATE VIII

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INDEX OF GLYPHS ON PLATE IX

MONTH SIGNS — INSCRIPTIONS. POP — CHEN

POP

1. T. C., P3.
2. Cop. St. N, base No. 16 (A. P. M.).
3. Cop. Alt. U, B1.

UO

1. T. F. C., N15.
2. Cop. Alt. L, No. 2.
3. P. N. St. 3, C6.
4. T. I. (62), D1.
5. Cop. Alt. Q, E6.

ZIP

1. T. C., T6.
2. T. I. (62), H11.
3. D7.
4. Cop. Alt. S, No. 7b, (A. P. M.).
5. Qu. St. F. (w), A19b.
6. Cop. St. N, A15.

ZOTZ

1. T. S., Q12.
2. T. C., B16.
3. T. I. (62), F8.
4. Cop. Alt. G 1, (s), B3.
5. St. 1, D2.
6. Chin. B1.
7. Cop. St. M, A3.

TZEC

1. T. S., A16.
2. T. C., B9.
3. T. I. (62), G2.
4. Yax. Lin. 21, D5.
5. Pal. Pier, Pl. 55. (A. P. M.).
6. Xax. Lin. 30, C5.
7. Qu. St. F (w), A12.

XUL

1. T. S., F1.
2. Q6.
3. T. C., H1.
4. Q14.
5. S7.
6. Qu. Alt. L, No. 9.

YAXKIN

1. T. I. (62), A9.
2. H9.
3. Qu. St. C (w), B6.
4. P. N. St. 1, C2.
5. T. I. (62), D11.
6. P. N. Alt. support, B1.
7. Cop. Alt. Q, B1.
8. A4.
9. St. N, base, No. 2 (A. P. M.).

MOL

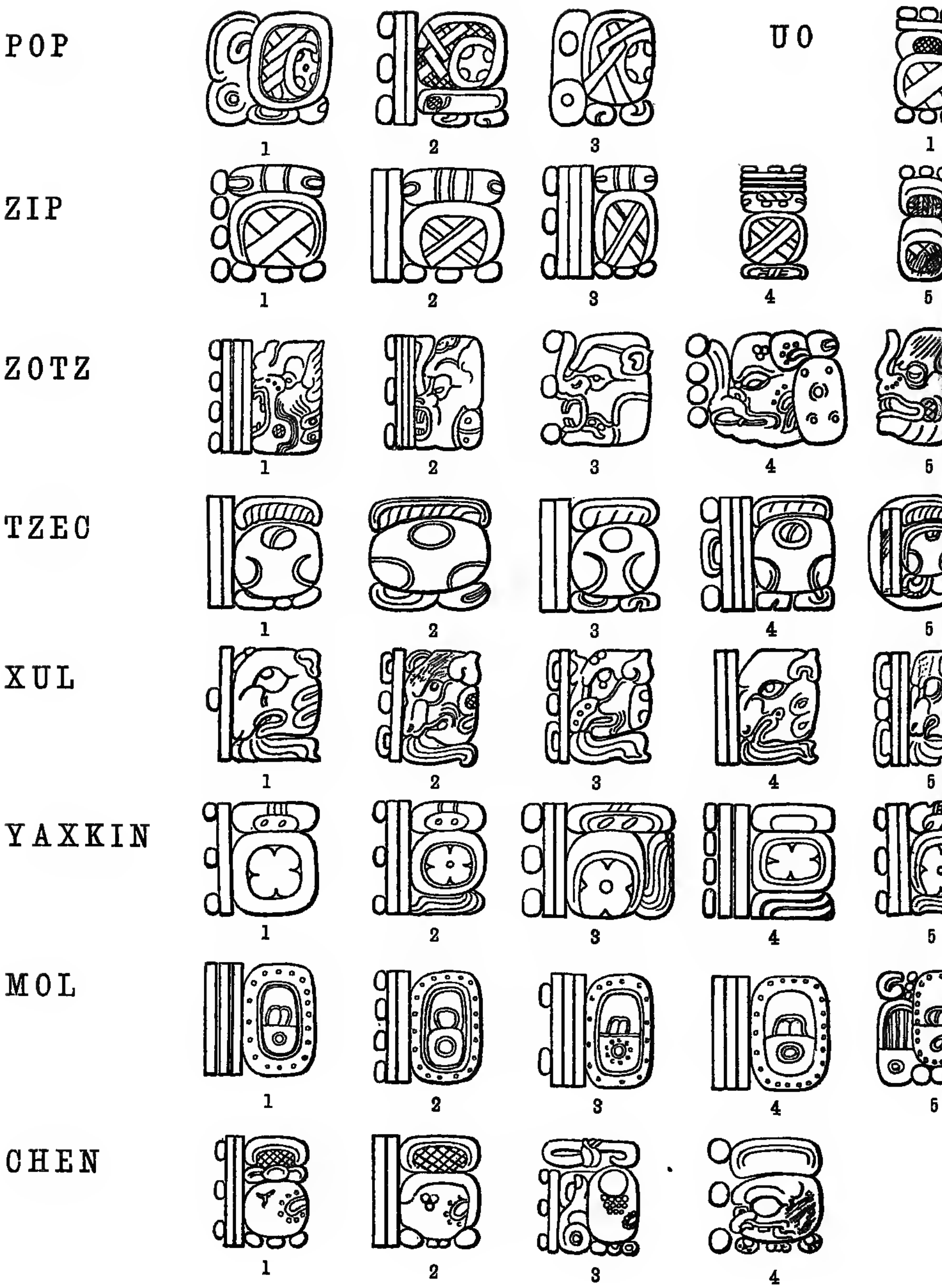
1. T. S., N8.
2. O4.
3. T. C., T11.
4. T. F. C., L6.
5. T. C., D9.
6. Cop. Alt. Q, side, No. 2, (A. P. M.).
7. Alt. R, No. 2, (A. P. M.).
8. Alt. U, side, D1.
9. Qu. St. F (e), B14b.
10. Nar. St. 10, B7.

CHEN

1. T. C., U14.
2. T. I. (62) L11.
3. Cop. St. N, B17.
4. T. I. (60) L6.

PLATE IX

MONTH



POP
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UO
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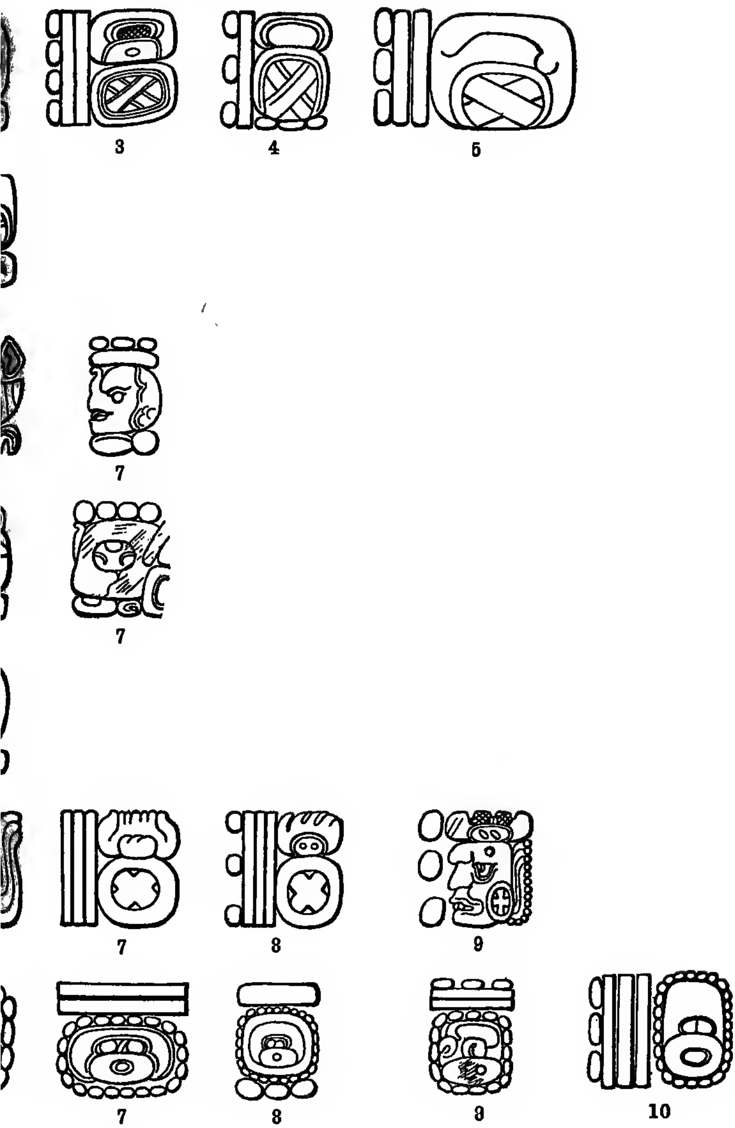
ZIP
1 2 3 4 5
ZOTZ
1 2 3 4 5
TZEC
1 2 3 4 5
XUL
1 2 3 4 5
YAXKIN
1 2 3 4 5
MOL
1 2 3 4 5
CHEN
1 2 3 4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INDEX OF GLYPHS ON PLATE X

MONTH SIGNS — INSCRIPTIONS. YAX — UAYEB

YAX

1. T. F. C., A14.
2. Cop. St. B, A8.
3. Qu. St. C, base, B, (A. P. M.).
4. E (w), E10.
5. Cop. St. 4, A7.
6. Alt. S, No. 4b, (A. P. M.).
7. St. A, C12.
8. T. I. (62), T5.
9. Yax. St. 21, A7.
10. Qu. St. K(n), A5.

ZAC

1. T. C., F9.
2. P. N., St. 1, G9.
3. Qu. St. A(w), B2.

CEH

1. T. S., B9.
2. T. C., R1.
3. F1.
4. T. I. (61), B2.
5. (60), J10.
6. (62), O7.
7. Cop. Alt. U, F4.
8. Alt. G 2, B1.
9. T. S., Q2.

MAC

1. T. I. (60), N7.
2. T. F. C., A9.
3. C15.
4. P. N., St. 25, A8.
5. Yax. Alt. (Str. 44), C10.
6. Tik. Round Alt. No. 26.

KANKIN

1. T. I. (62), Q11.
2. T. S., H2.
3. P15.
4. T. C., K9
5. P. N., St. 1, G4.

MUAN

1. Cop. St. A, F2.
2. Alt. Q, D1.
3. Qu. St. E (w), B14.
4. P. N., St. 3, F8.

PAX

1. T. I. (62), P10.
2. Cop. St. 9, B8.

KAYAB

1. T. S., M1.
2. T. C., P9.
3. T. F. C., E2.
4. Qu. St. E (w), B7.
5. A (e), B9.
6. T. C., Q4.
7. T. F. C., O5.
8. Cop. Alt. Q, E1.
9. Tik. St. 3, A7.
10. Nar. Stair. Ins. 6, C3b.

CUMHU

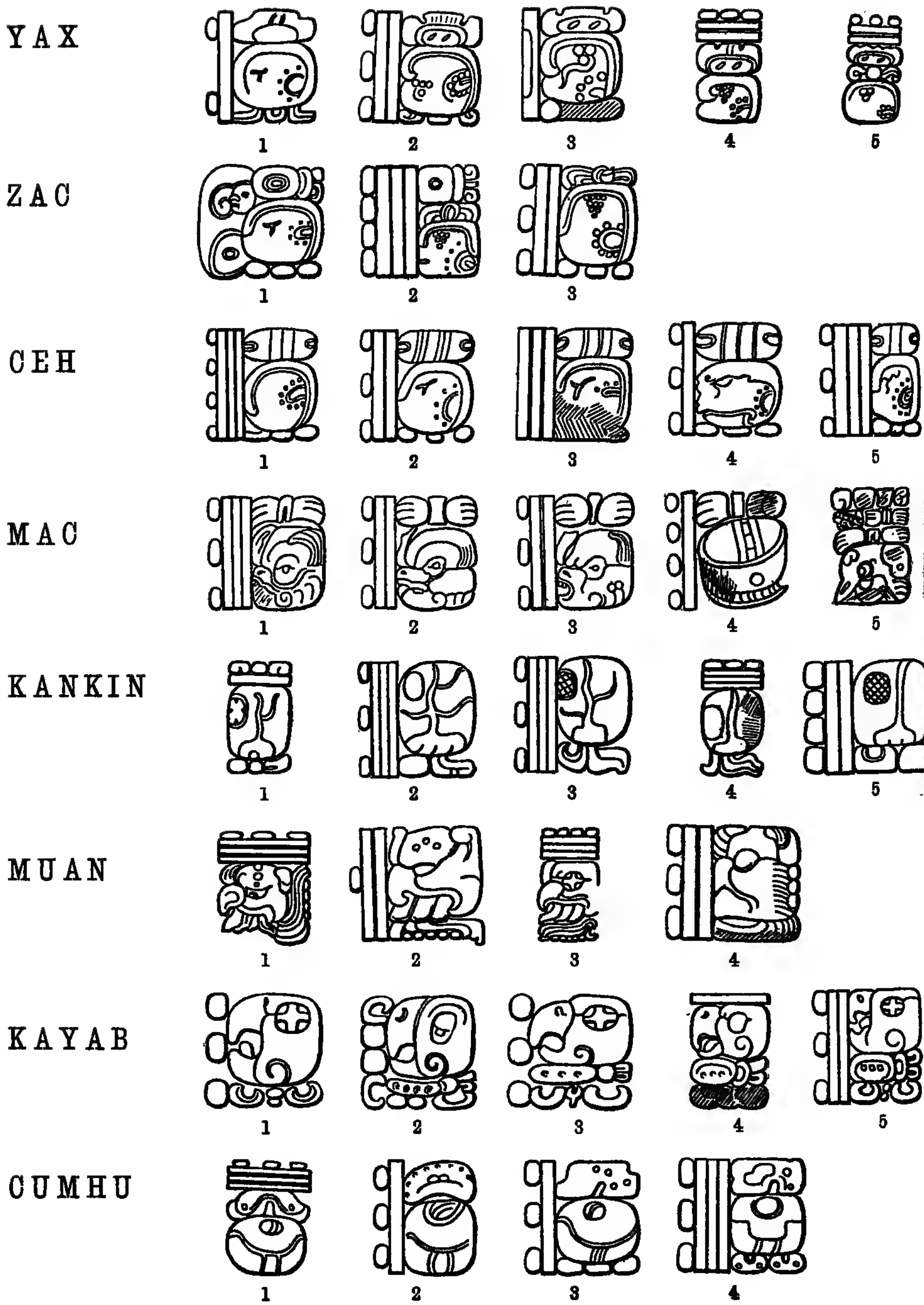
1. Cop. St. A, B9.
2. T. S., N3.
3. T. C., C4.
4. Qu. St. E (e), A7.

UAYEB

1. T. F. C., D8.
2. T. I. (60), E5.
3. (62), Q4.

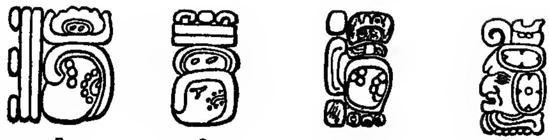
PLATE X

MONTH



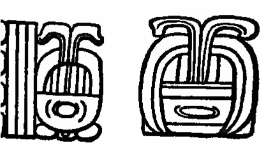
—INSCRIPTIONS

PLATE X



7 8 9 10

7 8 9



1 2

7 8 9 10

1 2 3

INDEX OF GLYPHS ON PLATE XI

GRAND CYCLES

1.	Cop. St. E.	
2.	P (e).	
3.	P (s).	
4.	P (n).	
5.	D.	
6.	A.	
7.	B.	
8.	C (e).	
9.	F.	
10.	Pal. Palace Steps.	
11.	Cop. St. C (w).	
12.	M.	
13.	Pal. T. C.	
14.	T. F. C.	
15.	Qu. An. B.	9.10.0. 0. 0.
16.	Cop. St. B.	9.15.0. 0. 0.
17.	Alt. S.	9.15.0. 0. 0.
18.	Qu. St. E (e).	9.17.0. 0. 0.
19.	C (e).	13. 0.0. 0. 0.
20.	C (w).	9. 1.0. 0. 0.
21.	Cop. St. I.	9.12.3.14. 0.
22.	P. N. St. 3.	9.12.2. 0.16.
23.	P. N. St. 1.	9.12.2. 0.16.
24.	Cop. St. M.	9.16.5. 0. 0.
25.	Pal. T. S.	1.18.5. 3. 6.
26.	Pal. Palace Steps.	9. 8. 9.13. 0.
27.	Qu. St. A (e).	9.17. 5. 0. 0.
28.	Turtle.	9.18. 5. 0. 0.
29.	P. N. Lintel 2	9.11. 6. 2. 1.
30.	Pal. T. F. C.	1.18. 5. 4. 0.
31.	P. N. St. 36.	9.10. 6. 5. 9.
32.	Qu. St. J.	9.16. 5. 0. 0.
33.	Cop. St. 6.	9.12.10. 0. 0.
34.	Qu. St. I.	9.18.10. 0. 0.
35.	Cop. St. N.	9.16.10. 0. 0.
36.	Qu. St. F (e).	9.16.10. 0. 0.
37.	Cop. St. 9.	9. 6.10. 0. 0.
38.	P (e).	9. 9.10. 0. 0.
39.	J (e).	9.13.10. 0. 0.
40.	F.	9.14.10. 0. 0.
41.	Qu. St. E (w).	9.14.13. 4.17.
42.	F (w).	9.14.13. 4.17.
43.	D (w).	9.18.12.14.12.
44.	Nar. St. 13.	9.17.10. 0. 0.
45.	Stair. Ins. 5.	9.10.10. 0. 0.
46.	Pal. T. C.	12.19.13. 4. 0.
47.	Cop. St. A.	9.14.19. 8. 0.
48.	1.	9.11.15.14. 0.
49.	Yax. Lintel 21.	9. 0.19. 2. 4.
50.	Qu. St. D. (e).	9.16.15. 0. 0.
51.	K (n).	9.18.15. 0. 0.
52.	An. G (e. l.).	9.17.15. 0. 0.
53.	Cop. Alt. K.	9.12.16. 7. 8.

PLATE XI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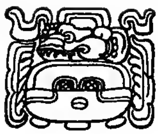

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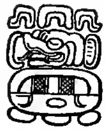

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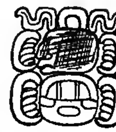

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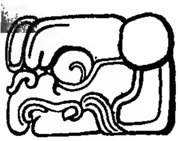

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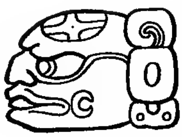

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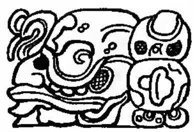

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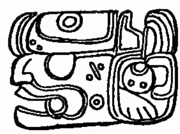

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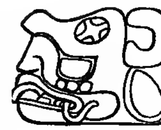

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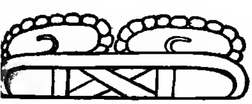

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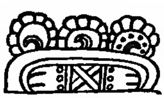

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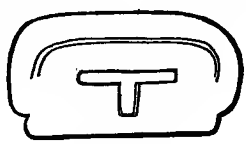

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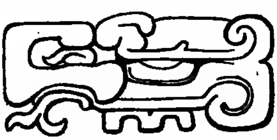

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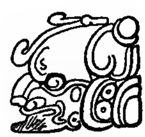

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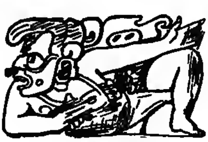

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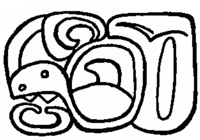

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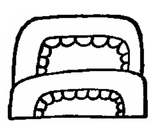

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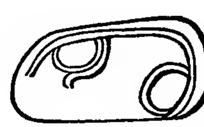

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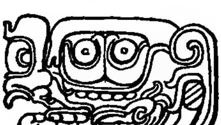

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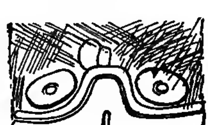

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INDEX OF GLYPHS ON PLATE XII

PERIODS — FACE SIGNS. CYCLES. KATUNS

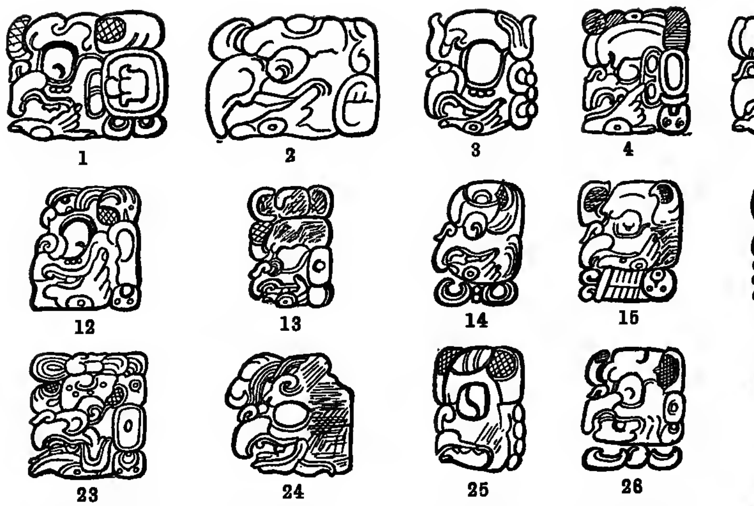
CYCLES

KATUNS

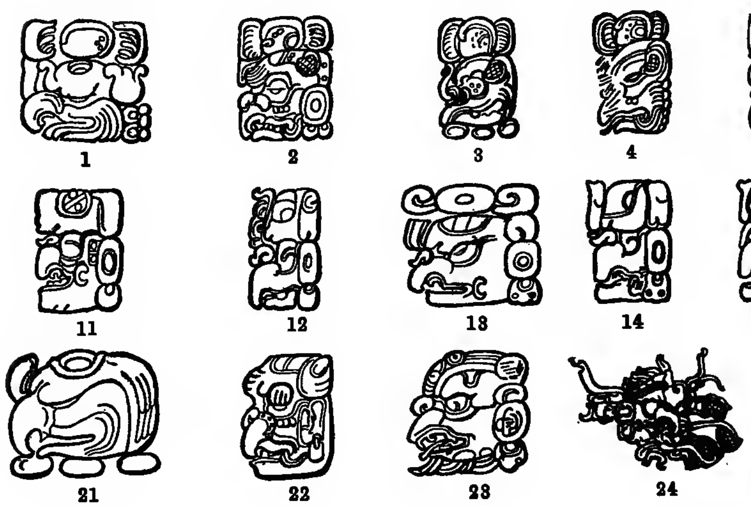
PLATE XII

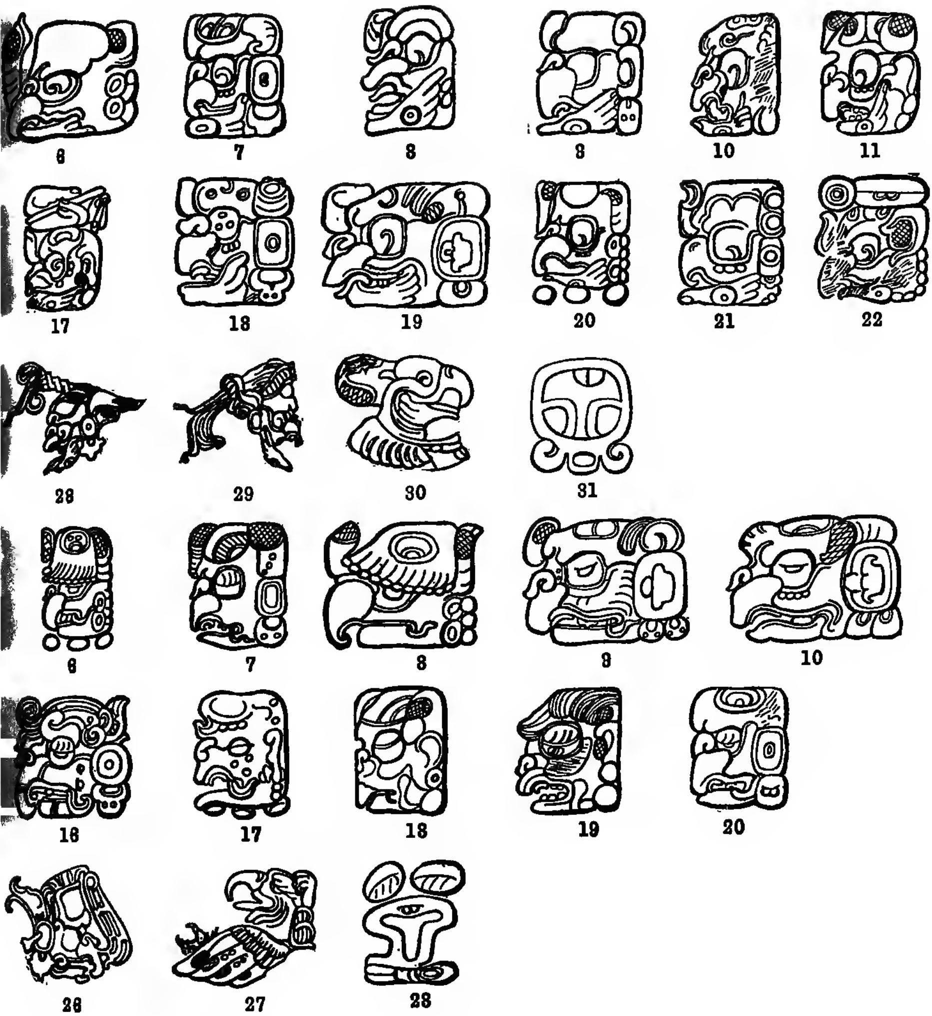
PER

CYCLE



KATUN




6 7 8 9 10 11
17 18 19 20 21 22
28 29 30 31
6 7 8 9 10
16 17 18 19 20
26 27 28

INDEX OF GLYPHS ON PLATE XIII

PERIODS — FACE SIGNS. TUNS. UINALS

TUNS

1. Cop. St. 1, A4.
2. Alt. K, No. 3 (A. P. M.).
3. Qu. St. E (e), A4.
4. Pal. Palace Steps, B2b.
5. Dr. 61.2.6.
6. Tik. St. 3, B2.
7. Cop. St. P, A4b.
8. T. S., B5.
9. Qu. St. F. (w), A4b.
10. T. F. C., B5.
11. Cop. St. I, A4.
12. J (e), A4.
13. N, A4
14. Qu. St. C (w), A4.
15. K (n), A4.
16. P. N. Lin. 2, B7–8.
17. T. F. C., D3.
18. Cop. St. N, B11.
19. T. F. C., D16.
20. P. N. St. 1, A4.
21. Cop. St. B, A4.
22. A, A3.
23. Qu. St. A (e), A4.
24. F (e), A4b.
25. T. I. (62), F7.
26. H4.
27. O8.
28. E10.
29. T. F. C., O6
30. Cop. St. C, B5.
31. Qu. St. F (w), B17b.
32. Cop. St. M, A2.
33. P. N. St. 3, B2.
34. Cop. St. J (s), D1.

TUNS (*continued*)

35. Cop. Alt. S, No. 2b. (A. P. M.)
36. P. N. St. 36, A3.
37. T. S., Q11.
38. Nar. Stair. Ins. 5, A2b.
39. Qu. St. D (w), B7–8.
40. Cop. St. D, B2b.
41. Qu. St. D (e), B7.
42. An. B. No. 3 (A. P. M.)
43. Alt. L, No. 15.

UINALS

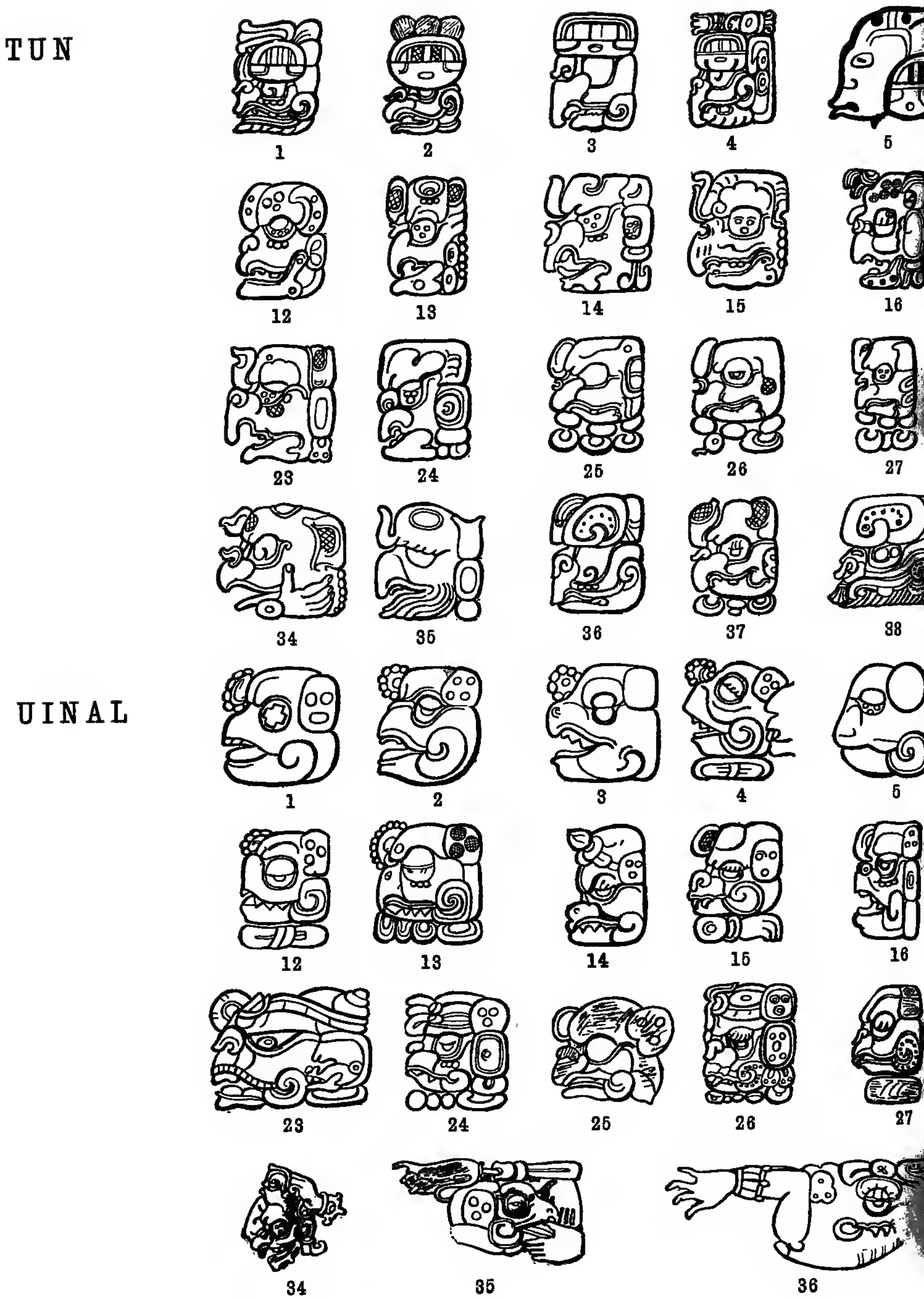
1. Cop. St. A, B3.
2. B, A5.
3. M, B2.
4. Alt. S, No. 3a (A. P. M.)
5. St. J (e), B4.
6. Qu. St. C (w), B4.
7. F (w), B4b.
8. J, B6.
9. T. I. (62), R11.
10. T6.
11. Qu. St. J, F1.
12. E (e), B4.
13. P. N. St. 3, F6.
14. T. I. (60), B4.
15. Cop. St. J (w), No. 16 (A. P. M.)

UINALS (*continued*)

16. Qu. St. A (e), B4.
17. Cop. St. 1, B4.
18. P. N. St. 1, A5.
19. T. I. (60), N6
20. T. F. C., C4.
21. B6.
22. T. S., B6.
23. Cop. St. 10, B3.
24. T. S., D14.
25. Cop. St. 2, B4.
26. I, B4.
27. Pal.Palace Steps, A3b.
28. Qu. St. F (e), B4b.
29. P. N. St. 3, A3.
30. Nar. Stair. Ins. 5, A2b.
31. Cop. St. N, A5.
32. P, B4a.
33. 9, B4.
34. Qu. St. D (e), B9.
35. (w), B9.
36. An. B. No. 4 (A. P. M.)
37. Cop. St. D, A3b.

PLATE XIII

PER


TUN
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37
38
UINAL
1
2
3
4
5
12
13
14
15
16
23
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25
26
27
34
35
36

-FACE SIGNS

PLATE XIII

INDEX OF GLYPHS ON PLATE XIV

PERIODS — FACE SIGNS. KINS. PERIODS — NORMAL

KINS

1. Cop. St. A, A4.
2. B, A6.
3. I, A5b.
4. Alt. S, No. 3b (A. P. M.)
5. Qu. St. C (w), A5b.
6. K (n), B4b.
7. An. G (e. l.), H1.
8. Yax. Lint. 21, B3.
9. Qu. St. C (e), A5.
10. A (e), A5.
11. P. N. St. 1, A6.
12. 3, B3.
13. Cop. St. N, A6.
14. Pal. Palace Steps, B3b.
15. P. N. Lint. 2, B11–12.
16. Cop. St. D, B3b.
17. T. S., B7.
18. Qu. St. E (e), A5.
19. T. F. C., B7.
20. P. N. St. 25, A6.
21. Qu. St. F (e), B5.
22. J, B7
23. Cop. St. P, B4b.
24. T. F. C., D4.
25. Cop. St. 10, A4.
26. Qu. St. D (w), B11.
27. An. B, No. 5 (A. P. M.)
28. St. D (e), B11–12.
29. Nar. Stair. Ins. 5, C2b.
30. Tik. St. 3, B3.
31. Cop. St. J (w), No. 17. (A. P. M.)
32. T. S., C14.
33. T. I. (62), G8.
34. Cop. St. J (e), A5.

NORMAL PERIODS

CYCLES

1. T. C., B3.
2. Yax. Lint. 21, B1.

KATUNS

1. T. C., B4.
2. Cop. St. J (w), No. 24, (A. P. M.)
3. St. M, D1.
4. Yax. Lint. 21, A2.
5. Cop. St. A, E12.
6. Qu. St. E (w), B13b.
7. Dr. 61.1.6.
8. 69.3.6.

TUNS

1. T. C., B5.
2. Cop. St. J, No. 23 (A. P. M.)
3. Yax. Lint. 21, B2.
4. T. S., P1.
5. Dr. 69.4.6.

UINALS

1. T. C., B6.
2. Cop. St. N, B10.
3. Yax. Lint. 21, A3.
4. Dr. 69.3.4 fr. bot.

KINS

1. T. C., B7.
2. Cop. St. M, C2.
3. 1, A5b.
4. 6, B4.
5. Dr. 69.4.7.
6. 61.2.4 fr. bot.
7. T. F. C., B12.
8. Cop. St. J (e), B11a.
9. I, E6.
10. Alt. Z, G1.
11. P. N. St. 1, F3.
12. Tik. Plate 74, A7 (A. P. M.)

PLATE XIV

PER

KIN

1 2 3 4 5

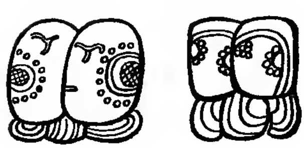
12 13 14 15 16

23 24 25 26 27

33 34

P

CYCLE



1 2

KATUN

1

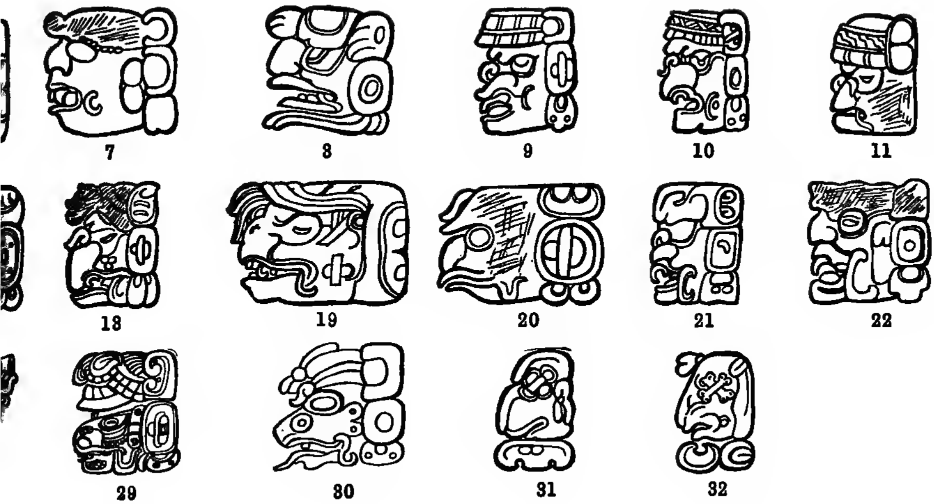
TUN

1 2 3 4 5

KIN

1 2 3 4 5

–FACE SIGNS



0S–NORMAL

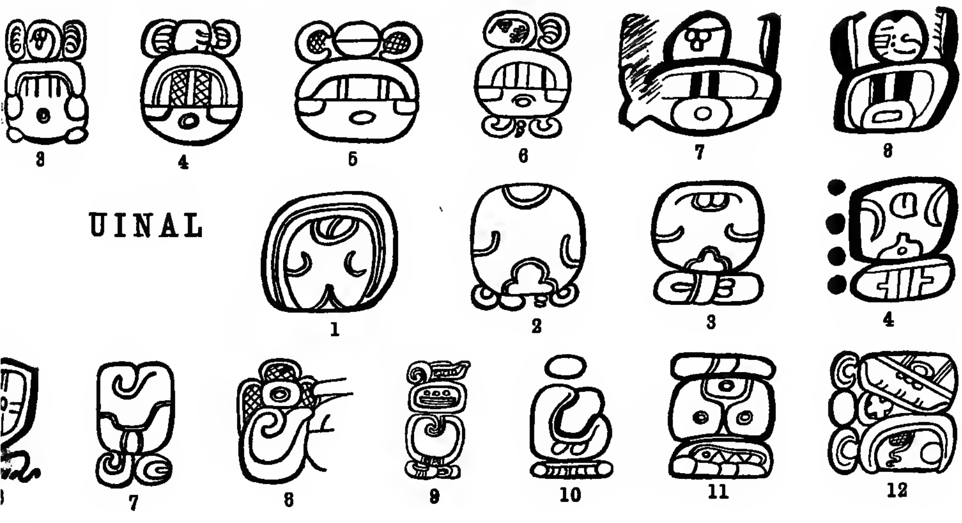


PLATE XV

NUMBERS

ONE

1 2 3

TWO

FOUR

1 2 3

FIVE

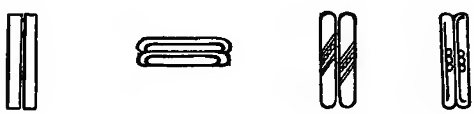
SIX

1 2 3

EIGHT

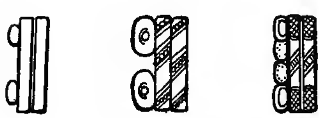
1 2 3 4

TEN



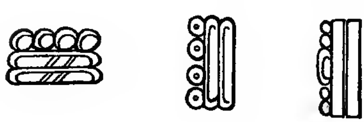
1 2 3 4

TWELVE



1 2 3

FOURTEEN

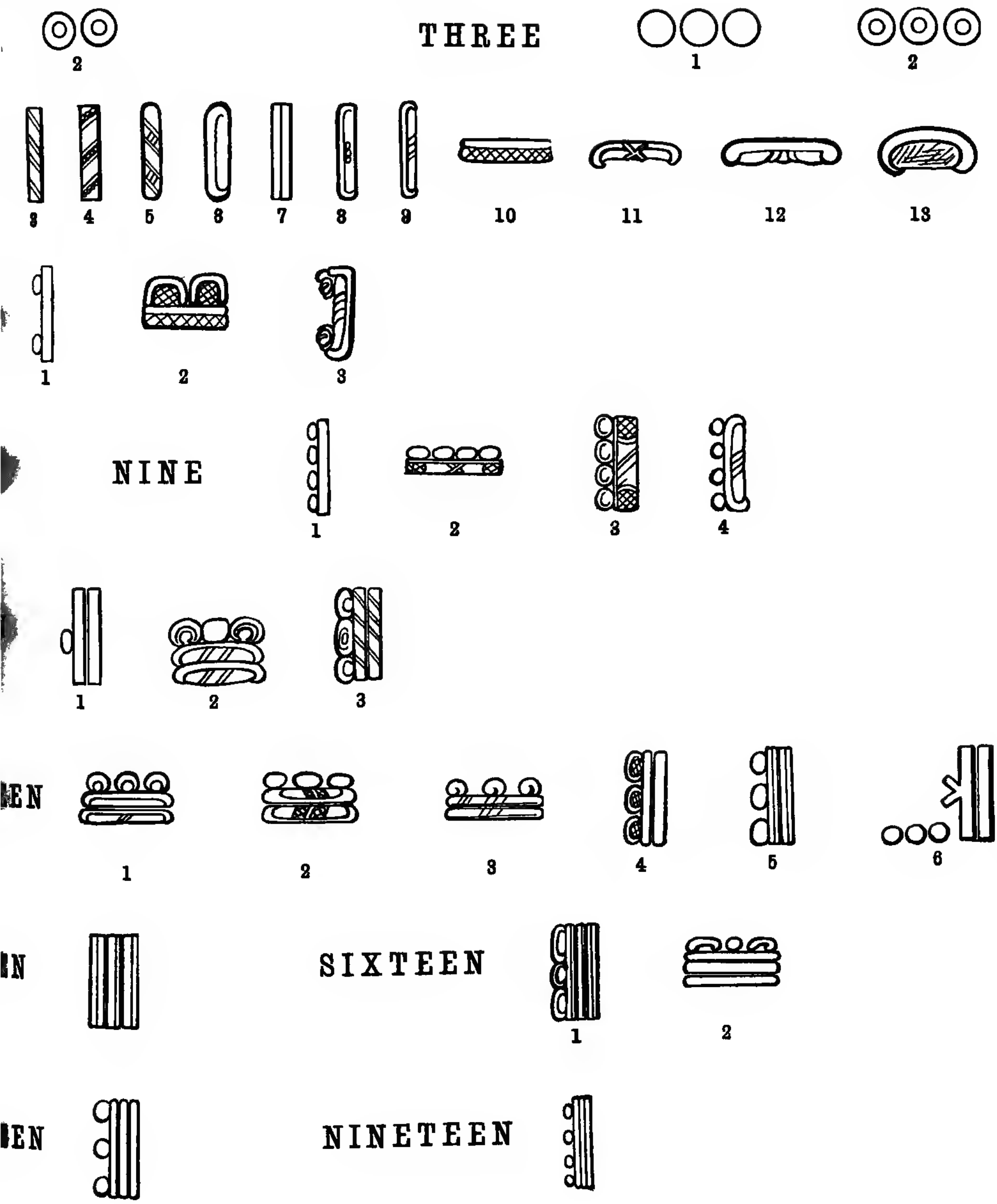


1 2 3

SEVENTEEN

1 2

AL—INSCRIPTIONS PLATE XV



INDEX OF GLYPHS ON PLATE XVI

NUMBERS — FACE SIGNS

ONE

1. T. F. C., A8.
2. Qu. St. F (e), B5a.
3. T. F. C., A3.
4. T. S., A3.
5. Qu. An. B, No. 6 (A. P. M.)
6. P. N. Lint. 2, A11–12.
7. Qu. St. F (w), A19a.
8. T. C., C15.

TWO

P. N. Lint. 2, A9–10.

THREE

1. Qu. St. F (e), B8a.
2. T. S., A6.

FOUR

1. T. C., A6.
2. T. F. C., A6.
3. Qu. St. F (w), B4a.
4. Cop. St. 1, C6a.

FIVE

1. Qu. St. J, A5.
2. Cop. St. I, B5a.
3. T. F. C., A5.
4. T. S., A5.
5. Qu. An. G (e. l.), G2.
6. Qu. St. F (w), A6.
7. Cop. St. D, B2a.

SIX

1. T. S., A7.
2. Qu. St. A (e), B5a.

SEVEN

Qu. St. D (e), A13.

EIGHT

1. Qu. St. J, A8.
2. T. C., A8.
3. Pal. Palace Steps, A2a.
4. Cop. St. D, A5a.
5. Pal. Palace Steps, A4a.

NINE

1. Cop. St. P, A3a.
2. B3a.
3. T. I. (60), S7.
4. Pal. Palace Steps, B1a.
5. B2a.
6. Cop. St. D, B1a.
7. Nar. Stair. Ins. 5, B1a.
8. Qu. St. F (e), A3a.
9. J, A3.
10. An. G (e. l.), C1.
11. St. D (e), A3a.
12. An. B, No. 1, (A. P. M.)
13. An. B, No. 11 (A. P. M.)
14. P. N. Lint. 2, A3–4.

TEN

1. Cop. St. I, F6.
2. E1.
3. P, A4a.
4. T. I. (61), G1.
5. Qu. St. F (e), A4a.
6. Cop. Plate 8, No. 15 (A. P. M.)
7. St. D, A4a.
8. Qu. An. B, No. 2 (A. P. M.)

ELEVEN

P. N. Lint. 2, A5–6.

TWELVE

1. T. C., A3.
2. Qu. St. F (w), B5a.
3. P. N. St. 1, C3.

THIRTEEN

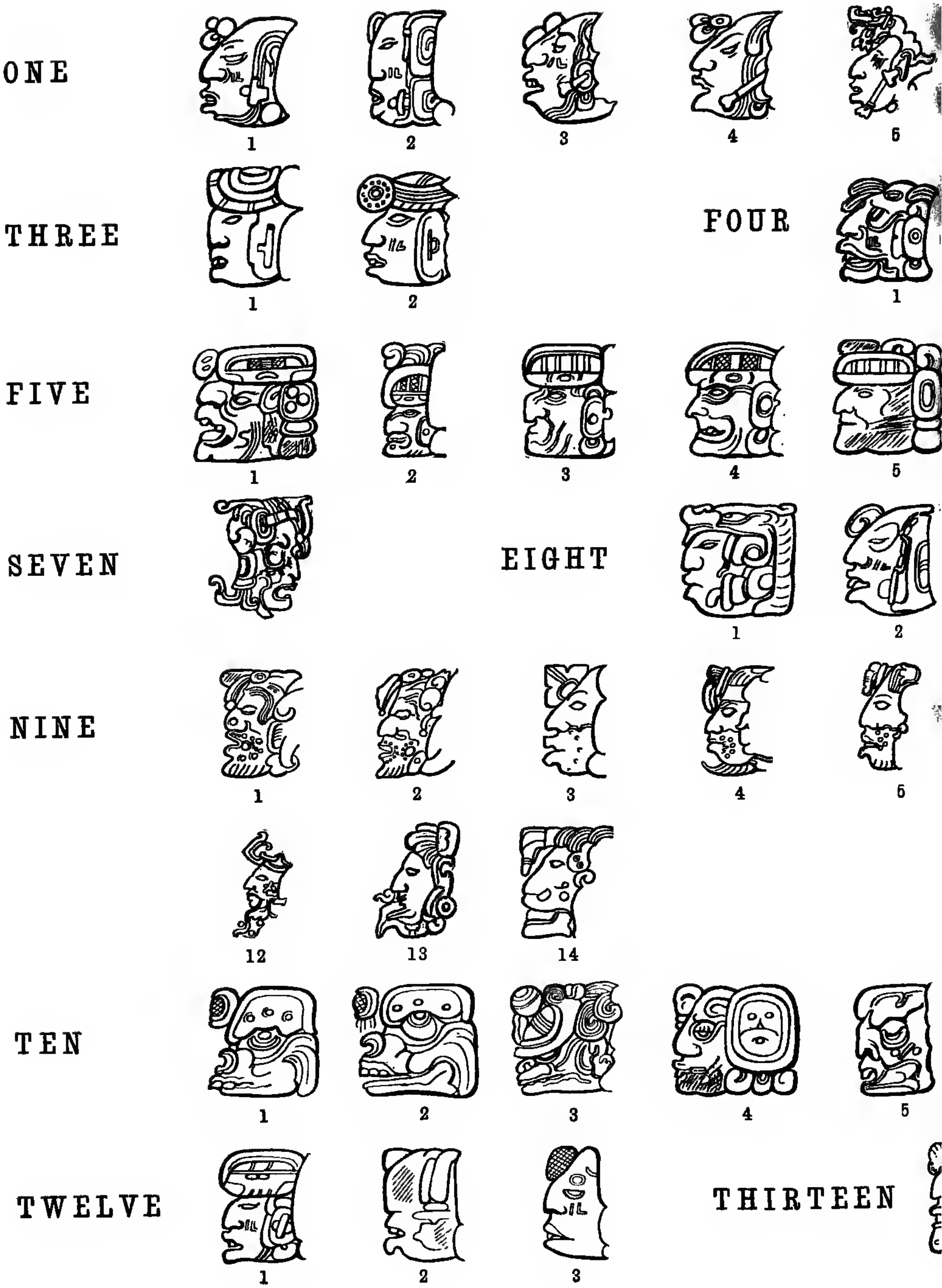
1. T. C., A5.
2. Pal. Palace Steps, A3a.
3. B4a.
4. T. S., A8.
5. Qu. St. F (w), A4a.

FOURTEEN

Qu. St. F (w), B3a.

PLATE XVI

NUMB



ONE
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3
4
5
THREE
1
2
FOUR
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FIVE
1
2
3
4
5
SEVEN
EIGHT
1
2
NINE
1
2
3
4
5
12
13
14
TEN
1
2
3
4
5
TWELVE
1
2
3
THIRTEEN

FACE SIGNS

INDEX OF GLYPHS ON PLATE XVII

NUMBERS — FACE SIGNS — ZERO

FIFTEEN

1. Qu. An. G (e. l.), E1.
2. Cop. St. D, A2a.
3. Qu. St. D (e), A7.

SIXTEEN

1. T. I. (61), I1.
2. (60), T6.
3. Qu. St. J, A4.
4. F (e), B3a.
5. Dr. 61.1.7.
6. 69.3.7.
7. Qu. St. D (e), A6.

SEVENTEEN

1. Qu. St. F (w), A5a.
2. An. G (e. l.), C2.

EIGHTEEN

1. T. F. C., A4.
2. T. S., A4.
3. T. C., A9.

NINETEEN

T. C., A4.

TWENTY or ZERO

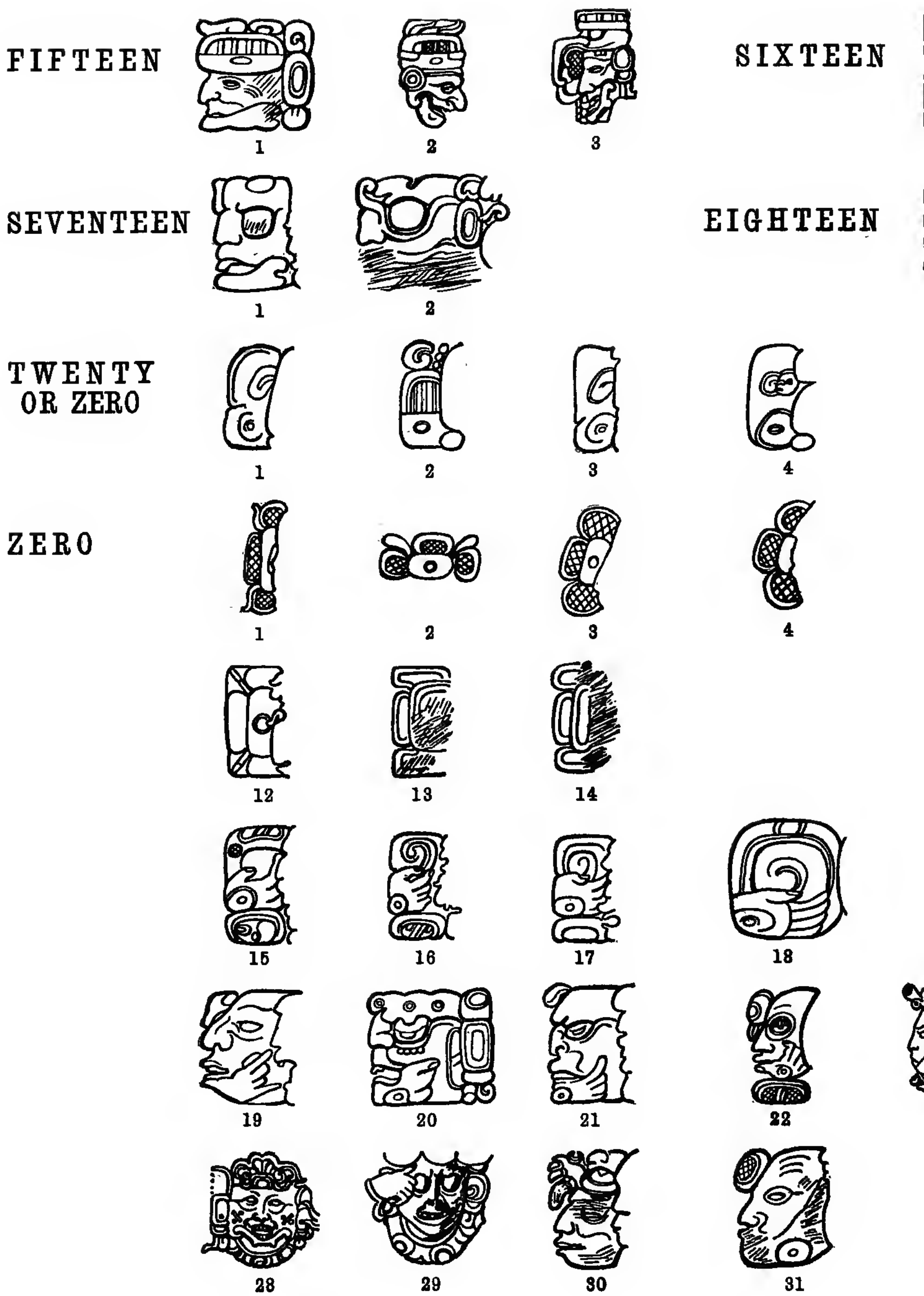
1. T. C., P3.
2. D9.
3. R13.
4. F9.
5. Cop. Alt. U (top), B1.
6. (side), H3.
7. Tik. Plate 74, A4a. (A. P. M.)
8. Dr. 48.4.14.
9. 50.2.14.
10. 1.1 from bottom.

ZERO

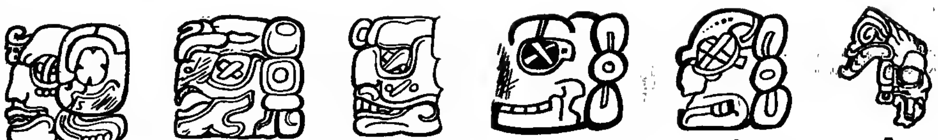
1. Cop. St. N, A6a.
2. M, C2.
3. J (e), B4a.
4. A5a.
5. Qu. St. C (e), B4a.
6. (w), B4a.
7. T. I. (62), P8.
8. Cop. St. A, A4.
9. Alt. S, No. 3 (A. P M.)
10. Qu. St. E (e), A4a.
11. B4a.
12. A5a.
13. Cop. St. 9, B4a.
14. A5a.
15. I, A5a.
16. Qu. St. A (e), A5a.
17. C (e), A5a.
18. T. C., A7.
19. T. F. C., A7.
20. Qu. St. J, A7.
21. C (w), A5a.
22. Cop. St. 1, A5a.
23. D, B3a.
24. A3a.
25. Qu. An. B, No. 5 (A. P. M.)
26. St. D (e), A11.
27. An. B. No. 4 (A. P. M.)
28. No. 3 (A. P. M.)
29. St. D (e), A9.
30. Pal. Palace Steps, B3a.
31. Cop. St. 6, B4a.

PLATE XVII

NUMBE


FIFTEEN
1 2 3
SIXTEEN
SEVENTEEN
1 2
EIGHTEEN
TWENTY OR ZERO
1 2 3 4
ZERO
1 2 3 4
12 13 14
15 16 17 18
19 20 21 22
28 29 30 31

CE SIGNS—ZERO PLATE XVII

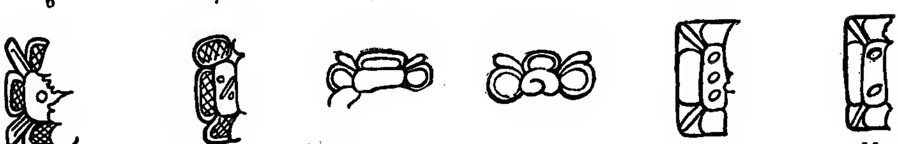


2 3 4 5 6 7

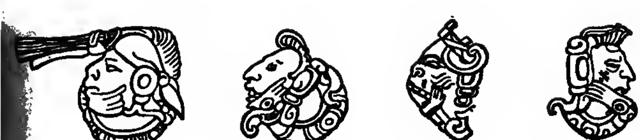
2 3

NINETEEN

6 7 8 9 10



6 7 8 9 10 11



24 25 26 27

INDEX OF GLYPHS ON PLATE XVIII

TWENTY — ZERO — CODICES

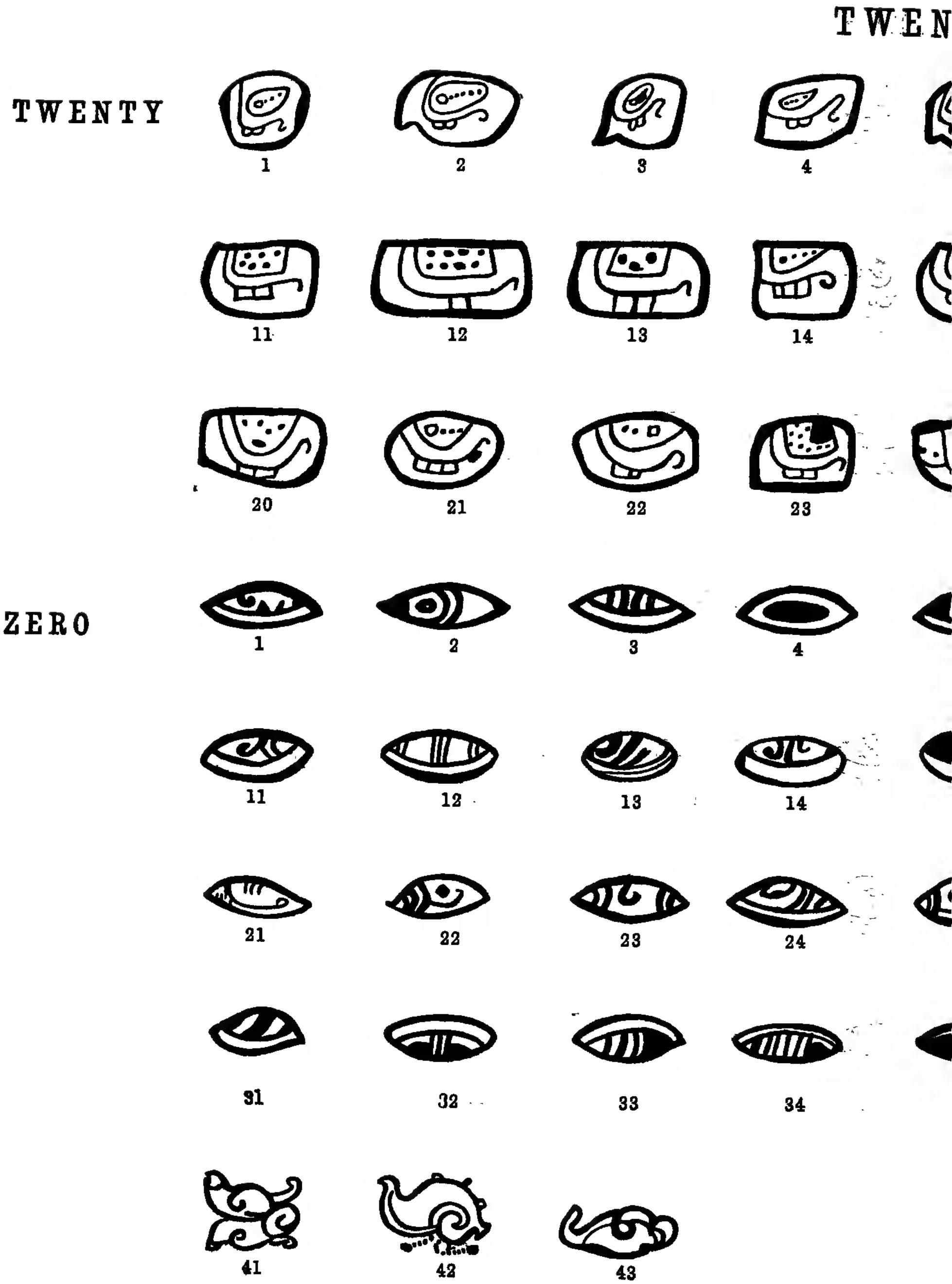
TWENTY

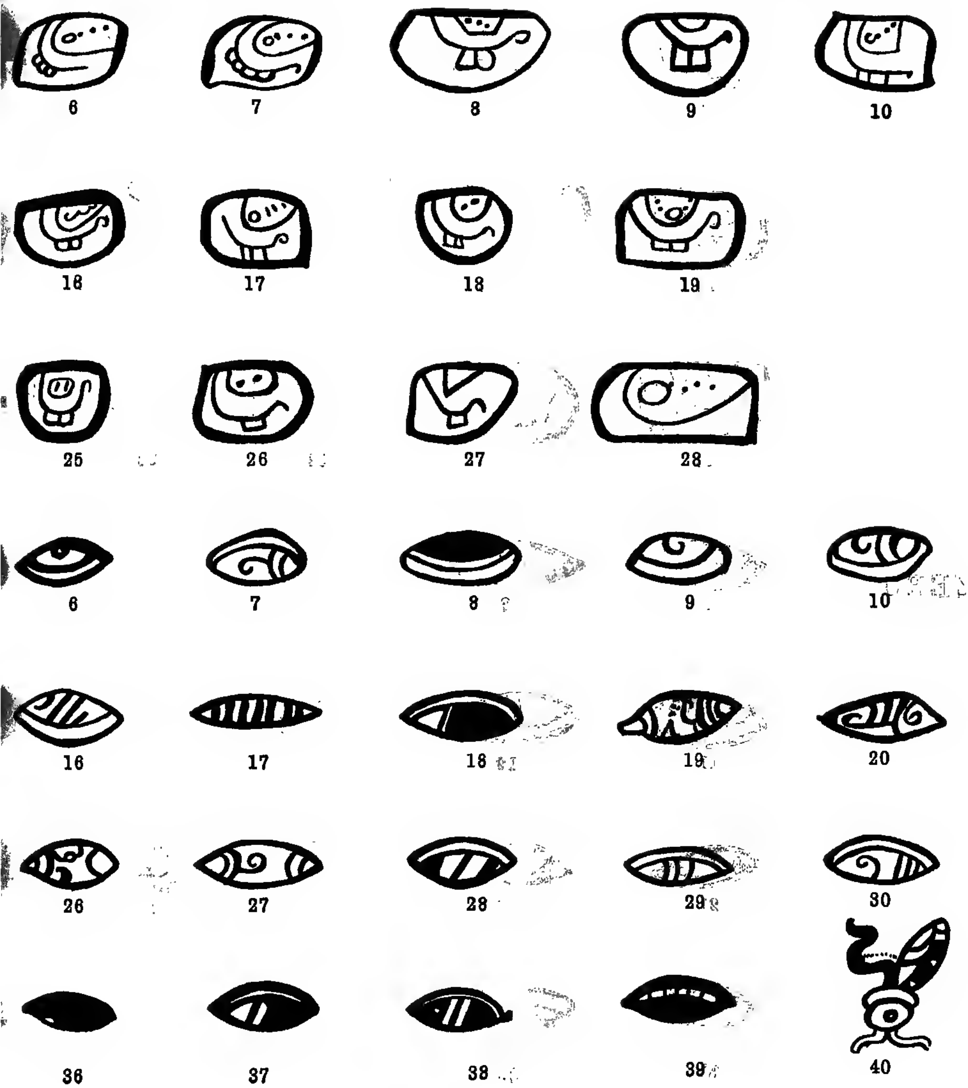
1. Dr. 45b.5.5.
2. 4c.4.3.
3. 34c.3.3.
4. 35c.5.3.
5. 37a.1.3.
6. 2d.4.3.
7. 2.3.
8. Tro-Cor. 8.
9. 8.
10. 14a.
11. 20a.
12. 20a.
13. 21c.
14. 24c.
15. 28d.
16. 64b.
17. 79c.
18. 89c.
19. 97a.
20. 97a.
21. 97c.
22. 101c.
23. 102b.
24. 102d.
25. 103a.
26. 105a.
27. 107c.
28. 112d.

ZERO

1. Dr. 24.5.
2. 7.
3. 5.
4. 7.
5. 6.
6. 4.2 from bottom.
7. 43b.3.7.
8. 4.4.
9. 4.8.
10. 4.10.
11. 5.4.
12. 6.4.
13. 6.9.
14. 7.4.
15. 44b.1.4.
16. 45a.1.3.
17. 51a.1.13.
18. 2.7.
19. 63.2.12.
20. 15.
21. 4.12.
22. 4.16.
23. 70.1.8.
24. 70.2.5 from bottom.
25. 5.1.
26. 2.
27. 6.
28. 7.
29. 14.
30. 6.7.
31. 6.16.
32. 2 from bottom.
33. 72b.1.6.
34. 72c.3.6.
35. Dr. 53b.2.4.
36. 55b.2.5.
37. 4.6.
38. 57a.3.5.
39. 58a.3.5.
40. 24.7.8 from bottom.
41. 63.6.19.
42. 64.4.19.
43. 54b.7.5.

PLATE XVIII


TWEN
TWENTY
1 2 3 4
11 12 13 14
20 21 22 23
ZERO
1 2 3 4
11 12 13 14
21 22 23 24
31 32 33 34
41 42 43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INDEX OF GLYPHS ON PLATE XIX

MISCELLANEOUS

ENDING SIGNS

CYCLES

1. T. C., R4.
2. Cop. Alt. S, No. 7a (A. P. M.)
3. Qu. An. G (w. u.), F5.
4. E10.
5. Seib. St. 11, F2a.
6. T. C., C5.
7. T. S., N2.
8. T. I. (60), O6.
9. T. F. C., D7.
10. Cop. St. 8 (s. w.), A2.

KATUNS

1. Cop. St. 8 (s. w.), B1
2. T. I. (60), P3.
3. P6.
4. Seib. St. 7, AB5.
5. T. I. (60), T2.
6. (61), A3.
7. G2.
8. (62), P3.
9. (60), D6.
10. T. F. C., O15.
11. Cop. St. A, E12.
12. B, B6.
13. P. N. St. 3, F10.
14. Yax. Lint. 31, GH5.
15. Nar. St. 23 (e), D18.
16. Stone Lint, F3. (Pl. 29.)
17. Tik. St. 16 (s), A4.

ENDING SIGNS

TUNS

1. T. I. (60), N2.
2. T. S., Q15.
3. Tik. St. 3, B8.
4. 5, A5.
5. Qu. St. F (w), B7a.

AHAU with SERPENT

1. T. I. (60), M7.
2. (62), L8.
3. P5.
4. E8.
5. R3.
6. Qu. St. F (e), B14a.
7. (w), B19b.
8. Cop. St. C, A9.
9. B7.
10. B2.
11. D2.
12. C7.
13. C11.
14. St. 2, F5.
15. 1, D1.
16. Qu. St. F (w), A17a.

HAND SIGNS

1. T. F. C., C7.
2. T. C., D4.
3. Cop. St. A, D12.
4. 2, F6.
5. T. I. (60), M1.
6. Qu. St. C (e), B14.
7. Cop. St. 4, B7a.
8. T. C., S1.

CALENDAR ROUND

T. I. (62), F11.

PLATE XIX

MISCELLA

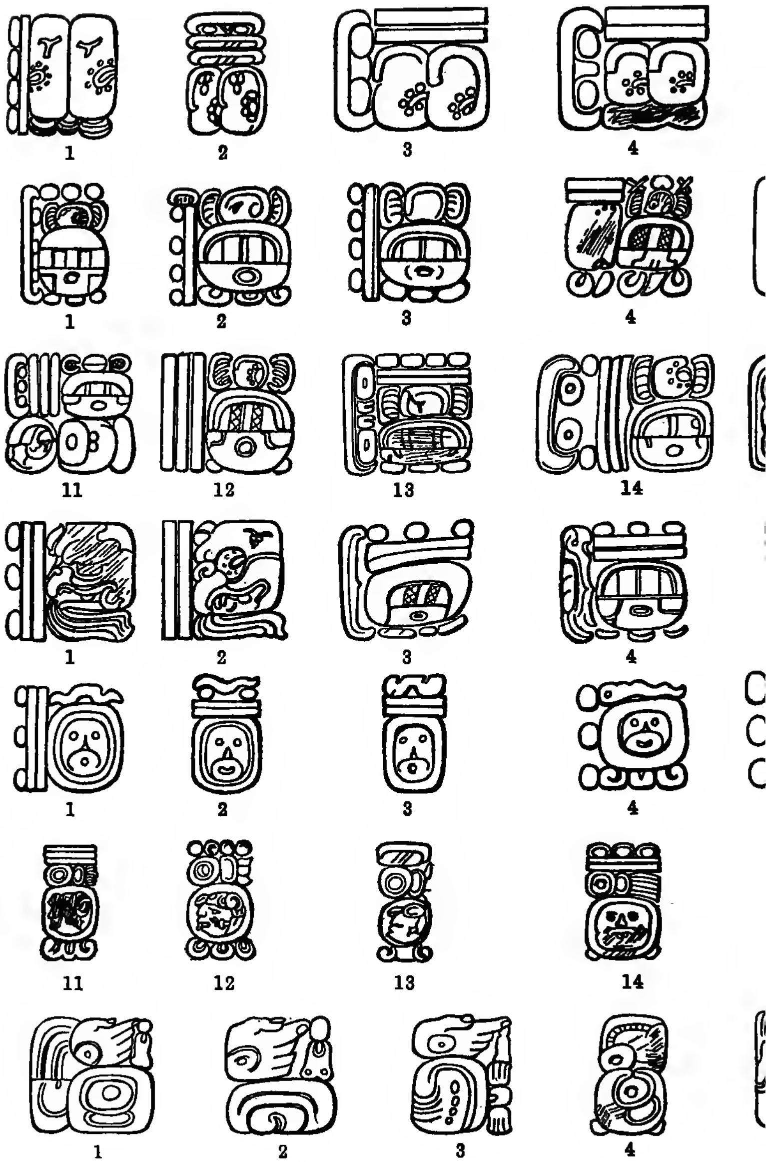
CYCLE

KATUN

TUN

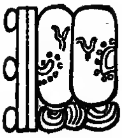
AHAU WITH SERPENT

HAND SIGNS



S—ENDING SIGNS

PLATE XIX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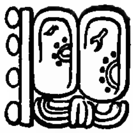
7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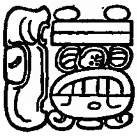
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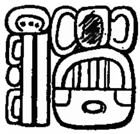
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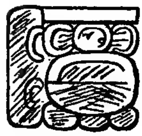
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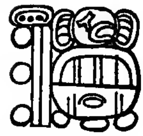
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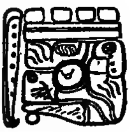
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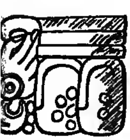
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CALENDAR ROUND