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NUMERAL SYSTEMS OF MEXICO AND CENTRAL AMERICA

BY

CYRUS THOMAS

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NUMERAL SYSTEMS OF MEXICO AND CENTRAL AMERICA

By Cyrus Thomas

PRIMARY NUMBERS

It is well known that the vigesimal system of numeration prevailed among the Mexican and Central American tribes, at least among all which had adopted the so-called "native calendar"—that is, the calendar specially referred to in my paper entitled Mayan Calendar Systems, published in this volume. Numerous short notices and incidental mentions of the general system and completer notices of the systems of particular tribes are to be found in the early Spanish authorities and in the works of more recent writers. As, however, most if not all of them are limited in scope, relating to the system of but one tribe or people, or referring only to certain points, and as no paper devoted specially to the subject of numeral systems has appeared in English, it is deemed expedient to present this paper as a supplement to those which have preceded it. Moreover, it is believed that a résumé of the subject in the light of the recent advance in our knowledge of Mexican and Central American archæology will be acceptable to those devoting attention to the study of prehistoric Mexico and Central America.

As my paper on the calendar systems[1] related to the time system and symbols of the Mayan tribes, and incidentally to the numeral system as used by them in counting time, attention will here be paid to the numeral system in its more general application among the Nahuatlan, Mayan, and other tribes of Mexico and Central America which used the vigesimal system.

I have shown in the paper on calendar systems that in counting time

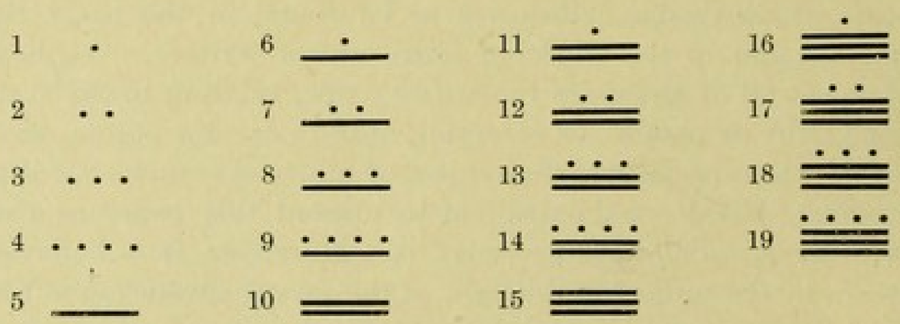
[1] This expression will be used throughout to refer to the paper mentioned above, published in this volume.

the units used by the Mayan tribes were as follow, the day being the primary unit:

1 unit of the 1st order = 1 day.
1 unit of the 2d order = 20 units of the 1st order = 20 days.
1 unit of the 3d order = 18 units of the 2d order = 360 days.
1 unit of the 4th order = 20 units of the 3d order = 7,200 days.
1 unit of the 5th order = 20 units of the 4th order = 144,000 days.
1 unit of the 6th order = 20 units of the 5th order = 2,880,000 days.

As this notation has been fully explained and discussed in the preceding paper, I pass at once to an examination of the general numeral system of the Mayan tribes. The notation given above differed from that of general application in the change of the second step from 20, as it should be according to the regular vigesimal system, to 18, probably to facilitate counting with the month factor.

As 20 is the basis of the higher counts, attention will be directed first to the steps leading up to this number. The oldest records to which we can appeal for knowledge of the system in use among the Mayan tribes are the inscriptions and codices. From these we can, however, learn only the method of *writing* numbers, not the number names; yet the method of writing will indicate to some extent the process in oral counts. Although the symbols commonly used for this purpose are now well known from the frequent notices of them which have been published, it is necessary for our present purpose that they be presented here.



From these it is seen that the count as expressed in symbols is from 1 to 4 by sing dots, or the unit repeated; but that to indicate 5 the method is changed, and a single short line is used instead of five dots. Though frequently horizontal, it is not necessarily so, but is found both in the codices and inscriptions in a vertical position; oftener, even, in the latter than in the former. The next four numbers, 6, 7, 8, and 9, are formed by adding to the single line one, two, three, and four dots or units, but 10 is represented by two parallel lines. That these lines must be parallel, or substantially so, whether horizontal or vertical, seems to be requisite in the Mayan hieroglyphic writing. Dots are added to the two lines to indicate the numbers 11, 12, 13, and 14; three parallel lines are used to represent 15, and dots are added to these to form the numbers 16, 17, 18, and 19, where the use of symbols of this form stops, 19 being the highest number for which they appear to have been used in Mayan writing. The higher numbers were, as has been shown in my paper on calendar systems, represented by other symbols, or by relative position. Substantially the same plan of writing numerals is seen in the Roman system, the line being used instead of the dot, thus: I, II, III, IV, V, VI, VII, VIII, IX, X, XI, etc., to XIX, 19. Attention is called to this because of another resemblance which will be noticed hereafter.

Now it is apparent that if these symbols, taken in the order in which they stand, indicate the method followed in actual or oral counting, this method must have been as follows, from five upward: 5 and 1; 5 and 2; and so on to 2 fives; then 2 fives and 1; 2 fives and 2; and so on to 3 fives; then 3 fives and 1; 3 fives and 2, to 19. If this theory be true, we should expect to find terms in the language to correspond with the symbols; evidence that these existed in Mayan count appears to be wanting, yet, as favoring the theory, we do find, as will appear, that the Nahuatl and some other surrounding languages contained terms corresponding precisely with this method of counting. It is, however, somewhat strange that the Borgian codex, which is probably the oldest of the existing Mexican codices, does not use the short line for 5, but counts with single dots as high as 26, and in fact no one of these codices appears to use it in counting time from date to date, though it is used in them for other purposes. The Mayan terms from 10 to 20 follow not this quinary system but the decimal order, as will be seen. The terms used for numbers up to 20 in the Maya (or Yucatec) dialect are, according to the usual orthography, as follow:

1	hun.	6	uac.	11	buluc.	16	uaclahun.
2	ca.	7	uuc.	12	lahca.	17	uuclahun.
3	ox.	8	uaxac.	13	oxlahun.	18	uaxaclahun.
4	can.	9	bolon.	14	canlahun.	19	bolonlahun.
5	ho.	10	lahun.	15	holahun.	20	hunkal, or kal.

It is scarcely necessary to state that the orthography is varied slightly by different authors, the Spanish *j* being used by some for *h* in *hun*, *ho*, and *lahun*, and *k* substituted for *c* in *uac*, *uuc*, and *uaxac*.

It is apparent from these terms that the numbers from 12 to 19 are formed by adding 2, 3, 4, etc., to 10. The terms for 6, 7, and 8 appear also to be composite, as the terminal *c* or *k* seems to indicate either the same radical throughout, or the same suffix, though no satisfactory explanation of this point, which will be again referred to, has been presented. As additional data bearing on these questions, the names of the numbers up to 10 in the different Mayan dialects as given by Stoll[1] are added here, the Spanish *j* being used by him instead of *h*.

[1] Zur Ethnographie der Guatemala, 1884, pp. 68–69.

	Dialect	1	2	3	4	5
1	Huasteca	jun	tzab	ox	tze	bo
2	Maya	jun	ca	ox	can	jo
2a	Peten	jun	ca	ox	can	jo
3	Chontal	jumpé	chapé	uxpé	chompé	joóp
4	Tzental	jun	cheb	oxeb	chanéb	jooéb
5	Tzotzil	jun	chim	oxim	chanim	joóm
6	Chañabal	juné	chabé	oxé	chané	joé
7	Chol	jum	cha	ux	chum	joo
8	Quekchi	jun	caib	oxib	cajib	oób
9	Pokonchi	jenáj	quiib	ixib	quijib	joób
10	Pokomam	janáj	quiém	ixiém	quiejém	joóm
11	Cakchiquel	jun	ca'i	oxi	caji	vuoó
12	Qu'iché	jun	quiéb	vuoxib	cajib	joób
13	Uspanteca	jun	quib	oxib	quejéb	joób
14	Ixil	úngvual	cávual	óxvual	cájvual	óvual
15	Aguacateca	jun	cab	ox	quiáj	o
16	Mame	jun	cáve	óxe	quiáje	jóvue

	Dialect	6	7	8	9	10
1	Huasteca	akak	buk	vuaxik	belléuj	lajú
2	Maya	uak	uúk	uaxák	bolón	lajún
2a	Peten	uak	uúk	uaxák	bolón	lajún
3	Chontal	(?)	(?)	(?)	(?)	(?)
4	Tzental	uakéb	uukéb	uaxakéb	balunéb	lajún
5	Tzotzil	uakim	uukúm	uaxakim	balunem	lajunem
6	Chañabal	uaké	juké	uaxaké	baluné	lajuné
7	Chol	vuök	juk	uaxök	bolón	lujúm
8	Quekchi	vuakib	vukúb	vuakxakib	beléb	lajéb
9	Pokonchi	vuakib	vukúb	vuaxakib	belejé	lajéb
10	Pokomam	vuakim	vukúm	vuaxakim	belejém	lajém
11	Cakchiquel	vuaki	vukú	vuajxaki	belejé	lajúj
12	Qu'iché	vuakib	vukúb	vuaxakib	belejéb	lajúj
13	Uspanteca	vuakakib	vukúb	vuajxakib	belejéb	lajuj
14	Ixil	vuajil	vújvual	vuaxajil	belúvual	lávual
15	Aguacateca	ukák	vuúk	vuájxak	bélu	láju
16	Mame	vuák	uk	vuacxák	belejúj	lajúj

Before commenting on the list, the names in some other dialects of this stock not included by Stoll and some variations from the orthography of his list will be noted.

Pupuluca[1]		Chuhe[2]		Jacalteca[3]		Subina[4]	
1	hun	1	hun	1	hune	1	hun
2	káú	2	chaab	2	caab	2	cheb
3	oxí	3	oxe	3	oxuan	3	oxê
4	kiahi	4	changue	4	canek	4	chaneb
5	voó	5	hoe	5	houeb	5	hoe
6	vahatzi	6	vuaque	6	cuaheb	6	guaqueb
7	vukú	7	uke	7	huheb	7	huquê
8	(?)	8	vuaxke	8	vuaxaheb	8	guaxaqueb
9	belehé	9	vuangue	9	baluneb	9	balunê
10	lahú	10	lahne	10	lahuneb	10	lahuneb
20	hunvinack	20	hun c'al	20	hun c'al	20	tab

Membreno gives the following numerals of the Honduras Chorti, which are added here for comparison:

Chorti (Honduras)[5]

1	yuté.	4	canté.
2	chajté.	5	guajté.
3	ushté.	12	astoraj.

Huasteca—Alejandre (Cartilla Huasteca) gives for 6, *acac;* for 7, *buc;* for 8, *huaxic;* for 9, *velleuh.*

Maya—The only variation from Stoll's orthography (the Spanish *j* and the *h* being considered equivalents) is the terminal *c* for *k* in the names for 6, 7, and 8; this can, however, scarcely be considered a variation.

Tzental—Charencey (Melanges, p. 44) has given as the Tzental names of numbers what are in fact the Tzotzil names, as is evident from the vocabularies of Stoll and Guardia and also the Vocabulario Tzotzil-Español edited by Charencey.

Tzotzil—The Vocabulario Tzotzil-Español gives for 1, *ghum;* for 6, *vuaquim;* for 8, *vuaxaquin;* and for 20, *tob.*

Cakchiquel—Guardia (op. cit., p. 23) gives *vakakib* for 6, but on page 42 *vuacaqi.*

[1] Ricardo Fernández Guardia, Lenguas Indigenas Cent. Am. Siglo, vol. XVIII, pp. 35–36. Probably a mere idiom of the Cakchiquel Pupuluca, near Volcan de Agua, Guatemala.

[2] Stoll, Sprache der Ixil-Indianer, p. 146 (*h* substituted for *j*). Apparently an idiom of the Chañabal.

[3] Ibid. This author associates this dialect with the Mam group; however, in its numerals it approaches the Maya very closely.

[4] Guardia, op. cit., pp. 79–80. The number names are closely related to those of the Chañabal and Tzental dialects, if not identical with the latter. *H* is substituted for the Spanish *j*.

[5] Alberto Membreno, Hondurenismos, p. 264.

Quiche—As Brasseur's orthography (Gram. Lang. Quiche, p. 141) differs considerably from Stoll's, we give his list here:

1	hun.	4	cah, or cahib.	7	vukub.	10	lahuh.
2	cab, or caib.	5	oo, or oob.	8	vahxakib.	20	huvinak.
3	ox, or oxib.	6	vakakib.	9	beleh, or beleheb.		

Charencey follows this list, except in 8, which he writes *vaxak*.

Quekchi (*K'ak'chi*, *or* *Cakgi*)—Pinart (Vocabulario Castellano-K'ak'chi, page 7) gives for 2, *kaib;* for 4, *kaaib;* for 5, *joob;* for 6, *guakib;* for 7, *gukub;* and for 8, *guajxakib*. Charencey (Melanges, page 64) gives for 1, *hoon;* for 2, *cai;* for 3, *oxi;* for 4, *cagi;* for 5, *joob;* for 6, *wakki;* for 7, *uuku;* for 8, *wakshaki;* for 9, *belojem;* and for 10, *lajegem*.

Mam—As Stoll gives another list (Sprache der Ixil-Indianer, p. 146) which differs somewhat from that given above, and as both vary from that given in Salmeron's Arte y Vocabulario, page 156, this and Stoll's second list are given here (*j* being changed to *h*):

	Salmeron	Stoll		Salmeron	Stoll
1	hum	hun	7	vuk	vuuk
2	k'abe	caabe	8	vuahxak	vuahxak
3	oxe	ox	9	belhuh	belhoh
4	k'iahe	chyah	10	lahuh	lahoh
5	hoe	hue	20	vuink'im	vuinqui
6	vuak'ak	kak			

When the names in these lists are examined, the following points appear worthy of attention in attempting to trace their origin and determine their signification. It requires but a cursory examination to see the very close agreement, morphologically, throughout; a fact which may reasonably be assumed as indicating that they had come into use while the ethnic group was still homogeneous, and before the tribal distinctions had become marked. This conclusion agrees with the inference drawn in our paper on calendar systems from a study of the hieroglyphics. As the names of the days in all the Mayan dialects are believed by Dr Brinton to belong "to an archaic form of speech, indicating that they were derived from some common ancient stock and not one from the other," the close agreement in the numeral terms may perhaps justify the same conclusion in regard to them, especially as it is generally true that the origin of the names of the lower numbers lies back of history. This similarity also agrees with the uniformity, in the different sections occupied by the Mayan tribes, in the method of writing the numerals up to 20.

The Chontal, Chañabal, Quekchi (or K'ak'chi) and Ixil names, and those in some of the other dialects, appear to be furnished with suffixes. These, in the numbers exceeding 1, are, in a large number of cases—as for example where the terminal letter is *b* or *m*—additions, apparently indicating the plural. In other cases, where they are joined to the name for 1, they play a different rôle; for example, the suffix *vual* in the Ixil dialect signifies turn or repetition, or, perhaps more correctly, step in counting, a sort of reflective from a vaguely defined unity connotative of direction and time; thus the name for 1, *ungvual*, may be rendered "one time"; for 2, *cavual*, "two times," etc. The plural sign may be taken as evidence that the name still holds a trace of or reference to the process of counting, and has not yet reached what we may term the abstract or purely simple form. The *pé* in Chontal, *é* in Chañabal, and *aj* (or *ah*) in Pokonchi and Pokomam, are also suffixes, though possibly merely phonetic. The replacing of *n* by *h* (or *j*), or the dropping of the letter entirely, as in *lahun*, *lahuh*, *lahu*, etc., is, of course, understood to be a mere dialectic variation.

It has been stated above that the terminal *b* or *ib*, and in some cases the *m*, are construed as suffixes denoting the plural. This conclusion is strongly supported by Charencey (Mélanges), but Stoll (Die Maya-Sprachen der Pokom-gruppe) gives a different interpretation. "By agreement," he says, "with the Ixil, an isolated *b*, complete as *ib*, is attached to the numerals 1–10 [not to 1]; it is undoubtedly to be explained as the better understood form *ib*, which appears in *vu-ib*, 'my head,' of the Aguacateca, as well as in the reflexive pronoun of the Pokonchi, Quiche, etc.; *ix-ib* would therefore have meant originally 'three human beings.'" Nevertheless this would still carry the idea of plurality and would properly receive a plural termination.

According to the same authority the suffix *aj* in *jen-aj*, Pokonchi for 1, "was chosen as the object, in which at any rate we may recognize the personal suffix *aj*, so that *jen-aj* very probably meant originally 'a man.'" This conclusion appears to me doubtful, notwithstanding Dr Stoll's thorough knowledge of the Mayan languages.

The names for the numbers 6, 7, and 8 in this list, as stated above, appear to be compound words, the terminal *k* or *c* indicating a suffix, or the radical with a prefix; as yet no generally accepted explanation of these terms has been offered. Charencey (Mélanges, page 156), following Brasseur, makes the following suggestion in regard to *uac*—6: "This corresponds to our expression 'hors, pardela, superflu, surabundant,'" in other words, over or beyond, that is, above or more than 5. Perez gives as the signification of the verb *uac*, *uacah*, "to take out one thing which is placed in another and united with it." If this be assumed as the origin of the name, it would seem to refer to counting on the fingers, turning them in while counting the first five and then opening them out in counting the next five. Although the literal signification of the names for 6, 7, and 8 may not be 5 + 1, 5 + 2, and 5 + 3, yet, judging by the Maya method of writing the numbers, shown above, and the Mexican terms, I am inclined to believe that this is the implied meaning, the words being doubtless archaic; and I will give on a later page an additional reason for this opinion.

As the names and method of counting in other languages may throw some light on the subject, the following lists of numerals up to 10 are added. The first is the Nahuatl or Mexican (using the term in its limited sense—Aztec as given by Charencey), the signification so far as satisfactorily determined being added.

Nahuatl

1 ce.
2 ome.
3 yei or ei.
4 naui.
5 macuilli ("hand taken").
6 chiqua-ce or chicua-cen (literally 5 and 1).
7 chic-ome (literally 5 and 2).
8 chicu-ei or chicu-ey (literally 5 and 3).
9 chico-naui or chiuc-naui (literally 5 and 4).
10 matlactli ("the two hands").

The term for 5, *macuilli*, is a composite word from *maitl*, hand, and *cui*, to seize or take—that is to say, the five fingers of the hand have been taken (Siméon, Dic. Lang. Nahuatl). The name for 10 is also composite from *maitl*, hand, and *tlactli*, bust or torso of the man; in other words, the two hands. It is apparent that the names for 6, 7, 8, and 9 are formed by adding the names for 1, 2, 3, and 4 to *chi* or *chico*, which here takes the place of *macuilli*, 5. The signification of this term is "at the side, in part, by fraction, a moiety," etc.; the name is apparently formed from *chico* and *ihuan* or *huan*, "near another." It is probable, therefore, that the correct interpretation is, one at the side, two at the side, etc., the 5 or hand being understood, the reference being evidently to the process of counting on the hands.

The following lists are those of related tribes belonging to the group called by Dr Brinton the "Uto-Aztecan family."[1] Some of these, as the tribes of the Shoshonean group, had not adopted the vigesimal system nor the "native calendar"; nevertheless, it is best to bring the material concerning them together, that all which seems to have any bearing on the questions that arise may be before the reader. That the boundaries of the use of the vigesimal system and "native calendar" in the southern half of North America were not governed entirely by the lines of linguistic or ethnic stocks is well known, and hence they must have been governed, in part at least, by some other influence. Possibly a careful study of the numeral systems of the

[1] This is used here provisionally, though the Bureau of American Ethnology will, according to the rule established by Major Powell, adopt the name Nahuatlan.

different tribes may throw some light on this question; hence we have thought it best to present sufficient examples, so far as our data will allow, to give a definite idea of geographic and tribal differences in the group. Examples from other stocks or families of Mexico and Central America are also given, the stock names being from Brinton.

Nahuatlecan branch

Pipil[1]		Alagüilac[2]	
1	ce	1	se
2	ome or ume	2	umi
3	yae, yei	3	jei
4	nahue, navui	4	nagui
5	maquil, macuil	5	makuil
6	chicuasin, chicuas=5+1	6	tschikuasi=5+1
7	chicome=5+2	7	tschikume=5+2
8	chicuei=5+3	8	tschikwei=5+3
9	chicunahue=5+4	9	matakticumi=(10−1)?
10	mahtlati	10	matakti
11	mahtatici=10+1	20	sempual
12	mahtatiome=10+2		
20	cempual		

[1] Stoll, Ethnog. Repub. Guatemala, p. 21. Squier, Notes on Cent. Am., p. 352.
[2] Brinton, The So-called Alaguilac Language of Guatemala, p. 376.

Sonoran branch

Cora[1]		Opata[2]		Cahita[3]	
1	ceaut or zeaut	1	se or seni	1	senu
2	huapoa or huahpoa	2	gode	2	uoi
3	huaeica	3	veide or vaide	3	vahi, or bei′bey
4	moacua or maocoa	4	nago	4	naequi
5	anxuvi or amauri	5	mazirs or marizi	5	mamni
6	a-cevi=(5)+1	6	bussani	6	busani
7	a-huapoa=(5)+2	7	seni-bussani, or seni gua bussani =1+6?	7	uobusani
8	a-huaeica or ahuveica=(5)+3	8	go nago=2×4?	8	uonaequi=2×4?
9	a-moacua or amaocoa=(5)+4	9	kimakoi	9	batani
10	tamoamata (moamati, "hand")	10	makoi	10	uomamni=2×5?
		20	seuri, or seneurini	11	uomamni aman senu=10+1
				20	tacahua, or senutacua="the body"

[1] Conant, Number Concept, p. 166, and Charencey, Melanges, pp. 15-17.
[2] Pimentel, Cuadro, Vocab. Opata, vol. II, p. 273.
[3] Ibid., Charencey, and Mélanges, pp. 15-17, and Eustaquio. Buelna, Arte Lengua Cahita, p. 199.

Sonoran branch—Continued

Pima[1]		Tarahumari[2]		Tepehuan[3]	
1	youmako, or humac	1	bire, pile, or sinepi	1	uma, or huma, or homad
2	houak, or kouak, or kcéko	2	oca, or oka, or guoca	2	gokado, or gaok
3	vaik, or vaiko	3	beica, baica, or beiquia	3	veicado, or baech
4	kick? or kiik	4	nagueoca, or naguo	4	maukao
5	pouitas, huitas, or khekhtaspe	5	mariki, or marika, or mariqui	5	chetam
6	tchu-ut, or tsautep	6	pussaniki, or usaniqui		
7	wawa, or bubak	7	kichao, or quichauco		
8	kikig	8	ossanagroc, okanako, or osanaguoco		
9	umu-tchiko, or humukt	9	kimakoë or quimacoiqui		
10	wistima	10	makoé, or macoiqui		
20	kuko-wistima	20	osamacoi		

[1] Charencey, Mélanges, pp. 15–16, and Hale, Trans. Am. Eth. Soc. (per Gatschet).
[2] Charencey, loc. cit. Miguel Tellechea, Compend. Gram. Tarahumar, p. 7.
[3] Charencey, loc. cit., and Brinton, American Race, p. 337.

Shoshone branch

Cahuillo[1]		Kauvuya[2]	
1	supli	1	sople
2	mewi	2	vuy
3	mepai	3	pa
4	mewittsu	4	vuitchiu
5	nome-kadnun	5	namu-kuanon
6	kadnun-supli=5+1	6	kuan-sople=5+1
7	kan-munwi=5+2	7	kuan-vuy=5+2
8	kan-munpa=5+3	8	kuan-pa=5+3
9	kan-munwitsu=5+4	9	kuan-vuitchiu=5+4
10	nomatsumi	10	nami-tchumi

[1] Conant, Number Concept, p. 165.
[2] Gatschet, Forty Vocabularies, Wheeler's Report, vol. VII (number 19).

Shoshone branch—Continued

Gaitchaim[1]	Kechi (of San Luis Rey)[2]
1 sopul	1 suploj
2 vue	2 whii
3 pahe	3 paa
4 vosa	4 witcho
5 maha-ar	5 nummu-quano (numma, "hand")
6 auva-khanuetch	6 suploj-namehon=1+5
7 se-ula	

[1] Gatschet, Forty Vocabularies, Wheeler's Report, vol. VII (number 20). [2] Ibid. (number 22).

Shoshone[1]	Pavant[2]	Southern Paiute[3]	California Paiute[4]	Shoshone[5]
1 shoui	1 soos	1 shui	1 shum-uue	1 simitich, or tchi-mouts
2 waii	2 wyune[6]	2 vay	2 voahay	2 hwat, or wat
3 pahi	3 piune	3 pay	3 pahi	3 pite, or manu-git
4 wachoui	4 watsuene	4 vatchue	4 voats-agve	4 watsuet, or hwat-chiwit
5 manĕk	5 manigin	5 manigi	5 manegi	5 managet, or tchu-manush
6 nāwā	6 naviune	6 navay	6 napahi	6 naviti, or natak-skweyu
7 moquesi	7 tatsuene	7 mukui-she	7 tatsuu	7 tatsuit
8 nāāntz	8 niwatsu-ene	8 nant-chui	8 voshu^n	8 nywat-suit
9 you-weep	9 surromsu-ene	9 yuvibe	9 kvanik	9 shimero-men
10 mat-shoui	10 tomsuene	10 mashu	10 shuvan	10 shimmer

[1] Gatschet, Forty Vocabularies, Wheeler's Report, vol. VII (number 6).
[2] Ibid. (number 5).
[3] Ibid. (number 12).
[4] Ibid. (number 11).
[5] Ibid. (number 10) and Charencey, Mélanges.
[6] Termination *ung*, probably from *onee*, "to stand up."

Shoshone branch—Continued

Comanche[1]		Chemehuevi[2]		Capote Uta[3]		Hopi[4]		Takhtam[5]	
1	semmus	1	shooy	1	soois	1	shukhga	1	aukpeya
2	waha	2	vay	2	wyüne	2	lei	2	vurm
3	pahu	3	pay	3	piune	3	pahhio	3	pahe
4	hagar-so-wa	4	vatchue	4	watssuüne	4	nale	4	voat-cham
5	mawaka	5	manuy	5	manegin[6]	5	tchibute	5	ma-hat-cham
6	nahwa	6	navay	6	naveune	6	navai	6	pa-ahave
7	tah-acho-te	7	mukui-she	7	navechiune	7	tsenggee	7	voatch-geve
8	nahua-wachota	8	nantchui	8	wahwatssu-üne	8	nanal	8	voa-otch
9	semmon-ance	9	yuepa	9	sooroosüüne	9	peve	9	ma-ak-ove
10	shurmun	10	mashu	10	towumsuüne	10	pakte	10	voa-ham-atch

[1] Charencey, Mélanges, pp. 15-17.
[2] Gatschet, Forty Vocabularies, Wheeler's Report, vol. VII (number 13).
[3] Ibid. (number 15).
[4] Ibid. (number 17).
[5] Ibid. (number 18).
[6] Probably "all."

Kechi (San Diego)[1]		Tobikhar[2]		Kij or Kizh[1]		Wihinacht[1]	
1	tchoumou	1	pügu	1	puku	1	siñgwein
2	echyou	2	vehe	2	wehe	2	wahêiu
3	micha	3	pahi	3	pahe	3	pahagu
4	paski	4	vatcha	4	watsa	4	watsikweyu
5	tiyerva	5	mahar	5	maharr	5	napaiu
6	ksoukouia	6	pavahe	6	paboi		
7	ksouamiche	7	vatcha-kabya				
8	scomo	8	vehesh-vatcha				
9	seou-motchi	9	mahar-kabya				
10	touymili	10	vehes-mahar				

[1] Charencey, Mélanges, pp. 15-17.
[2] Gatschet, Forty Vocabularies, Wheeler's Report, vol. VII (number 21).

The five following lists from California dialects obtained and furnished by Prof. W J McGee are inserted here as the most appropriate place to introduce them:

Hai′it dialect [1]

1	wŭk′-te.	4	tsoo′-ik.	7	tä-poo′-ik.	10	mä′-tsäm.
2	pen.	5	mä′-wŭk.	8	pen′-tsoo-ik.	20	pen′-i-mä-tsäm.
3	shä-poo′-i.	6	tŭm-bak′.	9	(lacking).		

Mi′wŭk dialect [2]

1	keng′-e.	4	o′-yee-sä.	7	kä-nek′-kä-koo.	10	nä′-ä-chä.
2	o-tee′-ko.	5	mä′-sho-kä.	8	kä′-wĭn-tä.	20	nä′-ä.
3	to-long′-ko-shoo.	6	tem′-o-kä.	9	woo′-e.	30	nä′-ä-nä-ä-chä.

Yet′tripih (Tulare) dialect [3]

1	yĕlk.	4	hät-pän′-ik.	7	näm′-cheet.	10	tree′-o.
2	bŏng′-ŏy.	5	hĭt-shĭn-ik.	8	mōn′-äc.	20	bŏng′-ŏy-tree-o.
3	shä′-pĭn.	6	chŭ-dā-pe.	9	nän-eep.	30	shä′-pĭn-tree-o.

Tätätl (Kern River) dialect [4]

1	chĭch.	4	nä′-now.	7	näm′-tsĭn.	10	äm-hai-tsĭng.
2	wo.	5	mä′-ee-tsĭng.	8	näp′-n-sĭng.	20	wom′-m-hai-tsĭng.
3	pai.	6	näp′-ai.	9	lä′-ä-kee.	30	pai′-m-mai-tsĭng.

Maricopa dialect [5]

1	shān-tee.	3	ka′-mōk.	5	sŭ-rŭp.
2	kŭ-wik.	4	shŭm-pŭp.		

Three other lists from California dialects, two collected by Stephen Powers and one from Major J. W. Powell's Comparative Vocabularies (Contributions to North American Ethnology, vol. III) are added here. One of these—the Konkau—appears to be substantially the same as the Haiit of Professor McGee's lists.

Konkau *a*		Nishinam *a*		Nakum *b*	
1	wuk-teh	1	wut-teh	1	chut
2	pe-nim	2	pen	2	penneh
3	sha-pwi	3	sa-pwi	3	cha-pwi
4	ch'u-yeh	4	chui, or chuch	4	chui
5	ma-cha-neh	5	mauk	5	ma-wuk
10	ma-cho-ko	10	ma-chum	10	ma-suk

a Powers, Contrib. to N. A. Eth., vol. III, p. 313.
b Powell, Comp. Vocab., ibid., pp. 594-596.

[1] Obtained at Nevada, California, October 3, 1898, and verified at Forest Hill and Colfax.
[2] Obtained near Jamestown, California, October 18, 1898.
[3] Obtained at Tule River agency, October 25, 1898.
[4] Obtained at Tule River agency, October 25, 1898.
[5] Obtained at Ashfork, Arizona, from girl en route to San Diego, California.

Zapotecan family[1]

Zapotec[2]	Mixtec[3]	Chuchon[4] (or Chocha)
1 tobi, tubi, or chaga	1 ec (ce?) or ek	1 ngu
2 topa, tiopa, or cato	2 wui, uvui, or uhui	2 yuu-rina,[5] or yuu
3 chona, or cayo	3 uni	3 ni-rina, or nyi
4 tapa, or taa	4 gmi, or kmi	4 nuu-rina, or ñuu
5 caayo, gayo, or goyo	5 hoho	5 nau-rina, or nau
6 xopa, or goxopa	6 ino	6 njau-rina, or nhau
7 caache, gaache or gooche	7 ucha	7 yaatu-rina, or yaatu
8 xoono, xono, or goxono	8 una	8 nh-rina, or nhi
9 caa, or gaa	9 ee	9 naa-rina, or naa
10 chii, or gochii	10 usi	10 te-rina, or te
	11 usi-ce	

[1] To conform to the rule proposed by Major Powell, which has been generally accepted, to use a single term terminating with *an* in forming family names, this family will be called the *Zapotecan*.

[2] Cordova, Arte del Idioma Zapoteco (reprint), p. 176, and Vocab. Castellano-Zapoteco.

[3] Charencey, Mélanges, p. 44.

[4] N. Leon, Introd. to Cordova, Arte del Idioma Zapoteco, p. lxxii.

[5] Leon says that *rina* appears to be a sign of the numeral adjective. This is merely a subdialect of the Chuchon.

Popoloca[1] (of Oaxaca)	Trike[2]	Mazateca[3]
1 gou, or ngu	1 ngo	1 gu
2 yuu	2 nghui	2 hó
3 nii, or nyi	3 guañânha	3 há
4 noo, or nuu	4 kaha	4 ni-kú
5 nag-hou, or nau	5 huhûha	5 û
6 tja, or nhau	6 guatânka	6 hû
7 yaata, or yaatu	7 chiha	7 yi-tú
8 gnii, or nhi	8 tônha	8 hi-i
9 na, or naa	9 hûnha	9 ñi-há
10 tie, or te	10 chia	10 te
20 kaa	11 chânha	20 kâ
	12 chuuiha	
	20 hikoo, or kooha	

[1] N. Leon, Introd. to Cordova Arte del Idioma Zapoteco, p. lxxii. Francisco Belmar, Lengua Mazateca, p. 43 (under the name Chocha).

[2] Belmar, Ensayo sobre la Lengua Trike, 1897, p. 10.

[3] Belmar, Lengua Mazateca, p. 40.

OTHOMIAN FAMILY

Othomi[1]

1	unra, n'nra, or ra.	6	rahto, or rathto=1+5.
2	yooho, or yoho.	7	yoto, or yohto=2+5.
3	hiû.	8	chiato, or hiâhto=3+5.
4	gooho.	9	guto, or gytho=4+5.
5	kuto, gyto, kuta, or qyta.	10	reta.

Matlaltzincan or Pirinda[2] (2 vocabularies)

1	indawi.	yndahhuy,[3] or rahui.
2	inawi.	ynahuy, or nohui.
3	inyuhu.	ynyuhu.
4	inkunowi.	yncunohuy.
5	inkutaa.	yncuthaa.
6	inda-towi=1 to 5.	yndahtohuy.
7	ine-towi=2 to 5.	ynethohuy.
8	ine-nkunowi=2×4.	ynencunovi.
9	imuratadahati=10—1?	ynturahtadahata.
10	inda-hata.	yndahatta.
20	———.	yndohonta.

ZOQUEAN FAMILY

Zoque[4]

1	tuma.	6	tutay, or tuch tan.
2	metza, or metsan.	7	cuyay, or wueus-tuch tan.
3	tucay, or tuan.	8	tucututay, or tuduchtan.
4	macscuy, or makchtashan.	9	mactulay, or makchtuchtan.
5	mosay, or morshan.	10	macay, or makch-kan.

Mixe or Mije[5]

1	tuck, or tuuc.	7	mirsh-tuk, miish-tuk, westuuk or huextuuc.
2	metzk, or metsk.	8	tuk-tuk, or tuktuuk.
3	tegeug, or tukok.	9	machk, tastuuk, or taxtuuc.
4	madarsk, maktashk, or mactoxc.	10	tards-tuk, makh, or mahc.
5	m'kossk (?) mokoshk, or macoxc.	20	ypx.
6	tech-teuchch, or tuduuk.		

Pupuluca (of Tepeaca)[6]

1	tuub.	5	mokoxko.	9	taxtujtujko.
2	mesko.	6	tujtujko.	10	mako.
3	tuö.	7	juxtukujtujko.	20	ipxe.
4	maktaxko.	8	tukujtujko.		

[1] Conant, Number Concept, p. 165; Charencey, Mélanges, p. 84; Ymolina, Arte del Idioma Othomi, p. 153.

[2] One under the first name by Conant, Number Concept, p. 166; the other under the second name by Charencey, Mélanges, p. 84.

[3] Charencey regards the *yn* as a "simple prefix," whether merely euphonic or not he fails to state.

[4] Charencey, Mélanges, p. 72; E. A. Fuertes, manuscript in Bureau of American Ethnology archives; Grassierie, Lengua Zoque, in Vocab.

[5] E. A. Fuertes, manuscript in Bureau of American Ethnology archives; Grassierie, Lengua Mixe, p. 332; Stoll, Ethnog. Guatemala, p. 28.

[6] Ibid. Belongs to the Mixe group.

TARASCAN OR MICHOACAN FAMILY

Tarasco[1]

1	ma.	6	cuimu.[2]	11	temben-ma=10+1.
2	tziman.	7	yun-tziman=(5)+2.	12	temben-tziman=10+2.
3	tanimu.	8	yun-tanimu=(5)+3.	20	macquatze, or makatori.
4	tamu.	9	yun-thamu=(5)+4.		
5	yumu.	10	temben.		

CHIAPANECAN FAMILY

Chiapanec[3]

1	tige, tique, tiqui, ticao, tighe, or tiche.	8	mahumihi, or hahu-mihi.
2	hao, jomi, or húmihí.	9	helimihi.
3	haui, jami, or hemihì.	10	henda.
4	ahau-mihi, ahu-mihi, or haha.	14	henda-mahua.
5	aomihi, haòmo, or haumihì.	15	henda-mu.
6	amba-mihi, or hamba-mihi.	20	hahua, hahue, ahué, or hahoy.
7	hendi-mihì.		

TOTONACAN FAMILY

Totonaca[4]

1	tum.	4	tati.	7	tushun.	10	kaū, or cauh.
2	tuyun.	5	kitsiz.	8	tsayan.		
3	tutu.	6	tchashan.	9	nahatsa.		

Totonaca (Starr)[5]

1	tla-ka-tin.	4	la-ka-ta-te.	7	la-ka-to-hon.	10	la-kāl-xāo.
2	tla-kā-to.	5	la-ka-ki-tsis.	8	la-ka-tsai-yun.	20	la-ka-po-shan.
3	tla-kā-to-tō^{n}.	6	la-ka-cha-shun.	9	la-ka-na-hās.		

Akal'man (Vera Cruz)[6]

1	tam.	9	naxatze.
2	thoi.	10	kau.
3	thut.	11	kautam=10+1.
4	thaate.	12	kauthoi=10+2.
5	kis.	20	pusham.
6	tchashan.	30	pushamkau=20+10.
7	taxun.	40	thoipusham=2×20.
8	tsaxen.		

As the origin of the names for 1 to 4 is a question belonging largely to the deductive domain because of the very meager data bearing on the subject, it will not be discussed at any length here. The reader is, however, referred for an examination of the subject in its broad and general aspect to a paper by Professor W J McGee, entitled The Beginning of Mathematics, in the American Anthropolo-

[1] Anales de Museo Michoacan, entraga 1, p. 59, 1888.

[2] *Cu*, "to join or mix one thing with another"—N. Leon, Anales de Museo Michoacan, entraga 1,106. Basalenque, Arte del Idioma Tarasco, p. 48, says *cu* refers to the hand.

[3] Charencey, Mélanges, p. 44; R. F. Guardia, Lenguas Indigenas Cent. Am. en el Siglo, vol. XVIII, p. 86.

[4] Grundriss, vol. II, p. 293.

[5] Notes on Ethnog. South Mexico.

[6] A. S. Gatschet, quoting Pinart, American Antiquarian, vol. IV, p. 237 (April–July, 1882).

gist, October, 1899, and to the preceding paper in this volume. This author points out that while the count of many primitive peoples has been by the fingers and hands, giving rise to the quinary and decimal systems, and sometimes by the toes and feet also, leading to the vigesimal system, yet the evidence derived from the method of counting by tribes in the lowest status seems to demonstrate that these systems are far from primeval.

He suggests that numbers of the lower scale, beginning with 1, representing the Ego, were the outgrowth of mysticism; 2, growing out of the lateral or the fore and aft aspects, being the first pausing point, and 4, the Cult of the Quarters, the second pausing point, beyond which a number of systems never advanced; to this the Ego being added gave the number 5. However, for a more complete and clear understanding of the author's suggestions on this interesting subject the reader is referred to his papers.

That the quinary system, or counting on the fingers and hand, could not have taken its rise until 5 had been reached by some other process appears to be self-evident, and is proved by the numerous systems in which 5 is not reached, and by others in which it does not form a basis. It would seem necessary, therefore, in order to obtain a satisfactory explanation of the origin of the primary numbers, to look for some other solution than the supposed method of counting on the fingers. The hand would not be likely to come into use in this respect until 5 had been reached and the attempt made to rise above that number; then the advantage of using the five fingers of the hand, or the hand as representing 5 as a basis would be perceived. Pebbles, sticks, or any other objects, would answer just as well for this purpose as the fingers until some reference to 5 was desirable, except that the latter were always convenient objects and were best adapted to use in sign language. When 5 was reached, and the advantage of using the hand became apparent, it would be used for the numbers below 5 as well as those above, but the inquiry here is, were the fingers considered so essential in counting 2 to 4, before 5 had been reached, as to bring evidence of the fact into the nomenclature? This can be determined only by obtaining the signification of the names of numbers in those dialects of tribes which have not reached 5 in their numeral systems.[1]

Orozco y Berra, speaking of the Mexican names for the numbers—*ce*, 1; *ome*, 2; *yei*, 3, and *nahui*, 4—says, "no one has given a reason for the origin of these names."[2] Chavero[3] contends that, although

[1] Conant (Number Concept, pp. 24-25) says: "It seems most remarkable that any human being should possess the ability to count to 4, and not to 5. The number of fingers on one hand furnishes so obvious a limit to any of these rudimentary systems, that positive evidence is needed before one can accept the statement. A careful examination of the numerals in upwards of a hundred Australian dialects leaves no doubt, however, that such is the fact. The Australians in almost all cases count by pairs; and so pronounced is this tendency that they pay but little attention to the fingers." The last sentence of this quotation appears to answer the author's cause of wonder expressed in the first sentence; the fingers were, it seems, considered by the Australians as no more essential in the process of counting than any other convenient objects.

[2] Anales Mus. Mex., pp. 2, 34.

[3] Op. cit., p. 33.

the Mexicans counted on the fingers and hands, 4 was the first basis, the four fingers completing the first count, 5 being formed of 4+1. He remarks as follows: "In the Hindu system the principal number of the system is 10, which is formed of 5+5; to it the number 5 is essential; but in the Nahua system the essential number is 4, hence the 20 is formed of 5 times 4, as 5 is formed of 4+1." The same author says that among the manuscript notes of Ramirez he has found one that says, "the Nahoas formed the number 5 with the four fingers of the hand, completing the sum with the thumb, as 4+1." However, it must be admitted that, in this dialect, in forming the numbers above 5 until 20 is reached, 5 is the basis, and its name is derived from the term for hand.

Charencey,[1] referring to the dialects of his so-called Chichimecan family, which corresponds substantially with Brinton's Sonoran and Shoshonean branches of his Uto-Aztecan family, says that "in almost all the idioms of this family, if not all, the name of the number 2 enters into composition in the word which signifies 4." This is very apparent in the Shoshonean branch, as is seen in the following examples:

Tribe	2	4
Cahuillo	mewi	mewittsu
Kauvuya	vuy	vuitchiu
Kechi (San Luis Rey)	whii	witcho
Shoshone (Gatschet's number 5)	wat	watsuet
Southern Paiute	vay	vatchue
California Paiute	voahay	voatsagve
Chemehuevi	vay	vatchue
Hopi	lei	nale
Tobikhar	vehe	vatcha

It is less apparent, however, in the Sonoran branch, as will be seen by reference to the lists given above.

This fact seems to bear evidence in favor of Professor McGee's suggestion in regard to the primary steps in the development of number systems—viz, that 2 and 4 were the first pausing points. An examination of other systems outside the scope of the present paper will furnish many items of evidence in this direction.

Hubert Bancroft[2] gives the following definitions of the Maya names of the first five numbers: *hun*, paper; *ca*, calabash; *ox*, shelled corn; *can*, serpent, or count; and *ho*, entry; it is apparent, however, that the meanings given can have no reference to the use of the terms as number names. However, as the origin of the names of the primary

[1] Mélanges, p. 16.

[2] Native Races, vol. II, p. 753.

numbers below 5 is not deemed of special interest in the present discussion, which relates more directly to the systems, we begin with 5.[1]

Ho or *jo*, the name for 5 in all the Mayan dialects (except the Huasteca) when the affixes are omitted, is without any signification except as a numeral, so far as is now known, that seems to be appropriate to this use. Bancroft gives "entry," as is stated above, but this, though one signification of the term, has no apparent application here. If a guess be permissible, I would offer the following suggestion: In Stoll's list for 5 we notice that the name for this number in Cakchiquel is *vuoo*, and for 15 in Quekchi is *vuolahu*, and in Cakchiquel *vuolahuh* (substituting the *h* for *j*). Now, as 6 is *uac*, *vuak*, or *vuok*, 7 *uuk*, *vuk*, or *vuuk*, and 8 *uaxak*, *uaxok*, or *vuaxak*, is it not possible that *ho* or *o* is an abbreviation of a word beginning with *u* or *vu*, as *uol*, which, in addition to its signification (as a verb) "to make round," "to will," also, according to Brasseur, signifies "filled up," "full, entire," etc.? Henderson, manuscript Maya-English dictionary, gives as another meaning "all in one," "the gross amount," and Beltran, Arte del Idioma Maya, states that in composition it signifies "todo junto," which is substantially the same signification as that given by Brasseur. The term was also used, according to all the authorities, in counting round or solid things, as bundles of cotton, etc. As Perez informs us that the ancient form of the word was *hol*, it is possible that in

[1] It is to be hoped, however, that Professor McGee, or some one who has given thought to the subject, will carry forward these investigations, as the working out of the beginnings of counting, and the origin of the lower number names, will have an important bearing on some of the problems of ethnology and linguistics not yet completely solved. The field most likely to yield fruitful results is of course to be found in the languages and customs of the lower savage tribes. The more the relation of 2 and 4 to one another is studied the more important becomes Professor McGee's suggestion that these numbers represent the first two steps in many primitive counts. The statement by Conant, quoted in the preceding note, that "the Australians in almost all cases count by pairs," seems to be exactly in line with this suggestion. Curr, to whom Conant refers as "the best authority on this subject," believes that where (among the Australians) a distinct word for 4 is given, investigators have been deceived in every case. This would seem to explain the supposed use of pairs; the 2 was used in naming the 4. This tendency, as indicated above in the text, is found in various dialects in widely separated countries. As a few examples we note the following:

Betoya (South America)	Jiviros (South America)	Bakairi (South America)	Torres Straits
2 cayapa	catu	asage	okosa
4 cajezea = 2 with plural termination	encatu	asage-asage	okosa-okosa

Mosquito (Central America)	Watchandies (South Africa)	Karankawa (Texas)
2 wal	utauara	haikaia
4 wal-wal	atarra-utarra	hayo hakn=2×2

Many examples might be presented, but these will suffice to show how widely spread they are, Australia and South America being the regions of most frequent occurrence, and few examples being found in Polynesian dialects.

these facts an explanation of the *ho*, the name for 5, is to be found. I offer this suggestion merely as a possible explanation, without as yet giving it my own positive acceptance.

The Mexican or Nahuatlan term for 5—*macuilli*—is as is shown above, a compound word signifying "hand taken," that is to say, one hand completed, referring to counting on the fingers. The same is also true in regard to the name in the allied Pipil and Alaguilac dialects. The name for 5 in the Opata and Tarahumari is apparently the same as the Mexican term modified by dialectic requirements. The Cahita name—*mamni*—is from *mama*, the general term for hand. Although Gallatin (Trans. Am. Eth. Soc., vol. I, p. 53) considers *kuto* or *gyto*, the name for 5 in Othomi, as uncompound, this seems to be somewhat doubtful; however, its signification is unknown to me; the same is true of the Matlaltzincan or Pirinda. The word for 5 in Tarascan—*yumu*—appears to be simple, but I am unable to determine the signification; it is not, however, the usual Tarascan word for hand. The *mihi* in *aomihi*, the Chiapanec name for 5, is a suffix common to a number of numeral terms in this dialect. This leaves *ao*, *hao*, or *mao*, written variously as the radical. The name for 5 in some of the dialects of the Shoshonean group appears to indicate "all," doubtless referring to all the fingers of the hand; for example, in the Chemehuevi, Capote Uta, Shoshoni, Pa Vant, Southern Pa Uta, and Uinta Uta dialects.

In some others the term appears to be derived from the name for "hand." It seems, therefore, that the name is usually based on the count on the hand, and implies the complete count of the fingers of one hand.

Examining now the terms for the numbers 6 to 9, we will begin with those of the Mexican proper or Aztec dialect:

chicua-ce	6.	chicu-ei	8.
chic-ome	7.	chico-naui	9.

These, as is shown above, signify or are equivalent to 5+1, 5+2, 5+3, and 5+4, the count being by additions to 5 or to one hand, and the names being compounded of *chico*, "at the side, in part," etc., *ihuan* or *huan*, "near another," and the terms for 1, 2, 3, and 4. These evidently refer to the process of counting on the fingers of the hand, and the system is a true quinary one up to 20. It would seem from this that Chavero's theory that the Mexican or Nahuatlan count was based on 4 instead of 5 can scarcely be maintained. The closely allied Pipil and Alaguilac dialects form the names for 6, 7, and 8 in the same way, but in the latter the name for 9 evidently has reference to 10.

In the Cora the numbers 6, 7, 8, and 9 are clearly based on 5, and the names are compound, being composed of *a* and the names for 1, 2, 3, and 4. Charencey (Mélanges, p. 17) says, "le *a* préfixe suivi du chiffre de l'unité de 1 à 5 indique les nombres depuis 5 inclusivement jusqu'à 10 exclusivement, c'est le remplaçant de *chic* Aztèque." This, however, does not give us the signification of the term.

In Opata, Cahita, and Tarahumari, where there is a somewhat close agreement in the number names, especially in the first two, the method of counting from 5 to 9 appears to vary to some extent from the quinary system. If we may judge from the termination *iki* in *pussaniki*, the Tarahumari name for 6, the count has reference to 5; as seems also to be true with regard to the name for 7 in Cahita; but the name for 7 in Opata, if correctly given, is apparently equivalent to 1+6. In the three dialects the name for 8 is equivalent to 2×4; and the 9 refers to 10, *kia*, the prefix in Opata, being interpreted "antes" by Pimental. The 10 in these dialects refers to the hand. The name for 1 in Tarahumari, as given in the list—*bire* or *pile*—is considered by Charencey as abnormal, who says that *sinepi* is given in one place. This would bring the dialect into harmony with the others.

Of the dialects belonging to the Shoshonean branch, we notice that the Cahuillo and Kauvuya are regularly quinary, 6, 7, 8, and 9 being formed by adding 1, 2, 3, and 4 to 5. The Kechi of San Luis Rey appears to follow the same rule. The numbers 6 to 10 in the Tobikhar appear, so far as can be determined by the names, to be formed irregularly. The name for 7 includes that for 4; 8 is 2×4; the name for 9 includes that for 5; and 10 as given is 2×5; but in counting the numbers above 10 another term—*hurura*—is used for 10, possibly an equivalent for "man," as 20 is *hurura-vehe*=2 *hurura*. However, a more perfect knowledge of the language may show the count to be quinary.

The method of forming the numbers 6 to 9 in the dialects of the Zapotecan family can not be determined with positive certainty from the names alone, except in the Mazateca, where, if Belmar (Lengua Mazateca) be correct, it follows with great regularity the quinary system even into the higher numbers. For example, 6, *hû*, is a contraction of *û-n-gu*, or 5+1; 7, *yi-tû*, of *û-n-ho* or 5+2 (?), etc. Judging from this and the slight indications in the Chuchon, Popoloca, and Trike, these idioms appear to follow the same system. For example, in the Trike, as we learn from Belmar's "Ensayo sobre la Lengua Trike," the *anka* in *guatanka*, 6, same as *ango*, signifies "another," or "other," and the 2, *nghui*, when changed to the ordinal by the prefix *tsi*, becomes *tsi-guaaha*. That the same rule is followed in the Zapotec seems evident from the fact that above 10 the quinary-vigesimal system is followed as distinctly as in the Nahuatl, 15 having a distinct name and the count therefrom to 20 being based on it.

In the Othomi the numbers 6 to 9 are formed regularly according to the quinary system. In Pirinda 6 and 7 are formed by the addition of 1 and 2 to 5 or its equivalent; 8 is 2×4, and 9 is based on 10. In Mixe 6, 7, and 8 are formed by adding 1, 2, and 3 to 5, but 9 is based on 10; and the same rule appears to be followed in the Zoque. In Tarasco the regular quinary order appears to prevail, though the term for 6 seems to refer to the process of counting, as the *cu* in *cuimu*, according to Basalenque (op. cit.), refers to the hand.

Passing over the other idioms of the Shoshonean group, of which the signification of the numeral terms has not been specially studied by linguists, we return to the terms for 6, 7, 8, and 9 in the Mayan dialects. It will be noticed that in all of these dialects, except the Chuhe, the name for 9 begins with *be*, *ba*, or *bo*, and that most of them, omitting the terminal *b*, add to complete the name the term for 10, *lahun*, *lahu*, etc., in more or less varied form. Thus, in Pokonchi, 9 is *be-lehe* and 10, *lehe;* in Pokomam, 9, *be-lehem*, and 10, *lehem;* in Ixil, 9, *be-luvual*, and 10, *lavual*, etc. It is evident, therefore, that in these idioms the term for 9 is based on that for 10, the *lehe*, *lun*, *lu*, and *lon* being mere abbreviations of *lahun*, *lahu*, etc. As *be* in the various dialects signifies "road, journey, way," etc., this is probably the term used here and is to be interpreted "on the way to," "next to." In Chuhe, however, the name for 9, *vu-angue*, shows that here this number, contrary to the rule which prevails in the other dialects, is formed by the addition of 4, *ch-angue*, to some equivalent of 5, thus conforming to the quinary system. It is somewhat singular, however, that the name for 19 is *ban-lahne*, the *ban* being doubtless an abbreviation of *balun*.

The *x* in the name for 8 in all the idioms seems to furnish the key to the problem of the numbers 6, 7, and 8, as it indicates that 3—*ox*, *ux*, or *ix*—is combined with some equivalent of 5 represented by *u* and *vu*, as in *u-ax-ac* and *vu-ax-ak*, to form the 8. Up to the present no suggestion as to the signification of this prefix has been presented other than what is contained in the quotation from Charencey in regard to *uac*, 6, given above. Of the correctness of the above suggestion in regard to the name for 8 there would seem to be but little doubt. If this be accepted, it follows as reasonably certain that the names, except the one for 9, correspond with the mode of counting indicated by the written number symbols; that is, with the quinary system. The numbers 6, 7, 8, and 9 in the Maya (Yucatec) dialect may therefore be written out as follows, the 5 being inclosed in parentheses to indicate that it is represented by some substitute:

6 u-ac=(5)+1.	8 u-ax-ac=(5)+3.
7 u-uc=(5)+2.	9 bo-lon=on the way to 10.

The name for 5 is not represented even by an ultimate abbreviation in the names for 6, 7, and 8, unless it be by the *u* and *vu*.

Before passing to the numbers above 10, some few examples of methods of counting by peoples bordering on or within the geographic limits embraced in this paper, and with whom some of the tribes we have mentioned must have come into contact, will be presented, as some of them are exceptional.

The first of these is a list of numerals given by Gallatin;[1] the particular tribe referred to is unknown.

San Antonio, of Texas

1 pil.
2 ajtê.
3 ajti c pil=2+1.
4 puguantzan.
5 juyopamáuj.
6 ajti c pil ajte=(2+1) 2, or chicuas.
7 puguantzan co ajti c pil=4+2+1.
8 puguantzan ajte=4×2.
9 puguantzan co juyopamauj=4+5.
10 juyopamauj ajte=5×2.
20 taiguaco.

The numbers to 10 in use among the Mosquito tribe of Honduras are as follows:

Mosquito[2]

1 kumi.
2 wal.
3 niupa.
4 wal-wal=2+2 or 2×2.
5 mata-sip=the fingers on one hand.
6 matlalkabe.
7 matlalkabe pura kumi=6+1.
8 matlalkabe pura wal=6+2.
9 matlalkabe pura niupa=6+3.
10 mata-wal-sip=fingers of the second hand.
20 twanaiska-kumi=20×1.
40 twanaiska-wal=20×2.

Dr Brinton[3] gives lists of numerals in three of the dialects of the Xinca stock as follows:

Sinacantan	Jupiltepeque	Jutiapa
1 ica	1 ical	1 ical
2 ti	2 piar	2 piar[4]
3 uala	3 ualar	3 guarar
4 jiria	4 iriar	4 iriar
5 puj	5 pijar	5 pujar
6 tacal	6 ———	6 tacalar
7 pujuá	7 puljar	7 pulluar
8 tepuc	8 apuj	8 apocar
9 uxtu		9 gerjsar
10 pakil		10 paquilar

[1] Trans. Am. Ethn. Soc., vol. I, table A, p. 114.

[2] Conant, Number Concept, p. 121. Membreño, Hondureñismos, p. 210, under the name "Zambo del Cabo."

[3] Xinca Indians of Guatemala, Proc. Am. Phil. Soc., 1885.

[4] Dr Brinton remarks that the termination *ar* in this dialect reminds one of the Ixil termination *vual*, indicating turn or repetition, as *ungvual*, one time, *cavual*, two times, etc.

The four following lists are from R. F. Guardia (Lenguas Indigenas Cent. Am. Siglo., pages 101 and 110). The tribes are classed with the Chibcha group, a South American stock, but are, or were, located in Guatemala and Porto Rico.

Cabecar		Viceyta		Lean y Mulia		Terrava	
1	estaba	1	etabageme	1	pani	1	crara
2	boctebá	2	buttebá	2	matiaa	2	crubu
3	mañalegui	3	mañac	3	contias	3	cromia
4	quetovo	4	quiet	4	chiquitia	4	cropquin
5	exquetegu	5	exquetegu	5	cumasopni	5	croshquin
6	sehen	6	sehen	6	comasampepani=5+1	6	cloter
7	curo .	7	curge	7	comasampematiao=5+2	7	crococ
8	(?)	8	(?)	8	comasampecontiac=5+3	8	croquon
9	(?)	9	(?)	9	comasampechiquitias=5+4	9	croshcap
10	dope	10	dop	10	comassopnas	10	crodobob
						11	quinsho crosa
20	ynste	20	ynste	20	comascoapssub	20	zac vbú

Another list in the last idiom—Terrava—given by Thiel,[1] differs so considerably from the preceding that it is given here:

1 krará.
2 krowü.
3 krommiáh.
4 krobking.
5 kraschking de.
6 terdéh.
7 kógodeh.
8 kwongdeh.
9 schkawdeh.
10 dwowdeh.

II

NUMBERS ABOVE 10

Our examination of the number names and the method of counting from 10 upward will be confined chiefly to the systems of some of the more important civilized tribes of Mexico and Central America, and those of other tribes will be alluded to only where occasion may call for comparison.

The first example to be presented is that of the Nahuatl or Aztec method of counting, this being selected because it follows strictly the quinary-vigesimal system, and presents clearly the characteristics of that system, and because of its importance. The signification of the terms or the equivalents of their parts in figures will be given in connection with the list so far as known.

[1] Vocabularium der Sprachen der Boruca—Terraba—und Guatuso—Indianer in Costa-Rica, Archiv. für Anth., Band XVI, p. 620.

Nahuatl[1]

10 matlactli=2 hands.
11 matlactli once=10+1, or 2 hands+1.
12 matlactli om-ome=10+2.
13 matlactli om-ei=10+3.
14 matlactli on-naui=10+4.
15 caxtolli.
16 caxtolli once=15+1.
17 caxtolli om-ome=15+2.
18 caxtolli om-ei=15+3.
19 caxtolli on-nau=15+4.
20 cempoalli[2]=1 counting or complete count.
21 cempoalli on-ce=20+1.
22 cempoalli om-ome=20+2.
23 cempoalli om-ei=20+3.
24 cempoalli on-naui=20+4.
25 cempoalli om-macuilli=20+5.
26 cempoalli on-chiqua-ce=20+5+1.
27 cempoalli on-chic-ome=20+5+2.
28 cempoalli on-chic-uei=20+5+3.
29 cempoalli on-chico-naui=20+5+4.
30 cempoalli om-matlactli=20+10.
31 cempoalli om-matlactli once=20+10+1.
32 cempoalli om-matlactli om-ome=20+10+2.
33 cempoalli om-matlactli om-ei=20+10+3.
34 cempoalli om-matlactli on-naui=20+10+4.
35 cempoalli on-caxtolli=20+15.
36 cempoalli on-caxtolli on-ce=20+15+1.
37 cempoalli on-caxtolli om-ome=20+15+2.
38 cempoalli on-caxtolli om-ei=20+15+3.
39 cempoalli on-caxtolli on-naui=20+15+4.
40 ompoalli=2×20, or two twenties.

The count follows the same order as that from 20 to 39, the only variation being in the names of the multiples of 20, that is to say, 60, 80, 100, etc., which are as follows:

60 ei-poalli, or epoalli=3×20.
80 nauh-poalli=4×20.
100 macuil-poalli=5×20.
120 chiqua-cem-poalli=6×20, or literally (5+1)×20.
140 chic-om-poalli=7×20, or literally (5+2)×20.
160 chic-ue-poalli=8×20, or literally (5+3)×20.
180 chico-nauh-poalli=9×20, or literally (5+4)×20.
186 chico-nauh-poalli chiqua-c=9×20+5+1.
199 chico-nauh-poalli ipan caxtolli on-nau=9×20+15+4.
200 matlac-poalli=10×20.
220 matlactli on-cem-poalli=11×20, or (10+1)×20.
240 matlactli om-om-poalli=12×20.
260 matlactli om-ei-poalli=13×20.
280 matlactli on-nauh-poalli=14×20.

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[1] Siméon, Dic. Langue Nahuatl, p. xxxiii.

[2] *Cempoalli* signifies one entire or complete count, from *ce*, one, and *poa* or *poua*, to be counted or estimated.

300	caxtol poalli=15×20.
320	caxtolli on-cem-poalli=16×20, literally (15+1)×20.
340	caxtolli om-om-poalli=17×20.
360	caxtolli om-ei-poalli=18×20.
380	caxtolli on-nauh-poalli=19×20.
399	caxtolli on-nauh-poalli ipan caxtolli on-nau=19×20+15+4.
400	cen-tzontli.
800	ome-tzontli=2×400.
1,200	ei-tzontli, or e-tzontli=3×400.
1,600	nauh-tzontli=4×400.
2,000	macuil-zontli=5×400.
2,400	chicua-ce-tzontli=6×400, literally (5+1)×400.
4,000	matlac-zontli=10×400.
6,000	caxtol-tzontli=15×400.
8,000	cen-xiquipilli, or ce-xiquipilli=1 xiquipilli, or 1×8,000.
16,000[1]	on-xiquipilli=2×8,000.
24,000	e-xiquipilli=3×8,000.
120,000	caxtol-xiquipilli=15×8,000.
160,000	cem-poal-xiquipilli=20×8,000.
320,000	om-poal-xiquipilli=2×20×8,000.
3,200,000	cen-tzon-xiquipilli=400×8,000.
64,000,000	cem-poal-tzon-xiquipilli=20×400×8,000.

The signification of *caxtolli*, the term for 15, does not appear to be given.

Centzontli, the name for 400, is from *ce*, 1, and *tzontli*, herb, hair, and signifies one handful, bundle, or package of herbs, or one wisp of hair, "au figuré une certaine quantité comme 400," says Siméon (op. cit.).

Xiquipilli, the name for 8,000, signifies a sack, bag, or wallet. Clavigero[2] says "They counted the cacao by *xiquipilli* (this, as we have before observed, was equal to 8,000), and to save the trouble of counting them when the merchandise was of great value [quantity?] they reckoned them by sacks, every sack having been reckoned to contain 3 *xiquipilli*, or 24,000 nuts."

It is apparent from the list given that this system was strictly quinary-vigesimal throughout, the higher bases—400 and 8,000—being multiples of 20. The retention of the quinary order in the higher numbers is evident from the use of 15 in counting 35 to 39, 55 to 59, etc. The complete maintenance of the vigesimal feature is also shown by the fact that the count from 20 to 400—that is, 20×20—so far as the multiples are concerned, is by 2, 3, etc., up to 19×20 plus the additions 1, 2, 3, etc, to 19. In its systematic uniformity it is one of the most perfect systems that has been recorded, though its nomenclature is somewhat cumbersome. Another point to which attention is called, as there will be occasion to refer to it further on, is the method of counting the minor intermediate numbers. It will be observed that the count above 40 as well as that from 20 to 40 is by additions to the base, thus: 40+1 for 41, 40+2 for 42, and so on; and the same rule is

[1] Thus Clavigero, Hist. Mex.

[2] Cullen's Trans., vol. I, 386.

true for the count from 60, 80, etc. This is mentioned because it will be found in some systems that 41 is not formed by adding 1 to 40, but is formed by counting the one on the next score—that is to say, one on the third score. This difference, slight as it seems to be, is nevertheless an important characteristic in comparing the numeral systems. The Maya method of writing numbers to 19, as shown above, is precisely in accord with the Mexican count.

The second example of the quinary-vigesimal system I present is that in use among the Zapotecs, as given by Cordova in his Arte del Idioma Zapoteco. This is so burdened with alternates that it will be best understood by presenting the regular series first and the alternates, so far as is necessary, in a separate list. The equivalent figures placed to the right show my interpretation of the terms. However, the correctness of the interpretation can be easily tested by considering the numbers up to 10 heretofore given in connection with those above 10 here presented.

Zapotec

10 chii.
11 chii-bi-tobi=10+1.
12 chii-bi-topa, or chii-bi-cato=10+2.
13 chii-ño, or chii-bi-chona=10+3.
14 chii-taa=10+4.
15 chino, or ce-caayo-quizaha-cal le=15, or 20—5.
16 chino-bi-tobi=15+1.
17 chino-bi-topa, or chino-bi-cato=15+2.
18 chino-bi-chona=15+3.
19 chino-bi-tapa=15+4.
20 cal le.
21 cal le-bi-tobi=20+1.
22 cal le-bi-topa, or cal le-bi-cato=20+2.
23 cal le-bi-chona, or cal le-bi-cayo=20+3.
24 cal le-bi-tapa, or etc=20+4.
25 cal le-bi-caayo=20+5.
26 cal le-bi-xopa=20+6.
27 cal le-bi-caache=20+7.
28 cal le-bi-xono=20+8.
29 cal le-bi-gaa=20+9.
30 cal le-bi-chii=20+10.
31 cal le-bi-chii-bi-tobi=20+10+1.
32 cal le-bi-chii-bi-topa=20+10+2.
33 cal le-bi-chii-bi-chona, or cal le-bi-chiiño=20+10+3.
34 cal le-bi-chii-bi-tapa, or cal le-bi-chii-taa = 20+10+4.
35 cal le-bi-chino=20+15.
36 cal le-bi-chii-bi-xopa=20+10+6.
37 cal le-bi-chii-bi-cache=20+10+7.
38 cal le-bi-chii-bi-xono=20+10+8.
39 cal le-bi-chii-bi-caa=20+10+9.
40 toua.
41 toua-bi-tobi=40+1.
50 toua-bi-chii=40+10.
51 toua bi-chii-bi-tobi=40+10+1.
So to 54.

At the next step there is a change in the method, or, as will be seen when the alternates are given, the regular method is abandoned and the second method of counting adopted. Thus, instead of saying for 55 *toua bi-chino*=40+15, they say *ce-caa quiona*, or *ce-caayo quiona*=5 from 60. The term *quiona* appears to be a variation of *cayona*, 60.

55 ce-caa quiona, or ce-caayo quiona=5 from 60.
56 ce-caayo quiona-bi-tobi=5 from 60+1.

The correctness of this interpretation seems to be confirmed by the alternate *ce-tapacaca quizahachaa-cayona*=4 from 60.

57 ce-caayo quiona-bi-tobi=5 from 60+2.

The alternate in this case is 3 from 60, etc.

60 cayona.
61 cayona-bi-tobi=60+1.
So to 70.
70 cayona-bi-chii=60+10.
71 cayona-bi-chii-bi-tobi=60+10+1.
So to 74.

At the next step—75—the order changes as at 55, for, instead of saying *cayona-bi-chii-bi-caache*=60+10+5, they say *ce-caa-taa*, or *ce-caayo-taa*=5 from 80.

75 ce-caayo-taa=5 from 80.
76 ce-caayo-taa-bi-tobi=5 from 80+1, or ce-tapa-quizahachaa-taa=4 from 80.
So to 79.
80 taa.
81 taa-bi-tobi=80+1.
90 taa-bi-chii=80+10.
95 ce-caayo-quioa=5 from 100.
96 ce-caayo-quioa-bi-tobi=5 from 100+1, or ce-tapa-quizahachaa-cayoa =4 from 100.
100 cayoa.
101 cayoa-bi-tobi=100+1.
120 xopalal-le=6×20.
121 xopalal-le-bi-tobi=120+1.
130 xopalal-le-bi-chii=120+10.
135 ce-caayo-caachelal-le=5 from 140.

The rule given above is followed throughout.

140 caachelal-le=7×20.
150 caachelal-le-bi-chii=140+10.
160 xoonolal-le=8×20.
170 xoonolal-le-bi-chii=160+10.
180 caalal-le=9×20.
190 caalal-le-bi-chii=180+10.
200 chiia=10×20?
210 chiia-bi-chii=200+10.
220 chiia-cal-le=200+20.
240 chiia-toua=200+40.
260 chiia-cayona=200+60.

280 chiia-taa=200+80.
300 chinoua (probably 15×20)
400 tobi-ela, or chaga-el-la=1×400.
500 tobi-ela-cayoa=400+100.
800 topael=2×400, or catoela=idem.
1,000 catoel-la chiia=2×400+200.
1,600 tapa-ela=4×400.
4,000 chii-ela=10×400.
8,000 chaga-çoti, or tobi-çoti=1×8000.

Cordova adds at this point: "Hasta aqui es toda la quenta de los yndios, y de aqui arriba van contando do ocho en ocho mil arriba esta declarado."

Of the alternates above alluded to it is only necessary to mention tne following:

15 ce-caayo-quizaha-cal le=5 from 20.
17 ce-chona-quizaha-cal le=3 from 20.
18 ce-topa-cal le, or ce-topa-quizaha-cal le=2 from 20.
19 ce-tobi-cal le, or ce-tobi-quizaha-cal le=1 from 20.

The alternates for the numbers 35 to 39 follow the method of counting from 55 to 59, 75 to 79, and 95 to 99 mentioned below, thus:

35 cecaatoua, or cecaayotoua=5 from 40.
36 cecaayotoua-bitobi=5 from 41; or cetapa caca quizah chaatoua=4 from 40.
So to 39.

A thorough knowledge of the language, enabling us to furnish a complete explanation of the terms and particles added and interjected in forming the intermediate numbers in the higher counts, would be more satisfactory. However, it is believed that the number equivalents given in the list will be found correct.

It is apparent from the list that the system is vigesimal and to some extent quinary-vigesimal (note the names for 15, 55, etc.) The most notable feature, however, is the intermediate position it seems to hold between the Aztec and the Maya systems. The tendency toward the quinary method and the use of a special term for 15 ally it on the one hand to the Aztec system, while, on the other hand, in the reference in counting to the next higher score, which will hereafter be shown as a feature of the Mayan systems, it resembles them. It is possible, however, that a more thorough knowledge of the language and the system may show that the names for 15, 40, etc., which have been assumed to be simple, uncompounded terms, are in fact composite. While *chino* is the usual term for 15, the alternate is *cecaayo-quizaha-calle*, which is equivalent to 5 from 20, showing direct reference to 5. It is possible, therefore, that *chino* is composite. As *toua*, the name for 40, contains the first syllable of *topa*—name for 2—it may also be, and probably is, composite; this supposition seems strengthened by the fact that *cayona*, the name for 60, appears to be based on *cayo*, 3; and *taa*, name for 80, on *tapa* or *taa*, 4; and *cayoa*, name for 100, on *caayo*, or 5. The similarity of the name for 20—*calle*—in this language and *cal* or *kal*, the term for the same number in most of the Mayan dialects, is noticeable, though apparently accidental.

The next numeral system referred to is that of the Mazateca, a tribe speaking a dialect of the Zapotecan family. This, if correctly given by Francisco Belmar, in his Ligero Estudio sobre Lengua Mazateca,[1] presents one of the most complete examples of the quinary system to be found in Mexico or Central America. In order that the formation of the names may be more apparent, the list from 1 to 10, which has been heretofore given, is repeated here.

Mazateca

1	gu.
2	ho.
3	ha.
4	ñi-hu.
5	û.
6	hû.
7	yi-tu.
8	hi-i.
9	ñi-ha.
10	te.
11	te-n-gu=10+1.
12	te-n-ho=10+2.
13	te-n-ha=10+3.
14	te-ni-hu=10+4.
15	te-û=10+5.
16	te-û-n-gu=10+5+1.
17	te-û-n-ho=10+5+2.
18	te-û-n-ha=10+5+3.
19	te-û-ñi-hu=10+5+4.
20	kâ.
21	kâ-n-gu=20+1.
22	kâ-n-ho=20+2.
23	kâ-n-ha=20+3.
24	kâ-ñi-hu=20+4.
25	kâ-û=20+5.
26	kâ-hu (kâ-û-n-gu)=20+5+1.
27	kâ-yitu (kâ-û-n-ho)=20+5+2.
28	kâ-hii (kâ-û-n-ha)=20+5+3.
29	kâ-ñika (kâ-û-ñi-hu)=2+5+4.
30	kâ-te=20+10.
31	kâ-ne-n-gu=20+10+1.
32	kâ-te-n-ho=20+10+2.
33	kâ-te-n-ha=20+10+3.
34	kâ-te-ñihu=20+10+4.
35	kâ-te-û=20+10+5.
36	kâte-hû (kâte-û-n-gu)=20+10+5+1.
37	kâte-yitu (kâte-û-n-ho)=20+10+5+2.
38	kâte-hii (kâte-û-n-ha)=20+10+5+3.
39	kâte-ñiha (kâte-û-ñihu)=20+10+5+4.

[1] Pp. 40–43.

40 yi-cha=2×20.
41 yicha-ngu=40+1.
So to 45.
46 yicha-hû (yicha-û-ngu)=40+5+1.
So to 49.
50 yichite (or ichite)=40+10.
51 ichite-ngu=40+10+1.
So to 55.
56 ichite-hû (ichite-û-ngu)=40+10+5+1.
So to 59.
60 ichite-ko-te=50+10, or literally 40+10+10.
61 ichite-ko-te-ngu=50+10+1.
So to 65.
66 ichite-ko-te-hû (ichite-kote-ngu)[1]=50+10+5+1.
So to 69.
70 ichite-koho-kâ=50+20.
71 ichite-koho-kâ-ngu=50+20+1.
So to 75.
76 ichite-koho-kâ-hû (ichite-koho-kâ-û-ngu)=50+20+5+1.

Belmar does not give any explanation of the *koho* in these names; however, it seems—though one signification of *ho* is two—to play no other rôle here than *ko* in the name for 60, etc.

80 ichite-koho-kate=50+20+10, literally 40+10+20+10.
90 ichite-koho-yicha=50+40.
95 ichite-ko-ho-yicha-û=50+40+5.
100 û-cha=5×20.
110 û-cha-te=5×20+10.
200 ho-ûcha=2×5×20.
300 ha-ûcha=3×5×20.
So to 900.
1,000 te-ûcha=10×100, literally 10×5×20.
2,000 ho-mi (ho-te-ûcha)=2×10×100.
So to 9,000.
10,000 te-mi (kâ-ûcha)=?

There seems to be some mistake here in Belmar's parenthetical explanation; if *kâ* is 20 and *ûcha* 100, *kâ-ûcha* would be 2,000, which, as shown above from his own list, is (*ho-te-ûcha*). As *mi* is given as the equivalent of *te-ucha*, 1,000, then 10,000, unless varying from the rule, should be *te-te-ûcha*, or *kâ-û-ûcha*=20×5×100; the latter is probably what was intended, as we judge from the following numbers:

20,000 ka-mi (kâ-te-ûcha)=20×10×100.
30,000 kâte-mi (kâte-te-ûcha)=30×10×100.
So to 90,000.
100,000 ûcha-te-ûcha=100×10×100.
110,000 ûchate-te-ûcha=110×10×100.
130,000 ûcha-kate-te-ûcha=(100+30)×10×100.

Although this numeral system carries out the quinary count to an unusual extent, yet it is clearly quinary-vigesimal. It is a little strange,

[1] In this, as in the three following numbers (not given here), Belmar, whose list I follow, seems, probably by a slip of the pen, to have failed to give the complete name; it certainly should be *ichite-kote-û-ngu*.

however, that 10 should have what appears to be a simple integral name. The name for 20 is also simple, but that for 40—*yi-chá*—is composite, signifying 2 times 20. The intermediate minor numbers in this system are always added to the preceding base and not, as in so many others, on that which follows, nor are they subtracted from a higher base or number, as we have found to be the case in the related Zapotec.

Some of the number counts which appear to follow somewhat closely the quinary-vigesimal system having been presented, the next method of counting to which attention is called is that used by the Maya. As this system is the one in which most interest centers because of its relation to the numerals found in the codices and inscriptions, we shall dwell upon it more fully than we have upon the others, beginning with the numerals used by the Maya proper (Yucatecs). We take as our basis the series as given by Beltran in his Arte del Idioma Maya, placing at the right the interpretations or equivalents of the terms.

Maya

10 lahun.
11 buluc.
12 lah-ca=11+2.
13 ox-lahun=3+10.
14 can-lahun=4+10.
15 ho-lahun=5+10.
16 uac-lahun=6+10.
17 uuc-lahun=7+10.
18 uaxac-lahun=8+10.
19 bolon-lahun=9+10.
20 hun-kal=one 20, or kal.
21 hun-tu-kal=1+20, or 1 to 20.
22 ca-tu-kal=2+20.
23 ox-tu-kal=3+20.
24 can-tu-kal=4+20.
25 ho-tu-kal=5+20.
26 uac-tu-kal=6+20.
27 uuc-tu-kal=7+20.
28 uaxac-tu-kal=8+20.
29 bolon-tu-kal=9+20.
30 lahu-ca-kal=10+20.
31 buluc-tu-kal=11+20.
32 lahca-tu-kal=12+20, literally 10+2+20.
33 oxlahu-tu-kal=13+20, literally 3+10+20.
34 canlahu-tu-kal=14+20.
35 holhu-ca-kal=15+20.
36 uaclahun-tu-kal=16+20.
37 uuclahu-tu-kal=17+20.
38 uaxaclahu-tu-kal=18+20.
39 bolonlahu-tu-kal=19+20, literally 9+10+20.
40 ca-kal=2×20.

Up to this point the forms are quite regular, except that of 11, which has a name as yet uninterpreted by the linguists. With this exception, the numbers from 10 to 19 are formed by the addition of 1, 2, 3, etc., to 10, the decimal system applying here. Twenty has a distinct name—*kal*. From 21 to 39 the numbers are formed by the addition to 20 of the numbers from 1 to 19; and 40 is twice 20.

Before alluding to the change which occurs in the next step, attention is called to *lahun*, the name for 10. Dr Brinton[1] says it is apparently a compound of *lah* and *hun*, and gives as the probable signification, "it finishes one (man)." As to its derivation, I think he is correct, as *lah*, as a substantive, signifies "end, limit, all, or the whole," and *hun* "one." The signification of the term would therefore seem to be "one finish," or "ending," or "all of one count," but not "one man." Henderson, in his manuscript Maya-English Dictionary, under *lah*, says, "whole hands," and this is doubtless the true rendering when used in this connection. *Kal*, 20, as a verb signifies "to fasten, shut, close," as a substantive, "a fastening together, a closing or shutting up."

Calling 20 a score, for the sake of simplicity, the count from 21 to 39 may be illustrated thus: *hun-tu-kal*, 1 on the score, or first score; *ca-tu-kal*, 2 on the score, etc. Here the addition is to the score already reached, but the additions to 40—*ca-kal*—or second score are counted differently, for 41, instead of being *hun-tu-cakal*, is *hun-tu-yoxkal*, the latter—*yoxkal* or *oxkal*—being the term for 60, or third score (3×20). As it is evident that this can not signify 1 added to 60, there has been a difference of opinion as to the true meaning of the expression and as to its correctness. Perez, as quoted by Dr Brinton, says, in an unpublished essay in the latter's possession, that Beltran's method of expressing the numbers is erroneous; that 41 should be *hun-tu-cakal;* 42, *ca-tu-cakal;* 83, *ox-tu-cankal*, etc. Nevertheless, as Dr Brinton has pointed out, the numerals above 40 are given in Perez's Dictionary of the Maya Language according to Beltran's system, which appears from other evidence to be correct.

Léon de Rosny[2] suggests that *hun-tu-yoxkal* should be explained thus: 60—20+1. However, the correct rendering appears to be 1 on the third score, or third 20. It is possible that an old and a new reckoning prevailed among the Mayas, as apparently among the Cakchiquels. According to Stoll[3] the latter people had an old and a more recent method of enumerating, which may be represented as follows:

Old	New
41 hun-r-oxc'al	ca-vinak-hun
42 cai-r-oxc'al	ca-vinak-cai, etc

[1] Maya Chronicles, p. 88.

[2] Numération des Anciens Mayas, in Compte-Rendu Cong. Internat. Américanistes, p. 449; Nancy, 1875.

[3] Zur. Ethn. der Guatemala, p. 136.

Perez says that *tu* is an abbreviation of the numeral particle *tul*, but Rosny[1] says, "Je crois que ce n'est point, comme il [Bancroft] le suppose, la simple conjonction 'et,' mais une phrase des mots *ti-u*, 'dans son, à lui, sien'; *u* est un pronoun appele par les grammairiens Espanols 'mixte' et qui forme la copulation, comme en Anglais l' *s* du genitif." Dr Berendt adopts the same opinion, which is probably correct.

As Beltran's method seems to have been followed in all the Maya lexicons down to and including Henderson's manuscript dictionary, it is followed here.

41 hun-tu-yoxkal=1 on or to the third 20, or third score.
42 ca-tu-yoxkal=2 on or to the third 20, or third score.
43 ox-tu-yoxkal=3 on or to the third 20, or third score.
So to 49.
50 lahu-yoxkal[2]=10 on the third 20, or third score.
51 buluc-tu-yoxkal=11 on the third 20, or third score.
So to 59.
60 oxkal=3×20.
61 hun-tu-cankal=1 on the fourth score, etc.
70 lahu-cankal=10 on the fourth score, etc.
71 buluc-tu-cankal=11 on the fourth score, etc.
80 cankal=4×20.
90 lahu-yokal=10 on the fifth score.
100 hokal=5×20.
101 hun-tu-uackal=1 on the sixth score.
110 lahu-uackal=10 on the sixth score.
119 bolonlahu-tu-uackal=19 on the sixth score.
120 uackal=6×20.
130 lahu.uuckal=10 on the seventh score.
140 uuckal=7×20.
150 lahu-uaxackal=10 on the eighth score.
160 uaxackal=8×20.
170 lahu-bolonkal=10 on the ninth score.
180 bolonkal=9×20.
190 lahu-tu-lahunkal=10 on the tenth score.
200 lahunkal=10×20.
210 lahu-tu-buluckal=10 on the eleventh score.
220 buluckal=11×20.
230 lahu-tu-lahcakal=10 on the twelfth score.
240 lahcakal=12×20.
250 lahu-tu-yoxlahunkal=10 on the thirteenth score.
260 oxlahukal=13×20.
270 lahu-tu-canlahukal=10 on the fourteenth score.
280 canlahunkal=14×20.
290 lahu-tu-holhukal=10 on the fifteenth score.
300 holhukal=15×20.
310 lahu-tu-uaclahukal=10 on the sixteenth score.
320 uaclahukal=16×20.
330 lahu-tu-uuclahuka =10 on the seventeenth score.
340 uuclahukal=17×20.

[1] Op. cit.
[2] The reason for the omission of *tu* in 50 70. and 90 is not apparent.

350	lahu-tu-uaxaclahukal=10 on the eighteenth score.
360	uaxaclahukal=18×20.
370	lahu-bolonlahukal=10 on the nineteenth score.
380	bolonlahu-kal=19×20.
390	lahu-hunbak=10 on 1 bak.
400	hun-bak=one 400.
500	ho-tu-bak [hokal-tu-bak?]=100+400?
600	lahu-tu-bak [lahun-kal-tu-bak?]=200+400?
700	holhu-tu-bak [holhu-kal-tu-bak?]=300+400?
800	ca-bak=2×400.
900	ho-tu-yoxbak [hokal-tu-yoxbak]=100 on the third bak, or third 400.
1,000	lohu-yoxbak, or hunpic (modern).
2,000	capic (modern).
8,000	hun-pic (former and correct use of the term).

So far I have followed Beltran's list, as it is that on which the numbers as given by subsequent writers and lexicographers are based, but it carries the numeration only to 8,000. The names for 500, 600, and 700 appear to be abbreviated; I have therefore added in brackets the supposed complete terms. These, however, as will be seen by comparison, follow the rule which prevails from 20 to 39, that is, the additions are to the last preceding basal number, and not toward that which is to follow; the first rule holds good from 41 to 399, but the second is followed after passing 800 or *ca-bak*, as 900 is *ho-tu-yoxbak*, or, complete, *hokal-tu-yoxbak*, which is equivalent to 100 on the third bak. The use of *hunpic* for 1,000 was adopted after the arrival of the Spaniards. One reason mentioned by Beltran for the change was to prevent confusion and to facilitate the numbering of the century in giving dates. The proper native expression for 1,000 was *lahu-yoxbak*, or, complete, *lahunkal-tu-yoxbak*, equivalent to 200 on the 3d bak. *Capic*—2,000—is in accordance with modern usage; according to native usage 2,000 would be *hobak*, or 5×400. In counting the minor numbers above 400 the particle *catac*, "and," was inserted, thus: 450, *hunbak catac lahuyoxkal*. However, in counting the added hundreds, *tu*, and not *catac*, was inserted, as is seen above in 500, 600, and 700; hence, as Beltran indicates, the latter was only prefixed or preposed to the minor numbers.

Bak as a numeral is supposed to be derived from the verb *bak*, *bakah*, "to roll up," "to tie around," and hence presumably refers to a bundle or package. *Pic* signifies "cotton cloth," also a kind of petticoat, which appears to have been the original meaning; as this article of dress was occasionally used as a sack the numeral term probably refers to it in this sense; and Henderson, in his manuscript dictionary, gives as one signification "a bag made out of a petticoat." This interpretation corresponds with the Mexican term for 8,000.

The count from 400, or one bak, when carried out regularly, would be 2 bak, 3 bak, and so on to 19 bak; 20 bak, or 8,000, forming a new basis to which the name *pic* or *hun-pic*, one pic, was applied. Above this number the count continued by multiplication, thus:

ca-pic =2×8,000.
ox-pic =3×8,000.
can-pic=4×8,000.

and so on to *bolonlahun-pic*, or 19 pic.

For 20 pic, or 160,000, another simple term—*calab*—is introduced; and for 20 calab, or 3,200,000, another simple term—*kinchil*—is introduced; and for 20 kinchil, the term *alau*. The series of primary or basal terms are therefore as follows:

20 units	=1 kal	=	20.
20 kal	=1 bak	=	400.
20 bak	=1 pic	=	8,000.
20 pic	=1 calab	=	160,000.
20 calab	=1 kinchil	=	3,200,000.
20 kinchil	=1 alau	=	64,000,000.

In reference to the signification of *calab*, Dr Brinton[1] writes as follows: "*Calab* seems to be an instrumental form from *cal*, to stuff, to fill full. The word *calam* is used in the sense of excessive, overmuch." His note (1) is as follows: "'*Cal;* hartar o emborrachar la fruta.' Diccionario Maya-Espanol del Convento de San Francisco, Merida, MS. I have not found this word in other dictionaries in my reach." As Perez, Brasseur, and Henderson give as one meaning of *calab*, "infinitely, many times," it is probable that this was the sense in which it came into use as a numeral adjective, a more definite meaning being afterward applied. Henderson gives as another signification "a buckle," but this may be modern. *Zotzceh*, which is sometimes used in place of *kinchil*, signifies "deer skin," but the latter term has received no satisfactory interpretation. As *chil* is interpreted by the lexicographers "knapsack, granary, barn," it is possibly the clue to the signification. The highest term—*alau*—remains unexplained. As *pic* has been used in post-Columbian times to denote 1,000, *kinchil* has been used to signify 1,000,000.

Before commenting further on this system it will be best to present the data at hand relating to the count above 10 by other tribes of the Mayan group, and by some tribes of surrounding stocks.

Huasteca[2]

10	lahu.	17	lahu-buk=10+7.
11	lahu-hun=10+1.	18	lahu-huaxik=10+8.
12	lahu-tzab=10+2.	19	lahu-belleuh=10+9.
13	lahu-ox=10+3.	20	hum-inik=1 man.
14	lahu-tze=10+4.	30	hum-inik lahu=20 (or 1 man)+10.
15	lahu-bo=10+5.	40	tzab-inik=2×20.
16	lahu-akak=10+6.		

[1] Maya Chronicles, p. 45.

[2] Stoll, Zur Ethnog. Guatemala, pp. 68-70, and Marcelo Alejandre, Cartilla Huasteca, p. 153 (*h* is substituted for *j*. Alejandre uses the terminal *c*, but to be uniform with Stoll, I have substituted *k*).

Huasteca—Continued

50	tzab-inik lahu=2×20+10.	800	huaxik-boinik=8×100.
60	ox-inik=3×20.	900	belleuh-inik=9×100?
70	ox-inik lahu=3×20+10.	1,000	hum xi.
80	tze-inik=4×20.	2,000	tzab xi=2×1,000.
90	tze-inik ca-lahu=4×20+10.	3,000	ox xi=3×1,000.
100	bo-inik=5×20.	4,000	tzaboinik xi? (tze xi?)
200	tza-boinik=2×100.	5,000	boi xi=5×1,000.
300	ox-boinik=3×100.	6,000	akak xi=6×1,000.
400	tze-boinik=4×100.	7,000	buk-inik xi? (buk xi?)
500	bo-boinik=5×100.	8,000	huaxik xi=8×1,000.
600	akak-boinik=6×100.	9,000	belleuh-hinik xi? (belleuh xi?)
700	bu-unik=7×100?		

It is apparent that from 100 upward the count is in accord with the decimal system, though the 5 times 20 to make the 100 is retained. *Xi*, the term for 1,000, appears to be modern, or, what is more probable, it is the term formerly used for 8,000, but changed, as *pic* in Maya, to 1,000; it is probably derived from *xil* or *xiil*, "hair." Several of the terms taken from Alejandre's list appear to be doubtful, to wit, those for 700, 900, 4,000, 7,000, and 9,000. Possibly the name for 700 is a shortened form of *buk boinik* and that for 900 of *belleuh boinik*, but this explanation will not apply to the other three, as *tzaboinikxi*, to conform to the system, would be 200×1,000 or 200+1,000. The proper term according to the rule would seem to be *tzexi*. I am unable to offer any other explanation of the terms for 7,000 and 9,000 than that *inik* has been improperly inserted. No data are available for determining the method of counting the minor additions from 41 to 59, 61 to 79, etc.

The next system of numeration to be considered is that of the Quiche, to which special attention is called for the reason that it is given somewhat fully by Brasseur, who seems to have studied it carefully, and who furnishes explanations drawn from his knowledge of the language. It therefore affords a good basis of comparison with the systems of other dialects of the same family, especially with that of the Maya proper.

Quiche[1]

10	lahuh.	17	vuk-lahuh=7+10.
11	hu-lahuh=1+10.	18	vahxak-lahuh=8+10.
12	cab-lahuh=2+10.	19	beleh-lahuh=9+10.
13	ox-lahuh=3+10.	20	hu-vinak=1 man.
14	cah-lahuh=4+10.	21	huvinak-hun=20+1.
15	o-lahuh=5+10.	22	huvinak-cab=20+2.
16	vak-lahuh=6+10.		

This continues to 39, the minor numbers 3–19 being placed after the huvinak or 20. However, it would have been more satisfactory if the author had written out more fully these added numbers to 39, thus

[1] Brasseur de Bourbourg, Grammaire Langue Quiche, pp. 141-146.

enabling us to see whether there are any contractions of the terms for 11 to 19 as given above.

40 cavinak=2 men or 2×20.

From this the *vinak* for 20 is replaced by *qal*, which is really the proper term in Quiche for the number 20, and corresponds with the *kal* (20) of the Maya dialect.

41 hun-r-oxqal=1 on the third score, or third 20.
42 cab-r-oxqal=2 on the third score, or third 20.
43 oxib-roxal=3 on the third score, or third 20.

This continues to 59 by prefixing the numbers 4–19 to *roxqal*. The latter term is composed of the possessive *ri* sincopated to *r*, and *ox-qal*, 3×20. The counting, therefore, is precisely as in the Maya dialect; that is to say, from 21 to 39 the minor additions (1–19) are made to the first score, or 20, but from 41 to 59 they are counted as so many on the following or third score. This method is followed, as will be seen, up to 399.

60 ox-qal=3×20.
61 hun-ri-humuch=1 on the fourth score.
62 cab-ri-humuch=2 on the fourth score.
63 ox-ri-humuch =3 on the fourth score
80 humuch.

The name *humuch* is composed of *hun*, 1, and *much*, a measure of quantity, a little mass or pile comprising 4 qal of cacao nuts.

81 hun-r-oqal=1 on the fifth score.
82 cab-roqal=2 on the fifth score.
83 oxib-roqal=3 on the fifth score.
So to 99.
100 o-qal=5×20.
101 hu-ri-vakqal=1 on the sixth score.
102 cab-ri-vakqal=2 on the sixth score.
103 oxib-ri-vakqal=3 on the sixth score.
So to 119.
120 vak-qal=6×20.
121 hun-ri-vukqal=1 on the seventh score.
122 cab-ri-vukqal=2 on the seventh score.
123 oxib-ri-vukqal=3 on the seventh score.
So to 139.
140 vuk-qal=7×20.
141 hun-ri-vahxakqal=1 on the eighth score.
142 cab-ri-vahxakqal=2 on the eighth score.
143 oxib-ri-vahxakqal=3 on the eighth score.
160 vahxak-qal=8×20.
161 hun-ri-belehqal=1 on the ninth score.
So to 179.
180 beleh-qal=9×20.
181 hun-r-otuk=1 on the tenth score, or literally 1 on the fifth 40.
So to 199.

Here is a change in the order from *lahuh-qal*, or 10×20, as it would be regularly, to *otuk*, or 5 *tuk*, which seems to give indications of modern influence. Brasseur gives the following explanation: "From the number 180 following they say *hun-rotuk*, 181, 1 toward 200, which is represented by the word *otuk* (this name for 200 is composed of *oo*, 5, and *tuk*, which appears to signify a tuft of a certain herb, which has, independently of its ordinary sense, that of 40. This makes, therefore, for the entire word, 40 multiplied by 5; that is to say, 200)." *Tuc* in Maya signifies as a verb "to count heaps, or by heaps" (Henderson, manuscript dictionary, and Beltran, Arte). The succeeding numbers, as will be seen by the list, follow in the count the regular order, though with abbreviated names.

201 hun-ri-hulah=1 on the eleventh score.
So to 219.

Hulah in this instance stands for *hulahu-qal;* that is, 11×20.

220 hulahu-qal=11×20.
221 hun-ri-cablah=1 on the twelfth score.
So to 239.

Cablah, abbreviation of *cablahuh-qal*.

240 cablahuh-qal=12×20.
241 hun-roxlah=1 on the thirteenth score.
So to 259.

Roxlah, abbreviation of *roxlahuh-qal*.

260 roxlahuh-qal=13×20.

The retention of the *r* here, contrary to the general rule, is without apparent reason unless it be for the sake of euphony. *Oxlahuhqal* would seem to be the proper term, as *oxlahuh* is given for 13, *oxqal* for 60, and *omuch-oxlahuhqal* for 660; however, the name for 300 is *rolahuhqal*.

261 hun-ri-cahlahuhqal=1 on the fourteenth score.
So to 279.
280 cahlahuh-qal=14×20.
281 hun-r-olahuhqal=1 on the fifteenth score.
So to 299.
300 rolahuh-qal=15×20.
301 hun-ri-vaklahuhqal=1 on the sixteenth score.
So to 319.
320 vaklahuh-qal=16×20.
321 hun-ri-vuklahuhqal=1 on the seventeenth score.
So to 339.
340 vuklahuh-qal=17×20.
341 hun-ri-vahxaklahuhqal=1 on the eighteenth score.
So to 359.
360 vahxaklahuh-qal=18×20.

361 hun-ri-belehlahuhqal=1 on the nineteenth score.
So to 379.
380 belehlahuh-qal=19×20.
381 hun-r-omuch=1 on the 400, or 1 on the fifth much.
So to 399.
400 omuch=5×80, or 5×4×20.
401 omuch-hun=400+1. Etc.
500 omuch-oqal=400+100.
600 omuch-otuk=400+200.
700 omuch-olah, or omuch-olahuh-qal=400+15×20.
720 omuch-vaklahuhqal=400+16×20.
780 omuch-belehlahuhqal=400+19×20.

At this point Brasseur remarks : "From here onward they count from 400 to 4,000 with the term *go*, that is to say, 400, in this manner; *cago*, two times four hundred; and they begin to count from 781, *hun-ri-cago*, as if they said, one on (or toward) the eight hundred; *cab-ri-cago*, two on eight hundred."

It would seem, therefore, from this remark, that this change in the count commenced only with the last 20 required to make up the 800. But as soon as the count rose above 800 it was based on the 400 next above, that is to say, the third 400, thus:

801 hun-r-oxogo=1 on the third 400.
840 cavinak-r-oxogo=2×20 on the third 400.
860 oxqal-r-oxogo=3×20 on the third 400.

Brasseur gives as the equivalent of *hun-roxogo* "es decir 399 para 1200." Though the term may indicate a number which is the same as 1200—399, it certainly does not indicate any such process of obtaining this number. The first number expressed is *hun*, or 1, and this is related in some way to 3×400, or, the third 400. Brasseur's explanation is therefore unsatisfactory. The count evidently proceeds in the same way as that of the minor numbers above the second score both in the Maya and Quiche dialects, that is, 1, 2, etc., on the next higher score; here it is on the next higher *go* or 400.

880 humuch-r-oxogo=80 on the third 400.
900 oqal-r-oxogo=5×20 on the third 400.
920 vakqal-r-oxogo=6×20 on the third 400.
940 vukqal-r-oxogo=7×20 on the third 400.
960 vahxakqal-r-oxogo=8×20 on the third 400.
980 belehqal-r-oxogo=9×20 on the third 400.
1,000 otuk-r-oxogo=5×40 on the third 400.
1,200 roxogo=3×400.

Here the prefixed *r* (for *ri*) is retained for no apparent use unless possibly for euphony.

1,600 cahgo=4×400.
2,000 roogo, or rogo=5×400.
2,400 vakago=6×400.
2,800 vukugo=7×400.
3,000 otuk-vahxakgo=5×40 on the eighth 400.

3,200 vahxa-go=8×400.
3,600 beleh-go=9×400.
4,000 lahuh-go=10×400.
4,400 hulahuh-go=11×400.
4,800 cablahuh-go=12×400.
5,000 otuk-oxlahuh-go=200 on the thirteenth 400.
5,200 oxlahuh-go=13×400.
5,600 cahlahuh-go=14×400.
6,000 roolahuh-go=15×400.
6,400 vaklahuh-go=16×400.
6,800 vuklahuh-go=17×400.
7,000 otuk-vahxaklahuh-go=200 on the eighteenth 400.
7,200 vahxak-lahuh-go=18×400.
7,600 belehlahuh-go=19×400.

Upward from this point to 7,999 the count is based on 8,000, for which the word *chuvy*—which, according to Brasseur, denotes the bag or sack containing 8,000 cacao nuts, corresponding exactly with the Mexican *xiquipilli*—was used.

7,601 hun-ri-hu-chuvy=1 on the first 8,000.
7,602 cab-ri-hu-chuvy=2 on the first 8,000, etc.
16,000 ca-chuvy=2×8,000.
24,000 ox-chuvy=3×8,000, etc.
80,000 lahuh-chuvy=10×8,000.
88,000 hulahuh-chuvy=11×8,000.
"Y asi de los demas hasta el infinito" (Brasseur).

In the other dialects of the Mayan family the lists of numerals above 10, so far as obtained, are as follow:

Cakchikel[1]

10	lahuh.	16	vuaklahuh=6+10.
11	huvilahuh[2]=1+10.	17	vuklahuh=7+10.
12	cablahuh=2+10.	18	vuahxaklahuh=8+10.
13	oxlahuh=3+10.	19	belehlahuh=9+10.
14	cahlahuh=4+10.	20	huvinak=1 man.
15	vuolahuh=5+10.		

Stoll[3] gives the old and new methods of counting among the Cakchiquels from 40 to 80, as follow (*h* being substituted for *j*); the number equivalents are our additions:

	Old		*New*
40	ca-vinak=2 men	40	ca-vinak=2 men.
41	hun-r-oxc'al=1 on the third score.	41	ca-vinak-hun=2 men and 1, or 2×20+1.
42	cai-r-oxc'al=2 on the third score.	42	ca-vinak-cai=2×20+2.
43	oxi-r-oxc'al=3 on the third score.	43	ca-vinak-oxi=2×20+3.
44	cahi-r-oxc'al=4 on the third score.	44	ca-vinak-cahi=2×20+4.
45	voo-r-oxc'al=5 on the third score.	45	ca-vinak-vuoo=2×20+5.
46	vuakaki-r-oxc'al=6 on the third score.	46	ca-vinak-vuaki=2×20+6.

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[1] Stoll, Zur Ethhnog. Guatemala, p. 136.
[2] The *vi* in this name is apparently incorrect; it is possibly a misprint for *u*.
[3] Soc. cit.

	Old		*New*
47	vuku-r-oxc'al=7 on the third score.	47	ca-vinak-vuku=2×20+7.
48	vuakxaki-r-oxc'al=8 on the third score.	48	ca-vinak-vuahxaki=2×20+8.
49	belehe-r-oxc'al=9 on the third score.	49	ca-vinak-belehe=2×20+9.
50	lahuh-r-oxc'al=10 on the third score.	50	ca-vinak-lahuh=2×20+10.
51	hu-lahuh-r-oxc'al=11 on the third score.	51	ca-vinak-huvilahuh=2×20+11.
52	cab-lahuh-r-oxc'al=12 on the third score.	52	ca-vinak-cablahuh=2×20+12.
53	ox-lahuh-r-oxc'al=13 on the third score.	53	ca-vinak-oxlahuh=2×20+13.
54	cah-lahuh-r-oxc'al=14 on the third score.	54	ca-vinak-cahlahuh=2×20+14.
55	vuo-lahuh-r-oxc'al=15 on the third score.	55	ca-vinak-vuolahuh=2×20+15.
56	vuak-lahuh-r-oxc'al=16 on the third score.	56	ca-vinak-vaklahuh=2×20+16.
57	vuk-lahuh-r-oxc'al=17 on the third score.	57	ca-vinak-vuklahuh=2×20+17.
58	vuakxak-lahuh-r-oxc'al=18 on the third score.	58	ca-vinak-vuahxaklahuh=2×20+18.
59	beleh-lahuh-r-oxc'al=19 on the third score.	59	ca-vinak-belehlahuh=2×20+19.
60	oxc'al=3×20.	60	ox-vinak, or oxc'al=3×20.
61	hun-ru-humu'ch=1 on the fourth score.	61	ox-vinak-hun=3×20+1.
80	humu'ch.	80	cah-vinak, or humu'ch =4×20, or 80.

Dr Brinton, in his Grammar of the Cakchiquel Language of Guatemala (page 68), translated from a manuscript in the Library of the American Philosophical Society, gives the following additional numbers, his *q* being changed to *c'* to correspond with Stoll's list:

100	oc'al=5×20.
101	hun-ru-vakc'al=1 on the sixth score.
120	vakc'al=6×20.
121	hun-ru-vukc'al=1 on the seventh score.
140	vukc'al=7×20.
160	vakxak-c'al=8×20.
180	beleh-c'al=9×20.
200	otuc=5×40.
300	volahuh-c'al=15×20.
400	omuch=5×80.
500	omuch-oc'al=5×80+5×20, or 400+100.
600	omuch-otuk=400+200.
700	omuch-volahuh-c'al=400+15×20.
800	cagho=2 gho or 2×400.
900	oxc'al-r-oxogho?

This is a mistake or misprint for

900	oc'al-r-oxogho=100 (or 5×20) on the third 400.
1,000	otuc-r-oxogho=200 (or 5×40) on the third 400.
8,000	hu-chuvy.

The following list of Pokonchi numerals is from Stoll's Maya-Sprachen der Pokom-Gruppe (p. 51):

Pokonchi

10	lahe-b.
11	hun-lah=1+10.
12	cab-lah=2+10.
13	ox-lah=3+10.
14	cah-lah=4+10.
15	ho-lah-uh=5+10.
16	vuak-lah=6+10.
17	vuk-lah=7+10.
18	vuaxak-lah=8+10.
19	beleh-lah=9+10.
20	hun-inak=1×20, or 1 man.
21	hen-ah ru-ca-vuinak=1 on the second score, or on the second 20.
22	quib ru-ca-vuinak=2 on the second score, or on the second 20.
30	laheb ru-ca-vuinak=10 on the second score, or on the second 20.
40	ca-vuinak=2×20.
50	laheb r-oxc'al=10 on the third score.
60	ox-c'al=3×20.
70	laheb ru-cah-vuinak=10 on the fourth score.
80	cah-vuinak=4×20.
100	ho-c'al=5×20.
200	ho-tuc=5×40.

Stoll interprets the *henah ru-ca-vuinak* of the above list by "1 sein 2×20;" that is, 1 of, or belonging to, 2×20 or the second 20. This is exactly the same as saying one on the second score. The *ru* for which "sein" stands is the third person, singular, possessive pronoun, as in *rupat*, "his house."

In Quekchi (or K'ak'chi), from which the next example of numbers above 10 is taken, we follow the "Vocabulario Castellano-K'ak'chi" of Enrique Bourgeois, as published by A. L. Pinart (pp. 7–8), always, however, changing the Spanish *j* to *h*.

K'ak'chi

10	laheb.
11	hun-lahu=1+10.
12	kab-lahu=2+10.
13	ox-lahu=3+10.
14	kabahu, or kaa-lahu=4+10.
15	ho-lahu=5+10
16	guac-lahu=6+10.
17	guk-lahu=7+10.
18	guaxak-lahu=8+10.
19	bele-lahu=9+10.
20	hun-may.

Why *may* or *mai* is used here instead of *kal*, the proper term for 20, is not apparent, as it is a term applied in counting a particular class of objects. Charencey[1] remarks as follows in regard to it:

Ainsi le Cakgi possède au moins cinq termes pour rendre notre nom de nombre 20, suivant les objets auquels il se rapporte. Ainsi, l'on dira *huvinc*, s'il s'agit de compter des graines de cacao ou de pataste (cacao sauvage); *huntaab*, pour les couteaux et instruments de fer ou de métal; *hunyut*, pour les plumes vertes; *humai*, s'il s'agit

[1] Mélanges, pp. 65–66

de compter les poutres, les bestiaux, les fruits et objets comestibles. De même le Quiché employait cette particule *mai* ou *may*, lorsqu'il s'agissait du comput de l'espace de vingt ans; de *vinak*, alors que l'on voulait supputer les mois, etc.

21 hun-x-kakal=1 on the second score.
22 kaib-x-kakal=2 on the second score.
23 oxib-x-kakal=3 on the second score.
24 kaaib-x-kakal=4 on the second score.
25 hoob-x-kakal=5 on the second score.
26 guakib-x-kakal=6 on the second score.
27 gukub-x-kakal=7 on the second score.
28 guahxakib-x-kakal=8 on the second score.
29 beleb-x-kakal=9 on the second score.
30 laheb-x-kakal=10 on the second score.
31 hun-lahu-x-kakal= 11 (or 1 + 10) on the second score.
32 kab-lahu-x-kakal=12 (or 2+10) on the second score.
33 ox-lahu-x-kakal=13 on the second score.
So to 39.
40 kakal=2×20.
41 hun-r-oxkal=1 on the third score.
42 kaib-r-oxkal=2 on the third score.
So to 49.
50 laheb-r-oxkal=10 on the third score.
51 hun-lahu-r-oxkal =11 (or 1+10) on the third score.
52 kab-lahu-r-oxkal= 12 (or 2+10) on the third score.
So to 59.
60 oxal=3×20.
61 hun-x-kakal?=1 on the fourth score.
62 kaib-x-kakal?=2 on the fourth score.
So to 69.
70 laheb-x-kakal?=10 on the fourth score.
71 hun-lahu-x-kakal?=11 (or 1+10) on the fourth score.
72 kab-lahu-x-kakal?=12 (or 2+10) on the fourth score.
So to 79.

The *kakal* in the last five numerals unquestionably denotes 4×20, or 80, the proper term for which is *kaakal*. As *kakal* is the term for 40, or literally 2×20, there must be either a distinction in the pronunciation not indicated in the vocabulary or an error in the printing. The data at hand do not furnish the means of determining the signification of the inserted *x* as in *hunxkakal;* it seems evident that it plays the same rôle as *r* before *o*, as in *roxkal*.

80 kaakal=4×20.
81 hun-r-okal=1 on the fifth score.
82 kaib-r-okal=2 on the fifth score.
So to 89.
90 laheb-r-okal=10 on the fifth score.
91 hun-lahu-r-okal=11 (or 1+10) on the fifth score.
So to 99.
100 hokal=5×20.
120 guackal=6×20.
200 hotuc=5×40.
400 hun-okob=1×400.
800 kaib-okob=2×400.

The list of numerals above 10 in the Mam dialect given below is from the Arte y Vocabulario en Lengua Mame, by Marcos Salmeron, published by Charencey (page 156).

Mam

10 lahuh.
11 hum-lahuh=1+10.
12 kab-lahuh=2+10.
13 ox-lahuh=3+10.
14 kiah-lahuh=4+10.
15 oo-lahuh=5+10.
16 vuak-lahuh=6+10.
17 vuk-lahuh=7+10.
18 vuahxak-lahuh=8+10.
19 belhuh-lahuh=9+10.
20 vuinkim or huing (Stoll)=1 man.
30 vuinak-lahuh=1 man, or 20+10.
40 ka-vuinak=2×20.
41 hum-t-oxkal-im=1 to the third score.
42 kabe-t-oxkal-im=2 to the third score.
43 oxe-t-oxkal-im=3 to the third score.
44 kiah-t-oxkal-im=4 to the third score.
45 hoe-t-oxkal-im=5 to the third score.
46 vuakak-t-oxkal-im=6 to the third score.
47 vuk-t-oxkal-im=7 to the third score.
48 vuahxak-t-oxkal-im=8 to the third score.
49 velhuh-t-oxkal-im=9 to the third score.
50 lahuh-t-oxkal-im=10 to the third score.
60 ox-kal=3×20.
70 lahuh-tu-hu-much-im=10 on the fourth score.
80 hum-mucx=1 much, or 1×80.
90 lahuh-t-okal-im=10 on the fifth score.[1]
100 okal=5×20.
200 ochuk=5×40.
300 oloh-kal=15×20.
400 o-mucx=5×80.
500 omucx-okal=400+100, lit. (5×80)+(5×20).
600 omucx-ochuh=400+200, lit. (5×80)+(5×40).
700 omucx-oloh-kal=400+300, lit. (5×80)+(15×20).
900 lahuh-tuki-okal.

Stoll[2] gives a method of counting above 40 in this idiom so different from that presented above that his brief notice is presented here:

40 caunak=2×20 ?, or 2 men.
50 caunak-t-iqui-lahoh=40+10.
60 ox-c'al=3×20.
70 ox-c'al-t-iqui-lahoh=60+10.
80 hu-much=1×80.
90 hu-much-t-iqui-lahoh=80+10.

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[1] Salmeson gives *t-oxkal*, which is an evident error.
[2] Sprache dêr Ixil-Indianer, p. 146.

This, as will be seen, adds to the preceding 20 instead of counting on the following 20, and is presumed to indicate the more modern method of counting.

Ixil[1]

10	la-vual.
11	hun-lavual=1+10.
12	cab-lavual=2+10.
13	ox-lavual=3+10.
14	ca-lavual=4+10.
15	o-lavual=5+10.
16	vuah-lavual=6+10.
17	vuh-lavual=7+10.
18	vuaxah-lavual=8+10.
19	bele-lavual=9+10.
20	vuink-il, or vuinquil.
21	vuinah-un-ul=20+1.
22	vuinah-cab-il=20+2.
23	vuinah-ox-ol=20+3.
24	vuinah-căl=20+4 (cal for cah-il).
25	vuinah-ŏl=20+5 (ol for o-ol).
26	vuinah-vuah-il=20+6.
27	vuinah-vuh-ul=20+7.
28	vuinah-vuaxah-il=20+8.
29	vuinah-belu-vual=20+9.
30	vuinah-lavual=20+10.
40	ca-vuink-il=2×20.
60	ox-c'al-al=3×20.
70	lavual-i-much=10 on the 80.
80	ung-much-ul=ome much, or one 80.
90	lavual-t-oc'al=10 on the fifth score.
100	o-c'al-al=5×20.
101	oc'alal-t-uc-ungvual=100+1.
110	lavual-i-vuahc'al=10 on the sixth score.
120	vuah-c'al-al=6×20.[2]
130	lavual-i-vuhc'al=10 on the seventh score.
140	vuh-c'al-al=7×20.
150	lavual-i-vuaxahc'al=10 on the eighth score.
160	vuaxah-c'al-al=8×20.
170	lavual-i-belec'al=10 on the ninth score.
180	bele-c'al-al=9×20.
190	lavual-i-lac'al=10 on the tenth score.
200	la-c'al-al=10×20 (or cavual-ciento=2×100—Spanish).
220	hunla-c'al-al=11×20.
230	lavual-i-cabla-c'al=10 on the twelfth score.
240	cabla-c'al-al=12×20.
260	oxla-n-c'al-al=13×20 (same as oxlahunc'alal).
280	cala-n-c'al-al=14×20.
300	ola-n-c'al-al=15×20.

[1] Stoll, op. cit., pp. 50–52.

[2] Stoll gives by slip of the pen "4×20."

320 vuahla-n-c'al-al=16×20.
340 vuhla-n-c'al-al=17×20.
360 vuaxahla-n-c'al-al=18×20.
380 belela-n-c'al-al=19×20.
400 vuinkil-an-c'al-al=20×20.
420 vuinah-un-ul-an-c'al-al=(20+1)×20.
440 vuinah-ca-vual-an-c'al-al=(20+2)×20.
460 vuinah-ox-l-an-c'al-al=(20+3)×20.
480 vuinah-ca-l-an-c'al-al=(20+4)×20.
500 vuinah-o-l-an-c'al-al=(20+5)×20.
520 vuinah-vuah-il-an-c'al-al=(20+6)×20.
540 vuinah-vuh-l-an-c'al-al=(20+7)×20.
560 vuinah-vuaxah-il-an-c'al-al=(20+8)×20.
580 vuinah-bele-l-an-c'al-al=(20+9)×20.
600 vuinah-la-vual-an-c'al-al=(20+10)×20.
620 vuinah-hun-la-vual-an-c'al-al=(20+1+10)×20.
640 vuinah-cab-la-vual-an-c'al-al=(20+2+10)×20.
660 vuinah-ox-la-vual-an-c'al-al=(20+3+10)×20.
680 vuinah-ca-la-vual-an-c'al-al=(20+4+10)×20.
700 vuinah-o-la-vual-an-c'al-al=(20+5+10)×20.
720 vuinah-vuah-la-vual-an-c'al-al=(20+6+10)×20.
740 vuinah-vuh-la-vual-an-c'al-al=(20+7+10)×20.
760 vuinah-vuaxah-la-vual-an-c'al-al=(20+8+10)×20.
780 vuinah-bele-la-vual-an-c'al-al=(20+9+10)×20.
800 ca-vuinkil-an-c'al-al=(2×20)×20.

Aguacateca[1]		Jacalteca[1]		Chuhe[1]	
10	lahu	10	lahuneb	10	lahne
11	hunla	11	hun-lahuneb	11	uxlche (?)
12	cabla	12	cab-lahuneb	12	lahchue (?)
13	oxla	13	ox-lahuneb	13	ux-lahne
14	quayahla	14	can-lahuneb	14	chanlahne
15	ola	15	ho-lahuneb	15	holahne
16	vuakla	16	vuah-lahuneb	16	vuaklahne
17	vukla	17	vuh-lahuneb	17	uklahne
18	vuahxakla	18	vuahax-lahuneb	18	vuaxlahne
19	belela	19	balun-lahuneb	19	banlahne
20	hunak	20	hun-c'al	20	hun-c'al
21	hunak-hun	21	hun-es-cavuinah	40	chavuinal
22	hunak-cab	30	lahun-s-cavuinah	60	hoix-vuinak (?)
23	hunak-ox	40	ca-vuinah		
40	caunak	60	ox-c'al		
60	ox-c'al	100	ho-c'al		
80	hun-much				

[1] Stoll, Sprache der Ixil-Indianer, p. 146.

Tzotzil (a)	Chanabal (a)	Chol (b)
10 lahunem	10 lahuné	10 lahum
11 buluchim	11 buluché, or baluche	11 humpé e luhumpé=1+10
12 lah-chaém=10+2	12 lah-chane (c)=10+2	12 chapé e luhumpé=2+10
13 ox-lahunéim=3+10	13 ox-lahuné=3+10	13 uxpé e luhumpé=3+10
14 chan-lahuném=4+10	14 chan-lahuné=4+10	14 chumpé e luhumpé=4+10
15 ho-lahuném=5+10	15 ho-lahuné=5+10	15 ho-lumpé=5+10 [ho e luhumpé]
16 uak-lahuném=6+10	16 uak-lahuné=6+10	16 uokpé e luhumpé=6+10
17 vuk-lahuném=7+10	17 huk-lahuné=7+10	17 hukpé e luhumpé=7+10
18 uaxak-lahuném=8+10	18 uaxak-lahuné=8+10	18 uaxokpé e luhumpé=8+10
19 balum-lahuném=9+10	19 bala-hune=9+10	19 bolompé e luhumpé=9+10
20 tom	20 huntahbe	20 hun-c'al=one 20
40 cha-vuinik=2×20, or 2 men	40 cha-vuiniké=2×20, or 2 men	40 cha-c'al=2×20
60 ox-vuinik=3×20	60 ox-vuiniké=3×20	60 ux-c'al=3×20
80 chan-vuinik=4×20	80 chan-vuiniké=4×20	80 chun-c'al=4×20
100 ho-vuinik=5×20	100 ho-vuiniké=5×20	100 hoo-c'al=5×20

a Stoll, Ethnog. Guatemala, pp. 69–70.
b Stoll, op. cit.
c Should not this be *lah-chabe*?

Mixe[1]

10 mahc.
11 mahc-tuuc=10+1.
12 mahc-metzc=10+2.
13 mahc-tucôc=10+3.
14 mahc-mactz=10+4.
15 mahc-mocx=10+5.
16 mahc-tuduuc=10+6 or mahc-mocx-tuuc=10+5+1.
17 mahc-huextuuc=10+7 or mahc-mocx-metzc=10+5+2.
18 mahc-tuctuuc=10+8 or mahc-mocx-tucoc=10+5+3.
19 mahc-taxtuuc=10+9 or atuuc cá ypx=1 from 20 or one more to 20.
20 ypx.
21 ypx-tuuc=20+1.
22 ypx-metzc=20+2.
23 ypx-tucôc=20+3.

[1] Raoul de la Grasserie, Langue Zoque et Langue Mixe, 332, 333.

24 ypx-maxtaxc=20+4.
25 ypx-mocoxc=20+5.
26 ypx-tuduuc=20+6 (literally 20+5+1).
27 ypx-huextuuc=20+7 (literally 20+5+2).
28 ypx-tuctuuc=20+8 (literally 20+5+3).
29 ypx-taxtuuc=20+9 or atuuc ca ypxmahc=1 from 30 or 1 more to 30.
30 ypx-mahc=20+10.
31 ypx-mahc-tuuc=20+10+1.
32 ypx-mahc-metzc=20+10+2.
33 ypx-mahc-tucôc=20+10+3.
40 huixticx (?) [metz-ipx?]
60 tucô-px=3×20.
80 mohcta-px=4×20.
100 mocô-px=5×20.
120 tuduu-px=6×20.
140 huextuut=7×20 ?
160 tuctuut=8×20 ?
180 taxtuut=9×20 ?
200 maiqu-ipx=10×20.
300 yucmocx=20×15 ?
400 tuuc-moiñ=1 moin.
500 tuuc-moiñ co mocopx=400+100 or 400+5×20.
600 tuuc-moiñ co maiquipx=400+200 or 400+10×20.
700 tuuc-moiñ co yucmocx=400+300.
800 metzc-moiñ=2×400.
900 metzc-moiñ co mocopx=2×400+100.
1,000 metzc-moiñ co maiquipx=2×400+200.

Zoque[1]

1		2	
10	makch-kan	10	macay
11	makch-tuman=10+1	11	(?)
12	makch-kues teut-kan	12	macueste-cuy
13	(?)	13	mac-tucay=10+3
20	i-itpshan	20	ips-vote, yps-vote, or yps-vate (literally yps or ips=20)
30	i-ips-comak-kan	30	yps co mac=20+10
40	wûeus-tu-gi-ipshan	100	mos-ips=5×20
50	wûeus-tu-gi-comak-kan=40+10	300	yet-ips
60	tugi-ipshan=3×20	2,000	mosmone
70	tugips-comak-kan=60+10	10,000	tzuno-comos-mone
80	mak-tapshan=4×20	12,000	tzuno-comac-mona
90	mak-tapshan-coma-kan=80+10	13,000	tzuno-coma, vestec-mone
100	mossiipshan=5×20	16,000	vestec-tzunu
200	magi-ipshan=10×20	20,000	vestectzuno-comac-mone
		30,000	tucuy-chuno coyet-mone
		300,000	yps-coyu covestec-tzuno

[1] This list of numerals must be accepted with some reserve; it is partly (1) from E. A. Fuertes' manuscript in the Bureau of American Ethnology archives and partly (2) from the Vocabulary in Grasserie's Langue Zoque.

Trike[1]

10 chia.
11 châ-nha=10+1.
12 chu-úiha=10+2.
13 cha-nûnha=10+3.
14 chi-gâha=10+4.
15 chinôônha=15×1?
16 chinônhi-ha=15+1.
17 chinôn-huiha=15+2.
18 chinôn-guanônha=15+3.
19 chinôn-gaha=15+4.
20 hikoo or kooha.
21 hikoo-ñia-nha=20+1.
22 hikoo-ghuiha=20+2.
30 hikoo-chiha=20+10.
31 hikoo-chân=20+11 (literally 20+10+1.
32 hikoo-chuuiha=20+12 (literally 20+10+2).
33 ikoo-chanûnha=20+13 (literally 20+10+3.)
40 ghuixiaâha=2×20?
41 ghuixiaâ-ngoha=40+1.
42 ghuixiaâ-ghuiha=40+2.
50 ghuixiaâ-chiha=40+10.
51 ghuixiaâ-chanha=40+11 (literally 40+10+1).
52 ghuixiaâ-chuuiha=40+12 (literally 40+10+2).
60 guanônxiaha=3×20?
61 guanonxia-ñia-nha=60+1.
62 guanônxia-ghuiha=60+2.
70 guanônxia-chiha=60+10.
71 guanônxia-chiñia-nha=60+10+1.
80 kâaxihaa=4×20?
81 kâaxia-ngoha=80+1.
90 kâaxia-chiha=80+10.
91 kâaxia-chân=80+11 (literally 80+10+1).
100 hûhû-chia=5×20.

The *xiaâ* in the names for 40, etc., appears to be an equivalent of 20.

Cahita[2]

10 uo-mamni=2×5.
11 uomamni aman-senu=10+1 or 2×5+1. Also, uomamni ama vepasenu.
20 senu-tacaua=one 20 or 1×20.
40 uoi-tacaua=2×20.
60 vahi-tacaua=3×20.
80 naequi-tacaua=4×20.
100 mamni-tacaua=5×20.
200 uo-mamni-tacaua=10×20 (literally 2×5×20).
400 uo-mamni uosa-tacaua=(2×5)×(2×20)?
500 uo-mamni uosa aman mamni-tacaua=400+100.
600 uo-mamni aman vahi-si-tacaua=(2×5)×(3×20)
700 uo-mamni vahi-si aman mamni-tacaua=600+100.
800 uo-mamni naequi-si-tacaua=(2×5)×(4×20).
900 uo-mamni naequi-si aman mamni-tacaua=800+100.
1,000 uo-mamni mamni-si-tacaua=(2×5)×(5×20).
4,000 naequi uommamni mamnistacaua.

The author adds the following paragraphs:

Some nations [?] say *senutacaua* or *sesavehere* for 20, others say *sesavehere* for 10, and follow up the count thus, 11 *sesavehere aman senu*, 12 *sesavehere aman uoi*, etc.; for 20 they say *uosavehere*, which is 2 times 10.

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[1] Francisco Belmar, Ensayo sobre Lengua Trike, p. 10.
[2] Arte Lengua Cahita (anon.), edited by Eustaquio Buelna, pp. 199, 200.

The Yaquis say for 5 *sesavehere*, and counting from 5 to 5 [more] say *uosavehere* 10, *vahivehere* 15; these also say for 20 *senutacaua* or *naequivehere*, and for 25 say *sesavehere*, and for 100 say *mamnitacaua* or *tacauavehere*, which is 20 fives.

He explains the "numeral adverbs" *sesa* and *uosa* thus: *se-sa*, "one time," *uo-sa*, "two times;" for example, *sesavehere*, one time 5, *uoivehere*, two times 5, etc.

Othomi[1]

10	réta or rāta.	30	n-ráhte-ma-réta=20+10.
11	réta-ma-ra=10+1.	40	yohte=2×20.
12	réta-ma-yooho=10+2.	50	n-yohte-ma-réta=40+10.
13	réta-ma-hiu[2]=10+3.	60	hiû-ráhte=3×20.
14	réta-ma-gooho=10+4.	70	hiûráhte-ma-réta=60+10 (literally 3×20+10).
15	réta-ma-qyta=10+5.	80	gooho-ráhte=4×20.
16	réta-ma-rahto=10+6.	90	gooho - ráhte - ma[3] - réta=80+10 (literally 4×20+10).
17	réta-ma-yohto=10+7.	100	n-ranthbe, or n-ranéhbe.
18	réta-ma-hiáhto=10+8.	1,000	n-ram-oo.
19	réta-ma-gyhto=10+9.		
20	n-ráhte.		

Tarasco[4]

10	temben.
11	temben-ma=10+1.
12	temben-tziman=10+2.
13	temben-tanimu=10+3.
14	temben-thamu=10+4.
15	temben-yumu=10+5.
16	temben-cuimu=10+6.
17	temben-yuntziman=10+7.
18	temben-yuntanimu=10+8.
19	temben-yunthamu=10+9.
20	maequatze or makatari.
30	maequatze ca-temben=20+10.
40	tziman-equatze=2×20.
50	tziman-equatze ca-temben=40+10 (literally 2×20+10).
60	tanime-equatze=3×20.
70	tanimequatze ca-temben=60+10.
80	thamequatze=4×20.
90	thamequatze ca-temben=80+10.
100	yumequatze=5×20.
200	temben-equatze=10×20.
300	temben-equatze ca yumequatze=200+100 (literally, 10×20+5×20).
400	ma-yrepeta=1×400.
500	ma-yrepeta ca-yum-equatze=400+100.
600	ma-yrepeta ca-temben equatze=400+200 (literally, 400+10×20).
700	ma-yrepeta ca-temben yumequatze=400+300, or in full, mayrepeta ca-temben-equatze yumequatze=400+10×20+5×20.
800	tziman yrepeta=2×400.
900	tziman yrepeta ca-yumequatze=800+100 (literally 2×400+5×20).
1,000	tziman yrepeta ca-temben-equatze = 800 + 200 (literally, 2×400+10×20).

[1] Luis de Neve Ymolina, Arte del Idioma Othomi, pp. 152, 153, and Éléments de la Grammaire Othomi (anon.), p. 14.

[2] *htu* in Ymolina's Arte (probably a misprint).

[3] *mo* in Arte.

[4] Arte y Diccionario Tarascos, by Juan Bautista de Laguna, edited by Nicholas Léon, pp. 59–61.

2,000	yum-yrepeta=5×400.
3,000	yun-tzïman yrepeta ca-temben-equatze=7×400+10×20.
4,000	temben yrepeta=10×400.
5,000	temben-tziman yrepeta ca-temben equatze=12×400+10×20.
6,000	temben yum-yrepeta=10×400+5×400 (written in full, temben yrepeta ca-yum-yrepeta.)
7,000	temben yuntziman yrepeta ca-temben equatze=17×400+10×20. (literally, (10+7)×400+10×20).
8,000	ma-equatze yrepeta=20×400.
9,000	ma-equatze tziman yrepeta ca-temben equatze=(20+2)×400+10×20.
10,000	ma-equatze yum yrepeta=8,000+200 (literally, ma-equatze yrepeta ca-yum yrepeta=20×400+5×400).
20,000	tziman equatze yrepeta ca-temben yrepeta=2×20×400+10×400.
30,000	tanim equatze temben yrepeta cayum yrepeta=70×400+2,000 (literally, (3×20+10)×400+5×400).
40,000	yum-equatze yrepeta=5×20×400.
50,000	cuim-equatze yrepeta ca-yum-yrepeta=6×20×400+5×400.
60,000	yun-tanim-equatze yrepeta(?)=?.
70,000	yun-tham-equatze yrepeta ca-yum-yrepeta(?)=?.
80,000	temben-equatze yrepeta, ca-temben-yrepeta=10×20×400 ("ca-temben yrepeta" surplusage?).
90,000	temben ma-equatze yrepeta, ca-temben yum yrepeta.
100,000	temben-tanim-equatze yrepeta(?)=?.
200,000	makararhi-equatze yrepeta ca-cuim-equatze yrepeta=?.
300,000	makatarhi-equatze ca-temben yuntham-equatze yrepeta=?.
400,000	tziman katarhi equatze ca-yuntanim equatze yrepeta=?.
500,000	tanim katarhi-equatze ca-tziman equatze yrepeta=?.
600,000	tanim katarhi-equatze catemben yum-equatze yrepeta=?.
700,000	tham-katarhi-equatze ca-yuntanim-equatze yrepeta=?.
800,000	yun-katarhi-equatze ca-ma-equatze yrepeta=?.
900,000	yum-katarhi-equatze ca-temben-tham-equatze yrepeta=?.

There appear to be several errors in this list which can not be corrected with satisfactory certainty without a somewhat thorough knowledge of the language. The name for 60,000 as it stands in the list is equal to 8×20×400, giving as the product 64,000. It is possible that this is the number intended. The proper expression for 60,000 appears to be *yun-tziman-equatze-yrepeta temben-yrepeta*=7×20×400+10×400. The name for 70,000 as it stands in the list signifies 9×20×400+5×400=74,000. As it is not probable that this is the number intended, the error must be in the name. If we write *yun-tanim-equatze yrepeta* =64,000 and add *temben yum-yrepeta*, the abbreviated name for 6,000, we shall get the required number, but the positive evidence that this form is correct is lacking. We observe that the first terms in the names for 10,000, for 20,000, for 30,000, and for 40,000 are, respectively, *ma*, 1; *tziman*, 2; *tanim*, 3; and *yum*, 5. Following this rule, the corresponding terms in the names for 50,000, 60,000, 70,000, and 80,000 should be *cuim*, 6; *yun-tziman*, 7; *yuntanim*, 8; and *temben*, 10. The corrections suggested for 60,000 and 70,000 (as 80,000 has *temben*) will conform to this order. These high round numbers have, however, a modern look inconsistent with original Mexican number systems.

Opata[1]

10 makoi.
11 makoi-seni-beguâ[2]=10+1.
12 makoi-go-beguâ=10+2.
13 makoi-ba-beguâ=10+3.
14 makoi-nago-beguâ=10+4.
15 makoi-mari-beguâ=10+5.
16 makoi-bussani-beguâ=10+6.
17 makoi-seni-gua-bussani-beguâ=10+7 (literally 10+1+6).
18 makoi-go-nago-beguâ=10+8 (literally 10+2×4).
19 kiseuri=before or next to 20.
20 seuri, or seneurini=1 man (?).
21 seuri-seni-beguâ=20+1.
30 seuri-makoi-beguâ=20+10.
40 gode-urini=2×20.
50 godeurini makoi-begua=40+10 (literally 2×20+10).
60 vaide-urini=3×20.
100 makoi-urini? (error; should be mari-urini=5×20?).

Tarahumari[3]

10 macoi-qui.
11 macoi-guamina-bire=10+1.
12 macoi-guamina-oca=10+2.
13 macoi-guamina-beiquia=10+3.
So to 19.
20 osa-macoi=2×10.
30 beisa-macoi=3×10.
40 naguosa-macoi=4×10.

Notwithstanding the evident resemblance of the numerals of this idiom up to 10 to those of the Nahuatl, it is clear from this short list, which is all we are enabled to offer from the data at hand, that the higher number names are based on the decimal system.

As the mode of counting used by the tribes of the Shoshonean group, so far as they have been obtained, is based on the decimal system, it is unnecessary to present more than one or two examples, which will be introduced farther on.

Before closing this chapter a few other examples, including two from northeastern Asia, will be presented for comparison. The first of these is the Totonacan count above 10. Unfortunately we have only the round numbers.

Totonaca[4]

10 cauh.
20 puxam.
30 puxam-a-cauh=20+10.
40 ti-puxam=2×20.
50 ti-puxam-a-cauh=2×20+10.
60 toton-puxam=3×20.
100 quitziz-puxam=5×20.
200 co-puxam=10×20.
400 tontaman.
1,000 ti-taman-a-co-puxam=2×400+10×20.

[1] This incomplete list is gathered from the Vocabulario Opata in Pimentel's Cuadro, vol. II.
[2] The signification of *beguâ* in this connection unknown to the writer.
[3] Miguel Tellechea, Compendio Grammatical idioma Tarahumari, p. 7.
[4] Conant, Number Concept, p. 205.

For numbers in a different dialect see Akal'man in the preceding chapter.

Squier[1] gives the numerals of a Nicaraguan tribe that he names Nagranda (Subtiabanss?), which show that the system was regularly vigesimal.

Nagranda

10	Guha=10.
11	Guanimba=10+1.
12	Guanapu=10+2.
13	Guanasu=10+3.
14	Guanacu=10+4.
15	Guanisu=10+5.
16	Guanmahu=10+6.
17	Guanquinu=10+7.
18	Guanuha=10+8.
19	Guanmelnu=10+9.
20	Dino, imbadiño, or 'badiño=1×20.
21	'Badiñoimbanu=1×20+1.
22	'Badiñoapunu=1×20+2.
23	'Badiñoasunu=1×20+3.
30	'Badiñoguhanu=1×20+10.
31	'Badiñoguanimbanu=1×20+10+1.
32	'Badiñoguanapunu=1×20+10+2.
33	'Badiñoguanasunu=1×20+10+3.
40	Apudiño=2×20.
41	Apudiñoimbanu=2×20+1.
42	Apudiñoapunu=2×20+2.
43	Apudiñoasunu=2×20+3.
50	Apudiñoguhanu=2×20+10.
51	Apudiñoguanimbanu=2×20+1.
52	Apudiñoguanapunu=2×20+10+2.
60	Asudiño=3×20.
70	Asudiñoguhanu=3×20+10.
80	Acudiño=4×20.
90	Acudiñoguhanu=4×20+10.
100	Huisudiño or guhamba=5×20 or great ten.
200	Guahadiño=10×20.
400	Diñoamba=great twenty.
1000	Guhaisudiño=10×5×20.
2000	Hisudiñoamba=five great twenties.
4000	Guhadiñoamba=ten great twenties.

As we shall have occasion to refer to one example from a California dialect not pertaining to the Uto-Aztecan family, we give it here.

Hŭchnōm[2]

1	pu-weh.
2	opeh.
3	mol-meh.
4	ke-so-peh.
5	pu-pukh.
6	pu-i-tal=(1+5)?
7	o-pi-dun=(2+5)?
8	ken-uh-sol-mi-nun.
9	hel-pi-suh-pu-tul=(10−1)?
10	hel-pis-oh.
11	hel-pis-i-pu-tek=10+1.
12	hel-pis-o-o-po-tek=10+2.
20	pu-al-yek.
30	mis-u-o-pal-yuh=(10 on second score)?
40	o-pal-yuh=2×20.
50	mis-u-mol-mal-yuh=(10 on third score)?
60	mol-mal-yuh=3×20.
70	mis-u-kas-a-pal-yuh=(10 on fourth score)?
80	kas-a-pal-yuh=4×20.
90	mus-u-pu-al=(10 on fifth score)?
100	pu-ol.

The number equivalents which we have added are given merely as suggestions. Those for 30, 50, 70, and 90 should possibly be 10 from 40, 10 from 60, etc. We can only say that the equivalent, though possibly not the signification of *mis-u*, must be 10, and that the count relates to the next higher score.

[1] Nicaragua, vol. II, p. 326.
[2] Compar. Vocabularies, by J. W. Powell, in Contrib. to N. Am. Ethn., vol. III, pp. 487, 488.

The two Asiatic examples are the Tschukschi and the Aino.

Tschukschi [1]

10	migitken=both hands.
20	chlik-kin=a whole man.
30	chlikkin mingitkin parol=20+10.
40	nirach chlikkin=2×20.
100	milin chlikkin=5×20.
200	mingit chlikkin=10×20, i. e., 10 men.
1,000	miligen chlin-chlikkin=5×200, i. e., five (times) 10 men.

Aino [2]

10	wambi.
20	choz.
30	wambi i-doehoz=10 from 40, or 10 on the second score.
40	tochoz=2×20.
50	wambi i-richoz=10 from 60, or 10 on the third score.
60	rechoz=3×20.
70	wambi [i?] inichoz=10 from 80, or 10 on the fourth score.
80	inichoz=4×20.
90	wambi aschikinichoz=10 from 100, or 10 on the fifth score.
100	aschikinichoz=5×20.
110	wambi juwanochoz=10 from 120?
120	juwano choz=6×20.
130	wambi aruwanochoz=10 from 140?
140	aruwano choz=7×20.
150	wambi tubischano choz=10 from 160?
160	tubischano choz=8×20.
170	wambi schnebischano choz=10 from 180?
180	schnebischano choz=9×20.
190	wambi schnewano choz=10 from 200?
200	schnewano choz=10×20.
300	aschikinichoz i gaschima chnewano choz=5×20+10×20.
400	toschnewano choz=2×(10×20).
500	aschikinichoz i gaschima toschnewano choz=100+400.

Miscellaneous Lists.

The following lists are added here chiefly as a means of comparison. Some of them have not as yet been satisfactorily classified by linguistic affinity. One or two of the dialects belong to that part of South America near the Isthmus of Panama, but are given because it appears that the tribes speaking them used the "native calendar." The localities where they are spoken are given in connection with the names of the dialects.

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[1] Conant, Number Concept, p. 191.

[2] Ibid, pp. 191-192.

Moreno (Honduras)[1]

The number names in this dialect present a curious admixture of Moreno and Spanish.

1	aba.	11	uns (Sp.).
2	biama.	12	dus (Sp.).
3	irua.	13	tres (Sp.).
4	gadri.	16	seis (Sp.).
5	senc (Sp.).	20	ven (Sp.).
6	sis (Sp.).	30	drandi (Sp.).
7	set (Sp.).	40	biaven=2×20.
8	vit.	50	biavendis=2×20+10.
9	nef (Sp.).	100	san (Sp.).
10	dis (Sp.).	300	iruasan=3×100.

For the purpose of showing the evident relation of the Moreno number names to those of the Carib group, those of the latter up to 5 are added here, from Rafael Celedon's Gramática Catecismo i Vocabulario de la Lengua Goajira (p. 29). I am not aware to what Carib dialect these belong, as this is not stated by Uricoechea, who wrote the introduction in which they are given—probably to that of the Magdalen district west of lake Maracaibo.

Carib

1 abana.
2 biama.
3 irhua, or eleua.
4 biamburi.
5 nacobo-aparcu, or abana-huajap (one hand).

Sumo (Honduras)[2]

1	as.	8	tiascobas=(5+3?).
2	buu′.	9	tiascarunca=(5+4?).
3	baas=(2+1?).	10	salap.
4	arunca.	12	salap-nica-buu′=10+2.
5	cinca (Sp.).	20	muiaslic.
6	tiascuas=(5+1?).	30	muyasloimincosala=20+10.
7	tiascabo=(5+2?).	40	muyas-leibu=20x2.

The author gives the names for 50, 60, 70, 80, 100, and 1,000 as follows:

cincuenta.	muy-as leibas.
sesenta.	muy-as leiarunca.
setenta.	muy-as leisinca ("sinca" Sp.).
ochenta.	muy-as leitiascobas.
cien.	muy-as leiarunca.
mil.	muy-as leisala.

[1] Alberto Membreño, Hondureñismos, p. 200.
[2] Ibid., pp. 223-224.

These are clearly erroneous. We venture to correct them so far as possible as follows:

50 muyas leibu-mincosala?=40+10.
60 muyas leibas=20×3.
70 muyas leibas-mincosala?=60+10.
80 muyas leiarunca=20×4.
100 muyas leisinca=20×5.
1,000 (muyas leisala may possibly be an abbreviation for muyas leisinca sala=100×10).

Sumo (*Nicaragua*)[1]

1 asla.
2 bo.
3 bas.
4 arunca.
5 cinca (Sp.).
6 tiascoguas=5+1.
7 tiascobo=5+2.
8 tiascobas=5+3.
9 tiascoarunca=5+4.
10 salap.
11 salapminitcoguas=10+1,
12 salapminitcobo=10+2.
13 salapminitcobas=10+3.
14 salapminitcoarunca=10+4.
15 salapminitcocinca=10+5.
16 salapminitcotisaguas=10+5+1.
17 salapminitcotiascobo=10+5+2.
18 salapminitcotiascobas=10+5+3.
19 salapminitcotiascoarunca=10+5×4.
20 müyaslüy.
30 müyaslüyminitcoslap=20×10.
40 müyaslüyminitcobo=20×2.
100 müyaslüyminitcocinca=20×5.

Paya (*Honduras*)[2]

1 as.
2 poc.
3 maig.
4 ca.
5 aunqui (sp.?).
6 sera.
7 taoag.
8 oguag.
9 tais.
10 uca.
12 ucarapoc=10+2.
20 wauca.
100 ispoc.?
1,000 arcapissas.

Jicaque de Yoro (*Honduras*)[3]

1 pani.
2 mata.
3 condo.
4 diurupana.
5 comasopeni.
10 comaspu.
11 quesambopani=10+1.
12 quesambobomata=10+2.

Jicaque del Palmar (*Honduras*)[3]

1 pfani.
2 pmata.
3 abrucua.
4 urubana.
5 pevebane.
6 peve-dro.
7 ashafaffani=6+1?.
8 ashafamata=6+2.
9 ashafaabruca=6+3.
10 commeavu.

Guajiquiro (*Honduras*)[4]

1 eto.
2 pee.
3 lagua.
4 erio.
5 sai.
6 eta sai=1+5.
7 pela sai=2+5.
8 lagua sai=3+5.
9 erio sai=4+5.
10 ishish lo sai=(2×5?).
11 ishish eta sai=10+1.

[1] Alberto Membreño, Hondureñismos, p. 223. [2] Ibid., p. 231. [3] Ibid., p. 239. [4] Ibid., p. 248.

Similaton (Honduras)[1]

1 eta.
2 pe.
3 lagua.
4 herea.
5 say.
6 issis (doubtful, 10?).

Guaymi (Veraguas)[2]

1 crada (krati).
2 crobu.
3 cromo.
4 crobogo (kroboko).
5 coirigue (krorigue).
6 croti.
7 crocugu.
8 crocuo.
9 croegon (krohonkoñ).
10 crojoto.
11 crododi-cradi=10+1 (krojoto ti krati).
12 crododi-crobu=10+2 (krojoto ti krobu).
13 crododi-cromo=10+3.
14 crododi-crobogo=10+4.
20 gre.
21 grebbi-cradi=20+1.
30 grebbi-crojoto=20+10 (grebi-krojoto).
31 grebbi-crojoto-dicradi=20+10+1.
40 gregueddabu=20×2 (gregue krobu).
41 gregueddabu-dicradi=40+1.
50 gregueddabu-dicrojoto=40+10 (gregue krobu ti krojoto).
60 greguedamo=20×3 (gregue kromo).
70 greguedamo-dicrojoto=60+10 (gregue kromo ti krojoto).
80 gregueddabugo=20×4 (gregue kroboko).
90 gregueddabugo-dicrojoto=80+10 (gregue kroboko ti krojoto).
100 greguetariguie=20×5 (gregue krorigue).

Guaymi Sabanero (Panama)[3]

1 gdaite.
2 gdabogue or gdabu.
3 gdamai.
4 gdabaga or gdatare.
5 datiga or gdabaga.
6 gdaderegue or gdabo.
7 gdadugue or gdain.
8 gdaapa or gdatiga.
9 gdaica or gdatadi.
10 gdataboco=5×2 or gdatabu.
Count from 10 to 19 by adding 1, 2, etc., to 10.
20 giriete.
21 giriete-gdaite=20+1.
30 guiriete-gdataboco=20+10 (girite?).

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[1] Alberto Membreño, Hondureñismos, p. 256.

[2] A. L. Pinart, Colección de Lingüística y Etnografía Americanas, tomo IV, p. 23. The words in parentheses are from Pinart's Vocabulario Castellano-Guaymie, appendix, p. 5.

[3] A. L. Pinart, Coll. Ling. y Etnog. Am. tomo IV, pp. 52-53, and Vocabulario Castellano-Guaymie, Murire dialect, p. 48.

40 guiribogue=20×2 (giribogue?).
50 guiribogue-gdataboco=40+10.
60 girimai=20×3.
70 girimai-gdataboco=60+10.
80 giribaga=20×4.
90 giribaga-gdataboco=80+10.
100 giritiga=20×5.

Dorasque (*Panama*)[1]

1 que.
2 como.
3 calabach.
4 calacapa (calapaca?).
5 calamale.
6 catacale.
7 catacalobo.

Other lists with dialectic variations are as follow:[2]

1 kue, úmai.
2 kumat, komo, umaidos.
3 kumas, kalabac, umaitres.
4 kupaki, kalapaka.
5 kulmale.
6 kulpaka, katakala.
7 katakalobo.
10 kulmalmuk.
20 sermalmuk.

Cuna (*Panama*)[3]

1 cuenchique.
2 pocua.
3 pagua.
4 paquegua.
5 atale.
6 nercua, or nericua.
7 cublegue.
8 pabaca.
9 paquebague.
10 ambegui.
11 ambegui caca cuenchique=10+1.
12 ambegui caca pocua=10+2.
20 tulabuena.
30 tulabuena caca ambegui=20+10.
40 tulapocua=20×2.
60 tulapagua=20×3.
80 tulapaquegua=20×4.
100 tula atale=20×5.
1000 tula guana (guala?) buena.

Choco (*Panama*)[4]

1 haba, aba.
2 ome.
3 ompea.
4 kimari, kimane.
5 huasima, juasoma.
6 huasimara-ba, juasoma-aba=5+1.
7 huasimara-nome, juasoma-ome=5+2.
8 huasimara-ompea, juasoma-ompea=5+3.
9 huasimara-kumari, juasoma-kimane=5+4.
10 huasimani manima, ome juasoma=5×2 or 2×5.
11 oma juasoma aba=2×5+1.
15 ompea juasoma=3×5.
20 kimari, or kimane juasoma=4×5.

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[1] A. L. Pinart, Coll. Ling. y Etnog. Am. tom. IV, p. 52.
[2] A. L. Pinart, Vocab. Castellano-Dorasque (Chumul, Gualaca, and Changuina dialects).
[3] A. L. Pinart, Vocab. Castellano-Cuna, pp. 6–7.
[4] A. L. Pinart, Vocab. Castellano-Chocoe, pp. 2–3.

Chibcha (near Bogota, Colombia)[1]

1	ata.
2	boza.
3	mica.
4	muyhica.
5	hyzca.
6	ta.
7	cuhupca.
8	suhuza.
9	aca.
10	ubchihica.
11	qhicha ata=10+1.
12	qhicha boza=10+2.
16	qhicha ta=10+6.
20	qhicha (or complete) quihicha ubchihica; also güe and güeta (sig. "foot ten").
21	güetas asaquy ata=20+1.
22	güetas asaquy boza=20+2.
30	güetas asaquy qhicha ata? (güetas asaquy ubchihica=20+10).
40	güetas asaquy qhicha ubchihica? (güe bozas=20×2).
41	güe bozas asaquy ata=20×2+1.
60	güe bozas asaquy qhicha ubchihica? (should be güe micas=20×3).
61	güe micas asaquy ata.
100	güe hizca=20×5.
200	güe ubchihica=20×10.

There is apparently some error in the names for 30, 40, and 60. The term *asaquy* is merely to indicate addition: "*asaquy*, que quiere decir, i mas, con el nombre de las unidades." As *güe bozas asaquy ata* denotes 41, the name for 40 should be *güe bozas*=20×2, as 100 is denoted by *güe hizca*=20×5. The proper term for 30 is probably *güetas asaquy ubchihica* (or *ghicha*)=20+10.

The following is a specimen of the numerals used by the Huave (of Tehuantepec) from Burgoa, Geog. Descrip., tom. II, fol. 396, as quoted by Hubert Bancroft, Native Races.[2]

1	anoeth.	10	agax-poax.
2	izquieo.	11	agax-panoethx?
3	areux.	12	agax-pieuhx.
4	apequiu.	13	agax-par.
5	acoquiau.	14	agax-papeux.
6	anaiu.	15	agax-pacoigx.
7	ayeiu.	20	nicumaio.
8	axpecau.	30	nieumiaomcaxpo.
9	axqueyeu.	100	anoecacocmiau.

Rama (island in Bluefields lagoon)[3]

1	saiming.	4	kunkun-beiso.
2	puk-sak.	5	kwik-astar.
3	pang-sak.		

[1] E. Uricoechea, Gram., Vocab., etc., de la Lengua Chibcha.
[2] Vol. III, p. 758. There are seeming errors in this list.
[3] Brinton, American Race, p. 367.

Bribri (Talamancan tribe, Costa Rica) [1]

1	et.	5	skang.
2	but.	6	terl.
3	mnyat.	7	kugu.
4	keng, ka.	8	oschtan, pai, pa.

Brunca (Talamancan tribe, Costa Rica) [2]

1	etsik.	5	kchisskan.
2	bug.	6	teschan.
3	mang.	7	kuchk.
4	bachkan.	8	ochtan.

Carrizo (near Monclova, Coahuila) [3]

1	pequeten.	4	naiye.
2	acequeten.	5	maguele.
3	guiye.		

DISCUSSION AND COMPARISONS

Before I discuss these lists and attempt to draw conclusions from them, there is one point which deserves notice. It is this: To what extent can these number lists be considered reliable? I do not by this inquiry wish to question the veracity of any author whose works I have quoted or used, but to refer to the method by which the lists were obtained, especially the portions relating to the high numbers. Did the Maya, Aztec, and other tribes make use in actual count or computation of thousands, tens of thousands, hundreds of thousands, and even millions as given in these lists, or have they been filled out, in part, by the authors according to the systems found in vogue? That implicit reliance can be placed on the judgment and accuracy of the more recent authorities who, as is known, derived their information direct from the natives, as Stoll, Gatschet, etc., is conceded, but the lists given by these authors seldom if ever reach beyond the thousand. Most of the lists from the tribes of Mexico and Central America, which run into high numbers, are given by the early authors (chiefly Spanish) or are based on their statements. When the Mexicans spoke of *caxtol-tzontli*=15 *tzontli* (6,000); *cem-poal-xiquipilli*=20 *xiquipilli* (160,000); and *cem-poal-tzon-xiquipilli*=20 times 400 *xiquipilli* (64,000,000—see list), did they have in thought the actual numbers given as equivalents of these terms, or merely measures? When, for example, they said, "15 *tzontli*" (*tzontli* signifying bundle or package) did they intend to signify 15×400, or simply 15 bundles or packages? In other words, did the reference

[1] Adolph Uhle, in Compte Rendu Cong. Americanistes, Berlin, 1888, p. 474.
[2] Ibid., p. 475.
[3] Uhle, Die Länder am untern Rio Bravo del Norte, p. 120, quoted by Brinton, American Race, p. 93.

pass from the number to the measure? To illustrate, if we say 3 barleycorns make 1 inch; 12 inches 1 foot; 3 feet 1 yard; and 1,760 yards 1 mile, do we in speaking of 1 mile have in view the 190,080 barleycorns? When the Mexicans spoke of *xiquipilli* they alluded, according to Clavigero, to sacks or bags. He says, as above quoted, "They counted the cacao by *xiquipilli* (this, as we have before observed, was equal to 8,000), and to save the trouble of counting them when the merchandise was of great value [probably quantity] they reckoned them by sacks, every sack having been reckoned to contain 3 *xiquipilli*, or 24,000 nuts." Now, are we to suppose that in counting the sacks the number of nuts was kept in view? Did the merchant who purchased a *tzontli* of sacks (400) have in mind or purpose buying 9,600,000 nuts? This will suffice to make clear the thought intended to be presented, and will, it seems, justify the question—have the high numbers in these lists been added in accordance with the computation of the recorder, or were they in actual use among the native Mexicans?

As contact with Europeans and their decimal system for nearly four centuries has modified to a greater or less extent the original native method of counting, it is doubtful whether direct reference to the surviving natives of the present day would settle the question. The Maya *pic* has, as we have seen, been changed from 8,000 to 1,000, and the signification of other numeral terms has been changed in similar manner. Our only appeal is therefore to the native records, and here, possibly from our inability to interpret the Mexican symbols, we are limited to the Mayan codices and inscriptions. Here, however, as has been clearly shown in another paper, and as has been proved by Förstemann and Goodman, the evidence is clear that the Maya, or at least the priests or authors of the Dresden codex and the inscriptions, could and actually did carry their computations to the millions, in terms where the number element was necessarily retained, where the primary unit—in these instances the day—had to be kept in view. Of course they made use of the higher units to facilitate counting, as we do at the present day. If the Maya were capable of counting intelligently to this figure, it is not unreasonable to suppose that the more advanced among the surrounding tribes may have made similar, though possibly not so great, progress in their numerical systems. That the Mexicans had symbols for high numbers is asserted by the early historians, and is evident from their remaining codices, but no means of testing these, as the Maya manuscripts and inscriptions have been tested, has yet been found; however, the explanation of symbols carrying the count to the tens of thousands has been given.

Notwithstanding this conclusion, it is apparent that the influence of the European decimal system has been felt in some of the native counts herein given. This, for example, is probably true of the Huastecan count, where the simple term *xi* is used to denote 1,000, and also in the count from 200 to 900 in this system and in some others.

All the preceding lists showing the count from 10 upward which belong to the Mexican and Mayan groups, except that of the Tarahumari, pertain to the vigesimal system and in method of counting bear a strong general resemblance one to another, yet when they are closely examined minor differences are found which have an important bearing on the question of the origin and relationship of these systems. Of these variations we notice the following:

The Nahuatl count follows strictly the quinary-vigesimal system, as has been already stated, 5 and 15, as well as 20, being basal numbers. The count is always from a lower number, that is to say, the minor numbers are always added to a number passed; thus 41 and 42 are formed by adding 1 and 2 to 40, and not by counting the 1 and 2 on the next or third score, as we have seen was the rule among some of the Mayan tribes, as the Maya proper or Yucatec, the Quiche, Cakchiquel, Pokonchi, Quekchi, Mam, Ixil, and probably most of the southern tribes of the group, but not among the Huasteca, who formed the northern offshoot. The count of the latter, though, like the others of the Mayan group, fundamentally vigesimal to 900, is, like the Nahuatl, by additions of the minor numbers to a number passed—as 20+10 to form 30 and 2×20+10 to form 50. The numeral system of the Mayan tribes generally differed from the Nahuatl, Zapotec, Mazatec, Trike, Mixe, and Zoque systems—all of which are regularly quinary-vigesimal, and generally add the minor numbers to the preceding base—in being more nearly decimal-vigesimal, and in adding the numbers above 40 to the following base, as 1 on the third score, or third 20, to form 41. In the Mayan dialects the count is never based on 5 except, as has heretofore been suggested, from 6 to 8, and in one dialect from 6 to 9. So far, therefore, as these differences are concerned, they tend toward grouping together the systems of the Nahuatlan, Zapotecan, and Zoquean tribes, as contrasted with the Mayan; but the term Nahuatlan is used here as referring only to the stock in its limited sense—the Aztecan branch—as the rule does not hold good throughout, when we pass into the Sonoran branch. However, the grouping on these points is interesting as it is in harmony with other data.

In one peculiarity, however, the Zapotec count differs from the Nahuatl and approaches the Mayan systems. From 55–59, 75–79, and 95–99 the numbers are obtained by subtraction from the next higher base—thus, for 55 they say *ce-caa quiona* or *ce-caayo quiona;* that is, 5 from 60. For 56–59, 76–79, and 95–99 they have two methods of counting—thus for 56 they say *ce-caayo quiona-bi-tobi;* that is, 5 from

60+1, or *ce-tapa quizahachaa-cayona*, which is 4 from 60, etc. The Mazateca, Mixe, Zoque, and Trike appear to follow throughout the Nahuatl method of adding the minor numbers to the preceding base.

The Othomian, Tarascan, and Totonacan systems are similar to the Huastecan—that is to say, are decimal-vigesimal—and form the higher numerals by adding the minor numbers to the preceding base.

Extending our inquiry northward to the Sonoran and Shoshonean branches of the Nahuatlan family, we notice the gradual change to the decimal system. For example, in the Cahita count the quinary-vigesimal rule prevails; 6, 7, and 10 are based on 5; 8 on 4; 11 to 19 on 10, or, rather, twice five. From 20 upward the count is vigesimal, 10 when used retaining throughout its form of 2×5. The contact, however, in this region with the decimal system is clearly indicated by the following statement of the author of the Arte Lengua Cahita, given above: "Some nations say *senutacaua* or *sesevehere* for 20; others say for 10 *sesavehere* and follow up the count thus: 11, *sesavahere aman senu;* 12, *sesavehere aman uoi*, etc. For 20 they say *uosavehere*, which is two times 10. The Yaqui say for 5 *sesavehere*, and counting from 5 to 5 say *uosavehere*, 10 [=2×5]; *vahivehere*, 15 [=3×5]. These also say for 20 *senu tacaua* [1×20] or *naequivehere* [4×5], and for 25 *sesavehere* (this particular count is of this nation only), and for 100 say *mamnitacaua* [5×20] or *tacauvehere*, which is 20 fives." In the paragraph which follows he states in general terms that some of the tribes count by fives, others by tens, both using the same term, *vehere*, prefixing the "numeral abverbs" *sesa*, "one time," *uosa*, "two times," etc. The "nations" alluded to are probably the Cahita tribes, such as the Tehueco, Zuaque, Mayo, Yaqui, and other related or neighboring tribes.

This change in the application of a given term in closely related dialects is not only interesting, but somewhat remarkable; and added to the fact that the closely related Tarahumari of the same section use the decimal system, indicates that the latter and the vigesimal system here came into contact. Do the data furnish evidence as to which was the spreading or aggressive and which the yielding one? Without entering into a discussion of the question the following facts are presented for the benefit of those desiring to look further into this subject. The similarity of the number names of the Cahita and Tarahumari to those of the Nahuatl is too apparent to pass unobserved even by the mere cursory glance. Include the allied Opata and take for example the numbers 1 to 5 and 10, as follow:

	1	2	3	4	5	10
Opata	se	go-de	vei-de	nago	marizi	makoi
Cahita	se-nu	uoi	vahi, or bei	naequi	mamni	uo-mamni
Tarahumari	bire	oca	bei-ca	naguo	marika	makoe
Nahuatl	ce	ome	yei	naui	macuilli	matlactli

The resemblance between the names in each column, except *bire*, 1 in Tarahumari (for which Charencey says he finds the alternate *sinepi*, which would be in harmony with the others), and *uomamni* (2×5), 10 in Cahita, is at once apparent. This, however, is merely in accordance with the recognized affinity of the first three idioms with the Nahuatl. It seems, however, that we look in vain to the Nahuatl names for the *vehere* (*vehe-re*) as it can not be derived from *macuilli* (5), *matlactli* (10), or *poalli* (20), nor from the names for 5, 10, or 20 in the Opata, Cahita, or Tarahumari. The name for 20 in Opata is *uri* (*se-uri*), which signifies "man;" in Cahita, *tacaua;* in Tarahumari, *osa-macoi* (2×10). In these languages the only number name which resembles it is that for 3, which is not a divisor.

Turning to the Shoshonean group we notice the following facts. Whether they are sufficient to justify a decision on the point is very doubtful; this, however, is left for the reader to determine. The following list of the names for 2, 5, 10, and 20 is from Gatschet's Forty Vocabularies.[1]

	2	5	10	20
Southern Paiute	vay	manigi	mashu	voyha-mashu
California Paiute	voa-hay	manegi	shuvan	voaha-vanoy
Chemehuevi	vay	manuy	mashu	voyha-mashu
Takhtam	vurm?	ma-hatcham	voa-hamatch	voava-hamatch
Kauvuya	vuy	namu-kuanon	nami-tchumi	vuys-nami-tchumi
Tobikhar	ve-he	mahar	vehes-mahar	hurura-vehe

In these our term appears in exact and (supposed) modified form, but only as the name for 2 even in the composite forms. This is seen in the Tobikhar, as appears from the following list:

Tobikhar

1	pu-gu.	8	vehesh-vatcha=2×4.
2	ve-he.	9	mahar-kabya=5+4.
3	pahi.	10	vehes-mahar=2×5 (2 hands?).
4	va-tcha.	11	puku-hurura=1+10.
5	mahar.	12	vehe-hurura=2+10.
6	pa-vahe=2×3?.	20	hurura-vehe=10×2.
7	vatcha-kabya=4+3?.	30	hurura pahi=10×3.

There is an apparent leaning toward the quinary system in one or two of the dialects, but this has little bearing on the question.

When the count rises above 10 it seems that the term used to designate this number is changed. The same thing is true in regard to numbers in several other idioms of this group. It is possible that we have in this fact an indication of change from an older and more

[1] Wheeler Report, vol. VII.

purely original method of counting to one more recent. It is, in fact, doubtful whether the lists more recently obtained from the natives give throughout the true original method of counting and the ante-Columbian names. There is nothing, however, in the number names of the Shoshonean dialects above 10 to indicate any system other than the decimal.

It appears, therefore, from the data presented, that the vigesimal system prevailed in Mexico and Central America from southern Sonora to the southern boundary of Guatemala, and to some extent as far as the isthmus. There seem to have been but few, if any, tribes in this area as far south as the southern boundary of Guatemala that did not make use of this system; at least the data obtainable bear out this conclusion. North of the northern boundary of this area this system is found, according to Conant,[1] "in the northern regions of North America, in western Canada, and in northwestern United States"; however, the only examples he gives are the systems of the "Alaskan Eskimos," "Tchiglit," "Tlingit," "Nootka," and "Tsimshian." As a general rule the systems of the tribes of the western part of the United States, from the southern boundary to the Columbia river, were decimal or quinary-decimal; however, instances of the vigesimal system appear here and there in this area. As one example we call attention to the numerals of the Hūchnōn dialect of the Yukian family obtained by Mr Stephen Powers at Round Valley reservation, California, given in the preceding chapter.

That a count referring the minor numbers to the next higher base, which is, as we have seen, confined in the southern regions almost exclusively to the dialects of the more southern sections, chiefly to those of the Mayan group, should be found in California is, to say the least, interesting; however, it is not the only example from this section, as will appear. It is somewhat singular that two other idioms of the same family, the vocabularies of which are given by Mr Powers, follow the decimal instead of the vigesimal system. Other examples of this system are found south of the Columbia river, as in the Pomo dialect (Round Valley reservation, California);[2] the Tuolumne dialect (Tuolumne river, California);[3] the Konkau and Nishinam dialects,[4] and the Achomawi dialect.[5] The first, third, and fourth of these appear to refer the count to the following score, while in the last (Achomawi) it is applied to the preceding score. The Tuolumne system is somewhat doubtful, as there are but two numbers (20 and 100) on which to base a decision. According to Major Powell's classification (7th Ann. Rept. Bur. Ethnology), the Pomo are included in the

[1] Number Concept, p. 195.
[2] Powers, Tribes of California, p. 502.
[3] Gibbs, op. cit., p. 548.
[4] Powers, op. cit., p. 596.
[5] Ibid., p. 606.

Kulanapan family; the Achomawi in the Palaihnihan family, and the Konkau and Nishinam in the Pujunan family.

Without referring to other examples it may be stated in general terms that while the vigesimal system has not been found in use east of the Rocky mountains, except in Greenland and among some tribes in the northwestern cis-montane portion of British Columbia, it prevailed to a considerable extent on the Pacific slope from Mexico northward to the Arctic ocean, and it may also be added that it is found among the eastern tribes of Siberia and was the method adopted by the Aino. Conant[1] says that the Tschukschi and Aino systems are "among the best illustrations of counting by twenties that are to be found anywhere in the Old World." These have been given in the preceding chapter for comparison.

The count of the minor numbers in the Aino is based, as will be seen, on the following score, as in the Mayan group. Whether the equivalents added are correctly given is somewhat doubtful, as the proper interpretation of the name for 30 may be 10 on the second score; that for 50, 10 on the third score, etc., as we have indicated in parenthesis. In the Tschukschi the addition is to the preceding score—thus 30 is formed by adding 10 to 20.

These and additional facts of the same character tend to show that in North America the vigesimal system of counting, like some other customs, was confined almost exclusively to that area which I have in a previous work[2] designated the "Pacific section," which includes the Pacific slope north of Mexico and all of Mexico and Central America. This fact and the additional fact that the system prevails in northeastern Asia, while it is rare in other parts of that grand division, except an area in the Caucasus region, and is wanting in the Atlantic slope of North America, are interesting and of considerable importance in the study of the ethnology of our continent.

It would be interesting in this connection to inquire into the range of this numeral system in South America, but we have not the data at hand necessary for this purpose. Conant says in general terms that it prevailed in the northern and western portions of the continent, though it is known that on the Pacific slope it did not extend southward farther than the borders of Peru, where the decimal system prevailed. It appears to have been in use among the Chibchas or Muyscas, a group extending both north and south of the Isthmus. It is or was in use among some of the tribes on the Orinoco, in eastern Brazil, and in Paraguay. However, the range of the system in South America is as yet unascertained.[3]

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[1] Number Concept, p. 191.

[2] Twelfth Ann. Rep. Bur. Ethn., pp. 723-24.

[3] Professor W J McGee suggests that it may possibly hold true in a general sense that the barefoot or sandal-wearing habit accompanied the use of this system of counting.

Before proceeding I wish to quote some remarks by Conant in regard to the origin and spread of the vigesimal system, which I will then refer to.[1]

In its ordinary development the quinary system is almost sure to merge into either the decimal or the vigesimal system, and to form, with one or the other or both of these, a mixed system of counting. In Africa, Oceanica, and parts of North America, the union is almost always with the decimal scale; while in other parts of the world the quinary and the vigesimal systems have shown a decided affinity for each other. It is not to be understood that any geographical law of distribution has ever been observed which governs this, but merely that certain families of races have shown a preference for the one or the other method of counting. These families, disseminating their characteristics through their various branches, have produced certain groups of races which exhibit a well-marked tendency, here toward the decimal and there toward the vigesimal form of numeration. As far as can be ascertained, the choice of the one or the other scale is determined by no external circumstances, but depends solely on the mental characteristics of the tribes themselves. Environment does not exert any appreciable influence either. Both decimal and vigesimal numeration are found indifferently in warm and in cold countries; in fruitful and in barren lands; in maritime and in inland regions; and among highly civilized or deeply degraded peoples.

Whether or not the principal number base of any tribe is to be 20 seems to depend entirely upon a single consideration; are the fingers alone used as an aid to counting, or are both fingers and toes used? If only the fingers are employed, the resulting scale must become decimal if sufficiently extended. If use is made of the toes in addition to the fingers, the outcome must inevitably be a vigesimal system. Subordinate to either one of these the quinary may and often does appear. It is never the principal base in any extended system.

To the statement just made respecting the origin of vigesimal counting, exception may, of course, be taken. In the case of numeral scales like the Welsh, the Nahuatl, and many others where the exact meanings of the numerals can not be ascertained, no proof exists that the ancestors of these peoples ever used either finger or toe counting; and the sweeping statement that any vigesimal scale is the outgrowth of the use of these natural counters is not susceptible of proof. But so many examples are met with in which the origin is clearly of this nature that no hesitation is felt in putting the above forward as a general explanation for the existence of this kind of counting. Any other origin is difficult to reconcile with observed facts, and still more difficult to reconcile with any rational theory of number system development.

I note some facts, taken in part from the work quoted, in order that the reader may see the bearing they have on the opinions expressed in this quotation. According to the data furnished by this writer it seems that this system occurred in Europe only along the western seacoast and that almost exclusively among the Celts, the only group of the Aryan stock which seems to have used it. In Asia it has been found to any extent only in the Caucasic group and in the northeastern part of of the continent, that is, in what Brinton terms the "Arctic Group" of his Siberic branch. Not a single example is noted from the Sinitic group or from the Semitic branch. In Africa none have been reported from the Hamitic group, and but few from the negro dialects, but the latter field has been only superficially examined in this respect. Not a single

[1] Number Concept, p. 176–8.

example is noted from Polynesia or from any of the Malayan dialects. So far the data seem to agree with Conant's conclusion, but more detailed examination presents at least some exceptions.

We see the Nahuatlan family divided into two groups in this respect, the Aztecan and part of the Sonoran branches using the vigesimal system, while the Shoshonean and other divisions of the Sonoran branch follow the decimal method. Among the multiplicity of small linguistic families in California and Oregon examples of the vigesimal system occur sporadically, so far as is indicated by the still incomplete data, even occurring in one or two small tribes of a family while other tribes of the same family use the decimal system. But it is necessary to bear in mind that here, as in the Shoshonean group, the lists have been obtained after there has been long intercourse with the whites, which may have materially modified original systems. These facts are sufficient to show that ethnic lines do not always govern the range of the system.

That there is a very general agreement among students in the opinion that as a general rule the adoption of the vigesimal system results from bringing the toes as well as the fingers into the count is admitted, yet it is possible that there are more exceptions to the rule than is supposed. That every vigesimal as well as decimal system has 5 at the base, or in other words, started with the hand, may be safely assumed, and that whenever 20 is expressly or impliedly understood as the equivalent of "one man" the toes are *considered* in the count may, perhaps, also be assumed. However, there are reasons for believing that in some instances the hands alone were used in actual count, being doubled to make the whole man; yet in such cases the toes were probably originally used.

It is possible and even probable that in some cases where the numeral terms have no reference to the toes or man a change from the original name has taken place. Such a change seems to be shown in the name for 20 in the Mayan dialects. In the Huasteca, Pokonchi, Pokomam, Cakchiquel, Quiche, Uspanteca, Ixil, Aguacateca, and Mam the name for 20 is "man," while in the Maya, Tzotzil, Chañabal, Chol, and Kekchi other terms are used, but even in these (except the Maya and Chol) *vuinik*, or "man," is introduced into the terms for the multiples of 20. Even in the Mexican (Aztec), which Conant looks upon as an exception, *cempoalli* (=one 20), which signifies "1 counting," evidently refers to something so well known and so generally understood as to require no explanatory term. What else could this, the thing counted, have been than one man—the fingers and toes? Although it must be admitted that there are some systems which can not be explained in this way, yet the explanation may be accepted as generally, in fact, almost universally, applicable. Even among the Greenland Eskimo, where we would suppose Professor McGee's suggestion, given in a note above, would fail, the toes were brought into the count, as shown by the following terms:

11 achqaneq-atauseq—first foot 1.
16 achfechsaneq-atauseq—other foot 1.
20 inuk navdlucho—a man ended.

Why tribes belonging to the same well-defined, limited linguistic group and living geographically in close relation—as, for example, in the Cahita group of northwestern Mexico and one or two of the California groups—should adopt different systems, some the vigesimal and others the decimal, we are unable to answer with our present information. Before answer can be made it will be necessary to eliminate what has been derived from contact with the whites.

In concluding this topic it may be added that Conant appears to be fully justified by the data in infering that environment exerts no appreciable influence in determining the system. In the regions occupied by the Semitic, Hamitic, and Polynesian races, where we should most expect to find the vigesimal system, it is entirely unknown, while, on the contrary, it is found in the frozen regions of the north, where it would be least of all expected. As yet we are unable to assign any general influencing cause for its development.

While the chief object of this paper is an examination and discussion of the numeral systems of the Mexican and Central American tribes with special reference to their relation to the Nahuatlan and Mayan systems, another object is to bring together the data which seem to have a bearing on the questions of the origin, development, and relations of these systems. In accordance, therefore, with this object, a comparison of the names used in counting (1 to 5, 10, and 20) in a number of dialects is herewith presented. It is true that nearly all of these can be found in the preceding lists. The object of reintroducing them here is to bring the corresponding names into close contrast for convenience in comparison. They are brought together in the order of the groups, the Nahuatlan, which is the most extensive, coming first. The names in the Mayan series are so uniform that it is unnecessary to reintroduce them here.

	1. Nahuatl	2. Pipil	3. Alaguilac	4. Cahita
1	ce	ce	se	senu
2	ome	ume	umi	uoi
3	yei	yei	hei	vahi, or bei'bey
4	naui	navui	nagui	naequi
5	macuilli	macuil	makuil	mamni
10	matlactli	mahtlati	matakti	uo-mamni
20	cem-poalli	cempual	sempual	tacahua

	5. Opata	6. Tarahumari	7. Tepehuan	8. Kern River
1	se, or seni	bire, or sinepi	uma	chich
2	gode	oca, or guoca	gokado, or gaok	wah
3	veide	beica	veicado	pai
4	nago	naguo	maukao	na-nau
5	marizi	mariki	chetam	mahaichinga
10	makoi	makoe	———	umhaichinga
20	seuri	bosamacoi	———	———

	9. Pima		10. Gaitchaim		11. Shoshone (number 6)	12. Southern Paiute
1	humak	1	so-pul	1	shoui	shui
2	houak	2	vue	2	waii	vay
3	vaik	3	pahe	3	pahi	pay
4	kiik	4	vosa	4	wachoui	vatchue
5	huitas	5	mahaar	5	manek	manigi
10	wistima	7	se-ula	10	matshoui	mashu
20	ku'ko-wistima			20	wai-matshoui	voyha-mashu

	13. Chemehuevi	14. Capote Uta	15. Shoshone (number 5)	16. Comanche
1	shooy	soois	simitich	semmus
2	vay	wy-une	hwat, or wat	waha
3	pay	pi-une	pite	pahu
4	vatchue	watssu-une	watsuet	hagar-sowa?
5	manuy	manegin	managet	mawaka
10	mashu	towumsu-une	shimmer	shurmun
20	voyha-mushu	wah-massee	wam-i-no	———
				8 nahua-wachota =4×2

	17. California Paiute	18. Kauvuya	19. Kechi (San Luis)	20. Cahuillo
1	shumuue	sople	suplöh	supli
2	voahay	vuy	whii	me-wi
3	pahi	pa	paa	me-pai
4	voatsagve	vuitchiu	witcho	me-wittsu
5	manegi	namu-kuanon	nummu-quano	nome-kadnun
10	shuvan	nami-tchumi	———	nomat-sumi
20	voaha-vanoy	vuys-namitchumi	———	———

	21. Takhtam	22. Tobikhar	23. Kij	24. Kechi (S. Diego)
1	aukpeya	pugu	puku	tchoumou
2	vurm?	vehe	wehe	echyou
3	pahe	pahi	pahe	micha
4	voatcham	vatcha	watsa	paski
5	ma-hatcham	mahar	maharr	tiyerva
10	voa-hamatch	vehes-mahar	———	touymili
20	voa-va-hamatch	hurura-vehe	———	———

	25. Hopi[1]	26. Millerton	27. Tejon Pass	28. Cora
1	sukia	si-muh	pau-kup	ceaut
2	luen	wohattuh	wah	huapoa
3	payam	pait	pahai	huaeica
4	naleem	watsukit	watsa	moacoa
5	tcivo	malokit	mahats	amauri
10	pakte	se-wanu	we-mahat	tamoamata
20	shuna-tu	———	———	———

	29. Zapotec	30. Mixtec	31. Chuchon	31. Popoloca
1	tobi, or chaga	ec (ce?)	ngu	gou
2	topa, or cato	wui	yuu	yuu
3	chona, or cayo	uni	ni, or nyi	nii
4	tapa, or taa	gmi, or kmi	ñuu	noo
5	caayo, or gayo	hoho	nau	nag-hou
10	chii	usi	te′	tie
20	cal le	———	———	kaa
		11 usi-ce		

	32. Trike	33. Mazateca	34. Zoque	35. Mixe
1	ngo	gu	tuma	tuuc
2	nghui	ho	metza	metsk
3	guañânha	ha	tucay	tukok
4	kaha	ni-ku	macscuy	maktash
5	huhûha	û	masay, or mosay	mo′koshk
10	chia	te	macay	makh, or mahc
20	hikoo, or kooha	kâ	yps, or ips	ypx

[1] Furnished by Dr J. W. Fewkes.

	36. Pupuluca (Tepeaca)	37. Othomi	38. Pirinda	39. Tarasco
1	tuub	n'nra, or ra	yndahhuy	ma
2	mesko	yoho	ynahuy	tziman
3	tuo	hiu	ynyuhu	tanimu
4	maktaxko	gooho	yncunohuy	tamu
5	mokoxko	kuta, or qyta.	yncuthaa	yumu
10	mako	reta	yndahatta	temben
20	ipxe	n-rahte	yndohonta	macquatze

	40. Totonaca	41. Sinacanta	42. Jutiapa	43. Cabecar
1	tum	ica	ical	estaba
2	tuyun	ti	piar	bocteba
3	tutu	uala	guarar	mañalegui
4	tati	hiria	iriar	quetovo
5	kitsiz	puh	puhar	exquetegu
10	kau, or cauh	pakil	paquilar	dope
20	———	———	———	ynste

	44. Viceyta	45. Lean y mulia	46. Terrava	47. Mosquito
1	etabageme	pani	krara	kumi
2	butteba	matiaa	krowü	wal
3	mañac	contias	krommia	niupa
4	quiet	chiquitia	krobking	walwal
5	exquetegu	cumasopni	kraschkingde	matasip
10	dop	comassopnas	dwowdeh	matawalsip
20	ynste	comascoapssub	zac-vbu	———

Although the first twenty-eight lists in this series, which are from idioms of the Nahuatlan stock, might possibly be arranged in a more systematic order as to terms, yet a careful study will suffice to detect the links by which they appear to be connected, thus agreeing with the conclusion of the linguists in regard to the relationship of the different groups of this great family. The terms for 2 and 3 appear to be the most persistent, especially the latter term, which shows but slight variation, except in the Kechi (San Diego) and Cora dialects. While the differences between the names in this family and the others represented in the series is too clearly marked to be overlooked, corresponding in this respect with the decision of the linguists in regard to the family distinctions, we notice here and there slight indications of the influence of intercourse.

Numbers 44 to 48, which pertain to the extreme southern dialects, are added merely for the purpose of comparison. The first four (44 to 47), are classed with the Chibcha stock, among which the vigesimal system prevailed.

In the tribes from the Mexican boundary northward, with the exception of those pertaining to the Nahuatlan group, most of which have been noticed, we find nothing in the numerals, so far as the data at hand show, to indicate any relationship other than that in accordance with the linguistic classification proposed by Major J. W. Powell. An apparent approach to the names in some of the Shoshonean dialects can be noticed in the Konkau, Nishinam, and Nakum dialects heretofore given.

The count in two of these idioms is, as has been already mentioned, in part, at least, vigesimal. Compare the Nakum list with that of Shoshone (number 5). These tribes are included in Major Powell's classification in his Pujunan family. The determination whether such resemblances are real or only apparent must be left to the linguists; I have included them merely as material for comparison.

Before closing this chapter attention is called to one point which, so far as I am aware, has not been discussed, but in regard to which I must acknowledge inability to offer an entirely satisfactory explanation.

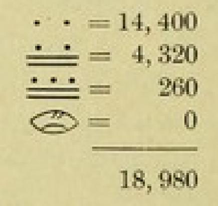
As has been shown in my paper on the calendar systems, and by the evidence presented by Dr Förstemann and Mr Goodman, the Mayan priests, or at least the authors of the Dresden codex and the Mayan inscriptions, did actually perform computations reaching into the millions, where the primary unit had necessarily to be retained, that is, could not be lost in higher units considered as measures. To illustrate: Take the following time count actually found in one of the Central American inscriptions: 8 cycles+14 katuns+3 ahaus+1 month+12 days, to the day 1 Eb, the 5th day of the month Zac. As 1 cycle equals 20 katuns, 1 katun equals 20 ahaus, 1 ahau equals 18 months, and 1 month equals 20 days, we can find by calculation that 1 cycle=144,000 days, 1 katun=7,200 days, and 1 ahau=360 days, and that the 8 cycles, 14 katuns, 3 ahaus, 1 month, and 12 days added together equal 1,253,912 days. The reader is familiar with the methods necessary to make this and all such computations. How did the Maya scribe or priest accomplish it? As a particular day was to be reached and there were numbers in each order of units, and the total had to be transferred into years of 365 days each, and the surplus months and days ascertained, it is apparent that it was necessary to reduce the whole to primary units—that is, to days—and then ascertain by division or in some other way, how many even years were contained therein, and how many months and days would be contained in the overplus.

That they had time tables by which they could compute intervals of moderate length, as the day series in the Codex Cortesianus, which could be used as the Mexican Tonalamatl, is well known; we can use them to-day for that purpose. It would seem also from the four plates in the Dresden codex, and four in the Troano codex, showing the four year series, that they also had tables by which to count year intervals, but there are no indications of tables to aid in the reduction of the higher orders of units—cycles, katuns, etc. In the Mexican manuscripts, as will be seen in the following chapter, the number of *tzontli* (400 each) and *xiquipilli* (8,000 each)—the highest counts discovered therein—were indicated simply by repeating the symbols, but the Maya had reached the art of numbering their symbols. Now, it is apparent that the latter must have had some method of computation where such high numbers as those indicated were involved. This was necessary even to ascertain the number of days in a cycle or katun, and when several of these and of each of the lower units were to be reduced to primary units, or days, and these to be changed into years, months, and days, and the commencing and ending dates determined, the count would seem to transcend the power of simple mental computation. How then was this accomplished? It would seem, therefore, that they must have had some way of making these lengthy calculations other than counting "in the head;" but what it was we have no means of determining.

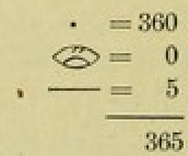
There would seem to be no doubt that they had a way of "ciphering"—to use a schoolboy term—and this appears to be confirmed by Landa, who, speaking of their method of counting, says:

> Que su cuenta es de v en v, hasta xx, y 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 cacao. Tienen otras cuentas muy largas, y que las protienden *in infinitum*, contandolas VIII mil XX vezes que son C y LX mil, y tornando a XX duplican estas ciento y LX mil, y despues yrlo assi XX duplicando hasta que hazen un incontable numero: cuentan en el suelo o cosa llana.

The last phrase, "cuentan en el suelo o cosa llana," indicates the manner in which they made their calculations, to wit, on the ground or on some flat or smooth thing. Brassuer translates the sentence thus: "Leurs comptes se font sur le sol, ou une chose plane." This certainly indicates "figuring" or performing calculations by marking on a smooth surface. Although multiplication and division seem impossible with their symbols, it is possible, as Professor McGee suggests to me, that they reached the desired result by repeated additions and subtractions. These operations may be readily performed with the ordinary number symbols (dots and short lines), the orders of units being indicated by position, as in the Dresden codex. The chief difficulty would be to change the sum of units into years. This, when the number was large, must have been accomplished by means of what Goodman calls the "calendar round" or 52-year period, for which they had a specific symbol, though not of the ordinary form. The sum (18,980) could be expressed thus:



By using this form and subtracting until the given sum should be reduced below 18,980 the number of subtractions would indicate the number of 52-year periods. The years could be obtained in the same way by repeated subtractions from the overplus with the ordinary symbols, thus:



Whether this was the method followed I can not say, but it is certain that the desired result could be obtained in this way. Nevertheless, this method of changing high series, reaching into millions of years, must have been very tedious, unless there was some way of shortening the process. I may, however, have more to say on this subject in a subsequent paper, in which I propose to discuss the Quirigua inscriptions.

NUMBERS IN THE MEXICAN CODICES

The data relating to the use of numbers in the Mexican codices, so far as we are as yet able to interpret the symbols, are meager compared with those relating to numbers in the Mayan codices and inscriptions. We lack also in this investigation the means of demonstration in regard to the higher numbers, being limited in this respect to the statements of historians and the interpreters of the Mendoza and Vatican codices. However before proceeding with the examination of the codices, it is necessary to refer briefly to certain facts in regard to the Mexican time system.

This system is, as is well known and as I have shown in a previous paper,[1] like that of the Maya, except in the names of the days and months and in the symbols used to represent them. As there will be occasion to refer to these in discussing the numbers in the Mexican codices they are for the convenience of the reader given here. A condensed calendar like that used in discussing Mayan dates in our previous paper is also given.

[1] Notes on certain Mayan and Mexican Manuscripts, in Third Ann. Rep. Bur. Eth.

The days as represented in the codices when placed in regular succession are as shown in table 1.

TABLE 1

1	Cipactli.	11	Ozomatli.
2	Ehecatl.	12	Malinalli.
3	*Calli.*	13	*Acatl.*
4	Cuetzpallin.	14	Ocelotl.
5	Coatl.	15	Quauhtli.
6	Miquiztli.	16	Cozcaquauhtli.
7	Mazatl.	17	Ollin.
8	*Tochtli.*	18	*Tecpatl.*
9	Atl.	19	Quiahiutl.
10	Itzcuintli.	20	Xochitl.

In attempting to form a condensed calendar for the Mexican system difficulties are met with which do not arise in forming one for the Mayan system. There can be no question that the year-bearers or dominical days were Tochtli, the rabbit; Acatl, the reed; Tecpatl, the flint or flint knife, and Calli, the house; but were these the first days of the years? Gemelli Carreri[1] says that the year Tochtli began with the day Cipactli, Acatl with Miquiztli, Tecpatl with Ozomatli, and Calli with Cozcaquauhtli, in which he is supported by Clavigero,[2] while Boturini and Veytia declare that they began with the dominical days. As the latter method appears to be the natural one, and is that adopted by Miss Nuttall[3] after a somewhat careful examination of the subject, I shall follow it. My condensed calendar will therefore be as shown in table 2.

[1] Churchill's Voyages, vol. IV, p. 492.
[2] Hist. Mexico, Cullen's Transl., vol. I, p. 292.
[3] Notes on the Ancient Mexican Calendar System, p. 5.

TABLE 2

Tochtli years	Acatl years	Tecpatl years	Calli years													
Tochtli	Acatl	Tecpatl	Calli	1	8	2	9	3	10	4	11	5	12	6	13	7
Atl	Ocelotl	Quiahuitl	Cuetzpallin	2	9	3	10	4	11	5	12	6	13	7	1	8
Itzcuintli	Quauhtli	Xochitl	Coatl	3	10	4	11	5	12	6	13	7	1	8	2	9
Ozomatli	Cozcaquauhtli	Cipactli	Miquiztli	4	11	5	12	6	13	7	1	8	2	9	3	10
Malinalli	Ollin	Ehecatl	Mazatl	5	12	6	13	7	1	8	2	9	3	10	4	11
Acatl	Tecpatl	Calli	Tochtli	6	13	7	1	8	2	9	3	10	4	11	5	12
Ocelotl	Quiahuitl	Cuetzpallin	Atl	7	1	8	2	9	3	10	4	11	5	12	6	13
Quauhtli	Xochitl	Coatl	Itzcuintli	8	2	9	3	10	4	11	5	12	6	13	7	1
Cozcaquauhtli	Cipactli	Miquiztli	Ozomatli	9	3	10	4	11	5	12	6	13	7	1	8	2
Ollin	Ehecatl	Mazatl	Malinalli	10	4	11	5	12	6	13	7	1	8	2	9	3
Tecpatl	Calli	Tochtli	Acatl	11	5	12	6	13	7	1	8	2	9	3	10	4
Quiahuitl	Cuetzpallin	Atl	Ocelotl	12	6	13	7	1	8	2	9	3	10	4	11	5
Xochitl	Coatl	Itzcuintli	Quauhtli	13	7	1	8	2	9	3	10	4	11	5	12	6
Cipactli	Miquiztli	Ozomatli	Cozcaquauhtli	1	8	2	9	3	10	4	11	5	12	6	13	7
Ehecatl	Mazatl	Malinalli	Ollin	2	9	3	10	4	11	5	12	6	13	7	1	8
Calli	Tochtli	Acatl	Tecpatl	3	10	4	11	5	12	6	13	7	1	8	2	9
Cuetzpallin	Atl	Ocelotl	Quiahuitl	4	11	5	12	6	13	7	1	8	2	9	3	10
Coatl	Itzcuintli	Quauhtli	Xochitl	5	12	6	13	7	1	8	2	9	3	10	4	11
Miquiztli	Ozomatli	Cozcaquauhtli	Cipactli	6	13	7	1	8	2	9	3	10	4	11	5	12
Mazatl	Malinalli	Ollin	Ehecatl	7	1	8	2	9	3	10	4	11	5	12	6	13

The symbols of the days are shown in figure 23, which is a photo-engraved copy from plates 51–52 of the Vatican codex B. The names in English of those in the four columns 8–11 as they stand in the figure are as follow:

Column 8	Column 9	Column 10	Column 11
Water	Dog	Monkey	Grass
Movement	Flint	Rain	Flower
Snake	Death	Deer	Rabbit
Cane	Tiger	Eagle	Vulture
Dragon	Wind	House	Lizard

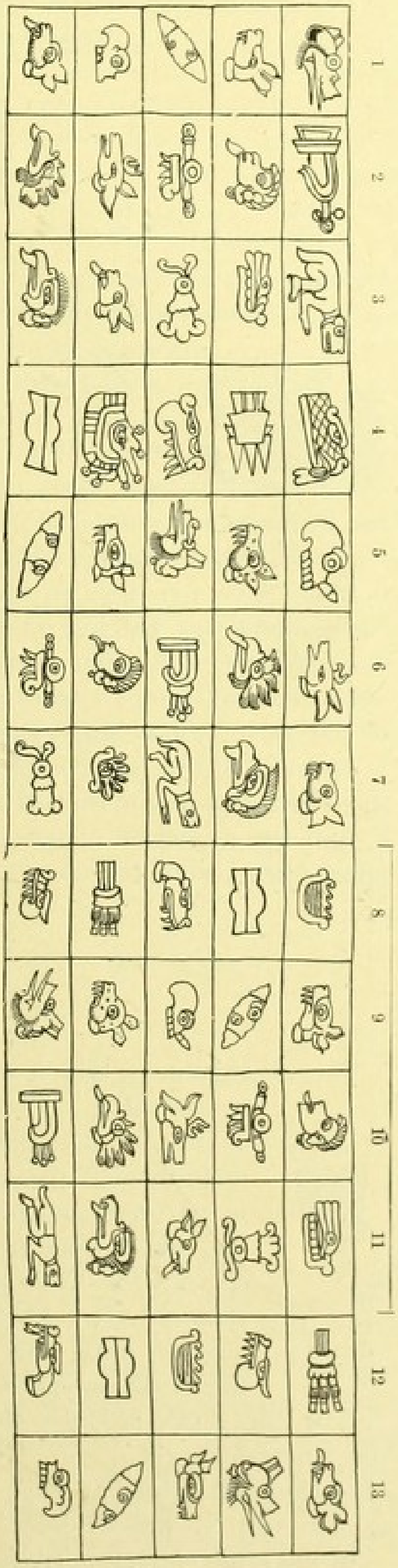
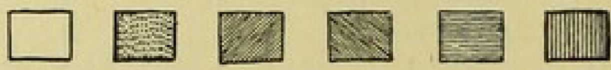


Fig. 23—Symbols of the Mexican days.

The symbol for water is oftener in the form shown in figure 24, and that for house in the form shown in figure 25. As the numerous plates of the codices to which reference will be made can not be copied here, these will enable the reader who is not already familiar with the subject, but who has the codices (at least as given in Kingsborough) before him, to follow my references. As the names of the Mexican months will not be used in this paper, it is not necessary to give them here. We shall have occasion to note particularly the direction in which the plates of the codices referred to are to be read, as the determination of this is the most important result obtained by an examination of the numerals, especially in cases where the order of the days fails us in this respect.

As a rule which has few if any exceptions, numbers which refer to time counts in the Mexican codices are expressed by dots, or sometimes small circles, usually colored, and never running higher, so far as has yet been determined, than 26. Their use is seen on plates 17–56 of the Vatican Codex number 3738



1 2 3 4 5 6

Color scheme used in figures 24–40.

1, yellow and white; 2, brown; 3, drab; 4, green; 5, blue; 6, red.

and in other similar counts. Here they are used to number the days in regular succession, beginning with 1 Cipactli, 2 Ehecatl, 3 Calli, etc., counting to 13, and then commencing again with 1, etc., as was the rule in the Mayan day-count. As the series on the pages referred to (the order being from left to right) runs through two hundred and sixty days, or twenty thirteens, the Mexican method of numbering days is clearly and distinctly shown. In this series two plates are allowed to each thirteen days, five days on the first (plate 17) and eight on the second (plate 18), five on the third, eight on the fourth, etc. Why this division into 5 and 8, when 6 and 7 is the usual method, is not apparent unless it was best adapted to the size of the original page, or was to introduce the 5. It is possible the latter explanation is the correct one, as the eight days are arranged in a line of 5 and column of 3, and the numerals above 5 are, with but two or three apparently accidental exceptions, arranged with reference to 5, thus:

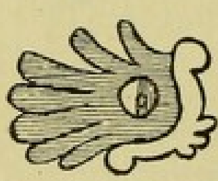


Fig. 24—Symbol for Atl (water).

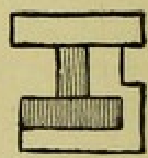


Fig. 25—Symbol for Calli (house).

6	10 . . . .
7	11 . . . .
8	12 . . . .
9	13 . . . .

This arrangement, which would seem to be merely for convenience in counting rather than for any mystic purpose, is not found in the Borgian or Bodleian codices, which are undoubtedly pre-Columbian, while the Vatican (3738) is, in part at least, post-Columbian. The numerals are, as is general in the codices, of different colors; for example, 1, the first of the series referred to, is green, the next (2) is yellow, the next (3) blue, the next (4) red, the fifth green, the sixth, seventh, and eighth red, the ninth yellow, the tenth red, the eleventh blue, the twelfth red, the thirteenth green, etc. The color no doubt had a signification understood at least by the priests, but which there is, so far as is known, no way of determining at this day.

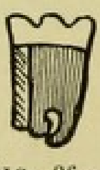
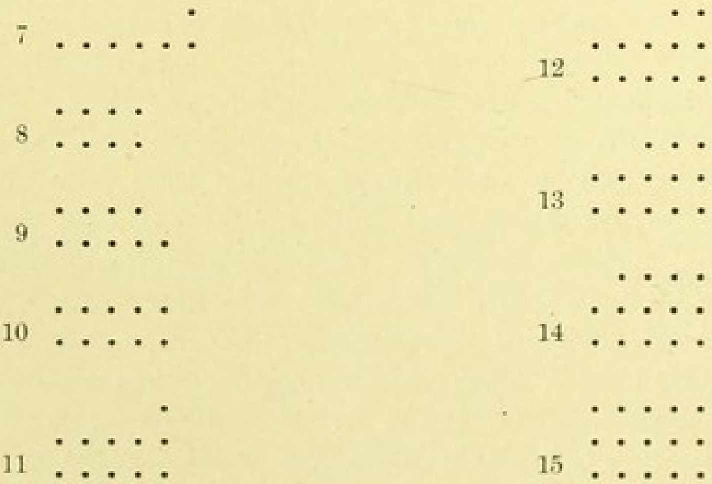


Fig. 26—Symbol for Itzquintli (dog).

Fig. 27—Symbol for Ocelotl (tiger).

In the same codex, on plates 91, 92, and 93 and those which follow, we see the years indicated by the symbols for Tochtli, Acatl, Tecpatl, and Calli, and numbered in regular succession. Here, as in case of the days, the numbering is from 1 to 13, this order being repeated throughout. There is in this series one continuous stretch of 208 (=4×52) years without a single break in the order of the years or of the numbers. We have in this fact proof not only that the years were numbered as in the Mayan calendar, and were of the same length, the 365 being completed by the addition of five days at the end, as was stated by the early writers (for only in this way can this succession be accounted for), but also presumptive evidence, although not positive proof, that there was no provision for bissextile years, unless it was made by counting unnumbered and unnamed days. As the years are numbered from the day numbers as they come in regular succession, there could be no additional numbered and named days without making a jog in the numbering of the years. The assumption that there were added days which were neither named nor numbered is a mere supposition based on the seeming need of them; there appears to be no proof of it in the codices.

On plates 59–62 of the Mendoza codex we find numerals used to state the different ages of youth from 3 to 15. These are given by the little circles already described, all of them in this instance being blue. From 3 to 6 they are placed in single straight lines. The other numbers are given thus:



While there are indications of the tendency to count by fives, it seems a little strange that the arrangement of the dots in 7 and 8 should have varied from this rule. Attention is called to these seemingly unimportant points in view of what has been said in the preceding part of this paper in reference to the Mexican method of counting as indicated by the names of their numerals. In the lists of years on the first seven plates of this codex the numbers above 5 are arranged in almost every instance by fives or with regard to 5. However, it is necessary to bear in mind that most, if not all, of this codex is post-Columbian, an explanation of it having been made by native priests and turned into Spanish for the use of the Emperor Charles V. It must be admitted, however, that very slight, if any, indications of European contact are to be found in it.

Turning now to the Fejervary codex, to plates 22, 21, 20, etc., to 13 (taking them backward as paged), we find the method of counting from day to day, and thereby the order in which the days are to be taken. As the colored figures can not be introduced here, Arabic numbers are substituted for the dots or little circles, and the day names, for the symbols. The relation one to another in which they stand on the plates is maintained. The pages are given in the order of the numbering, but are to be read in the opposite direction, beginning with 22.

Plate 13

Upper line: Xochitl, Quiahuitl, Tecpatl. 3 Ocelotl.
Lower line: 23 Tochtli. 13 Ocelotl.

Plate 14

Upper line: 3 Itzquintli. 3 Miquiztli.
Lower line: 12 Cipactli. 9 Ozomatli.

Plate 15

Upper line: 2 Calli. 1 Cipactli.
Lower line: 10 Xochitl. 7 Malinalli.

Plate 16

Upper line: 3 Ollin. 3 Acatl.
Lower line: 7 (?) 10 (?)

Plate 17

Upper line: 3 Atl. 3 Coatl. 3 Cipactli.
Lower line: 8 (?) 9 (?)

Plate 18

Upper line: 3 Ollin. 3 Acatl. 3 Atl.
Lower line: 6 (?) 5 (?)

Plate 19

Upper line: 3 Coatl. 3 Cipactli. 3 Ollin.
Lower line: 6 Atl, Coatl, Ollin, Acatl, Cipactli.

Plate 20

Upper line: 3 Acatl. 3 Atl. 3 Coatl.
Lower line: (?) 7 Acatl.

Plate 21

Upper line: 3 Cipactli. 3 Ollin. 3 Acatl.
Lower line: 4 Tochtli. 2 Coatl. 4 Xochitl. 2 Ollin.

PLATE 22

Upper line:	3	Atl.	3	Coatl.	3	Cipactli.		
Lower line:	4	Malinalli.	2	Atl.	4	Cuetzpallin.	2	Cipactli.

In counting in this case the numbers are to be understood as indicating the intervening days, and do not include either the day counted from or the day reached. The "lower lines" are throughout independent and not connected with the "upper lines." Commencing with Cipactli at the right of the lower line of plate 22, and referring to table 1 for the list of the days, we see that counting forward—that is, passing over—two days we reach Cuetzpallin; passing over four more we come to Atl; passing over two more brings us to Malinalli, and four more to Ollin, which is found at the right of the lower line of plate 21; and so we reach Acatl, the right of the lower line of plate 20. Counting 7 from the last brings us to Cipactli. As the count here ends with Xochitl, the last of the twenty days, this series may end here, or may pass to Cipactli. However, as there are no day symbols to guide us until we get back to plate 15, where we find 7 Malinalli at the right, we begin again with this day.

Passing over seven days from Malinalli we reach Xochitl; passing over ten more we reach Ozomatli, at the right of the lower line of plate 14. Passing over nine more we come to Cipactli; twelve more bring us to Ocelotl, at the right of the lower line of plate 13; thirteen more to Tochtli; twenty-three more would bring us to Malinalli, but the day is not found, as the series appears to end here. Possibly we go back, as is a common rule in the Troano codex, to the first date; if so, Malinalli, on plate 15, begins a second series. This is probably the true method, as adding together the counters and the days represented by symbols gives eighty, just four twenties. It is probable that the same rule applies to the first series, beginning with Cipactli (plate 22) and ending with 7 Acatl (plate 20), as the counters and days added together make forty, or two twenties.

Taking now the upper line, beginning with 3 Cipactli at the right (plate 22), we pass over three days, which brings us to Coatl, three more to Atl, and so on by threes to Ollin at the left of plate 16; three days more bring us to Cipactli, but whether to the beginning or to 1 Cipactli at the right of the upper line of plate 15 is a question. However, as the number of days counted up to this point is 80, or four twenties, and a new series begins in the lower line with Malinalli at the right of plate 15, it is most likely a new series begins here with Cipactli in the upper line. This supposition appears to be confirmed by the fact that to Xochitl at the left of the upper line of plate 13 is just twenty days.

No attempt will be made at this point to explain the figures connected with these day and numeral series, the only object in view at present being to illustrate the use of the numerals and thereby to show the direction in which the plates are to be read. It is clear that in this case they are to be read from right to left; that is, in a reverse order to the paging.

We turn next to plates 11 and 12 of the same codex. Here, as in the preceding illustrations, the series of counters and days are placed in two lines, an upper and a lower; however, the numbers in the lower, apparently because of the want of space, are not placed in connection with the day symbols, but by the side of the larger figures. In each section of the lower line are five day symbols; for convenience I have placed the names in columns, the top one corresponding with the symbol at the left in the plate.

PLATE 11

Upper line:	4	Malinalli.	4	Mazatl.
Lower line:	12	Tochtli. Cozcaquauhtli. Cuetzpallin. Malinalli. Xochitl.	12	Quauhtli. Calli. Ozomatli. Quiahiutl. Mazatl.

PLATE 12

Upper line:	4	Ehecatl.	4	Ollin.
Lower line:	12	Ehecatl. Itzcuintli. Tecpatl. Miquiztli. Ocelotl.	12	Atl. Ollin. Coatl. Acatl. Cipactli.

Commencing with Cipactli at the right of the lower line of plate 12, we go backward (upward as given in the list above) to Atl, then to Ocelotl and back (up) to Ehecatl, thence to Mazatl, right of lower line, plate 11, and so on to Tochtli. We begin the upper line with 4 Ollin, at the right of plate 12. Passing over four days we reach Ehecatl; four days more bring us to Mazatl, upper line, plate 11; four more to Malinalli, and four more back to Ollin, thus covering twenty days. The Ollin symbol of this series (plate 12) is immediately under the blue sitting figure; Mazatl, or Deer (plate 9, upper line) is represented by the foot or lower portion of the leg of a deer. This proves that the reading is from right to left and from the bottom upward as in the preceding plates. It also enables us to determine positively the unusual Mazatl symbol.

The days in the lower line are arranged five to a section, after the manner explained in a previous paper.[1] Commencing with Cipactli, at the right (bottom in our list) of plate 12, we count or pass over twelve days and reach Ocelotl, the day at the right (bottom) of the left series of the same plate; twelve more bring us to Mazatl, right

[1] Notes on Certain Maya and Mexican Manuscripts, in the Third Annual Report of the Bureau of Ethnology.

of plate 11; and twelve more to Xochitl, right of the left series, same plate; counting twelve more brings us to Acatl. As this makes no connection, let us try another method: Counting from Atl, the left (upper) name of the right series of plate 12, we reach Ehecatl, left (upper) name of the left series, same plate; twelve more to Quauhtli, left (upper) name of the right series of plate 11; twelve more to Tochtli, left (upper) name of the left series, same plate; and twelve more to Cipactli, the beginning. This proves that the reading is to the left and upward, and that from a day in one section to the corresponding day in the next section an interval of twelve days is to be reckoned.

The arrangement on plates 5 to 10 (inclusive) is the same, except that the days in the upper line follow one another in regular order without any interval and that the counters belonging to the lower line vary. The movement here is backward, as before. By this series, counting as indicated, we are enabled to determine that the unusual symbol (figure 4) on plate 6 is that of the day Itzcuintli, and the symbol (figure 5), same plate, is that for the day Ocelotl. Plate 5 appears to be connected backward with plates 4, 3, and 2 by the lower series, column to the right. The counter in the lower half of plate 5 is 9, and the lowest day of the column at the right is Cipactli. Counting nine intermediate days from this brings us to Ozomatli, the first or lowest day of the column in the lower half of plate 4; the counter here is 3, and passing over this number of days brings us to Quauhtli, lowest day of plate 3; here the counter is 16, which carries us to Malinalli, lowest day in plate 2, and eight days more to Cipactli, the commencement.

This lower series of plates 10 to 2 (inclusive) if to be considered as one, embraces one hundred and four days, not an even twenty, but exactly eight thirteens.

The upper series of plates 4 and 3 has five days to each section arranged in the same manner as the column in the lower half. The counters here are small black dots, 12 to each section. Counting this number from Cipactli, the day at the right of the right-hand section of plate 4, brings us to Ocelotl, right of left section; twelve more to Mazatl, etc.

The dots or little circles used as counters in this codex are, with the exception just named, colored blue, red, green, and yellow, those of different colors being found in almost every number. There is no tendency shown to arrange by fives, though plates 23 to 40 (inclusive) are largely filled with number symbols, short black lines (fives) and dots, as in the Mayan writings. So far I have been unable to determine the use of these numbers in the connection they are found.

Vatican codex—Plates 81 to 90 of this codex (Kingsborough, vol. III) are, as is shown by the numbers and day symbols, to be read as follow: The upper line, containing day symbols each followed by the counter 3, in regular succession from left to right throughout; the lower, where the numbers are unaccompanied by day symbols, from right to left, beginning on plate 90 with the number 2, to plate 81, where the number is 26. The upper line is simple and easily followed, and, counting the days, embraces four twenties. To what the numbers in the lower line—which follow in regular succession, 2, 3, 4, etc.—refer is as yet unknown, though it seems they have some relation to 13; and why they begin with 2 is also without satisfactory explanation.

Plates 91 to 96 are to be taken from left to right, according to the paging. The counters in the middle express the intervals between the left-hand day of the lower line of one plate and the left-hand day of the lower line of the next plate, etc. The same is true also of plates 72 to 75.

Borgian codex—As the only object in view at present is to illustrate the use of numbers in the Mexican codices, and not to introduce attempted explanations of the figures, I give a few illustrations from the Borgian codex, which is probably the oldest of the existing Nahuatl manuscripts. Neither in this nor in the two last codices to which I have referred does there appear to be any indication of a tendency to arrange the counters in groups of 5. Where it is practicable—that is, where the number is not too great—they are placed in a single straight row, but the arrangement is governed by the space.

We turn to plates 18 to 21. Here the pages are arranged in two divisions, an upper and lower, each having a row of day symbols running along its lower edge; in the upper division the large red counters are placed in a column at the right of each page, and in the lower at the left. With two exceptions (upper divisions of plates 20 and 21) there are six counters in each column; in the exceptions there are 4 in a column. Starting with Cipactli, right of lower division plate 21, passing over six days we reach Tochtli, at the right of the lower division of plate 20, and so on to Ehecatl, at the right of the lower division of plate 18. Counting six more takes us to Atl, at the left of the upper division of plate 18; six more to Cozcaquauhtli, left of the upper division, plate 19; six more to Calli, plate 20, and four more to Tochtli, left of the upper division of plate 21. Counting four days from Cozcaquauhtli to the last day of the upper division of this plate brings us back to Cipactli, the beginning, the sum of the days being 52, or 4×13.

The 12 large red counters in the upper division of plate 17 express the number of intervening days between a day of the right section and a corresponding day of the left section, the counting being always forward in the calendar. The red counters on plate 58 indicate the interval between the corresponding days of the different sections in the order in which they follow one another. Commencing with the right section of the lowest division, the movement is to the left up to the middle division, then to the right up to the upper division, and then to the left. The 12 large red counters of plate 59 denote the interval between the days of the two columns, commencing with Cipactli in the lower right-hand corner, and passing to the lower day in the left column, to the second (next to the lower) in the right column, to the second in the left, and so on throughout. The 12 red counters (plates 63 to 65) denote the intervals between the corresponding days in the lower line of the pages in the order in which they follow one another; that is, from right to left, beginning with plate 65. But in this instance the count includes the beginning or ending day.

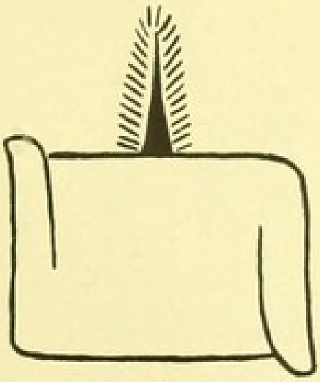


Fig. 28—Symbol for 400. Mendoza codex, plate 20, figure 16.

This will suffice to illustrate the use of the counters in the Mexican codices in connection with days, so far as it has been ascertained.

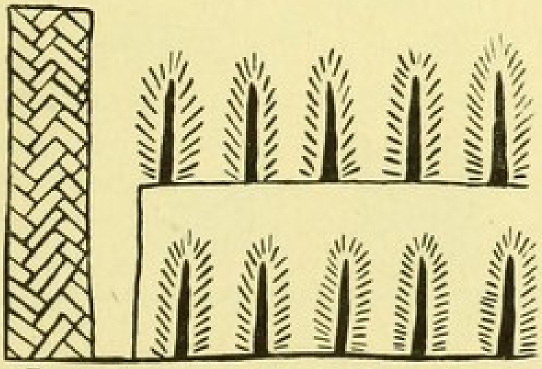


Fig. 29—Symbol for 4,000. Mendoza codex, plate 28, figure 24.

The higher numbers are represented in the Mexican codices by a different class of symbols from those which have been noticed, but for the explanation of these we have to rely wholly upon the interpretations made by early Spanish authorities and based upon the statements of native priests. The first to which reference will be made are found in the Mendoza codex, in Kingsborough, vol. I, the original Spanish explanations being given in volume 5 of the same work. As the different symbols for these higher numbers are not numerous, it will only be necessary to present a sufficient number of examples to illustrate the forms of the symbols and their use.

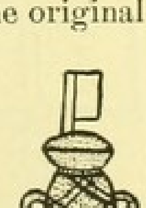


Fig. 30—Symbol for 20 jars of honey. Mendoza codex, plate 38, figure 21.

Mendoza codex—Plate 20, figure 16, shown in our figure 28, is interpreted 400 loads of great mantles, the number symbol being the fringed spike or leaf on top.

Plate 28, figure 24, shown in our figure 29, is interpreted 4,000. This is correct, counting each spike as 400.

Plate 38, figure 21 (our figure 30), is interpreted 20 jars of honey.

Plate 39, figure 20 (our figure 31), is interpreted 100 (that is, 5 × 20) hatchets of copper.

Plate 19, figure 2 (our figure 32), is interpreted 20 baskets of ground cacao ("cestos de cacao molido"); but it is evident that the number indicated by the symbols is 20×400×4 or 32,000. The reference therefore is to the grains or beans, each basket containing, or supposed to contain, 4×400 or 1,600 grains or beans.

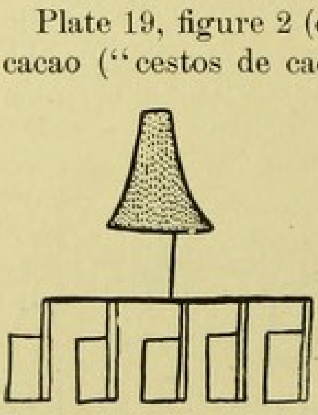


FIG. 31—Symbol for 100 hatchets. Mendoza codex, plate 39, figure 20.

Plate 19, figures 10, 11, 12, 13 is our figure 33: These four vari-colored circles, which are spoken of in the interpretation as flowers or as flower like, denote 80 days, each circle indicating 20 days.

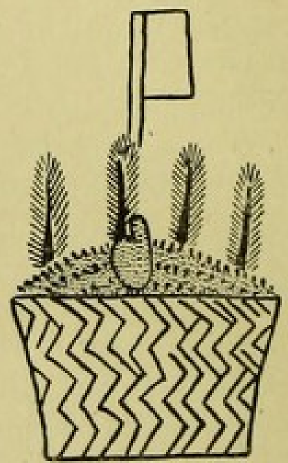


FIG. 32—Symbol for 20 baskets. Mendoza codex, plate 19, fig. 2.

Plate 25, figure 11 (our figure 34) is interpreted 8,000 sheets of paper of the country ("pliegos de papal de tierra"). The reticule-shaped figure is the number symbol; this is evident from the next example.

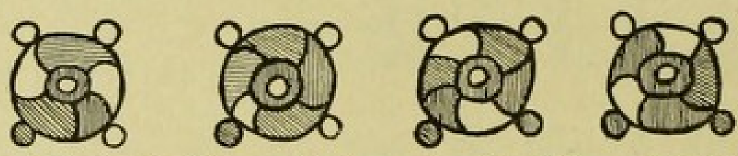


FIG. 33—Symbols for 20 days. Mendoza codex, plate 19, figures 10, 11, 12, 13.

Plate 38, figure 35 (our figure 35) is interpreted 8,000 pellets of copal for refining, wrapped in palm leaves.

Plate 44, figure 34 (our figure 36) is interpreted 200 *cacaxtles* ("sorte de crochet en bois pour porter des fardeaux," Siméon); I would explain it as a hand barrow! It is doubtful whether there is any numerical symbol here.

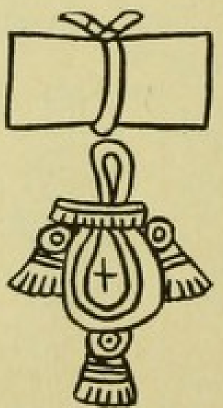


FIG. 34—Symbol for 8,000 sheets paper. Mendoza codex, plate 25, figure 11.

Codex Telleriano-Remensis plate 25 (Kingsborough, vol. I; explanation, vol. V). The figure in the lower left-hand portion of this plate represents a mass of people overwhelmed by a flood; the explanation says in consequence of an earthquake. The number symbol is reproduced in our figure 37. It

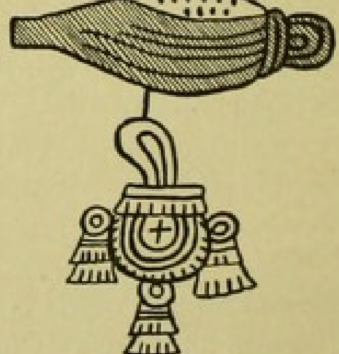


FIG. 35—Symbol for 8,000 pellets copal. Mendoza codex, plate 38, fignre 35.

denotes 1800, that is $4 \times 400 + \frac{400}{2}$. The $\frac{400}{2}$ or 200 is indicated by the half leaf or spike at the right.

Vatican codex, number 3738 (Kingsborough, vol. II; explanation, vol. V)—On plate 7, figures 2 and 3, are the symbols shown in our figure 38, interpreted 4008 and supposed to refer to the years of the second age of the world. Each one of the crossed and fringed circles (blue in the original) represents 400 and is an equivalent and perhaps a mere variation of the fringed spike-like leaf. The 8 is represented by the upper row of smaller circles (also blue). We add one more of this type from plate 10 (see our figure 39). This is interpreted 5042; this, however, is a mistake; the correct number according to the symbol is $5206 = 13 \times 400 + 6$. Attention is called to this mistake in a note to the English translation of the explanation in Kingsborough, vol. VI, but the correct number is not stated.

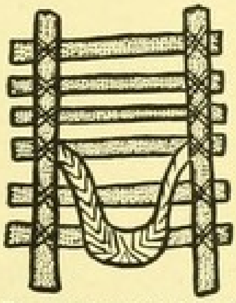


FIG. 36—Symbol for 200 cacaxtles. Mendoza codex, plate 44, figure 34.

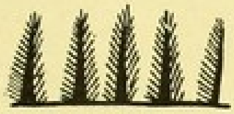


FIG. 37—Symbols for 1800. Codex Telleriano-Remensis, plate 25.

We find on plate 123 the combination shown in our figure 40. Although no interpretation of this page is given, the symbols clearly signify $2 \times 8{,}000 + 9 \times 400$ or 19,600. To what the numbers refer is uncertain, but probably to warriors.

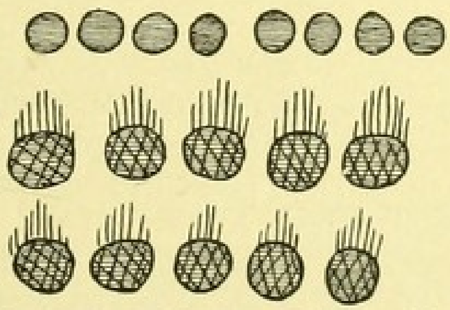


FIG. 38—Symbol for 4,008. Vatican codex 3738, plate 7, figures 2, 3.

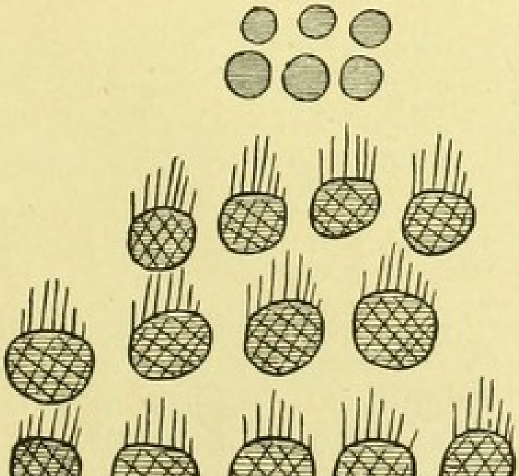


FIG. 39—Symbol for 5,206. Vatican codex 3738, plate 10.

These are all the types of numeral symbols, except the combined short lines and dots found in the codices, which are known as such and have been determined, and are all that Clavigero gives. There are reasons for believing that there are some others, but there are no means known by which to determine the point. Although the value of the various groups of short (black) lines and dots can easily be determined, their application and use in the connections in which they are found has not been ascertained.

It is apparent from the data presented that the Aztec or Mexican

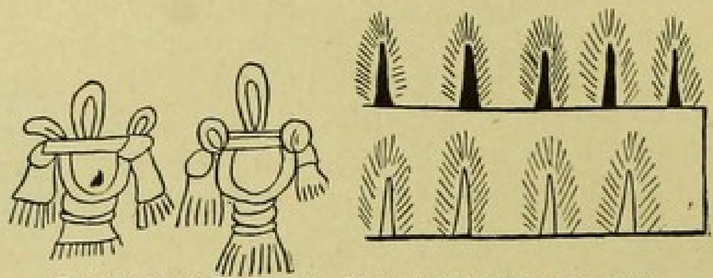


FIG. 40—Symbol for 19,600. Vatican codex 3738, plate 123.

tribes by whom the codices were made were not so well advanced in mathematics and time count, or in the symbolic designation of numbers, as the Mayan tribes.

THE MYSTIC AND CEREMONIAL USE OF NUMBERS

In taking up this branch of the subject we enter upon a field where the evidence must be drawn very largely from the early (chiefly Spanish) authorities; their testimony is, however, corroborated to some extent by the codices and inscriptions. As there is no intention of entering at this time upon a general discussion of the subject of the mystic and ceremonial use of numbers among the Mexican and Central American tribes, but simply of presenting the data so far as they may seem to have relation to the subject treated in this paper, this part will be brief.

As 2 is a number connected in some way with almost every action of life, and necessarily referred to in almost every ceremonial and mystic rite, it is difficult to determine where it is specially referred to because of its numeral value. I therefore omit it from consideration in this respect. Three is a number so seldom brought into use in the customs of the natives of the regions mentioned that it may be passed over.

Reference to the number 4 in myths and ceremonials as well as in other relations by savage tribes, as also by peoples of more advanced 'ture, is so general and so well known that it requires no proof here. This, as is well understood, arises to a large extent from the universal custom of considering the horizontal expanse with reference to four cardinal points, governed primarily by the rising and setting of the sun—east and west—the midway points on the circle being the north and south. The number, even outside of any process of counting, would become apparent in any figure or structure in the form of a square, the four sides and the four corners; and in the personal relations, front and back, right and left, as is suggested by Professor

McGee. And this would be true even in advance of a number system. The number 4 was therefore one which would naturally become prominent, and would necessarily become connected with the recognition of the cardinal points. The "Cult of the Quarters" in mystic and ceremonial rites was therefore a natural outgrowth of the recognition of these points.

This Cult of the Quarters and recognition of the number 4 appears to have been carried almost to the extreme limit among the Mexican and Central American tribes. Reference to the cardinal points appears hundreds of times in the Mexican and Mayan codices, and reference to the number 4 is scarcely less frequent. In the latter, as in the Troano codex, on plate after plate the symbols of the cardinal points are placed in the four corners of the sections around the main central figure, indicating, as we may reasonably presume, that reference to these points is made in the ceremony to which the figure relates. In the Mexican codices they are referred to in several ways, sometimes, it would seem, almost unconsciously, from the mere force of habit. Several plates of the Borgian codex—which is probably the oldest of the series—are crowded with figures referring to the quarters and with symbolic representations of them, some plates being devoted entirely thereto. For example, three out of the four chief figures of plate 4 are evidently drawn with direct reference to these points, and the large figure on plate 7 is devoted to the same cult, this being indicated in the figure in different ways, as by colors, figures, four-day symbols, etc. Reference to this cult, or to the number 4, is also distinctly seen in plates 9, 10, 11, 12, 13, 14, 43, 61, 71, 72, 73, 74, and 75.

Four is a prominent number in the time systems of the Mexican and Central American tribes. The years are arranged in four series, each with its dominical day. The Mexican cycle of fifty-two years consisted of four thirteens or four weeks of years, and according to the mythology of the same people the world has passed through four ages. In both Mexican and Mayan mythology the culture heroes appear as four brothers.

This number also occurs so frequently in other connections as to show that it had with the native population a mystic significance. For example, it was believed by the Mexicans that the end of the world would happen on the day 4 Ollin, and in accordance with this belief the "Feast of the Lords" lasted four days, beginning with 1 Ocelotl and ending with 4 Ollin; and other great feasts usually continued four days. The cross appears also to relate to the cult of the quarters, especially such as the four-colored St Andrew's cross on plate 70 of the Borgian codex. The Mexicans also assigned four gods as rulers over the inferno. It is stated in the Maya Chronicles, where they speak of the coming of the Tutulxiu, that there were four. The Cakchiquels, according to their Annals, consisted of four subtribes or clans, though there were thirteen divisions. The same Annals, alluding to the origin of the people, speak of four men (leaders), four Tulans or traditional homes, and four rulers. The great Mexican festivals occurred on the fourth, thirteenth, and fifty-second years. Four arrows were placed in the hand of their great deity, Huitzilopochtli. At the great feast symbolizing the death of this deity four of the chief priests officiated and four youths were chosen as attendants.

The Guatemalans recognized four culture heroes; at Cholula, four disciples of Quetzalcoatl were charged with the government; in Tlaxcalla, four princes formed the supreme council; and finally, according to Brasseur, almost all the villages or tribes of Mexico were divided into four clans or quarters. According to the Popol Vuh, in the descent to Xibalba (Inferno?) four roads were encountered; one of these was red, one black, one white, and one yellow. And Gucumatz, in his ascent to heaven and descent to Xibalba every seven days, underwent four changes in form, becoming first, a serpent; next, an eagle; next a tiger, and last, coagulated blood.

This number and 5, together with the product of 4 and 5, 20, form the base and scaffolding of the Mexican and Mayan numeral and time systems, though two other factors, 13 and 18, were brought into the latter.

Although the number 5 does not appear to have entered so extensively into the mythology and ceremonials—that is to say, in so many different relations—as the 4, yet in some respects it was more prominent. For example, there is scarcely a page of the Troano, Dresden, or Cortesian codices without from one to four groups (usually columns) of five days, arranged in some regular order, which bear some relation to the accompanying symbolic figures and numerals. Similar groups of five days frequently occur in the Mexican codices, where they also bear some relation to the accompanying symbolic figures. The day symbols in the Tonalamatl, as found in three of these codices, are arranged in 5 lines of 4 times 13 days each.

The use of this number with a mystic or mythological significance appears to be shown on several plates of the Mexican codices, as for example, on plates 11 and 12 of the Borgian codex. On each of these plates are five scenes or groups of figures in five sections, placed as is shown in the diagram (figure 41).

The fact that the chief symbolic figure in each is the Rain god, Tlaloc, and that the lower portion of each section apparently denotes earth and vegetation growing therefrom, renders it probable that there is some reference here to the seasons or the vicissitudes of cultivated plant life. Be this as it may, the reference to five is apparent, not only from the number and position of the sections, but also from the colors of the Tlalocs on plate 12, one of the outer four being red, another blue, another yellow, and another black, while that in the center is striped with red and white.

One thing worthy of notice in this diagram (figure 41) is that one of the five figures is placed centrally, at the expense of the four outer squares. We have in this, it seems, evidence of reference to the four quarters and the center. What is to be understood in these figures by the "center" is somewhat uncertain. It may be simply a convenient way of locating the fifth symbol, which is in all probability the correct explanation in some cases, but even here it may have arisen, as is suggested by Professor McGee, through reference to the Ego in considering the quarters, giving rise to the quincunx. The same concept is symbolized on plate 4 of the Borgian codex, where we see four outer colored squares and a central colored circle, the Cipactli figure over which the latter is placed symbolizing the earth, and the dark outer border surrounding the whole figure denoting the clouds or sky. The central circle may in this case indicate the sun, which we find clearly represented on plate 43 of the same codex, though what seems to be the corresponding figure on plate 24 of the Vatican codex is without any central symbol. In some of the figures indicating the quarters, as one on plate 4 of the Borgian codex, where the four winds are represented, the center is occupied by a human form. In another place where wind symbols occupy the corners a death's-head is placed in the center.

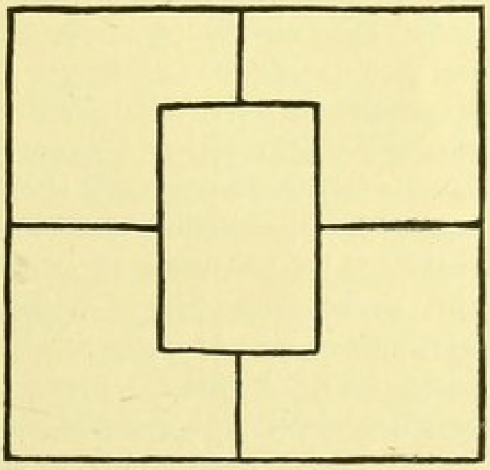


Fig. 41—Diagram of figures on plates 11 and 12 of the Borgian Codex.

It is proper, however, to bear in mind the fact that the arrangement of the days by fours and fives would follow as a necessary consequence of the time system. The year being divided into eighteen months of twenty days each, and five days being added at the end to complete the 365, each year would be five days in advance of that which preceded, and the years necessarily began on the same four days. The division of the twenty days of the month into four periods of five days would be a natural result. Why the five days of the columns in the codices are not in regular order according to this division, but are selected by skipping over regular intervals, is not so easily determined, though as has been shown in a previous paper, they usually have some reference the 260-day period.

The number 7, though playing a less important rôle than 4 and 5, seems to have had some significance in the mysteries and ceremonies of the Mexicans and Maya. Dr Brinton, in his Native Calendar says that the Tzental appear to have developed the number 7 as an arithmetic element in their astronomic system, as they had in their calendars seven days painted with black figures, the first beginning with a Friday. This period was, however, probably based on the European week. That 7 would appear in the adjustment of the thirteen series to the twenty days of the month is evident; it is also noticeable that in some of the Mexican codices where the space is not sufficient to place thirteen day-symbols in a single series, where series of this length are referred to, the division is usually, though not always, into seven and six. However, the necessity of referring to seven in these instances does not appear to have brought it into use as a counter. Its appearance, therefore, in the time system and time count may be considered as accidental, or at least without significance. Nevertheless it does appear occasionally in relations where its use seems to be mystical. From the earliest times, the Cakchiquel, with perhaps others with whom they were related, are mentioned in their annals as "seven tribes" or seven villages arranged in thirteen divisions. Their sacred days were the seventh and the thirteenth. Tradition brings the ancestors of the Mexicans from seven caves; they come as seven tribes, the descendants of seven brothers. Among their gods was a deess named Centeocihuatl, also called Chicomecohuatl or the "Seven Serpents," who, it is said, nourished the seven gods who survived the flood. It is said in the Quiche legend (Popul Vuh) that Gucumatz, their great culture hero, ascended each seven days to heaven, and in seven days descended into Xibalba; that for seven days he took the form of a serpent; seven others that of an eagle; seven others that of a tiger, and seven others that of coagulated blood, as has been already mentioned. Among their mythical heroes was Vukub-Cahix ("Seven Aras"), and the ruler of Xibalba was Vukub-Came ("Seven Deaths").

The number 9, though seldom referred to in the ceremonials and mysteries, was not without a place therein among the Mexicans. They recognized nine "Lords of the Night." These are evidently referred to in the Borgian codex, as in the Tonalamatl, plates 31 to 38, where they are marked by footprints, and on plate 75, where the night is symbolized by the large black figure and the nine lords by nine star-like figures. It is stated in the Explanation of the Codex Telleriano-Remensis that he who was born on the day 9 Ehecatl would be prosperous as a merchant, while he who was born on the day 9 Itzcuintli would be a great magician. The Mexicans also recognized nine heavens. This number appears also to have had some significance among the Quiche, as they held that in each month there would be nine good and nine bad days, and two indifferent.

Next to 20, 13 was the most important number in the time systems of Mexico and Central America. Not only was it the number of days in their so-called week, but it was that by which the days were numbered. Although it did not form one of the regular time periods, as the month, ahau, year or katun, the so-called week not being recognized as a regular period in their systems, it entered into almost every time count and every time series in the codices and inscriptions. It was one of the factors on which the so-called "sacred year" of 260 days and the cycle of fifty-two years were based.

Being so important in the time systems, it would be expected to enter more or less into the activities of life; nevertheless it appears to have played a comparatively unimportant rôle as a mystic or ceremonial number. It was the custom of several Mayan tribes to arrange their armies in thirteen divisions. It appears in the Votan myth among the Tzental, where "thirteen serpents" are referred to; and among the Cakchiquel the day numbered 13 was considered sacred.

The number 20 is the base of the numeral system of the Mexican and Central American tribes, and it may perhaps also be correctly considered the base of their calendar system, although there are other necessary factors. Nevertheless 20 does not appear to have been used as a mystic number in rites and ceremonies, except so far as the calendar was made to serve divinatory purposes. Why twenty days were adopted as a time period and a division of the year has as yet received no entirely satisfactory explanation, though it is generally supposed that it was chosen because the arithmetical system of these tribes was vigesimal. That there is some connection between the two is quite likely, especially as this would seem to correspond with the probable order of the steps in the formation of the two systems. That the formation of the vigesimal system preceded that of the time system appears to be an absolute requisite, but the steps in the formation of the latter can not be assumed with the certainty which we may have with regard to the former.

That the custom of grouping the days by fives did not begin until 20 had come into use is clear. Did the introduction of 13 as a factor precede or follow the adoption of 20? Dr Brinton states in his Native Calendar that he is persuaded that this period was posterior and secondary to the twenty-day period. Although this opinion may be, and probably is, correct, the evidence on which to base it is not so apparent as to leave no doubt. It seems probable, as Dr Brinton suggests, that the twenty-day period was derived from the vigesimal number system, but this does not explain the origin of the peculiarities of the unusual time system, which seems to have reference to no natural phenomena save the earth's annual revolution. There are other peoples than those of Mexico and Central America who use the vigesimal system, but no others, so far as known, who adopt the twenty-day month or eighteen-month year. The moon's revolution is the factor on which the month in most of the world's time systems is based, and the name for month in most, or at least several of the Mayan tongues, is the same as that for moon. This is also true of the Zapotec language, and Cordova (Arte Idioma Zapoteco) says that the people of this tribe even count by moons; however, the latter statement may apply to post-Columbian times. The names for month and moon are the same in Cahita, Othomi, and Zoque. This fact, and the further fact that substantially the same term has passed over, in some instances, from one linguistic family to another, as the Zapotec, *peo* or *beo;* Zoque, *poya;* Kakchi (Mayan), *po* or *poo*, would seem to indicate an original lunar month. It is also true that the oldest inscriptions and the Dresden codex refer to a year of 365 days. However, against this evidence must be placed the fact that all the inscriptions and codices base the time count on the twenty-day month, and the day numbering on 13, the latter also being a factor in other counts of the inscriptions and codices. The oldest evidence, therefore, to which we can appeal where numbers are used, agrees with the time system of the "native calendar."

That a change from a lunar count to a twenty-day period could have been made otherwise than arbitrarily seems impossible; we can not conceive how the one could have grown out of the other. This must have been true or the system must have developed with the growth of the number system; at least no other supposition seems possible unless we assume that two time systems, a secular and a sacred one, were in use at the same time, and that the latter finally obscured the former. This seems to have been the case with some tribes. If the supposition that the time system developed with the number system be correct, then the lunar period could never have been a factor. It is somewhat strangely in accordance with this supposition that the moon, so far as the aboriginal records and early authorities show, is almost wholly absent from the codices, and does not appear, so far as is known, in the inscriptions.

Notwithstanding this negative evidence, I can not believe that a time system without reference to the lunar periods could have developed among the tribes of the region of which we are treating. My conclusion is, therefore, that the priests at an early date adopted a method of counting time for their ceremonial and divinatory purposes which would fit most easily into their numeral system, and that this system, in consequence of the overwhelming influence of the priesthood, caused the lunar count to drop into disuse. Moreover, the only native records which are available are those made by the priests for their purposes. This will probably account for the introduction of the twenty-day period, but does not account for the introduction of the 13.

Dr Förstemann suggests that at one time the Mayas arranged the days of the solar year in four groups of seven weeks each, the week consisting of 13 days, the year being then counted as 364 days (4×13

×7=364), and that each of the four groups was assigned to a particular cardinal point. Although it is true that the Tonalamatl, as given in some of the Mexican codices, seems to show, by the upper and lower border lines, which contain 52 figures each, some indications of a year of 364 days, this does not account for the introduction of the 13; moreover, Dr Förstemann's explanation introduces the factors 7 and 91 (7×13), and 7 and 28 (4×7), which are not found in the time counts of the codices or inscriptions. However, it is possible that the 28 (4×7) may be supposed to indicate the true lunar period, and the 4 times 7 the four changes of the moon. Mr Cushing suggests another explanation based on his observations among the Zuñi. In the ceremonies of this people the complete terrestrial sphere is symbolized by pointing or blowing smoke toward the four cardinal points, to the zenith and nadir, the individual making the seventh number. When the celestial sphere was symbolized only the six directions were added to the seven, no further reference to the individual being made. Thus 13 typifies the whole universe. While this explanation seems plausible, we lack the evidence that such a custom was in vogue among the people using the native calendar, nothing suggesting it being stated in the authorities or indicated in the codices, unless in the so-called title-pages of the Troano codex and Codex Cortesianus, which are supposed by most investigators to be parts of one plate or series. There we find the four cardinal point symbols taken in one direction followed by two symbols, which Seler believes indicate the zenith and nadir; these are followed by the cardinal point symbols taken in the opposite direction, and these by three other symbols, two of which appear to be the same as the supposed zenith and nadir symbols. Unfortunately the third, which makes the thirteenth, is too nearly obliterated to determine its form. The number symbols 1 to 13 stand above these.

Other suggestions as to the reason of the use of this number as a factor in the time system have been offered, but, like those mentioned, they are not entirely satisfactory. That 13 was considered important by most of the tribes is true, and that it was used by some otherwise than in time counts is true, but why is as yet an unsolved mystery, nor is there any satisfactory evidence that it was preceded by the twenty-day period, though this is probable. Clavigero asserts that the Mexicans, in their computations of time, disregarded months and years, counting by thirteens, but he evidently means by this that 13 was used as the multiplier, and, like Goodman, evidently confounds the system of numeration with the time system. However, this will be discussed more fully in a subsequent paper relating to the native time system.