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CANON OF THE HUMAN BODY, MEXICAN MEASURES OF LENGTH AND THE PYRAMID OF QUETZALCOATL FROM TEOTIHUACAN

1. EXPLANATION OF THE PROBLEM

The societies from the ancient centres of civilisation of the Old and New World were ideologically regulated by the astrobiological religion. This religion was locally variable in style and ritual performances but, its general model of the world and man was essentially everywhere the same (for the assumptions of this model see A. Wierciński 1977).

Also, it was attempted to demonstrate (A. Wierciński 1976) that the most mounmental and impresive sacral buildings, like stepped and true pyramids and ziggurats, were the architectonical representations of an ideo-archetype of the Cosmic Mountain of which two — dimensional projection is the concentrical symbolizm of the Mandala. The Cosmic Mountain (or Mandala) yields, in turn, all the main assumptions of the astrobiological world's vision, coded both — iconically and numerically. Its fundamental and well known assumption defines the relation between man and the world in the form of an equivalence between man an Microcosmos and the World as Anthropocosmos or a Cosmic Man. Consequently, man is a measure of all things might be what literally conceived too, since the ancient systems of measures of lenght were usually derived from a canon of the human body. Such terms as foot, cubit or step leave no doubt in this respect. The variation of the local systems of measures suggest that different standard individuals were selected in different centers of civilisation, though, the very idea of a canonical human somatotype was universally accepted. The latter statement may be easily evidenced by the fact that in all the known systems the dependence: 1 cubit = 11/2 foot, was fulfilled.

Also, there is no doubt that within one and the same center (like, for instance, in Greece and in Egypt) could function two or more systems, one based on natural standard and the other, on a standard of a gigantic individual. Furthermore, both such system could be geometrically related to each other. In ancient Egypt, for example, 1 short cubit (remen) was equal to the side of the square of which diagonal was one royal cubit, the latter refering to a gigantic standard. At the same time, 1 remen = 1·5 of natural foot which was derived from the low-statured

Table 1

A review of some ancient and modern system of measures of length

Area and name of the unit	in centimeters	in minimum native units	Remarks
1	2	3	4
England:			
line	0·254	1	
inch	2·54	10	
foot	30·48	120	
yard	91·44	360	= 360 days of the basic solar cycle
fathom	182·88	720	corresponds to standard stature = 6 feet = 2 yards
rod (pole, perch)	502·92	1980	= 300 shusi = 10 Sumerian cubits = 15 Sumerian feet
furlong	16093·44	63360	
France:			
line	0·226	1	
royal foot	32·48	144	the standard stature = 6 feet, could 6 be = 194·9 cm.
Greece:			The Olympic foot belonged evidently to a different standard derived from the stature = 185·4 cm.
finger	2	1	
Attic foot	32	16	
Olympic foot	30·9	15·45	
cubit	48	24	
fathom	192	96	= corresponds to the standard stature = 4 cubits = 6 feet
plethron	3200	1600	
stadion	19200	9600	A general correspondance to Solar cycle of 360 days and the lunar year of 13 months = 384
Rome:			The standard stature = 4 cubits = 6 feet = 177·8 cm.
finger	1·8519	1	
inch	2·469	1 1/3	
palm	14·815	8	
foot	29·63	16	
cubit	44·445	24	= analogical correspondance as in Chaldean cubit!
step	148·15	80	A general correspondance to Solar cycle of
rod	296·3	160	360 days and the lunar year of 13 months = 384 days
Sumer:			
finger (shusi)	1·6764	1	The standard stature = 4 cubits = 6 feet = 201·2 cm!
foot	33·528	20	
cubit	50·292	30	A general correspondance to solar cycle of 360 days

1	2	3	4
Babylonia:			
finger (ubanu)	1·6459	1	The standard stature = 6 feet = 197·5 cm. or, when based on 4 cubits = 158 cm.
foot	32·92	20	
Chaldean cubit	39·50	24	= might correspond to 1 days = 24 hours introduced in Chaldean times
rod (kanu)	237·01	144	
gar	474·02	288	= diagonal of the square formed by 10 Sumerian feet!
ashlu	4740·2	2880	A general correspondance to solar cycle of 360 days
Assyria:			
cubit	49·43	30	= evident relation to Sumerian division into 30 shusi, but based on Babylonian ubanu
Northern cubit ("Aryan") (the restas in Babylonia)	67·594	41·07	
Egypt:			In Egypt functioned, at least, 3 different systems of measures, with standard statures 209·6 cm, 201·2 cm. and 148·1 cm.
finger	1·8707	1	
palm	7·483	4	
royal foot (long)	34·925	18 2/3	
royal cubit	52·38	28	= undoubted reference to lunar cycle of 28 days
short cubit	44·9	24	= a relation of Chaldean division in to 24 fingers = side of the square with the royal cubit as its diagonal = 20 Roman digits!
cubit remen	37·038	19·8	
royal foot	33·528	17·92	=Sumerian foot
natural foot	24·692	13·2	= remen divided by 1 1/2

individual (ca. 148 cm.), not uncommon in Egyptian population. However, the standard based on the royal cubit refers to gigantic stature of ca. 210 cm. Is it possible that gigantic standards are related, in some way, to the universal myth of giganths as cultural heroes?

The table 1 gives a short rewiew of some better known ancient systems of measures of length.[1]

It brings a suggestion that, despite an undoubted local variation of the accepted standards, some strange connections could probably exist between them. Thus, for example, in the English system appears the astonishing equivalence between Mesopotamian *shusi* and cubit *ammatu* on one hand, and the English *foot* and *rod*, on the other, while the Egyptian *remen* is exactly equal to 20 Roman *digities*. The English fathom represents the stature of the standard individual equal to 6 feet.

However, some deeper insight into the conceptual frame of systems of measure is needed. For instance, it is probable that some cosmic correspondancies were

[1] Some data presented in the table 1 were taken from the list sent by Nr. Forshaw Kalin, to Whom the author is much indebted for all His kind assistance.

reflected in them. They were assessed for Egyptian royal cubit which was devided into 28 fingerbreadths corresponding to 28 days of the Moon cycle (A. Wierciński 1976a), while the Babylonian *ammatu* might reflect the 30 days of the month, because it was divided into 30 *ubanu*.

After all these elucidatory remarks, the aims of this paper should be precised. Thus its purpose is to present a new attempt of the reconstruction of the Prehispanic Nahuatl system of measures of lenght on the basis of an analysis of anthropometrical data and in reference to the previous reconstruction published by V. Castillo (1972). Also, some kind of an exemplification of newly reconstructed system will be shown, by means of a numerical analysis of the main architectonical dimensions of the pyramid of Quetzalcoatl from Teotihuacan.

2. THE ANALYSIS OF ANTHROPOMETRICAL DATA

The main premisse of this study is the same one as has been accepted in Castillo's work, i. e. that the Mexican measures of lenght had been derived from a canon of the human body which was based on a real male standard individual.

First of all, however, the very possibility of the existence of canonical, species specific proportions of the human body should be considered. A first approach to this problem represents table 2 [2]. It shows that the anthropometrical dimensions

Table 2

The correlation of various diameters of the human body with the stature (Polish adult males in the age of 18—20 years)

Anthropometrical diameter	coefficient of r with stature	
	Town Wrocław $N = 196$	Villages $N = 100$
Upper extremity length (a–da III)	· 83	—
Arm length (a–r)	· 77	· 71
Forearm length (r–sty)	· 68	—
Upper extremity length without hand (a–sty)	—	· 79
Hand length (sty–da III)	· 71	—
Shoulders breadth (a–a)	· 51	· 64
Sitting height (sst–sy)	· 65	· 70
Public height (B–sy)	· 89	· 91
Hips breadth (ic–ic)	· 53	· 72
Thigh length (sy–ti)	· 78	· 75
Foot length (pte–ap)	· 74	—

[2] The data presented in the table 2 descend from the investigation of A. Waliszko, Z. Welon and S. Górny from the Department of Anthropology of the Polish Academy of Science in Wrocław of which Director, Prof. Dr. hab. T. Bielicki kindly gave them at author's disposal.

Table 3

A comparison of simple proportions of the human body between two entirely different populations

Poland (villages) \ Triques (Oaxaca)	Stature (B–v) = 156·4	Upper extremity length (a–da III) = 69·8	Upper extremity lenght to wirst (a–sty) = 53·1	Forearm + hand length (r–da III) = 36·5	Shoulder breadth (a–a) = 36·5	Arm length (a–r) = 31·0	Foot length (pte–ap) = 24·2	Forearm length (r–sty) = 22·1	Hand length (sty–da III) = 16·7
Stature (B–v) = 167·0	1	2·244 0·078	2·945 0·066	4·031 0·118	4·285 0·019	5·045 0·030	6·463 0·089	7·078 0·317	9·365 0·522
Upper extremity length (a–da III) = 77·1	2·161	1	1·315 0·014	1·799 0·039	1·912 0·075	2·252 0·063	2·884 0·059	3·158 0·037	4·190 0·154
Upper extremity length to wrist (a–sty) = 58·0	2·879	1·329	1	1·369 0·045	1·455 0·040	1·713 0·029	2·194 0·020	2·403 0·055	3·180 0·143
Forearm + hand length (r–da) III) = 43·8	3·813	1·760	1·324	1	1·063 0·066	1·252 0·063	1·603 0·069	1·756 0·017	2·323 0·030
Shoulder breadth (a–a) = 38·8	4·304	1·987	1·495	1·129	1	1·187 0·022	1·508 0·027	1·652 0·071	2·186 0·155
Arm length (a–r) = 33·3	5·015	2·315	1·742	1·315	1·165	1	1·281 0·010	1·403 0·055	1·856 0·113
Foot length (pte–ap) = 26·2	6·374	2·943	2·214	1·672	1·481	1·271	1	1·095 0·034	1·449 0·078
Forearm legth (r–sty) = 24·7	6·761	3·121	2·348	1·773	1·571	1·248	1·061	1	1·323 0·030
Hand length (sty–da III) = 19·1	8·743	4·036	3·037	2·293	2·031	1·743	1·371	1·293	1

Remark: upper part of the matrix includes also the differences between respective propoitions in both compared populations.

of various anatomical regions of the body are strongly correlated linearily with the stature. But, it should be emphasised that the maesuring errors are far greater on the living material than on the skeleton what surely is leading to certain lowering of the values of coefficients *r*. The fact that they increase to 0·8–0·9 for the long bones and stature is well known in anthropology and assessed for very different populations. Therefore, the lengths of the long bones are commonly used as the basis for accurate reconstructing of an individual stature. Among others, it was proved for recent Amerindians in Mexico by S. Genoves (1967).

If so, we may expect that only very slight differences will appear between proportions of various anthropometrical diameters, calculated for even entirely different population. This statement is clearly evidenced by the comparison of Polish population with the series of Triques (J. Comas 1965) from Mexico, (see:table 3) among others, very different in stature. In fact, only two greater differences appeared in the proportions of forearm length to stature, for the total number of 36 items! Thus the canon of the human body, based on highly stable proportions of diameters of its component parts, may be accepted for reconstruction the ancient Nahuatl system of measures of length.

The departure anthropometrical material for further, more detailed analysis was taken from the new publication of Mexican anthropologists kindly sent to the present author (Jaen et al. 1976) and presented in the table 4.

Table 4

Some anthropometrical data as departure material for the present attempt pf reconstruction of Nahuatl measures of length

Ethnic series / Anthropometrical diametetr	Poland village (*n* = over 4000)	Triques (Oaxaca) (*n* = 100)	Aztecas (*n* = 19)	Tarascos (n = 29 — 31)	Otomies (*m* = 28)	Coras (*n* = 36 — 38)	Huicholes (*n* = 46 — 47)
Stature (B–v)	167·0	156·4	162·9	160·0	159·8	165·2	162·9
Shoulders breadth (a–a)	38·8	36·5	37·0	36·4	36·1	37·0	36·1
Acromiale height (B–a)	136·8	128·5	133·6	131·2	129·5	135·3	132·7
Radiale height (B–r)	103·5	97·5	102·4	99·9	99·2	105·2	102·7
Stylion height (B–sty)	78·8	75·4	79·8	76·7	76·6	81·2	80·3
Dactylion height (B–da III)	59·7	58·7	62·0	59·3	58·5	62·7	61·6
Hand length (sty–da III)	19·1	16·7	17·8	17·4	18·1	18·5	18·7
Foot length (pte–ap)	26·2	24·2	—	—	—	—	—

3. THE DETAILED RECONSTRUCTION OF NAHUATL MEASURES OF LENGTH

The fundamental basis for this part of our study consists of the data and information included in the cited above paper of V. Castillo, supplemented by the following additional assumptions:

1·1 the proportions between different reconstructed units of measure should correspond strictly to the mean proportions of the respective anthropometrical diameters, calculated for the investigated Amerindian series from Mexico;

1·2 the unit *cemacolli* is not equal to 80 cm. but to 82·9 cm. (= "megalithis yard" of Thom) and so, it has been derived from the standard individual with the stature = 165·8 cm., if Castillo's proportion is being accepted, i. e. that doubled *cemacolli* is equal to *cënnequatzalli* (= stature or fathom);

1·3 the *cemmatl* is equal to 3 *cemacollis* = 248·7 cm. what corresponds to 2·975 Spanish *varas*, rounded by Ixlixochitl to 3 *varas*;

1·4 the *cemmacolli* = 82·9 cm. was divided into 48 *cemmapillis* and 52 *iztetls*.

It is immendiately apparent that these assumptions, and especially 1·1 and 1·3, impose on our procedure of reconstruction harder constrains than it was the case of Castillo's attempt.

Now, let us consider the particular unit of measure established by Castillo and refined according to the assumptions 1·1–1·4. The fig. 1 and tables 5–6 represent the probable anthropometrical correspondancies with the human body.

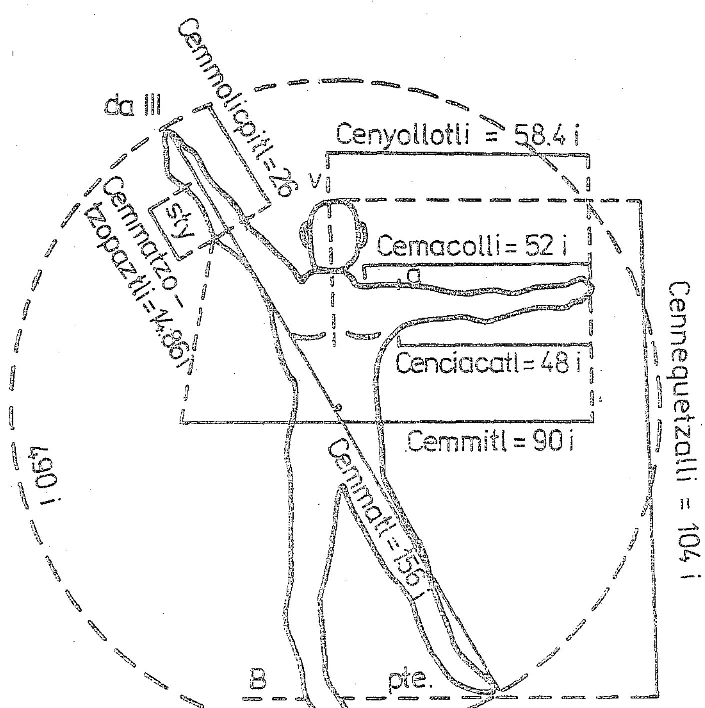

Fig. 1. The present attempt of reconstruction of Mexican measures of length on the basis of anthropometrical diameters of standard individual with the stature = 165·8 cm. (i. denotes *iztetls* — breadth of finger-nail = 1·594 cm).

Comparison of anthropometrical data with two attempts of

Comparative anthropometrical data and two attempts of reconstruction / exican easuring iits	Poland (villages)	relation to stature	Triques	relation to stature	Aztecas	relation to stature	Tarascos
nnequeztalli: stature (B–v)	167	1	156·4	1	162·9	1	160
mmatl: from top-toe of left foot to top-nger of extended right arm (ap–da III)	—	—	—	—	—	—	—
mmitl: from elbow articulation to top-nger of opposite arm (a–r) + (a–a) + ı–da III)	149·1	1·12	137·3	1·14	139·8	1·17	139·6
nyollotli: from the middle of breast to op-finger of extended arm (a–da III) + ı – a):2	96·5	1·73	88·2	1·77	90·1	1·81	90·1
nmacolli: from neck to top-finger of ex-nded arm	—	—	—	—	—	—	—
ciacatl: arm-pit to top-finger of extended rm	(77·2)	2·17	(69·8)	2·24	(71·6)	2·28	(71·9)
mmolicpitl: from elbow articulation to op-finger (r–da III)	43·8	3·81	38·8	4·03	40·4	4·03	40·6
mmatzotzopaztli: from elbow articulation wrist (r – sty)	24·7	6·76	22·1	7·08	22·6	7·21	23·3
ntlacxitamachihualoni: foot length (pte–p)	26·2	6·37	24·2	6·46	—	—	—
miztetl (or *Xeme*) extension between –V fingers	—	—	—	—	—	—	—
mmapilli: finger-breadth	—	—	—	—	—	—	—
etl: breadth of finger-nail	—	—	—	—	—	—	—

Remark: the values in brackets denote the diameter (a – da III) which is very near to the distance between

Cemmatl (= "hand" or "arm") was difined in the taxation of Tultitlán in 1552 ıs the diameter from the left foot to the right hand, when the arm is extented upwards, what generally corresponds to other similar expressions cited by Castillo rom the other sources. Castillo accepted the rounded value of 250 cm. Based on he overcalculations of Ixtlixochitl, who gave the lenght and width of the palast of Nezahualcóyotl in Texcoco in Spanish *varas* and in unnamed native units which could represent only *cemmatls*. According to these data, 1 *cemmatl* = 3 *varas* = 3 × 83·59 cm. = 250·77cm. Castillo attributed *cemmatl* to the diameter from o the diameter from the top–toe of the left foot to the top-finger of the right ıand extended upwards, when a man is standing freely, with both legs close together. At the same time, he emphasizes rightly a discrepancy of such diameter = 250 cm. vith the accepted value for stature = 160 cm. However, this discordance may asily disappear, if we shall admit that:

Table 5

reconstruction of Mexican system of measures of length (in cm.)

relation to stature	Otomies	relation to stature	Coras	relation to stature	Huicholes	relation to stature	Castillo's reconstruction	relation to stature	Present reconstruction	relation to stature	Mean relation to stature of Amerindian tribes
1	159·8	1	165·2	1	162·9	1	160	1	165·8	1	1
—	—	—	—	—	—	—	250	0·64	248.7	2/3	—
1·15	137·4	1·16	139·7	1·18	137·2	1·19	125	1·28	143·46	1·16	1·165
1·78	89·1	1·79	91·1	1·81	89·2	1·83	90	1·78	93·09	1·78	1·798
—	—	—	—	—	—	—	80	2	82·9	2	—
2·23	(71·0)	2·25	(72·6)	2·28	(71·1)	2·29	70	2·29	73·32	2·26	2·262
3·94	40·7	3·93	42·5	3·89	41·1	3·96	40–45	3·56–4	41·45	4	3·963
6·87	22·6	7·07	24·0	6·88	22·4	7·27	30	5·33	23·68	7	7·063
—	—	—	—	—	—	—	—	—	27·63	6	6·463
—	—	—	—	—	—	—	17·5	9·14	18·42	9	—
—	—	—	—	—	—	—	1·7	94·1	1·727	96	—
—	—	—	—	—	—	—	—	—	1·594	104	—

arm-pit and top-finger, when the arm is extended sidewards.

— *cemmatl* near to 250 cm corresponds to the diameter defined by the same anthropometrical points (i. e. ap–da III) but when a man is standing with the legs placed asunder, i. e. in the position of "X",

— the stature will be of higher value, i. e. near to 166 cm.

Furthermore, if we admit that *cemmatl* was simply divided into 3 *cemacollis* (here equal to 82·9 cm.) and not into 3·13 as it is in Castillo's reconstruction, the value of *cemmatl* will be exactly equal to 248·7 cm. In this case, 1 *cemmatl* = 2·975 *varas*, the value so exeedingly near to 3 that it is most probable that Ixtlixochitl rounded simply this correspondance to 3 varas. Also, the value of 248·7 cm, being lower than 250 cm. is still more concordant with the above mentioned natural diameter.

Cemmaquetzalli (= "erect position of man") according to Molina and Simeon sponds with the stature. Castillo accepted for it the value of 160 cm. following

Table 6

Mutual proportions of particular Mexican measures of length in Castillo's reconstruction in comparison to the new one

Castillo's reconstruction / Proposed new reconstruction	*Cennequetzalli*	*Cemmatl*	*Cemmitl*	*Cenyollotli*	*Cemacolli*	*Cenciacatl*	*Cemmolicpitl*	*Centlacxita-machihualoni*	*Cemmatzotzo-paztli*	*Cemiztetl*	*Cemmapilli*	*Iztetl*
Cennequetzalli (cq.)	1	0·64	1·28	1·78	2	2·29	4–3·65	—	5·33	9·14	94·12	—
Cemmatl (ct.)	0·67	1	2	2·78	3·13	3·57	6·25–5·56	—	8·33	14·29	147·06	—
Cemmitl (cl.)	1·16	1·73	1	1·39	1·57	1·79	3·13–2·78	—	2·78	7·15	73·53	—
Cenyollotli (cy.)	1·76	2·67	1·54	1	1·13	1·29	2·25–2	—	3	5·14	52·94	—
Cemacolli (c.)	2	3	1·73	1·12	1	1·14	2–1·78	—	2·67	4·57	47·56	—
Cenciactl (ca.)	2·26	3·39	1·96	1·27	1.13	1	1·75–1·56	—	2·33	4	41·18	—
Cemmolicpitl (cp.)	4	6	3·46	2·25	2	1·77	1	—	1·33–1·5	2·29–2·57	23·53–26·47	—
Centlacxitamachihualoni (cx.)	6	9	5·19	3·37	3	2·65	1·5	1	—	—	—	—
Cemmatzotzopaztli (cz.)	7	10·5	6·06	3·93	3·5	3·10	1·75	1·17	1	1·71	17·65	—
Cemiztetl (ci.)	9	13·5	7·79	5·05	4·5	3·98	2·25	1·5	1·29	1	10·29	—
Cemmapilli (ce).	96	144	83·07	53·9	48	42·46	24	16	13·71	10·67	1	—
Iztetl (i.)	104	156	90	58·4	52	46	26	17·33	14·86	11·6	1·08	1

the results of the calculations of B. Leander, who regarded this figure as the arithmetic mean for Mexican population in Precolumbian times. However, the anthropometrical data summarized by the present author (A. Wierciński 1975) show very high variation of populational means among Mexican Amerindian tribes, ranging from 154 cm. in Chiapas up to 172 cm. in Sonora. Similar variability should be assessed for Prehispanic Mexico, though, the representative materials are lacking and Leander could not have any safe statistical basis for her estimation. It is especially evident, if we recall the information of Ixtlixochitl when he deals with the question of living representatives of Quinametzin and rightly stresses the fact of highening the stature in Mexico going from South to North.

Thus there is a lack of empirical data for an exact estimation of *cennequetzalli*, especially, since we do not know, how near to the modal value was the standard individual and from which population this standard had been selected. However, if we shall follow Castillo that *cennequetzalli* was divided into 2 *cemacollis* and the latter unit was equal to 82·9 cm., the value for *clnnequetzalli* = 165·8 cm, what is quite reasonable from the anthropological point of view. In this case, it is not improbable that a standard individual might be selected from the range around the modal value of one of the very ancient groups from the Valley of Mexico, since the mean stature calculated by the present author (by use of Genoves formulas) for the male series from Tlatilco cemetery was equal to 162·3 cm. (A. Wierciński 1972). At any rate, the accurate estimation of *cennequetzalli* is of highest importance for reconstructing of remaining units of measure as anthropometrical diameters, due to the indicated above strong their correlations with the stature (see again: table 2).

Cemmitl (= "arow") was defined clearly by Molima and Simeon as the measure from the elbow to the hand of opposite upper extermity. Thus Castillo has precised its anthropometrical correspondace to a dimension from the elbow articulation of the left arm to the top-finger of the right hand, when both extremities are extended sidewards. He estimated its value as 1/2 of *cemmitl* what is equal to 125 cm. However, if we are going to accept exactly his anthropometrical definition, *cemmitl* as the diameter (a – r) + (a – a) + (a–da III), even with the stature = 160 cm. will be ca. 12 cm. too small. Of course, the deviation from the natural proportion will be still greater, if the stature is 165·8 cm. In this case, the value of *cemmitl* should be equal to roundly 143 cm. We shall admit its exact value = 143·46 cm. = 90 *iztetls*.

Cenyollotli (="hearth") was defined by Molima and Simeon as the measure from the breast to the hand, what Castillo interpreten anthropometrically as the diameter from middle of the breast to the top-finger of the extended sidewards upper extermity. More exactly, it might be the diameter (a – da III) + (a – a):2. Without further discussion, Castillo estimated *cenyollotli* as equal to ca. 90 cm., what is very good approximation of natural proportion with the stature of 160 cm. Accepting the same proportion with the stature 165·8 cm. our *cenyollotli* = 93·09 cm.

Cemacolli (="extended arm") was defined by Simeon very generally as a measure of length: the arm, what Castillo precised as the diameter from the point on shoulder articulation to the top-finger of the extended upper extermity (a–da III), making it equal to 80 cm. i. e., one half of *cennequetzalli*. In this case, however, this value would be at variance with natural proportion, being ca. 9 cm. too high. Also, the diameter (a – da III) is practically the same as the length from the arm-pit and so, if the arm would be extended sidewards, it would not differ from the *cenciacatl*. But, very good agreement with anthropometrical reality may be obtained, if we assume that *cemacolli* is the diameter from the beginning of the neck to the top-finger of the extended sidewards arm which is keeping the proportion of 1/2 of stature. If so, with the stature 165·8 cm., our *cemacolli* is equal to 82·9 cm. = 1 megalithic yard of Thom.

As it has been mentioned above, this was one of the main assumptions of our reconstruction of Nahuatl units of measures, empirically validated by the discovery that the architectonical dimensions of the Sun and Moon pyramids from Teotihuacan show striking correspondancies to the astronomical calendric cycles, when the former had been expressed in megalithic yard (see: A. Wierciński 1974—1975, 1976, 1976a).

At any rate, the value of 82·9 cm. is very near to Castillo's estimation of *cemacolli* = 80 cm. and to Spanish *vara* = 83·59 cm.

Cenciacatl (="arm-pit") was defined by Molina as the measure from the arm-pit to the hand, what Castillo precised as the diameter from the arm-pit to the top-finger of the extended arm. As it was said above, this diameter for the extended sidewards extremity should be anthropometrically very near to (a – da III), which is 2·26 lesser than the stature. Thus the Castillo's estimation to ca. 70 cm. is around this proportion. However, with the stature 165·8 cm., the value of *cenciacatl* = 73·32 cm. = 46 *iztetls*.

Cemmolicpitl (="cubit") was defined by Molina as the measure to the top of the longest finger, what Castillo interpreted as the diameter from the elbow's articulation ot the top-finger of the extended arm and discribed the value ranging between 40—45 cm. His estimation is fully concordant with the real anthropometrical proportion of the diameter (r–da III) which is 1/4 of the stature. Therefore, our *cemmolicpitl* will be exactly equal to 41·45 cm., being 1/2 of *cemacolli* and 26 iztetls.

Cemmotzotzopaztli (="forearm") was defined by Molina as the measure of the arm-lenght, what Castillo precised as the true forearm lenght, i. e. (r – sty) which is almost exactly 1/7 of the stature. Thus, for the stature = 160 cm., it should amount 22·9 cm. and not 30 cm. as it was estimated by Castillo. With the stature = 165·8, our *cemmotzotzopaztli* will be equal to 23·60 cm.

Cemiztetl or *Xeme* (="finger-nails") was invariantly interpreted in the Spanish sources as a lenght of the extension between I and V fingers. Castillo estimated its value as equal to 17·5 cm., since Anales de Cuauhtitlan say that *cemiztetetl* is one fourth of *cenciacatl*. If so, the *cemiztetl* in our reconstruction should be 18·33 cm. or, if it was 1/9 of *cennequetzalli*, it might be equal to 18·42 cm. In the latter case, it will be 3·98 part of *cenciacatl*, what is exceedingly near to 4.

Cemmapilli (="finger") was interpreted simply by Castillo as the finger-breadth with the value of 1/48 th of vara and so ca. 1·7 cm. We shall admit the same proportion but, with the departure value of cemacolli = 82·9 cm. In this case, our *cemmapilli* will be equal to 1·727 cm.

Iztetl (="mail") was currently used as the name of a measure for things as small as the finger-nail. Unfortunately, there is a lack of evidencies for its estimation and Castillo did not make it. However, being possibly near to anthropometrical reality, we shall advance the hypothesis that *Iztetl* was 1/52 part of *cemacolli* and so, it was equal to 1·592 cm.

Centlacxitamachihualomi (="foot") was also only mentioned by Castillo due to a lack of sufficient information for its estimation. However, it is difficult not to fall at temtation and not to try to precise this so common unit of measure. We think that there exist two possibilities of reconstructing its value:

a) by keeping closely the mean proportion to stature which is according to our data 6·46 for the Triques or,

b) by accepting the assumption that the stature was divided into roundly 6 feet and, one cubit into 1 1/2 of foot, what has been so universally present in the ancient systems of measures in the Old World.

In the first case, the foot length defined antropometrically as the diameter (pte – ap) will be equal to 25·51 cm. what is exactly 16 *iztetls* and 1·625 of *cemmolicpitl* (the latter value is very near to Gold Proportion). In the second case Nahuatl foot = 27·633 cm. = 17·33 *iztetls* = 1/9 of *cemmatl* = 1/3 of *cemacolli* etc. It is apparent that the latter value offers more possibilities of expressing various divisions in the integral numbers. Therefore, we shall accept that *cemtlacxitamachihualoni* is equal to 27·633 cm.

4. POSSIBLE ASTRONOMICAL SIGNIFICANCES

The ancient astrolobiological religion was deeply penetrated by astronomical contents. Its priests were fascinated by correspondancies between periodical movements of coelestial bodies on the firmament and the climatic, meteorological and biological rhythms occurring on the Earth's surface. Everything on Earth seemed to be a reflection of heavenly images, what might be expressed not only iconically but also numerically. The canon of the human body and the system of measures as its derivative, should not be an exception.

As it was shown above, the Egyptian royal cubit, at least, has revealed such correspondanes with the lunar cycle of 28 days. But, how it could be in ancient Mexico where penetration of the religion by astronomy had reached its peak? In order to answer this question, the comparison of all newly reconstructed measures of length expressed in smallest units (i. e. in *cemmapilis* and *iztetls*) with astronomical calendric cycles was presented in the table 7.

The coincidencies between both kinds of these data are striking indeed and some of them surely did not result from our hypothesis that *cemacolli* was divided into 52 *iztetls*. The *cenyollotli* and *cemiztetl*, which consist of 58 2/5 and 11 3/5

Table 7

Possible correspondancies of measuring units with astronomical calendric cycles

Calendric correspondancies / Mexican units of measure	Expressed in cemmapillis	Possible astronomical calendric correspondancies	Expressed in *iztetls*	Possible astronomical calendric correspondancies
Cemmatl	144	4 × 360/10 (basic solar cyle)	156	156 × 10 = 2 × 780 days of Mars cycle = 6 × 260 days of Tonalpohualli cycle
Cemequetzalli	96	1/4 of 384 (lunar cycle of 31 months with 295 days)	104	104 × 10 = 4 × 260 days of Tonalpohualli cycle or 104 years of Great Aztec Era
Cemmitl	83·07	?	90	4 × 90 = 360 days of basic Solar cycle (or 10 × 90 = 2·5 × 360)
Cenyollotli	53·9	?	58·4	10 × 58·4 = 584 days of Venus cycle
Cemacolli	48	8 × 48 = 384	52	10 × 52 = 520 = 2 × 260 days of Tonalpohualli cycle represented in the Aztec Stone Calandar or 52 years of Short Aztec Era
Cenciacatl	42·46	13 + 29·5 = 42·5 Tonalpohualli's "week" + synodical month?	46	400 — 46 = 354 (= 12 × 29·5) i. e. common lunar year
Cemmolicpitl	24	16 × 24 = 384; 384 — 24 = 360 376 + 24 = 400	26	10 × 26 = 260 days of Tonalpohualli cycle
Centlacxitamachihualoni	16	24 × 16 = 384; 384 + 16 = 400	17·33	15 × 17·33 = 260 days
Cemmatzotzopaztli	13·71	29 × 13·71 = 384	14·8	?
Cemiztetl	10·67	36 × 10·67 = 384	11·6	10 × 11·6 = 116 days of Mercure cycle

iztetls respectively, may serve as convincing examples. There is no neccesity to describe in details all these evident correspondancies, since everybody may easily read them from the table 7.

Thus we shall limit ourselves to the following remarks:

a) the discovered astronomical correspondencies of *cemmitl*, *cenyollottli*, *centlacxitamachihualoni* and *cemiztetl* (when expressed in *iztetls*), as well as, in all the divisions into *cemmapilis*, can not be accidental or intentional artefacts, of the present author since they resulted from the canon of the human body which was based on the real anthropometrical proportions of 6 Amerindian tribes from Mexico;

b) the apparent connection of the divisions into *cemmapilis* with the lunar year of 384 days is fully concordant with the results of two idepended studies, one based on the numerical analysis of architectonical dimensions of the Sun and Moon pyramids from Teotihuacan, when expressed in *cemacollis* (A. Wierciński, 1976a) and, the second study on calendric significance of the Olmec mosais from Las Bocas (A. Marshack 1977);

c) all the calendric cycles which appeared in our reconstruction of the Nahuatl system of measures of length are precisely the same ones which have been discovered in the mentioned above analysis of Teotihuacan pyramids and are typical for ancient Mexico;

d) our findings agree with idea of mapping the astrological influences at the particular organs of the human body, evidenced by E. Seler (1953) in Codex Vaticanus A and Codex Borgia, and the same idea was functioning in the other centres of civilisation of the Old World.

Thus, the ancient Mexico shared with the Old World strictly analogical ideas of some more detailed representation of Macrocosmos in man.

5. THE EXAMPLE OF THE QUETZALCOATL'S PYRAMID FROM TEOTIHUACAN

At present, a new exemplification of a possible validity of our reconstruction of Nahuatl measures of lenght will be shown on the basis of the numerical analysis of the architectural dimensions of the so called pyramid of Quetzalcoatl from Teotihuacan. This pyramid is especially convenient object of study, since it must be attributed to both, Feathered Serpent and Tlaloc because their heads are present at the façades of the pyramid and, since the phases of the planet Venus, of which Lord was Quetzalcoatl, are of inequal time-lenght, what makes rather improbable a possibility of only accidental numerical correspondancies. The departure data were taken from the reconstruction of H. Harleston (1974) based on Millon's exhauctive survey of Teotihuacan. They are presented in the table 8. First look at the table leaves no doubt that the multiplicators of $\frac{383{\cdot}5}{100}$ and $\frac{341}{100}$ seem to play a fundamental role in bringing the dimensions of our pyramid into the correspondancies with astronomical cycles.

Table 8

Main architectonical dimensions of Quetzalcoatl's pyramid from Teotihuacan

Architectonical dimension	Harlestons' primary measurement (in.m.)	Slightly refined measurement in cemacollis	Difference between primary and refined measurement (inm.)	Measurement in c. divided by 3·835	Measurement in c. divided by 3·41	Measurement in c. divided by 5·84
Side of the pyramid's base	63·564	76·7	0·020	20	22·5	13·13
Height of each step (I—VI)	2·825	3·41	0·002	0·89	1	0·584
Total height of first 6 steps	16·95	20·46	0·011	5 1/3	6	3·5
Height of VII-th step	5·297	6·385	0·004	1 1/3	1·87	1·09
Total height of pyramid	22·247	26·845	0·008	7	7·87	4·6
Width of "Adosado"	50·85	61·38	0·034	16	18	10·5
Lenght of "Adosado"	33·9	40·92	0·023	10 2/3	12	7
Sum of diagonals of the pyramid's base	—	216·94	—	56·57	63·64	37·15
Sum of diagonals of the base of "Adosado"	—	147·54	—	38·47	43·27	25·26

As regards the first of these values, representing exactly the mentioned already lunar year of 13 months, the same discovery was made in the previous analysis of the Sun and Moon pyramids. But, what about the possible meaning of the second value? In our opinion, here must be hidden the relationship with the Venus synodical cycle of 584 days, because $3{\cdot}41 = \frac{584 \times 584}{10^5} = 5{\cdot}84 \times 0{\cdot}584$, what is also equal to 1/100th of the circumference of the circle formed by the diagonal of the base of the pyramid. i. e. to: $\frac{\pi \times 308{\cdot}5}{100}$, what corresponds to number of days of the "Underworld Venus" = 584—243, evidenced in Codex Borgia.

In any case, the direct correspondance with the Venus cycle show already the dimensions of the "Adosado" and the total height of the first 6 steps of the pyramid, while the total height of the pyramid relates 383·5 with 584, since $70 \times 383{\cdot}5 = 46 \times 584 - 2$.

It is possible that these basic numerical associations between Venus and Moon in the main dimenions of the pyramid with "Adosado" correspond symbolically with the association between the heads of the Feathered Serpent and the Rain God emerging from the facades?

But some more coincidencies will appear, when we shall proceed further with analysis.

Thus, the circuference of the base of the pyramid is equal to $4 \times 76{\cdot}7$ c. = 306·8 c. and $306{\cdot}8 = 80 \times 3{\cdot}835 = 118 \times 2{\cdot}60 = 84 \times 3{\cdot}6525$, i. e. there is included the fitting equation which relates lunar year with the full solar year and the sacral cycle of Tonalpohualli. In turn, the circumference of "Adosado", equal to 204·6 c., brings together the Venus cycle with the full solar year, because: $204{\cdot}6 = 35 \times 5{\cdot}84 = 56 \times 3{\cdot}6525$.

The latter correspondance might be very meaningfull, since it seems to refer to the life-span of 56 years of Quetzalcoatl Ce Acatl Topitzin, as it is evidenced by the IInd "report" on his deeds in Anales de Quauhtitlan [3]. If this hypothesis is not wrong, it would support the statement of W. Lehmann (1974) about the existence of, at least, two Quetzalcoatls as the historical figures, of which one was living in Teotihuacan times.

Also, worthy of notice it that the total sum of diagonals of the bases of the pyramid and "Adosado" is equal to $216{\cdot}94 + 147{\cdot}54 = 364{\cdot}48$ e., what corresponds to 365 days of the solar year, without the correction of 1/4 of a day. It has been undoubtedly used in ancient Mexico as the fitting cycle to Venus and Tonalpohualli according to well known equation: "Great Aztec Era" $= 104 \times 365 = 65 \times 584 = 146 \times 260$.

Another possible coincidence with the typical Mexican sacral cycle of 117 days= 9×15 (which connects the 13 Lords of Heaven with 9 Lords of the Underworld) brings the total length of the pyramid with "Adosado", equal to 117·57c.

But, where might be coded the particular phases of the Venus cycle which amount respectively:

— 243 days of visibility as the Morning Star,
— 77 days of invisibility, when upper conjuction occurs,
— 252 days of visibility as the Evening Star and,
— 12 days of invisibility, when the lower conjuction occurs,

and were noticed in the Codex Borgia (E. Seler 1953). In order to try to answer question, lest us consider the plan of the Citadel (fig. 2), taken from Harleston's paper and with some diameters expressed in *cemacollis*.

Thus the diagonals of the base of Quetzalcoatl's pyramid are located at the lines reaching the mid-points of the bases of the last small pyramids from the northern and southern rows. This distance amounts 360. Also, the distance of 360 c. spaces the midpoint of the central small pyramid from the eastern row, from the lins joining the centres of the mentioned above last pyramids of the side rows.

And now, if we accept 360 as the fitting number, the relations to particular phases ot the Venus cycle become visible, because:

— $360 - 117{\cdot}57 = 242{\cdot}43 \simeq 243$
— $360 - 108{\cdot}47 = 251{\cdot}53 \simeq 252$
— $360 - 26{\cdot}864 = 333{\cdot}14 \simeq 243 + 77 + 12$.

Moreover, even the side of pyramid's base = 76·7c. might correspond to the phase of 77 days.

Perhaps, some more coincidencies with the phases of Venus cycle would appear as well, if we would have at disposal the dimensions of particular bodies of the

[3] Namely, the verse 1587 a of *Anales de Quauhtitlan* says that: "auh in Topitzin empohualxiuhtl on eaxtolli ipan ce xihuitl" i. e. "And Topiltzin was 2 x 20, to this 15 and 1, years old" (see: Lehmann W. 1974).

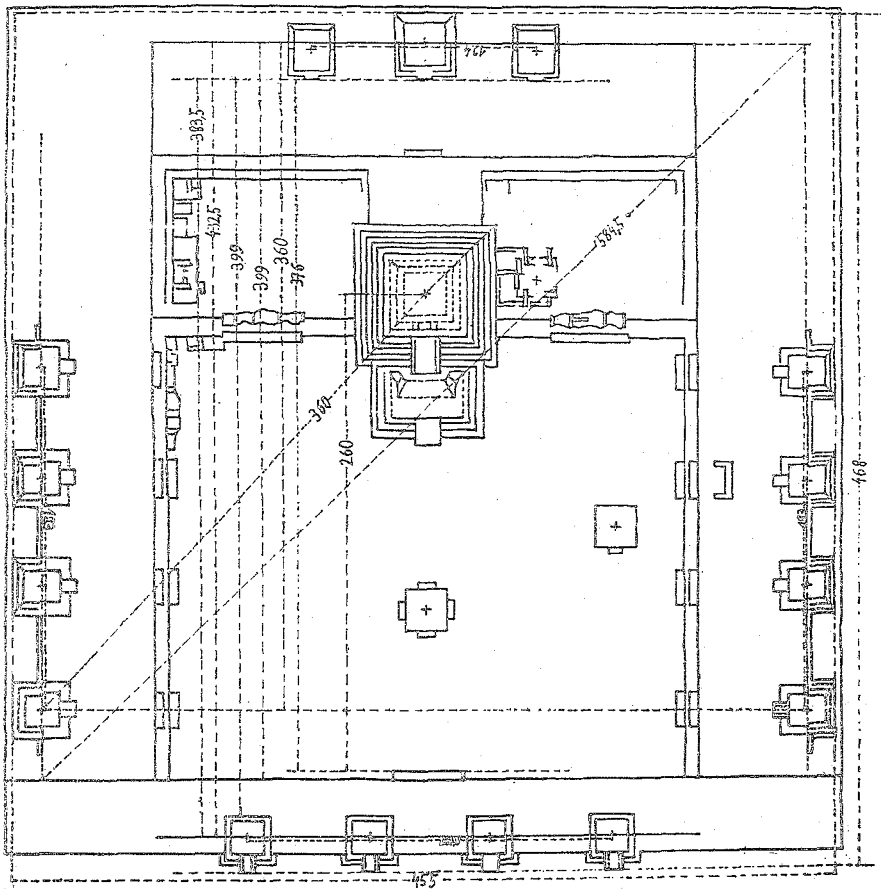

Fig. 2. The plan of "Citadel" from Teotihuacan with some dimensions converted into *cemacollis* (taken from Harleston 1974)

pyramid. At any rate, the discovered coincidencies with these phases seem to relate the architectonical structure of the pyramid of Quetzalcoatl with the phases of the wander of this god through various zones of the Underworld, represented in the Codex Borgia and so excellently interpreted by E. Seler (1953).

May be, worthy of emphasizing are also other probable, though uncertain, coincidencies with astronomical cycles represented in some dimensions of the Citadel, as it was indicated in the fig. 2, especially, the distance between the center of the Quetzalcoatl's pyramid and the eastern side of a monolith before the western row of the small pyramids which amounts to 260 c.

Finally, some concern should be devoted to the question of a possible use of the other measuring units in Teotihuacan which were mentioned in our reconstruction. Unfortunely, its solution demands very extensive numerical analysis, based on well founded statistical hypothesis. Here, we shall limit ourselves, only to the statement that the discovered astronomical correspondancies in the reconstructed system of measures of length, as well as, the relations between them, not rarely manifesting in integral numbers, should bring, more or less, to analogically sound results as revealed by the analysis in *cemacollis*.

Just one example may be selected for illustration. Thus, if the circumference of the base of Quetzalcoatl's pyramid, equal to 306·5 e. will be convered into *cemiztetls*, the following correspondancies will appear:

$$306{\cdot}8 \text{ c.} = 1380{\cdot}6 \text{ ci.} = 360 \times 3{\cdot}835 = 531 \times 2{\cdot}60 = 378 \times 3{\cdot}6526 = 177 \times 780$$

(i. e. Mars cycle).

Therefore, it is impossible to overjudge which of the assumed here units of measure was the main for the builders of Teotihuacan. For the sake of simplicity, such role will be admitted for *cemacolli* and its 1/100 th part = 0·829 cm. what brings the coincidencies with astronomical cycles to total number of days.

At the end of this part of the study, it is worthy of noties that our results of the numerical analysis of architectonical dimensions from Teotihuacan are concordant with analogical results obtained for Angker Vat by R. Stencel, F. Gifford and E. Moron (1976) who published them one year later after the first preliminary study of the Sun pyramid of the present author (A. Wierciński 1974—1975).

5. THE QUESTION OF HARLESTON'S "HUNAB"

In the light of the presented here analysis of architectonical dimensions of Quetzalcoatl's pyramid, together with previously received results for the Sun and Moon pyramids, the relation of *cemacolli* = 82·9 cm. to so called "Hunab" of Harleston may be precised.

Thus, the mathematical analysis of c. 200 principal Teotihuacan measurements made by Harleston in 1974 has shown that their averaged metric values approximate integral numbers when divided by 105·9463 cm. Consequently, Harleston regarded this length (="Hunab") as the main unit of measure used by Teotihuacan architects. Incidentally, it is one 12-millionth of the Earth's polar diameter. However, one only numerical coincidence between two different objects can not serve as the argument in favour of such working hypothesis that these architects knew the polar diameter of the Earth, if the probabilistic standpoint is being accepted. Moreover there is a lack of any scrap of evidence which could support such a hypothesis in a qualitative way. In any case, further discussion on the possible level of knowledge of Teotihuacan priests is beyond the scope of this paper. However, how to explain the very discovery of Harleston that his "Hunab" brings dimensions to integral numbers? In order to answer this question, let us recall that one of the main common divisors revealed by our analysis, was the lenght of 3·835 c. corresponding to lunar year of 13 months.

And presisely:

$$\frac{1 \text{ Hunab}}{1 \text{ cemacolli}} = \frac{105{\cdot}9463 \text{ cm.}}{82{\cdot}9 \text{ cm.}} = \frac{3{\cdot}835}{3} = 1{\cdot}278, \text{ while:}$$

$$3\text{H.} = 3{\cdot}835 \text{ e.}, \ 1\text{H} = \frac{3{\cdot}835 \text{ c.}}{3} \text{ and } 1\text{c.} = \frac{3\text{H.}}{3{\cdot}83}.$$

Of course, the use of "Hunab" as the measuring unit in Teotihuacan can not be excluded. Unfortunately, in spite of all efforts, it was impossible to derive, up to now, Harleston's "Hunab" from the accepted canon of the human body. The diameter from the waist to basis, with standard stature = 165·8 cm., may serve as one of very uncertain suggestions.

6. INSTEAD OF ACKNOWLEDGEMENTS

At the very end of all these considerations, the present author wants to emphasize that without Castillo's excellent work, the new attempt of reconstruction of the Mexican system of measures of length would be practically impossible while without Harleston's exhaustive analysis of architectonical dimensions of Teotihuacan, the numerical analysis of 3 main Teotihuacan pyramids in cemacollis would be impossible as well.

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