ON METOPISM OF CHINESE SKULLS AND ITS RELATION TO THE SIZE OF CRANIAL MEASUREMENTS.

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The object of the present paper is twofold: (a) to determine the incidence or frequency of metopism occurring in the Chinese crania and to compare its percentage distribution among various races, and (b) to ascertain the quantitative relations of this anomaly to the size of the cranial measurements.

The material dealt with consists of 358 modern Chinese crania of both sexes obtained four years ago in the public graveyards of Lien Hua Ch'ih near the northwestern gate of Kunming. They are all of adult specimens, those of which the third molars are not fully erupted or the basilar sutures still open were entirely excluded. Out of the total, 237 are males and the remaining 121 females. For the purpose of comparison, the specimens are divided into two groups, metopic and non-metopic. The metopism or a persistent metopic suture, as well known is defined as an anomaly found by the non-union of the two lateral halves of the frontal bone along the median line of the forehead In the present study the specimens with the complete interfrontal suture from the bregma to nasion were recorded, while those showing some trace at the upper, middle or lower parts of its course not considered.

In the first place, we will consider the incidence of this anomaly in our Chinese specimens. Of the 358 skulls examined, we found that 49 male and 14 female specimens show undoubted metopic sutures. The percentage of metopism is thus 14.8 in males, 11.6 in females, or 13.7 in all. It is the highest value ever found for this feature. The percentages of previously published materials for different racial series were separately shown in Table I. The material includes 33 series representing some principal races in different parts of the world. It will be seen that their values vary considerably from 1.0 to

13.7. In the European group, the range of percentages amounts to 6.0. For the convenience of comparison the values of individual series are averaged in accordance with the general racial stocks. The mean percentages for six racial groups are given below:

Racial groups:	Weighted mean percentages:
Australian (1)[1]	1.0
Negro (2)	1.2
American Indian (4)	1.6
Malay and Melanesian (4)	3.0
Mongolian (3)	7.4
European (19)	9.1
All races (33)	8.0

It is clear that the Australians have the least vaule. The percentages for Negroes, American Indians, Malays and Melanesians increases gradually from 1.2 to 3.0. The average value of the Mongolian group lies intermediately between the above mentioned groups and the Europeans, and the mean of the last is the largest. If comparing the percentages of metopism for separate series, the Chinese, though belonging to the Mongolian group, have the largest value among all.

With regard to the origin of the metopic fontanell, several explanations have been given by previous authors, notably, Schultz, Maggi, Zanotti,Rauber, Schwalbe and Martin. The one which has customarily been accepted is that advocated by Schwalbe. He attributed this anomaly to some progressive variation which bears a relation to the greater development of the frontal lobe of the cerebrum. A greater percentage of incidence of the anomaly has usually been found in the more highly civilized races. The fact gave rise with some authors to the view that metopism is the product of a strongly developed brain representing one of the signs of racial superiority. If Schwalbe s hypothesis would be accepted, the Chinese race, then should be at

(1) The figures in the bracket indicate the number of the series pooled.

Table I. Percentages of Metopism as Found for Different Races.*

Faces	No of cases	per cent	Authors
Australians	193	1.0	Anutschin
Congo Negroes	93	1.0	Bartels
North Americans	1127	1.1	Russell
Peruvians	438	1.1	Russell
Negroes	959	1.2	Anutschin
Americans	426	1.2	Anutschin
Burmese (A, B & C)	142	1.4	Tildesley
Filipinos	619	2.2	Limson
Malays	422	2.8	Anutschin
Melanesians	693	3 4	Anutschin
Peruvians	563	3.5	Anutschin
Papuans	209	4.3	Regolia
Mongols	621	5.1	Anutschin
Bavarians	144	6.3	Ried
Slavs	1093	6.1	Gruber
Swiss (Disentis)	250	7.1	Wettstein
English (Moorfields)	103	7.4	Macdonell
Bavarians	2535	7.5	Ranke
East Prussians	804	7.9	Springer
Russians (Charkow)	210	8.0	Popow
English (Whitechapel)	275	8.0	Macdonell

* Series which consist of less than 80 cases were excluded.

Table I. Percentages of Metopism as Found for Different Races.

(continued)

Races	No. of cases	per cent	Authors
Europeans	10781	8.7	Anutschin
Tyrolese	827	8.8	Frizzi
English (Spitalfields)	668	9.3	Morant
Germans (Hamburg)	809	9.5	Simon
Scottish	750	9.5	Bryce
Parisians	10000	9.9	Topinard
English (Farringdon St.)	157	10.0	Hooke
Parisians	1336	10.4	Papiliault
Portuguese	1000	10.6	Marchado
Pompeiians	93	10.7	Schmidt
Germans	567	12.3	Weicker
Chinese	358	13.7	Woo

least as superior as the European. But whether different percentage values of metopism simply indicate the racial differentiation of the anatomical constitution of this particular suture or connote the rank of the racial superiority, are problems deserving further research.

The second point we consider is to determine the quantitative relationship between metopism and the sizes of different cranail measurements. The subject has long been investigated by many authors. But the majority of earlier studies in this respect led to somewhat divergent results owing to the fact that the characters examined were too few in number and the methods of comparison not consistent. Calmette and Welcker stated that metopism is more frequently found in brachycephalic than in dolichocephalic, but both Bryce and Limson based on their Scottish and Filipino specimens showed that

this anomaly has no certain relations to the shape of the head. Bolk, Welcker, Papiliault, Morant and Hooke observed that the maximum head breadth and maximum and minimum frontal diameters of the metopic skulls on the average are greater than the corresponding characters for the non-metopic specimens in the same series, but on the contrary, Limson found that only a slight or insignificant difference of the least frontal diameter between two groups was obtained. Schwalbe, David, Fischer and Schultz all asserted that the metopic crania have a larger value of interorbital width and its index, and similar result was reached by Limson. Fischer based on a few specimens reported that the capacity of the metopic crania is larger than the average cranial capacity, but Limson's study of a larger sample of the Filipino crania yeilded a divergent result.

In order to determine the quantitative relations of metopism to these cranial characters more accurately, 21 absolute and 5 relative measurements which have customarily been adopted in the routine description of the crania were taken by an identical method on the two groups of the present series. The absolute characters include: (1) maximum cranial length, (2) maximum cranial breadth, (3) basio-bregmatic height, (4) horizontal circumference, (5) transverse cranial arc, (6) sagittal cranial arc, (7) frontal chord, (8) frontal arc, (9) least frontal breadth, (10) maximum frontal breadth, (11) inner biorbital breadth, (12) interorbital breadth, (13) biasteric breadth, (14) upper facial height, (15) bizygomatic breadth, (16) nasal height, (17) nasal breadth, (18) maxillary breadth, (19) palatal length, (20) palatal breadth and (21) cransial capacity. The relative characters consist of (1) cephalic index, (2) facial index, (3) nasal index, (4) palatal index and (5) interorbital index. The last is defined to be 100xinterorbital breadth / inner biorbital breadth. In Table II are provided the means of all characters for metopic and non-metopic groups. The mean differences of each character between these two groups and the rations of these differences to their corresponding probable errors are also shown in the same table. A glance of the ratios given in the last column of the table will convince us to say that there are six absolute and one relative characters with significant differences between the metopic and non-metopic groups. In other words, they are affected in their sizes by the incidence of the metopic suture. For the metopic group, the maximum

cranial breadth, and the maximum and minimum frontal breadths are markedly greater. The results are similar to that obtained by Bolk, Wecker and several other authors. The average capacity of the metopic crania is greater and their interorbital breadth wider, interorbital index larger. These accord well with the previous findings of Schwalbe, David, Fischer and Schultz. It is of interest to note that the frontal chord is negatively correlated with the metopic feature. It means that the frontal bone with this anomaly is broader in width, but shorter in length. However, the shape of the head or cephalic index holds no relation to this anomaly so far as judged from the present materials. The innerorbital breadth, horizontal circumference and transverse arc are all slightly influenced by the incidence of metopism.

In view of the results arrived at we may conclude here that the incidence of metopism of the Chinese crania is considerably high (13.7%), and that the metopic crania increasing or decreasing their sizes in different parts depend wholly upon the kind of characters dealt with. Of the 26 characters compared, both absolute and relative, we found that maximum cranial breadth, cranial capacity, maximum and minimum frontal diameterse, interorbital width and its index and frontal chord are significantly affected by the incidence of this anomaly. For the metopic group, the size of the first six characters is broader or larger while that of the last shorter.

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Table II. Comparison of Mean Characters between the Metopic and Non-metopic Groups of the Kunming Crania.

I. Character	II. Metopic		III. Non-metopic		IV. Difference	V. P. E of	VI. Ratio
	mean	no.	mean	no.	(II—III)	difference	(IV÷V)
Frontal chord	106.92±0.52	49	109.35±0.21	309	—2.47	0.55	—4 49
Palatal length	39.86±0.33	33	40.70±0.13	211	—0.84	0.35	—2.40
Palatal breadth	42.24±0.31	41	42 90±0.12	270	—0.66	0.33	—2.00
Upper facial height	70.50±0.48	41	71.39±0.19	250	—0.89	0.52	—1.71
Frontal arc	122.32±0.63	49	123.39±0.25	309	—1.07	0.68	—1.57
Nasal breadth	25.84±0.19	49	26.01±0.08	305	—0.17	0.21	—0.81
Basio-bregmatic height	131.61±0.48	49	131.64±0.19	305	—0.03	0.52	—0.06
Nasal height	52.04±0.32	49	52.03±0.13	309	0.01	0.34	0.03
Maxillary breadth	96.84±0.47	47	96.74±0.19	306	0.10	0.51	0.20
Biasteric breadth	107.52±0.49	49	107.24±0.19	309	0.28	0.53	0.53
Maximum cranial length	177.80±0.62	49	176.96±0.25	309	0.84	0.67	1.19
Sagittal cranial arc	369.40±1.35	40	366.65±0 55	298	2.75	1.46	1.38
Bizygomatic breadth	130.90±0.57	42	128.72±0.23	262	1.18	0.61	1.93
Transverse cranial arc	311.66±0.98	49	308 81±0.39	309	2.85	1.05	2.71
Horizontal cranial circumference	512.74±1.38	49	503.59±0.55	303	4.15	1.49	2.79
Inner orbital breadth	96.21±0.48	47	94.68±0.19	308	1.53	0.52	2.94
Maximum cranial breadth	139.52±0.59	49	137.40±0.24	309	2.12	0.64	3.31
Cranial capacity	1420.72±13.39	43	1360.26±5.30	306	51.46	14.40	3.57
Minimum frontal breadth	93.04±0.47	49	89.57±0.19	307	3.47	0.51	6.80
Interorbital breadth	22.52±0.23	49	20.45±0.09	305	2.07	0.25	8.23
Maximum frontal breadth	118.03±0.56	49	112.90±0.22	303	5.13	0.60	8.55
Upper facial index	72.71±0.53	39	73.83±0.21	248	—1.12	0.56	—2.00
Nasal index	49.81±0.44	43	50.17±0.18	305	—0.36	0.48	—0.75
Palatal index	95.77±0.96	31	95.11±0.37	207	0.66	1.03	0.64
Cephalic index	78.55±0.40	49	77.75±0.16	309	0.80	0.43	1.86
Interorbital index	23.34±0.22	47	21.56±0.08	306	1.78	0.23	7.74