

**Anatomy.** — *Indices for the anthropology of the brain applied to Chinese, dolicho- and brachycephalic Dutch, fetuses and neonati.*  
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(Communicated at the meeting of November 27, 1926.)

The results attained hitherto in the study of the brains of different races and types are disappointing to students of the subject.

Even the variations in cerebral morphology, that have been described in types of the same country are based more on general impressions than on exact measurements.

The best researches in this respect are CALORI's<sup>1)</sup>, who, besides giving the weight and surface figures of a great number of brachycephalic and dolichocephalic Italian brains, also tried to express the general type of those brains by means of the length-breadth index, the bitemporal diameter, and the shape of the fronto-occipital arch, which he indicated by its length, its cord and its perpendicular without, however, simplifying these in indices (l.c. p. 55.).

CALORI also examined the convolitional pattern in dolichocephalics and brachycephalics, but without obtaining important general results.

RÜDINGER<sup>2)</sup> called attention to the shortening of the longitudinal convolutions in brachycephalic brains, associated with a prolongation of the transverse convolutions, and the frequent appearance of angular curves in the former.

MEYER<sup>3)</sup> pleaded the mechanical cause of these phenomena on account of a study of a pathological case with growth repression of the posterior part of the skull, in consequence of which the transverse furrows in that region were more than usually pronounced, some of them (as the s. temporalis) even being opercularised<sup>4)</sup>.

ZUCKERKANDL<sup>5)</sup> reached the same conclusions, considering a precocious closing of the sutures an important factor in shaping the brain.

Exact information about the general shape of the brain among non-European races is very rare. Most of the authors on that subject have also confined themselves to descriptions of furrows and convolutions.

Though there is occasional information about the general shape of the brain, especially concerning the Mongols, (PARKER and MILLS<sup>6)</sup>,

1) CALORI. Del cervello nei due tipi brachicefalo e dolicocefalo italiani. Memorie dell'Accademia delle Scienze dell'istituto di Bologna. Seconda serie, 10, 1870.

2) RÜDINGER. Gehirnwindungen bei Lang- und Kurzköpfen und bei verschiedenen Geschlechtern. Korrespondenzbl. der Deutschen Gesellsch. f. Anthrop. u. Ethnol., 1877.

3) MEYER. Ueber den Einfluss der Schädelform auf die Richtung der Grosshirnwindungen. Zentralblatt f. die med. Wiss., Jahrg. 14, 1876.

4) I also made this observation a few times among my Chinese brains.

5) ZUCKERKANDL. Ueber den Einfluss des Nahtwachstums und der Schädelform auf die Richtung der Gehirnwindungen. Wiener med. Jahrbücher, 1883.

6) PARKER and MILLS. Preliminary studies of a Chinese brain. Journ. of nervous and mental diseases, Vol. 13, 1886.

DERCUM <sup>1)</sup>, RETZIUS <sup>2)</sup> and KURZ <sup>3)</sup>), indices, which enable us to make exact comparisons, are nowhere to be found.

The result is even more disappointing when one sees the poor state of preservation of some of the brains hitherto described as appears from in the pictures.

I do not blame the authors for this, as the brains they described have generally been preserved by others.

How shall we obtain anthropological data concerning the brain, approaching in exactness, the anthropological measurements of other parts of the body?

In the subsequent pages I will present some indices, that seem to be useful for this purpose.

In the first place, however, I must emphasize that more attention should be given to the fixation and preservation of the brain.

The best way to fix the brain is to inject 10% formalin into the carotids, before taking it out, and transporting it in the skull.

If, however, this cannot be done, one can, after taking the measurements of the skull, remove the brain under water, thus neutralizing its weight and avoiding lesions due to pressure.

The organ should be suspended by the arteria basilaris in a vessel, containing sufficient 10% formalin to prevent its touching the walls. It remains there at least one month, the liquid being weekly renewed. Then it should be photographed from the dorsal, ventral, frontal and lateral side, and subsequently cut in the sagittal midline with a long knife and photographed again laterally and medially, so that the axis of the photographic apparatus stands perpendicularly on the medial brainwall.

After this, it may be forwarded in moist formalincotton so that the flat mesial side of the brain lies on the bottom of the container, separated from the bottom by a thin and even layer of cotton and covered plentifully with a similar, but heavier layer of moist cotton at the other sides.

On the box in which it is sent should be a label, stating which side is to remain up (the mesial side of the brain should always be down).

These instructions are so simple, and at the same time so necessary, that it seems superfluous to write them down, were it not that practice has proved that they are generally neglected <sup>4)</sup>.

After this the general morphology may be recorded in the following way :  
The general relations to be measured on the brain itself, are the greatest

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<sup>1)</sup> DERCUM. A description of two Chinese brains. Journ. of nervous and mental diseases, Vol. 16, 1889.

DERCUM. Note on a Chinese brain. Ibidem Vol. 19, 1892.

<sup>2)</sup> RETZIUS. Das Gehirn eines Lappländers. Internationale Beiträge zur wissenschaftlichen Medicin. Festschr. f. R. Virchow. Bnd. I, 1891.

<sup>3)</sup> KURZ. Zwei Chinesengehirne. Zeitschr. f. Morphologie und Anthropologie. Bnd. 16, 1913.

KURZ. Das Chinesengehirn. Zeitschr. f. Anatomie und Entwicklungsgeschichte. Bnd. 72, 1924.

<sup>4)</sup> The meninges are best removed after the brain has been in formalin for a few days. It may be a little easier immediately before fixation, but then there is a greater chance of disforming the brain.

The removal of the meninges should also be done under water.

transverse diameter and the greatest length (brainindex), the diameter between the triangular opercula (frontal diameter) and the greatest bitemporal diameter.

The other indices can be best measured on the photographs of the lateral and the medial sides. For these, the following lines (see figs. 1 2, 3, 4, 5, 6, 7, 8) should be drawn:

*Laterally:*

1. A line connecting the basis of the operculum orbitale with the basis of the lobus occipitalis: the *lateral horizontal*.

On this line the following perpendiculars are traced:

2. the perpendicular along the anterior pole of the frontal lobe: the *frontal perpendicular*.

3. the perpendicular along the anterior pole of the temporal lobe: the *insular perpendicular* (measured from the top to the lateral horizontal).

4. the perpendicular from the highest point of the parietal lobe: the *parietal perpendicular*.

5. the perpendicular along the posterior pole of the occipital lobe: the *occipital perpendicular*.

6. the perpendicular from the utmost ventral part of the temporallobe: *temporal perpendicular*.

*Medially:*

7. the line connecting the basis of the splenium with the basis of the genu corporis callosi: the *basal callosum line*.

8. the perpendicular from the highest point of the corpus callosum upon this line: the *callosum perpendicular*.

9. the line between the most frontal and most caudal points of the callosum: the *callosumlength*<sup>1)</sup>.

10. a line parallel with the bottom of the fourth ventricle to the basal callosumline: the *stemaxis*.

By the use of these lines, which should be measured with the nonius, the following indices may be calculated:

A. The *general height index* of the brain, being the parietal perpendicular divided by the lateral horizontal.

B. The *occipital index*, being the parietal perpendicular, divided by its distance to the occipital perpendicular.

C. The *temporal index*, being the temporal perpendicular divided by the lateral horizontal.

D. The *frontal height index*, being the insular perpendicular, divided by its distance to the frontal perpendicular.

E. The *frontal length index*, being the distance from the insular to the frontal perpendicular divided by the lateral horizontal.

<sup>1)</sup> In my photographs this line is drawn over the whole cerebrum for reasons of no importance here.

F. The *callosum index*, being the callosum perpendicular, divided by the callosumlength.

G. The *stemangle*, being the frontal angle between the stemaxis and the basal callosumline.

The lateral horizontal, furthermore, permits a measurement of the ventral extension of the *rostrum orbitale*.

The following tables contain the figures thus found in some dolichocephalic Dutch, some Chinese, some brachycephalic Dutch and some foetuses and neonati.

Dolichocephalic Dutch brains.

Origin	L.B. index Brain	Height index	Occipital ind.	Tempo-ral ind.	Frontal height index	Frontal length index	Callosum height
W.G. 15296	75.2	0.487	1.15	0.142	1.91	0.227	0.315
W.G. 15302	76.8	0.457	1.37	0.130	1.74	0.233	0.261
Garens	77.0	0.486	1.15	0.130	1.84	0.224	0.327
W.G. 15297	77.2	0.477	1.08	0.175	1.85	0.214	0.314
W.G. 15258	78.5	0.520	1.14	0.136	1.88	0.241	0.300
W.G. 15256	79.8	0.507	1.28	0.162	1.85	0.252	0.370
W.G. 15244 A	80.3	0.501	1.18	0.143	1.90	0.230	0.357
Average:		0.491	1.19	0.145	1.85	0.231	0.321

That the number of brains mentioned in this table (I disposed in total of 22 Chinese brains and many more dolichocephalic Dutch brains and foetuses) is not larger, depends on the fact that I have used only the best preserved material for this purpose.

Comparing the average figures of the dolichocephalic Dutch with those of the Chinese, we see that all perpendicular indices in the Chinese are greater, the general height index (Chinese: 0.535, Dol. Dutch 0.491) as well as the occipital (Chin. 1.56, D. Dutch 1.19), temporal (Chin. 0.166, D. Dutch 0.145) and the frontal height index (Chin. 1.93, D. Dutch 1.85).

The average callosumheight is also larger in the Chinese than in the dolichocephalic Dutch (Chin. 0.383, D. Dutch 0.321), (thus confirming Dr. MA WEN CHAO's<sup>1)</sup> interesting observation).

The stemangle in the dolichocephalics here used is not recorded in my table, because I had removed the cerebella, for my researches on

<sup>1)</sup> A comparison of the form of the callosum and septum in the Chinese, Philippino and Dutch brains. These Proceedings, Vol. XXX, Febr. 1927.

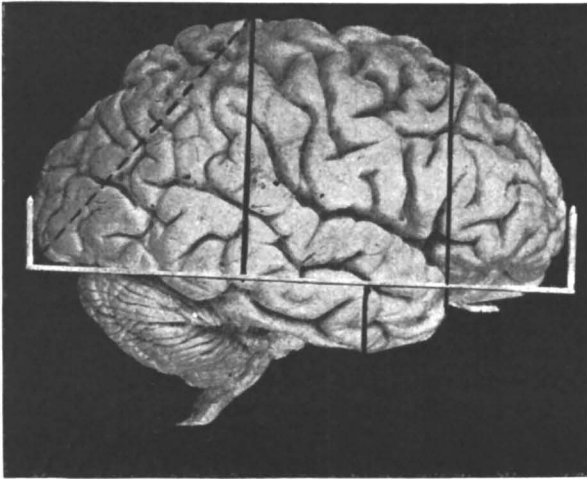


Fig. 1. Dolichocephalic Dutch cerebrum. Right hemisphere, lateral side (Garens).

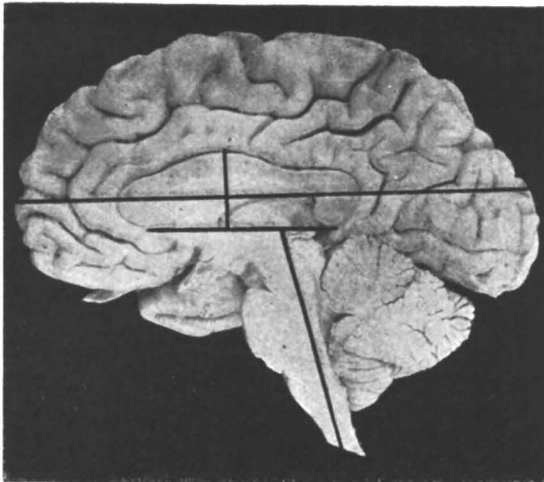


Fig. 2. The same. Mesial side.

Chinese.

Origin	L.B. index Brain	Height index	Occipital ind.	Tempo-ral ind.	Frontal height index	Frontal length index	Callos. height	Stem-angle
N. Chin. 11	75.3	0.524	1.43	0.160	1.90	0.214	0.420	100°
N. Chin. 7	75.4	0.525	1.52	0.180	1.94	0.216 <sup>1/2</sup>	0.423	105°
N. Chin. 21	77.7	0.557	1.40	0.135	1.92	0.254	0.360	104°
N. Chin. 15	81.2	0.534	1.82	0.193	1.91	0.226	0.360	99°
N. Chin. 18	86.6	0.536	1.61	0.163	1.98	0.206	0.350	100°
Average:		0.535	1.56	0.166	1.93	0.223	0.383	101 <sup>3</sup> / <sub>5</sub> °

the relative cerebellar weights <sup>1)</sup>, before photographing them, and I am not sure that the stemangle has not changed by this manipulation.

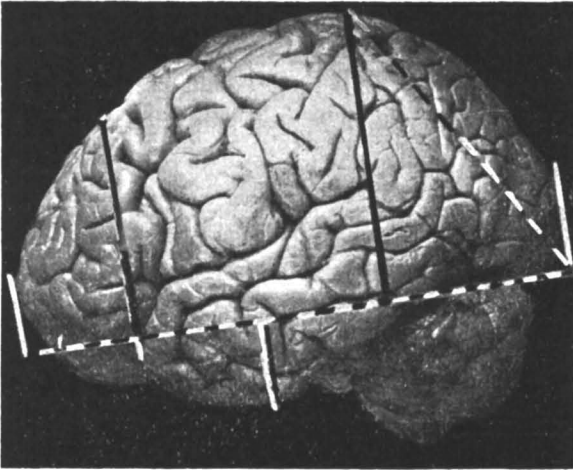


Fig. 3. Northern Chinese.  
N<sup>o</sup>. 18.  
Left hemisphere, lateral side

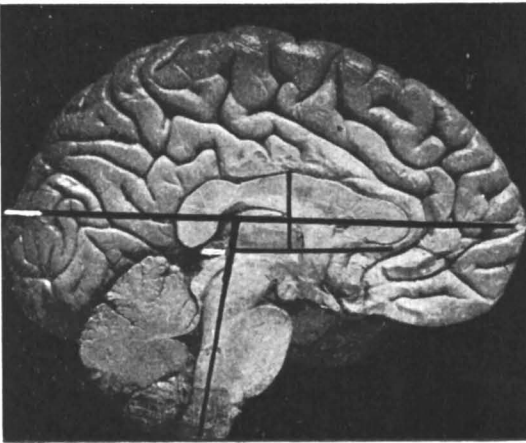


Fig. 4.  
The same. Mesial side.

In other dolichocephalic material (among which one examined in the halved skull) I found an average stemangle of at least  $106^{\circ}$ , while the average in my Northern Chinese is only  $101\frac{3}{5}^{\circ}$ . The narrow fossa interpeduncularis thus arising in the Chinese also struck KURZ (l.c.).

These figures illustrate the fact which I pointed out before <sup>2)</sup>, namely, that the explanation of this phenomenon is to be found especially in the antero-posterior shortness and dorsal height of the Chinese brains (and skulls); in other words in the hypsicephalic type of the Chinese.

<sup>1)</sup> These Proceedings, Vol. 28, 1925.

<sup>2)</sup> ARIENS KAPPERS. Over de hersenen der Chineezzen. Ned. Tijdschr. v. Geneesk. 1926. — Eerste helft, no. 11, p. 8.

While the Central-Asiatics are more brachycephalic, the Chinese are more hypsicephalic. MOCHI<sup>1)</sup> called the Samoyedes platybrachycephalic (as also the Kalmucks, Kirgeese and Tartars) while he calls the Chinese hypsi-mesati-brachycephalic.

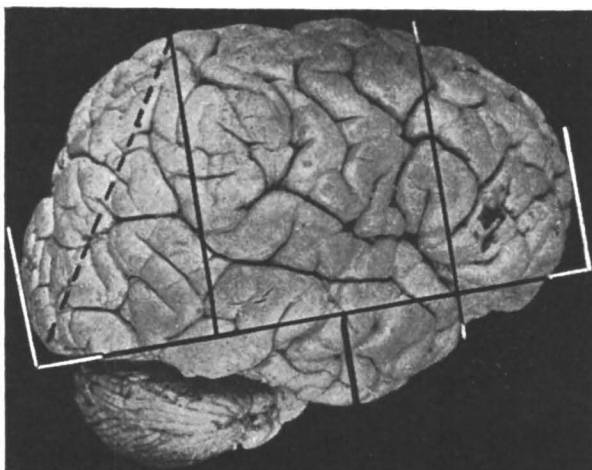


Fig. 5.  
Dutch, brachycephalic.  
Right hemisphere, lateral side.  
Velt.

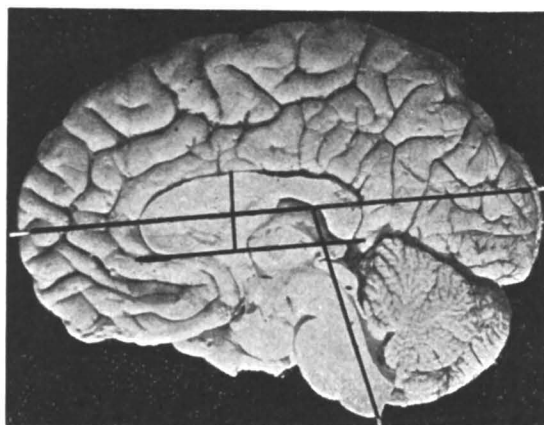


Fig. 6.  
The same. Mesial side.

REICHER<sup>2)</sup> gives as the breadth height index in Buriates 85,9 and in the Kalmucks 87,5, whereas according to the same author this index in the Chinese is 97,7 and, according to KOGANEI<sup>3)</sup> even 100,2.

Now, reviewing the figures found in exquisite brachycephalic Dutch brains it is evident that they approach those of the Chinese.

1) MOCHI. Cranii cinesi e giapponesi. Arch. per l'Antropologia, Vol. 38, 1908 p. 324: "Dei cranil cinesi alcuni pochi sono simili per forma ai Samoiedi, ma la grande maggioranza ne differisce notevolmente per lo sviluppo in altezza".

2) REICHER. Untersuchungen über die Schädelform der alpenländischen und mongolischen Brachycephalen. Bnd. 15 u. 16 Zeitschr. f. Morphol. u. Anthropol. 1913, p. 59.

3) KOGANEI. Messungen an männlichen Chinesen Schädel. Zentralblatt für Anthropologie Bnd. 7, 1902, p. 129.

## Dutch Brachycephalics,

Origin	L.B. index Brain.	Height index	Occipital ind.	Temporal ind.	Frontal height index	Frontal length index	Callos. height	Stem-angle.
Bo	84.8						0.369	97°
Le	85.5	0.451	1.46	0.135	1.73	0.241	0.337	st. cut off
Go	87	0.512	1.20	0.182	1.99	0.230	0.434	103°
Velt	89.87	0.536	1.64	0.164	1.90	0.240	0.366	101°
Krijt	90.24	0.591	1.50	0.160	1.93	0.262	0.402	st. cut off
Average:		0.522 <sup>1</sup> / <sub>2</sub>	1.45	0.160	1.88	0.243	0.382	100 <sup>1</sup> / <sub>3</sub> °

Putting the average figures next each other we get the following review:

Brain-Indices	Chinese	Dutch Brachycephalics	Dutch Dolichocephalics
Height index	0.535	0.522 <sup>1</sup> / <sub>2</sub>	0.491
Occipital index	1.56	1.45	1.19
Temporal index	0.166	0.160	0.145
Frontal height index	1.93	1.88	1.85
Callosum height	0.383	0.382	0.321
Stemangle	101 <sup>3</sup> / <sub>5</sub> °	100 <sup>1</sup> / <sub>3</sub> °	106°

From this it is evident that in these relations the brachycephalic Dutch are nearer to the Chinese than the dolichocephalic Dutch. This is not strange, as in both the Chinese and the brachycephalic Dutch the skull is *relatively* short. Though in the Chinese this is compensated for particularly by the height, and in the brachycephalic Dutch more by the breadth of the brain (Dutch brachycephalic are not really hypsicephalic), it is apparent that the height indices have increased to some extent in Dutch brachycephalics also, though not nearly as much as in the Chinese.

If, however, I compare my most brachycephalic brains (*Velt* and *Krijt*) with those of the Chinese, these indices approach or even excel those of the Chinese.

Among the Dutch such indices are only found in strongly brachycephalic individuals, whereas they occur in mesaticephalic Chinese.

Apparently this is to be explained by the fact that the brains of the



Brain-Indices	Average of my Northern Chinese	Velt 1)	Kryt 1)
L. B. Index	79.20	89.87	90.24
Height index	0.535	0.536	0.591
Occipital index	1.56	1.64	1.50
Temporal index	0.166	1.64	1.60
Frontal height index	1.93	1.90	1.93
Callosum height	0.383	0.366	0.402
Stemangle	101 $\frac{3}{5}$ °	101°	Stem cut off.

Dutch brachycephalics extend more laterally and less in height than those of the Chinese, so that only a part of the relative shortening of the Dutch brain is compensated for by an increase in height.

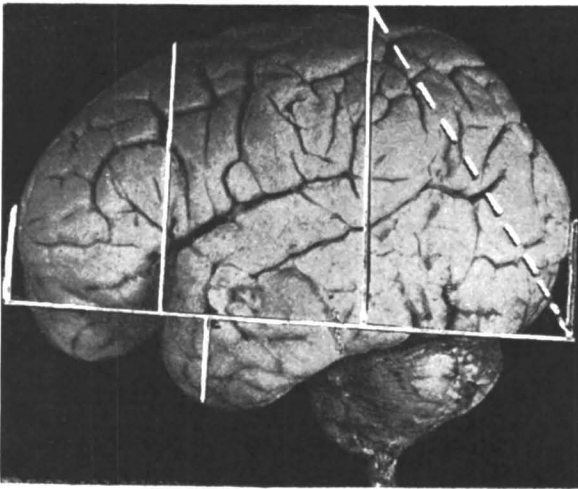


Fig. 7. Child two months of age. Left hemisphere, lateral side.

KURZ is inclined to derive the form of Chinese brain from that of the Orang Utang, which (in addition to the Gibbon) is the only Asiatic anthropoid. One need not go so far, however, as to accept a different anthropoid ancestry for the Chinese and the Caucasians.

As I pointed out already some years ago the general morphology of the human brain about the time of birth resembles that of the brachycephalic Dutch and especially that of the Chinese.

1) The skull indices of Velt and Kryt, according to the measurements, made in the pathological institute at Groningen, were 87, 87 and 88.

I wish to express my thanks to Prof. DEELMAN and Dr. DIJKSTRA for giving me these figures and these brains.

So calculating the above mentioned indices in foetuses shortly before

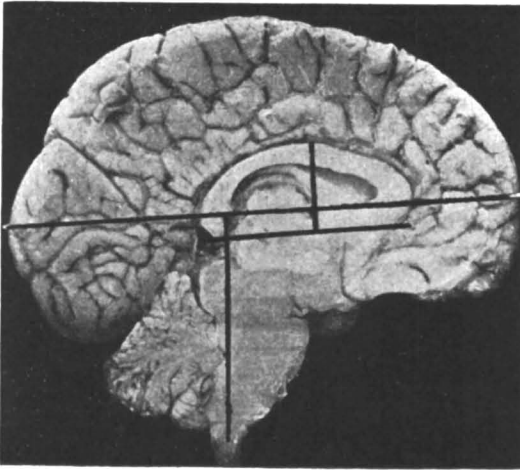


Fig. 8.  
The same. Mesial side.

birth, in neonati and young individuals, again using only well preserved material, I get the following figures:

Foetus and Neonati.

Origin	Height index	Occipital ind.	Temporal ind.	Frontal height index	Frontal length index	Callos. height	Stem-angle
Foetus 45 cM.	0.622	1.54	0.154	1.91	0.290	0.434	cut off
Praemature (4 weeks)	0.596	1.54	0.142	1.86	0.284	0.424	92°
Neonatus nearly à terme	0.592	1.60	0.144	1.90	0.272	0.366	cut off
Neonatus à terme	0.564	1.33	0.181	1.71	0.286	0.355	93° 1)
Child 2 months	0.564	1.50	0.164	1.74	0.260	0.433	93°
Child 4 months	0.577	1.30	0.155	1.81	0.282	0.402	106°
Average:	0.586	1.47	0.157	1.82	0.279	0.402	96°

Arranging these average figures next to the average figures of the Chinese, brachycephalic and dolichocephalic Dutch, it appears that the indices found in foetuses and neonati, excepting the frontal height index<sup>2)</sup> are larger than those in the dolichocephalic Dutch. They resemble those in the brachycephalic and Chinese, and their general height and callosum-indices, even surpass those of the Chinese.

1) Another neonatus measured in the skull had a stemangle of 98 0/0.

2) The frontal height-index of foetuses and neonati cannot be compared with those of the adult, as the temporal lobe still grows out in a frontal direction in postfoetal life, and thus this perpendicular in the adult is displaced in a frontal direction.

Brain-Indices	Chinese	Dutch Brachycephalics	Foetuses and Neonati	Dutch Dolichocephalics
Height index	0.535	0.522 <sup>1</sup> / <sub>2</sub>	0.586	0.491
Occipital index	1.56	1.45	1.47	1.19
Temporal index	0.166	0.160	1.57	0.145
Frontal height index	1.93	1.88	1.82	1.85
Callosum height	0.383	0.382	0.402	0.321
Stemangle	101 <sup>3</sup> / <sub>5</sub> °	100 <sup>1</sup> / <sub>3</sub> °	96°	106°

This result corresponds to the skull indices of neonati. Thus RETZIUS found Swedish foetal skulls inclining more to brachycephaly than full grown ones (quoted after MARTIN <sup>1</sup>). Similarly RÖSE <sup>2</sup>, in Swiss schoolboys in Schaffhausen stated a decrease from 84 to 82.5 between 8 and 18 years and FRETTS <sup>3</sup> in Dutch boys found a decrease from 82.14 to 79.27 from the 1st. to the 20th year.

In this connection, it is not strange to find indices in Dutch perinatal brains, similar to those of the brachycephalic Dutch or even to those of the Chinese.

It is evident, however, that Dutch foetuses also have a more *hypsicephalic* character than full-grown Dutch <sup>4</sup>).

In view of these facts we should consider if it is not possible to use BOLK's theory of retardation to explain the general morphology of the Chinese brain, the more so as not only their height indices, but also their more rounded temporal lobes, their larger rostrum orbitale (c.f. fig. 3 and 7) and smaller stemangle remind us the fetal and neonatal characteristics of the Dutch brains.

To escape being called a partial critic I may remark that some of the characteristics of the Chinese brain can be accounted for without this theory, in as much it is a custom among the Chinese to force the babies, immediately after birth and later on, to rest their heads on the occiput in sleeping.

A flattening of that part which thus may arise, is favored, — so I have heard — sometimes by massage of the posterior part of the head.

This may lead to a fronto-occipital abbreviation and to an increase of the height of the skull, which again might explain the occipital and general height-indices of the brain.

As far as the transverse orbital ridge is concerned, this explanation is the more probable, as I found it most pronounced in a hydroptic Chinese cerebrum, in which the pressure in the skull is naturally greater.

Even the broader opening to the fossa sylvii and round temporal pole

<sup>1</sup>) MARTIN, Lehrbuch der Anthropologie, FISCHER Jena, 1914, p. 605.

<sup>2</sup>) RÖSE, Beiträge zur Europäischen Rassenkunde. Arch. für Rassenbiologie, Bnd 2 (p. 689), 1905; Bnd 3 (p. 42), 1906.

<sup>3</sup>) FRETTS, Heredity and Headform in man, Genetica, Vol. 3, p. 193.

<sup>4</sup>) REUTER noted an analogous phenomenon at the skulls of Pommerian children. See MARTIN, Lehrbuch der Anthropologie. p. 606.

already observed by KURZ (which occurred in three of my brachycephalic Dutch as well) may perhaps be thus explained, as these features, just as the transverse orbital ridge immediately in front of the temporal lobe (also present in RETZIUS' Laplander), may be produced by pressure against the wings of the sphenoid.

It is, however, more than doubtful whether the often occurring rostrum orbitale, the concave form of the orbital brain surface, and the smaller stemangle of the Chinese may thus be accounted for.

Besides we should be very careful about accepting a one-sided artificial external pressure <sup>1)</sup> as a sufficient explanation of the whole skull form <sup>1)</sup>. It is well known that WALCHER <sup>2)</sup> thus explained brachycephaly as a consequence of the infants sleeping occiput down and dolichocephaly by their sleeping with the lateral sides of their heads on the cushion.

Though the influence of these positions may be noted at times, VAN DEN BROEK's <sup>3)</sup>, observations upon his own twins do not favor this as a constant factor. Also the fact that in animals (Canidae, Suidae, Ovidae) domestication produces a shorter, broader skull <sup>4)</sup>, though pressure in the above named sense is excluded, should us make careful in this respect. Probably many factors besides the form of the brain are important in determining the form of the skull. So general metabolic influences (NATHUSIUS, NEHRING, HENSELER, BOAS) <sup>5)</sup>, or the action of vitamins (ECKSTEIN), and the influence of hormones (KEITH <sup>6)</sup>, BOLK <sup>7)</sup>, STOCKARD <sup>8)</sup>), must also be considered as well as general cultural relations (RETZIUS, AMMON) including the collective influence of all surrounding factors.

Finally the relative proportions between the head and the body of the individual are important, principally in animals (KLATT).

If, however, artificial pressure on the occiput is insufficient as an explanation, it is reasonable that we should view these phenomena in

<sup>1)</sup> Already MACALISTER (The causation of brachy- and dolichocephaly. Journ. of Anat. and Physiol., vol. 32, 1898 p. 334), criticized this standpoint. He considered the primary development of the central lobes as the principal cause of perinatal brachycephaly.

<sup>2)</sup> WALCHER. Ueber die Entstehung von Brachy- und Dolichocephalie durch willkürliche Beeinflüssung des kindlichen Schädels. Zentralblatt f. Gynaek., Bnd 29, 1904 and Korrespondenzbl. der Anthrop. Ges., Bnd. 36, 1905.

WALCHER. Weitere Erfahrungen etc. Münchener Med. Wochschr., 58, 1911.

<sup>3)</sup> VAN DEN BROEK. Korrespondenzbl. der Deutschen Gesellsch. f. Anthrop., Jahrg. 47, 1916, p. 68. Zur Frage der willkürlichen Beeinflüssung der Schädelform. One of his twins, born dolichocephalic (measured two days after birth its index was 72,4) put in the cradle gave its head a lateral position, the other, born brachycephalic (82,2) gave its head an occipital position. The dolichocephaly of the one and the brachycephaly of the other first increased, being 71 and 86,3 after 4 months, but after a year the dolichocephaly and brachycephaly both decreased (75 and 83) and after 3 years still more so (77,1 and 82,4). VAN DEN BROEK therefore doubts WALCHER's conclusion and asks whether this author does not reverse cause and consequence.

<sup>4)</sup> Concerning the influence of domestication and feeding, see KLATT. Studien zum Domestikationsproblem. Untersuchungen am Gehirn. Bibliotheca genetica, Bnd. 2, 1921, and BASLER, Die Beeinflüssung der Schädelform durch die Umwelt. Deutsche medizinische Wochenschrift, No. 43 und 44, 1925.

<sup>5)</sup> BOAS. Changes in bodily form of descendants of Immigrants. Immigration Committee Document No. 208, Washington.

<sup>6)</sup> KEITH, Differentiation of mankind etc. Ass. for Adv. of sciences, 1919.

<sup>7)</sup> BOLK, The part played by the endocrine glands etc. Lancet, 1921.

<sup>8)</sup> STOCKARD. Human types etc. Am. Journ. of Anatomy, Vol. 31, 1923, p. 261.

the light of BOLK's theory, and consider a further development of the skull in its fetal form as a basis of explanation particularly since analogous features are observed in brachycephalic Dutch, where artificial pressure as a constant factor cannot be adduced.

Proof might be attained if other parts of the Chinese body showed characteristics, which could be explained as persisting late fetal or early post-natal features. Now this actually occurs.

Thus BIRKNER<sup>1)</sup> found the size of the platysma-muscle to be unusually large, extending as a rather closed plate over the face, a feature which occurs only among the West-Europeans, in very young children.

Furthermore in the Chinese, the zygomaticus and the quadratus labii superioris persist as rather closed muscleplates, enlarged by irradiating bundles from the orbicularis oculi to the mouth-angles, another finding which also occurs in young European children. Similarly TOKUYASO KUDO<sup>2)</sup> who compared the facial musculature in fifteen Japanese, three Chinese and five Europeans, stated (l. c. p. 669) „the Japanese and Chinese are separated from the Europeans by a somewhat smaller differentiation, a tendency of single muscles to fuse superficially in a single plate. This tendency is stronger in the Chinese than in the Japanese (l. c. p. 669—670). And „In Mongolians as a race the three parts of the quadratus labii superior fuse into a single plate, further, the caput zygomaticus, constantly present in Mongolians, is distinguishable with difficulty from the neighbouring muscles (l. c. p. 671). BOLK<sup>3)</sup>, though generally inclined to regard the white Homo nordicus as the most fetalised type has pointed out himself, however, that the Mongoloïd fold and epicanthus, characteristics of the Chinese upper eyelid, are encountered as a fetal phenomenon in Europeans. The deep noseroot and protusio bulbi should also be considered as foetal relics, according to this author.

SHELLSHEAR<sup>4)</sup> (l. c. p. 7) has remarked that the parenchyma of the thymusgland persists until a later age than in the European. HAMMAR's<sup>5)</sup> ages corresponding to that type are not in agreement with the findings in the Chinese. In them the young adult condition, instead of changing at 20, runs on till about 25 years of age.

The thymusgland undergoes its involution at a later period in the Chinese than in Europeans.

Finally SHIROKOGOROFF and APPLETON<sup>6)</sup> point out (l. c. p. 110) that — especially among the northern Chinese — the hairgrowth is strongly retarded in comparison with that of Europeans. In men this holds good as well for the beard as for the pubic hair and in women it applies to the pubic and axillary hair. These writers say: „It is very characteristic in Chinese women that they have sometimes no axillary and pubic hair at all (l. c. p. 110).“

Dentition among the Chinese also seems to follow a different periodicity from that of Europeans: „there is a retardation of full dentition (except in the third molar) which

1) BIRKNER. Die Anthropologie der Mongolen. Arch. für Rassen u. Gesellschaftsbiologie, Jahrg. 1, 1904, p. 817.

2) TOKUYASO KUDO. The facial musculature of the Japanese. Journ. of. Morphology Vol. 32, 1919, p. 637.

3) BOLK. Over Mongolenplooï and Mongoloïde idiotie. Ned. Tijdschr. v. Geneesk. 1ste helft 1923. Afl. 3. See also: Over de oorzaak en de beteekenis van het niet sluiten der schedelnaden bij den mensch. Ibidem 1926, 2de helft N<sup>o</sup>. 21.

4) SHELLSHEAR. The thymusgland in the Chinese. China med. Journal, August 1924.

5) HAMMAR. Die Menschenthymus Teil 1. Das normale Organ, Akad. Verlag, Leipzig, 1926.

6) SHIROKOGOROFF, Process of physical growth among the Chinese. Volume 1. The Chinese of Chekiang and Kiangsu measured by Dr. APPLETON. The Commercial Press lim., Shanghai, China, 1925.

continues after the age of 15 years. On the other hand there is a premature (comparatively with Europeans) appearance of the second and third molars."

All of these factors point to a retardation, especially in the Northern Chinese (among the inhabitants of Kiangsu these phenomena are even more pronounced than in those of Chekiang), and seem to confirm SHELLSHEAR's statement (l.c. p. 10) „the anthropological type (of the Chinese) might almost be regarded from a European standpoint as a childlike type". They also support my view concerning the general brainform of the Northern Chinese, that we should explain this form from the standpoint of fetalisation.

A few words more about the *frontal length index* and the *stemangle*.

My figures show that the relative length of the part in front of the temporal lobe in the Chinese is smaller (0,223) than in the Dutch (Br. 0,243 and D. 0,231), This shortening of the frontbrain, is also expressed by the fact that the Chinese have such a great frontal height index.

On the contrary, the frontal length, that is the distance from the frontal point of the brain to the frontal pole of the temporal lobe, is very large in neonati, larger than in the Chinese. Consequently in this respect one cannot adduce a retarded proportion in this index among the Chinese, although the frontal lobe itself in fetuses is also relatively short. This fetal shortness of the frontal lobe is, however, not expressed by this index, since the insular perpendicular has no constant position in the fetus. Its site depends on the frontal outgrowth of the temporal lobe (the temporal operculum) and in as much as this operculum develops gradually, this perpendicular lies more caudally in the foetal than in the adult brain.

The *stemangle*, in the N. Chinese (similarly in RETZIUS' Laplander, also a Mongol) is smaller than in dolichocephalic Dutch it is also small in brachycephalics, but it is still smaller in the fetus.

In my opinion this depends on the location and the inclination of the foramen magnum in the skull.

BOLK<sup>1)</sup> has drawn attention to the fact that the foramen magnum occupies a relatively more frontal position at the end of fetal life than in the adult. As my stemaxis runs through the foramen magnum, it is not surprising, that in the fetus it runs steeper than in the adult, where it has a more backward inclination.

Though BOLK believes that the fetal condition has no direct connection with the brachycephaly of the fetal skulls, it is remarkable. that he also found the inclination of the foramen magnum to be turned more frontally in brachycephalic than in dolichocephalic Dutch, as I did for the stemangle.

Considering all the other fetal relations of the Chinese brain, it seems probable to me that also their smaller stemangle should also be regarded from this view point.

<sup>1)</sup> L. BOLK, On the position and displacement of the Foramen magnum in the Primates, These Proceedings, 12, p. 362, (1909); On the slope of the Foramen magnum in Primates. Ibidem, 525, (1909).