ANTHROPOLOGICAL PAPERS

OF

THE AMERICAN MUSEUM OF NATURAL HISTORY

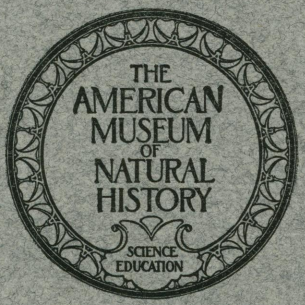
VOL. XXIII, PART V

—

THE FREQUENCY AND DISTRIBUTION OF SOME ANATOMICAL VARIATIONS IN AMERICAN CRANIA

BY

LOUIS R. SULLIVAN



NEW YORK
PUBLISHED BY ORDER OF THE TRUSTEES
1922

American Museum of Natural History

Publications in Anthropology

In 1906 the present series of Anthropological Papers was authorized by the Trustees of the Museum to record the results of research conducted by the Department of Anthropology. The series comprises octavo volumes of about 350 pages each, issued in parts at irregular intervals. Previous to 1906 articles devoted to anthropological subjects appeared as occasional papers in the Bulletin and also in the Memoir series of the Museum. A complete list of these publications with prices will be furnished when requested. All communications should be addressed to the Librarian of the Museum.

The recent issues are as follows:—

Volume XV.

I. Pueblo Ruins of the Galisteo Basin, New Mexico. By N. C. Nelson. Pp. 1–124, Plates 1–4, 13 text figures, 1 map, and 7 plans. 1914. Price, $.75.

II. (In preparation.)

Volume XVI.

I–VII. The Sun Dance of the Plains Indians.

Volume XIX.

I. The Whale House of the Chilkat. By George T. Emmons. Pp. 1–33. Plates I–IV, and 6 text figures. 1916. Price, $1.00.

II. The History of Philippine Civilization as Reflected in Religious Nomenclature. By A. L. Kroeber. Pp. 35–67. 1918. Price, $.25.

III. Kinship in the Philippines. By A. L. Kroeber. Pp. 69–84. Price, $.25.

IV. Notes on Ceremonialism at Laguna. By Elsie Clews Parsons. Pp. 85, 131, and 21 text figures. 1920. Price $.50.

V. (In press.)

Volume XX.

I. Tales of Yukaghir, Lamut, and Russianized Natives of Eastern Siberia By Waldemar Bogoras. Pp. 1–148. 1918. Price, $1.50.

II. Basket Designs of the Mission Indians of California. By A. L. Kroeber. Pp. 149–183, Plates 1–6, and 97 text figures. 1922. Price, $.50.

III. (In preparation.)

Volume XXI.

I. Notes on the Social Organization and Customs of the Mandan, Hidatsa, and Crow Indians. By Robert H. Lowie. Pp. 1–99. 1917. Price, $1.00.

II. The Tobacco Society of the Crow Indians. By Robert H. Lowie Pp. 101–200, and 13 text figures. 1920. Price, $1.25.

III. (In preparation.)

ANTHROPOLOGICAL PAPERS

OF

THE AMERICAN MUSEUM OF NATURAL HISTORY

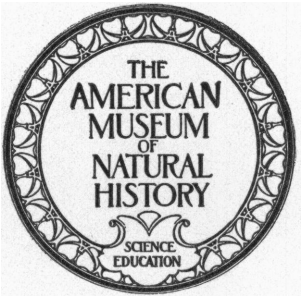
VOL. XXIII, PART V

—

THE FREQUENCY AND DISTRIBUTION OF SOME ANATOMICAL VARIATIONS IN AMERICAN CRANIA

BY

LOUIS R. SULLIVAN



NEW YORK
PUBLISHED BY ORDER OF THE TRUSTEES
1922

THE FREQUENCY AND DISTRIBUTION OF SOME ANATOMICAL VARIATIONS IN AMERICAN CRANIA

By Louis R. Sullivan

CONTENTS.

LIST OF ILLUSTRATIONS.

Text Figures.

I. INTRODUCTION.

The term "anatomical variation" is used to designate the types of variations which are not expressible in measurements. Studies in craniometrical variations in American groups are seriously impeded by the widespread deformation of the crania. Roughly, this deformation is of three types: the fronto-occipital type, which results in a very much shortened and widened cranium and is prevalent in certain North Pacific Coast groups, in southeastern United States, and in certain parts of South America, notably Peru and nearby countries; the annular type, which results in a greatly elongated and constricted cranium, is prevalent among the Kwakiutl groups of the North Pacific Coast area and in a majority of the Peruvian and Bolivian groups; and the occipital type, which may be either intentional or accidental, is quite widespread, but is particularly prevalent in southwestern and southeastern United States. The result of such deformation renders all measurements of the braincase futile and in a good many instances nullifies the significance of certain facial proportions, notably the width of the face, the frontal diameters, and possibly the proportions of the orbits.

For this reason craniometry has not been so useful in determining the relationships of American Indian groups to each other as it has in many other areas. Other methods must be employed. All that remains are the variations which I have called anatomical in contradistinction to the craniometrical. I am led to believe that when proper study is made of these anatomical characteristics considerable progress can be made towards indicating both racial and local affinities, but more particularly local affinities. In a measure, they parallel craniometric characters in frequency and distribution. One important difference must be stressed in interpreting them, however. While in a majority of craniometric characters relationship or non-relationships are usually indicated by similarities or differences in their mean or average values, a large number of descriptive characters are valuable only in a positive sense. For example, the presence of metopism in high frequency in two groups, closely located geographically, would undoubtedly be indicative of close physical relationship of the two groups. The absence of metopism in a third group would as unquestionably indicate that this group had not recently been in contact with either of the other two, but would not necessarily exclude it from close relationship at an earlier date before metopism had become characteristic. The value of metopism as an indicator of relationship would vary considerably in different areas and depend entirely upon the length of time that metopism had been characteristic

of the group or groups in question. For this reason, this method is not urged as a substitute for craniometry or anthropometry, but only as another possible method of approach when these two methods fail or as a supplementary method when they are applicable.

A serious objection to studies of these descriptive characters is the lack of standards which will insure comparable results.

However, the elimination of the personal equation seems possible to a large degree if we confine ourselves to certain characteristics which are either present or absent or which present certain easily recognizable stages of gradation. This involves a certain preliminary agreement of method of classification, since, to be strictly accurate, no characteristic lends itself wholly to such classification. I have selected such characters as the number of cusps on the lower second molar, the form of the lower border of the nasal aperture, the arrangement of the sutures in the region of the pterion, the presence or absence of the fossa pharyngea, the perforation of the tympanic element of the temporal bone, metopism, occurrence of the inca bone, the presence of sutural bones in various regions, and the frequency of mastoid division. Of these the following may be classified as the presence or absence group:—

A fifth cusp on the lower second molar
The fossa pharyngea
Perforation of the tympanic part of the temporal bone
Metopic suture
Inca bone
Sutural bones
Mastoid division

The remaining two, the form of the lower border of the nasal aperture, and the arrangement of the sutures in the region of the pterion, present some four or five more or less arbitrary types.

To take, for example, the number of cusps on the lower second molar, it is evident to any one who has examined teeth that the hypoconulid is not always conveniently present or absent. Some observers have attempted to designate its presence in terms of ⅓, ⅔, or even ⅙. I have found it impossible to make such estimates consistently and to obtain results comparable with a second series of my own observations or with the observations of another observer. The number of teeth examined for this character, the kinds of teeth examined, and the conception of the normal proportions of the hypoconulid in man all enter into and influence one's judgment in estimating fractional portions of such a small object. When I confined myself to noting what I more or less arbitrarily termed

the presence or absence of the hypoconulid, the results were more nearly comparable. A more minute classification seems to me to be exaggerated accuracy.

In recording the presence or absence of the fossa pharyngea I have studiously avoided designating all slight depressions in this region as pharyngeal fossæ. Only well marked cases were recorded. The same method was followed in recording the perforation of the tympanum. In noting metopism, only complete cases were recorded as metopic. A suggestion of metopism in the region from the nasion to the glabella is of very common occurrence in the Eskimo crania, but was not classified as metopism. Symmetry as well as size was considered in designating the inca bone present or absent.

In the case of the form of the lower border of the apertura pyriformis there is considerable difficulty encountered in some instances in distinguishing between a fossa and a sulcus, but if one adheres rigidly to the definition and is not influenced by general impressions, considerable uniformity of results should be expected. The principal difficulties arise in a few cases where the landmarks are ill defined. The arrangement of the sutures in the region of the pterion permits of fairly accurate results. A few borderline cases will undoubtedly fall now in one class and on second examination in another, but the changes more or less balance each other.

Many other characteristics beside those included in this paper were studied, but because the gradations were so minute and the error of observation so great I have not included them in this study.

Finally, I am aware that my material is inadequate for far-reaching conclusions and that the percentages of frequency would in many cases be considerably altered by the study of larger series; yet I feel that the series are of sufficient size to indicate the possibilities of tracing racial and local affinities by the study of anatomical characteristics where craniometrical data are inaccessible.

It is very important to note another possible source of error. It is possible that certain series of crania have been collected and selected on the basis of the presence of some of these characters. This is most likely to occur when there is an abundance of material to select from or when the collector is particularly interested in some one or two characters. In the collections of the American Museum of Natural History the possibility of such selection is encountered only in the Peruvian and Bolivian material. There is a possibility that with an enormous amount of material to select from, crania with such obvious peculiarities as metopism and the os inca were chosen more frequently than those in

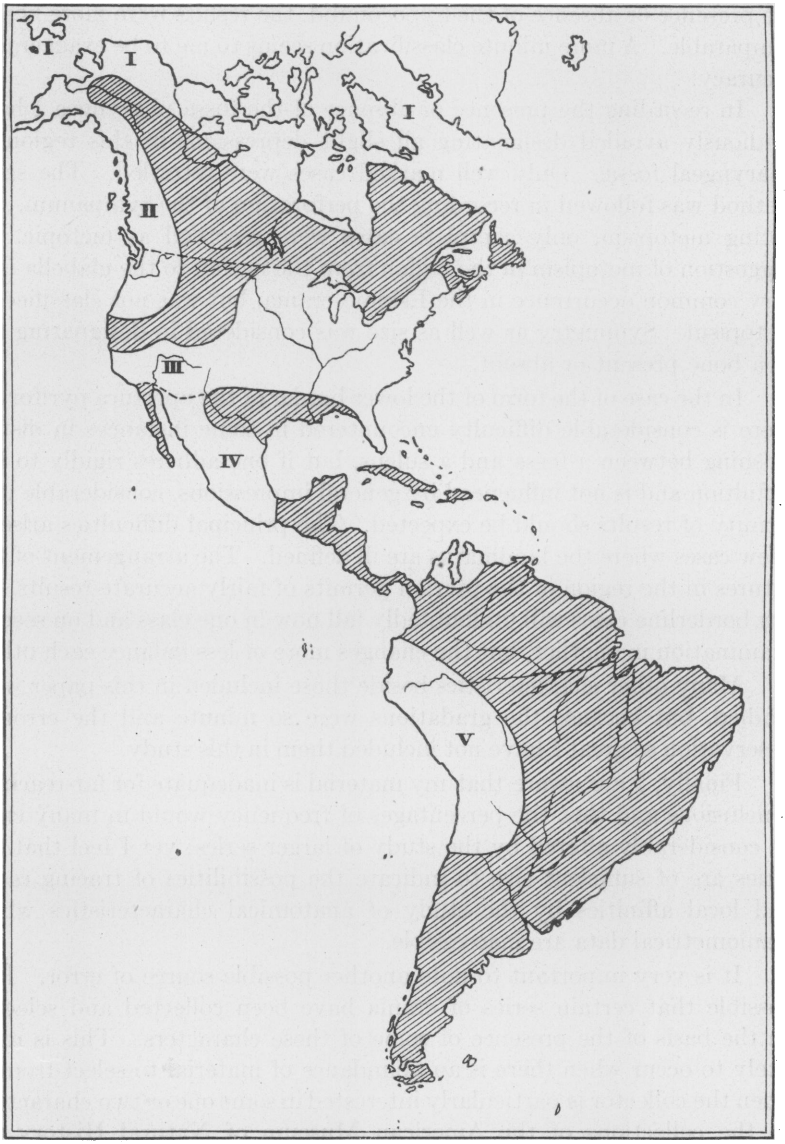


Fig. 1. Geographical Distribution of the Crania available for this Research. Shading indicates areas not represented in this study; numbered areas are represented by large collections as follows: I, Eskimo, II, North Pacific Coast; III, Southwest; IV, Mexico; V, Lake Titicaca.

which such features did not exist. Whether or not this actually happened I have no means of determining.

The map, Fig. 1, indicates the distribution of my material.

The data are grouped roughly in order of their racial and local significance. Such characters as the number of cusps on the lower second molar and the form of the lower border of the nasal aperture, which are fairly uniform throughout, I look upon as fundamental racial characters. The other characters which are more or less sporadic in occurrence I regard as local characters.

II. DIFFERENCES IN THE PATTERN OF THE LOWER SECOND MOLAR TEETH.

That the cusp patterns of the molar teeth in man vary considerably is well known. While this variability is sometimes the result of the formation of extra cusps or the fission of certain cusps, it is more often the result of the partial or total suppression of cusps that formerly were characteristic of man. While this reduction in the size and number of cusps is characteristic of all the molars it is particularly noticeable in the upper third molar and the lower second molar. The upper third molar has a tendency to become secondarily tritubercular through the loss of the hypocone. The lower second molar, on the other hand, is becoming secondarily quadritubercular through the loss of the hypoconulid.

With these two reduction processes in mind, I was particularly struck, in examining American Indian mandibulæ, by the fact that a very large percentage of the lower second molars were large, well-formed, five-cusped teeth.

While I did not have at hand sufficient material to make a detailed analysis of the condition typical of American Indians as a whole, I did have one particularly good series of mandibulæ of Tarascan Indians. This series is made up of forty-three mandibulæ of young adults showing little or no wear. As a contrasting group I had another series of thirty young adult crania from Southern India. This collection represents, in the main, a modified Mediterranean type although there are a few crania of the Veddah type.

The conditions in the two groups are quite different. In the collection of Tarascan Indians from Mexico the lower second molar has five cusps in 76.8 percent of the cases and four cusps in only 23.2 percent. The mandibulæ from Southern India, on the other hand, show five cusps in only 16.6 percent of the cases and four cusps in 83.4 percent. In the Tarascan group the fifth cusp (hypoconulid) in question is in a majority of cases large and well formed.

That the condition found in Tarascan Indians may be taken as representative of the condition in many American Indian groups I feel fairly certain. While, as I have said, I have insufficient material to point out the details of this distribution a random sample of 335 mandibulæ, coming from nearly all parts of the two American continents, gave the following results:—

5 cusps: 248, or 74.1 percent
4 cusps: 87, or 25.9 percent

Hrdlička (1916 and 1920 in correspondence), on the basis of a miscel-

laneous collection from the south and southwestern United States and Mexico, gives the frequency of 5 cusps as 21 percent, of 4 ½ cusps as 25 percent and of 4 cusps as 54 percent. But in sixty-seven lower second molars of the Sioux he observed 5 cusps in 68 percent; 4 ½ cusps in 6 percent, and 4 cusps in 26 percent. If we disregard Hrdlička's 4 ½ cusp class it will be seen that his Sioux group gave results almost identical with my Tarascan group.

Hrdlička's data suggest the possibility of a much higher frequency of the primitive five-cusped molar in some Indian groups than in others. The nature and significance of this difference in frequency must await further study on more extensive material.

Outside of America we have considerable comparative material. Allen, Cope, Topinard, Regnault, Vram, Martin, Schwerz, and de Terra have all contributed to the subject. From Topinard we take the following ing data:—

Number of Cusps on Lower Second Molar (after Topinard, 1892)

	Cusps: 6	5½	5	4½	4
European	1.7	...	10.0	30.0	60.0
Semite, Berber, Egyptian	...	...	13.1	13.1	75.8
Japanese, Chinese, etc.	6.9	...	37.9	10.4	44.7
Malay	...	...	29.8	8.9	61.2
Polynesian	...	...	22.2	25.0	52.8
Melanesian	1.0	3.1	33.0	14.4	48.5
African Negro	...	...	11.5	4.9	52.6
Miscellaneous	...	...	32.5	2.7	64.7

By far the most satisfactory treatment of the subject from an anthropological point of view is that of de Terra. Combining de Terra's extensive material with that of Schwerz, Martin, Hrdlička, and my own material I obtain the following seriation:—

Number of Cusps on Second Lower Molar

Group	Number	5	5.4	4	Author
Europe					
Early Swiss	26	7.7	....	92.4	de Terra
Alaman	20	10.0	....	90.0	de "
Römer Gräber	33	3.0	....	96.9	" "
North German	22	13.6	....	86.4	" "
Recent Swiss	31	6.2	3.1	90.7	" "
All recent European	281	16.0	1.1	82.2	" "
Hungarian	..	2.0	....	98.0	Schwerz
Lapp	..	15.0	....	85.0	Martin
Asia					
Malay (mixed)	46	26.1	17.4	56.5	de Terra
Battak	19	63.1	....	36.9	" "
Burmese	13	15.3	46.1	38.4	" "
Chinese	24	25.0	....	75.0	" "
Japanese	10	40.0	....	60.0	" "
Tamil	12	0	33.0	66.0	" "
Southern Indian	30	16.6	....	83.4	Sullivan
Australia	15	73.3	....	26.7	de Terra
Africa					
Negroes	104	33.6	3.9	62.9	de Terra
Negroes	..	34.0	....	66.0	Schwerz
Non-Negroid Africans	76	14.5	11.8	73.7	de Terra
American					
Tarascan	43	76.8	....	23.2	Sullivan
Sioux	67	68.0	6.0	26.0	Hrdlička
Southwestern Indians	..	21.0	25.0	54.0	"

While we need data from many groups not represented and also more adequate data from many groups now represented by small series, the material at hand indicates clearly that the so-called European or Caucasoid peoples are uniform in having a high percentage of cusp reduction in the lower second molar. Four cusps is the rule. Next in order of cusp reduction are the negroid groups and the yellow division of the mongoloid race. The Australian and the brown division of the mongoloid race (American Indians, Malays, and Indonesians) have a low frequency of cusp reduction. Five lower molar cusps is the rule.

III. THE APERTURA PYRIFORMIS.

The lower border of the nasal aperture presents a great variety of forms. These forms have been grouped by Macalister (1898) and others as follows:—

1. Infantile, or amblycraspedote type. In this type the lateral marginal edge remains as in the foetus and does not meet with the outward continuation of the paraseptal line. The persistence of the intermediate area gives a rounded interrupted appearance to the border. This type occurs in many South European and most mongoloid crania.

2. Anthropine, or oxycraspedote type. The lateral marginal edge and the paraseptal line are confluent making a sharp lower border which separates the nasal aperture from the alveoli. This type is common in European crania.

3. Prenasal fossæ, or bothrocraspedote form. This is an exaggeration of the foetal condition modified by the inward extension of the lateral margin above the incisor alveoli resulting in a scaphoid fossa obliquely placed.

4. Naso-alveolar sulcus, or oxygmocraspedote form. The lateral marginal edge is lost on the front of the lateral incisor alveoli. In consequence of this obliteration the floor of the nose is continued forward without any line of demarcation, from the facial surface of the alveolar process.

While these four forms are designated as types, it should be clearly recognized that they do not exist as separate types, but really represent recognizable phases of a normal frequency distribution. They are all developmental variants of a single form. There are a good many intermediate types and in many cases it is difficult to classify a given form. Even the two sides of the nasal aperture vary in form. My own experience would lead me to believe that the results of two different observers would not be strictly comparable. It should be possible, however, to obtain an agreement on the percentage of anthropine and non-anthropine forms.

Some idea of the distribution of this characteristic will be obtained from the table of Mingazzini (1891).

Group	No. of Cases	Anthropine	Fossæ	Infantile	Sulcus
Slav	65	50	8	2	5
Swiss	23	18	5	..	..
Italian	273	202	23	27	21
African	30	19	8	2	..
Argentine	5	1	2	2	..
Peruvian	19	7	5	3	4
Papuan	6	2	..	3	1
Fuegian	14	4	2	2	6
Australian	1	..	..	..	1
Siamese	4	3	..	..	1
Kanaka	2	..	..	1	..
Italian (insane)	141	118	9	6	8
Italian (criminals)	69	52	11	6	..

From the above it will be seen that the Europeans have a greater frequency of the anthropine form. About 80 percent approach this form. From my data, tabulated below, it will be seen that, considered as a group, about 65 percent of the American crania present the infantile form. This is true of a large number of the individual groups considered. In Kentucky, Bolivia, and Mexico we get a higher frequency of the anthropine form. The absence or low frequency of the anthropine type may be regarded as a characteristic of a majority of the Indian groups studied.

TYPES OF APERTURA PYRIFORMIS IN AMERICAN INDIAN CRANIA.

Group	No. of Crania	Percent with Sulcus	Percent with Prenasal Fossæ	Percent with Infantile form	Percent with Anthropine form
Kentucky, May's Lick	28	....	....	39.2	60.8
Bolivia, Island of Titicaca	37	....	2.7	43.2	54.0
Mexico, San Simon	55	....	16.3	34.5	49.1
Mexico, Tlanepantla	24	....	16.6	37.5	45.8
Bolivia, Charassani	125	1.6	4.0	52.0	42.4
Mexico, Tarascan	122	6.5	7.4	44.2	41.7
Utah, Miscellaneous	23	8.7	4.3	47.8	39.1
Bolivia, Sicasica, Takana Chullpa	49	....	....	61.2	38.7
Mexico City	22	....	9.0	54.5	36.3
Mexico, Huichol	32	....	12.4	53.1	34.4
Bolivia, Huata, Chujun Paki	90	....	3.3	66.6	30.0
Bolivia, Sicasica, Churkoni Chullpa	54	....	1.8	68.5	29.6
Bolivia, Sicasica, Tama Tam Chullpa	172	....	4.0	66.2	29.6
Chinook	83	....	10.8	62.6	26.5
Bolivia, Sicasica, Kupa Pukio Chullpa	134	....	2.2	70.1	26.8
Peru, Coastal Area	57	....	7.0	66.6	26.3
New York	29	....	6.8	68.9	24.1
Kwakiutl, Koskimo	19	....	5.2	73.7	21.1
Eskimo, Hudson Bay Region	48	8.3	4.2	66.6	20.8
New Mexico, Pueblo	84	....	7.1	72.6	20.2
Kwakiutl, Miscellaneous	84	....	17.8	63.1	19.1
Peru, Marañon Country	21	....	4.7	76.1	19.0
Mexico, Tarahumare	44	4.5	9.0	68.2	18.2
Peru, Cachilaya	25	....	4.0	80.0	16.0
Oregon, Miscellaneous	26	....	....	84.6	15.4
Kwakiutl, Nimkish	30	....	10.0	76.6	13.3
Salish, Washington and British Columbia	123	1.6	14.6	72.3	11.4
Mexico, Cora	19	....	15.7	73.6	10.5
Eskimo, St. Lawrence Island and Siberia	43	2.3	16.3	72.1	9.3
Kwakiutl, Nootka	22	9.0	18.1	63.6	9.0
Eskimo, Alaska, Point Barrow	96	2.1	3.1	86.4	8.3
Haida	32	3.1	12.5	78.1	6.2
Utah, Grand Gulch, Basket Maker	96	2.0	9.4	82.3	6.2

TYPE OF APERTURA PYRIFORMIS IN AMERICAN CRANIA. DISTRIBUTION BY CULTURE AREA GROUPS.

		Sulcus	Fossa	Infantile	Anthropine	Total
Eskimo	No.	7	12	146	22	187
	Percent	3.7	6.4	78.1	11.7	
North Pacific Area	No.	6	62	325	77	470
	Percent	1.3	13.2	69.1	16.4	
California	No.	0	1	17	1	19
	Percent	0	5.2	89.2	5.2	
Eastern Woodlands	No.	0	5	32	15	52
	Percent	0	9.6	61.7	28.8	
Southeastern Area	No.	0	1	24	19	44
	Percent	0	2.3	54.5	43.2	
Plains Area	No.	0	2	1	5	8
	Percent	0	25.0	12.5	62.5	
Southwest	No.	4	18	173	36	231
	Percent	1.7	7.8	74.9	15.5	
Mexico	No.	10	43	177	125	355
	Percent	2.8	12.1	49.9	35.2	
Peru	No.	0	7	95	32	134
	Percent	0	5.2	70.9	23.8	
Bolivia, Huata Region	No.	0	4	92	59	155
	Percent	0	2.5	59.3	38.1	
Bolivia, Sicasica Region	No.	3	16	345	179	543
	Percent	.5	2.9	63.5	32.9	
Total American Crania	No.	30	171	1427	570	2198
	Percent	1.3	7.7	64.9	25.9	

IV. THE ARRANGEMENT OF THE SUTURES IN THE REGION OF THE PTERION.

The form of the pterion varies considerably in crania, but a given group usually presents a fairly uniform type of sutural arrangement. In descriptive work the practice has been to classify these arrangements as types approaching the form of a wide letter "H," a narrow letter "H," a letter "K," a letter "X", or with a frontal process on the temporal bone (less frequently a temporal process on the frontal bone), or with an extra element, the epipteric bone occurring in this region. These designations describe fairly accurately and aptly the forms of variation occurring in the region of the pterion. The "H" forms are the most frequent and the "X" form the least frequent. This statement holds true for American crania, at least. In a majority of the groups examined from 75 to 95 percent of the crania have the "H" forms of pterion. The variation most frequently met with, and of most interest, since it is the normal arrangement for some anthropoids and Old World monkeys, is the occurrence of the fronto-temporal articulation, or a frontal process on the temporal bone. Both sides should be considered in calculating its frequency. The method has been to count the occurrence of a fronto-temporal articulation on one side only as ½ in reckoning the percentage of occurrence. The following table from Bauer (1915) summarizes the results published, prior to his report:—

Number	Group	Percentage of Fronto-temporal Articulation
11,000	European	1.53
2,520	American	1.74
1,200	Asian	2.00
710	Mongolian	3.80
1,250	Malay	4.32
830	North African	5.66
422	Australian	9.00
787	Papuan	9.28
81	Ceylonesian	11.11
1,231	Negro	11.86
76	Baining	26.31
53	New World Monkeys	7.5
73	Gibbon	13.7
307	Orang-utang	33.6
374	Old World Monkeys	68.4
70	Chimpanzee	77.0
35	Gorilla	100.0

These data point clearly to the fact that the fronto-temporal articulation is of much greater frequency in African and Melanesian Negro crania and in Australians. It is constant in the gorilla and normal for the chimpanzee and the Old World monkeys.

My findings for American crania agree very closely with the above results. The fronto-temporal articulation is decidedly infrequent among these crania. Heading the list are found a majority of the Bolivian crania. They are well above the average in point of view of frequency. A few Kwakiutl and Mexican groups are slightly above the average also. The Peruvian, Northwest Coast, Southwest, and Eskimo groups show little or no frequency of this variation.

FREQUENCY OF FRONTO-TEMPORAL ARTICULATION AT PTERION IN AMERICAN CRANIA.

Group	Type of Deformation[1]	Number Examined	Frequency in Percent
Bolivia, Takana Chullpa	A	50	10.0
Bolivia, Chujun Paki	A	95	9.4
Kwakiutl, Koskimo	A	18	8.3
California, Miscellaneous	..	20	7.5
Bolivia, Tama Tam Chullpa	A	184	7.3
Bolivia, Belen Chullpa	A	7	7.1
Peru, Cuzco	A	17	5.8
Eskimo, Siberia, Indian Point	..	28	5.3
Mexico City	..	21	4.7
Mexico, Tlanepantla	..	24	4.1
Oregon	F.O.	26	3.8
Bolivia, Kupa Pukio	A	144	3.8
Eskimo, St. Lawrence Island	..	13	3.8
Peru, Cachilaya	A	32	3.3
Bolivia, Hank'o Kala	A	17	3.1
Bolivia, Lluchini Amaya	A	20	2.7
Bolivia, Churkoni Chullpa	A	57	2.6
Mexico, Cora	..	22	2.2
Kwakiutl, Nootka	A	23	2.1
Mexico, San Simon	..	50	2.0
Kwakiutl, Miscellaneous	A	86	1.7
New York	..	30	1.6
Haida	..	34	1.4
Kentucky, May's Lick	O	41	1.2
Mexico, Tarahumare	..	43	1.1
Utah, Basket Makers	..	92	1.0
Peru, Coastal Area	..	58	.8
Mexico, Tarasco	..	121	.8
New Mexico, Pueblo	O	76	.6
Bolivia, Charassani	A	144	.3

[1]Deformation.
O = Occipital flattening.
F.O. = Fronto-occipital compression
A = Annular deformation.

No Fronto-Temporal Articulation.

Colombia	9	A
Peru, Amazonas	21	..
Peru, Sillustani	11	A
Kwakiutl, Bella Bella	13	O
Kwakiutl, Nimkish	34	A
Lillooet	5	..
Salish, Saanich, British Columbia	10	F.O.
Salish, Bella Coola	19	F.O.
Salish, Thompson	26	..
Salish, Nanaimo	12	F.O.
Salish, Kamloops	9	..
Salish, British Columbia	32	F.O.
Salish, Washington	20	F.O.
Washington	22	F.O.
Tsimshian	8	O
Athapascan	7	..
Florida	17	..
Tennessee	8	O
Michigan, Illinois	14	..
Ohio	9	..
Arizona	16	O
Utah, Miscellaneous	23	O
Mexico, Huichol	30	..
Eskimo, Hudson Bay	49	..
Eskimo, Alaska	103	..

Another variation of some frequency is the presence of the epipteric bone. To some extent it is correlated with the fronto-temporal form of articulation or at least occurs very frequently in groups having a high frequency of the fronto-temporal articulation. Bauer's table is as follows:—

Peruvian	6.0
Polynesian	9.3
Malay	10.3
Negro	10.9
Bavarian	12.7
Mongolian	16.0
Russian	16.8
Friesien	17.1
Andamanese	17.4
Vedda	21.1
Bavarian	22.4
Melanesian	25.9
Baining	27.6
Australian and Tasmanian	28.4
Swiss	28.4

Again the high frequency occurs in the Melanesian and Australian groups, but to these are added a number of Alpine European groups.

My method has been to count only as epipteric bones those with an area of at least 1 square centimeter. The occurrence on one side only has been counted as ½ a case. The Bolivian, Peruvian, a few Mexican groups, and several Salish groups head the list in point of view of frequency.

One's first impression is that the high frequency of epipteric bones is correlated with artificial or accidental deformation of the cranium, but the exceptions to the rule are sufficiently numerous to make this seem extremely doubtful. No individual correlation is possible since all or nearly all of a given group are deformed or undeformed. Since the ex-

FREQUENCY OF EPIPTERIC BONES IN AMERICAN CRANIA.

Group	Number Examined	Deformation	Epipteric Bones in Percent
Colombia	9	A	11.1
Bolivia, Belen Chullpa	7	A	7.1
Bolivia, Takana Chullpa	50	A	7.0
Mexico, Cora	22	..	6.8
Washington	15	F.O.	6.6
Peru, Cuzco	17	A	5.8
New Mexico, Pueblo	76	O	5.2
Eskimo, Hudson Bay	49	..	5.1
Salish, Washington	20	F.O.	5.0
Salish, Nanaimo	12	F.O.	4.1
Oregon	26	F.O.	3.8
Bolivia, Churkoni Chullpa	57	A	3.5
Peru, Cachilaya	34	A	3.3
Bolivia, Kupa Pukio Chullpa	144	A	2.7
Peru, Coastal Area	58	..	2.5
Kentucky, May's Lick	41	O	2.4
Mexico City	21	..	2.3
Peru, Marañon Country	21	..	2.3
Mexico, Tlanepantla	24	..	2.0
Bolivia, Charassani	144	A	1.7
New York	30	..	1.6
Bolivia, Chujun Paki	95	A	1.5
Mexico, Tarasco	121	..	1.5
Mexico, Tarahumare	43	..	1.1
Eskimo, Alaska	103	..	1.0
Kwakiutl, Miscellaneous	86	A	.5
Bolivia, Tama Tam Chullpa	184	A	.5

ceptions to the rule are both negative and positive I do not believe it possible to demonstrate that the two characters are related in the sense of cause and effect.

No Epipteric Bones.

Mexico	..
Utah	O
Arizona, Miscellaneous	O
Massachusetts	..
Illinois	..
Michigan	..
Plains Area	..
Tennessee	..
Florida	..
Athapascan, Alaska	..
Tsimshian	O
Yakima	O
Chinook	F.O.
Salish, British Columbia	F.O.
Salish, Kamloops	..
Salish, Thompson	..
Salish, Bella Coola	F.O.
Salish, Saanich	F.O.
Salish, Lillooet	..
Kwakiutl, Bella Bella	O
Peru, Sillustani	A
Utah, Basket Makers	..
Haida	..
Mexico, San Simon	..
Kwakiutl, Nootka	A
Bolivia, Lluchini Amaya	A
Bolivia, Hank'o Kala	A
Eskimo, St. Lawrence Island	..
Eskimo, Siberia	..
California	..
Kwakiutl, Koskimo	A

V. THE FOSSA PHARYNGEA.

The fossa pharyngea, fovea bursea, or medio-basial fossa is a small oval depression in the ventral surface of the basilar part of the occipital bone. The major axis lies in the antero-posterior direction in the median line. It varies in depth from 2 millimeters to 7 millimeters. The width is approximately 4 millimeters on the average while the length varies from 5 to 11 millimeters.

The function or purpose of the fossa is not altogether clear. Anatomical text-books dismiss it with a sentence. Thompson (1917) writing in Cunningham (1917) says:—

> An oval pit, the fovea bursea or pharyngeal fossa, is sometimes seen in front of the tuberculum pharyngeum. This marks the site of the bursa pharyngea. . . . The origin and morphological significance of this pouch are not yet solved.

Romiti (1891) and Agostino (1901) claim that the fossa pharyngea is produced by a pharyngeal diverticulum either abnormal or accessory. This is in agreement with the opinion stated above. Perna (1906) concludes that the fossa pharyngea can be explained as a survival of that part of the median basilar canal which passes below the perichondrium on the ventral surface of the basilar portion of the occipital bone. The basilar part of the occipital bone ossifies like a vertebra and the fossa is the result of the non-ossification of the hypochordal bow element due to the position of the notochordal element of this region. I am not in a position to state the relative merits of the two opinions, nor am I altogether certain that they are necessarily contradictory.

However, its anthropological importance and utility are not wholly dependent on its physiological, morphological, or phylogenetic significance, but in great part on its relative frequency. According to all authors consulted, the fossa pharyngea is rather an uncommon structure both in man and other animals. Perna (1906) and Agostino (1901) give very little data on its frequency. Romiti (1891) found it five times in 700 crania (0.7%). He quotes Gruber as finding it 46 times in 4000 to 5000 skulls or in about 1 percent of the cases examined. Le Double (1903) records its frequency as 1.4 percent on the basis of 5000 skulls examined. Rossi (1891) is the only author to my knowledge who has attempted to segregate his material racially. His results follows:—

In 2911 European crania the fossa occurred 33 times or 1.31%.
In 801 non-European crania the fossa occurred 31 times or 3.87%.
In 240 Papuasian crania the fossa occurred 10 times or 4.16%.
In 159 Asiatic crania the fossa occurred 7 times or 4.40%.

The only conclusion one may draw from the above data is that the fossa pharyngea is of relatively rare occurrence and certainly not frequent enough to be of any great significance racially. It appears to be somewhat more frequent in Asiatic crania than in European crania. But even here the material is grouped in such a way that its significance is obscured. Bearing in mind the tremendous differentiation of mankind at the present time, material studied under such headings as European, Asiatic, and Papuasian can throw very little light upon our modern anthropological problems. Especially is this true in the study of such characters as the fossa pharyngea and other anomalous conditions. There is every reason to believe that these characters develop in individuals and are transmitted by inheritance. Their local distribution is of much greater significance than their racial distribution.

GROUPS REPRESENTED BY AT LEAST TWENTY CRANIA WHICH SHOW A RELATIVELY HIGH FREQUENCY OF THE PHARYNGEAL FOSSA.

Group	No. of Skulls[1]	Number with Pharyngeal Fossa	Percent with Pharyngeal Fossa
Basket Maker, Grand Gulch, Utah	97	26	26.8
Cora Indian, Mexico	21	5	23.8
California Indian (Hrdlička[2])	42	7	16.6
Huichol Indian, Mexico	32	5	15.5
Utah, Grand Gulch, deformed	22	3	13.6
Tlanepantla, Mexico	23	2	8.6
San Simon, Mexico	49	4	8.2
Tarahumare, Mexico	48	3	6.2
Total	334	55	16.4

I have not much non-American material at my disposal but the small amount available suggests that the fossa pharyngea occurs with a much greater frequency in some areas than in others. Out of five crania from New Hebrides two have the fossa pharyngea well marked. Two out of four crania from the Solomon Islands have it also. The number of cases are too small to permit any valid conclusions, but suggest a high frequency.

[1]Only crania or calvaria having the basilar part of the occipital bone in good condition are included in the totals throughout.
[2]Hrdlička, 1906.

GROUPS REPRESENTED BY A SMALL NUMBER OF CRANIA BUT SHOWING A RELATIVELY HIGH FREQUENCY OF THE PHARYNGEAL FOSSA.

Group	No. of Skulls	Number with Pharyngeal Fossa	Percent with Pharyngeal Fossa
Papago	1	1	100.0
Clear Creek, Arizona	6	2	33.3
Tepecano, Mexico	4	1	25.0
Guatemala Indian	6	1	16.6
Williamson County, Tennessee	8	1	12.5
Illinois	8	1	12.5
Miscellaneous Plains Indian	10	1	10.0
Otomi, Mexico	11	1	9.0
Total	54	9	18.5

GROUPS REPRESENTED BY A LARGE NUMBER OF CRANIA WHICH SHOW A LOW FREQUENCY OF THE PHARYNGEAL FOSSA.

Group	No. of Skulls	Number with Pharyngeal Fossa	Percent with Pharyngeal Fossa
Tarascan, Mexico	130	7	5.4
Hank'o Kala, Huata, Bolivia	17	1	5.3
Salish, Washington	24	1	4.3
City of Mexico	25	1	4.0
Chinook	92	3	3.3
May's Lick, Kentucky	45	1	2.2
Kwakiutl	87	2	2.2
Eastern Eskimo	50	1	2.0
Takana Chullpa, Bolivia	50	1	2.0
Peru, Coastal Region	58	1	1.7
Charassani, Bolivia	144	2	1.4
Tama Tam Chullpa, Bolivia	184	2	1.0
Kupa Pukio Chullpa, Bolivia	144	1	.7
Total	1050	24	2.3

Turning to the American material, I first became interested in the fossa pharyngea during the study of a group of Basket Maker crania from Grand Gulch, Utah. About 25 percent of the crania examined showed a larger or smaller fossa pharyngea. A little later I encountered it again in some Mexican Indian crania. Hrdlička (1906) also found it in his examination of California Indian crania.

GROUPS IN WHICH NO PHARYNGEAL FOSSAE WERE FOUND.

Group	No. of Crania Examined
Chukchi, Siberia	7
Eskimo, Indian Point, Siberia	32
Eskimo, St. Lawrence Island, Bering Strait	13
Eskimo, Alaska (Point Barrow)	102
Athapascan, Alaska	8
Tsimshian	9
Haida	40
Yakima	15
Salish, Eburne, British Columbia	54
Salish, Kamloops	13
Salish, Nanaimo	13
Salish, Thompson	26
Salish, Bella Coola	20
Salish, Saanich, British Columbia	14
Salish, Lillooet	8
Kwakiutl, Nimkish	41
Kwakiutl, Nootka	23
Kwakiutl, Bella Coola	10
Washington, Miscellaneous	15
Oregon	27
California	21
New Mexico, Pueblo	86
New Mexico, Chaco Cañon	22
Colorado	6
New York	33
Massachusetts and Connecticut	6
Ohio, Madisonville	17
Michigan, Saginaw	7
Virginia	1
Georgia	1
North Carolina	1
Florida	25
Mexico, Yaqui	7
Mexico, Casas Grandes	11
Mexico, Zacateco	4
Colombia	10
Peru, Marañon Country	20
Peru, vicinity of Cuzco	18
Peru, Sillustani	11
Peru, Cachilaya	34
Island of Titicaca	64
Island of Cojata	2
Bolivia, Chujun Paki	95
Bolivia, Llucĥini Amaya	18
Bolivia, Belen Chullpa	8
Bolivia, Churkoni Chullpa	55
Bolivia, Tiahuanaco	3
Cape Horn	3
Total	1079

TOTAL FREQUENCY OF FOSSA PHARYNGEA IN AMERICAN CRANIA.

Total Crania Examined	Total Crania with Fossa	Percent of Crania with Fossa
2517	88	3.5

I then decided to examine all the Indian and Eskimo crania in the collections of the American Museum of Natural History. The results are tabulated above. Considering the crania as a whole, the fossa pharyngea is not of very frequent occurrence in the American Indian and Eskimo. Of the 2517 crania examined it was present in 88 or 3.5 percent of the cases. This percentage is somewhat lower than that found by Rossi in miscellaneous collections of Asiatic and Papuasian crania.

When we consider the frequency in local groups the distribution becomes significant. All of the groups of high frequency are in the southwestern United States and Mexico. However, it was not found in the crania of the Pueblo peoples of New Mexico, Arizona, or Colorado. The distribution follows quite closely the distribution of the linguistic stocks tentatively grouped together as Uto-Aztecan. The crania in which it occurred with greatest frequency were moderately elongated with a cranial index averaging about 76 to 78. There is some overlapping in the distribution, notably in the case of the Otomi and Tarascan groups. This could undoubtedly be explained by contact and intermixture. On the other hand, the fossa was not found among the Yaqui or Zacatecan crania. In a few cases our material is inadequate to serve as a basis for valid deductions. This is true especially in the case of the Papago, Clear Creek, Arizona, and Otomi material. While our material as a whole may be taken as a fair sample in many areas, it is particularly deficient in the Plains area, Southeastern area, Plateau area, and in eastern and southern South America.

On the basis of the material at hand, it seems that the frequent occurrence of the fossa pharyngea is limited to that area of North America which is, or was, the home of the Uto-Aztecan linguistic stock. From the data at hand I can speak only of southern relationships. I have not enough Plains and Plateau material to determine the frequency in these groups.

At this point it would be well to recall the fact that our data can be interpreted in a positive sense only. Absence of the fossa would not necessarily bar any group from a fairly close relationship with those groups in which the fossa occurs.

It might be urged that this fossa is due to the presence of some environmental factor and non-indicative of relationship. But since this same Southwestern area is shared by short-headed Pueblo peoples, who do not show this peculiarity, this explanation seems inapplicable.

VI. THE PERFORATION OR DEHISCENCE OF THE TYMPANIC ELEMENT OF THE TEMPORAL BONE.

The perforation or dehiscence of the tympanic element of the temporal bone is undoubtedly a maldevelopment and due to a retardation of growth. It is commonly met with in all groups of crania of any considerable size examined. Yet, its very great frequency in certain American groups is worthy of record. It is usually bilateral in its occurrence, but when it occurred on one side only the frequency was recorded as ½. Hrdlička (1906) found it in 27.5 percent of the male crania from California and in 46.0 percent of the female crania. In nearly all of the Bolivian groups the frequency ranged from 40 to 50 percent. Next in order are the Peruvian groups. Following these are certain Mexican, Kwakiutl, Salish, and Southwestern groups. Only a few large groups show a total absence of auditory dehiscence.

FREQUENCY OF PERFORATED TYMPANIC BONES IN AMERICAN CRANIA.

Group	Number Examined	Percent with Perforated Tympanum
Peru, Marañon Country	20	55.0
Bolivia, Chujun Paki	94	52.1
Bolivia, Lluchini Amaya	20	50.0
Arizona, Clear Creek	6	50.0
Bolivia, Island of Titicaca	51	47.0
Bolivia, Charassani	144	46.5
Peru, Cachilaya	34	44.1
Bolivia, Churkoni Chullpa	56	42.8
Bolivia, Takana Chullpa	50	42.0
Bolivia, Kupa Pukio	139	41.7
Bolivia, Hank'o Kala	17	41.2
Washington, Yakima	8	37.5
Peru, Sillustani	11	36.3
Colorado	6	33.3
Bolivia, Tiahuanaco	3	33.3
Bolivia, Tama Tam Chullpa	184	32.0
Peru, Cuzco	17	29.4
Bolivia, Belen Chullpa	7	28.6
Utah, Deformed type	24	25.0
Mexico, Tepecano	4	25.0
Peru, Coastal Area	59	20.3
Colombia	10	20.0
Oregon, Columbia River Vicinity	27	18.5
Mexico, Tlanepantla	25	16.0

FREQUENCY OF PERFORATED TYMPANIC BONES IN AMERICAN CRANIA. (Continued)

Group	Number Examined	Percent with Perforated Tympanum
Eskimo, St. Lawrence Island	13	15.3
Kwakiutl, Koskimo	20	15.0
Mexico, Tarasco	130	14.6
Guatemala	7	14.3
Chukchi	7	14.3
Kentucky, May's Lick	42	14.3
Kwakiutl, Nimkish	37	13.5
Kwakiutl, Miscellaneous	89	13.4
Athapascan, Alaska	8	12.5
Eskimo, Hudson Bay	50	12.0
Haida	34	11.7
New Mexico, Pueblo	87	11.5
Mexico, Tarahumare	48	10.4
California	20	10.0
Mexico, Otomi	11	9.1
Salish, Washington	22	9.0
Salish, Kamloops	12	8.5
Salish, Nanaimo	12	8.5
Salish, British Columbia	39	7.7
Mexico, San Simon	56	7.1
Utah, Basket Makers	95	7.0
Salish, Thompson	29	6.8
Mexico, Huichol	33	6.0
Salish, Bella Coola	20	5.0
Eskimo, Indian Point, Siberia	32	3.1
New York	34	2.9
Eskimo, Alaska	107	1.0

TYMPANUM NOT PERFORATED.

Washington
Arizona, Miscellaneous
Papago and Pima
Massachusetts and Connecticut
Ohio
Illinois
Michigan
Plains Area
Tennessee
Florida, North Carolina
Virginia, Georgia
Tsimshian
Chinook
Salish, Saanich
Salish, Lillooet
Kwakiutl, Nootka
Kwakiutl, Bella Bella
Mexico City
Mexico, Yaqui
Mexico, Cora
Mexico, Zacatecan
Bolivia, Island of Cojata
Mexico, Casas Grandes

VII. METOPISM.

Metopism is the term used to designate in the adult an embryonic form of frontal bone in which the suture between the right and left halves of the bone is persistent. The condition is readily recognized and allows little opportunity for error of observation with different observers. Upwards of 40,000 crania from various parts of the world have been examined for this characteristic. Le Double (1903) summarizes the results on large series of crania representing the main racial types as follows:—

	Number Examined	Frequency in Percent
White race	11,459	8.2
Mongoloid race	621	5.1
Melanesian race	698	3.4
American race	1,191	2.1
Malay race	802	1.9
Negro race	959	1.2
Australian race	199	1.0

Martin (1914) gives a much more detailed table:—

Group	Number	Percent	Author
Ainu	60	0.0	Tarenetzky
Congo Negro	93	1.0	Bartels
Australian	199	1.0	Anutschin
North American	1127	1.1	Russell
Peruvian	458	1.1	Russell
Negro	959	1.2	Anutschin
American	426	1.2	Anutschin
Malay	422	2.8	Anutschin
Melanesian	698	3.4	Anutschin
Peruvian	565	3.5	Anutschin
Papuan	209	4.3	Regalia
Mongoloid	621	5.1	Anutschin
Bavarian	144	6.3	Ried
Slav	1093	6.4	Gruber
Swiss (Disentis)	250	7.1	Wettstein
Bavarian	2535	7.5	Ranke
East Prussian	804	7.9	Springer
Russian	210	8.0	Popori
European	10781	8.7	Anutschin
Tirolese	827	8.8	Frizzi
Hamburger	809	9.5	Simon
Parisian (Catacombs)	10000	9.9	Topinard
Parisian	1336	10.4	Papillault
Pompeian	93	10.7	Schmidt
Friesien	35	11.4	Barge
Portuguese	1000	11.8M9.3F	Machado
German	567	12.3	Welcker

There is a direct increase from the Australian race up through the negro and mongoloid types to the white race. From these data the deduction has been made that metopism is an advanced character and much more frequent in civilized races than in uncivilized groups.

The results are roughly in accord with those of Le Double. Russell (1900) reported on the American crania in the Peabody Museum, Cambridge, Massachusetts:—

Group	Number	Percent
Eskimo	52	.0
New England	68	2.9
Ohio and Tennessee	681	.8
California	160	1.9
Miscellaneous	260	.0
North America	1127	1.1
Peru	458	1.1
Total	1585	1.1

These data indicate a very low frequency of metopism in American crania. Anutschin found a little higher frequency in all his American material. In a series somewhat larger than Russell's (2496), but, for the most part, from different areas, I obtained quite different results. Russell's Peruvian crania are almost wholly from the coastal area and his results are only slightly different from mine for that area.[1] The average frequency is 7.6 percent. This in itself means little, however. The range and distribution of the frequency is of greater interest. My results are tabulated below:—

FREQUENCY OF METOPISM IN AMERICAN CRANIA.

Group	Type of Deformation	No. of Crania	Number of Metopic Crania	Percent of Metopic Crania
Bolivia	A	3	1	33.3
Bolivia, Huata, Lluchini Amaya	A	19	5	26.3
Bolivia, N. Sicasica, Tama Tam Chullpa	A	184	46	25.0
Bolivia, Kupa Pukio Chullpa	A	144	34	23.6

[1]The tabulated results for this character show such an extremely high frequency and disagree to such an extent with Russell's data it is difficult to rid myself of the impression that my material has been somewhat highly selected on the basis of the presence of this character.

FREQUENCY OF METOPISM IN AMERICAN CRANIA (Continued).

Group	Type of Deformation	No. of Crania	Number of Metopic Crania	Percent of Metopic Crania
Colombia, South America	A	13	3	23.0
Bolivia, N. Sicasica, Churkoni Chullpa	A	56	12	21.4
Bolivia, N. Sicasica, Takana Chullpa	A	50	9	18.0
Bolivia, vicinity Charassani	A	144	25	17.3
Bolivia, Island of Titicaca	A	60	10	16.6
Bolivia, Huata, Chujun Paki	A	94	14	14.8
Alaska, Athapascan	..	8	1	12.5
Peru, Region of Cuzco	A	17	2	11.7
Salish, Bella Coola	F.O.	20	2	10.0
Koskimo	A	20	2	10.0
Salish, Washington	F.O.	23	2	8.7
Salish, Saanich, British Columbia	F.O.	12	1	8.3
Eskimo, St. Lawrence Island	..	13	1	7.6
Mexico, San Simon	..	54	4	7.4
Peru, Cachilaya	A	34	2	5.8
Nimkish	A	38	2	5.3
Peru, Lima and Coastal Region	..	58	3	5.2
Nootka	A	22	1	4.5
Mexico City vicinity	..	25	1	4.0
Oregon	A	27	1	3.7
Mexico, Huichol	..	32	1	3.1
Salish, British Columbia	F.O.	37	1	2.7
Kentucky, May's Lick	O	39	1	2.5
Kwakiutl, Vancouver Island	A	87	1	1.1
Tsimshian	O	9	0	
Haida	..	40	0	
Yakima	O	15	0	
Chinook	F.O.	92	0	
Salish, Kamloops	..	13	0	
Salish, Nanaimo	F.O.	13	0	
Salish, Thompson	..	26	0	
Salish, Lillooet	..	8	0	
Nootka	A	23	0	
Bella Bella	O	10	0	
Washington, Miscellaneous	F.O.	15	0	
Oregon	F.O.	27	0	
California	..	21	0	

FREQUENCY OF METOPISM IN AMERICAN CRANIA (Continued).

Group	Type of Deformation	No. of Crania	Number of Metopic Crania	Percent of Metopic Crania
New Mexico, Pueblo	O	86	0	
Utah, Basket Makers	..	97	0	
Utah, Miscellaneous	O	22	0	
New Mexico, Chaco Cañon	O	..	0	
Arizona, Clear Creek	..	6	0	
Colorado	O	6	0	
New York	..	33	0	
Massachusetts and Connecticut	..	6	0	
Ohio	..	17	0	
Illinois	..	8	0	
Michigan	..	7	0	
Plains Area	..	10	0	
Tennessee	O	8	0	
Virginia	..	1	0	
Georgia	F.O.	1	0	
North Carolina	F.O.	1	0	
Florida	..	25	0	
Mexico, Yaqui	..	7	0	
Mexico, Tarascan	..	130	0	
Mexico, Cora	..	21	0	
Mexico, Tarahumare	..	48	0	
Mexico, Casas Grandes	..	11	0	
Mexico, Tlanepantla	..	23	0	
Mexico, Tepecano	..	4	0	
Mexico, Zacateco	..	4	0	
Mexico, Otomi	..	11	0	
Guatemala	O	6	0	
Peru, Marañon Country	..	20	0	
Peru, Sillustani	A	11	0	
Bolivia, Island of Cojata	..	2	0	
Bolivia, Huata, Hank'o Kala	A	17	0	
Bolivia, Belen Chullpa	A	8	0	
Tierra del Fuego	..	3	0	
Eskimo, Indian Point, Siberia	..	32	0	
Eskimo, Alaska, Point Barrow	..	102	0	
Eskimo, Eastern, Hudson Bay, Smith Sound	..	50	0	
Chukchi	..	7	0	
Totals		2496	190	7.6

Disregarding altogether the smaller series in which one case may make a large change in the percentage, we have a frequency ranging from 15 to 25 percent in six series from Bolivia in the regions of Huata near Lake Titicaca and Sicasica. All of the Bolivian crania excepting twenty-five from Hank'o Kala and Belen Chullpa are included in this group which head the list for a high frequency of metopism.

Certain Salish and Kwakiutl tribes in the North Pacific area stand next, but they are represented by a smaller number of crania and the percentage is of lesser significance. Two groups from Peru, Cachilaya and Cuzco, and one from San Simon, Mexico have a rather high frequency, but are also represented by a small number of cases only. The other areas represented by our collection are free from metopism.

I have indicated in the table the types of artificial cranial deformation existing in the groups examined because my first impression was that the deformation was to some extent responsible for the high frequency of metopism. It is easy to imagine that pressure exerted in the frontal region in accomplishing the annular and fronto-occipital type of deformation might interfere with or delay the closing of the frontal suture. The exceptions to this explanation are too great to permit any such explanation. The Chinook, represented by a series of ninety-two crania, show an extreme form of fronto-occipital flattening, but no metopism. The Kwakiutl from Vancouver, with the annular type of deformation, show only one case of metopism. On the other hand, four of the fifty-four undeformed crania from San Simon, Mexico, are metopic. Numerous other groups, represented by a smaller number of crania, are also exceptions to the above inference and make it clear that no such generalization is possible. It seems more probable that metopism is a local characteristic, for some cause or causes arising in a given group and transmitted by heredity. Its frequency is determined largely by its dominance and length of time since its appearance in the group.

VIII. THE INCA BONE.

Much interest has centered on the frequency of the os inca which received its name from its supposedly high frequency in the Inca crania. Later research has shown that many other groups have a higher frequency. The os inca is the term used to designate the upper or supra occipital portion of the occipital bone when this is separated from the rest of the bone by a suture. This bone manifests itself in a variety of forms, but is properly called the inca bone only when it is of considerable size and includes that portion of the occipital bone above the torus or inion. Frequently it is divided symmetrically into two, three, or four parts. The one part inca is of most frequent occurrence. Occasionally, only one or two parts of the composite inca bone appear. This is usually easily distinguishable from a wormian or sutural bone by its symmetry. Matthews (1893) gives the following data:—

Group	Complete and Incomplete Os Inca in Percent
Saladoan	6.81
Peruvian	6.08
American, not Peruvian	3.86
Negro	2.65
Malay and Polynesian	1.42
Mongolian	2.26
Papuan	.57
Caucasian in general	1.19
Caucasian in Asia	1.70
European	1.09
Melanesian	1.65
Australian and Tasmanian	.64

Compare this with Martin's (1914) table, which includes Russell's data:—

Group	Inca Bone Percent	Group	Inca Bone Percent
European	1.2	Peru	5.2
Malay	1.4	Old Bavarian	.1
Mongolian	2.3	Bavarian	.0
Negro	2.6	Mongoloid	3.7
Australian	.8	Malay	.0
Melanesian	1.6	Loango	2.1
Eskimo	4.0	Congo	2.0
New England	3.0	Bongo	.0
Florida	6.5	Egyptian (mummy)	3.7
Ohio and Tennessee	5.7	New Britain, New Ireland	10.0
New Mexico	0.0	Australian	.0
California	3.1	Old Peru	5.1
Mexico	3.6	Old Mexico	.0
North America	4.8		

While the frequency of the os inca in American crania is lower than the frequency of metopism, it is more widespread in its distribution. While my series from the North Pacific Coast area is small, there is a suggestion that the os inca is equally frequent here and in Peru. In Mexico, too, the frequency is fairly high in a number of groups. The Florida and Kentucky groups suggest a high frequency in the Southeastern area. The os inca is found to some extent in the Bolivian groups and Eskimo series. The Southwest, in so far as it is represented in this study, shows no instances of a high frequency of the os inca. Again, we cannot attribute the high frequency of the inca bone to the practice of deforming the cranium.

My own data are listed below:—

FREQUENCY OF THE INCA BONE IN AMERICAN CRANIA.

Group	Type of Deformation	Number Examined	Percent with Inca Bone
Michigan	..	11	18.2
Salish, British Columbia	F.O.	39	15.3
Salish, Nanaimo	F.O.	15	13.3
Peru, Coastal Area	..	58	12.1
Florida	..	20	10.0
Kwakiutl, Koskimo	A	20	10.0
Salish, Saanich	F.O.	11	9.0
Peru, Sillustani	A	11	9.0
Peru, Marañon Country	..	23	8.6
Mexico, Tarahumare	..	48	8.3
Bolivia, Island of Titicaca	A	61	8.1
Kwakiutl, Nimkish	A	37	8.1
Kentucky, May's Lick	O	42	7.1
Eskimo, Indian Point, Siberia	..	32	6.0
Tarasco, Mexico	..	130	5.4
Bolivia, Tama Tam Chullpa	A	184	5.3
Mexico, San Simon	..	56	5.3
Bella Coola	F.O.	20	5.0
Bolivia, Lluchuni Amaya	A	20	5.0
California	..	22	4.5
Kwakiutl, Miscellaneous	A	90	4.5
Bolivia, Kupa Pukio	A	144	3.4
Thompson, Salish	..	29	3.4
Chinook	F.O.	92	3.2
Haida	..	34	3.0
Huichol, Mexico	..	33	3.0
Bolivia, Chujun Paki	A	94	2.1
Bolivia, Charassani	A	144	2.1
Eskimo, Hudson Bay	..	50	2.0
Bolivia, Churkoni Chullpa	A	56	1.8

GROUPS IN WHICH NO INCA BONE WAS FOUND.

Group	Deformation
Athapascan, Alaska	..
Yakima, Washington	O
Salish, Kamloops	..
Bella Bella	O
Lillooet	..
Salish, Washington	F.O.
Tsimshian	O
Papago	..
Pima	..
Colorado	O
Massachusetts and Connecticut	..
Illinois	..
Plains Area	..
Virginia	..
North Carolina	F.O.
Tennessee	O
Arizona, Clear Creek	..
Arizona, Miscellaneous	O
Utah, deformed type	O
Utah, Basket Makers	..
New Mexico	O
Washington, Columbia River	F.O.
Oregon	F.O.
Yaqui, Mexico	..
Casas Grandes, Mexico	..
Tepecano, Mexico	..
Zacatecas, Mexico	..
Otomi, Mexico	..
Guatemala	O
Eskimo, Alaska	..
Eskimo, St. Lawrence Island	..
Chukchi	..
Bolivia, Island of Cojata	..
Bolivia, Tiahuanaco	A
Bolivia, Takana Chullpa	A
Bolivia, Hank'o Kala	A
Peru, Cachilaya	A
Peru, Cuzco	A
Colombia	A

IX. SUTURAL OR WORMIAN BONES IN THE LAMBDOIDAL SUTURE.

Sutural bones in the lambdoidal suture are of common occurrence and high frequency in a number of groups, particularly among American Indians. Martin's summarizing table (rearranged in the order of frequency) is as follows:—

Group	Percent	Group	Percent
Bongo	29.6	Egyptian mummies	7.6
Peru	21.5	Australian	7.6
Mexico	21.0	Loango	6.5
New Britain, New Ireland	18.0	Congo	6.5
Mongolian	14.2	California	4.7
North America	13.0	Bavarian	3.5
Mexico	12.3	Ohio and Tennessee	3.1
Florida	11.7	Eskimo	2.0
Peru	11.5	Old Bavarian	1.4
Malay	9.5		

My observations on American crania are tabulated below. A large majority of the groups have sutural bones in the region of the lambda. The number varies from one to thirty and the size from one-fourth of a square centimeter in area to twelve square centimeters. The greatest frequency occurs in the Bolivian groups. All groups from Bolivia of which I have fair samples show a very high frequency of this peculiarity. Next in frequency are the Peruvian and Southwestern United States groups. The Kwakiutl and Salish groups are also high in the scale. The crania from Mexico and the Eskimo crania have few or no sutural bones.

FREQUENCY OF SUTURAL OR WORMIAN BONES IN THE LAMBDOIDAL SUTURE OF AMERICAN CRANIA

Group	Type of Deformation	Number Examined	Percent with Sutural Bones
Utah, Miscellaneous	O	25	56.0
Bolivia, Churkoni Chullpa	A	56	53.5
Tennessee	..	8	50.0
Colombia	A	10	50.0
Bolivia, Kupa Pukio Chullpa	A	144	45.8
New Mexico	O	87	43.6
Bolivia, Takana Chullpa	A	50	42.0
Oregon	F.O.	25	40.0
Bolivia, Tama Tam, Chullpa	A	184	37.9
Bolivia, Hank'o Kala	A	17	35.3
Guatemala	O	6	33.3
Bolivia, Charassani	A	144	31.9
Utah, Basket Makers	..	100	31.0
Peru, Coastal Area	..	58	31.0
Bolivia, Lluchini Amaya	A	20	30.0
Kentucky, May's Lick	O	42	26.2
Arizona, Miscellaneous	O	16	25.0
Kwakiutl, Miscellaneous	A	90	23.6
Peru, Cuzco	A	17	23.5
Kwakiutl, Nimkish	A	37	21.6
Peru, Island of Titicaca	A	61	21.3
Bolivia, Chujun Paki	A	94	21.2
Mexico, San Simon	..	56	20.7
Salish, British Columbia	F.O.	39	20.5
Bella Coola, Salish	F.O.	20	20.0
Salish, Washington	F.O.	25	20.0
Mexico, Tarasco	..	128	19.5
Peru, Sillustani	A	11	18.2
Washington, Miscellaneous	F.O.	17	17.6
Arizona, Clear Creek	..	6	16.6
Kwakiutl, Koskimo	A	20	15.0
Florida	..	20	15.0
Peru, Cachilaya	A	34	14.7
Mexico, Tarahumare	..	48	14.6
Kwakiutl, Vancouver Island	A	15	13.3
Peru, Marañon Country	..	23	13.0
Tsimshian	O	8	12.5
Mexico City	..	25	12.0
Eskimo, Hudson Bay	..	50	12.0
Salish, Lillooet	..	9	11.1
California	..	22	9.0
Salish, Saanich	F.O.	11	9.0
Chinook	..	92	8.7
Thompson	..	29	6.8

GROUPS IN WHICH NO SUTURAL OR WORMIAN BONES WERE FOUND IN THE LAMBDOIDAL SUTURE.

Group	Type of Deformation
Michigan	..
Eskimo, Indian Point, Siberia	..
Ohio	..
Athapascan, Alaska	..
Yakima, Washington	O
Salish, Kamloops	..
Bella Bella	O
Papago	..
Pima	..
Colorado	O
Massachusetts and Connecticut	..
Illinois	..
Plains	..
Virginia	..
North Carolina	F.O.
Yaqui, Mexico	..
Casas Grandes, Mexico	..
Tepecano, Mexico	..
Zacatecas, Mexico	..
Otomi, Mexico	..
Eskimo, Alaska	..
Eskimo, St. Lawrence Island	..
Bolivia, Island of Cojata	A
Bolivia, Tiahuanaco	A
Haida	..
Huichol, Mexico	..

In this instance, we get more clearly a correlation between a high frequency of sutural bones in the region of the lambda and deformation of the head. All the large groups of deformed crania stand high in the list, while the reverse is true of the non-deformed crania, with the exception of a few groups. If deformation may not be said to be the cause of the origin of these sutural bones, the indications are that it has been an aid.

X. OTHER SUTURAL BONES; MASTOID DIVISION.

Sutural bones in regions other than the lambda are relatively rare. However, a few American groups, notably the Salish and Kwakiutl of the North Pacific area and a few groups from Bolivia, show a fairly high frequency of sutural bones in the coronal suture. For the most part only one or two such sutural bones occur in any one cranium. The results are tabulated below:—

FREQUENCY OF CORONAL SUTURAL BONES IN AMERICAN CRANIA.

Group	Deformation	Number Examined	Percent with Coronal Suturals
Salish, Nanaimo	A	12	16.6
Kwakiutl, Koskimo	A	20	15.0
Kwakiutl, Miscellaneous	A	87	9.2
Kwakiutl, Nootka	A	23	8.7
Bolivia, Kupa Pukio	A	144	6.2
New York	..	34	5.6
Bolivia, Charassani	A	144	5.5
Salish, Washington	F.O.	24	4.1
Bolivia, Takana Chullpa	A	50	4.0
Oregon	F.O.	27	3.7
Bolivia, Churkoni Chullpa	A	56	3.5
Bolivia, Tama Tam Chullpa	A	184	2.7
Chinook	F.O.	92	2.1
Bolivia, Island of Titicaca	A	60	1.6
Utah, Basket Makers	..	97	1.0
Bolivia, Chujun Paki	A	94	1.0

NO CORONAL SUTURAL BONES.

Chukchi, Siberia
Eskimo, Indian Point, Siberia
Eskimo, St. Lawrence Island
Eskimo, Alaska
Eskimo, Hudson Bay
Athapascan, Alaska
Tsimshian
Salish, Lillooet
Kwakiutl, Nimkish
Kwakiutl, Bella Bella
Washington
California
New Mexico
Utah, Miscellaneous
Arizona, (all)
Haida
Yakima
Salish, British Columbia
Salish, Kamloops
Salish, Thompson
Salish, Bella Coola
Salish, Saanich
Tarascan, Mexico
Cora, Mexico
Tarahumare, Mexico
Casas Grandes, Mexico
Tlanepantla, Mexico
Tepecano, Mexico
Zacatecan, Mexico
Otomi, Mexico

No Coronal Sutural Bones. (Continued).

Colorado	San Simon, Mexico
Massachusetts	Mexico City, Mexico
Ohio	Guatemala, Mexico
Illinois	Peru, Marañon Country
Michigan	Peru, Coastal Region
Plains Area	Peru, Sillustani and Cachilaya
Kentucky, Tennessee, Virginia	Bolivia, Hank'o Kala, Lluchini
Georgia, Florida	Amaya
Yaqui, Mexico	Belen Chullpa
Huichol, Mexico	Tiahuanaco

True bregma bones are also rare. Among the American groups examined I found the bregma bone present in only four crania, one each from the Marañon country group, Peru, from the Tarahumare, Mexican group, from the Churkoni Chullpa of Bolivia and from the Island of Titicaca.

Frequency of Bregma Bones In American Crania.

Group	Deformation	Number Examined	Percent with Bregma Bones
Peru, Marañon Country	..	21	4.8
Mexico, Tarahumare	..	48	2.1
Bolivia, Churkoni Chullpa	A	56	1.8
Bolivia, Island of Titicaca	A	60	1.6
All others	..	..	0

Russell's (1900) results show a similar low frequency:—

Group	Number	Percentage of Occurrence
Eskimo	52	1.9
New England	64	0
Florida	57	0
Ohio and Tennessee	468	1.1
New Mexico	22	0
California	159	0
Miscellaneous	62	1.6
Mexico	52	0
North America	884	.7
Peru (Ancon, Arica) etc.	449	.2
Total	1333	.5

Mastoid Division.

A true and complete division of the mastoid element of the temporal bone into its embryological components is of very rare occurrence. Of the crania examined by me it occurred only in the Eskimo groups and in a single cranium from Cuzco, Peru. While I have tabulated below only the cases of complete division it should be stated that traces of mastoid division are of very great frequency in Eskimo crania.

Frequency of Mastoid Division in American Indian Crania.

Group	Number Examined	Percent with Mastoid Divided
Eskimo, Hudson Bay, Western Greenland	50	8.0
Peru, Cuzco	17	5.9
Eskimo, Alaska	106	5.6
All others	..	0.0

XI. CORRELATIONS.

Correlations are of two types: group correlations and individual correlations. The first type may be regarded largely as accidental, or, more strictly speaking, as associations; while the latter is of greater anatomical significance. For example, we have an association of a high frequency of the pharyngeal fossa with an anthropine form of nasal aperture in the San Simon series. The two are not correlated in individuals. In the Basket Maker series from Utah we have a high frequency of the pharyngeal fossa associated with an infantile form of nasal aperture. In some groups we have an association of high frequency of five or six characters. In the Charassani group we have the anthropine form of nasal aperture very frequent as are also metopism, lambdoid sutural bones, perforated tympanum, and coronal sutural bones. In the Takana group we have a high frequency of epipteric bones, the fronto-temporal articulation, metopism, lambdoid suturals, coronal suturals, and perforation of the tympanum.

The following tables, however, show that there is no significant correlation of these characteristics in individuals.

CORRELATION BETWEEN INCA BONE AND METOPISM.
TAMA TAM CHULLPA, BOLIVIA (ANNULAR DEFORMATION)

	Inca or Interparietal	No Inca	Totals
Metopic	8	39	47
Non-metopic	8	129	137
Total	16	168	184

$r_2 = .53$

CORRELATION BETWEEN PERFORATED TYMPANUM AND INCA BONE.
TAMA TAM CHULLPA, BOLIVIA.

	Tympanum Perforated	Tympanum Normal	Totals
Inca Bone	7	10	17
No Inca Bone	53	114	167
Totals	60	124	184

$r_2 = .20$

CORRELATION BETWEEN PERFORATED TYMPANUM AND METOPISM.
BOLIVIA, ISLAND OF TITICACA.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	1	9	10
Non-Metopic	23	28	51
Totals	24	37	61

$r_2 = -.76$

BOLIVIA, TAMA TAM CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	12	32	44
Non-Metopic	36	104	140
Totals	48	136	184

$r_2 = .04$

BOLIVIA, CHUJUN PAKI.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	9	5	14
Non-Metopic	41	39	80
Totals	50	44	94

$r_2 = .26$

BOLIVIA, KUPA PUKIO CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	17	16	33
Non-Metopic	46	65	111
Totals	63	81	144

$r_2 = .20$

BOLIVIA, CHARASSANI.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	13	11	24
Non-Metopic	56	64	120
Totals	69	75	144

$r_2 = .14$

CORRELATION BETWEEN METOPISM AND LAMBDOID SUTURAL BONES.
BOLIVIA, ISLAND OF TITICACA.

	Metopic	Non-Metopic	Totals
Sutural bones	2	10	12
No Sutural bones	7	42	49
Totals	9	52	61

$r_2 = .01$

BOLIVIA, TAMA TAM CHULLPA.

	Metopic	Non-Metopic	Totals
Sutural bones	27	34	61
No Sutural bones	18	105	123
Totals	45	139	184

$r_2 = .64$

BOLIVIA, KUPA PUKIO CHULLPA.

	Metopic	Non-Metopic	Totals
Sutural bones	15	47	62
No Sutural bones	20	62	82
Totals	35	109	144

$r_2 = .00$

BOLIVIA, CHARASSANI.

	Metopic	Non-Metopic	Totals
Sutural bones	9	30	39
No Sutural bones	14	91	105
Totals	23	121	144

$r_2 = .32$

CORRELATION BETWEEN LAMBDOID SUTURAL BONES AND PERFORATED TYMPANUM.

BOLIVIA, ISLAND OF TITICACA.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	8	5	13
No Sutural bones	15	32	47
Totals	23	37	60

$r_2 = .54$

BOLIVIA, TAMA TAM CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	17	46	63
No Sutural bones	39	82	121
Totals	56	128	184

$r_2 = -.12$

BOLIVIA, TAKANA CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	6	12	18
No Sutural bones	15	17	32
Totals	21	29	50

$r_2 = -.29$

BOLIVIA, CHURKONI CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	11	9	20
No Sutural bones	12	24	36
Totals	23	33	56

$r_2 = .42$

BOLIVIA, KUPA PUKIO.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	27	39	66
No Sutural bones	39	48	87
Totals	66	87	153

$r_2 = -.08$

BOLIVIA, CHARASSANI.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	16 a	22 b	38
No Sutural bones	54 c	53 d	107
Totals	70	75	145

$r_2 = -.16$

NOTE: The coefficient of correlation (r_2) given is Yule's approximation to the true coefficient of correlation and is derived from the formula:

$$r_2 = \frac{ad - bc}{ad + bc}$$

in which a, b, c, d correspond to the values and the positions marked a, b, c, and d in the last table.

XII. SUMMARY.

I appreciate that my series in a large majority of instances is not sufficiently large to give accurate and final percentages; yet, I believe they are sufficiently large to indicate such frequency approximately and that the areas of high and low frequency are not accidental.

The most interesting results are naturally from the North Pacific area, Southwestern United States and Mexico, and Peru and Bolivia, since my material from these areas is greater in amount and more closely distributed.

Considering first the frequency of a frontal process on the temporal bone, we get a point of high frequency in the material from the Chullpa in the vicinity of Sicasica (Takana, Tama Tam, Belen and Kupa Pukio). This peak dwindles down in the material from the ruins of Lake Titicaca and the Peninsula of Huata, yet is of greater frequency here than in the other groups studied. There is a minor mode of considerable frequency in California and Mexico and one North Pacific tribe, the Koskimo, also shows this characteristic quite frequently. The high frequency of epipteric bones, lambdoidal sutural bones, and metopism show a similar distribution for the major modes. In the case of the epipteric bones there is again a minor mode of high frequency in Mexico and the North Pacific area. While these three characteristics have the same general distribution there is little or no individual correlation of them. It is rather an exception to find them all or any two of them in the same individual. Such cases as do occur are no more numerous than would be expected on the law of chance.

The perforated tympanum has the reverse distribution. It reaches its greatest frequency in the material from the ruins near Lake Titicaca and dwindles down towards Sicasica on the one hand and Charassani on the other.

The pharyngeal fossa has its area of greatest frequency in Utah and in that part of Mexico inhabited by the Uto-Aztecan peoples.

The inca bone is most frequent in the North Pacific Coast area among the Kwakiutl and Salish people. A minor peak of high frequency exists in the material from coastal Peru, the Marañon country, and Sillustani.

The infantile type of the lower border of the apertura pyriformis prevails in the American Indian as a group as it does also in mongoloid peoples generally. It persists most frequently in the material from Utah designated as "Basket Maker," in the Eskimo, the Indians from Oregon and Cachilaya, Peru.

The anthropine or distinctly human type of apertura pyriformis has arisen in several areas in America. The principal points of high frequency in the groups studied were the San Simon, Tlanepantla, and Tarascan material from Mexico, another in the material from the Island of Titicaca, diminishing in frequency north and south towards Charassani and Sicasica, respectively, and the more or less isolated series (so far as my material is concerned) from May's Lick, Kentucky.

The prenasal fossæ were not of very great frequency in any group, yet were most common in the North Pacific Coast material, notably that from the Kwakiutl, Salish, Haida, and Chinook groups and from those Southwestern groups in which we found a high frequency of the pharyngeal fossa: Basket Makers, San Simon, Huichol, Cora, and Tlanepantla groups.

In general, the distribution of the above-mentioned characteristics may be said to be as follows. The points of greatest frequency occur in groups located for the most part in close proximity to each other. The farther away from the mode we move geographically the lower the frequency. In a few instances we have minor modes in areas well removed from the point of the major mode geographically.

Our interpretation of this distribution will hinge somewhat upon our conception of the American Indian. I believe that the greater number of anthropologists who have studied the American Indian tribes agree that they all belong to the same race of mankind and that a majority of their fundamental characteristics are unquestionably mongoloid. They have in common coarse lank black hair, a yellowish brown skin, dark brown eyes, a poor development of hair upon the face, body and limbs, rather wide and massive faces, an intermediate nasal development, and concave shovel-shaped upper incisors. But going beyond these similarities we encounter quite a range of variability in several characters. The following anthropometric data illustrate this variability.[1]

[1]These seriations are given to show the variation in the range of the averages. The form of the curves resulting are not significant from a biometric standpoint since the grouping of our material has been to some extent accidental. Averages of tribes are represented. Since a dozen tribes may represent the same physical stock and one tribe may represent two physical types the resulting frequencies are not properly weighted. The form of the curve is also affected by the intensity of work done in certain areas.

STATURE OF AMERICAN INDIANS (Males, Averages).

CM		
175	111	
174	11	
173	1111111	
172	111111111	
171	1111111111	
170	1111111111111	
169	1111111111	
168	111111111111	
167	1111111	
166	1111111111111	
165	11111	
164	111111111111111	
163	111111111	
162	1111111111	
161	1111111	
160	1111111111	
159	111111111	
158	1111111	
157	1111111	
156	1111111	
155	1111	
154		
153	1	Averages of 177 groups.

Each (1) represents the average for a tribe or group and is placed opposite the centimeter nearest the average stature for the group.

CEPHALIC INDEX OF AMERICAN INDIANS (Males).

73	1	
74	11	
75		
76	1	
77	11111	
78	1111111	
79	11111111111111	
80	11111111111111111111111111111111111	
81	1111111111111	
82	11111111111111111111	
83	11111111111111	
84	1111111111111111	
85	11111111	
86	111	
87	111	
88	111	
89	11	
90	1	Averages of 148 groups.

NASAL INDEX OF AMERICAN INDIANS.

63	11	
65		
67	111	
69	11	
71	111	
73	111111111	
75	1111111111	
77	11111111	
79	1111111111111	
81	111111111111	
83	111111111111	
85	1111111	
87	111	
89		
91		
93		
95	1	Averages of 85 groups.

FACE WIDTH OF AMERICAN INDIANS (Male).

MM		
130	11	
132	11	
134	1	
136	11	
138	11111	
140	111111111111111111	
142	111111111	
144	11111111	
146	1111111	
148	1111111111111	
150	1111111	
152	1111	
154	1	
156	1111	
158		
160	1	Averages of 84 groups.

In stature, they range from tribes approaching the pygmy types to the tall tribes surpassed by few groups of mankind. Although the range is considerable, the bulk of the tribes fall around the median. A somewhat similar distribution holds for head form as expressed by the cephalic index. A majority of the Indians have an intermediate average. The extremely long heads and extremely short heads are rare. Some of the latter are unquestionably due to artificial deformation. Nose form, as indicated by the nasal index, varies considerably. There is also consider-

able variation in the elevation of the nose from the face and in the contour of the profile. Face width is also quite variable, yet in most instances is greater than that of the European groups. The Eskimo, who are easily recognizable as a fairly distinct racial type (although also mongoloid in origin), form the upper limits of this distribution.

There is some disagreement as to the significance of this variation. Boas (1912) has suggested that this variation is largely the result of isolation, that as the population expanded over the New World it scattered out into more or less isolated local groups whose inbreeding soon differentiated varieties of head form and other features. Wissler (1917) has also apparently accepted this explanation and has made an attempt to designate the local groups. He limits the distribution of some thirteen local types. More recently, Hrdlička, who has had the greatest opportunity of examining Indian material both living and dead, has made the suggestion that there are two great types of American Indians, exclusive of the Eskimo and Athapascan groups, both of which he regards as fairly recent arrivals. However, he has not published his evidence for such conclusions in any detail and all discussion of the proposal must await the publication of such evidence. I believe all will agree that the Eskimo is a fairly distinct type, not likely to be confused with the Indian. From the published data it is also quite evident that the Southern Athapascan at least are quite different from their neighbors. The only questionable point in Hrdlička's suggestion is whether or not two types can be postulated which will include all other American groups. It is at least safe to say that we shall still have to call upon environmental influence to account for many apparently aberrant groups.

Until these types are more clearly indicated and defined, I prefer to regard the variations as more or less local variations from a single stock. The random distribution of the anthropometric characteristics already published and the lack of correlation or association of these characteristics in their distribution would seem to justify this stand at present. Stature, head form, nose form, and face width vary independently with very little tendency to form well-defined types extending over any considerable area. In fact, their distribution is similar to that found for the descriptive characteristics that are the subject of this paper. Such distributions point to a somewhat stable condition of the population for a very considerable time and, within reasonable limits, to a greater or less amount of isolation of regional groups.

The physical diversity in individual traits parallels, although it does not equal in extent, the linguistic diversity. In a large number of in-

stances these anatomical characteristics in their greatest frequency were confined to one or two linguistic stocks.

Another consideration is the phylogenetic significance of these characters. Many of them are unusual and uncommon in man but typical for certain anthropoids and other primates or even the lower mammals, reptiles and amphibians. For this reason, their occurrence in man has been regarded as the retention of a primitive trait and indicative of anatomical primitiveness. Such conclusions are open to objection. It is quite possible, from their very nature, for certain of these characteristics to be acquired secondarily. They can not be considered as a group but must be discussed separately. When we find, as we do, that the lower second molar tooth retains its primitive five-cusped pattern in a majority of the American Indians, as well as in other mongoloid types, it seems safe to assume that this is indeed the retention of a primitive characteristic. Almost the same may be said for the infantile type of the lower border of the apertura pyriformis. The anthropine or exclusively human type occurs only sporadically in mongoloid types. It is most logical to assume that the mongoloids are primitive in this characteristic. But, while it is logical, it is not as certain as is the primitive nature of the five-cusped lower second molar, for the anthropine type is but a developmental modification of the infantile type. By this I mean that the lower border of the nasal aperture is infantile in the early developmental stages. Any one of a number of disturbing elements during the formative period might result in a retention of the infantile type. However, as I said in the case at hand, with the widespread regional and racial distribution, I believe that this may be looked upon as a retention of a primitive character and not a secondary acquisition.

But, when we consider such characters as the frontal process on the temporal, the presence of epipteric bones, the fossa pharyngea, metopism, the presence of the inca bone, the perforated or incomplete tympanum, all of which are clearly represented in the embryonic and later development of the crania of all individuals, it is easier to believe that they may often arise secondarily as sports in groups in which they have not appeared in adults for centuries. They are, for the most part, the results of the non-union of embryonic elements that normally united, or the union of two embryonic elements in close contact which do not normally unite. Their sporadic and limited distribution would also seem to indicate this and eliminate them as racial characters, although it is conceivable that with opportunities for distribution one of these characteristics might become secondarily a racial characteristic.

Artificial deformation of the head has often been assigned as a causative factor for the appearance of such characteristics as metopism, the inca bone, epipteric bones, and other sutural bones. My data would seem to indicate that such conclusions are not warranted. Many groups that are not deformed have these elements in great frequency and many others that are deformed do not have these elements. The closest associations between deformation and the high frequency of extra elements occurs in the presence of lambdoidal sutural bones.

Finally, it seems clear that the true significance of such characteristics as have been dealt with here can only be determined when more detailed data are available for interpretation.

XIII. BIBLIOGRAPHY.

ALLEN, H.

1878. Distinctive Characters of Teeth (Proceedings, Academy of Natural Sciences of Philadelphia, vol. 30, p. 39, Philadelphia, 1878.)

BATUJEFF, N.

1893. Allgemeine Morphologische Merkmal der Krone der Zahne des Menschen (Arbeiten der Anthropologische Gesellschaft an der kaiserlische militar medizin Akademie, vol. 1, part 1, pp. 26–100, St. Petersburg, 1893.)

BAUER, LUDWIG.

1915. Beiträge Zur Kraniologie der Baining (Neu Pommern) (Archiv für Anthropologie, N. F. Band 14, pp. 145–202, Braunschweig, 1915.)

BOAS, FRANZ.

1912. The History of the American Race (Annals, New York Academy of Sciences, vol. 21, pp. 177–183, New York, 1912.)

COPE, E. D.

1888. On the Tritubercular Molar in Human Dentition (Journal of Morphology, pp. 7–23, 1888.)

CUNNINGHAM, D. J.

1917. Text-book of Anatomy. Edited by Arthur Robinson. New York, 1917.

HRDLIČKA, A.

1906. Contribution to the Physical Anthropology of California (University of California Publications in American Archæology and Ethnology, vol. 4, no. 2, Berkeley, 1906.)

1915. The Peopling of America (The Journal of Heredity, vol. 6, pp. 79–91, Washington, February 1915.)

1916. Physical Anthropology of the Lenape or Delawares, and of the Eastern Indians in General (Bulletin 62, Bureau of American Ethnology, Washington, 1916.)

LE DOUBLE, A. F.

1903. Traité des Variations des Os du Crane de l'Homme et de leur Signification au point de vue de l'Anthropologie zoologique. Paris, 1903.

MACALISTER, A.

1898. The Apertura Pyriformis (Journal of Anatomy and Physiology, vol. 32, pp. 223–230, London, 1898.)

MARTIN, RUDOLPH.

1914. Lehrbuch der Anthropologie; in systematischer Darstellung mit besonderer Berücksichtigung der Anthropologischen Methoden. Jena, 1914.

MATTHEWS, WASHINGTON.

1893. Human Bones of the Hemenway Collection in the United States Army Medical Museum (Memoirs, National Academy of Sciences, vol. 6, part 7, pp. 139–286, Washington, 1893.

MINGAZZINI, G.
1891. Ueber die onto- und philogenetische Bedeutung der verschiedenen Formen der Apertura pyriformis (Archiv für Anthropologie, Band 20, Braunschweig, 1891.)

PERNA, GIOVANNI.
1906. Sul canale basilare mediano e sul significato della fossetta faringea dell' osso occipitali (Anatomischer Anzeiger, vol. 28, pp. 379–394, Jena, 1906.)

REGNAULT, F.
1894. Variations dans la Forme des Dents suivant les Races Humaines. (Bulletins de la Societe d'Anthropologie de Paris, Tome 5, pp. 14–18, Paris, 1894.)

RIZZO, AGOSTINO.
1901. Canale cranio faringeo, fossetta faringea, interparietali e preinterparietali nel cranio umano (Monitore Zoologico Italiano, vol. 12, pp. 241–252, 1901.)

ROMITI, GUGLIELMO.
1891. La Fossetta Faringea nell'osso Occipitale dell'Uomo (Atti della Società Toscana di Scienze Naturali residente in Pisa, Memorie 11, Pisa, 1891.)

ROSSI, UMBERTO.
1891. Il Canale Cranio-Faringeo e le Fossetta Faringea (Monitore Zoologico Italiano, vol. 2, pp. 117–122, 1891.)

RUSSELL, FRANK.
1900. Studies in Cranial Variation (The American Naturalist, vol. 34, pp. 737–743, Boston, 1900.)

SCHWERZ, FRANZ.
1915. Die Völkerschaften der Schweiz von der Urzeit biz zur Gegenwart (Studien und Forschungen zur Menschen und Volkerkunder, Vol. 13. Edited by Georg Buschan. Stuttgart, 1915.)

DE TERRA, MAXIMILIAN.
1905. Beitrage zu einer Odontographie der Menschen-Rassen. Inaugural Dissertation. Zurich, 1905.

THOMPSON, ARTHUR.
1917. See Cunningham, D. J.

TOPINARD, PAUL.
1892. De l'Evolution des Molaires et Prémolaires chez les Primates et en particular chez l'Homme (L'Anthropologie, vol. 3, pp. 641–710, Paris, 1892.)

VRAM, U. G.
1897. Studio sui Denti Molari Umani (Atti della Società Romana di Antropologia, vol. 5, Roma, 1898.)

WATERSON, DAVID.
1917. See Cunningham, D. J.

WISSLER, CLARK.
1917. The American Indian. An Introduction to the Anthropology of the New World. New York, 1917.

Volume XXII.

I. Contributions to the Archaeology of Mammoth Cave and Vicinity, Kentucky. By N. C. Nelson. Pp. 1–73, and 18 text figures. 1917. Price, $.75.

II. Chronology in Florida. By N. C. Nelson. Pp. 75–103, and 7 text figures. 1918. Price, $.25.

III. Archaeology of the Polar Eskimo. By Clark Wissler. Pp. 105–166, 33 text figures, and 1 map. 1918. Price, $.50.

IV. The Trenton Argillite Culture. By Leslie Spier. Pp. 167–226, and 11 text figures. 1918. Price, $.50.

V. (In preparation.)

Volume XXIII.

I. Racial Types in the Philippine Islands. By Louis R. Sullivan, Pp. 1–61, 6 text figures, and 2 maps. 1918. Price, $.75.

II. The Evidence Afforded by the Boskop Skull of a New Species of Primitive Man (*Homo capensis*). By R. Broom. Pp. 33–79, and 5 text figures. 1918. Price, $.25.

III. Anthropometry of the Siouan Tribes. By Louis R. Sullivan. Pp. 81–174, 7 text figures, and 74 tables. 1920. Price, $1.25.

IV. A Few Andamanese Skulls with Comparative Notes on Negrito Craniometry. By Louis R. Sullivan. Pp. 175–201, 1 text figure, and 9 tables. 1921. Price, $.30.

V. The Frequency and Distribution of Some Anatomical Variations in American Crania. By Louis R. Sullivan. Pp. 203-258, and 1 text figure. 1922. Price, $.50.

Volume XXIV.

I–IV. Myths and Texts from the Apache.

Volume XXV.

I. Myths and Traditions of the Crow Indians. By Robert H. Lowie. Pp. 1–308. 1918. Price, $3.00.

II. The Religion of the Crow Indians. By Robert H. Lowie. Pp. 309–444 and 7 text figures. 1922. Price, $1.25.

Volume XXVI.

I The Aztec Ruin. By Earl H. Morris. Pp. 1–108, and 73 text figures. 1919. Price, $1.00.

II. The House of the Great Kiva at the Aztec Ruin. By Earl H. Morris. Pp. 109–138, and 5 text figures. 1921. Price, $.30.

III. (In preparation.)

Volume XXVII.

I. Pueblo Bonito. By George H. Pepper. Pp. 1-490. Plates I-XII, and 155 text figures. 1920. Price $3.50.


AMERICAN·MUSEUM·PRESS