TRIGONID-TALONID HEIGHT RELATION INDICES OF THE PERMANENT LOWER MOLARS OF PRIMATES

MUZAFFER SÜLEYMAN ŞENYÜREK, Ph. D.

Professor of Anthropology, University of Ankara

INTRODUCTION

The tuberculo-sectorial lower molars of the early and primitive mammals consist of a trigonid section and a lower talonid section behind it [1]. In the subsequent course of evolution of the lower molars of sonıe mammalian orders and of the Primates, the originally lower talonid section has tended to be raised vertically relative to the trigonid section as well as being expanded transversely (Clark, 1934, pp. 73-76; Romer, 1946, pp. 301-302).

This process of equalization of the heights of the talonid and trigonid sections, vvhereby the tuberculo-sectorial lower molars have been modified is well-known by the paleontologists and is clearly shown by a picture published by Gregory (Gregory, 1920, fig. 287) whichis reproduced in this paper as figüre 1. Gregory states regarding this picture that the second lower milk molar of *Dryepithecus "is more primitive than that of a modern chimpanzee in retaining more than distinct traces of the primitive tuberculo-sectorial pattern: the trigonid being smaller and higher than the talonid, the hypoconid less protuberant laterally."* and that in the second lower milk molar of Man the trigonid is *"on same general plane zvith talonid"* [2]. Although in this figüre a permanent tuberculo-sectorial lower molar of *Omomys* (an Eocene tarsioid genus) is compared with the second lower milk molars of three other genera, and although the protoconid of the human specimen is certainly worn[3], it is stili clearly seeri that in passing from *Omomys* to *Dryopithecus* and then to *Pan* and *Homo sapiens* the talonid section is elevated in relation to the trigonid section[4]. Although this process of elevation of talonid relative to

[1] For the cusps of the trigonid and talonid sections see Fig. 1.

[2] Gregory, 1920, p. 711.

[3] it must be noted however that in the human specimen in this figüre the protoconid is clearly worn vvhile the tip of hypoconid is only slightly abraded.

[4] The same picture of Gregory was reproduced also by the late Professör Franz VVeidenreich, with the addition of the second lower milk molar of *Sinanthropus* (VVeidenreich, 1937, Fig. 344). The *Sinanthropus* tooth used by VVeidenreich (1937, Fig. 343) is No. 139' in which the protoconid is worn and this worn part has been restored with dotted lines (See VVeidenreich, 1937, Fig. 344b), Although considerable difference betvveen the heights of protoconid and hypocomd in the second lower milk molar of *Sinanthropus* is indicated by VVeidenreich's reconstruction, judging by the second lower milk molar of

trigonid in the course of evolution is well known by the paleontologists, so far as I am aware nobody has yet attempted to study it metrically to see to what extent it has been carried out in the different genera of the order Primates.

In view of this need I thought that it would be worthwhile to study this relation metrically, by means of two indices devised, which are described below.

MATERIAL

The material upon which this study is based was measured in the Museum of Comparative Zoology and the Peabody Museum of Harvard University (in 1938-1939 and 1946-1947), the American Museum of Natural of History of New York (in 1946-1947), and the United States National Museum in Washington, D. C. (in 1946-1947)[5]. A small series of Chalcolithic and Copper Age human teeth from Anatolia have also been added to the tables. The material studied is listed in table 1.

In this study only one selective requirement has been made. it is known that attrition affects the dimensions of the teeth, especially the height measurements. Thus it is evident that to be comparable the teeth studied should be of the the same or nearly the sarae state of preservation. Therefore the teeth studied for this purpose are either fresh or very slightly worn. A slight degree of wear is present in some of the human teeth measured at Harvard. This "Homo sapiens series" includes teeth of American Indians, Medieval Icelanders, Negroes and Melanesians. However, another series of first lower molars of ancient Icelanders and American Indians, agahı measured at Harvard, consists of entirely fresh teeth in the process of eruption. The Anatolian series measured contains unworn teeth.

Sinanthropus No. 128 (Weidenreich, 1937, Fig. 202b), in which the dıfference between the heights of these two cusps is much less, I am inclined to think that the difference between the heights of protoconid and hypoconid of the second deciduous lower molar of *Sinanthropus* is probably less than that indicated in Weidenreich's (1937) reconstruction in his Fig. 344b.

[5] On this occassion I wish to express my thanks to Prof. Dr. E. A. Hooton, Prof. Dr. A. S. Romer, Miss Barbara Lawrence of Harvard **University; Prof. Dr. W. K.** Gregory and Dr. E. H. Colbert of the American Museum of Natural History of New York and Dr. R. Kellog of the United States National Museum of Washington, D. C, for generously allovving me to study the material in their respective departments. I also wish to express my thanks to the Ministry of Education of Turkey and to the University of Ankara for sending me to America in 1946-1947 to further my Studies on Primates and to the Wenner-Gren Foundation for Anthropological Research (The Viking Fund, Inc.), of New York, for generously extending me ah additional grant. I also extend my thanks to my wife for the dravving shown in fig. 2. Last but not least, I would like to take advantage of this opportunity to remember the memory of the late Prof. G. Ailen of the Mammals Department of Harvard, who had placed ali the collections of his department at my disposal.

The trigonid heights given here are not ali the trigonid heights measured, but only of those specimens in which the talonid heights of the corresponding sides could also be taken. That is, for instance, if on a lower molar only the buccal trigonid'height could be measured, while the buccal talonid height could not be taken owing to a damage, this trigonid height is not registered in the present report. The same is also true for the lingual side.

METHOD OF MEASUREMENT

a. *Measurements:*

1. *Buccai Trigonid Height:* This is the distance between the tip of the protoconid and the lowest point of enamel on the buccal surface beneath this cusp, measured as nearly vertically as possible (line AB in fig. 2).

2. *Buccal Talonid Height:* This is the distance, measured as nearly vertically as possible, between the tip of the hypoconid and the lowest point of enamel beneath this cusp on the buccal surface, provided the enamel line beneath this cusp did not stand at a different level from the enamel margin below the protoconid (line CD in fig. 2).

3. *Lingual Trigonid Height:* This is the distance between the tip of the metaconid and the lowest point of enamel beneath this cusp on the lingual side, measured as nearly vertically as possible (line EF in fig. 2).

4. *Lingual Talonid Height:* This was measured as nearly vertically as possible between the tip of the entoconid and the iowest point of enamel underneath this cusp on the lingual side if the enamel line beneath this cusp was at the same level as that below the metaconid (line GH in fig. 2).

In cases where there was an observable discrepancy in the downward extension of enamel on the trigonid and talonid sections, the talonid heights, on both the buccal and lingual sides, were taken from the level at which the trigonid height of the çorresponding side was measured.

b. Indices:

I. Buccal trigonid-talonid height relation index:

$$\frac{\textit{Buccai Talonid Height} \times 100}{\textit{Buccal trigonid height}}$$

This index expresses the buccal talonid (hypoconid) height as a percentage of the buccal trigonid (protoconid) height. it ekpresses the vertical development of talonid relative to trigonid on the; buccal side.

II. Lingual trigonid-talonid height relation index:

$$\frac{\textit{Lingual Talonid Height} \times 100}{\textit{Lingual trigonid height}}$$

This index expresses the lingual talonid (entoconid) height as a percentage of the lingual trigonid (metaconid) height. it expresses the vertical development of talonid on the lingual side relative to the trigonid.

The trigonid and talonid heights of the lower molars are given in tables 2, 3 and,4 and trigonid-talonid height relation indices are shown in table 5.

First Lower Permanent Molar

Buccal Trigonid-Talonid Height Relation Index :

Among the genera studied the lowest average index is seen in *Tarsius* and the highest in *Papio,* the other genera falling between these two extremes. In general, the Prosimians have lower indices than the genera of the suborder Anthropoidea, but among them *Adapis, Propithecus* and *Lichanotus* tend to have relatively high indices. it is rather strange to observe that the fossil *Pelycodus* and *Adapis* specimens studied do not appear to be more primitive in this respect than the living *Lemur, Lepilemur, Hapalemur, Perodicticus* and *Nycticebus.* Similarly, one specimen of *Mecrolemur* has a higher index than the three specimens of modern *Tarsius* measured.

Among the Platyrrhines the specimens of *Leontocebus, Saimiri* and *Cebus* studied fail within the range of Lemuroidea and Tarsioidea, while one specimen of *Pithecia,* with an index of 100, exceeds ali the Prosimians measured. Of the Catarrhine monkeys, the Oligocene genus *Apidium,* which is a primitive Catarrhine monkey[6], exceeds ali the Prosimians and Platyrrhines measured in this respect, with the exception of one specimen of Pithecia, while the average of three modern *Papio* is över 100.

The index of one *Hylobates* measured is lower than the averages of the great anthropoids and man, although it is within the range of some. *Pongo, Pan* and *Gorilla* exceed ali the Prosimians and Platyrrhines studied on the average in this index with the exception of one *Pithecia.* Ali the anthropoid genera, however, fail short of *Papio.* Although their averages fail short of *Apidium,* the upper ranges of variation of *Pongo, Pan* and *Gorilla* exceed this Oligocene monkey. Modern man surpasses in this index ali the primate genera studied, with the exceptions of *Pithecia* and *Papio.*

Lingual Trigonid- Talonid Height Relation Index:

The lowest index is found in one specimen of *Tarsius,* while the average of three specimens of *Propithecus* exceeds those of ali the other primates; although the maxima for *Papio* and *Homo* exceed the maximum for this genus as far as the present series goes. Two specimens of *Pelycodus* and one of *Adapis magnus* (67.56) have much lower indices than the two lemurs measured. On the other hand, one specimen of *Adapis parisiensis* (86.95) exceeds the two lemurs in this index. One specimen of *Mecrolemur* again

[6] Gregory, 1920, pp. 616-618.

has a higher index than the one *Tarsius* rneasured and exceeds ali the • lemuroids rneasured with the exceptions of *Propithecus* and one specimen of *Adapis parisiensis.* Amongst the Platyrrhines, two specimens of *Leontocebus* have an average index as low as that of *Adapis,* while the average of two *Saimiri* exceeds those of Prosimians studied with the exceptions of *Propithecus,* one specimen of *Adapis parisiensis* and one *JVecrolemur.* One specimen of *Pithecia* comes quite close to the average of *Propithecus,*

On the whole, the modern Catarrhine monkeys studied exceed the averages of the Prosimians and Platyrrhines, with the exceptions of *Propithecus* and *Pithecia.* However, *Apidium* comes close to the average of *Saimiri* and agrees with one *Necrolemur* in this index. Again *Papio* has the highest index among the Old World monkeys examined. The average of three *Hylobates* is lower than those of the great anthropoids studied and is even lower than that of the two lemurs rneasured. The great anthropoids, on' the whole, tend to have lower averages than those of the Catarrhine monkeys. Among them only the averages of *Pongo* and *Pan* surpass *Apidium* but fail short of other 'Catarrhine genera studied. As far as the present series goes man in this index exceeds the averages of ali the anthropoids, and indeed, most of the primate genera with the exceptions of *Propithecus* and *Pithecia.*

Second Lower Permanent Molar

Buccal Trigonid-Talonid Height Relation Index:

Among the Primates studied, the lowest average index is found in *Tarsius* while the type specimen of *Apidium* exceeds the averages of ali the other genera, although it is equal to the mâximum for man. The lemuroids tend to have higher indices than the tarsioids studied. *Pelycodus* and *Adapis* studied have higher indices than some of the present lemuroids, while *Propithecus* and *Lickanotus,* appear to surpass the other Prosimians. The Platyrrhines studied are within the range of Prosimians in this index, among them only one specimen of *Cebus* coming close to the Indrisidae. The Catarrhine monkeys rneasured exceed the averages of the Prosimians and Platyrrhines.

Anthropoids on the whole appear to possess somewhat lower indices than the Catarrhine monkeys. *Pan* has the highest index among the anthropoids studied, falling within the range of the Catarrhine monkeys. Man exceeds ali the primate genera studied in this index, with the exceptions of *Apidium, Cercopithecus (Cercopithecus talapoin), Erythrocebus* and *Pan. Lingual Trigonid-Talonid Height Relation Index:*

The lowest index is found in one specimen of *Adapis magnus*[1], followed by *Pelycodus* and *Tarsius,* each represented by one specimen. The few. Platyrrhine specimens studied fail within the range of lemuroids, and among them only one specimen of *Lagothrix* exceeds the averages of Prosimians,

[7] One specimen of *Adapis parisiensis* has a higher index (85.18).

but not their maxima. The Catarrhine monkeys examined are within the upper ranges of Prosimians and Platyrrhines, but the average of *Cercopithecus* exceeds those of the Prosimians and Platyrrhines, although its range overlaps with that of *Lemur.* Among the anthropoid apes, *Pan and Gorilla* have the highest averages, exceeding the averages of ali the infrahurnan Primates measured with the exception of *Cercopithecus. Hylobates* and *Pongo* seem to have lower indices than *Pan* and *Gorilla,* which is also true for one Siamang measured. As far as the present data is concerned *Homo sapiens* seems to have the highest index amongst the Primates on the average.

Third Lower Permanent Molar

Buccal Trigonid-Talonid Height Relation Index:

The lowest index is encountered in one *Lepilemur* and the highest in *Pan,* as far as the present data is concerned. Among the Prosimians studied, *Tarsius* is next to *Lepilemur,* although its maximum is within the range of *Lemur,* while *Propithecus* has the highest average. *Pelycodus* and *Adapis* appear to possess higher indices than some of the modern lemuroids, but not ali of them. One specimen of N*ecrolemur* also exceeds the two modern *Tarsius* measured in this index. Two specimens of *Saimiri* studied fail within the range of Prosimians. The two Catarrhine specimens measured, while in the range of Prosimians, are near the maxima for them. *Pongo* and *Gorilla* come near the Catarrhine monkeys measured, while *Pan* seems to exceed ali the other Primates. As far as the present material is concerned, *Homo sapiens* exceed ali the infrahurnan Primates on the average in this index, with the only exception of *Pan.*

Lingual Trigonid-Talonid Height Relation Index:

The lowest index is seen in one specimen of *Adapis magnus* [8] and the highest in one *Maçaca.* The specimens of *Adapis, Pelycodus* and *Notharctus* measured possess lower indices than the available modern lemuroids. In Lemuroidea listed, *Propithecus* exhibits the highest indices. One *Tarsius* examined is in the range of fossil lemuroids in this index. Among the Platyrrhines studied, two *Saimiri* and one *Lagothrix* are within the range of Prosimians, while one *Aotes* exceeds ali the Prosimian genera measured. Of the Catarrhine monkeys, one *Cercopithecus* has a slightly lower index than *Aotes,* but exceeds the maxima of the Prosimians measured. On the other hand, one specimen of *Maçaca* exceeds ali' the other Primates. One *Hylobates* measured is within the range of Prosimians. *Gorilla* and *Pan* have lower indices than the two Catarrhine monkeys studied. *Homo. sapiens* possess a higher index than the anthropoids measured. Indeed, man seems to exceed, on the average, ali the infrahurnan Primates studied, with the exception of one specimen of *Maçaca.*

[8] The one *Adapis parisiensis* specimen measured has a higher index (71.42).

The Relation Between The Buccal and Lingual Trigonid-Talonid Ileight Relation Indices

An examination of table 5 shows that in most of the Primate genera studied the buccal trigonid-talonid height relation index is higher than the lingual trigonid-talonid height relation index in the same molar. In other words, in most of the Primate genera talonid relative to trigonid is lower on the lingual side than on the buccal side. The only exceptions to this rule are found in the first lower molars of *Propithecus* and *Saimiri* and in the second and third lower molars of *Lemur,* in which the index for the lingual side exceeds that of the buccal side. A lower trigonid-talonid height relation index on the lingual side than on the buccal side must be considered as the primitive condition for the Primates, as it occurs in most Primate genera whether they have relatively low or high talonids. Similarly, the few genera in which the indices for the lingual side exceed those of the buccal side may be considered specialized in this respect. Furthermore, it appears that in genera where the talonids have been raised in relation to the trigonids, this primitive relation between the buccal and lingual sides is stili retained, as in most such genera the buccal trigonid-talonid height relation indices stili exceed those of the lingual side.

SUMMARY AND CONCLUSION

The series that has been studied is rather small for too definite statements. it is hoped that this index is applied to a larger series of Primates, which will certainly give better results. Nevertheless, I believe that, although small, the present series stili gives some useful indications which are discussed below.

The genera listed in table 5 have been rearranged in tables 7 and 8, according to the magnitude of their trigonid-talonid height relation indices. An examination of these two tables reveals that the lowest indices are found amongst the Prosimians and the highest values are encountered usually in the various genera of the suborder Anthropoidea, with the only exception of the lingual trigonid-talonid height relation index of the first lower molar of *Propithecus.* it also appears that in the suborder Anthropoidea, the highest indices are most often found in one genus or the other of the Catarrhine division, including the Old World monkeys, anthropoids and Man. In the buccal trigonid-talonid height relation index, in the first lower molar the highest index is found in *Papio,* in the second lower molar in *Apidium* and in the third lower molar in *Pan.* In the lingual trigonid-talonid height relation index, in the first molar the highest index is seen *m. Propithecus,* in the second lovver molar in *Homo sapiens* and in the third lower molar in *Maçaca.* As far as the present data are concerned, the highest average index, irrespective of the side and the number of the tooth in the molar series, is found in *Papio,* in the first lower molar of which the

buccal trigonid-talonid height relation index exceeds 100. That is, *in Papio,* in at least the first lower molar, there is a tendency on the buccal side for the talonid section to surpass the trigonid in height. The first lower molar of a baboon is shown in figüre 3.

From the account given it is clear that talonid relative to trigonid has been elevated during the phylogeny of Primates, but it also appears that there is no constant rise in the index as we go from the primitive to the more advanced. In other words, there is considerable overlapping between the three suborders of the order Primates. For instance *Propithecus,* of the family Indrisidae of Lemuroidea, seems to exceed in at least some indices some more advanced genera. This fluctuation and overlapping can be explained only by assuming that in different families of the order there has been considerable parallelism in this feature. That is, starting from a relatively low index, some families or genera have tended to have higher indices independently of each other. Examples of this are to be found in Indrisidae, some Platyrrhine genera, Cercopithecidae, some anthropoid genera and in Man.

it is observed that some fossil Eocene lemuroids seem to have, especially on the buccal side, indices which are not lower than those of some of the modern lemuroids, and that one *Necrolemur* has on both sides higher indices than ali the specimens of *Tarsius* measured. it would appear that the fossil Eocene genera studied are probably not the direct ancestors of the modern lemuroid genera with lower indices since the latter is certainly the more primitive condition, althoügh, as far as this index is concerned, the same cannot be said about the genera of Lemuroidea with higher indices. Similarly, *Necrolemur* may not be considered a direct ancestor of modern *Tarsius,* which seems to be one of the most primitive of the Primates in this feature. In this connection it is worthwhile to recall that among the existing Primates *Tarsius* is the only genus preserving the paraconid of the original trigonid section, which cusp (paraconid) has been lost in the permanent lower molars of ali the living Primates. Thus it is seen that the modern *Tarsius* retains a genuinely primitive tubercule-sectorial condition in its lower molars. Regarding the Eocene Tarsioids *Necrolemur* and *Microchoerus* Gregory states that : *"these genera exhibit certain important advances in the direction of the Old World Primates."*[9] *it would* appear that in the trigonid-talonid height relation also, *Necrolemur* had developed a more pithecoid tendency than *Tarsius.* Some of the Eocene lemuroid genera studied also would seem to manifest more pithecoid tendencies in this feature than some of the modern lemuroids.

From tables 6 and 7 it is seen that, according to the data available, *Homo sapiens,* althoügh the highest only in the lingual trigonid-talonid height relation index of the second lower molar in the order, has indices

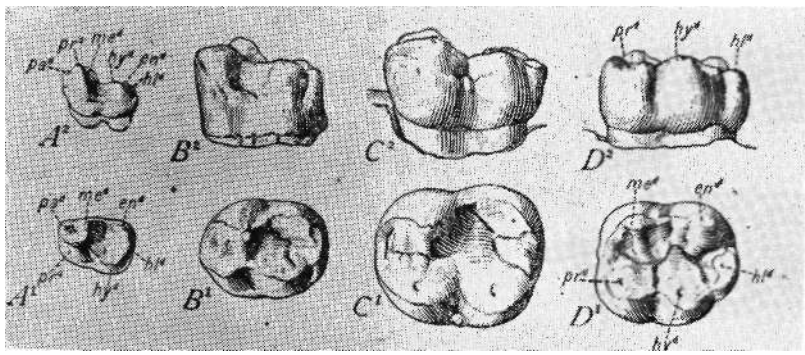
[9] Gregory, 1920, p. 400.

TABLE 5

Trigonid-Talonid Height Indices of the Lower Permanent Molars of Primates (o + o)

	M_1						M_2						M_3					
	Buccal Talonid Ht. x 100			Lingual Talonid Ht. X 100			Buccal Talonid Ht. x 100			Lingual Talonid Ht. X 100			Buccal Talonid Ht. X 100			Lingual Talonid Ht. X 100		
	Buccal Trigonid Ht.			Lingual Trigonid Ht.			Buccal Trigonid Ht.			Lingual Trigonid Ht.			Buccal Trigonid Ht.			Lingual Trigonid Ht.		
	No. of individuals	Range	Average	No. of individuals	Range	Average	No. of individuals	Range	Average	No. of individuals	Range	Average	No. of individuals	Range	Average	No. of individuals	Range	Average
codus	I	-	84.37?	• 2	61.53?-68.o	64.76?	2	'88.88-92.59	90.73	1	—	65-38	2	—*	86.95	2	56.52-70.83	63.67
catharctus	—	—	—.	—	—	—	—	—	—	1	—	85.00	—	—	—"	1	—	68.42
Adapis	I	—	91.66	2	67.56-86,95	77-25	2	82.60-92.59	87-59	2	63.63-85.18	74.40	2	76.74-91.66	84.20	2	48.93-71.42	60.17
Lemur	5	81.08-90.90	84.60	2	*—	80.0	5	72.97-81.81	79.06	4	76.66-90.90	83-57	2	73-52-76-92	75.22	2	73.91-80.00	76.95
Lepilemur	I	—'	76.92	—	—	—	1	—	80.00	—	—	—	I	—	65.21	—	—	—
Hapalemur	I	—	83-33	—	— '	—	1	—	77.41	—	—	—	I	—	74.07	—	—	—
Propithecus	3	90.47-92.85	91-33	3	93-75-96.96	95-86	3	92.50-93.02	92.67	3	82.85-86.11	84,24	3	83.87-90.00	87.36	3	80.64-87.09	84.79
Lichanotus	2	89.28-93.10	9I-I9		—	—	2	92.00-96.15	94.07	—	—	—	1	—	84.21	—	—	—
Perodicticus	I	· _	86.36	—	—	—	1	—	82.60	—	—	—	I	—	75-oo		—	—
Nycticebus	5	80.95-86.36	83.49	—	--	—	5	78.94-90.47	85.81	—	—	—	5	81.25-88.23	83,81	—	— .	—
Necrolemur	I	—	88.88	1	—	85-71	1	—	76.19	1		75-oo	1	—	83-33	1	—	80.00
Tarsius	3	69.23-76.92	73-o7	I	—	58.82	3	69-23-75-oo	71.26	I	—	68.75	2	68.18-75.00	71-59	1	—.	66.66
Leontocebus	2	85.00-87.50	86.25	2	76.47-77.77	77.12	1	—	86.66	—	—:	—	—	—	—	—	_	—
Aotes	—	—	—	—	—	—	—	—	—	I	—	82.60	—	—	—	I	—	89.47
Pithecia	I	.—	100.00	I	—	95-65	I	—	82.14	—	—	—	—	—	—	-	—	—
Lagothrix	—	—	—	—	—	—	—	—	—	I	—	85-7I	—	—	—	I	—	85.29
Saimiri	3	76.19-90.00	82.06	2	82.35-88.88	85.61	3	76.47-94.11	82.78	2	70.00-88.23	79-11	2	73-33-83-33	78.33	2	71.42-78.57	74.99
Cebus	I	—	89.28	—	_	—	1	—	92.30	, —	—	—	—	—	—	—	—	—
Apidium phiomensis	I	—	96.00	I	—	85-7I	I	—	I0O.0O?	I	—	84.61	—	—	—	—	—.	—
Cercopithecus	—	—;	—	I	—	91-30	3	93.75-100.0	97-91	3	86.66-92.59	90.41	I	—	89.28	I	—	88.46
Erythrocebus	— -	—	—	—	—	—	1	-	96.36	—	—	—	I	—	91.22	—	—	—
Macaca	—	—	—	I		90.19	2	94.52-94.59	94-55	2	71.64-87.71_	79-67	—	—	—	I	—	95-91
Papio	3	100.0-104.54	102.70	3	92.30-98,24	94-39	—	—	—	—	—	—	—	-	—	—	—	-
Hylobates	1	—	90.90	3	60.60-91.42	78.02	3	90.90-97-36	94-57	5	70.58-87,50	80.93	—	—	—	I	—	70.00
Symphalangus	—	—	—	—	—	—	—	—	—	1	—	78.84	—	—	—	—	—	—
Pongo	•4	87.50-98.82	95-58	5	79.10-95.89	89.70	1	—	92-69	4	75.71-90.27	81.98	I	— -	90.13	—	—	—
Gorilla	5	87-15-99-00	93-51	7	75.00-87.17	82.44	6	83-33-97-47	92.48	8	78.94-96.38	88.88	6	83-87-92.52	89.17	7	81-39-93-47	87-73
Pan	5	92.30-97.14	95-74	4	82.69-95.00	89.89	5	95.16-98.71	96.36	8	76.00-93.84"	88.52	2	95-83-96.54	96.18	4	72.72-82.60	79-51
Homo sapiens (Adult)	6	90.90-100.0	97-32	11	90.00-98.55	93-23	9	93.33-100.0	95-78	12	91.30-100.0	95-54	5	90.00-96.22	93.40	4	85-7I-94-44	91.01
Homo sapiens (Teeth in process of eruption or just erupted)	7	93.97-IOO.O	97.02	9	91.42-100.0	94.88	—	—	-	—	—	—	—	—	—	—	—	—
Ancient Anatolians	2	96.29-98.76	97-52	5	93.05-96.82	94-67	5	91.04-97.36	94.62	4	90.16-98.33	93-77	3	89-85-95-38	92.73	3	89.28-93.75	92.15

* Two indices equal.



Fig, 1

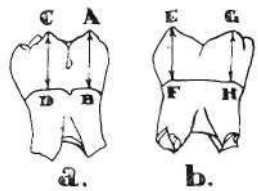
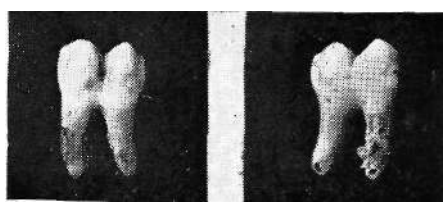
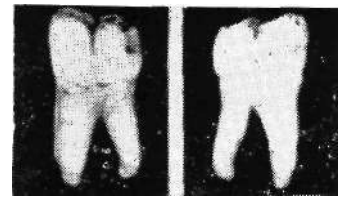


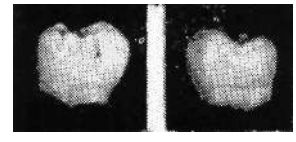
Fig. 2



a. b.

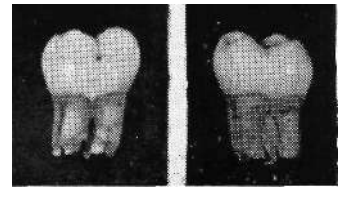
Fig. 3





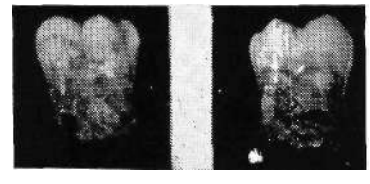
a. b.

Fig. 5



a. b.

Fig. 6



a. b.

Fig. 7

which are amongst the highest of the Primates. For instance, .according to the present information, in the buccal and lingual trigonid-talonid height relation indices of the third lower molar man is the second highest Primate and in the buccal and lingual indices of the first lower molar he is the third and in the buccal trigonid-talonid height relation index of the second lower molar he is the fifth highest amongst the Primate genera studied. But as far as this present knowledge goes stili it appears that man does not constantly have the highest indices amongst the Primates as might perhaps have been expected, as he is surpassed by some other genera of infrahuman Primates in most indices.

With the exceptions of the buccal trigonid-talonid height relation indices of the second and third lower molars *oîPan,* man appears to surpass ali the living anthropoids in both the buccal and lingual trigonid-talonid height relation indices. Thus it appears that in the subsequent course of evolution of man, after his separation from the ancestors of the modern great anthropoids, there has been a tendency in at least some of the molar teeth to elevate further the talonid relative to the trigonid section. Hovvever, there is stili considerable variation in the indices of man, the minima falling within the range of the anthropoid apes.

Table 5 clearly shows that in most Primate genera, with a few exceptions, the talonids are stili lower than the trigonids on both the buccal and lingual sides to varying degrees. In other words, the lower molars of most Primate genera, including those of the anthropoids and man, stili manifest to varying extents traces oftheir tuberculo-sectorial origin. Figures 4 to 7 show the variation occuring in the relation of talonid and trigonid heights of the lower molars o/ man, recent and prehistoric. From these photographs it can be seen that some lower molars of recent man do stili clearly betray their tuberculo-sectorial derivation [10].

In the Primate genera, with only a few exceptions, the trigonid-talonid height relation index is usually higher on the buccal side than on the lingual side of the same molar tooth. That is, in most Primate genera the entoconid relative to metaconid is lower than the hypoconid relative to protoconid. This relation of buccal and lingual sides must have been the primitive condition for the Primates, which has however been retained even in most genera with talonids elevated to various degrees. In other words, in the process of equalization of the heights of talonid and trigonid sections of the lower molars of Primates the lingual side usually lags behind the buccal side. The few genera in which the indices for the lingual side exceed those of the buccal side may be considered specialized in this feature.

[10] The variation in the relation of talonid and trigonid heigths is also seen in the lower molars of recent man shown in Tratman's figures 23, 24, 25 (1,2,3) end 27 (see Tratman, 1950), which are reprödüced by Tratman to show other features of the teeth.

LITERATURE CITED

Clark, W. E. Le Gros : Early forerunners of man. Bailhere, Tindall and Cox, London, 1934.

Colbert, E. H. : A new Primate from the Upper Eocene Pondaung formation of Burma. American Museum Novitates, No. 951, New York, 1937.

Gregory, W. K. : The origin and evolution of the human dentition. A palaeontological revievv. The Journal of Dental Research, Vol. II, Nos. 1, 2,3 and 4(1920) and Vol. III, No. 1 (1921).

Romer, A. S. : Vertebrate PaJeontology. The University of Chicago • Press, Chicago, 1946.

Simpson, G. G. : The principles of classification and a classificâtion of Mammals. Bulletin of the American Museum of Natural History, Vol. 85, 1950.

Tratman, E. K. : A comparison of the teeth of people. Indo-European racial stock vvith the Mongoloid racial stock. The Dental Record, Vol. 10, No. 2 and No. 3, 1950 (Reprinted in: Yearbook of Physical Anth'ropology, Vol. 6, New York, 1950, pp. 272-314).

YVeidenreich, F.: The dentition of Sinanthröpus pekinensis: A comparative odontography of the hominids. Palaeontologia Sinica, New Series D, No. 1 (Whole Series No. 101), Peiping, 1937.

EXPLANATION OF THE PLATES

Plate I

Fig. 1: A^1, A^2 : A permanent lower molar of the genus Omomys; B^1, B^2 : Second lovver milk molar of the fossil anthropoid genus Dryopithecus (Dryöpithecus rhenanus); C^1, C^2: Second lovver milk molar of the living anthropoid genus Pan; D^1, D^2: Second lovver milk molar of a recent human child. The upper rovv shovvs the buccal and the lovver rovv the occlusal aspect of these teeth. The naraes of the cusps are as follovvs: Protoconid (Prd), paraconid (pa^d), metaconid (me^1), hypoconid (hy^d) and entoconid (en^d). After Gregory, 1920., Fig. 287, p. 710. (This picture is reproduced here vvith the kind permission of Professör W. K. Gregory and of the VVilliams and Wilkins Co. of Baltimore, Md.)

Fig. 2: A first right lovver permanent molar of an Ancient Anatolian. a: buccal vievv; b: lingual view.

Fig. 3: A first left lovver permanent molar of a Papio papio. U. S. National Museum No. 59'59- a: buccal side; b: lingual side. (Published here through the courtesy of the U. S. National Museum and of the Smithsonian Institution of Washington, D. C).

Plate II

Fig. 4: An isolated first left lovver molar of a recent Anatolian. a: buccal vievv; b: lingual view.

Fig. 5: Third right lovver molar of Masat No. 7 (Copper Age). a: buccal vievv; b: lingual view.

Fig. 6: Second right lovver molar of Alaca Höyük No. III (Copper Age). a: buccal vievv; b: lingual view.

Fig. 7: First left lovver molar of Alaca Höyük No. VIII (Copper Age). a: buccal vievv b: lingual view.

TABLE 1

The Material Studied

Genus	Number of individuals studied	Genus	Number of individuals studied
Pelycodus	" 2	Lagothrix	1 1
Notharctus	1	Saimiri	3
Adapis	2	Cebus	1
Lemur	5	Apidium	1
Lepilemur	1	Cercopithecus *(Cercopithecus talapoin)*	3
Hapalemur	1	Erythrocebus	1
Propithecus	3	Macaca	4 -
Lichanotus* (Avahi)	2	Papio	3
Perodicticus	1	Hylobates	6
Nycticebus	5	Symphalangus	1
Necrolemur	1	Pongo	7
Tarsius	3	Gorilla	10
Leontocebus**	3	Pan	12
Aotes'* (Aotus)	1	Homo sapiens (American Indian, Melanesian, Negro and ancient Icelander)	25
Pithecia	1	Homo sapiens (Ancient Anatolian)	9

*- Generic names used by Simpson have been adopted (see Simpson, 1950).

**- Generic name used by Simpson (Simpson, 1950, p. 65) has been adopted. Thefigures include in addition to one specimen of Leontocebus, one Oedipomidas and one of Mystax. The latter two genera have now been included in the genus Leontocebus Wagner by Simpson (Simpson, 1950, p. 65).

TABLE 2

Trigonid and Talonid Heights of the Pcrmanent First Lower Molars of Primates (♂ + ♀)

(Measurements in Millirneters)

	Buccal Side			Lingual Side		
	No. of individuals	Trigonid Ht. Average	Talonid Ht. Average	No. of individuals	Trigonid Ht. Average	Talonid Ht. Average
Pelycodus	1	3.2?	2.7	2	2-55?	1.65?
Adapis	1	2.4	2.2	2	3.0	2-25
Lemur	5	3-34	2.82	2	2-5	2.0
Lepilemur	1	2.6	2.0	—	—	—
Hapalemur	1	3-0	2-5		—	—
Propithecus	3	4-23	3.86	3	3-23	3.10
Lichanotus	2	2.85	2.6	-	—	—
Perodicticus	1	2.2	1-9	—	—	—
Nycticebus	5	2.18	1.82	—	—	—
Necrolemur	1	1.8	1.6	1	1.4	1.2
Tarsius	3	2.6	1•9	1	1-7	1.0
Leontocebus	2	1.8	1-55	2	1-75	1.35
Pithecia	1	2.4	2.4	1	2-3	2.2
Saimiri	3	2.03	1.66	2	1-75	1-5
Cebus	1	2.8	2.5	—	—	—
Apidium phiomensis	1	2.5*	2.4	1	2.1	1.8
Cercopithecus	—	—	—	1	2-3	2.1
Maçaca	—	—	—	1	5-1	4.6
Papio	3	7-96	8.16	3	6-33	5-96
Hylobates	1	3-3	3-0	3	3-56	2.8
Pongo	4	7.76	7-43	5	6.90	6.20
Gorilla	5	9.48	8.86	7	8.52	7.02
Pan	5	6.47.	6.20	4	5-42	4.88
Homo sapiens (Adult)	6	7-24	7.04	11	6.52	6.08
Homo sapiens (Teeth in process of eruption or just erupted)	7	8.0	7-75	9	7.08	6.72
Ancient Anatolians	2	8.1	7-9	5	6.72	6.36

* This measurement is exactly the same as the height given by Colbert, 1937.

TABLE 3

Trigonid and Talonid Heights of the Permanent Second Lower Molars of Primates (♂ + ♀)

(Measurements in Millimeters)

	Buccal Side			Lingual Side		
	No. of individuals	Trigonid Ht. Average	Talonid Ht. Average	No. of individuals	Trigonid Ht. Average	Talonid Ht. Average
Pelycodus	2	2.7?	2-45	1	2.6	1-7
Notharctus	—	—	—	*1*	4.0	3-4
Adapis	2	3-65	3-15	2	3-55	2.55
Lemur	5	3-32	2.62	4	2.5a	2.10
Lepilemur	I	2-5	2.0	—	—	—
Hapalemur	I	3-1	2.4	—	—	—
Propithecus	3	4.10	3.8	3	3-6	3-03
Lichanotus	2	2-55	2.4	—	—	—
Perodicticus		2-3	1-9	—	—	—
Nycticebus	5	2.0	1.72	—	—	—
Necrolemur	I	1.6	1.4	1	1,2	0.9
Tarsius	3	2-43	1-73	I	1.6	1.1
Leontocebus	I	1-5	1-3	—		—
Aotes	—	—	—	I	2-3	1-9
Pithecia	I	2.8	2.3	—	—	—
Lagothrix	—	—	--	I	3-5	3-0
Saimiri	3	1-73	1.43	2	1.85	1-45
Cebus	I	2.6	2.4	—	—	—
Apidium phiomensis	I	2.6?	2.6	I	2.6	2.2
Cercopithecus	3	3.0	2-93	3	2-73	2.46
Erythrocebus	1	5-5	5-3	—	—	—
Maçaca	2	7-35	6-95	2	6.2	4-9
Hylobates	3	4.2	3-96	5	3-92	3.20
Symphalangus	—	—	—	1	5-2	4.1
Pongo	I	7-55	7.0	4	7.22	5-92
Gorilla	6	10.17	9.41	8	8.61	7-65
Pan	5	6.50	6.27	8	5-4'	4-73
Homo sapiens (Adult)	9	7-55	7-23	12	6.38	6.10
Ancient Anatolians	5	7-58	7.18	4	6.42	6.02

TABLE 4

Trigonid and Talonid Heights of the Permanent Third Lower Molars of Primates (♂ + ♀)

(Measurements in Millimeters)

	Buccal Side			Lingual Side	
	No. of individuals	Trigonid Ht. Average	Talonid Ht. Average	No. of individuals	Trigonid Ht. Average	Talonid Ht. Average
Pelycodus	2	2.3?	2.0	2	2-35	1-5?
Notharctus	—	—	—	1	3.8	2.6.:.
Adapis	2	3-35	2.75	2	3-75	2.15?
Lemur	2	3.0	2.25	2	2.4	1.85
Lepilemur	1	2-3	1-5	—	—	—
Hapalemur	1	2.7	2.0	~~	—	—
Propithecus	3	3-16	2.76	3	3.06	2.60
Lichanotus	1	1-9	1.6 .	—		
Perodicticus	1	2.0	1-5	—	—	—
Nycticebus	5	1.74	1.46			—
Necrolemur	1	1.2	1.0	1	1.0	0.8
Tarsius	2	2.1	1-5	1	1-5	1.0
Aotes			—	1	'•9	1.7
Lagothrix	—	—		1	3-4	2.9
Saimiri	2	1-35	1.05	2	1-4	1.05
Cercopithecus	1	2.8	2-5	1	2.6	2.3
Erythrocebus	1	5-7	5-2	—	—	
Macaca			—	1	4-9	4.7
Hylobates			—	1	3.0	2.1
Pongo	1	7-1	6.4	—		
Gorilla	6	9-39	8.36	8	8.20	7.20
Pan	2	5-30	5.10	4	5-31	4.20
Homo sapiens (adult)	4	6.8	6-45	5	6.06	5:66.
Ancient Anatolians	3	6.36	5-90	3	5-50	5.06

TABLE 6

Buccal Trigonid-Talonid Height Relation Index *.

Indices	M_1	M_2	M_3
60-70	. —	—	Lepilemur
70-80	Tarsius, Lepilemur	Tarsius, Necrolemur, Hapalemur, Lemur, Lepilemur	Tarsius, Hapalemur, Perodicticus, Saimiri
80-90	Saimiri, Hapalemur, Nycticebus, Pelycodus, Lemur, Leontocebus, Perodicticus, Necrolemur, Cebus	Pithecia, Perodicticus, Saimiri, Nycticebus, Leontocebus, Adapis	Necrolemur, Nycticebus, Adapis, Lichanotus, Pelycodus, Propithecus, Gorilla, Cercopithecus
90-100	Hylobates, Lichanotus, Propithecus, Adapis, Gorilla, Pongo, Pan, Apidium,Homo,Pithecia	Pelycodus,Cebus,Gorilla, Propithecus, Pongo, Lichanotus, Macaca, Hylobates, Homo, Erythrocebus = Pan, Cercopithecus, Apidium	Pongo, Erythrocebus, Homo, Pan
IOO-X	Papio		

[1] In each subdivision the index increases from above downwards. Equal sign shows identical indices.

TABLE 7

Lingual Trigonid-Talonid Height Relation Index

Indices	M_1	M_2	M_3
50-60	Tarsius	—	—
60-70	Pelycodus	Pelycodus, Tarsius	Adapis, Pelycodus, Tarsius, Notharctus, Hylobates.
70-80	Leontocebus, Adapis, Hylobates, Lemur	Adapis, Necrolemur, Symphalarıgus, Saimiri, Macaca	Saimiri, Lemur, Pan, Necrolemur
80-90	Gorilla, Saimiri, Necrolemur = Apidium, Pongo, Pan	Hylobates, Pongo, Aotes, Lemur, Propithecus, Apidium, Notharctus, Lagothrix, Pan, Gorilla	Propithecus, Lagothrix Gorilla, Cercopithecus, Aotes
90-100	Macaca, Cercopithecus, Papio, Homo, Pithecia, Propithecus	Cercopithecus, Homo	Homo, Macaca
I00-X	— '	—	—