# **Craniometric investigations on** *Mesopithecus* in comparison with two recent colobines

Kraniometrische Untersuchungen an Mesopithecus im Vergleich zu zwei rezenten Colobinen

#### by

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HOHENEGGER, J. & ZAPFE, H., 1990. Craniometric investigations on Mesopithecus in comparison with two recent colobines. – Beitr. Paläont. Österr. 16:111–143, Wien

# Abstract

Craniometric measurements were taken on Mesopithecus pentelicus from the Miocene of Pikermi (Greece). Landmark distances and angle measurements were obtained to the skull, while mesiodistal length and trigonid width were used as tooth measurements. A number of indices were calculated that are less significant in discrimination analysis than direct measurements.

The same set of measurements was carried out on archetypic representatives of the recent African (Procolobus badius) and Asiatic (Presbytis entellus) colobine monkeys. These were compared to the fossil species in order to elucidate phenetic relationships. Sexual dimorphism is demonstrated in various characters using uni- and multivariate statistical methods; the mesiodistal length of the canines playing an especially important role. It is furthermore possible to differentiate between species using the length of the upper canines.

Morphological relationships are determined by calculating generalized distances. *Mesopithecus pentelicus* differs equally from both recent forms in skull measurements, but its dental measurements show a stronger relationship to the Asiatic form.

Keywords: Mesopithecus, Colobines, Craniometry, Analysis of Variance, Discriminant Analysis.

# Zusammenfasssung

An Mesopithecus pentelicus aus dem Miozän von Pikermi wurden kraniometrische Messungen durchgeführt, wobei am Schädel die gebräuchliche Methode der Landmarken und Winkelmessungen Verwendung fanden, während bei den Zähnen die mesiodistalen Längen und trigonalen Breiten erfaßt wurden. Weiters konnten auch verschiedene Indizes berechnet werden, die sich in den folgenden Analysen als weniger aussagekräftig als die Einzelmerkmale erwiesen.

Als Vergleich zur fossilen Art wurden an jeweils einem Vertreter der afrikanischen (Procolobus badius) und asiatischen (Presbytis entellus) Colobinen die gleichen Messungen durchgeführt, um die phänetischen Verwandtschaftsbeziehungen aufzuklären. Mittels uni- und multivariater statistischer Verfahren konnten die Geschlechtsunterschiede anhand verschiedener Merkmale untermauert werden, wobei die mesiodistale Länge der Caninen eine wesentliche Rolle spielt. Die Länge des oberen Canins kann darüber hinaus auch zur Trennung der Arten herangezogen werden.

Verwandtschaftliche Beziehungen, die auf der Morphologie basieren, ließen sich durch Berechnung der Generalisierten Distanzen ermitteln. Während bei den reinen Schädelmessungen Mesopithecus pentelicus von den beiden rezenten Vertretern in einem ähnlichen Grade verschieden ist, ergeben sich bei den Zahnmessungen stärkere Konnexe zwischen der asiatischen und der fossilen Form.

# Problem

Craniometric methods for comparisons within the cercopithecids (compare HULL, 1979) were applied within a project on the osteology and dentition of *Mesopithecus*. Compared to other fossil catarrhines, the tooth and skull remains of *Mesopithecus* are numerous, thus allowing statistical evaluations. This does not hold true for the poorly documented postcranial skeleton.

Mesopithecus, well known since GAUDRY (1862), has more recently been studied by DELSON (1973, 1975). New data concerning geographic distribution, which can deliver important clues to phylo-

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genetic relationships, are now available. In addition to the classic locality of Pikermi near Athens (GAUDRY 1862), further Eastern European localities are known from Bulgaria, Macedonia and southern Russia. The distribution of Mesopithecus also reached across Hungary up to the "Dinotherien-sande" of Hessen in SW-Germany. All finds are of Turolian age (Miocene) with the exception of the "Dinotheriensande", which are dated as Vallesian. Of especial importance from the standpoint of biogeography are the localities of Maragha, Persia (MECQUENEM 1925) and the region of Kabul, Afghanistan (BRUNET et al. 1982), which are similarly dated as Turolian in age. Here the distribution of Mesopithecus is contiguous with the Asiatic colobine monkeys. The relationship of Mesopithecus to the Asiatic as well as to the African representatives of recent colobine monkeys is problematic due to the postulated faunal boundary in the Turolian between northern Eurasia and India (HEINTZ & BRUNET 1982).

Another open question is which metric character of the skull and dentition (additional to the canines, which are not always present) can be used in order to differentiate between the sexes of *Mesopithecus*, and how these characters behave in recent colobine monkeys.

# Material and methods

#### Material and measurements

Only those skulls, jaws or teeth of *Mesopithecus* were analyzed which originate from the type locality in the valley of the Megalorhema Creek at Pikermi near Athens (Greece). The finds come from numerous European collections including Athens, Basel, Munich, Paris, Stuttgart and Vienna. The material studied originates from the same stratigraphic level of the classic locality (Turolian, Miocene). Thus the individuals belong to a fossil population with a restricted area of origin (compare BACHMAYER et al. 1982 for the formation of the bonebed of Pikermi). In further investigations only those *Mesopithecus* remains were included which could be identified as males or females by canine tooth height.

One species each of Asiatic and African colobine monkey was used for comparison (Plate 1). The 20 complete skulls (10 males, 10 females) of the African red colobus (*Procolobus badius*) from the collections of the NHM Wien all originate from the Ituri forest (NE Zaire, Grauer collections), so that they can be considered as being members of a single geographic population.

The skulls of the Asiatic Hanuman langur (Presbytis entellus) originate, on the other hand, from different collections. In addition to skulls from the Zoologisches Museum der Universität Hamburg, other collections (Munich, Stuttgart and Frankfurt) were drawn upon for comparison. Thus they originate from different populations within the distribution area of this species. Some of the individuals originate from NE India (Assam), the larger part lived in Western and Southern India and Sri Lanka.

The skull characters chosen for measurement varied according to the state of preservation of the Mesopithecus skull. These are always deformed to some extent by sediment compaction, so that some, often important, dimensions could not be taken at all. Thus only those dimensions of recent colobine monkey skulls were measured which were also intact in Mesopithecus. Primarily, those dimensions were taken as defined in detail by OPPENHEIM et al. 1927. Exceptions are the biorbital width, interorbital width, orbital rim thickness and palatine width (SCHULTZ 1958, p.81).

The longest mesio-distal length was taken as an attribute characterizing the dentition. Within the molars, trigonid (trigon) width was measured perpendicular to the length, whereas the largest crown width was taken for the premolars. The length of the tooth rows (premolars, molars and dental lengths) are to be understood as the shortest mesio-distal lengths. Tooth measurements presented little difficulty. In *Mesopithecus*, however, the length dimensions of the tooth rows can also be affected by deformation.

#### Statistical methods

All six groups (3 species with different sexes) had approximately the same number of specimens (9-14 individuals). The variances can thus be better compared when using parametric methods. The skull and jaws of the fossil Mesopithecus are rarely associated. It was thus impossible to consider the skull and the jaws as a unified set within the multivariate analysis, which handles all characters together. This results in 4 parallel multivariate analyses, with the skull and lower jaw proportions and the teeth of the upper and lower jaws each being analyzed independently from one another. Whereas all characters (with the exception of certain teeth dimensions) of the recent Procolobus badius and Presbytis entellus are measurable, this is not the case for Mesopithecus pentelicus. If it was not possible to measure more than half of the specimen of Mesopithecus, then these characters were deleted in the subsequent multivariate analyses. Otherwise the missing measurements were estimated using step-wise multivariate regressions (DILLON & GOLDSTEIN, 1984). The characters with the least missing measurements were the first to be supplemented. A comparison of both the correlation matrices (original and supplemented

characters) proves the correctness of this procedure.

The normal distribution of individual characters was tested with the Kolmogoroff-Smirnov-test (see Tables 1 to 3). With few exceptions (some angle measurements of the skull and jaw) all variables show a good agreement with the normal distribution. Thus the following parametric methods are justified. Variance analyses were used to prove the differences in the individual characters between the six groups. With only few exceptions (some incisor lengths in the upper and lower jaws) all were highly significant (see Tables 4–14). Following the variance analyses, a Student-Newman-Keuls test (compare SOKAL & ROHLF 1969) was applied, allowing a pairwise comparison between the different groups (see Tables 4– 14).

The variables important for distinguishing groups can be determined through a multivariate discriminant analysis, using the Mahalanobis method for extraction. A step-wise reduction to the significant differentiating variables followed. The advantage of this method is that the differences between groups can be shown in distances (Mahalanobis-Distances, see Table 17). These represent the degree of morphological similarity. The conversion of the multivariate F-values between the groups to Mahalanobis-Distances follows the equation of DILLON & GOLD-STEIN (1984, p.367). In the discriminant analysis only direct and no derived measurements (indices), as in the univariate analysis, were included.

An advantage of discriminant equations is that new forms, not incorporated in the analyses before, can be assigned to the group with the highest similarity. This occurs by the appointment of the characters' measurements in the discriminant equations, which include as parameters the classification function coefficients (Table 15) for the individual groups.

# Results

The statistical parameters for each character of the six groups are presented in Tables 1-3. All characters of the tooth dimensions show a normal distribution. Within the skull and lower jaw characters, the angle measurements tend to deviate from a normal distribution. As far as the facial skull is concerned, only the profile angle of the male Hanuman langur is not normally distributed. The females of this species and the remaining two studied species (both sexes) always show normal distribution. The bicondylar width and the mandibular length of Mesopithecus pentelicus was only measured in a few cases. A test for normal distribution of this character is thus superfluous. The mandibular angle does not show a normal distribution for both sexes of Presbytis and for the female red colobus. Within Mesopithecus females this character also shows tendencies to an

asymmetric distribution. The same is true for the tooth row angle. The deviation from the normal distribution in this character is highly significant only for Hanuman langur females. This approaches to the significance threshold of 5% probability of error for the male red colobus, male *Presbytis* and female *Mesopithecus*.

A test for homogeneity of variances between the 6 groups revealed correspondences in only a few skull characters (see Tables 4-14), these being the thickness of the orbital rim and the nasal width. Some angle measurements of the lower jaw also show uniform variances. Furthermore the homogeneity of variances can be determined for most of the index calculations.

Within tooth measurements, only the lengths of the lower premolars are similar as far as variances are concerned. All other characters show a significant statistical inhomogeneity. This is caused by the comparatively high variances of male and female *Presbytis* (with the exception of the mesio-distal lengths of the upper and lower canines). A higher variance of the mesio-distal lengths of the canines is shown by the males of all species.

Similar differences are also responsible for the inhomogeneity of the variances of the skull and lower jaw dimensions. The variances in male and female Hanuman langurs are distinctly higher than in other groups. A possible explanation for these inhomogeneities is that the *Procolobus* individuals originate from a more or less uniform population. Similar population uniformity can be assumed for the fossil *Mesopithecus* specimens as all originate from a single "fossil population" Population homogeneity can be excluded for the *Presbytis* skulls. This could explain the relatively uniform variances in *Procolobus* as well as *Mesopithecus* for most dimensions.

The homogeneity in the variances of most indices can be explained as follows: When no correlation between direct measurements exists, the variances of the calculated characters (indices) are higher than the variances of both the single characters. The correlations between the characters used in the index calculations are high, the variances of the relationships of both measurements have to remain small and therefore homogeneity within the variances of indices results.

#### Group differentiation

The results of the univariate variance analyses show that only few characters are useful in separating species or genera. Within the characters of the facial skull the nasion-prosthion length shows a significantly high F-value. The relationships between the individual groups are, however, not clear. Palatine breadth shows even higher F-values (with similar number of degrees of freedom). This parameter



Fig. 1. Discriminant analysis by facial skull characters. Position of individuals and group centroids within the first three canonical discriminant functions indicated by numbers corresponding to group numbers of Plate 1.

separates Presbytis from Procolobus and Mesopithecus. Within the variance analyses of the facial skull characters, the orbital rim thickness shows the highest F-values. In each species male individuals are separated from females. Although the dental length of the skull shows a lower F-value than the previously described parameters, Presbytis is separated from both the other species.

It is noteworthy that only those indices whose elements already allow clear differentiations as individual characters also allow a discrimination of the groups. This is true for the index palatine breadth/nasion-prosthion height, which orders the female Presbytis to Mesopithecus. The Presbytis male shows no differences to Procolobus, which has uniform characters amongst the sexes. All other indices, with the exception of molar-premolar length/nasion-prosthion height, show little or absolutely no differences between the groups. They are thus less suitable than the directly measured characters in differentiating between the groups. Furthermore they could not be important for all multivariate analyses.

Lower jaw measurements show similar results. The best differentiations can be made with the characters chin height, dental (molar-premolar) and molar length. The highest chin height values are found within both sexes of *Presbytis*, followed by *Procolobus*. *Mesopithecus* is characterized by the lowest values. The values are not significantly different between either the males or females of *Presbytis* and *Procolobus*. *Mesopithecus*, however, is distinctly different in the sexes. The variability in chin height of the *Mesopithecus* male falls within the range of both recent female forms. Dental and molar length show similar properties. Both the *Presbytis* sexes can be separated from the relatively uniform *Procolobus*. *Mesopithecus* group.

As far as derived characters are concerned, the index corpus height/molar length joins all male and





Fig. 2. Discriminant analysis by mandibular characters. Position of individuals and group centroids within the first three canonical discriminant functions indicated by numbers corresponding to group numbers of Plate 1.

female individuals of the three species, although significantly separating the sexes. All further indices are even worse separators than the individual characters from which they are computed.

The trend revealed by individual characters and indices is that *Mesopithecus* is closer to *Procolobus* than to *Presbytis* as far as facial skull and lower jaw characters are concerned.

The tooth measurements show, as opposed to the skull measurements, higher F-values in variance analyses between the groups. Therefore the number of separating characters is higher. The best result is provided by mesiodistal length of the superior canine, which significantly differentiates between all groups. Further useful characters are the breadth of the P4 sup., the M1 sup. and the M2 sup., which separates all *Procolobus* specimens (with smaller values) from the *Mesopithecus-Presbytis* group. The length of M1 sup. and M3 sup. show a different relationship: here, *Presbytis* is separated with higher values

#### from the Procolobus-Mesopithecus group.

Only few significant differences between the groups are recognizable based on the remaining maxillar teeth characters. The lengths of both upper premolars are especially unsuitable for differentiation. Even the lengths of both upper incisors do not allow any differentiations.

The mandibular teeth show similar results to those of the maxillar teeth. Here, the mesiodistal length of the canine is also especially suitable for separating the sexes. Procolobus is always separated from the uniform Mesopithecus-Presbytis group in the breadth of molars M1 inf., M2 inf. and M3 inf.

M1 inf. and M2 inf. lengths separates *Presbytis* from the remaining species. An especially good character for species discrimination is the length of M3 inf. Although no significant differences are found between the sexes of the species, the differences between the species are highly significant. These good diagnostic characters stands in opposition to the pa-



Fig. 3. Discriminant analysis by maxillary teeth characters. Position of individuals and group centroids within the first three canonical discriminant functions indicated by numbers corresponding to group numbers of Plate 1.

rameters I2 inf. length and P4 inf. breadth, which do not allow a differentiation into groups.

The analysis of tooth characters allows the conclusion that *Mesopithecus* and *Presbytis* are the morphologically closer groups whereas *Procolobus* stands somewhat aside.

In order to determine which variables are important for group differentiation and how these groups are morphologically related, multiple discriminant analyses and the calculation of Mahalanobis distances must be employed.

Only those skull dimensions which could be measured in all specimens were used for the discriminant analysis. Thus only 7 characters were used in the analysis (basion-prosthion length, nasion-prosthion height, interorbital width, palatine breadth, orbital rim thickness, nasal width, dental length). The stepwise reduction of the characters shows that all 7 characters are important for group differentiation. From the 5 discriminant functions the first 4 are of importance. Whereas the 1st function is highly correlated with the character nasal width, the 2nd function is determined to the same extent from all the variables. The 3rd function shows high correlation with the variables orbital rim thickness, basion-prosthion length and palatine breadth. The 4th function is highly correlated with nasion-prosthion height.

Identifications of the individuals using the classification functions resulted in a very high number (97.06%) of correctly classified individuals. Some female Hanuman langurs and *Mesopithecus* are incorrectly identified as the male of the same species.

The variables for the lower jaw do not show such promising results. The following characters were used in the multivariate analysis: symphysal width, chin height, corpus height, mandibular angle, chin angle, dental length and molar length. All variables are important for the discrimination of the groups. A difference to the skull measurements is that only the first three discriminant functions are significant.

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Fig. 4. Discriminant analysis by mandibular teeth characters. Position of individuals and group centroids within the first three canonical disciminant functions indicated by numbers corresponding to group numbers of Plate 1.

Whereas the first function is highly correlated with all variables, the 2nd function is determined by chin angle. All other variables are correlated with the 3rd discriminant function.

The identification of individuals using the classification functions yielded a lower percent of correct classifications (59.15%) than the skull measurements. The highest number of correct classifications are found in the fossil species. The classification of the male red colobus monkey was especially poor.

The results of univariate analysis demonstrate that tooth measurements are suitable for species separation. This becomes more apparent in the multivariate analysis through a distinctly better identification of the individuals. Using the step-wise reduction of the variables in the discriminant analyses within the maxillar teeth, it can be shown that the mesiodistal lengths of P4 sup., M1 sup. and M2 sup. as well as the breadth of P4 sup. are not necessary for discrimination. The remaining characters are highly correlated with the discriminant functions and thus prove their importance for group separation.

The first and most important function is determined by the breadth of P3 sup., M1 sup. and M2 sup. The 2nd discriminant function is determined solely by the mesiodistal length of the Caninus sup. The 3rd function is determined by the length of M3 sup., the 4th by its breadth. All remaining variables are correlated with the irrelevant 5th function. The classification of the individuals using the classification functions yielded a high percentage (86.48%) of correctly identified individuals.

The analysis of mandibular teeth provided almost identical results. Only the length of I2 inf. and M2 inf. as well as the breadth of M1 inf. were removed. Of the three significant discriminant functions the first is correlated with the remaining variables. The second function shows a high correlation to the length of Caninus inf. and to the breadth of M2 inf. and M3 inf. With the exception of P4 inf. and M1 inf. breadth, all other measurements are correlated with the 3rd discriminant function. An even better result (89.86%) is obtained for the classification of the individuals than using maxillary teeth. Even the sexes of *Procolobus* were correctly classified.

The relationships between groups can be shown using the false classifications. According to mandibular teeth, incorrectly classified male *Presbytis* individuals belong to male *Mesopithecus*, whereas the incorrectly associated females are placed within *Mesopithecus* females. The same holds true for the maxillary teeth. Incorrectly classified male *Presbytis* are associated with *Mesopithecus* males; female *Presbytis* tend to be placed within female *Mesopithecus*.

In order to determine differences and relationships between groups, a graphic method can be used. The mean of the discriminant function values for each group can be depicted in space, which is determined by the first three discriminant functions (see Figures 1-4). The following relationships between the species and sexes can be recognized from the distances of the skull measurements: Greatest affinities (shortest distances) exist between the sexes of each species. They are especially separated by the 3rd discriminant function. All species show comparable degrees of similarity among themselves (Figure 1).

Clearly structured relationships are evident according lower jaw distances between group centroids. In this case, *Procolobus* and *Mesopithecus* are more similar to one another than *Presbytis*, which clearly stands aside (Figure 2).

The distances of the maxillar teeth demonstrate the following morphological affinities: The closest association occurs between males of *Presbytis* and *Mesopithecus* as well as between the females of both species (Figure 3). The sexes of *Procolobus* are clearly separated from the other species. The 2nd discriminant function again has the strongest influence in the separation of the sexes.

Similar relationships are evident according to the mandibular teeth. Presbytis and Mesopithecus females are in close contact, whereas male Mesopithecus show a stronger connection to the Presbytis males. Procolobus females are drawn to the neighborhood of male Presbytis and male Mesopithecus; the Procolobus male, however, stand clearly aside. (Figure 4).

Methods which allow the intensity of relationships to be shown - such as the Mahalanobis distance are even more suitable for the determination of morphological relationships The relations between the groups can be shown in the form of distance matrices (Table 17). An interpretation of the degree of morphological relationships using Mahalanobis distances is included in the discussion below.

#### Sexual differentiation

Sexual dimorphism in *Mesopithecus pentelicus* is clearly developed not only in the canines but also in other tooth and skull dimensions. With the exception of the variables palatine width and dental length, all those facial skull dimensions representing direct measurements can be drawn upon to distinguish the sexes. Within the indices only the relationship dental length/nasion-prosthion height are suitable for differentiation. Correct assignment to sex using individual characters is not possible because of strong variance overlap.

The discriminant analysis between the sexes (Table 16) of *Mesopithecus* shows that optimal separation is reached by using only 2 variables: basionprosthion length and orbital rim thickness. A 100% assignment of the individuals is attained using these two characters with the classification coefficients of the discriminant functions.

Direct lower jaw measurements are much less suitable for the discrimination of sex in *Mesopithecus* than skull characters. Only three characters (chin height, corpus height below the M2 inf. and mandibular angle) show significant differences (Tables 6-7). As far as the indices are concerned, the relationships corpus height/molar length and corpus height/dental length show sexual differences.

The discriminant functions again allow a 100% assignment despite the rather poor differentiation possibilities using the single characters. The combination of the variables symphysal width, chin height, corpus height, mandibular angle and dental length allow this optimal discrimination. It is also demonstrated that the remaining characters (chin angle and molar length) add little more to this differentiation as they are highly correlated with a number of variables.

Both of the recent colobine monkey species show a 100% assignment of the individuals in the discriminant analysis which separates the sexes. The genera, however, show differences in the importance of the variables providing the base for these discriminations. Within the facial skull measurements, Presbytis shows a closer correspondence with Mesopithecus: here, both the basion-prosthion length and the orbital rim thickness contribute to the discrimination of sex. Of additional importantance for the discrimination are palatine width and interorbital width. The palatine breadth and nasal width are also important for the separation of the sexes in Procolobus. The basion-prosthion length which is important in Mesopithecus only play a small role in the discrimination of the Procolobus sexes.

The differences in the importance of lower jaw characters for separating the sexes in the studied colobine monkeys are not so large. Almost all variables are important for the discrimination of the groups, so that large conformity between the genera is also present (Table 16).

When tooth measurements are taken into consideration in form of univariate analyses, then only the mesiodistal length of the upper and lower canines is suitable for a differentiation of the Mesopithecus sexes. A definite assignment is difficult due to the strong overlap of variances. The discriminant analyses confirm the importance of these characters, as a high correlation exists between the discriminant function and canine length. Among the maxillar teeth measurements, the lengths of P3 sup., M1 sup. and of M2 sup. as well as the breadth of M1 sup. are important for the differentiation of the sexes, although this is not apparent from the univariate analyses.

In addition to the lower canines lengths, the lengths of I2 inf., P4 inf. and M2 inf. and the width of P3 inf. of the mandibular teeth are also important for the discrimination of the sexes (Table 16). With the exception of a single false result for the maxillar teeth, the classification of the individuals is optimal using the classification function coefficient for all teeth measurements.

Recent and fossil species are to a large extent similar in character discrimination. All Presbytis females have an average higher value than the males, with the exception of P3 sup. length, and M3 sup. breadth. The opposite it true for Mesopithecus, where in most cases the average maxillar teeth measurements are larger in the male. This is also true for mandibular teeth dimensions. Here Hanuman langur females also show higher values, with the exception of P3 inf. length and P3 inf. and P4 inf. breadths. Finally, in contrast to Mesopithecus, the length and breadths of P3 inf. in Presbytis is significantly different between the sexes. Procolobus badius shows a similar relationship between the sexes. In most parameters the males surpass the females. Exceptions are the lengths of P4 sup., M2 sup., I1 inf., and I2 inf. as well as the breadth of P4 inf., M1 inf. and M3 inf. Sexual dimorphism, however, has not been statistically confirmed. This contradicts the observations of YAMADA & SAKAI (1983), who found significant differences in Procolobus badius with respect to the lengths and breadth of P3 inf. Additionally, the tooth dimensions of the postcanine dentition are always larger in the female than the male.

The importance of the mesiodistal canine length for the separation of the sexes is once again proven by multivariate discriminant analysis. Other important characters of *Presbytis entellus* are restricted, in the upper jaw, to the lengths of P4 sup. and M3 sup. All other dimensions are of less importance for an optimal discrimination. Equally important as in *Mesopithecus* for separating the sexes are the lengths of I2 inf., P3 inf. and M3 inf. as well as the breadths of P3 inf. and M3 inf.

In Procolobus the maxillar teeth play an equally dominant role in discriminant analysis as do the canines. Important are further the lengths of P3 sup. and M1 sup. as well as the breadths of P3 sup., P4 sup., M1 sup and M2 sup. The role of canine lengths is distinctly more important in the lower jaw of Procolobus badius. In addition to P3 inf. and P4 inf. lengths the length of I2 inf. is also important.

The importance of I2 inf. length for the discrimination of sexes is thus documented for all of the studied colobine monkeys. Additionally, both measurements of P3 inf. are useful in the separation of sexes within these colobines.

# Discussion

#### **Cranial measurements**

The relationship of both sexes in *Mesopithecus* to recent colobine monkeys using Mahalanobis distances (Table 17) indicates phenetic relationships. The correspondence in the measurements does not necessarily represent the degree of phylogenetic relationship.

As far as skull measurements of *Presbytis* and *Mesopithecus* are concerned, the highest similarities occur between the sexes. In *Procolobus*, however, distinct sexual dimorphism is indicated by a much smaller degree of similarity (more than twice the Mahalanobis distance) between the sexes. Relationships between the genera and species are demonstrated by the shortest distance for both male and female *Mesopithecus* to female *Procolobus*. Relationships with the same degree occur between the males of *Mesopithecus* and *Presbytis* as well as between *Mesopithecus* females and both sexes of *Presbytis*.

The lower jaw dimensions show no such clear relationships between sexes and species. This is additionally expressed in the higher proportion of false classifications within the discriminant analyses. Similarities between the sexes of the species, as shown by the skull measurements, are not present. The sexes of Mesopithecus are very similar (small Mahalanobis distances), but the Mesopithecus male shows a corresponding degree of similarity (with even smaller distance values) with the Presbytis male. The Mesopithecus female shows virtually the same distances to the other sex on the one hand and to the Presbytis female on the other hand. The red colobus again differs here from other species. Highest similarity occur between the female red colobus and the Hanuman langur female. The Procolobus male also shows a closer connection to the Presbytis male than to the Procolobus female.

Considering the skull measurements as a whole, the greatest similarity is present between the sexes of *Mesopithecus*, whereby in almost all measurements the males are larger than the females. This is also true for the measurements of *Procolobus* and *Presbytis.* 

The skull of the Mesopithecus female is somewhat more similar to the Procolobus female than to the Presbytis female. For the male the opposite is true; here Mesopithecus and Presbytis are clearly more similar to one another than to the specialized Procolobus.

If these morphological similarities are interpreted as phylogenetic relationships, then the fossil species must be interpreted as being the primitive form from which both recent forms have developed to almost the same extent. Procolobus and Mesopithecus are similar in those characters that pertain solely to the facial skull. If the braincase and the lower jaw are also considered, then the connection between Mesopithecus and Presbytis is somewhat stronger. Characteristic for these differences is also the development of a sagittal crest, which is only present in the Procolobus male. Within the Procolobus and Colobus species, however, this character varies considerably (compare SCHULTZ 1958).

It must be stressed once again that all Mesopithecus pentelicus measurements were made on individuals belonging to a uniform fossil population. Thus the variances in the characters remained relatively small, being equal to those seen in recent populations (Procolobus badius). Multivariate differences in characters can be highly significant between species of a colobine monkey genus. This has been shown in the black and white colobus species, where statistically significant differences are found even in the subspecies (compare HULL 1979). Considering the large distribution area of Mesopithecus (ranging from the Mediterranean area across Asia Minor to Afghanistan), the development of subspecies or even species, significantly differing in craniometric characters, would be expected. The large variances shown by Presbytis entellus represent the scatter of the whole species. In comparison, the small variances of Mesopithecus from Pikermi could be a clue to the existence of further species or subspecies.

#### Tooth measurements

Phenetic relationships of the species were analyzed using Mahalanobis distances. The sexual differences in teeth dimensions are clearly greater than the differences between the species. This is in contrast to the skull dimensions, where, with the exception of *Procolobus*, the sexes of a species show the greatest similarities (Table 17).

Based on the maxillary teeth of Mesopithecus the largest similarities occur between the male of this species and the Presbytis male. The Mesopithecus female is most similar first to the opposite sex and then to the *Presbytis* female. The red colobus stand clearly aside. Closest connections are present between the males of *Procolobus* and *Mesopithecus* on the one hand and between the *Procolobus* female and the male of the fossil species on the other hand. The very large Mahalanobis distances correspond to 2 to 4 times the value between *Presbytis* and *Mesopithecus*.

Mandibular teeth reveal the same relationships. Here the *Mesopithecus* female shows the greatest similarity first to the *Presbytis* female and then to the *Mesopithecus* male. The connections between the *Mesopithecus* and *Presbytis* males are also very close, although somewhat larger similarities occur between male and female *Mesopithecus*.

Again the red colobus monkey stands clearly aside as far as mandibular teeth dimensions are concerned. Large morphological differences exist between all groups and sexes, even within the same species.

The results of the multiple discriminant analyses and the Mahalanobis distances allow the following interpretation. The differentiation of the sexes according to dental measurements is very clear. The strong phenetic relationship between Mesopithecus and Presbytis points to a similar method of food gathering. Mesopithecus is interpreted to be a ground dweller; Presbytis often collects food on the ground. Procolobus, however, is a tree inhabitant and leaf eater, in the case of the red colobus monkey also fruit consumer. The result is a recognizable specialization of the dentition. Gradational differences are also recognizable within the African colobine monkeys. Thus the black-white Guereza (genus Colobus) - a pure leaf consumer - is the most specialized representative of its genus group (compare LEUTENEGGER 1971, YAMADA & SAKAI 1983). It differs in its sexual and intraspecific differentiation even more clearly from the studied red colobus monkeys as well as from the Nasalis group of equally highly specialized leaf consumers within the Asiatic representatives (compare SWINDLER & ORLOSKY 1974). Thus according to tooth measurements the phenetic relationships between Mesopithecus and Presbytis are even closer than between the fossil species and Procolobus badius.

If both recent species are considered as archetypical representatives of their genus, and if they are phylogenetically linked to *Mesopithecus*, then the following hypothesis can be forwarded:

Mesopithecus pentelicus stands close to the primitive form of the African and Asiatic colobine monkeys (compare DELSON 1973, 1975, STRASSER & DELSON 1987, FLEAGLE 1988). A relationship of the European Mesopithecus to the Asiatic colobine monkeys can be assumed. Mesopithecus more strongly resembles the Asiatic colobine monkeys in the facial skull and tooth measurements than the specialized, leaf-consuming African representatives. The somewhat closer relationship of *Mesopithecus* to the *Presbytis* group was already assumed earlier (compare DELSON 1973, SIMONS 1971) and has since been confirmed through studies on tooth prism structure (DOSTAL & ZAPFE 1986).

Here the specialization of the African colobine monkeys in the metric characters of the facial skull and in the tooth measurements can be proven. A clear differentiation is shown from *Mesopithecus* on the one hand and from contemporary Asiatic genera (for example *Presbytis*) on the other hand.

# Summary

# Discrimination of sexes

As far as sex differentiation according to metric characters is concerned, Mesopithecus pentelicus shows a degree of differentiation similar to that of recent African (Procolobus badius) and Asiatic (Presbytis entellus) colobine monkeys. The species studied here show very similar skull and teeth dimensions. With the exeption of orbital rim thickness, the facial skull characters vary in importance for sexual discrimination. The basion-prosthion length is important for the differentiation of the sexes in Mesopithecus and Presbytis; in Procolobus badius this role is taken over by palatine breadth. The male red colobus is additionally characterized by a sagittal crest.

Among the tooth dimensions the importance of the upper and lower canine lengths for sexual differentiation in all three species is notable. The length and breadth of P3 sup. and P3 inf. as well as the length of I2 inf. can also contribute to this separation.

#### **Discrimination of species**

Several characters are important for differentiating the studied species. No skull dimension is suitable for separating all three species in univariate analysis. For some characters at least one species is significantly different from the others two.

Another situation exists as far as the tooth measurements are concerned. Here the mesiodistal length of C sup. is suitable not only for separating the sexes, but also for species differentiation. While canine length in the lower jaw is significantly different in the sexes, the breadth of all lower molars is suitable for differentiating the specialized *Procolobus badius* from *Mesopithecus* and *Presbytis*. The importance of these variables in the separation of the species is also confirmed through multiple discriminant analysis.

The premolars and especially the lengths of the lower 2 incisors play a large role in the differentiation

of the sexes. These characters are totally unsuited for the separation of species.

The multivariate analyses determinating the phentic relationships show a great affinity between Mesopithecus and Presbytis, especially in the teeth measurements. Procolobus badius appears to be more clearly differentiated. Procolobus and Presbytis stand to one another in about the similar degree of phenetic relationship, as far as the skull measurements are concerned, and show almost identical distances to the fossil representative of the colobine monkeys, Mesopithecus pentelicus.

# Acknowledgements

One of the authors (HOHENEGGER) was supported by the "Fonds zur Förderung der wissenschatlichen Forschung in Wien", project number P 2258 "Quantitative Morphology" and by the "Eduard Suess Stiftung der Österreichen Akademie der Wissenschaften" The other author (ZAPFE) is indebted to the "Wenner-Gren Foundation for Anthropological Research" for supporting the project "Osteology and Odontology of Mesopithecus"

The authors thank all the curators of the collections mentioned in the text for access to recent material. Especial thanks are reserved for Prof.Dr.H. SCHLIEMANN (Hamburg) for a large number of *Presbytis* skulls. For fossil material the following collegues are thanked: Dr. P. ANDREWS (London), Dr. L. GINSBURG (Paris), Dr. H. JAEGER (Berlin), Dr. B. ENGESSER (Basel), Dr. E. HEIZ-MANN (Stuttgart), Dr. H. KOLLMANN (Wien), Prof. Dr. N. SYMEONIDIS (Athens) and Dr. P. WELLNHOFER (München). Thanks are due to J. NEBELSICK and Dr. M. STACHOWITSCH for critical revision of the English text.

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		m a l	e			f e m a	l e	
	x	sd	P(z)	<u>n</u>	x	sd	P(z)	n
Basion-prosthion	85.45	4.19	.669	12	72.72	5.78	.963	9
Nasion-prosthion	39.05	5.13	.902	12	33.18	2.22	.870	9
Interorbital width	10.68	.97	.986	12	8.70	.59	.886	9
Palatine breadth	37.15	1.81	.983	12	34.93	1.50	.955	9
Biorbital breadth					65.00	.00		2
Orbital rim thickness	4.57	.36	.613	12	3.82	.60	.515	9
Nasal width	11.77	1.68	.927	12	10.22	.99	.485	9
Molar-premolar length	30.79	2.04	.504	12	30.42	1.01	.899	9
Sagittal crest height	1.00	1.16	.846	4	.00	.00		5
Profile angle	69.58	12.38	.227	12	63.33	8.12	.652	9
Interorbital width/								-
palatine breadth	29.15	2.15	.669	10	25.96	2.93	.997	5
Palatine breadth/				-•	20.00	2.00		•
nasion-prosthion	97.26	13.79	.756	8	104.30	6.04	.931	5
Molar-premolar length/	01.20	10.10		Ũ	101.00	0.01		Ŭ
nasion-prosthion	77 02	8 53	385	11	89.20	8 85	.978	3
Nasion-prosthion/	11.02	0.00	.000	**	00.20	0.00	1010	v
biorbital breadth				1	50.35	49		2
Interorbital width /				1	00.00	. 10		-
hiorbital-breadth				1	14 65	07		2
Symphysal width	19.89	1.13	.880	12	17.42	1.73	.983	13
Bicondylar width	71.50	4.95		2				
Chin height	25.50	1.67	.985	12	20.78	1.31	.344	13
Corpus height	20.19	1.28	.511	12	16.32	1.18	.534	13
(below second molar)								
Mandibular length	78.75	6.01		2	66.00	5.66		2
Mandibular angle	38.33	7.34	.475	$12^{-12}$	31.39	1.94	.086	13
Tooth row angle	6.00	4.90	.682	6	9.33	8.33		3
Chin angle	56.00	4 37	512	12	54.31	3.25	.335	13
Molar-premolar length	36.55	1.01	941	12	34 54	9.20	899	13
Molar length	23.83	80	756	12	23 44	.02	480	13
Corpus height /	20.00	.00	.100	12	20.11	.00	.100	10
chin height	78 01	4 77	703	12	78.03	5 11	550	12
Corpus height /	10.51	1.11	.100	12	10.00	0.11	.000	12
corpus neight/	102.00	12 95	0.28	Q	06.03	13 97	730	1
Corrus height /	102.00	10.20	.740	0	20.20	10.41	.103	4
molar longth	84 50	7 75	014	10	60 62	5.08	507	٥
Compus hoight /	04.00	1.10	.714	10	03.02	0.00	.031	Э
vorpus neight/	55 00	1 15	001	n	46.09	978	740	0
Sumphysic u: 141 /	00.22	4.10	.991	Э	40.92	2.10	.149	9
Symphysis width/	E9 40	9.07	079	7	47 75	7 67	090	A
molar-premolar length	<b>JJ</b> .40	3.91	.813	(	41.13	1.01	.030	4

Table 1. Craniometric characters and their statistical parameters in Mesopithecus pentelicus. Measurements in mm.  $\bar{x}$  = arithmetic mean, sd = standard deviation, P(z) = probability proving normal distribution, n = number of individuals.

# Continuation Table 1

		me	ما		female				
	Ÿ	sd sd	P(z)	n	v	re m sd	P(7)	n	
	л	bu	1(2)	- 11	^	Bu	1 (2)	·	
Maxillary teeth									
Length central incisor	5.18	.21	.640	17	4.95	.18	.975	11	
Length lateral incisor	4.42	.41	.572	17	4.26	.27	.964	11	
Length canine	8.49	.81	.643	17	6.30	.82	.873	11	
Length first premolar	5.21	.44	.797	17	4.84	.28	.879	11	
Breadth first premolar	5.75	.38	.502	17	5.80	.36	.794	11	
Length second premolar	5.21	.36	.776	17	5.00	.27	.897	11	
Breadth second premolar	6.38	.33	.970	17	6.43	.21	.826	11	
Length first molar	7.01	.38	.888	17	7.02	.19	.792	11	
Breadth first molar	6.99	.24	.352	17	6.95	.26	.975	11	
Length second molar	7.78	.33	.377	17	7.49	.16	.743	11	
Breadth second molar	7.75	.35	.692	17	7.64	.20	.517	11	
Length third molar	7.34	.56	.694	17	7.09	.36	.677	11	
Breadth third molar	7.31	.33	.879	17	7.02	.23	.792	11	
Length molar-premolar	31.31	1.50	.951	16	29.88	.95	.965	10	
Length molar	21.96	.92	.360	16	20.85	.69	.840	10	
Length premolar	9.99	.73	.979	16	9.66	.66	.999	11	
				· · · · · ·					
Mandibular teeth									
Length central incisor	3.10	.21	.819	12	3.29	.33	.561	11	
Length lateral incisor	3.78	.27	.248	12	3.63	.23	.907	11	
Length canine	7.47	.73	.843	12	5.45	.45	.838	11	
Length first premolar	7.48	.91	.957	12	6.73	.81	.757	11	
Breadth first premolar	4.12	.20	.231	12	3.81	.25	.702	11	
Length second premolar	6.19	.42	.781	12	5.86	.52	.443	11	
Breadth second premolar	4.64	.22	.871	12	4.79	.26	.964	11	
Length first molar	7.08	.38	.422	12	6.82	.35	.847	11	
Breadth first molar	5.82	.39	.813	12	5.65	.23	.968	11	
Length second molar	7.68	.43	.481	12	7.45	.31	.985	11	
Breadth second molar	6.74	.39	.952	12	6.55	.23	.990	11	
Length third molar	9.38	.40	.391	12	9.22	.49	.174	11	
Breadth third molar	6.82	.44	.339	12	6.53	.23	.907	11	
Length molar-premolar	36.48	1.18	.989	12	34.76	.83	.643	8	
Length molar	23.86	.99	.987	12	23.46	.67	.496	8	
Length premolar	12.79	.67	.888	12	11.56	.53	.998	11	

Table 2.	Craniometric characters and their statistical parameters in Procolobus badius. Measurements in
	mm. $\bar{x}$ = arithmetic mean, sd = standard deviation, $P(z)$ = probability proving normal distribution
	by Kolmogoroff-Smirnov test, $n = number$ of individuals.

		ma	le		female					
	x	sd	P(z)	n	x	sd	P(z)	n		
			- (-)				- (-)			
Basion-prosthion	79.01	2.48	.969	10	70.51	3.81	.861	10		
Nasion-prosthion	44.61	2.42	.820	10	39.37	2.56	.991	10		
Interorbital width	11.15	.98	.618	10	10.09	1.09	.701	10		
Palatine breadth	35.08	1.32	.962	10	32.38	.66	.951	10		
Biorbital breadth	66.73	3.39	.711	10	59.88	1.56	.998	10		
Orbital rim thickness	5.48	.55	.719	10	2.90	.52	.791	10		
Nasal width	10.30	.82	.600	10	9.54	1.25	.899	10		
Molar-premolar length	29.58	1.69	.878	10	29.09	1.41	.873	10		
Sagittal crest height	4.12	1.74	.878	10	.25	.42	.057	10		
Profile angle	58.80	4.26	.921	10	60.80	2.57	.708	10		
Interorbital width/										
palatine breadth	31.75	2.75	.907	10	31.10	3.15	.919	10		
Palatine breadth/								-		
nasion-prosthion	78.70	3.35	.955	10	82.54	6.01	.814	10		
Molar-premolar length/										
nasion-prosthion	66.20	2.68	.926	10	74.05	5.02	.928	10		
Nasion-prosthion/										
biorbital breadth	66.93	4.68	.929	10	65.72	4.40	.924	10		
Interorbital width/										
biorbital-breadth	16.64	1.06	.805	10	16.20	2.56	.886	10		
					_					
Symphysal width	21.66	1.83	.685	10	18.45	1.60	.380	10		
Bicondylar width	66.47	3.92	.868	10	62.23	2.61	.899	10		
Chin height	29.17	3.14	.393	10	25.08	1.60	.935	10		
Corpus height	19.38	1.33	.977	10	16.24	1.62	.719	10		
(below second molar)										
Mandibular length	81.15	3.96	.489	10	71.92	3.01	.844	10		
Mandibular angle	36.50	4.74	.130	10	31.70	3.65	.020	10		
Tooth row angle	8.50	4.74	.055	10	3.50	4.74	.130	10		
Chin angle	<b>51.80</b>	4.59	.523	10	45.40	3.86	.956	10		
Molar-premolar length	36.79	2.73	.946	10	34.40	1.63	.342	10		
Molar length	22.09	1.18	.800	10	22.48	.98	.831	10		
Corpus height/										
chin height	66.68	3.80	.983	10	64.69	4.50	.972	10		
Corpus height/										
symphysis width	89.61	4.35	.998	10	88.09	6.55	.987	10		
Corpus height/										
molar length	87.70	4.15	.829	10	72.30	7.71	.998	10		
Corpus height/										
molar-premolar length	52.72	2.76	.907	10	<b>47.24</b>	4.91	.999	10		
Symphysis width/										
molar-premolar length	58.81	1.93	.820	10	53.64	4.30	.812	10		

# Continuation Table 2.

		m a	le			fema	ale	
	x	sd	P(z)	n		sd	P(z)	r
Maxillary teeth								
Length central incisor	5.21	.55	974	10	5 62	40	669	10
Length lateral incisor	4.33	.43	.680	10	4.29	.40	.571	11
Length canine	9.71	1.22	.943	11	6 27	38	994	1
Length first premolar	4.97	.61	.705	11	4 76	.00	514	1
Breadth first premolar	5.33	.83	.788	11	5.00	.00	215	1
Length second premolar	4.66	.38	.723	11	4 85	32	201	1
Breadth second premolar	5.59	.55	303	11	5 45	39	860	1
Length first molar	6.74	.00	.960	11	6 56	29	988	1
Breadth first molar	5.95	34	823	11	5.84	.20	861	1
Length second molar	6.85	.35	.756	11	7 12	53	987	1
Breadth second molar	6 42	37	981	11	6 20	40	969	1
Length third molar	7 13	43	807	11	6 99	.10	571	1
Breadth third molar	6 34	32	983	11	6 25	.00	909	1
Length molar-premolar	29.92	1.58	595	11	29.20	1.31	924	1
Length molar	20.02	93	351	11	20.20	79	998	1
Length premolar	9.62	.00	815	11	9 44	61	852	1
Mandibular teeth								
Length central incisor	3.80	.37	.780	10	4.00	.30	.819	1
Length lateral incisor	3.71	.46	.990	10	3.94	.21	.277	1
Length canine	8.52	.87	.993	11	6.00	.29	.720	1
Length first premolar	9.72	1.29	.898	11	7.15	1.19	.306	1
Breadth first premolar	4.48	.38	.987	11	3.92	.58	.435	1
Length second premolar	5.63	.47	.426	11	5.55	.53	.911	1
Breadth second premolar	4.22	.23	.481	11	4.49	.89	.222	1
Length first molar	6.73	.37	.987	11	6.66	.63	.497	1
Breadth first molar	4.73	.31	.411	11	5.15	.90	.733	1
Length second molar	7.15	.45	.845	11	7.03	.57	.279	1
Breadth second molar	5.45	.27	.078	11	5.83	.95	.289	1
Length third molar	8.52	.60	.689	11	8.25	.93	.271	1
Breadth third molar	5.57	.34	.750	11	5.60	.26	.818	1
Length molar-premolar	36.84	2.48	.901	11	34.70	1.23	.910	1
Length molar	22.10	1.20	.801	11	22.45	.83	.947	1
		_ · <b>_ ·</b>						-

Table 3. Craniometric characters and their statistical parameters in *Presbytis entellus*. Measurements in mm.  $\bar{x}$  = arithmetic mean, sd = standard deviation, P(z) = probability proving normal distribution by Kolmogoroff-Smirnov test, n = number of individuals.

		m a l	le			fema	ale	
- <u>-</u>	<u> </u>	sd	P(z)	n	x	sd	P(z)	n
Basion-prosthion	85.51	9.32	.941	13	77,19	8 89	959	14
Nasion-prosthion	48.07	6.38	828	13	43 34	6.30	374	14
Interorbital width	10.07	1 70	978	13	11.36	1.84	599	14
Palatine breadth	40 12	3 95	.510 Q41	13	30 06	3 05	018	14
Riorbital breadth	71 88	5.20	783	13	66 <i>4</i> 1	3.30	020	14
Orbital rim thickness	11.00	0.20 Q0	850	13	2 92	0.40 78	.929	14
Need width	4.21	1.45	.000 000	19	0.20	.10	.949	14
Nasai widin	9.02	1.40	.000	10	10.0	1.00	.910	14
Molar-premolar length	33.92	3.09	.918	13	33.90	3.31	.800	14
Sagittal crest height	.00	.00	050	13	.00	.00	0.01	14
Profile angle	60.23	3.68	.056	13	63.00	2.94	.901	14
Interorbital width /								
palatine breadth	<b>31.74</b>	1.81	.987	13	28.28	2.68	.937	14
Palatine breadth/								
nasion-prosthion	83.83	4.70	.865	13	92.89	6.87	.901	14
Molar-premolar length/								
nasion-prosthion	70.83	4.47	.957	13	79.14	7.20	.832	14
Nasion-prosthion/								
biorbital breadth	66.68	5.53	.449	13	65.00	7.14	.644	14
Interorbital width/								
biorbital-breadth	17.67	1.36	.820	13	16.99	2.09	.885	14
<del> </del>					·····	-		
Symphysal width	21.17	3.10	.823	12	19.48	2.36	.488	14
Bicondylar width	75.37	6.82	.887	12	73.50	8.31	.944	14
Chin height	29.92	4.40	.734	12	26.84	2.62	.990	14
Corpus height	20.93	3.08	.948	12	19.21	3.18	.980	14
(below second molar)								
Mandibular length	87.38	9.21	.868	12	80.71	8.70	.840	14
Mandibular angle	39.42	2.02	.002	12	37.14	4.69	.008	14
Tooth row angle	4 17	5 15	.070	12	9.64	3.08	.004	14
Chin angle	51 02	3.85	855	12	46 57	4.05	637	14
Molar-premolar length	40.82	4 39	775	12	40.15	3.84	820	14
Molar longth	95 47	9.46	855	12	26.48	0.04 9.36	730	14
Comme height /	20.41	2.40	.000	12	20.40	2.30	.130	14
Corpus neight/	70.04	4 70	000	10	71.06	6 41	057	14
chin height	10.04	4.72	.929	12	/1.20	0.41	.957	14
Corpus height/	00.01	F 10	405	10	00 50	0.00	=00	• •
symphysis width	98.91	5.13	.437	12	98.58	9.98	.700	14
Corpus height/								
molar length	81.90	6.46	.983	12	72.35	8.14	.994	14
Corpus height/								
molar-premolar length	51.14	4.33	.958	12	47.76	5.07	.948	14
Symphysis width/								
molar-premolar length	51.71	3.69	.784	12	48.47	2.93	.257	14

# Continuation: Table 3.

		1	1.		female				
		ma. ad	D(-)	_	-	Iema	11e D(-)		
· · · · · · · · · · · · · · · · · · ·	X	su	P(z)	n	<u> </u>	sa	P(z)	<u>n</u>	
Maxillary teeth									
Length central incisor	5.35	.99	.978	11	5.38	.69	.996	10	
Length lateral incisor	4.80	.76	.995	11	4.79	.58	.600	10	
Length canine	9.50	1.42	.394	12	7.29	.66	.905	12	
Length first premolar	5.53	.79	.939	12	5.52	.81	.871	11	
Breadth first premolar	6.32	.58	.673	12	6.33	.82	.992	11	
Length second premolar	5.29	.69	.988	12	5.37	.41	.739	11	
Breadth second premolar	6.82	.78	.967	12	6.86	.69	.820	11	
Length first molar	7.56	.77	.990	12	7.58	.59	.998	12	
Breadth first molar	7.22	.82	.857	12	7.29	.89	.886	12	
Length second molar	8.15	1.02	.576	12	8.53	.99	.978	12	
Breadth second molar	8.18	.80	.998	12	8.20	.77	.945	12	
Length third molar	8.31	.96	.625	12	8.45	.86	.514	12	
Breadth third molar	7.98	.90	.693	12	7.95	.87	.781	12	
Length molar-premolar	34.03	3.72	.910	12	34.38	3.21	.970	12	
Length molar	23.81	2.51	.828	12	24.28	2.50	.970	12	
Length premolar	10.93	1.45	.969	12	10.71	.96	.989	12	
Mandibular teeth									
Length central incisor	3.63	.43	.844	11	3.72	.66	.896	11	
Length lateral incisor	4.15	.57	.999	12	4.07	.51	.837	12	
Length canine	8.59	1.24	.371	12	6.21	.58	.915	12	
Length first premolar	10.26	1.13	.915	12	8.57	1.61	.611	12	
Breadth first premolar	5.42	.89	.373	12	4.41	.61	.892	12	
Length second premolar	6.63	.83	.776	12	6.73	.74	.753	12	
Breadth second premolar	4.93	.63	.949	12	4.89	.58	.836	12	
Length first molar	7.87	.86	.685	12	7.93	.68	.881	12	
Breadth first molar	6.04	.55	.742	12	6.05	.60	.983	12	
Length second molar	8.40	.97	.671	12	8.63	.76	.999	12	
Breadth second molar	6.97	.57	.779	12	7.06	.75	.980	12	
Length third molar	10.34	1.16	.932	12	10.58	1.04	.497	12	
Breadth third molar	7.08	.66	.630	12	7.07	.77	.665	12	
Length molar-premolar	41.93	4.92	.734	12	40.61	3.72	.854	12	
Length molar	26.12	2.94	.904	12	26.71	2.16	.856	12	
Length premolar	16.10	2.04	.982	12	14.22	1.59	.334	12	

Table 4. Analyses of variance, X indicates significant differences (5% error estimation) in pairwise comparison.

Basion-pros	thion					Nasion-prost	hion							
P(F) between Homogeneity	groups of varia	s = .000 ances P	(F) = .0	00		P(F) between Homogeneity o	groups : of varian	= .000 .ces P(F	) = .00	0				
Student-New:	man-Ke	euls test	<u></u>			Student-Newm	an-Keu	ls test	·					
	Р	М	Р	Р	М		М	М	Р	Р	Р			
	r	е	r	r	е		е	е	r	r	r			
	o	s	e	ο	s		s	S	ο	e	ο			
	f	f	· f	m	m		f	m	f	f	m			
Procl.fem.						Mesop.fem.								
Mesop.fem.	0					Mesop.mas.	Х							
Presb.fem.	Х	0				Procl.fem.	Х	0						
Procl.mas.	Х	0	0			Presb.fem.	Х	0	0					
Mesop.mas.	Х	Х	Х	Х		Procl.mas.	Х	х	Х	0				
Presb.mas.	Х	Х	X	0	0	Presb.mas.	X	X	Х	X	0			
Interorbital	width	L				Palatine breadth								
P(F) between	groups	s = .000	)			P(F) between groups = .000								
Homogeneity	of varia	ances P	(F) = .0	11		Homogeneity of variances $P(F) = .000$								
Student-New:	man-Ke	euls test				Student-Newman-Keuls test								
	М	Р	М	Р	Р		Р	М	Р	М	Р			
	е	r	e	r	r		r	е	r	е	r			
	s	0	s	ο	e		ο	S	0	S	e			
	f	f	m	m	f		f	f	m	m	f			
Mesop.fem.						Procl.fem.								
Procl.fem.	Х					Mesop.fem.	Х							
Mesop.mas.	Х	0				Procl.mas.	Х	0						
Procl.mas.	Х	0	0			Mesop.mas.	Х	0	0					
Presb.fem.	Х	0	0	0		Presb.fem.	х	х	Х	х				
Presb.mas.	Х	Х	Х	x	Х	Presb.mas.	Х	X	X	X	0			
Biorbital b	readth					Orbital rim	thickne	ess						
P(F) between	groups	s = .000	1			P(F) between	groups	.000						
Homogeneity	of varia	ances P	(F) = .0	09	-	Homogeneity of	of variar	ices P(F	r) = .11	4				
Student-New:	man-Ke	euls test				Student-Newn	1an-Keu	ls test						
	Р	М	Р	Р			Р	Р	М	Р	М			
	r	e	r	r			r	r	е	r	е			
	ο	f	e	ο			ο	e	s	e	s			
	f	f	f	m			f	f	f	m	m			
Procl.fem.	-	-	-			Procl.fem.	-	-	-					
Meson fem	0					Presh fem	0							
Presh fem	x	n				Meson fem	x	n						
Procl mas	x	ñ	0			Presh mas	x	x	0					
Presh mas	x	ñ	x	x		Meson mas	x	x	ř	n				
1 1050.11103.	Λ	0	Λ	Λ		Procl mas	X X	Ŷ	Y	ř	x			
						r roci.mas.	Λ	Λ	л	л				

Nasal width						Molar-premolar length								
P(F) between Homogeneity	groups of varia	= .000 nces P(I	F) = .33	32		P(F) between Homogeneity	groups of varia	= .000 nces P(1	F) = .00	)1				
Student-Newn	nan-Keu	ls test				Student-Newn	nan-Keu	ıls test						
	Р	Р	Р	М	Р		Р	Р	М	М	Р			
	r	r	r	е	r		r	r	е	е	r			
	е	е	0	S	0		ο	ο	s	s	е			
	f	m	f	f	m		f	m	f	m	m			
Presb.fem.						Procl.fem.								
Presb.mas.	0					Procl.mas.	0							
Procl.fem.	0	0				Mesop.fem.	0	0						
Mesop.fem.	Х	0	0			Mesop.mas.	0	0	0					
Procl.mas.	Х	0	0	0		Presb.mas.	Х	Х	х	Х				
Mesop.mas.	Х	X	X	X	X	Presb.fem.	X	X	X	Х	0			
Sagittal cres	t heigh	nt				Profile angle	9							
P(F) between Homogeneity	groups of varia	= .000 nces P(H	<u>F) = .00</u>	01		P(F) between groups = .004 Homogeneity of variances $P(F) = .000$								
Student-Newn	n <b>an-</b> Keu	ls test				Student-Newman-Keuls test								
	Р	Р	М	Р	М		Р	Р	Р	Р	М			
	г	r	е	r	е		r	r	r	r	е			
	e	e	s	0	s		ο	e	ο	е	s			
	m	f	f	f	m		m	m	f	f	f			
Presb.mas.						Procl.mas.								
Presb.fem.	0					Presb.mas.	0							
Mesop.fem.	0	0				Procl.fem.	0	0						
Procl.fem.	0	0	0			Presb.fem.	0	0	0					
Meson.mas.	0	0	0	0		Meson.fem.	0	0	0	0				
Procl.mas.	x	x	x	x	х	Mesop.mas.	x	x	x	x	Х			
Interorbital	width/	palatir	ie brea	dth		Palatine bre	adth/n	asion p	orosthi	on				
P(F) between	groups	= .000				P(F) between	, groups	000						
Homogeneity	of varia	nces P(F	r) = .57	7		Homogeneity	of varia	nces P(1	F) = .00	2				
Student-Newn	n <b>an-</b> Keu	ls test				Student-Newn	nan-Keu	ıls test						
	М	Р	М	Р	Р		Р	Р	Р	Р	М			
	e	r	е	r	r		r	r	r	r	е			
	S	e	5	0	e		0	0	e	е	S			
	f	f	m	f	m		m	f	m	f	m			
Mesop.fem.						Procl.mas.								
Presb.fem.	0					Procl.fem.	0							
Mesop.mas.	0	0				Presb.mas.	0	0						
Procl.fem.	Х	Х		0		Presb.fem.	Х	Х	х					
Presb.mas.	х	Х	х	0		Mesop mas.	Х	х	х	0				
Procl.mas.	Х	Х	0	0	0	Mesop.fem.	х	х	х	х	0			

Table 5. Analyses of variance, X indicates significant differences (5% error estimation) in pairwise comparison.

Table 6. Analyses of variance. X indicates significant differences (5% error estimation) in pairwise comparison.

Molar-prem	olar ler	ngth/na	asion p	rosthic	on	Nasion-prost	thion/t	oiorbita	l bread	lth				
P(F) between Homogeneity o	groups of varia	= .000 nces P(I	F) = .01	.9		P(F) between Homogeneity	groups of variar	= .013 ices P(F	) = .16	4				
Student-Newn	n <b>an-</b> Keu	ls test				Student-Newn	1an-Keu	ls test	-		-			
	Р	Р	Р	М	Р		М	М	Р	Р	Р			
	r	r	r	e	r		e	е	r	r	r			
	ο	e	ο	s	e		s	s	e	ο	е			
	m	m	f	m	f		f	m	f	f	m			
Procl.mas.						Mesop.fem.								
Presb.mas.	0					Mesop.mas.	0							
Procl.fem.	х	0				Presb.fem.	х	0						
Mesop.mas.	х	Х	0			Procl.fem.	х	0	0					
Presb.fem.	х	х	0	0		Presb.mas.	х	0	0	0				
Mesop.fem.	X	X	X	X	Х	Procl.mas.	Х	0	0	0	0			
Interorbital	width/	'biorbi	al brea	adth		Symphysal width								
P(F) between	grouds	= .097				P(F) between groups = .000								
Homogeneity of	of varia	nces P(I	F) = .01	.1		Homogeneity of variances $P(F) = .030$								
Student-Newn	nan-Keu	ls test				Student-Newn	nan-Keu	ls test						
							М	Р	Р	М	Р			
							e	r	r	e	r			
no dif	ference	es betw	een gr	oups			e	0	e	s	е			
							f	ſ	f	m	m			
						Mesop.fem.								
						Procl.fem.	0							
						Presb.fem.	x	0						
						Meson mas	x	Õ	0					
						Presh mas	x	x	ñ	0				
						Procl.mas.	X	X	Õ	0	0			
Bicondylar v	width					Chin height					-			
P(F) between	groups	- 000				P(F) between	groups	- 000						
Homogeneity of	of varia	– .000 1ces P(I	F) = .01	.2		Homogeneity	of variar	000 nces P(F	`) = .00	0				
Student-Newn	1an-Keu	ls test				Student-Newn	1an-Keu	ls test						
	М	Р	Р	М	Р		М	Р	М	Р	Р			
	e	r	r	e	r		e	г	e	r	r			
	s	o	ο	s	e		e	ο	s	e	ο			
	f	f	m	m	f		f	f	m	f	m			
Mesop.fem.	•	•			•	Mesop.fem.	•	•		•				
Procl fem	0					Procl fem	x							
Procl mas	ñ	n				Meson mas	x	0						
Meson mas	ñ	n	0			Presh fem	x	ñ	Ο					
Presh fem	n n	x	x	n		Procl mas	x	x	x	x				
	0	N V	v	0	•	Decel mas	N V	v	v	v	0			

Corpus heig	ht					Mandibular length								
P(F) between Homogeneity	groups of variar	= .000 nces P(F	`) = .00	0		P(F) between groups = .000 Homogeneity of variances $P(F) = .019$								
Student-Newn	nan-Keu	ls test				Student-Newn	an-Keu	ls test						
	Р	М	Р	Р	М		М	Р	М	Р	F			
	r	e	r	r	e		e	r	e	r	I			
	ο	s	е	ο	s		s	ο	S	е	C			
	f	f	f	m	m		f	f	m	f	n			
Procl.fem.						Mesop.fem.								
Mesop.fem.	0					Procl.fem.	0							
Presb.fem.	Х	Х				Mesop.mas.	0	0						
Procl.mas.	х	Х	0			Presb.fem.	Х	х	0					
Mesop.mas.	Х	х	0	0		Procl.mas.	0	х	0	0				
Presb.mas.	Х	Х	0	0	0	Presb.mas.	Х	Х	0	0	>			
Mandibular	angle					Tooth row angle								
P(F) between Homogeneity	groups of variar	= .000 nces P(F	) = .00	0		P(F) between groups = .013 Homogeneity of variances $P(F) = .370$								
Student-Newn	nan-Keu	ls test	/		Student-Newn	an-Keu	ls test							
	м	Р	Р	Р	м		Р	Р	м	Р	N			
	e	- T	r	r	e		r	r	e	- T	e			
	s	0	0	e	s		0	e	s	0	5			
	f	f	m	f	m		f	m	m	m	+			
Mesop.fem.	•	•		-		Procl.fem.	•							
Procl.fem.	0					Presb.mas.	0							
Procl.mas.	x	х				Mesop.mas.	0	0						
Presb.fem.	x	x	0			Procl.mas.	0	0	0					
Mesop.mas.	x	x	0	0		Mesop.fem.	0	0	0	0				
Presb.mas.	X	X	0	0	0	Presb.fem.	X	X	0	0	(			
Chin angle						Molar-premo	olar len	$\mathbf{gth}$						
P(F) between	groups	= .000	·) 01	7		P(F) between	groups	= .000	2) 00	0				
nomogeneity (			) = .91	<u> </u>					<u>() = .00</u>					
Student-Newn	nan-Keu	lis test	P	n		Student-Newn	nan-Keu	ls test		n				
	Р	Р -	P -	Р -	M		Р -	M	м	Р -	ł			
	r o	r e	г 0	r e	e s		r O	e s	e s	r	1 6			
	-	-	-	-	-		-	=	-	-				
Procl fem	f	f	m	m	f	Procl fem	f	f	m	m	t			
Presh fem	Λ					Meson form	n							
Procl mag	v	v				Meson mas	0	n						
Proch man	A V	л v	0			Drock mas	0	0 A	n					
Moron for	A V	л v	0	0		FIUCI.Mas.	v	v	U V	v				
Mesop.tem.	A V	A V	0	v	0	Presb.iem.	A V	л v	л v	л v				
mesop.mas.	л		0		U	r resu.mas.	л	л	л	л				

Table 7. Analyses of variance. X indicates significant differences (5% error estimation) in pairwise comparison.

Table 8. Analyses of variance. X indicates significant differences (5% error estimation) in pairwise comparison.

Molar length	L					Corpus height/chin height							
P(F) between Homogeneity o	groups = of varian	= .000 ces P(F	) = .000	)		P(F) between Homogeneity o	groups = of varian	= .000 .ces P(F	) = .667				
Student-Newm	an-Keul	ls test				Student-Newn	1an-Keul	ls test					
	Р	Р	М	М	Р		Р	Р	Р	Р	М		
	r	r	e	e	r		г	r	r	r	е		
	0	0	s	s	e		ο	ο	e	e	s		
	m	f	f	m	m		f	m	m	f	f		
Procl.mas.						Procl.fem.							
Procl.fem.	0					Procl.mas.	0						
Mesop.fem.	0	0				Presb.mas.	Х	0					
Mesop.mas.	0	0	0			Presb.fem.	Х	0	0				
Presb.mas.	Х	Х	Х	Х		Mesop.fem.	Х	Х	Х	Х			
Presb.fem.	Х	Х	Х	Х	0	Mesop.mas.	Х	Х	Х	Х	0		
Corpus heigh	nt/sym	physal	width			Corpus height/molar length							
P(F) between	groups =	= .004				P(F) between groups = .000							
Homogeneity of	of varian	ces P(F	) = .007	,		Homogeneity of variances $P(F) = .326$							
Student-Newm	an-Keul	ls test			Student-Newn	an-Keu	ls test						
	Р	Р	М	Р	Р		М	Р	Р	Р	М		
	r	r	e	r	r		е	r	r	r	e		
	ο	ο	S	e	е		S	0	e	е	S		
	f	m	f	f	m		f	f	f	m	m		
Procl.fem.						Mesop.fem.							
Procl.mas.	0					Procl.fem.	0						
Mesop.fem.	0	0				Presb.fem.	0	0					
Presb.fem.	х	0	0			Presb.mas.	Х	Х	Х				
Presb.mas.	х	0	0	0		Mesop.mas.	Х	Х	Х	0			
Mesop mas.	Х	х	0	0	0	Procl.mas.	Х	х	х	0	0		
Corpus heigh	nt/mola	ar-pren	nolar le	ngth		Symphysis w	/idth/n	nolar-p	remola	r lengtl	1		
P(F) between	groups -	- 000				P(F) between	groups -	- 000					
Homogeneity of	of varian	ces P(F)	) = .319			Homogeneity of	of varian	ces P(F)	) = .039	) 	·		
Student-Newm	an-Keul	ls test				Student-Newn	1an-Keu	ls test					
	М	Р	Р	Р	Р		М	Р	Р	М	Р		
	е	r	r	r	r		e	r	r	e	r		
	S	ο	e	е	ο		S	e	e	S	ο		
	f	f	f	m	m		f	f	m	m	f		
Mesop.fem.						Mesop.fem.							
Procl.fem.	0					Presb.fem.	0						
Presb.fem.	0	0	Х			Presb.mas.	0	Х					
Procl.mas.	Х	Х	Х	0		Procl.fem.	0	Х	0	0			
Mesop.mas.	X	X	<u> </u>	0	0	Procl.mas.	X	<u>X</u>	<u> </u>	X	X		

Table 9. Analyses of variance. X indicates significant differences (5% error estimation) in pairwise comparison.

Length upper central incisor	Length upper lateral incisor
P(F) between groups = .127 Homogeneity of variances $P(F) = .000$	P(F) between groups = .027 Homogeneity of variances $P(F) = .030$
Student-Newman-Keuls test	Student-Newman-Keuls test

no differences between groups

no differences between groups

Lenght uppe	er canir	ıe				Length upper first premolar						
P(F) between Homogeneity	groups of variar	= .000 aces P(F	) = .002	2	·	P(F) between groups = .007 Homogeneity of variances $P(F) = .016$						
Student-Newn	nan-Keu	ls test				Student-Newn	nan-Keu	ls test				
	Р	М	Р	М	Р		Р	М	Р	М	Р	
	r	e	r	e	I		r	е	r	e	r	
	0	s	e	s	e		0	ο	ο	s	e	
	f	f	f	m	m		f	f	m	m	f	
Procl.fem.						Procl.fem.						
Mesop.fem.	0					Mesop.fem.	0					
Presb.fem.	Х	Х				Procl.mas.	0	0				
Mesop.mas.	Х	х	Х			Mesop.mas.	0	0	0			
Presb.mas.	Х	Х	Х	Х		Presb.fem.	Х	Х	0	0		
Procl.mas.	X	X	X	<u>X</u>	0	Presb.mas.	X	0	0	0	0	
	Breadth upper first premolar											
Breadth upp	per first	premo	olar			Length uppe	er secon	ld pren	nolar			
Breadth upp P(F) between Homogeneity	per first groups of variar	<b>premo</b> = .000 aces P(F	blar	)		Length uppe P(F) between Homogeneity o	er secon groups : of varian	nd pren = .001 .ces P(F	nolar $) = .030$			
Breadth upp P(F) between Homogeneity Student-Newn	per first groups of variar nan-Keu	= .000 nces P(F ls test	$\mathbf{blar}$	)		Length uppe P(F) between Homogeneity of Student-Newn	er secon groups : of varian nan-Keu	nd pren = .001 .ces P(F ls test	nolar ) = .030	l <u> </u>		
Breadth upp P(F) between Homogeneity Student-Newn	per first groups of variar nan-Keu P	= .000 aces P(F ls test P	blar r) = .000 M	) M	 P	Length uppe P(F) between Homogeneity o Student-Newn	er secon groups = of varian nan-Keu P	nd pren = .001 .ces P(F ls test P	nolar ) = .030 M	M	 Р	
Breadth upp P(F) between Homogeneity Student-Newn	per first groups of variar nan-Keu P r	premo = .000 aces P(F ls test P r	Dlar () = .000 M e	) M e	Pr	Length uppe P(F) between Homogeneity o Student-Newn	er secon groups = of varian nan-Keu P r	nd pren = .001 .ccs P(F ls test P r	molar ) = .030 M e	) M e	P	
Breadth upp P(F) between Homogeneity Student-Newn	per first groups of variar nan-Keu P r o	= .000 nces P(F ls test P r o	Dlar () = .000 M e s	) M e s	P r e	Length uppe P(F) between Homogeneity o Student-Newn	er secon groups : of varian nan-Keu P r o	nd pren = .001 .ces P(F ls test P r o	nolar ) = .030 M e s	M e s	P r e	
Breadth upp P(F) between Homogeneity Student-Newn	per first groups of variar nan-Keu P r o f	= .000 aces P(F ls test P r o m	Dlar () = .000 M e s m	) M e s f	P r e m	Length uppe P(F) between Homogeneity o Student-Newm	er secon groups : of varian nan-Keu P r o m	nd pren = .001 .ces P(F ls test P r o f	nolar ) = .030 M e s f	M e s m	P r e m	
Breadth upp P(F) between Homogeneity Student-Newn Procl.fem.	per first groups of variar nan-Keu P r o f	= .000 aces P(F ls test P r o m	D <b>lar</b> () = .000 M e s m	) M e s f	P r e m	Length uppe P(F) between Homogeneity of Student-Newn Procl.mas.	er secon groups : of varian nan-Keu P r o m	nd pren = .001 aces P(F) ls test P r o f	nolar ) = .030 M e s f	M e s m	P r e m	
Breadth upp P(F) between Homogeneity Student-Newn Procl.fem. Procl.fem.	per first groups of variar nan-Keu P r o f 0	= .000 aces P(F ls test P r o m	D <b>lar</b> () = .000 M e s m	) M e s f	P r e m	Length uppe P(F) between Homogeneity of Student-Newm Procl.mas. Procl.fem.	er secon groups = of varian nan-Keu P r o m 0	nd pren = .001 aces P(F) ls test P r o f	nolar ) = .030 M e s f	M e s m	P r e m	
Breadth upp P(F) between Homogeneity Student-Newn Procl.fem. Procl.fem. Mesop.mas.	per first groups of variar nan-Keu P r o f f X	= .000 aces P(F ls test P r o m	olar ) = .000 M e s m	) M e s f	P r e m	Length uppe P(F) between Homogeneity of Student-Newn Procl.mas. Procl.fem. Mesop.fem.	er secon groups : of varian nan-Keu P r o m 0 0 0	nd pren = .001 aces P(F) ls test P r o f 0	nolar ) = .030 M e s f	M e s m	P r e m	
Breadth upp P(F) between Homogeneity Student-Newn Procl.fem. Procl.mas. Mesop.mas. Mesop.fem.	per first groups of variar nan-Keu P r o f f X X X	= .000 aces P(F ls test P r o m 0 0	olar <u>()</u> = .000 M e s m 0	) M e s f	P r e m	Length uppe P(F) between Homogeneity of Student-Newn Procl.mas. Procl.fem. Mesop.fem. Mesop.mas.	er secon groups : of varian nan-Keu P r o m 0 0 X	ed pren = .001 aces P(F) ls test P r o f 0 0	nolar ) = .030 M e s f 0	M e s m	P r e m	
Breadth upp P(F) between Homogeneity Student-Newn Procl.fem. Procl.mas. Mesop.mas. Mesop.fem. Presb.mas.	per first groups of variar nan-Keu P r o f f X X X X X	= .000 aces P(F ls test P r o m 0 0 X	olar <u>()</u> = .000 M e s m 0 X	) M e s f X	P r e m	Length upper P(F) between Homogeneity of Student-Newn Procl.mas. Procl.fem. Mesop.fem. Mesop.mas. Presb.mas.	er secon groups : of varian nan-Keu P r o m 0 X X X	ed pren = .001 aces P(F) ls test P r o f 0 0 0 0	nolar ) = .030 M e s f 0 0	M e s m	P r e m	

Table 10. Analyses of variance. X indicates significant differences (5% error estimation) in pairwise comparison.

									-	_	
Breadth upp	per seco	ond pre	emolar			Length uppe	r first	molar			
P(F) between Homogeneity	groups of variar	= .000 	`) = .00	1		P(F) between groups = .000 Homogeneity of variances $P(F) = .000$					
Student-Newn	nan-Keu	ls test				Student-Newn	nan-Keu	ls test			
	Р	Р	М	М	Р		Р	Р	М	М	Р
	r	r	e	е	r		г	r	e	e	r
	о	o	s	s	е		о	ο	S	S	е
							-				
<b>D</b> 14	f	m	m	1	m	<b>D</b> 14	f	m	m	f	m
Procl.tem.	0					Procl.tem.					
Procl.mas.	0					Procl.mas.	0	_			
Mesop.mas.	X	X				Mesop.mas.	0	0			
Mesop.fem.	Х	X	0			Mesop.fem.	0	0	0		
Presb.mas.	Х	x	0	0		Presb.mas.	Х	Х	Х	Х	
Presb.fem.	<u> </u>	X	0	0	0	Presb.fem.	<u> </u>	X	<u> </u>	<u>X</u>	0
Breadth upp		Lenght uppe	r secon	d mola	r						
P(F) between	groups	000. =				P(F) between	grouds :	000. =			
Homogeneity	of variar	ices P(F	) = .00	)		Homogeneity of	of varian	ces P(F	) = .000		
Student-Newn	nan-Keu	ls test				Student-Newn	nan-Keu	ls test	Ī		
	Р	Р	М	М	Р		Р	Р	М	М	Р
	r	r	е	е	r		r	r	e	e	r
	о	ο	s	s	e		ο	о	s	s	e
	f	m	f	m	m		m	f	f	m	m
Procl.fem.						Procl.mas.					
Procl.mas.	0					Procl.fem.	0				
Mesop.fem.	Х	х				Mesop.fem.	0	0			
Mesop.mas.	Х	х	0			Mesop.mas.	Х	х	0		
Presb.mas.	х	х	0	0		Presb.mas.	х	х	х	0	
Presb.fem.	x	X	0	0	0	Presb.fem.	x	x	x	x	0
		nd me				Longth uppe	n thind				
breadin upp	Jer secu	mu mu	lar			Length uppe	er unru	morar			
P(F) between	groups	000. =				P(F) between	groups :	000. =			
Homogeneity	of variar	ices P(F	<u>) = .00</u>	)		Homogeneity of	of varian	ces P(F	) = .003		
Student-Newn	nan-Keu	ls test				Student-Newn	1an-Keu	ls test			
	Р	Р	М	М	Р		Р	М	Р	М	Р
	r	r	e	е	r		r	е	r	е	r
	о	ο	S	s	е		ο	s	ο	s	е
	f	m	f	m	m		f	f	m	m	m
Procl.fem.						Procl.fem.					
Procl.mas.	0					Mesop.fem.	0				
Mesop.fem.	Х	Х				Procl.mas.	0	0			
Mesop.mas.	х	Х	0			Mesop.mas.	0	0	0		
Presb.mas.	Х	х	Х	х		Presb.mas.	Х	х	х	х	
Presb.fem.	х	х	0	0	0	Presb.fem.	х	х	х	х	0

Table 11.	Analyses of variance.	X indicates significant	differences	(5%error	estimation)	in pairwise	e comp <mark>ari-</mark>
	son.						

							_				
Breadth up	per thir	d mola	r			Upper mola	r-premo	olar len	gth		
P(F) between Homogeneity	groups = of varian	= .000 ces P(F	) = .000			P(F) between Homogeneity (	groups : of varian	= .000 .ces P(F	) = .000	1	
Student-Newr	nan-Keul	s test	,			Student-Newn	nan-Keu	ls test	,		
	Р	Р	м	м	Р		Р	P	м	м	P
	r	r		e	r		r	- -	P	- MI - P	- -
	0	0	5	s	e		0	0	s	s	e
	U	Ū	5	5	č		Ũ	Ū	5	5	C
	f	m	f	m	f		f	m	f	m	m
Procl.fem.						Procl.fem.					
Procl.mas.	0					Procl.mas.	0				
Mesop.fem.	Х	Х				Mesop.fem.	0	0			
Mesop.mas.	Х	Х	0			Mesop.mas.	0	0	0		
Presb.fem.	Х	Х	Х	Х		Presb.mas.	Х	Х	Х	Х	
Presb.mas.	Х	Х	Х	Х	0	Presb.fem.	Х	Х	Х	Х	0
Upper mola	r length					Upper prem	olar ler	ngth			
D(F) hotwoon		- 000				D(F) between		_ 000			
Homogeneity	of varian	= .000 ces P(F	) = .000			Homogeneity	of varian	= .000 lces P(F	) = .037		
Student-News	man-Keul	ls test				Student-Newn	nan-Keu	ls test			
	Р	Р	М	М	Р		Р	Р	М	Μ	Р
	r	r	е	е	r		r	г	е	e	г
	ο	ο	s	s	e		ο	ο	S	S	e
							r		r		
Development	1	m	1	m	m	Development	1	m	1	m	1
Procl.iem.						Procl.iem.					
Procl.mas.	U					Procl.mas.	0				
Mesop.tem.	0	0				Mesop.tem.	0	0	-		
Mesop.mas.	X	0	0			Mesop.mas.	0	0	0		
Presb.mas.	Х	Х	X	Х		Presb.fem.	X	X	Х	Х	
Presb.fem.	X	<u> </u>	<u> </u>	X	0	Presb.mas.	<u>X</u>	X	X	X	0
Length lowe	er centra	al incis	or			Length lowe	r latera	l inciso	or		
P(F) between	groups =	= .000				P(F) between	groups :	= .019			
Homogeneity	of varian	ces P(F	) = .011			Homogeneity	of varian	ces P(F	) = .004	:	
Student-News	man-Keul	ls test	<u>/</u>			Student-Newn	1an-Keu	ls test	/		
	м	м	Р	Р	Р		м	Р	м	Р	Р
	e	e	r	r	r		e	- T	e	r	r
	s	5	e	e	0		s	0	e	0	e
	5	5	C	C	Ū		5	Ū	C	U	C
	m	f	m	f	m		f	m	m	f	f
Mesop.mas.						Mesop.fem.					
Mesop.fem.	0					Procl.mas.	0				
Presb.mas.	Х	0				Mesop.mas.	0	0			
Presb.fem.	Х	Х	0			Procl.fem.	0	0	0		
Procl.mas.	Х	Х	0	0		Presb.fem.	0	0	0	0	
Procl.fem.	х	Х	0	0	0	Presb.mas.	Х	0	0	0	0

Table 12.	Analyses of variance.	X indicates significant	differences	(5%error	estimation)	in pairwise	compari-
	son.						

Length lower	canin	e				Length lower first premolar						
P(F) between Homogeneity o	groups = of varian	= .000 .ces P(F	) = .000	)		P(F) between groups = .000 Homogeneity of variances $P(F) = .299$						
Student-Newm	an-Keul	ls test				Student-Newman-Keuls test						
	м	Р	Р	м	Р		м	Р	м	Р	Р	
	 P	- T	r	e	- 7			- -		- -	•	
	s	0	P	s	0		's	1	د د	I P	0	
	5	Ū	C	5	Ū		Б	U	5	C	Ū	
	f	f	f	m	m		f	f	m	f	m	
Mesop.fem.						Mesop.fem.	-	-		-		
Procl.fem.	0					Procl.fem.	0					
Presb.fem.	0	0				Mesop.mas.	0	0				
Meson.mas.	x	x	х			Presb.fem.	x	x	х			
Procl.mas.	х	х	X	х		Procl.mas.	x	X	x	х		
Presb.mas.	x	x	x	x	0	Presb.mas.	x	x	x	x	0	
Breadth lower first premolar						Length lower	secon	d prem	olar			
								-				
Homogeneity o	P(F) between groups = .000 Homogeneity of variances $P(F) = .000$							= .000 ces P(F	) = .184			
Student-Newm	an-Keul	ls test				Student-Newman-Keuls test						
	м	Р	м	Р	Р		Р	Р	м	м	Р	
	- MI P	r r	e	r	r		- -	r	- M1 P	- M1 - P	- -	
	s	0	s	e	0		•	•	s	s	P	
	5	Ū	5	C	Ū		Ū	U	5	5	C	
	f	f	m	f	m		f	m	f	m	m	
Mesop.fem.	-	-		-		Procl.fem.	-		-			
Procl.fem.	0					Procl.mas.	0					
Meson.mas.	0	0				Mesop.fem.	0	0				
Presb.fem.	0	0	0			Meson mas.	0	0	0			
Procl.mas	x	0	0 0	0		Presh mas	x	x	x	0		
Presh.mas.	x	x	x	x	x	Presb.fem.	x	x	x	Ő	0	
Broadth low						Longth lower	finat m					
Dreauth lowe	er secoi	na htei	noiar			Length lower	nrst n	lolar				
P(F) between ( Homogeneity o	groups = of varian	= .020 .ces P(F	) = .000	)		P(F) between ( Homogeneity o	groups = f varian	= .000 ces P(F	) = .011			
Student-Newm	an-Keu	ls test	<u> </u>	· · ·		Student-Newm	an-Keul	s test	·			
	р	р	м	м	р		P	р	м	м	Р	
	- -	1 r	M	111	1		1 T		141	MI	1 F	
	1	1	e	e	1		1	1	e	e	1	
	U	0	5	3	e		U	U	3	5	C	
	m	f	m	f	f		f	m	f	m	m	
Procl.mas.						Procl.fem.						
Procl.fem.	0					Procl.mas.	0					
Mesop.mas.	0	0				Mesop.fem.	0	0				
Mesop.fem.	0	0	0			Mesop.mas.	0	0	0			
Presb.fem.	Х	0	0	0		Presb.mas.	х	х	х	Х		
Presb.mas.	X	0	0	0	0	Presb.fem.	<u>X</u>	X	X	X	0	

Breadth low	er first	molar				Length lowe	r secon	d mola	r		
P(F) between Homogeneity of	groups of variar	= .000 aces P(F	) = .000	)		P(F) between Homogeneity (	groups : of varian	= .000 .ces P(F	) = .005	5	
Student-Newn	1an-Keu	ls test	<u> </u>			Student-Newn	1an-Keu	ls test	/		
	Р	Р	м	м	Р		Р	Р	м	м	
	r	r	e	e	r		r	- F	P	- M1 - P	
	0	0	s	s	e		0	0	s	s	
			,				r		r		
Prod mas	m	I	1	m	m	Drad for	1	m	1	m	1
Procl form	0					Procl. mag	0				
Magan fam	v	v				F foci.mas.	0	0			
Mesop.iem.	A V	A V	0			Mesop.iem.	U	0	•		
Mesop.mas.	X	X	U	•		Mesop.mas.	0	0	0	77	
Presb.mas.	X	X	0	0		Presb.mas.	X	X	X	X	
Presb.fem.	<u>X</u>	<u> </u>	0	0	0	Presb.fem.	<u> </u>	<u> </u>	<u>X</u>	X	
Breadth lower second molar $P(F)$ between groups = 000						Length lower	r third	molar			
P(F) between Homogeneity o	(F) between groups = $.000$ progeneity of variances $P(F) = .000$						groups : of varian	= .000 .ces P(F	) = .004	Ł	
Student-Newn	1an-Keu	ls test				Student-Newn	1an-Keu	ls test			
	Р	Р	М	М	Р		Р	Р	м	М	
	r	r	e	P	r		- T	- r	P	e	
	0	0	s	s	e		0	0	s	s	
	· ·	-	-	-	·		•	•	Ū	2	
	m	f	f	m	m		f	m	f	m	1
Procl.mas.						Procl.fem.					
Procl.fem.	0					Procl.mas.	0				
Mesop.fem.	Х	Х				Mesop.fem.	Х	0			
Mesop.mas.	Х	Х	0			Mesop.mas.	Х	Х	0		
Presb.mas.	Х	Х	0	0		Presb.mas.	х	Х	Х	Х	
Presb.fem.	х	х	0	0	0	Presb.fem.	х	х	х	х	
Breadth low	er thir	d mola	 r			Lower molar	-premo	lar len	gth		
P(F) between	GEOUDE	- 000				P(F) between	aroune :	- 000	0		
Homogeneity (	of variar	000 1ces P(F	) = .000	)		Homogeneity of	of varian	- .000 ices P(F	) = .000	)	
Student-Newn	1an-Keu	ls test				Student-Newn	1an-Keu	ls test			
	Р	Р	М	М	Р		Р	М	М	Р	
	- T	r	e	 P	r		- T	e	e	r	
	· •	- 0	s	s	P		•	s	s	•	
	Ũ	0	5	6	C		Ŭ	5	5	Ũ	
	m	f	f	m	m		f	f	m	m	
Procl.mas.						Procl.fem.					
Procl.fem.	0					Mesop.fem.	0				
Mesop.fem.	Х	Х				Mesop.mas.	0	0			
Mesop.mas.	х	х	0			Procl.mas.	0	0	0		
Presb.mas.	х	х	х	0		Presb.fem.	Х	Х	Х	х	
Presh fem	x	v	 0	ñ	n	Presh mas	x	x	x	x	

Table 13.	Analyses	of variance.	X indicates	significant	differences	(5%error	estimation)	in pairwi	se compari-
	son.								

Table 14. Analyses of variance. X indicates significant differences (5% error estimation) in pairwise comparison.

Lower mola	length	L				Lower preme	olar len	gth			
P(F) between Homogeneity	groups : of varian	= .000 .ces P(F	`) = .000	)		P(F) between groups = .000 Homogeneity of variances $P(F)$ =			) = .000	)	_
Student-Newn	nan-Keul	ls test				Student-Newn	1an-Keul	ls test			
	Р	Р	М	М	Р		М	Р	М	Р	Р
	r	r	e	e	r		е	r	e	r	r
	0	ο	S	S	e		S	0	S	е	0
	m	f	f	m	m		f	f	m	f	m
Procl.mas.						Mesop.fem.					
Procl.fem.	0					Procl.fem.	0				
Mesop.fem.	0	0				Mesop.mas.	0	0			
Mesop.mas.	0	0	0			Presb.fem.	Х	Х	Х		
Presb.mas.	Х	Х	Х	Х		Procl.mas.	Х	Х	Х	0	
Presb.fem.	Х	Х	Х	х	0	Presb.mas.	Х	Х	х	Х	Х

	Рго	colobus	Pres	bytis	Mesop	ithecus
	male	female	male	female	male	female
Cranial measurements						
Basion-prosthion	798	1 264	1 174	011	2 700	1 000
Nasion-prosthion	-1 204	-1.652	1.174	.911	2.100	1.992
Interorbital width	-1.254	-1.032	-1.031	-2.172	-3.287	-3.240
Deletine breedth	-2.820	-4.304	-3.809	-5.205	-1.257	-7.971
Croital rim thickness	3.921	4.000	0.131	1.101	0.122 0.471	6.037
Need width	4.790	-3.062	-1.112	-3.203	-2.4/1	-2.389
Malar promoler les eth	040	.104	-2.410	-3.190	.180	.247
Molar-premolar length	2.201	2.021	2.312	2.821	2.164	3.037
Constant	-103.752	-92.252	-133.443	-144.413	-141.620	-133.783
Mandibular measurements						
Symphysal width	.723	188	930	-1.555	642	804
Chin height	1.704	1.647	1.268	.860	.090	- 434
Corpus height	.703	.053	1.474	1.246	3,039	2 104
Mandibular angle	2.174	1 745	2 250	1 975	2 204	1 731
Chin angle	5 488	5 032	5 762	5 4 4 9	6 126	5 885
Molar-premolar length	-3 155	-5 741	-4 170	-5 945	-6.054	-6.664
Molar length	13 888	19 514	18 281	22 613	20.623	23.030
Constant	-318.442	-283.618	-367.957	-353.751	-376.040	-349.213
Maxillary teeth measurement	s					
Length central incisor	4.666	8.999	-5.128	-4.949	791	-2.460
Length lateral incisor	3.773	3.369	10.991	13.498	8.584	11.248
Length canine	7.926	.500	5.469	282	4.927	.636
Lenght first premolar	-12.550	-6.163	-12.529	-7.987	-12.350	-9.925
Breadth first premolar	3.669	4.438	5.681	8.062	3.793	6.035
Breadth first molar	11.376	10.694	5.796	4.904	10.471	9.859
Breadth second molar	20.030	12.850	33.516	33.256	33.689	35.652
Length third molar	7.576	7.326	7.695	9.312	4.811	5.469
Breadth third molar	-13.273	-7.072	-11.640	-13.074	-14.924	-17.138
Constant	-121.791	-107.401	-165.597	-164.619	-148.572	-144.809
··· ···						
Mandibular teeth measureme	nts					
Length central incisor	13.482	11.223	3.247	.946	116	.343
Length canine	10.158	1.066	3.962	-5.048	.875	-5.327
Length first premolar	1.704	-2.066	-1.054	-4.167	-4.104	-4.472
Breadth first premolar	-7.394	-10.672	-5.176	-10.114	-9.367	-10.202
Length second premolar	-1.134	5.045	4.606	11.057	8.776	10.702
Breadth second premolar	9.835	11.398	4.519	5.348	.417	5.969
Length first molar	16.991	19.824	17.486	17.665	13.751	14.489
Breadth second molar	5.062	5.939	11.559	12.877	14.658	11.213
Length third molar	-1.665	-1.098	.828	3.230	1.666	2.728
Breadth third molar	-10.948	-2.422	-2.019	6.198	7.227	9.286

Table 15. Discriminant analyses. Classification function coefficients using Fisher's linear discriminant functions.

# Table 16. Discriminant analyses between sexes. Significance of variables between sexes after stepwise variable selection.

$\lambda$ P(\lambda) $\lambda$ P(\lambda)Mandibular conservementsGranial measurementsMandibular measurementsBasion-prosition.355.000Chin height.269.000Orbital rim thickness.275.000Mandibular angle.195.000Orbital rim thickness.275.000Mandibular angle.195.000Maxillar teeth measurements.131.000Symphysal width.124.000Length first molar.235.000Length lateral incisor.181.000Length first molar.235.000Length second molar.126.000Length second molar.220.000Length second molar.126.000Presbytis entellusCranial measurements.011Symphysal width.391.000Palatine breadth.688.011Symphysal width.206.000Interorbital rim thickness.733.000Molar length.275.000Interorbital width.208.000Molar length.266.000Maxillar teeth measurements.000Molar length.356.000Canine length.437.000Breadth first premolar.118.000Length second premolar.133.000Canine length.366.000Length third molar.133.000Canine length.366.000Length first premolar.131.000 <th></th> <th>Wilks'</th> <th></th> <th></th> <th>Wilks'</th> <th></th>		Wilks'			Wilks'	
Mesopithecus pentelicus   Mandibular measurements     Cranial measurements   .355   .000   Chin height   .269   .000     Orbital rim thickness   .275   .000   Chin height   .160   .000     Maxillar teeth measurements   .000   Carine length   .143   .000     Canine length   .352   .000   Mandibular teeth measurements   .000     Ength first premolar   .306   .000   Length histeral incisor   .181   .000     Breadth first premolar   .259   .000   Length first molar   .262   .000     Length first molar   .220   .000   Length second molar   .263   .000     Presbytis entellus   .268   .000   Mandibular measurements   .000     Dribtal rim thickness   .733   .006   Chin angle   .671   .002     Palatine breadth   .688   .011   Symphysal width   .311   .000     Maxillar teeth measurements   .000   Mandibular teeth measurements   .000   Mardibular teeth measurements   .000     Canine length   .437   .000   Canine length		λ	$P(\lambda)$		λ	Ρ(λ)
Mactional and the second premolar   Mandibular measurements     Basion-prosthion   .355   .000   Chin height   .269   .000     Orbital rim thickness   .275   .000   Mandibular angle   .195   .000     Maxillar teeth measurements   .275   .000   Mandibular angle   .160   .000     Maxillar teeth measurements   .352   .000   Canine length   .143   .000     Length first premolar   .352   .000   Dength first measurements   .000   Length first measurements   .000     Length first molar   .259   .000   Breadth first premolar   .153   .000     Length second molar   .220   .000   Length second molar   .126   .000     Length second molar   .226   .000   Length second molar   .18   .000     Presbytis entellus   Cranial measurements   .001   Symphysal width   .391   .000     Mandibular teeth measurements   .000   Molar-premolar   .266   .000     Mardibular teeth measurements   .000   Mandibular teeth measurements   .000     Crania length <td< td=""><td>Maganithagua nantaligua</td><td></td><td></td><td></td><td></td><td></td></td<>	Maganithagua nantaligua					
Cranial measurementsMandibular measurementsBasion-prosthion.335.000Chin height.269.000Orbital rin thickness.275.000Mandibular angle.195.000Corpus height.160.000Corpus height.143.000Symphysal width.124.000Symphysal width.124.000Maxillar teeth measurements.352.000Length first premolar.252.000Length first premolar.356.000Length second molar.252.000Length first molar.235.000Length second molar.252.000Length second molar.220.000Length second molar.252.000Length second molar.220.000Length second molar.252.000Presbytis entellusCranial measurements.000Mandibular measurements.000Orbital rin thickness.733.006Chin angle.671.002Palatine breadth.688.011Symphysal width.391.000Basion-prosthion.258.000Molar greenolar length.206.000Mardibular teeth measurementsCanine length.356.000Length third molar.201.000Breadth first premolar.110.000Length second premolar.101.000Breadth first premolar.126.000Length third molar.133.000Length first premolar.126.000Length third	Mesophnecus pentencus					
Basion-prosthion     .355     .000     Chin height     .269     .000       Orbital rim thickness     .275     .000     Mandibular angle     .195     .000       Maxillar teeth measurements     .275     .000     Mandibular angle     .195     .000       Carine length     .143     .000     Molat-premolar length     .143     .000       Canine length     .352     .000     Length first pemolar     .252     .000       Length first molar     .259     .000     Breadth first premolar     .153     .000       Length second molar     .220     .000     Length second molar     .126     .000       Presbytis entellus     .733     .006     Chin angle     .671     .002       Orbital rim thickness     .733     .006     Symphysal width     .391     .000       Maxillar teeth measurements     .000     Molat-premolar length     .265     .000       Mandibular teeth measurements     .000     Mandibular teeth measurements     .000       Canine length     .437     .000     Eareth third molar<	Cranial measurements			Mandibular measureme	ents	
Orbital rim thickness     .275     .000     Mandibular angle     .195     .000       Maxillar teeth measurements	Basion-prosthion	.355	.000	Chin height	.269	.000
Corpus height.160.000Maxillar teeth measurements.000Canine length.352.000Length first premolar.306.000Length first molar.259.000Breadth first molar.253.000Length first molar.235.000Length first molar.235.000Length first molar.235.000Length first molar.220.000Length second molar.126.000Length second molar.126.000Length second molar.126.000Length second premolar.118.000Presbytis entellus	Orbital rim thickness	.275	.000	Mandibular angle	.195	.000
Molar-premolar length1.43.000 Symphysal widthMaxillar teeth measurements.000Canine length.352.000Length first premolar.306.000Length first molar.259.000Breadth first molar.235.000Length first molar.235.000Length first molar.220.000Length second molar.126.000Length second molar.126.000Length second molar.118.000Presbytis entellus				Corpus height	.160	.000
Maxillar teeth measurementsSymphysal width.124.000Canine length.352.000Canine length.252.000Length first premolar.306.000Length lateral incisor.181.000Length first molar.235.000Length first premolar.153.000Length second molar.220.000Length second molar.126.000Length second molar.220.000Length second molar.118.000Presbytis entellusCranial measurementsMandibular measurementsOrbital rim thickness.733.006Chin angle.671.002Palatine breadth.688.011Symphysal width.391.000Basion-prosthion.258.000Molar length.206.000Maxillar teeth measurements.000Marillular teeth measurements.000Canine length.437.000Canine length.356.000Length hird molar.201.000Breadth first premolar.110.000Length second premolar.110.000Length first premolar.101.000Length second premolar.124.000Chin angle.343.000Length hird molar.133.000Corpus height.446.000Maxillar teeth measurements.000Corpus height.446.000Mariliar teeth measurements.000Corpus height.446.000Cranial measurements				Molar-premolar length	.143	.000
Maxillar teeth measurements   Mandibular teeth measurements     Canine length   .352   .000   Canine length   .252   .000     Breadth first premolar   .335   .000   Length lateral incisor   .181   .000     Breadth first molar   .253   .000   Length second molar   .126   .000     Length first molar   .220   .000   Length second molar   .18   .000     Cranial measurements   Mandibular measurements   .000   Length second premolar   .118   .000     Palatine breadth   .688   .011   Symphysal width   .391   .000     Basion-prosthion   .258   .000   Molar-premolar length   .266   .000     Maxillar teeth measurements   Mandibular measurements   .000   Mandibular teeth measurements   .000     Canine length   .437   .000   Breadth first premolar   .126   .000     Length hascond premolar   .170   .000   Breadth first premolar   .126   .000     Length hascond molar   .100   .000   Breadth first premolar   .126   .000     Length hascond mo				Symphysal width	.124	.000
Canine length     .352     .000     Canine length     .252     .000       Length first premolar     .306     .000     Breadth first premolar     .181     .000       Length first molar     .259     .000     Breadth first premolar     .183     .000       Length second molar     .226     .000     Length second molar     .126     .000       Length second molar     .220     .000     Length second molar     .118     .000       Presbytis entellus	Maxillar teeth measurements			Mandibular teeth meas	urements	
Length first premolar   .306   .000   Length lateral incisor   .181   .000     Breadth first molar   .255   .000   Breadth first premolar   .153   .000     Length first molar   .225   .000   Length second molar   .126   .000     Length first molar   .220   .000   Length second premolar   .118   .000     Presbytis entellus   .220   .000   Length second premolar   .118   .000     Cranial measurements   .220   .000   Length second premolar   .011   .002     Palatine breadth   .688   .011   Symphysal width   .391   .000     Basion-prosthion   .286   .000   Molar length   .287   .000     Mardibular measurements   .206   .000   Mardibular teeth measurements   .000     Canine length   .437   .000   Canine length   .356   .000     Length second premolar   .170   .000   Length first premolar   .110   .000     Length hird molar   .120   .000   Length first premolar   .126   .000     Le	Canine length	.352	.000	Canine length	.252	.000
Breadth first molar     259     .000     Breadth first premolar     .153     .000       Length second molar     .235     .000     Length second molar     .126     .000       Length second molar     .220     .000     Length second molar     .118     .000       Presbytis entellus     .000     Length second premolar     .118     .000       Orbital rim thickness     .733     .006     Chin angle     .671     .002       Palatine breadth     .688     .011     Symphysal width     .391     .000       Interorbital width     .208     .000     Molar length     .287     .000       Maxillar teeth measurements     .000     Mandibular teeth measurements     .000     Mandibular teeth measurements     .000       Length second premolar     .170     .000     Breadth first premolar     .126     .000       Length second molar     .101     .000     Length lateral incisor     .084     .000       Length second molar     .101     .000     Length first premolar     .110     .000       Length second mola	Length first premolar	.306	.000	Length lateral incisor	.181	.000
Length first molar   235   .000   Length second molar   .126   .000     Length second molar   .220   .000   Length second molar   .118   .000     Presbytis entellus     Cranial measurements   .671   .002     Palatine breadth   .688   .011   Symphysal width   .391   .000     Basion-prosthion   .258   .000   Molar length   .287   .000     Mandibular measurements   .208   .000   Molar-premolar length   .266   .000     Maxillar teeth measurements   .000   Canine length   .356   .000     Length second premolar   .110   .000   Breadth first premolar   .110   .000     Length second premolar   .110   .000   Breadth first premolar   .110   .000     Length second premolar   .110   .000   Length first premolar   .110   .000     Length second premolar   .110   .000   Length second molar   .110   .000     Length second premolar   .101   .000   Length first premolar   .126   .000     Le	Breadth first molar	.259	.000	Breadth first premolar	.153	.000
Length second premolar   .118   .000     Presbytis entellus   .733   .006   Chin angle   .671   .002     Orbital rim thickness   .733   .006   Chin angle   .671   .002     Basion-prosthion   .258   .000   Molar length   .287   .000     Maxillar teeth measurements   .000   Mandibular teeth measurements   .000     Canine length   .437   .000   Canine length   .356   .000     Length second premolar   .110   .000   Breadth third molar   .188   .000     Length second premolar   .110   .000   Breadth third molar   .188   .000     Length second premolar   .110   .000   Breadth first premolar   .101   .000     Brocolobus badius   .110   .000   Length lateral incisor   .084   .000     Procolobus badius   .110   .000   Corpus height   .446   .000     Procolobus badius   .110   .000   Corpus height   .446   .000     Nasal width   .107   .000   Chin angle   .343   .000	Length first molar	.235	.000	Length second molar	.126	.000
Presbytis entellus     Mandibular measurements     Orbital im thickness   .733   .006   Chin angle   .671   .002     Palatine breadth   .688   .011   Symphysal width   .391   .000     Basion-prosthion   .258   .000   Molar length   .287   .000     Interorbital width   .208   .000   Molar-prenolar length   .206   .000     Maxillar teeth measurements   Mandibular teeth measurements   .000   Canine length   .356   .000     Length third molar   .201   .000   Breadth third molar   .126   .000     Length second premolar   .170   .000   Length first premolar   .126   .000     Length second molar   .101   .000   Length second molar   .101   .000     Procolobus badius   Cranial measurements   Mandibular measurements   .000   .000   .000     Practil measurements   .133   .000   Corpus height   .446   .000     Palatine breadth   .120   .000   Chin angle   .343   .000     Nasal width </td <td>Length second molar</td> <td>.220</td> <td>.000</td> <td>Length second premolar</td> <td>.118</td> <td>.000</td>	Length second molar	.220	.000	Length second premolar	.118	.000
Presbytis entellus     Mandibular measurements     Orbital rim thickness   .733   .006   Chin angle   .671   .002     Palatine breadth   .688   .011   Symphysal width   .391   .000     Basion-prosthion   .258   .000   Molar length   .287   .000     Interorbital width   .208   .000   Molar length   .287   .000     Maxillar teeth measurements   Canine length   .266   .000     Canine length   .437   .000   Canine length   .356   .000     Length second premolar   .170   .000   Breadth first premolar   .126   .000     Breadth first premolar   .126   .000   Breadth first premolar   .126   .000     Length second molar   .101   .000   Length first premolar   .101   .000     Procolobus badius   Cranial measurements   Mandibular measurements   .000   .000   .000     Nasal width   .107   .000   Chin angle   .343   .000     Nasal width   .107   .000   Mandibular measuremen						
Cranial measurements     Mandibular measurements       Orbital rim thickness     .733     .006     Chin angle     .671     .002       Palatine breadth     .688     .011     Symphysal width     .391     .000       Basion-prosthion     .258     .000     Molar length     .287     .000       Mardibular teeth measurements     Mandibular teeth measurements     .000     Mandibular teeth measurements     .000       Canine length     .437     .000     Canine length     .356     .000       Length second premolar     .170     .000     Breadth first premolar     .126     .000       Length second premolar     .170     .000     Length first premolar     .101     .000       Procolobus badius      .000     Corpus height     .446     .000       Vial rim thickness     .133     .000     Corpus height     .446     .000       Palatine breadth     .120     .000     Chin angle     .343     .000       Nasal width     .107     .000     Mandibular angle     .279     .000	Presbytis entellus					
Orbital rim thickness   .733   .006   Chin angle   .671   .002     Palatine breadth   .688   .011   Symphysal width   .331   .000     Basion-prosthion   .258   .000   Molar length   .287   .000     Interorbital width   .208   .000   Molar-premolar length   .206   .000     Maxillar teeth measurements   Mandibular teeth measurements   .000   Breadth third molar   .188   .000     Length third molar   .201   .000   Breadth third molar   .188   .000     Length second premolar   .170   .000   Length first premolar   .126   .000     Length second molar   .110   .000   Length first premolar   .101   .000     Verschlause   .133   .000   Corpus height   .446   .000     Palatine breadth   .120   .000   Chin angle   .343   .000     Nasal width   .107   .000   Chin angle   .343   .000     Nasal width   .107   .000   Mandibular angle   .217   .000     Machibular teeth measurem	Cranial measurements			Mandibular measureme	ents	
Palatine breadth   .688   .011   Symphysal width   .391   .000     Basion-prosthion   .258   .000   Molar-length   .287   .000     Interorbital width   .208   .000   Molar-premolar length   .206   .000     Maxillar teeth measurements   Mandibular teeth measurements   Canine length   .356   .000     Length third molar   .201   .000   Breadth third molar   .188   .000     Length second premolar   .170   .000   Length first premolar   .110   .000     Breadth first premolar   .101   .000   Breadth first premolar   .001   .000     Procolobus badius   Carpus height   .446   .000     Cranial measurements   Mandibular measurements   .000     Orbital rim thickness   .133   .000   Chin angle   .343   .000     Nasal width   .107   .000   Mandibular angle   .279   .000     Maxillar teeth measurements   Mandibular angle   .279   .000   Molar-length   .149   .000     Nasal width   .107   .000   Mandibu	Orbital rim thickness	.733	.006	Chin angle	.671	.002
Basion-prosthion.258.000Molar length.287.000Interorbital width.208.000Molar-premolar length.206.000Maxillar teeth measurements.437.000Canine length.356.000Length third molar.201.000Breadth third molar.188.000Length second premolar.170.000Length first premolar.126.000Maxillar teeth measurements.170.000Length first premolar.126.000Length second premolar.170.000Length first premolar.101.000Breadth first premolar.101.000Length lateral incisor.084.000Procolobus badiusCranial measurements.133.000Corpus height.446.000Palatine breadth.120.000Mandibular measurements.217.000Nasal width.107.000Mandibular angle.279.000Maxillar teeth measurementsCanine length.149.000Chin height.136.000.000.2217.000Maxillar teeth measurementsCanine length.149.000Chin height.216.000Chin height.202.000Length first premolar.159.000Length lateral incisor.078.000Maxillar teeth measurements.202.000Length lateral incisor.078.000Breadth first premolar.101.000Leng	Palatine breadth	.688	.011	Symphysal width	.391	.000
Interorbital width   .208   .000   Molar-premolar length   .206   .000     Maxillar teeth measurements   .437   .000   Canine length   .356   .000     Length third molar   .201   .000   Breadth third molar   .188   .000     Length second premolar   .170   .000   Length first premolar   .126   .000     Breadth first premolar   .101   .000   Breadth first premolar   .101   .000     Procolobus badius   .133   .000   Corpus height   .446   .000     Platine breadth   .120   .000   Mandibular measurements   .000     Nasal width   .107   .000   Mandibular angle   .279   .000     Maxillar teeth measurements   .133   .000   Chin angle   .343   .000     Nasal width   .107   .000   Mandibular angle   .217   .000     Maxillar teeth measurements   Mandibular teeth measurements   .000   Molar-premolar length   .149   .000     Maxillar teeth measurements   .136   .000   Canine length   .202   .000 <tr< td=""><td>Basion-prosthion</td><td>.258</td><td>.000</td><td>Molar length</td><td>.287</td><td>.000</td></tr<>	Basion-prosthion	.258	.000	Molar length	.287	.000
Maxillar teeth measurementsMandibular teeth measurementsCanine length.437.000Canine length.356.000Length third molar.201.000Breadth third molar.188.000Length second premolar.170.000Length first premolar.126.000Length second molar.110.000Breadth first premolar.110.000Breadth first premolar.101.000Length first premolar.001Procolobus badius	Interorbital width	.208	.000	Molar-premolar length	.206	.000
Canine length.437.000Canine length.356.000Length third molar.201.000Breadth third molar.188.000Length second premolar.170.000Length first premolar.126.000Length second molar.110.000Breadth first premolar.101.000Breadth first premolar.101.000Length lateral incisor.084.000Procolobus badiusCranial measurements.133.000Corpus height.446.000Palatine breadth.120.000Chin angle.343.000Nasal width.107.000Mandibular angle.279.000Maxillar teeth measurements.101.000Molar length.217.000Maxillar teeth measurements.159.000Length second premolar.101.000Breadth first premolar.124.000Length second premolar.101.000Breadth first premolar.159.000Length second premolar.011.000Breadth first molar.101.000Length lateral incisor.078.000Breadth first molar.087.000Length first premolar.056.000Breadth second premolar.080.000Breadth first premolar.056.000	Maxillar teeth measurements			Mandibular teeth meas	urements	
Length third molar.201.000Breadth third molar.188.000Length second premolar.170.000Length first premolar.126.000Length second molar.110.000Breadth first premolar.110.000Breadth first premolar.101.000Breadth first premolar.001Procolobus badius	Canine length	.437	.000	Canine length	.356	.000
Length second premolar.170.000Length first premolar.126.000Length second molar.110.000Breadth first premolar.101.000Breadth first premolar.101.000Length lateral incisor.084.000Procolobus badiusCranial measurementsMandibular measurementsOrbital rim thickness.133.000Corpus height.446.000Palatine breadth.120.000Chin angle.343.000Nasal width.107.000Mandibular angle.279.000Maxillar teeth measurements.116.000Chin height.136.000Maxillar teeth measurements.1216.000Canine length.149.000Canine length.216.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Breadth first molar.087.000Length first premolar.056.000Breadth second premolar.070.000	Length third molar	.201	.000	Breadth third molar	.188	.000
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Breadth first premolar.101.000Length lateral incisor.084.000Procolobus badiusCranial measurementsOrbital rim thickness.133.000Corpus height.446.000Palatine breadth.120.000Chin angle.343.000Nasal width.107.000Mandibular angle.279.000Maxillar teeth measurements.107.000Molar-premolar length.149.000Maxillar teeth measurements.159.000Canine length.202.000Length first premolar.159.000Length lateral incisor.078.000Breadth first molar.101.000Length first premolar.056.000Breadth first molar.080.000Length first premolar.056.000				Length second molar	.110	.000
Length lateral incisor.084.000Procolobus badiusCranial measurementsMandibular measurementsOrbital rim thickness.133.000Corpus height.446.000Palatine breadth.120.000Chin angle.343.000Nasal width.107.000Mandibular angle.279.000Molar length.217.000Molar length.117.000Molar length.116.000Chin height.136.000Maxillar teeth measurementsMandibular teeth measurementsCanine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first molar.101.000Length first premolar.056.000Breadth first molar.080.000Breadth first premolar.056.000Breadth first molar.070.000.000				Breadth first premolar	.101	.000
Procolobus badiusCranial measurementsMandibular measurementsOrbital rim thickness.133.000Corpus height.446.000Palatine breadth.120.000Chin angle.343.000Nasal width.107.000Mandibular angle.279.000Molar length.217.000Molar length.149.000Maxillar teeth measurementsMandibular teeth measurements.000Chin height.136.000Maxillar teeth measurements.216.000Canine length.202.000.000Length first premolar.159.000Length second premolar.101.000.000.000Breadth first molar.087.000Length first premolar.056.000.000Breadth first molar.080.000.000.000.000.000.000				Length lateral incisor	.084	.000
Procolobus badiusCranial measurementsMandibular measurementsOrbital rim thickness.133.000Corpus height.446.000Palatine breadth.120.000Chin angle.343.000Nasal width.107.000Mandibular angle.279.000Molar length.217.000Molar-premolar length.149.000Canine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first molar.087.000Length first premolar.056.000Breadth first molar.080.000.000						
Cranial measurementsMandibular measurementsOrbital rim thickness.133.000Corpus height.446.000Palatine breadth.120.000Chin angle.343.000Nasal width.107.000Mandibular angle.279.000Molar length.217.000Molar-premolar length.149.000Chin height.136.000Chin height.136.000Maxillar teeth measurementsMandibular teeth measurements.136.000Canine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first molar.101.000Length first premolar.070.000Breadth first molar.080.000	Procolobus badius					
Orbital rim thickness   .133   .000   Corpus height   .446   .000     Palatine breadth   .120   .000   Chin angle   .343   .000     Nasal width   .107   .000   Mandibular angle   .279   .000     Molar length   .217   .000     Molar-premolar length   .149   .000     Canine length   .216   .000   Canine length   .202   .000     Length first premolar   .159   .000   Length second premolar   .101   .000     Breadth first molar   .101   .000   Length first premolar   .078   .000     Breadth first molar   .087   .000   Length first premolar   .056   .000     Breadth first molar   .080   .000   Length first premolar   .056   .000	Cranial measurements			Mandibular measureme	ents	
Palatine breadth   .120   .000   Chin angle   .343   .000     Nasal width   .107   .000   Mandibular angle   .279   .000     Molar length   .217   .000     Molar-premolar length   .149   .000     Chin height   .136   .000     Maxillar teeth measurements   Mandibular teeth measurements     Canine length   .216   .000   Canine length   .202   .000     Length first premolar   .159   .000   Length second premolar   .101   .000     Breadth first premolar   .124   .000   Length first premolar   .056   .000     Breadth second molar   .087   .000   Length first premolar   .056   .000     Breadth first molar   .080   .000   Length first premolar   .056   .000     Breadth first molar   .070   .000   Length first premolar   .056   .000	Orbital rim thickness	.133	.000	Corpus height	.446	.000
Nasal width.107.000Mandibular angle.279.000Molar length.217.000Molar-premolar length.149.000Chin height.136.000Maxillar teeth measurementsMandibular teeth measurementsCanine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Breadth second molar.087.000Length first premolar.056.000Breadth first molar.080.000.000	Palatine breadth	.120	.000	Chin angle	.343	.000
Molar length.217.000Molar-premolar length.149.000Chin height.136.000Chin height.136.000Mandibular teeth measurementsMandibular teeth measurementsCanine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Breadth second molar.087.000.000.000.000Breadth first molar.080.000.000.000.000	Nasal width	.107	.000	Mandibular angle	.279	.000
Molar-premolar length.149.000Maxillar teeth measurements.136.000Mandibular teeth measurementsMandibular teeth measurementsCanine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Length first molar.087.000Length first premolar.056.000Breadth first molar.080.000.000				Molar length	.217	.000
Maxillar teeth measurementsChin height.136.000Mandibular teeth measurementsCanine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Length first molar.101.000Length first premolar.056.000Breadth first molar.087.000.000.000.000Breadth second premolar.070.000.000.000				Molar-premolar length	.149	.000
Maxillar teeth measurementsMandibular teeth measurementsCanine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Length first molar.101.000Length first premolar.056.000Breadth first molar.087.000.000				Chin height	.136	.000
Canine length.216.000Canine length.202.000Length first premolar.159.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Length first molar.101.000Length first premolar.056.000Breadth second molar.087.000.000.000.000Breadth second premolar.070.000.000.000	Maxillar teeth measurements			Mandibular teeth meas	urements	
Length first premolar.159.000Length second premolar.101.000Breadth first premolar.124.000Length lateral incisor.078.000Length first molar.101.000Length first premolar.056.000Breadth second molar.087.000.000.000.000Breadth second premolar.070.000.000.000	Canine length	.216	.000	Canine length	.202	.000
Breadth first premolar.124.000Length lateral incisor.078.000Length first molar.101.000Length first premolar.056.000Breadth second molar.087.000.000.000.000Breadth second premolar.070.000.000.000	Length first premolar	.159	.000	Lenght second premolar	.101	.000
Length first molar.101.000Length first premolar.056.000Breadth second molar.087.000Breadth first molar.080.000Breadth second premolar.070.000	Breadth first premolar	.124	.000	Length lateral incisor	.078	.000
Breadth second molar.087.000Breadth first molar.080.000Breadth second premolar.070.000	Length first molar	.101	.000	Length first premolar	.056	.000
Breadth first molar.080.000Breadth second premolar.070.000	Breadth second molar	.087	.000			
Breadth second premolar .070 .000	Breadth first molar	.080	.000			
	Breadth second premolar	.070	.000			

Table 17. Generalized	distances	between	groups
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	Procolobus		Presbytis		Mesopithecus	
	male	female	male	female	male	female
Cranial manufamenta						
Drasalahua mala	0					
Procolobus male	25.94	0				
Procolodus lemale	20.04	0 12	0			
Presbytis male	20.42	20.13	0 80	0		
Mesopitheeus male	JJ.90 45.07	33.00	9.09	52 52	0	
Mesopithecus famale	40.91	04.72 91 / 9	36.30	24 92	11 40	0
Mesoprinecus remaie	00.10	31.43	30.32	34.03	11.49	
Mandibular measurements						
Procolohus male	0					
Procolobus female	25 25	0				
Presbytis male	16 44	23 16	0			
Presbytis female	44 79	17 11	12 79	0		
Mesonithecus male	32.87	33 64	11.75	18 74	Ο	
Mesopithecus female	55.44	26.18	27.85	13.58	12.88	0
				20100		
Maxillar teeth measurements						
Procolobus male	0					
Procolobus female	97.84	0				
Presbytis male	91.45	176.29	0			
Presbytis female	205.55	152.37	61 61	0		
Mesonithecus male	46.69	81.40	15.48	42.85	0	
Mesopithecus female	141.69	108.69	64.32	31.03	20.63	0
Mandibular teeth measurements						
Procolobus male	0					
Procolobus female	112.28	0				
Presbytis male	102.76	84.16	0			
Presbytis female	304.55	92.47	100.92	0		
Mesopithecus male	194.92	82.19	51.67	38.61	0	
Mesopithecus female	307.33	86.98	123.13	12.59	33.26	0

#### PLATE 1.

Complete skulls of selected colobine monkeys. Magnification 0.85 X.

Fig. 1. Procolobus badius, male. Coll. Grauer, Naturhistorisches Museum, Wien.

- Fig. 2. Procolobus badius, female. Coll. Grauer, Naturhistorisches Museum, Wien.
- Fig. 3. Presbytis entellus, male. Zoologische Staatssammlung, München.

Fig. 4. Presbytis entellus, female. Zoologische Staatssammlung, München.

Fig. 5. Mesopithecus pentelicus, male. Naturhistorisches Museum, Wien.

Fig. 6. Mesopithecus pentelicus, female. University of Athens, Greece.

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Zeitschrift/Journal: Beiträge zur Paläontologie

Jahr/Year: 1990

Band/Volume: 16

Autor(en)/Author(s): Hohenegger Johann, Zapfe Helmuth [Helmut]

Artikel/Article: Craniometric investigations on Mesopithecus in comparison with two recent colobines 111-143