QUATERNARY LANGURS AND MACAQUES FROM THE MALAY ARCHIPELAGO

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(with pls. I-II)

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INTRODUCTION

The subfossil and fossil remains of monkeys dealt with in the present paper originate from limestone caves in the Padang Highlands, Central Sumatra, as well as from Pleistocene and cave deposits in the island of Java. The Sumatran caves were explored by Eug. Dubois in the years 1888-1890; the fauna is characterized by the relative abundance of orang-utan (well over 3000 teeth: Hooijer, 1948b), and contains no extinct species. The cave teeth

differ from their homologues in recent skulls of the same species only by their greater average size, and the difference in size proved to stand the statistical test in various cases [1]). Dubois (1891, p. 93) has referred the Sumatran cave fauna to the prehistoric portion of the Holocene; a post-Pleistocene age of the cave deposits is indeed most likely, for a few thousand years would suffice for the subspecific advance shown by a number of recent Sumatran species of mammals over their representatives in the caves. The Pleistocene fossils from Java were collected by Dubois in the early nineties; he also unearthed monkey material in various caves in that island.

Whereas the Sumatran cave collection of monkeys consists mainly of isolated teeth, and an occasional jaw fragment, the collections of monkeys from Java also comprise skulls, jaws, and partial limb bones. Dubois, who has never even mentioned the occurrence of monkeys in his Sumatran cave collection in any of his published works, has made only few references to the Pleistocene material from Java in his collection. In his reports to the Geological Survey ("Mijnwezen") he records finds of "*Cercocebus*" (Anonymus, 1891a, p. 12), of one or two unidentifiable monkeys (Anonymus, 1891b, p. 13), and of "*Semnopithecus*" (Anonymus, 1893a, p. 12; 1893b, p. 13). "*Semnopithecus*" and "*Macacus*" appear for once in a preliminary paper (Dubois, 1907, p. 455), but no reference to these fossil monkeys is found in any of Dubois's subsequent papers on the fossil mammalian fauna of Java. The monkeys from the cave deposits in Java have never been described either.

While all this material awaited description, various papers have been published that deal with fossil and prehistoric monkeys from Java. Deninger (1910) wrote a paper on a fossil mandible of a macaque from Saradan, Java, collected by Elbert, and Stremme (1911) described and figured an isolated molar from Trinil in the Selenka Expedition collection as "*Macacus* sp." Prehistoric monkeys from the Sampoeng cave in Java have been recorded by Dammerman (1934) as *Macaca* "*irus*" and "*Pithecus*" *pyrrhus*. The same two forms have been recorded from the Pleistocene of Java by Von Koenigswald (1940), who adds two more fossil species of *Macaca* provisionally designated as I and II. He further stated that Deninger's "*Inuus nemestrinus* L. mut. *saradana*" in reality belongs to *Macaca* "*irus*", and (mistakenly) notes that Stremme's Trinil macaque would be "*Pithecus*" *pyrrhus* (l.c., p. 64). Pleistocene teeth from fissure deposits in Java have recently been recorded as "*Macacus*" sp. (Badoux, 1959).

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1) This holds not only for the Primates, but also for rodents, carnivores, and ungulates; see Hooijer, 1960b, and references cited therein.

The Pleistocene monkey material collected by Dubois originates from various sites in Central Java (Bangle, Soember Kepoeh, Tegoean, Trinil), which are in the "Kendeng beds" of Dubois, the Djetis and Trinil beds of Von Koenigswald, the age of which is Middle Pleistocene (Hooijer, 1952, 1957). It will be described in the present paper under the headings *Presbytis, Trachypithecus,* and *Macaca,* respectively.

Before embarking upon the study of the fossil and prehistoric remains I have examined the skins, skulls, and skeletons of Southeastern Asiatic monkeys in the Leiden Museum (registered below as L.M.) and in the Zoological Museum at Amsterdam (A.M.). The outmoded nomenclature of most of the museum specimens has been brought up to date, and certain identifications had to be corrected. The series of specimens of each of the subspecies have been arranged according to age: infants (milk dentition), juveniles (M^1 erupted), subadults (M^2 erupted) and adults (M^3 erupted). Within the adult group, the sexes have been listed separately; there is a marked sexual dimorphism in the canines of the cercopithecids.

When checking the "*Semnopithecus*" skins from Deli, Northeastern Sumatra, in the Leiden Museum, it was found that they represent a distinct subspecies of *Presbytis aygula* (L.), which was duly described as new (Hooijer, 1948a). One further specimen of this subspecies is in the Museum of Comparative Zoölogy of Harvard University, where I found it in 1951: the skin and skull of an adult male collected in 1937 at Pematang Siantar, Northeastern Sumatra, by Mrs. Barbara Lawrence Cheville, who had put it aside for further study because it did not fit in with the descriptions of the then known forms of *Presbytis.* Skins and skulls of *Trachypithecus cristatus* (Raffles) from Banka and Billiton islands were examined in the U. S. National Museum, Washington, D.C., in 1950.

The following measurements have been taken throughout the series of monkey skulls:

Calvarium

1. Greatest length (prosthion-opisthocranion; nuchal crest, if any, not included).
2. Basal length (prosthion-basion).
3. Length of cranial cavity (from basion).
4. Greatest width of brain case.
5. Biorbital width.
6. Postorbital constriction.
7. Height of calvarium (projective height from basion to vertex, perpendicular to ear-eye horizon; exclusive of sagittal crest, if any).

Mandible

8. Total length (infradentale-gonioncaudale, but to condyle in *Macaca*).
9. Length of ramus ascendens.
10. Bicondylar width (across outer edges).
11. Height of symphysis.
12. Height of corpus mandibulae (a):
    between P_3 and P_4 (*Presbytis, Trachypithecus*)
    at middle of P_4 (*Macaca*)
13. Height of corpus mandibulae (b) at middle of M_3.
14. Height of ramus ascendens (from deepest point of incisura semilunaris to gonionventrale).

These measurements (in mm) will be indicated by the above numbers in the various tables of measurements throughout this work. I have further taken dental measurements, which are self-explanatory, and employed some statistics: n = the number of variates; R = range of variation; M = mean; σ = standard deviation; C = coefficient of variation. The standard deviation, σ, is $\sqrt{\frac{\Sigma e^2}{n-1}}$, in which e is the deviation of every single variate from the mean. The variation coefficient, C, is $\frac{\sigma \cdot 100}{M}$. The standard error $E_M = \frac{\sigma}{\sqrt{n}}$. Differences from the mean greater than two times the standard error are considered to have statistical significance. To determine whether the difference in average size between two series of variates has statistical significance one has to compute the standard error of the difference, $E_{diff.} = \sqrt{E_M^2 + E_M'^2}$. Differences between the means more than two times greater than the standard error of the difference may be considered statistically significant.

Order PRIMATES Linnaeus

Family CERCOPITHECIDAE Gray

Genus PRESBYTIS Eschscholtz

Presbytis melalophos (Raffles)

There are three subspecies of the present species in Western Central Sumatra, viz., *P. m. sumatrana* (Müller et Schlegel) (typical locality Mt. Ophir, or Goenoeng Talamau, 120 km N. of Padang), *P. m. melalophos* (Raffles) (Mt. Korinchi, or Indrapoera Peak, 125 km S.E. of Padang), and *P. m. ferruginea* (Schlegel) from Padang. Some notes on these are here given; the lists of material examined to which these notes refer begin on p. 12 of the present paper.

In *P. m. sumatrana* the upper parts of head, body, and tail are dark grey brown; the outer sides of the limbs are black. The forehead, throat, underparts of body and tail, and the inner sides of the limbs are buffy white. There is an erect tuft of hair on the head.

With the four skins from Mt. Ophir in the Leiden Museum answering to the above description (*sumatrana* nos. 1 and 4-6) there is also a mounted female skin (*sumatrana* no. 11) that has been described by Müller and Schlegel (1841, p. 74, pl. 10 bis fig. 2) as a distinct variety, *aurata*. The specimen is in bad condition and is very faded. There are bald spots on throat, right upper arm, and knees, while the greater part of the tail is deprived of hair. The colour is brownish-buff above, slightly lighter on the sides of the limbs, especially the hind limb which is cinnamon-buff on the outer side. The underparts are blackish brown, and there is a small dark spot on the crown.

Two perfect skins, of an adult female (*sumatrana* no. 13) and of a young male (*sumatrana* no. 3), respectively, are brighter coloured than the old female skin described above, but evidently represent the same colour phase as the latter. The adult female is from Mt. Ophir, and has been described by Robinson and Kloss (1919, p. 300) as having the same colour pattern as *P. m. melalophos* from Benkoelen and Mt. Korinchi except that it is a good deal paler. Since the specimen displays much less resemblance to the more richly coloured *P. m. ferruginea* from Padang, which Robinson and Kloss would expect to find in the neighbourhood of Mt. Ophir, they have left the specimen specifically unidentified.

The adult female from Mt. Ophir (*sumatrana* no. 13) as well as the young male from Talang Taloe (Ophir district, *sumatrana* no. 3) are brownish grey above, with a blackish crown. The brownish grey of the back is continued on the outer side of the fore limb and on the upper side of the tail. The forehead, throat, and outer side of hind limb down to the ankle are cinnamon-buff to pinkish-buff; the underparts of body and tail, and the inner sides of the limbs are whitish. The hands and feet, however, are blackish brown.

The disposition of colour in these specimens is exactly that found in *P. m. melalophos*. Of this form the Leiden Museum possesses a series of skins from Benkoelen, Mt. Korinchi, and Palembang. To an infant skin from Benkoelen (*melalophos* no. 3) and to two from Mt. Korinchi (*melalophos* nos. 1 and 2), as well as to an adult from Mt. Korinchi (*melalophos* no. 15) the above description can be even almost literally applied. The back and upper side of tail are of the same brownish grey colour, and the outer side of the fore limb is concolorous with the back, in contrast to the outer sides of thigh

and leg, which are lighter. The hands and feet, however, are not blackish brown in the Benkoelen and Mt. Korinchi specimens as they are in the three pale skins from Mt. Ophir (*sumatrana,* nos. 3, 11 and 13). On the contrary, in *melalophos* nos. 1-3 and 15 the feet are only a little darker than the outer side of the hind limbs, and are more like the fore limb and back in colour. This, it may be emphasized, is the only character by which the three pale Mt. Ophir skins can be distinguished from the four Benkoelen and Mt. Korinchi specimens.

Three adult skins from Palembang in S. Sumatra (*melalophos* nos. 10, 16 and 17) as well as one subadult (unlocalized: *melalophos* no. 5) have a brownish grey back and upper side of tail, and a blackish coronal tuft. Forehead, throat, and outer side of hind limb are buffy white, the outer side of the forearm, the hands and feet are cinnamon-buff, and not pigmented at all. In fact, these specimens are separable from the Benkoelen and Mt. Korinchi skins mentioned above only by their having still paler limbs. I can see no reason, however, for not referring them to *P. m. melalophos* just the same; the race described from Palembang by Pocock (1934, p. 916) and named *fluviatilis* by Chasen (1940, p. 76) is said to be paler still: buffy white or creamy buff on the back.

There is a fourth skin from Palembang in the Leiden Museum (*melalophos* no. 9), which differs from the other Palembang skins in having the back not coloured brownish grey: it is cinnamon-buff to pinkish-cinnamon all over the back, which is sparsely sprinkled with long, black hairs, over the tail (not bicoloured), the outer sides of the limbs, and the hands and feet. The hairs forming the median crest on the head are long and blackish distally between the ears; in the anterior portion of the crest they are cinnamon-buff, as is also a narrow streak on each side of the head from the brow to above the ear. The remainder of the head, the nape, throat, underparts, and inner sides of the limbs are white. The present specimen is rather peculiar because of its almost uniform colour and unblackened back. In the absence of any evidence as to its being a local race, however, I regard it as a colour variant of *P. m. melalophos,* the Palembang skins of which agree with it in the cinnamon-buff of forearm, hands, and feet,

We have got skins from Mt. Korinchi other than those recorded above, and these are deeper coloured. The grey-brown of the back found in *melalophos* nos. 1-3 and 15 is darker, tinged with red. The most conspicuous difference, however, is found in the colour of the outer sides of the limbs, especially of the thigh, which is not so pale as in the above-mentioned specimens but changes from cinnamon (*melalophos* no. 7) over orange-cinnamon (*melalophos* no. 14) into cinnamon-rufous (*melalophos* no. 6). The

hands and feet, again, are not blackish brown, as they are in the Mt. Ophir series; they are of the same colour as the outer sides of the limbs, or only a little darker. In their description of a series of skins from Mt. Korinchi, Robinson and Kloss (1918, p. 4/5) note that sometimes the hands and feet are darkened with blackish. One of the skins of their series (*melalophos* no. 8) is now in the Leiden Museum collection; the back is less blackened than that in *melalophos* nos. 6, 7 and 14, and the colour of the outer side of the hind limb is more rufous even than the corresponding part in *melalophos* no. 6. It is as reddish as the specimens from Padang which Schlegel (1876, p. 42) described as "*Semnopithecus ferrugineus*", and it is distinguishable only by its more blackened back.

From 45 km N. of Padang on the coast, Pariaman, originates an adult skin (*melalophos* no. 13) and that of an infant (*melalophos* no. 4), which agree with *P. m. melalophos* from Benkoelen and from Mt. Korinchi except in the colour of the back, which is pale rufous. In typical *P. m. ferruginea* [1]) the back is hardly or not overlaid with black; the animal is rufous or ferruginous all over the body except for the white underparts and inner sides of the limbs, and the black median crest on the head. As in *P. m. melalophos* the outer side of the arm may be slightly darker than that of the hind limb, but in most of the six specimens (*ferruginea* nos. 1, 5-7, 9 and 10) the red is so dominant that the back and fore limb are not different in colour from the hind limb. The hands and feet are not darker than the limbs. An extremely bright-coloured skin (*ferruginea* no. 4) unfortunately is not localized.

The Dutch Expedition to Central Sumatra in the years 1877 to 1878 brought back a series of langur skins collected by J. F. Snelleman. Although unfortunately the specimens are not exactly localized, we do know (Snelleman, 1887, p. 9/10) that they originate from four localities in the Padang Highlands, viz., Solok (35 km N.E. of Padang), Soepajang (47 km E.N.E. of Padang), Silago (100 km E.S.E. of Padang), and Loeboe Gedang (17 km N. of Mt. Korinchi, which is itself 125 km S.E. of Padang). At any rate, we may say that the specimens were collected at least 35 km inland from Padang, and 120 km in S.E. direction from Mt. Ophir, and N. of Mt. Korinchi, 100 km at most. From this area one would a priori expect to find specimens that intergrade between the three typical races from Padang in the West, Mt. Korinchi in the South, and Mt. Ophir in the North. This is borne out by the examination of the specimens, as follows.

The first of the four adult skins (*sumatrana* no. 9) is very much like *P. m.*

1) Chasen (1940, p. 76) placed *ferruginea* in the synonymy of *P. m. nobilis* (Gray, 1842, p. 256), which is bright rufous but with a blackish back. I agree with Robinson and Kloss (1918, p. 5) that *nobilis* is a synonym of *melalophos*.

melalophos, with the outer thigh orange-cinnamon and the back brownish grey. The hands and feet of the present specimen, however, are blackish brown as they are in the pale Mt. Ophir form which is only less reddish [1]).

The second skin (*sumatrana* no. 12) is almost exactly like the dark *P. m. sumatrana* from Mt. Ophir. The back and upper side of tail are of the same dark grey brown colour; the outer sides of the limbs, however, are concolorous with the back, and not black as in the Mt. Ophir form.

The third skin (*ferruginea* no. 14) is indistinguishable from *P. m. ferruginea* of Padang; the hands and feet are not blackened.

The fourth skin (*sumatrana* no. 8) resembles the first (*sumatrana* no. 9) in having blackish brown hands and feet. For the rest it cannot be distinguished from *P. m. melalophos* of Mt. Korinchi.

An infant skin collected by J. F. Snelleman in the Padang Highlands (*sumatrana* no. 2a) is buffy white and has a chestnut brown stripe on the back and upper side of tail.

There are two infant skins in the collection that differ widely from each other. The first (*sumatrana* no. 2b) is the suckling of the adult female listed as *sumatrana* no. 13, described by Robinson and Kloss (1919, p. 301); it is dull white except for a light brownish grey stripe along the back and upper side of tail, a similarly coloured patch on the head, and dark hairs on the fingers. The other (*ferruginea* no. 2) is dull white, too, but has a rufous coronal tuft and spinal stripe, slightly darkening toward the tip of the tail.

It is evident, therefore, that there is a zone of intergradation between the three subspecies *sumatrana, melalophos,* and *ferruginea,* doubtless due to interbreeding. I cannot but consider the dark and the pale Mt. Ophir forms to be colour phases of *P. m. sumatrana,* agreeing in their blackish brown hands and feet. This very character distinguishes the pale phase of Mt. Ophir from some otherwise similar specimens which come from Benkoelen and from Mt. Korinchi. The Palembang skins share their unblackened hands and feet with the Southern Padang Highlands and Benkoelen form, but differ from the latter in their paler limbs.

Some specimens from Mt. Korinchi and from the Padang Highlands (*sumatrana* nos. 8 and 9) intergrade between the brownish grey backed skins with buffy outer thigh from Mt. Korinchi and the almost uniformly reddish *P. m. ferruginea* from Padang. They were collected at least 120 km S.E. of Mt. Ophir, that is, half way between Mt. Ophir in the North, and Mt.

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1) As correctly observed by Chasen (1940, p. 73) in the hidden parts of the pelage of the faded "var. *aurata*" of Müller and Schlegel from Mt. Ophir there is a tinge of orange. It may have been redder, nearer to the orange-cinnamon of the Mt. Korinchi specimens in which, however, the feet are not blackish.

Korinchi in the South, and they have the characteristic blackish brown hands and feet of the Mt. Ophir form. The fact remains, however, that the specimens from Pariaman (*melalophos* nos. 4 and 13), further to the North than any of the localities of Snelleman's material although still 80 km S. of Mt. Ophir, have no trace of black on their hands and feet. This is a character they have in common with the Padang skins. In my opinion this difference should not be ignored; it constitutes the only difference between the pale Mt. Ophir form and that of Mt. Korinchi.

The colour of the hands and feet has been found to be of value, too, in discriminating between the races of *Presbytis rubicunda* (Müller): Chasen and Kloss (1931, p. 5) remark that the dark-footed animals occur in the Eastern half of Borneo, and the pale-footed in the Western parts of the island. In gibbons the colour of the hands and feet is likewise a valuable character: *Hylobates moloch mülleri* Martin from South-eastern and Central Borneo has black hands and feet (Schlegel, 1876, p. 21; Kloss, 1929, p. 120) in contradistinction to *Hylobates moloch abbotti* Kloss (1929, p. 119) from Western Borneo in which the hands and feet are not markedly darker than the adjoining parts of the limbs. Büttikofer (in Jentink, 1897, p. 34) collected skins of *Hylobates moloch* (Audebert) both at Roema Manoeal at the Southern foot of Mt. Kenepai in Western Borneo, and at Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo; the former belong to the pale-footed race whereas the latter represent the dark-footed race. Mt. Kenepai and Mt. Liang Koeboeng are not more than 160 km apart.

I have classed the Pariaman skins with *P.m. melalophos*, and the black-footed Padang Highlands skins with *P.m. sumatrana*. One of the Padang Highlands skins (*sumatrana* no. 12) is practically *sumatrana*, the outer sides of the limbs being only dark grey brown instead of black, thereby approaching the reddish form. Another Padang Highlands skin (*ferruginea* no. 14) is typically *ferruginea*, totally without black; it was collected at least 35 km inland from Padang, possibly at Loeboe Gedang which is near Mt. Korinchi.

Further notes on some of the subspecies of *Presbytis melalophos* are given under their headings.

Presbytis melalophos femoralis (Martin)

Material examined (labelled "*Semnopithecus neglectus*"):

Juveniles

1. Mounted skin and skull. Singapore, from Frank, 1869. L. M., cat. syst. c, cat. ost. b.
2. Mounted skin and skull. Singapore, coll. P. Diard, 1859. L.M., cat. syst. b, cat. ost. c.

Adult males

3. Mounted skin and skull. Singapore, from Frank, 1869. L.M., cat. syst. a, cat. ost. a.

Presbytis melalophos sumatrana (Müller et Schlegel)

Material examined (labelled "*Semnopithecus femoralis*" or "*S. melalophus*"):

Infants

1. Mounted skin and skull of female (cotype). Mt. Ophir, Central Sumatra, coll. L. Horner. L.M., "*S. femoralis*", cat. syst. d, cat. ost. e.
2a. Mounted skin and skeleton. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1878. L.M., "*S. melalophus*", cat. syst. m, cat. ost. o.
2b. Stuffed skin and skull of female. N. W. slope of Mt. Ophir, Central Sumatra, coll. E. Jacobson, 1-5-1917. L.M., reg. no. 1013.

Juveniles

3. Stuffed skin and skull of male. Talang Taloe, Ophir district, Central Sumatra, coll. E. Jacobson, May, 1915, received 1-6-1920. L.M., reg. no. 991.

Subadults

4. Mounted skin and skull of male (cotype). Mt. Ophir, Central Sumatra, coll. L. Horner. L.M., "*S. femoralis*", cat. syst. b, cat. ost. d.
5. Mounted skin and skeleton of female (cotype). Mt. Ophir, Central Sumatra, coll. L. Horner. L.M., "*S. femoralis*", cat. syst. c, cat. ost. a.

Adult males

6. Mounted skin and skull (cotype). Mt. Ophir, Central Sumatra, coll. L. Horner. L.M.,"*S. femoralis*", cat. syst. a, cat. ost. c.
7. Skull. Mt. Ophir, Central Sumatra, coll. L. Horner. L.M., "*S. femoralis*", cat. ost. f.
8. Mounted skin and skeleton (without the limbs). Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1877. L.M., "*S. melalophus*", cat. syst. l, cat. ost. c and g.
9. Mounted skin and skeleton. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1877. L.M., "*S. melalophus*", cat. syst. i, cat. ost. e.
10. Skull. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1877. L.M., "*S. melalophus*", cat. ost. h.

Adult females

11. Mounted skin and skeleton (cotype). Mt. Ophir, Central Sumatra, coll. L. Horner. L.M., "*S. femoralis*", cat. syst. e, cat. ost. b.
12. Mounted skin and skeleton (without skull and limbs). Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1877. L.M., "*S. melalophus*", cat. syst. j, cat. ost. b.
13. Stuffed skin and skull. N. W. slope of Mt. Ophir, Central Sumatra, coll. E. Jacobson, 1-5-1917. L.M., reg. no. 1013.

Presbytis melalophos melalophos (Raffles)

Material examined (labelled "*Semnopithecus melalophus*"):

Infants

1. Mounted skin and skull of female. Mt. Korinchi, Central Sumatra, from S. Müller, July, 1835. L.M., cat. syst. f.
2. Mounted skin and skull of female. Mt. Korinchi, Central Sumatra, from S. Müller, July, 1835. L.M., cat. syst. g.
3. Mounted skin and skull. Benkoelen, W. Sumatra, coll. G. F. Wienecke, 1865. L.M., cat. syst. h.
4. Stuffed skin and skull. Pariaman, 45 km N. of Padang, W. Sumatra, coll. F. von Faber, 1883. L.M., cat. syst. n.

Subadults

5. Flat skin and skeleton of male. From the Rotterdam Zoo, 4-12-1924. L.M., reg. no. 1363.

Adult males

6. Mounted skin and skull. Mt. Korinchi, Central Sumatra, from S. Müller, July, 1835. L.M., cat. syst. b.
7. Mounted skin and skull. Mt. Korinchi, Central Sumatra, from S. Müller, July, 1835. L.M., cat. syst. c.
8. Stuffed skin and skull. Sungei Kumbang, Korinchi (1500 m), Central Sumatra, May, 1914. Coll. Robinson and Kloss no. 617/14. L.M.
9. Mounted skin and skeleton. Palembang, S. Sumatra, from the Rotterdam Zoo, 22-8-1924. L.M., reg. no. 1332.
10. Flat skin and skeleton. Palembang, S. Sumatra (imported 16-9-1924), from the Rotterdam Zoo, 26-11-1924. L.M., reg. no. 1362.
11. Skull. Benkoelen, W. Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4677.

Adult females

12. Skull. Mt. Korinchi, Central Sumatra, from S. Müller, July, 1835. L. M., cat. ost. f.
13. Mounted skin and incomplete skull. Pariaman, 45 km N. of Padang, W. Sumatra, coll. F. von Faber, 1883. L.M., cat. syst. a.
14. Mounted skin and incomplete skull. Mt. Korinchi, Central Sumatra, from S. Müller, July, 1835. L.M., cat. syst. d.
15. Mounted skin and skull. Mt. Korinchi, Central Sumatra, from S. Müller, July, 1835. L.M., cat. syst. e.
16. Mounted skin and skeleton. Palembang, S. Sumatra, from the Rotterdam Zoo, 20-7-1923. L.M., reg. no. 1245.
17. Flat skin and skeleton. Palembang, S. Sumatra, from the Rotterdam Zoo, 7-11-1924. L.M., reg. no. 1355.
18. Skull. Benkoelen, W. Sumatra, from the collection of E. Dubois, 1941, L.M., reg. no. 4670.

Presbytis melalophos ferruginea (Schlegel)

Material examined (labelled "*Semnopithecus ferrugineus*" or "*S. melalophus*"):

Infants

1. Mounted skin and skull of female (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. melalophus*", cat. syst. t.
2. Mounted skin. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1880. L.M.

Juveniles

3. Skeleton (cotype). Padang, W. Sumatra, from S. Müller, September, 1835. L.M., "*S. ferrugineus*", cat. ost. c.
4. Stuffed skin and skull of female. From the Rotterdam Zoo, 25-9-1934. L.M., reg. no. 2270.

Subadults

5. Mounted skin and skull (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. melalophus*", cat. syst. r.
6. Mounted skin and skull (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. melalophus*", cat. syst. s.

Adult males

7. Mounted skin and skull (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. melalophus*", cat. syst. p.

8. Skull (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. ferrugineus*", cat. ost. e.

Adult females

9. Mounted skin and skull (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. melalophus*", cat. syst. o.
10. Mounted skin and skull (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. melalophus*", cat. syst. q.
11. Skeleton (cotype). Padang, W. Sumatra, from S. Müller, 1835, L.M., "*S. ferrugineus*", cat. ost. a.
12. Skeleton (cotype). Batang Singalang, Central Sumatra, from S. Müller, August, 1835. L.M., "*S. ferrugineus*", cat. ost. b.
13. Skull (cotype). Padang, W. Sumatra, from S. Müller, 1835. L.M., "*S. ferrugineus*", cat. ost. d.
14. Mounted skin. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1877. L.M., "*S. melalophus*", cat. syst. k.

Presbytis melalophos fuscomurina Elliot

Material examined:

1. Stuffed skin and skull of young male. Sumatra, from C. Blazer, 26-7-1938. L.M., reg. no. 3501.

Although the present specimen is not exactly localized, the dark mouse grey back, outer side of arm, and upper side of tail, the blackish crown and brow-ear streaks, and the white outer sides of thighs and legs leave no doubt as to its subspecific position.

Presbytis melalophos siamensis (Müller et Schlegel)

Material examined (labelled "*Semnopithecus albocinereus*"):

Juveniles

1. Mounted skin and skull of male. Malay Peninsula, from G. Schneider, 1875, L.M., cat. syst. d, cat. ost. d.

Subadults

2. Mounted skin and skeleton of male. "Lahat", from G. Schneider, 1875. L.M., cat. syst. b, cat. ost. b.

Adult males

3. Mounted skin (skull inside) (cotype). Malay Peninsula, coll. P. Diard. L.M., cat. syst. f.

Adult females

4. Mounted skin (skull inside) (cotype). Malay Peninsula, coll. P. Diard. L.M., cat. syst. g.
5. Mounted skin (skull inside) (cotype). Malay Peninsula, coll. P. Diard. L.M., cat. syst. h.
6. Mounted skin. Malay Peninsula, from Frank, 1839. L.M., cat. syst. e.
7. Mounted skin and skeleton. "Lahat", from G. Schneider, 1875. L.M., cat. syst. a, cat. ost. a.
8. Mounted skin and skull. Malay Peninsula, from G. Schneider, 1875. L.M., cat. syst. c, cat. ost. c.
9. Stuffed skin and skull. Bukit Cheraka, Jeram, Selangor coast, Malay Peninsula, 17-11-1910. Purchased from the Raffles Museum, 1-5-1939. L.M., reg. no. 3904.

Schneider's specimens from "Lahat" (nos. 2 and 7) are certainly incorrectly localized (cf. Chasen, 1940, p. 72).

Presbytis melalophos natunae (Thomas et Hartert)

Material examined:

1. Stuffed skin and skull of adult female (cotype). Bunguran Island, North Natuna Islands, coll. A. Everett, 4-10-1893, from Frank, August, 1900. L.M.

Presbytis melalophos chrysomelas (Müller)

Material examined:

Juveniles

1. Mounted skin of female (skull inside) (cotype). Pontianak, W. Borneo, coll. P. Diard. L.M., cat. syst. d.

Adult males

2. Mounted skin (skull inside) (cotype). Pontianak, W. Borneo, coll. P. Diard. L.M., cat. syst. a.
3. Skull. Roema Manoeal, S. foot of Mt. Kenepai, W. Borneo, 23-12-1893. Coll. Büttikofer no. 17a. L.M.
4. Mounted skin and skull. Mt. Kenepai, W. Borneo, 29-1-1894. Coll. Büttikofer no. 103. L.M.

Adult females

5. Mounted skin (skull inside) (cotype). Pontianak, W. Borneo, coll. P. Diard. L.M., cat. syst. b.
6. Mounted skin (skull inside) (cotype). Pontianak, W. Borneo, coll. P. Diard. L.M., cat. syst. c.
7. Skull. Pontianak, W. Borneo, coll. P. Diard. L.M., cat. ost. a.
8. Skull. Pontianak, W. Borneo, coll. P. Diard. L.M., cat. ost. b.
9. Stuffed skin (skull inside). Batang Lupar, Sarawak, Borneo, coll. A. Everett, September, 1893, from Frank, March, 1894. L.M.
10. Flat skin and skull. Ketoengan river, W. Borneo, June, 1894. Coll. Büttikofer no. 237. L.M.

Skull no. 8 of the above list is not that figured by Müller and Schlegel (1841, Atlas, pl. 11 fig. 3), as erroneously stated by Jentink (1887, p. 11).

Presbytis melalophos (Martin) subsp.

Material examined:

1. Skull. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1878. L.M., "*S. melalophus*", cat. ost. n.

Adult males

2. Skull. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1878. L.M., "*S. melalophus*", cat. ost. m.
3. Skull. From the collection of E. Dubois, 1941. L.M., reg. no. 4623.
4. Skull. Pangkalan, Padang Highlands, Central Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4625.
5. Skull. From the collection of E. Dubois, 1941. L.M.

Adult females

6. Skull. From the collection of E. Dubois, 1941. L.M., reg. no. 4624.
7. Skull. From the collection of E. Dubois, 1941. L.M.

In the absence of skins these skulls cannot be identified subspecifically.

Presbytis aygula (L.)

The various races of the Sunda Island leaf monkey have already been dealt with by me (Hooijer, 1948a) in a paper describing a new subspecies, *Presbytis aygula margae*, from Deli, North-eastern Sumatra. The material of the various subspecies available to me is listed below.

Presbytis aygula aygula (L.)

Material examined (labelled "*Semnopithecus mitratus*"):

Infants

1. Mounted skin. Western Java, from S. Müller. L.M., cat. syst. h.
2. Stuffed skin and skull. Western Java, coll. H. W. van der Weele. L.M., reg. no. 5919u.
3. Mounted skin and skull of female. Western Java, coll. P. Diard, 1863. L.M., cat. syst. f, cat. ost. e.

Juveniles

4. Mounted skin. Western Java, coll. H. Boie. L.M., cat. syst. g.
5. Stuffed skin and skull of female. Tjidjoelang, Mt. Salak (600 m), W. Java, 1929. Coll. Sody no. 6a. L.M.

Subadults

6. Stuffed skin and skull of female. Mt. Salak, near Tapos (600 m), W. Java, 1930 Coll. Sody no. 14d. L.M.
7. Stuffed skin and skull of male. Mt. Salak, near Tapos (600 m), W. Java, 1930. Coll. Sody no. 38d. L.M.
8. Skull. Djampang Koelon, W. Java, 1-5-1931. Coll. Sody. L.M.

Adult males

9. Mounted skin. Western Java, from C. L. Blume. L.M., cat. syst. b.
10. Mounted skin (skull inside). Tapos, W. Java, August, 1827, coll. H. C. Macklot. L.M., cat. syst. c.
11. Mounted skin (skull inside). Western Java, from S. Müller. L.M., cat. syst. d.
12. Mounted skin and skull. Western Java, coll. P. Diard, 1863. L.M., cat. syst. e, cat. ost. d.
13. Skeleton. Western Java, from S. Müller. L.M., cat. ost. a.
14. Skeleton. Western Java, from S. Müller. L.M., cat. ost. b.
15. Skull. Buitenzorg, W. Java, from M. Weber, 1888. A.M., S 265.
16. Stuffed skin and skull. Mt. Tidoe, W. Java, 6-5-1910, coll. H. W. van der Weele. L.M., reg. no. 5919w.
17. Stuffed skin and skull. Mt. Tjisalak (600 m) near Tapos, W. Java, 1930. Coll. Sody no. 3d. L.M.
18. Stuffed skin and skull. Tjeringin near Bandjar, W. Java. Coll. Sody no. 9f. L.M.
19. Stuffed skin and skull. Mt. Salak near Tapos (600 m), W. Java, 1930. Coll. Sody no. 37d. L.M.
20. Mounted skin. Purchased from Schlüter and Mass, 20-4-1932. L.M., reg. no. 2067.
21. Mounted skin (skull inside). Purchased from Schlüter and Mass, 20-4-1932. L.M., reg. no. 2067.

Adult females

22. Mounted skin and skull. Western Java, from C. G. C. Reinwardt. L.M., cat. syst. a.
23. Stuffed skin and skull. Mt. Salak, W. Java, coll. A. G. Vorderman, May, 1891. L.M., cat. syst. i.

24. Skeleton. Java, coll. P. Diard, 1863. L.M., cat. ost. c.
25. Stuffed skin and skull. Tjibeureum, W. Java, 13-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919s.
26. Stuffed skin. Pangalengan, W. Java, 5-2-1910, coll. H. W. van der Weele. L.M., reg. no. 5919t.
27. Stuffed skin. Java, coll. H. W. van der Weele. L.M., reg. no. 5919v.
28. Flat skin and skull. Java. Coll. Bartels no. 1687. L.M.

Presbytis aygula fredericae (Sody)

Material examined:

Subadults

1. Stuffed skin and skull of male. Tjoeroegilang, Mt. Slamat (1000 m), Central Java, 30-9-1929. Coll.Sody no. 19c. L.M.

Adult males

2. Stuffed skin and skull (holotype). Tjoeroegilang, Mt. Slamat (1000 m), Central Java, 28-9-1929. Coll. Sody no. 9c. L.M.
3. Stuffed skin and skull. Tegalsari, Mt. Slamat, Central Java Coll. Sody L.M.
4. Flat skin and skull. Java. Coll. Bartels no. 1969. L.M.

Presbytis aygula thomasi (Collett)

Material examined:

Adult males

1. Flat skin and skull. Aloer Poerba, Atjeh, N. Sumatra, coll. Rookmakers, 3-10-1930. L.M., reg. no. 5101.
2. Flat skin. Medan, N.E. Sumatra, from the Rotterdam Zoo, 20-10-1928. L.M., reg. no. 1702.

Adult females

3. Mounted skin and skeleton. Pangkalan Brandan, N.E. Sumatra, from the Rotterdam Zoo, 6-11-1923. L.M, reg. no. 1267.
4. Flat skin and skeleton. Sumatra, from C. Blazer, 6-9-1929. L.M., reg. no. 1771.
5. Flat skin. Sumatra, from C. Blazer, 11-9-1929. L.M., reg. no. 1774.
6. Stuffed skin and skull. Sumatra, from C. Blazer, 17-9-1929. L.M., reg. no. 1776.

Presbytis aygula margae Hooijer

Material examined:

Subadults

1. Mounted skin and lower jaw of female (holotype). Serdang, Deli, N.E. Sumatra, 25-3-1887, coll. B. Hagen. L.M., "*Semnopithecus femoralis*", cat. syst. f, cat. ost. g.
2. Stuffed skin and skull of female (paratype 1). Serbadjadi, N.E. Sumatra, 29-7-1915, coll. L. P. de Bussy. L.M., reg. no. 647.
3. Flat skin and skeleton of male (paratype 2). Deli, N.E. Sumatra, from the Rotterdam Zoo, 27-6-1930. L.M., reg. no. 1854.

Adult males

4. Skull. Tandjoeng Morawa, N.E. Sumatra, coll. B. Hagen, 1882. L.M., "*S. ferrugineus*", cat. ost. f.
5. Skull. Tandjoeng Morawa, N.E. Sumatra, coll. B. Hagen, 1882. L.M., "*S. ferrugineus*", cat. ost. g.

6. Skull. Tandjoeng Morawa, N.E. Sumatra, coll. B. Hagen, 1882. L.M., "*S. ferrugineus*", cat. ost. h.
7. Skeleton, Tandjoeng Morawa, N.E. Sumatra, coll. B. Hagen, 1883. L.M.
8. Flat skin and skull. Pematang Siantar, N.E. Sumatra, coll. Barbara Lawrence, July, 1937. Museum of Comp. Zoöl., Harvard University, Cambridge, Mass., U.S.A., no. 36027.

Presbytis aygula hosei (Thomas)

Material examined:

Subadults

1. Stuffed skin and skull. Mt. Mulu, N. Sarawak, Borneo, March, 1898, coll. G. Waterstraat, from H. Rolle, January, 1899. L.M., cat. syst. c.
2. Stuffed skin and skull of male. Baram river, Sarawak, Borneo, coll. A. Everett. L.M.
3. Mounted skin. Mt. Malingai, N. Borneo, July, 1892, coll. A. Everett, from Frank, 1893. L.M., cat. syst. b.

Adult males

4. Mounted skin and skull. N.E. Borneo, from Frank, 1892. L.M., cat. syst. e, cat. ost. a.
5. Stuffed skin and skull. Mt. Dulit, N. Borneo (4000 ft.), coll. Ch. Hose. L.M.

Adult females

6. Stuffed skin and skull. Mt. Kalulong, N. Borneo, coll. Ch. Hose, from Frank, March, 1894. L.M.
7. Stuffed skin. Marabok river, Brunei, N. Borneo, coll. G. Waterstraat, March, 1898, from H. Rolle, January, 1899. L.M.

In their "Mammals of the Pacific World", Carter, Hill, and Tate (1946) describe both *thomasi* and *hosei* as distinct species (here recognized as subspecies of the Javanese *Presbytis aygula*). Some unfortunate misprints have crept in their accounts of the external characters, which may give rise to confusion. In the description of *thomasi* on p. 73, lines 6 to 8 from top, it is stated: "It is dark smoky gray on the back. The upperside of tail, the outersides of limbs, feet, and hands are black . . .". This should be corrected as follows: "It is dark smoky gray on the back, the upper side of tail, and the outersides of limbs. Feet and hands are black . . .". Further, on the same page, in the description of *hosei*, lines 9 to 10 from bottom, it reads: "The back and sides, tail and outsides of the limbs are ashy gray. The hands and feet are black", which should be corrected as follows: "The back and sides, and tail are ashy gray. The outsides of the limbs, hands and feet are black".

Presbytis rubicunda (Müller)

The Maroon leaf monkey of Borneo, with its golden red colour one of the prettiest of the lot, is divisible into dark-footed animals from the Eastern half, and pale-footed in the Western parts of the island (Chasen and Kloss, 1931, p. 5). To the former belong the typical S.E. Bornean specimens col-

lected by Müller, whereas in the skins from Mt. Liang Koeboeng in Central Borneo collected by Büttikofer the hands and feet are not darker than the limbs.

Presbytis rubicunda rubicunda (Müller)

Material examined:

Infants

1. Mounted skin and skull. S.E. Borneo, from S. Müller, 1836. L.M., cat. syst. e, cat. ost. c.
2. Mounted skin and skull. Tanah Laoet, S.E. of Bandjermasin, S.E. Borneo, from S. Müller, 1836. L.M., cat. syst. f, cat. ost. d.
3. Mounted skin. Kapoeas river, S. E. Borneo, coll. L. A. C. M. Schwaner. L.M., cat. syst. g.

Juveniles

4. Mounted skin of male. Mt. Sakoembang, Tanah Laoet, S.E. Borneo, from S. Müller, November, 1836. L.M., cat. syst. d.

Adult males

5. Mounted skin and skull (cotype). Kertingan, S.E. Borneo, from S. Müller, November, 1836. L.M., cat. syst. c, cat. ost. b.
6. Skull. S.E. Borneo, from S. Müller, 1836. L.M., cat. ost. e.

Adult females

7. Mounted skin (cotype). Tanah Laoet, S.E. Borneo, from S. Müller, 1836. L.M., cat. syst. a.
8. Mounted skin (cotype). Mt. Sakoembang, Tanah Laoet, S. E. Borneo, from S. Müller, 1836. L.M., cat. syst. b.
9. Skeleton. Mt. Sakoembang, Tanah Laoet, S.E. Borneo, from S. Müller, 1836. L.M., cat. ost. a.
10. Skull. Mt. Sakoembang, Tanah Laoet, S.E. Borneo, from S. Müller, 1836. L.M., cat. ost. f.
11. Skull. S.E. Borneo, from S. Müller, 1836. L.M., cat. ost. g.

Presbytis rubicunda ignita Dollman

Material examined:

Juveniles

1. Flat skin and skull of male. Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo, 2-4-1894. Coll. Büttikofer no. 150. L.M.

Subadults

2. Flat skin and skull of male. Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo, 12-4-1894. Coll. Büttikofer no. 163. L.M.

Adult males

3. Flat skin and skull. Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo, 29-3-1894. Coll. Büttikofer no. 143. L.M.
4. Flat skin and skull. Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo, 21-4-1894. Coll. Büttikofer no. 189. L.M.
5. Flat skin and skull. Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo, 21-4-1894. Coll. Büttikofer no. 190. L.M.
6. Stuffed skin (skull inside). Borneo, coll. Ch. Hose, from Frank. L.M.

7. Stuffed skin (skull inside). Borneo, coll. Ch. Hose, from Frank. L.M.

Adult females

8. Flat skin and skull. Mt. Liang Koeboeng, Upper Kapocas, Central Borneo, 21-4-1894. Coll. Büttikofer no. 191. L.M.

Presbytis frontata (Müller)

The White-fronted leaf monkey, the series of which is listed below, is characterized by a naked (or nearly naked) patch on the forehead, which is sometimes divided by a vertical median crest of short hairs. It seems doubtful whether the Sarawak race, *nudifrons* Elliot (admitted by Chasen, 1940, p. 81), is really distinct from that of Southeastern and Central Borneo; Banks (1931, p. 100) states that it is impossible to separate specimens from these localities either on the characters given or on any others.

Material examined:

Infants

1. Mounted skin and skull (cotype). Pamattan, S.E. Borneo, from S. Müller, 1836. L.M., cat. syst. d, cat. ost. c.

Juveniles

2. Mounted skin of male (cotype). Pamattan, S.E. Borneo, from S. Müller, 1836. L.M., cat. syst. c.

Adult males

3. Skull. Pamattan, S.E. Borneo, from S. Müller, 1836. L.M., cat. ost. b.
4. Mounted skin and skeleton (cotype). Poeloe Lampy, S.E. Borneo, from S. Müller, 1836. L.M., cat. syst. b, cat. ost. a.

Adult females

5. Mounted skin (cotype). Pamattan, S.E. Borneo, from S. Müller, 1836. L.M., cat. syst. a.
6. Flat skin and skull. Dingei, Upper Mahakam, Central Borneo, 19-10-1896. Coll. A. W. Nieuwenhuis no. 92. L.M.

PRESBYTIS AND TRACHYPITHECUS

In his paper on Western Bornean mammals, Lyon (1907, p. 568) listed "rather striking cranial differences between the *Presbytis chrysomelas* and *P. cristata* groups of monkeys". The latter group, comprising the so-called negro leaf monkeys or loetoengs, variously known as *pyrrhus* or *maurus*, has since been placed in a distinct genus, *Trachypithecus* Reichenbach, by Pocock (1934, p. 928), thereby relying not only on the cranial characters already given by Lyon, but adding important observations on the colour of the neonati, which serve to distinguish between the two genera at a glance. Further support for Pocock's generic division was provided by Washburn (1944), who found the two genera easily distinguishable by the proportions of the post-cranial skeleton. For their obvious importance, the skull differences given by Lyon in 1907 are presented below:

Presbytis	*Trachypithecus*
Anterior nares suddenly contracted to a point antero-inferiorly.	Anterior nares gradually tapering to a point antero-inferiorly.
Superciliary ridge barely indicated.	Superciliary ridge well marked.
A well-marked arch under malo-maxillary suture.	No well-marked arch under malo-maxillary suture.
Constriction behind orbits less well marked.	Constriction behind orbits considerable.
A well-marked swelling of brain-case just beneath lambdoid suture.	No prominent swelling of brain-case just beneath lambdoid suture.
Palate shorter.	Palate longer.
Rostrum less pronounced.	Rostrum more pronounced.
Ramus of mandible shallow, and angular process not unusually enlarged.	Ramus of mandible deep, and angular process enlarged.

These distinguishing cranial characters have been restated by Pocock (1934, p. 896/897) as follows: "On the average the cranium (of *Presbytis*) is less sharply constricted behind the orbits (than that of *Trachypithecus*) and has the occipital region inflated, with a weaker crest; the brow ridges are weaker, the upper edge of the orbit straighter, giving a "frowning" aspect to the brow, the anterior nares are inferiorly broader and less elongated, there is a well-marked emargination where the zygomatic arches pass into the muzzle, the muzzle is more abbreviated and the nasal region usually prominently convex, and the mandible is not so robust, especially in its postdental portion".

"An additional difference is found in the coloration of the newly-born young, which (in *Presbytis*) is typically of the "cruciger" type, white, with a cruciform blackish pattern. Very rarely the young is all white, with the cruciform mark apparently suppressed, but it never exhibits the wholly golden-red hue of the young of *Trachypithecus*" (Pocock, l.c., p. 897).

The skulls of *Presbytis melalophos* and *Presbytis aygula* are exceedingly alike, and they do not show any marked sexual differences, as will be evident from the inspection of tables 1-3A. Although the females of *Presbytis melalophos ferruginea* in most skull dimensions average larger than the males of *Presbytis melalophos sumatrana* (table 1), when males and females of the same race are compared the females average smaller than the males, both in *Presbytis melalophos melalophos* (table 2) and in *Presbytis aygula aygula* (table 3A).

Skull measurements of the males and the females of the various sub-

TABLE 1

Skull measurements of adult males and females of *Presbytis melalophos*

P. m. sumatrana *P. m. ferruginea*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	5	90-104	94	5.8	6.2	5	91-98	94	2.5	2.7
2	4	61-67	63	2.9	4.6	5	59-68	62	3.5	5.6
3	4	53-56	54	1.4	2.6	5	52-53	53	0.5	0.9
4	5	52-57	55	2.0	3.6	5	54-55	54	0.5	0.9
5	5	58-63	61	1.9	3.1	5	61-64	63	1.1	1.7
6	5	42-46	44	2.3	5.2	5	42-44	43	0.7	1.6
7	4	46-50	48	1.8	3.8	5	46-49	48	1.2	2.5
8	5	57-64	60	2.7	4.5	5	61-65	62	1.7	2.7
9	5	20-22	21	0.9	4.3	5	22-24	23	0.9	3.9
10	5	53-61	56	3.5	6.4	5	57-66	60	3.5	5.8
11	5	17-21	19	1.6	8.4	5	19-23	21	1.5	7.1
12	5	14-17	16	1.2	7.5	5	15-19	17	1.5	8.8
13	5	14-18	17	1.7	10.0	5	17-19	18	0.9	5.0
14	5	26-31	29	2.0	6.9	5	30-34	32	1.4	4.4

species of *Trachypithecus cristatus* (Raffles) will be given later in the present work. In table 3B are presented the means of the skull dimensions of the males of *Presbytis aygula aygula* and *Trachypithecus cristatus pyrrhus* (Horsfield); the differences in skull proportions between the two genera are shown in the last column of the table, which gives the ratios of size. *Presbytis* differs from *Trachypithecus* in the larger cranial part (3, 4) relative to the basal length (2), the more prominent orbits (5), much less well marked

TABLE 2

Skull measurements of adult males and females of *Presbytis melalophos melalophos*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	6	90-96	93	2.4	2.6	5	89-94	91	2.0	2.2
2	6	61-66	63	1.8	2.9	6	56-63	61	2.6	4.2
3	6	54-58	56	1.7	3.0	5	49-55	52	2.6	5.0
4	6	54-58	56	1.3	2.3	6	53-57	55	1.4	2.5
5	6	57-65	62	3.1	5.0	7	57-67	62	3.4	5.5
6	6	42-48	45	2.1	4.7	7	41-45	43	1.3	3.0
7	6	48-52	50	1.3	2.6	6	47-50	48	1.8	3.8
8	6	59-67	62	3.3	5.3	7	58-65	61	2.2	3.5
9	6	21-25	23	1.8	7.8	7	21-23	22	1.1	5.0
10	6	56-61	58	1.9	3.3	7	54-61	57	1.5	2.6
11	6	17-20	19	1.3	6.8	7	17-22	20	1.6	8.0
12	6	14-16	15	0.8	5.3	7	14-18	16	1.4	8.8
13	6	17-19	18	0.9	5.0	7	16-20	17	1.5	8.8
14	6	29-33	31	1.5	4.8	7	28-32	30	1.3	4.3

TABLE 3A

Skull measurements of adult males and females of *Presbytis aygula aygula*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	8	90-98	94	2.6	2.8	5	93-97	94	1.7	1.8
2	8	58-65	62	2.0	3.2	5	57-63	60	2.5	4.2
3	8	51-58	55	2.2	4.0	5	52-54	53	1.2	2.3
4	8	51-56	54	1.8	3.3	5	52-55	53	1.2	2.3
5	8	59-64	61	1.8	2.9	5	55-62	59	2.7	4.5
6	8	42-47	44	1.9	4.3	5	41-45	42	2.0	4.8
7	8	47-53	51	1.9	3.7	5	49-52	50	1.2	2.4
8	8	62-65	64	1.1	1.7	5	58-64	62	2.2	3.5
9	8	22-24	23	0.8	3.5	5	20-23	22	1.3	5.9
10	8	57-62	59	1.5	2.5	5	56-58	57	1.0	1.8
11	8	19-23	21	1.3	6.2	5	18-21	20	1.3	6.5
12	8	14-17	16	1.1	6.9	5	13-15	14	0.7	5.0
13	8	17-19	18	0.7	3.9	5	15-18	17	1.9	11.2
14	8	30-34	32	1.5	4.7	5	30-32	31	0.7	2.3

postorbital constriction (6), and higher calvarium (7), whereas the mandible as a whole (8-14) is less robust, with a shallower corpus (12, 13), and ascending ramus (14). These differences in average skull proportions between *Presbytis* and *Trachypithecus* correspond with those given by Lyon and Pocock, cited above. In my opinion Pocock was fully justified in treating the negro or silvered leaf monkeys as a genus distinct from that of the *melalophos, aygula, rubicunda,* and *frontata* groups of leaf monkeys, and I shall adopt the same generic distinction in the present work.

TABLE 3B

Means of skull dimensions of males of *Presbytis aygula aygula* and of *Trachypithecus cristatus pyrrhus*

	Presbytis	*Trachypithecus*	Ratio
1. Greatest length	94	106	89 : 100
2. Basal length	62	76	82 : 100
3. Cranial cavity	55	57	96 : 100
4. Width brain case	54	58	93 : 100
5. Biorbital width	61	66	92 : 100
6. Postorbital constriction	44	43	102 : 100
7. Height calvarium	51	49	104 : 100
8. Mandible length	64	77	83 : 100
9. Ascending ramus length	23	29	79 : 100
10. Bicondylar width	59	67	88 : 100
11. Symphysis height	21	26	81 : 100
12. Corpus height (P_{3-4})	16	21	76; 100
13. Corpus height (M_3)	18	24	75 : 100
14. Ascending ramus height	32	42	76 : 100

Although the genus *Trachypithecus* has been accepted by Osman Hill (1936, 1939) and Washburn (1944) in their valuable contributions to the systematics of the leaf monkeys, it has not been accepted by Chasen (1940), who used the now suppressed genus "*Pithecus*" E. Geoffroy et G. Cuvier throughout, and neither by Miller (1942), Simpson (1945), Ellerman and Morrison-Scott (1951, 1955), Fiedler (1956) or Hill (1960), who use *Presbytis* instead, considering *Trachypithecus* of subgeneric value at most. As long as it is recognized that the genera *Presbytis* and *Trachypithecus* as constituted by Pocock each comprise a natural group, differing from the other in the colour of the neonati, adult skull proportions, and proportions of the skeleton, it does not matter much what rank is given to each unit. I, for one, am convinced that both deserve generic rank: *Presbytis,* with *Simia aygula* L. = *Presbytis aygula aygula* (L.) from Western Java as the type, and *Trachypithecus,* with *Semnopithecus pyrrhus* Horsfield, a subspecies of *Simia cristatus* Raffles = *Trachypithecus cristatus pyrrhus* (Horsfield) from Eastern Java as the type.

PLEISTOCENE REMAINS OF PRESBYTIS FROM JAVA

In the collection of Primates from various Middle Pleistocene sites in Central Java made by Dubois, which contains mainly *Trachypithecus* and *Macaca,* there is a single specimen of *Presbytis.* It is of considerable interest as it shows that in Pleistocene times *Presbytis* ranged further Eastward in Java than it does at present. The specimen is a fragment of the right palate with P^3-M^2 in situ, and originates from Soember Kepoeh (Coll. Dub. no. 3780, pl. II fig. 7). Unfortunately the sex cannot be determined as nothing of the canine is preserved. The teeth, which are all worn, are indistinguishable from those of the recent *Presbytis aygula,* and slightly exceed those of *Presbytis aygula aygula* in size (table 4). The typical subspecies of *Presbytis aygula* occurs in Western Java exclusively; the black race *Presbytis aygula fredericae* is confined to Mt. Slamat in Western Central Java, and represents the eastermost stronghold of the species in Java. It is, perhaps, significant that among only three males of *fredericae* we find upper molars that are larger than those in a series of twelve males and females of typical *aygula,* and even exceed the fossil specimens in size.

There appears to be no doubt that the fossil Soember Kepoeh specimen should be referred to the species *Presbytis aygula,* and its occurrence beyond the present range of the species and in a Middle Pleistocene deposit would seem to entitle to distinct subspecific rank. As we shall see further on, the Pleistocene *Trachypithecus* from Java differs in cranial and dental characters

TABLE 4

Tooth measurements of Pleistocene and recent *Presbytis*

	Coll. Dub. no. 3780	*P. aygula frederícae*	*P. aygula aygula*	
		♂♂	♂♂	♀♀
P^3, transverse	6.0	4.9-5.3	4.8-5.8	4.7-5.3
P^4, transverse	6.5	5.7-6.0	5.5-6.2	5.5-5.8
M^1, transverse	6.4	5.9-6.6	5.8-6.3	5.8-6.1
M^2, transverse	6.9	6.5-7.1	6.1-6.6	6.1-6.4

from the living forms. The Soember Kepoeh specimen of *Presbytis,* however, gives too little in the way of distinguishing characters to allow of a description of a new form, and it may for the present be identified only as *Presbytis aygula* (L.) subsp.

There is no material of *Presbytis* from the Early Holocene caves in Java (Goea Djimbe, Goea Ketjil, Wadjak) that yield *Trachypithecus* as well as *Macaca,* indicating, perhaps, that *Presbytis* had already become extinct in Eastern Central Java by the time of formation of these deposits.

CAVE MATERIAL OF PRESBYTIS FROM SUMATRA

A number of isolated teeth from the Early Holocene cave deposits in Central Sumatra appear to belong to *Presbytis,* but they give no clue as to their specific identity. The teeth of the various races of *Presbytis melalophos* and *Presbytis aygula* living in Sumatra at present are so very much alike that more than a broad assignment of the subfossil teeth to *Presbytis* spec. cannot be attempted. Some last lower molars, typified by their abortive talonids, keep within the limits of size of their recent homologues, which are rather wide (anteroposterior diameter 6.0-7.3 mm; transverse diameter 4.8-5.7 mm), and consequently do not offer distinguishing characters.

Genus TRACHYPITHECUS Reichenbach

Trachypithecus cristatus (Raffles)

Various subspecies of the present species are currently recognized: *T. c. sondaicus* (Robinson et Kloss) from Western Java, almost totally black; *T. c. pyrrhus* (Horsfield) from Central and Eastern Java, with grey-tipped hairs; *T. c. kohlbruggei* (Sody) from Bali, similar in colour to the last; *T. c. cristatus* (Raffles) from Sumatra and Borneo, with greyer hair tips and paler ground colour, and *T. c. ultimus* (Elliot), likewise from Sumatra and Borneo, which is a still paler form. The lists of material seen are given below.

Trachypithecus cristatus pyrrhus (Horsfield)

Material examined (labelled "*Semnopithecus pyrrhus*" or "*S. maurus*"):

Infants

1. Flat skin and skeleton of female. Tosari, E. Java, coll. Kohlbrugge no. 121. L.M.
2. Stuffed skin and skull of female. Pangonan, Mt. Moeria (550 m), Central Java, 1928. Coll. Sody no. M 39. L.M.
3. Calvarium of female. Madioen, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4637.

Juveniles

4. Mounted skin and skull of female. Between Djember and Poeger, E. Java, 30-12-1890, coll. A. A. W. Hubrecht. L.M., "*S. pyrrhus*", cat. syst. c, cat. ost. c.
5. Flat skin and skeleton of female. Tosari, E. Java, coll. Kohlbrugge no. 17. L.M.
6. Skull of female. Kawi, Malang, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4639.

Subadults

7. Mounted skin and skull of male. Batoe district, res. Pasoeroean, E. Java, coll. W. H. de Vriese, 1860. L.M., "*S. pyrrhus*", cat. syst. a, cat. ost. a.
8. Skeleton of female. Between Djember and Poeger, E. Java, 30-12-1890, coll. A. A. W. Hubrecht. L.M., "*S. pyrrhus*", cat. ost. d.
9. Stuffed skin and skull of female. Wonosalam, Central Java [1]), coll. A. G. Vorderman, August, 1892, received March, 1896. L.M.
10. Skeleton of female. Tosari, E. Java, coll. Kohlbrugge no. 25. L.M.
11. Stuffed skin and skeleton of male. Samarang, Central Java, from the Rotterdam Zoo, 29-6-1933. L.M., reg. no. 2182.
12. Skull of male. Mt. Wilis, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4630.
13. Skull of female. Mt. Wilis, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4632
14. Skull of female. Mt. Wilis, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4633a
15. Mounted skin of female (skull inside). Batoe district, res. Pasoeroean, E. Java, coll. W. H. de Vriese, 1861. L.M., "*S. maurus*", cat. syst. h.
16. Mounted skin of female (skull inside). Batoe district, res. Pasoeroean, E. Java, coll. W. H. de Vriese, 1861. L.M., "*S. maurus*", cat. syst. g.

Adult males

17. Mounted skin and skull. Between Djember and Poeger, E. Java, 30-12-1890. coll. A. A. W. Hubrecht. L.M., "*S. pyrrhus*", cat. syst. b, cat. ost. b.
18. Stuffed skin and skull. Wonosalam, Central Java, coll. A. G. Vorderman, August, 1892, received March, 1896. L.M.
19. Skull. Tosari, E. Java, coll. Kohlbrugge no. 81. L.M.
20. Skull. Tosari, E. Java, coll. Kohlbrugge no. 87. L.M.
21. Skull. Tosari, E. Java, coll. Kohlbrugge no. 100 L.M.
22. Skull. Tosari, E. Java, coll. Kohlbrugge no. 110. L.M.
23. Flat skin and skeleton. Tosari, E. Java, coll. Kohlbrugge no. 119. L.M.
24. Skull. Wonokojo, Dampit, S. Malang, E. Java. Coll. Sody no. Won. 1. Healed fracture of left mandibular corpus. L.M.
25. Stuffed skin and skull. Gedangan (65 m), res. Samarang, Central Java, 1931. Coll. Sody no. 11. L.M.

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1) There is a Wonosalam in Central Java, 25 km N.E. of Samarang, and another one 30 km S. of Modjokerto, in Eastern Java.

26. Skull. Ngawi, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4626.
27. Skull. Mt. Pandan, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4628.
28. Skull. Mt. Wilis, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4629.
29. Mounted skin (skull inside). Soerabaja, E. Java, coll. H. Gevers, 1868. L.M., "*S. maurus*", cat. syst. e.
30. Mounted skin (skull inside). Soerabaja, E. Java, coll. H. Gevers, 1868. L.M., "*S. maurus*", cat. syst. f.

Adult females

31. Skull. Tosari, E. Java, coll. Kohlbrugge no. 10. L.M.
32. Skeleton. Tosari, E. Java, coll. Kohlbrugge no. 33. L.M.
33. Skull. Tosari, E. Java, coll. Kohlbrugge no. 60. L.M.
34. Skull. Tosari, E. Java, coll. Kohlbrugge no. 104. L.M.
35. Skull. Tosari, E. Java, coll. Kohlbrugge no. 105. L.M.
36. Skull. Tosari, E. Java, coll. Kohlbrugge no. 113. L.M.
37. Skull. Tosari, E. Java, coll. Kohlbrugge no. 114. L.M.
38. Skull. Tosari, E. Java, coll. Kohlbrugge no. 115. L.M.
39. Skull. Tosari, E. Java, coll. Kohlbrugge no. 116. L.M.
40. Skull. Wonokojo, Dampit, S. Malang, E. Java. Coll. Sody no. Won. 2, L.M.
41. Flat skin and skull. Pangonan, Mt. Moeria (550 m), Central Java, 1928. Coll. Sody no. M 38. L.M. P^3 sin. congenitally absent.
42. Stuffed skin and skull. Gedangan (65 m), res. Samarang, Central Java, 1931. Coll. Sody no. 8. L.M.
43. Incomplete skull. Mt. Wilis, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4633b.
44. Skull. Mt. Pandan, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4634.
45. Skull. Mt. Wilis, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4635.
46. Skull. Mt. Wilis, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4636. A small supernumerary element between the central upper incisors.
47. Skull. Mt. Kloet, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4638.
48. Facial part of calvarium, and lower jaw. Mt. Kloet, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4640a.
49. Skull. Mangis, Mt. Kloet, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4640b.
50. Incomplete skull. Madioen, E. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4674.

Three out of the six adult male skins (nos. 17, 18 and 23 of the above list) represent erythristic mutants, the others (nos. 25, 29 and 30) being black. The two adult female skins (nos. 41 and 42) are both black. Kohlbrugge (1896, p. 279/280) states that almost all reddish specimens from the Tengger Mts. in Eastern Java are males. Reddish specimens of *Trachypithecus cristatus* occur in Northern Borneo as well (below p. 31).

Trachypithecus cristatus sondaicus (Robinson et Kloss)

Material examined:

Infants

1. Mounted skin (skull inside). Western Java, coll. H. Kuhl and J. C. van Hasselt. L.M., "*S. maurus*", cat. syst. m.
2. Mounted skin (skull inside). Western Java, coll. P. Diard, 1863. L.M., "*S. maurus*", cat. syst. n.
3. Mounted skin (skull inside). Western Java, coll. P. Diard, 1863. L.M., "*S. maurus*", cat. syst. o.
4. Skull. Western Java. L.M., "*S. maurus*", cat. ost. g.
5. Mounted skin of female (skull inside). Tjiboegoer, W. Java, 6-5-1898, purchased from Schlüter and Mass. L.M., reg. no. 2067.
6. Stuffed skin and skull of female. Tjibeureum, W. Java, 9-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919b.
7. Stuffed skin and skull of female. Pangalengan, W. Java, 26-3-1910, coll. H. W. van der Weele. L.M., reg. no. 5919c.

Juveniles

8. Mounted skin (skull inside). Western Java, coll. H. Boie and H. C. Macklot. L.M., "*S. maurus*", cat. syst. i.
9. Mounted skin (skull inside). Western Java, coll. C. L. Blume. L.M., "*S. maurus*", cat. syst. j.
10. Mounted skin (skull inside). Western Java, from C. G. C. Reinwardt. L.M., "*S. maurus*", cat. syst. k.
11. Mounted skin of female (skull inside). Mt. Pangerango, W. Java, 28-11-1898, purchased from Schlüter and Mass. L.M., reg. no. 2067.
12. Mounted skin. Western Java, purchased from Schlüter and Mass. L.M., reg. no. 2067.
13. Flat skin and skull of male. Pangalengan, W. Java, 25-1-1910, coll. H .W. van der Weele. L.M., reg. no. 5919e.
14. Flat skin and skull of female. Tjibeureum, W. Java, 13-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919 f.
15. Stuffed skin and skull of female. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 14f. L.M.
16. Stuffed skin and skull of female. Mt. Salak (2000 m), W. Java. Coll. Sody no. A 127. L.M.
17. Stuffed skin and skull of female. Mt. Salak (2000 m), W. Java. Coll. Sody no. A 128. L.M.

Subadults

18. Skeleton of female. Western Java, coll. G. van Raalten. L.M., "*S. maurus*", cat. ost. b.
19. Stuffed skin and skull of male. Pangalengan, W. Java, 20-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919i.
20. Flat skin and skull of male. Tjibeureum, W. Java, 30-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919k.
21. Flat skin and skull of male. Tjitasari, W. Java, 30-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919 m.

Adult males

22. Mounted skin (skull inside). Western Java, coll. H. C. Macklot. L.M., "*S. maurus*", cat. syst. a.
23. Skeleton. Western Java, coll. H. Kuhl and J. C. van Hasselt. L.M., "*S. maurus*", cat. ost. a.
24. Skull. Western Java, from S. Müller. L.M., "*S. maurus*", cat. ost. e.

25. Mounted skin (skull inside). Mt. Pangerango, W. Java, 8-12-1898, purchased from Schlüter and Mass. L.M., reg. no. 2067.
26. Stuffed skin and skull. Western Java, coll. H. W. van der Weele. L.M., reg. no. 5919h.
27. Skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 20 f. L.M.
28. Stuffed skin and skull. Mt. Salak (1700 m), W. Java, September, 1931. Coll. Sody no. A 214. L.M.
29. Skull. Buitenzorg, W. Java, coll. M. Weber, 1888. A.M.

Adult females

30. Mounted skin (skull inside). Western Java, from S. Müller. L.M., "*S. maurus*", cat. syst. b.
31. Mounted skin and skull. Western Java, coll. P. Diard, 1863. L.M., "*S. maurus*", cat. syst. c, cat. ost. d.
32. Mounted skin (skull inside). Western Java, coll. P. Diard, 1863. L.M., "*S. maurus*", cat. syst. d.
33. Skull. Western Java, coll. H. Boie. L.M., "*S. maurus*", cat. ost. f.
34. Skull. Western Java, from C. G. C. Reinwardt. L.M., "*Semnopithecus mitratus*", cat. ost. f.
35. Skull. Western Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4642.
36. Flat skin and skull. Tjibeureum, W. Java, 25-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919a.
37. Flat skin and skull. Tjibeureum, W. Java, 9-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919d.
38. Flat skin and skull. Western Java, coll. H. W. van der Weele. L.M., reg. no. 5919g.
39. Flat skin and skull. Western Java, coll. H. W. van der Weele. L.M., reg. no. 5919j.
40. Flat skin and skull. Tjibeureum, W. Java, 9-1-1910, coll. H. W. van der Weele. L.M., reg. no. 5919l.
41. Skull. Mt. Salak, W. Java, from an animal that lived in the captive state for 2½ years. Coll. Sody no. 1. L.M.
42. Stuffed skin and skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 6f. L.M.
43. Stuffed skin and skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 10f. L.M.
44. Stuffed skin and skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 21f. L.M.

Trachypithecus cristatus kohlbruggei (Sody)

Material examined:

Subadults

1. Stuffed skin and skull of male. Sendang, W. Bali. Coll. Sody no. E 9. L.M.

Adult males

2. Stuffed skin and skull. Sendang, W. Bali. Coll. Sody no. E 77. L.M. The right P_3 is duplicated.

Adult females

3. Stuffed skin and skull (holotype). Sendang, W. Bali. Coll. Sody no. E 42. L.M.
4. Stuffed skin and skull. Sendang, W. Bali. Coll. Sody no. E 27. L.M.
5. Stuffed skin and skull. Sendang, W. Bali. Coll. Sody no. E 35. L.M.
6. Stuffed skin and skull. Sendang, W. Bali. Coll. Sody no. E 38. L.M.
7. Stuffed skin and skull. Sendang, W. Bali. Coll. Sody no. E 39. L.M.

Trachypithecus cristatus (Raffles) subsp. nov.?

1. Stuffed skin and skull of adult male. Billiton, coll. A. G. Vorderman, May, 1891. L.M., "*S. maurus*", cat. syst. cc. Whitish mutant.
2. Flat skin and skull of female. Billiton, coll. W. L. Abbott, 1904. U.S. Nat. Mus., Washington, D.C., no. 124971 (listed by Lyon, 1906, p. 606, under *Presbytis cristata*).

Trachypithecus cristatus cristatus (Raffles)

Material examined:

Infants

1. Mounted skin and skull of female (suckling of no. 12, below). Bandjermasin, S. E. Borneo, from S. Müller, 1837. L.M., "*S. maurus*", cat. syst. y, "*S. pruinosus*", cat. ost. f.

Juveniles

2. Mounted skin of female (skull inside). Padang, W. Sumatra, from S. Müller, 1837. L.M., "*S. maurus*", cat. syst. s.
3. Mounted skin (skull inside). Bandjermasin, S. E. Borneo, coll. L. A. C. M. Schwaner. L.M., "*S. maurus*", cat. syst. x.
4. Mounted skin of female (skull inside). Bandjermasin, S. E. Borneo, from S. Müller. L.M., "*S. maurus*", cat. syst. w.

Subadults

5. Mounted skin (skull inside). Bandjermasin, S. E. Borneo, coll. L. A. C. M. Schwaner. L.M., "*S. maurus*", cat. syst. u.

Adult males

6. Mounted skin. Padang, W. Sumatra, from S. Müller, 1836. L.M., "*S. maurus*", cat. syst. p.
7. Mounted skin and skull. Padang, W. Sumatra, from S. Müller, 1836. L.M., "*S. maurus*", cat. syst. q.
8. Mounted skin and skull. Padang, W. Sumatra, from S. Müller, 1836. L.M., "*S. maurus*", cat. syst. z.
9. Mounted skin and skull. Pontianak, W. Borneo, coll. P. Diard. L.M., "*S. maurus*", cat. syst. v, "*S. pruinosus*", cat. ost. e. Extra cusp in M^3 sin.
10a. Skeleton. Mt. Korinchi, Central Sumatra, from S. Müller. L.M., "*S. pruinosus*", cat. ost. a.
10b. Flat skin and skull. Sumatra, coll. Bartels no. S 226. L.M.
11. Mounted skin and skull. Padang, W. Sumatra, from S. Müller, 1836. L.M., "*S. maurus*", cat. syst. r.

Adult females

12. Mounted skin and skull. Bandjermasin, S. E. Borneo, from S. Müller, 1837. L.M., "*S. maurus*", cat. syst. t.
13. Mounted skin and skull. E. S. E. Borneo, coll. C. Bock, 1879, received in 1880. L.M., "*S. maurus*", cat. syst. aa.
14. Skeleton. Padang, W. Sumatra, from S. Müller. L.M., "*S. pruinosus*", cat. ost. b.
15. Skull. Benkoelen, W. Sumatra, coll. G. F. Wienecke, 1865. L.M., "*S. pruinosus*", cat. ost. g.

Trachypithecus cristatus ultimus (Elliot)

Material examined:

Infants

1. Flat skin and skull of male. Deli, N. E. Sumatra, from the Rotterdam Zoo, 24-7-1905. L.M.
2. Stuffed skin and skull of female. Rantau, 65 km N.E. of Bandjermasin, S.E. Borneo, coll. F. C. E. van der Putten, received 7-10-1919. L.M., reg. no. 4617.

Adult males

3. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., "*Semnopithecus melalophus*", cat. ost. i.
4. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., "*Semnopithecus melalophus*", cat. ost. j.

5. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M. "*Semnopithecus melalophus*", cat. ost. k.
6a. Skull. Rantau, 65 km N.E. of Bandjermasin, S. E. Borneo, coll. F. C. E. van der Putten, received 7-10-1919. L.M., reg. no. 5869d.
6b. Skull. Seroewai, Tamiang district, N. E. Sumatra, December, 1931. Coll. Sody no. F 146. L.M.

Adult females

7. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., "*Cercocebus cynamolgos*", cat. ost. x.
8. Skull. Tandjoeng Morawa, N.E. Sumatra, coll. B. Hagen, 1882. L.M., "*Cercocebus cynamolgos*", cat. ost. y.
9. Skeleton. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1883. L.M.
10. Mounted skin and skull. Serdang, Deli, N. E. Sumatra, coll. B. Hagen, 1887, received in 1889. LM., "*Semnopithecus maurus*", cat. syst. bb, "*S. pruinosus*", cat. ost. j.
11. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., "*Semnopithecus melalophus*", cat. ost. l.
12. Flat skin and skull. Pontianak, W. Borneo, 17-1-1895, coll. Büttikofer no. 280. L.M.
13. Stuffed skin and skull. Rantau, 65 km N.E. of Bandjermasin, S. E. Borneo, coll. F. C. E. van der Putten, received 7-10-1919. L.M., reg. no. 5869a.
14. Stuffed skin and skull. Rantau, 65 km N. E. of Bandjermasin, S. E. Borneo, coll. F. C. E. van der Putten, received 7-10-1919. L.M., reg. no. 5869b.
15. Stuffed skin and skull. Rantau, 65 km N.E. of Bandjermasin, S. E. Borneo, coll. F. C. E. van der Putten, received 7-10-1919. L.M., reg. no. 5869c. The upper incisors are crowded.
16. Skull. Seroewai. Tamiang district, N. E. Sumatra, December, 1931. Coll. Sody no. F 147. L.M.

The external differences between *Trachypithecus cristatus cristatus* and *T. c. ultimus* are slight, consisting in the less blackened and more silvery appearance of the latter as compared with the former. In Borneo the two forms may not even be geographically separate: four skins from Rantau, 65 km N.E. of Bandjermasin, S. E. Borneo, are clearly *ultimus*, whilst two from Bandjermasin (*cristatus* nos. 5 and 12) are less frosted, and darker. One of the two skins from Pontianak, W. Borneo, is a *cristatus* (no. 9), whereas the other is *ultimus* (no. 12). Pocock (1934, p. 935) states that the Borneo skins in the British Museum are very variable in colour individually, and lumps *ultimus* with *cristatus*. However, in Sumatra the two forms are believed to have distinct ranges (Chasen, 1940, p. 82), and the Deli skin from Hagen (*ultimus* no. 10) indeed is paler than, and has the forearm not largely black as in the Padang skins (*cristatus* nos. 6-8 and 11). I have listed the two races separately, but the ranges in Borneo are insufficiently known and should be established.

Erythristic mutants are known not only from Eastern Java (above, p. 27) but also from Northern Borneo. Allen and Coolidge (1940, p. 144) record that seven out of fifteen adult males, but only three out of twenty-six adult females collected at Abai, Kinabatangan river, N. Borneo, are reddish. This

means that 46.6 ± 12.9 per cent. of the males, against 11.5 ± 6.3 per cent. of the females, are erythristic. The difference between these percentages (35.1) is more than two times its standard error (14.4), from which we may conclude that erythristic mutants are decidedly more frequent among males than among females.

TABLE 5

Skull measurements of adult males and females of *Trachypithecus cristatus pyrrhus*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	12	102-111	106	2.8	2.6	18	87-108	96	4.3	4.4
2	12	71-81	76	2.9	3.8	18	64-74	69	2.9	4.2
3	12	53-59	57	1.9	3.3	18	50-56	54	1.8	3.3
4	12	56-60	58	1.4	2.4	17	51-58	55	1.9	3.5
5	12	61-70	66	2.6	3.9	19	56-65	61	2.6	4.3
6	12	41-46	43	1.5	3.5	18	39-44	41	1.6	3.9
7	12	46-51	49	1.8	3.7	17	44-52	48	1.9	4.0
8	12	69-83	77	3.9	5.1	20	62-77	69	3.4	4.9
9	12	26-33	29	2.2	7.6	20	25-33	27	2.2	8.1
10	12	61-72	67	3.3	4.9	19	57-68	63	3.0	4.8
11	11	22-28	26	2.1	8.1	20	17-24	21	1.7	8.1
12	12	19-23	21	1.4	6.7	20	15-20	18	1.3	7.2
13	12	21-26	24	1.6	6.7	20	19-23	21	1.2	5.7
14	12	36-45	42	2.8	6.7	20	34-45	39	2.7	6.9

RACE AND SEX IN TRACHYPITHECUS CRISTATUS [1])

Skull measurements of the males and females of five races of *Trachypithecus cristatus* (*pyrrhus, sondaicus, kohlbruggei, cristatus,* and *ultimus*) are presented in tables 5-9. In all of them, as a rule, the female skull differs from that of the male in its smaller average dimensions as well as in proportions. The female skull has a proportionally wider brain case and greater height; the mandibular symphysis is relatively lower than that in the male. There are certain racial differences in the amount of sexual dimorphism, which will be treated in the pages that follow.

To begin with, it will be seen from the tables that the male skull of *T. c. pyrrhus,* the race from Eastern Java, is larger than the male skull of *T. c. sondaicus* from Western Java. The difference in size is statistically significant (table 11). However, there is no difference in size between the female skulls of the two races from Java. It follows from this that the sexual difference in skull size is greater in *pyrrhus* than it is in *sondaicus.*

1) A summary of this chapter will be found in Hooijer, 1960a.

TABLE 6

Skull measurements of adult males and females of *Trachypithecus cristatus sondaicus*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	6	97-103	101	2.4	2.4	13	91-102	96	2.9	3.0
2	6	65-74	72	3.5	4.9	13	63-74	69	3.5	5.1
3	6	54-57	55	1.3	2.4	13	51-56	53	1.9	3.6
4	6	54-58	56	1.5	2.7	13	51-60	54	2.1	3.9
5	6	60-67	65	2.8	4.3	13	59-66	62	2.0	3.2
6	6	41-45	43	1.9	4.4	13	38-44	41	2.0	4.9
7	6	46-51	48	1.8	3.8	13	45-52	48	2.7	5.6
8	6	64-76	72	3.8	5.3	13	63-76	69	3.6	5.2
9	6	22-31	28	3.1	11.1	13	23-30	28	2.3	8.2
10	6	59-64	63	1.9	3.0	13	58-67	62	3.0	4.8
11	6	19-24	22	1.7	7.7	13	19-23	21	1.3	6.2
12	6	17-20	18	1.3	7.2	13	17-19	18	0.9	5.0
13	6	18-23	21	1.8	8.5	12	18-23	21	1.4	6.7
14	6	32-43	39	3.7	9.5	13	31-43	38	3.0	7.9

TABLE 7

Skull measurements of one adult male and of females of *Trachypithecus cristatus kohlbruggei*

male		females				
No.		n	R	M	σ	C
1	101	5	93-101	97	3.6	3.7
2	73	5	64-73	67	3.7	5.5
3	56	5	52-53	52	0.7	1.3
5	57	5	53-57	55	1.5	2.7
5	64	5	59-62	60	1.3	2.2
6	43	5	38-42	41	1.6	3.9
7	49	5	45-47	46	0.9	2.0
8	—	5	65-74	69	3.5	5.1
9	—	5	23-27	24	1.7	7.1
10	—	5	60-64	62	1.6	2.6
11	24	5	21-22	22	0.7	3.2
12	19	4	17-20	18	1.4	7.8
13	21	5	20-23	21	1.6	7.6
14	43	5	36-43	40	2.7	6.8

The male skulls of *T. c. cristatus* and *T. c. ultimus*, the two races from Sumatra and Borneo, are as large as the male skull of *sondaicus* (the smaller of the two Java races), but the female skulls of *cristatus* and *ultimus* are smaller than the female skulls of *pyrrhus* and *sondaicus*, and the difference in size has again statistical significance (table 11). Thus, the sexual difference in skull size in the Sumatran and Bornean races is greater than that in the western Java race.

The female skull of *T. c. kohlbruggei* from Bali does not differ in size from the female skull of *sondaicus,* and the only male skull of *kohlbruggei* is likewise very near in dimensions to the mean of the male skull of *sondaicus. T. c. kohlbruggei,* therefore, does not appear to differ from *sondaicus* either in size of the skull or in the amount of sexual dimorphism.

The only male skull from Billiton available (table 10) is smaller than the male skull of *sondaicus,* and the difference in size stands the statistical test for the majority of the measurements (table 11). The female skull from

TABLE 8

Skull measurements of adult males and females of *Trachypithecus cristatus cristatus*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	6	96-101	99	1.8	1.8	—	—	—	—	—
2	6	68-72	70	1.7	2.4	—	—	—	—	—
3	6	53-55	54	1.0	1.9	—	—	—	—	—
4	6	52-57	54	1.8	3.5	4	53-56	54	1.4	2.6
5	5	55-64	61	3.5	5.7	4	57-61	60	1.9	3.2
6	6	40-42	41	0.8	2.0	4	41-43	42	1.1	2.6
7	6	44-48	47	1.7	3.6	—	—	—	—	—
8	6	69-73	71	1.7	2.4	4	60-67	65	3.4	5.2
9	6	27-30	28	1.3	4.6	4	23-26	25	1.4	5.6
10	6	61-66	63	1.9	3.0	4	58-63	60	2.3	3.8
11	6	22-24	23	0.8	3.5	4	17-21	18	1.9	10.5
12	6	18-20	19	0.8	4.2	4	15-18	16	1.3	8.1
13	6	21-25	23	1.7	7.4	4	19-21	20	1.1	5.5
14	6	36-40	38	1.5	4.0	4	32-36	35	2.0	5.7

Billiton is within the variation limits of the female skulls of *cristatus* and *ultimus*; it is smaller than the female skull of *pyrrhus.* In the Billiton form, therefore, the sexual difference in skull size would appear to be smaller again than that in *cristatus* and *ultimus*: the male skull is smaller than that in the Sumatran and Bornean races, the female skulls from Billiton, Sumatra and Borneo being equal in size.

As we have seen, the sexual difference in skull size in *sondaicus* (Western Java) is equal to that in *kohlbruggei* (Bali). In *pyrrhus* (Eastern Java) the sexual difference is greater than that in the races to the East and to the West because the male skull in *pyrrhus* is larger than that in *sondaicus,* the female skulls being equal in size. In *cristatus* and *ultimus* (Sumatra, Borneo) the sexual difference in skull size is also greater than that in *sondaicus,* but this is due to the female skulls of *cristatus* and *ultimus* being smaller than those of *sondaicus* and *kohlbruggei*; the male skulls do not show any size differences.

TABLE 9

Skull measurements of adult males and females of *Trachypithecus cristatus ultimus*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	5	98-103	101	2.2	2.2	10	87-93	90	2.3	2.6
2	5	70-75	72	2.3	3.2	10	60-66	63	1.7	2.7
3	5	52-57	55	2.1	3.8	9	49-53	51	1.2	2.4
4	5	51-56	54	2.2	4.1	10	50-54	52	1.1	2.1
5	5	63-66	65	1.6	2.5	10	57-61	58	1.3	2.2
6	5	39-46	41	2.9	7.1	10	38-42	39	1.6	4.1
7	5	43-48	46	2.1	4.6	10	43-48	45	1.7	3.8
8	5	68-74	71	2.3	3.4	9	61-66	63	1.7	2.7
9	5	27-28	27	0.7	2.6	9	20-28	24	2.3	9.6
10	5	61-67	63	2.3	3.7	10	57-62	59	2.0	3.4
11	5	20-22	21	0.7	3.3	10	15-19	18	1.3	7.2
12	5	17-19	18	1.0	5.6	10	14-17	15	0.9	6.0
13	5	20-23	21	1.3	6.2	10	17-21	19	1.3	6.8
14	5	36-42	38	2.9	7.6	9	32-37	35	1.8	5.1

The form from Billiton (which most probably would deserve subspecific distinction) appears to differ from *cristatus* and *ultimus* in the same point as that in which *sondaicus* and *kohlbruggei* do differ from *pyrrhus*: the male skull only is smaller, not that of the female.

In conclusion, it would seem that we are able to distinguish four racial groups in the species *Trachypithecus cristatus*, each different from that immediately preceding it in the size of the skull in one sex only, as follows:

I. *pyrrhus*
male skull smaller: II. *sondaicus, kohlbruggei*
female skull smaller: III. *cristatus, ultimus*
male skull smaller: IV. (Billiton)

It is of interest to note that the skull of *Trachypithecus cristatus* from Banka, male (U.S.N.M. no. 124725) as well as female (U.S.N.M. nos. 124711-124713), are within the limits of *cristatus* and *ultimus* from Sumatra and Borneo; as already stated by Lyon (1906, p. 607) externally the Banka specimens differ in no respects from those of Sumatra. On external as well as cranial characters I would class the Banka specimens with *cristatus*.

The arrangement of the races of *Trachypithecus cristatus* according to decreasing skull size deviates somewhat from that based on external characters: *sondaicus* is the darkest, and *ultimus* the palest race of all. Unfortunately the male from Billiton is a whitish mutant, but the female from Billiton is indistinguishable externally from *cristatus*. The groupage on skin colours coincides with that on cranial characters only in the case of *cristatus*

TABLE 10

Skull measurements of adult males and females of *Trachypithecus cristatus* from Banka and Billiton

	Banka (U.S.N.M.)		Billiton	
	male	3 females	male (L.M.)	female (U.S.N.M.)
No.				
1	97	87-88	91	85
2	71	61-63	66	59
3	53	48-50	50	50
4	55	49-55	51	51
5	62	57-59	60	58
6	40	39-41	39	40
7	45	42-45	44	46
8	74	61-64	68	61
9	29	21-25	28	22
10	64	56-60	59	55
11	23	18-19	23	15
12	19	15-16	19	15
13	22	18-19	22	18
14	39	30-37	40	34

and *ultimus*: craniometrically they are the same, and the external differences are very slight indeed. However, while the Bali form, *kohlbruggei*, craniometrically has to be classed with the Western Java *sondaicus*, externally it is similar to *pyrrhus* of Eastern Java, to which form it is also nearest geographically. Thus, while the arrangement on skin colours follows the geographi-

TABLE 11

Statistical data on the skull of *Trachypithecus cristatus*

	male skulls *pyrrhus — sondaicus*			female skulls *pyrrhus — ultimus*			male skulls *sondaicus* & Billiton		
No.	Diff. M	$E_{diff.}$	$\frac{Diff.\ M}{E_{diff.}}$	Diff. M	$F_{diff.}$	$\frac{Diff.\ M}{E_{diff.}}$	*sondaicus* M	E_M	Billiton
1	5	1.3	3.8	6	1.2	5.0	101	1.0	91
2	4	1.6	2.5	6	0.9	6.7	72	1.4	66
3	2	0.8	2.5	3	0.6	5.0	55	0.5	50
4	2	0.5	4.0	3	0.6	5.0	56	0.6	51
5	1	1.3	0.8	3	0.7	4.3	65	1.1	60
6	0	0.9	0	2	0.6	3.3	43	0.8	39
7	1	0.9	1.1	3	0.7	4.3	48	0.7	44
8	5	1.9	2.6	6	1.0	6.0	72	1.6	68
9	1	1.4	0.7	3	0.9	3.3	28	1.3	28
10	4	1.2	3.3	4	0.9	4.4	63	0.8	59
11	4	0.9	4.4	3	0.5	6.0	22	0.7	23
12	3	0.7	4.3	3	0.4	7.5	18	0.5	19
13	3	0.9	3.3	2	0.5	4.0	21	0.7	22
14	3	1.7	1.7	4	0.8	5.0	39	1.5	40

cal pattern (dark in Western Java; lighter in Eastern Java and Bali), that on cranial characters is at variance (male skull largest in Eastern Java; smaller in Western Java and Bali). It is hoped that more material of the Billiton form will become available for study in due course; at present it would seem that we may have a distinct race in this islet, externally similar to *cristatus* but differing in the smaller size of the male skull.

PLEISTOCENE REMAINS OF TRACHYPITHECUS FROM JAVA

An almost completely preserved calvarium from Tegoean (Coll. Dub. no. 3778) clearly belongs to the genus *Trachypithecus* (pl. I figs. 1-3). It belongs to a subadult male, as is evident from the partially erupted long canines, which do not project downward beyond the premolars. The last molars are not yet fully in place either; the left has not reached the level of the base of the crown of M^2, the right M^3 is slightly more advanced. The cranial portion is somewhat deformed, the right parieto-temporal region being more flattened than that on the left side, with the posterior zygomatic root displaced outward. The zygomatic arches are incomplete, and the anterior root of the left arch is distorted. The incisors have broken off; the premolars and the first and second molars, however, are excellently preserved and unworn except for the M^1 of which the internal cusps are worn.

The supraorbital ridges are quite marked; the anterior nasal opening gradually tapers to a point inferiorly, the postorbital constriction is considerable, and the palate is of the elongated type of *Trachypithecus*. The fossil is very similar in size to recent subadult males of the largest race, *Trachypithecus cristatus pyrrhus*, which, incidentally, is the subspecies today inhabiting the area from which the fossil specimen came. In the recent form (skulls nos. 7 and 11 of the list on p. 26 above), when M^3 is just appearing at the alveolar margin, the milk molars are being shed and P^{3-4} are not yet or just about in place; the milk canine is still in function, and the tip of its successor is not yet visible. The permanent canine, therefore, appears to erupt earlier in the fossil than in the now living form.

In table 12 the measurements of the fossil specimen may be compared with those of two recent skulls of *Trachypithecus cristatus pyrrhus* of the same sex and dental age (nos. 7 and 11). In the Pleistocene skull, the brain case width is too great, while the height of the calvarium and the vertical diameter of the orbit are too small, because of the pressure to which it has been subjected, but the remaining measurements do not seem to have been affected by the distortion of the fossil specimen. It will be seen that these measurements of the fossil skull agree very closely with the corresponding

recent apart from the biorbital width, despite the fact that the horizontal diameters of the orbit are the same. Like the supraorbital ridges, the lateral orbital margins are more thickened in the Pleistocene specimen than in the recent (7 mm in transverse width at level of centre of orbit against 4 mm in the recent). The height of the zygomatic process of the maxillary just below the orbit is also greater in the fossil than in the recent specimens (16 mm as opposed to 11 mm), and the zygomatic arches are thicker (at least 7 mm vertically against 4 mm). The nuchal crest is much more prominent in the fossil than in the recent subadult skulls.

TABLE 12

Skull measurements of subadult males of Pleistocene and recent *Trachypithecus*

	Coll. Dub. 3778	recent		
Greatest length	97	97	94	
Basal length	65	67	62	
Braincase width	62—	58	57	
Biorbital width	66	60	57	
Postorbital construction	45	45	44	
Orbit, horizontal diameter	23	23	23	
Idem, vertical diameter	18+	20	21	
Height of calvarium	44+	50	48	
P^3, ant. post.	5.0	4.9	—	Range
transverse	6.7	6.5	—	5.8-6.8
P^4, ant. post.	5.2	5.3	—	
transverse	7.2	6.6	6.2	6.2-7.0
M^1, ant. post.	7.3	7.2	6.9	
transverse	7.1	6.6	6.3	6.3-6.9
M^2, ant. post.	7.5	7.4	7.2	
transverse	7.6	7.3	7.0	7.0-7.6

Thus, although similar in over-all dimensions, the fossil is a more heavily-constructed skull than the recent, with a more strongly developed musculature no doubt. Even in fully adult males of *Trachypithecus cristatus pyrrhus* the bony orbit is more lightly-constructed (thickness of lateral wall 6 mm; height of ventral border 14 mm at most), and the zygomatic arch is more slender (6 mm vertically at most) than that in the subadult Pleistocene calvarium. The brow ridges and nuchal crest in the fossil specimen are as strongly developed as those in the most robust adult males of the recent form.

Coming now to the dentition (table 12), the premolars and molars of the fossil specimen are larger than those of the subadult specimens of the recent form used for comparison, especially in their transverse diameters (in these young skulls, with unworn or hardly worn teeth, the anteroposterior

diameters have not yet been affected by interproximal wear and can be taken exactly). However, when the total range of variation in transverse diameters of the premolars and molars of recent males of *Trachypithecus cristatus pyrrhus* (12 specimens) is taken into consideration (the greatest width of these teeth is at or near the base and hence will be unaffected by wear) only the transverse diameters of the fossil P^4 and M^1 are in excess of the recent maxima; those of P^3 and M^2 are within recent limits. It seems likely that, had more recent material been available, the widths of the fossil P^4 and M^1 would fall between the recent limits as well, but at any rate these figures suggest that the fossil *Trachypithecus* averaged larger in tooth size even than the largest living race of *Trachypithecus cristatus*.

The conclusion that the teeth of the fossil *Trachypithecus* from Java are larger, on an average, than of the living form, is fully verified by another specimen from the Pleistocene of Java, viz., the right half of a palate originating from Bangle, Coll. Dub. no. 3781 (pl. II fig. 6). It has the full permanent dentition in situ, and from the short canine it can be seen that it belongs to a female. The incisors (I^1 from the left side is also preserved) are broken, but the C, P, and M can be measured, and are definitely larger than those in twenty recent females of *Trachypithecus cristatus pyrrhus*; all, except the C and M^3, exceed the recent males in transverse diameters as well (table 13).

TABLE 13

Tooth measurements of Pleistocene female and recent female and male *Trachypithecus*

Coll. Dub. nos.	3779	3781	recent	
	♀	♀	♀♀	♂♂
C, transverse	—	6.2	4.8-5.9	5.8-7.0
P^3, transverse	7.0	7.2	5.0-5.8	5.8-6.8
P^4, transverse	6.9	7.3	5.4-6.6	6.2-7.0
M^1, transverse	7.0	7.4	5.4-6.8	6.3-6.9
M^2, transverse	—	7.8	6.0-7.5	7.0-7.6
M^3, transverse	—	7.2	5.8-7.0	6.7-7.4
Length P^4-M^3	—	26	21-25	24-26

There is a zone of overlap of dimensions of the recent female and male teeth. From the fact that the fossil female from Bangle exceeds the fossil male from Tegoean in tooth size it follows that the ranges of the teeth in the two sexes of the Pleistocene *Trachypithecus* overlapped as well, and that both specimens fall in this portion of the size range in which the two sexes overlap. The skull of the Pleistocene female is more lightly built than

that of the fossil male: the zygomatic process of the maxillary is preserved and measures 14 mm in height instead of 16 mm. In the recent females this dimension varies from 9 to 12.5 mm only.

An isolated right upper female canine from Soember Kepoeh (Coll. Dub. no. 3782) is of the same size as that in the Bangle specimen.

There is only one further specimen of *Trachypithecus* in the Dubois collection from the Pleistocene of Java that can be sexed, viz., a fragment of the left maxillary with P^4-M^2 but also the alveolus of the canine, the external wall of which is incomplete but which is comparatively small in size, indicating that it belonged to a female. The teeth in this specimen (Coll. Dub. no. 3779, from Soember Kepoeh) are slightly smaller than those of the female from Bangle (table 13); P^4 and M^1 are also smaller than those in the male from Tegoean (table 12), while P^3 is intermediate in width (M^2 cannot be measured as it is incomplete externally). Like the female from Bangle, the female from Soember Kepoeh has teeth larger than the maxima found in the recent female series.

An isolated right lower last molar originating from Trinil (Coll. Dub. no. 3783; pl. II figs. 2-3) should be referred to *Trachypithecus*. It has as well-developed talonid (poorly developed or absent in *Presbytis*), and the lingual cusps are prominent, separated by deep clefts (a distinction from *Macaca*).

TABLE 14

Measurements of M_3 of Pleistocene and recent *Trachypithecus*

	Coll. Dub.	recent	
	no. 3783	♂ ♂	♀ ♀
M_3, ant. post.	9.7	8.3-9.8	7.5-9.0
transverse	6.4	5.7-6.3	4.9-6.2

In greatest width the Pleistocene tooth exceeds all the recent homologues in *Trachypithecus cristatus pyrrhus* (12 males and 19 females); the length of the crown is just within the limits of recent male M_3.

Our knowledge of the Pleistocene *Trachypithecus* from Java rests upon the five specimens recorded above. Von Koenigswald (1940, p. 63) lists "*Pithecus pyrrhus*" from both the Djetis and the Trinil faunas. He does not give any details, but further notes (l.c., p. 64) that the M_3 from Trinil described by Stremme as "*Macacus* sp." belongs to the same form. The Trinil tooth has been well described and figured by Stremme (1911, pp. 140-141, pl. XVII figs. 9-11), and from the data presented it is quite evident that Stremme's identification is correct. The molars of *Trachypithecus* have wide and deep transverse valleys, extending further down to the base of the crown

than in *Macaca* molars. The difference is most clearly seen on the buccal surface of the upper, and the lingual surface of the lower molars. In *Macaca* the lingual surface of the uppers and the buccal surface of the lowers are less vertical, more inclined toward the centre of the crown, than in *Trachypithecus*. In the M_3, the talonid is more distinctly marked off from the second loph in *Trachypithecus* than in *Macaca,* a difference most clearly seen in lingual aspect.

The description and figures of the Trinil tooth given by Stremme (the legends to fig. 9 and 10 have been transposed: fig. 9 is the lingual aspect, fig. 10 the buccal) leave no doubt whatsoever that the fossil belongs to *Macaca.* It will be further considered under its appropriate heading.

Whether the "*Pithecus pyrrhus*" recorded by Von Koenigswald (1940, p. 63) from the Pleistocene of Java actually is *Trachypithecus* or in reality *Macaca* remains doubtful as long as the material has not been described or figured.

The specimens of *Trachypithecus* in the Dubois collection, although equal in characters to the living species *Trachypithecus cristatus,* show consistent deviations in size from the recent material, and may be distinguished as follows:

Trachypithecus cristatus robustus nov. subsp.

Diagnosis: Skull and teeth identical in specific characters with those of *Trachypithecus cristatus* (Raffles). The skull is more robustly constructed, the canine erupts earlier, and the premolars and molars are larger even than those of the largest living race, *T. c. pyrrhus* (Horsfield) today inhabiting the same area.

Holotype: The subadult male skull (Coll. Dub. no. 3778) described and figured in the present paper.

Locality: Tegoean, Central Java.

Age: Middle Pleistocene.

CAVE MATERIAL OF TRACHYPITHECUS FROM JAVA

Among the material of Primates from the Goea Djimbe near Redjotangan in Java, which is mostly *Macaca,* there are a few specimens of *Trachypithecus.* There is also material of *Trachypithecus* from the Wadjak cave in Java. These caves are early Holocene in age, and the specimens are as follows:

Coll. Dub. no. 10041a, Goea Djimbe, left palate with C-M^3 of female.

Coll. Dub. no. 10041b, Goea Djimbe, left palate with I^1-M^1 of male.

Coll. Dub. no. 10041c, Goea Djimbe, right palate with P^4-M^2, sex?

Coll. Dub. no. 10043a, Goea Djimbe, right corpus and part of ramus of mandible with M_{1-3} of female.

Coll. Dub. no. 1457a, Wadjak cave, right body of mandible with M_{2-3}.

Coll. Dub. no. 1457b, Wadjak cave, right body of mandible with M_2.

Coll. Dub. no. 1457c, Wadjak cave, right body of mandible with P_3-M_2.

The measurements of these cave specimens are presented in table 15. Comparison with tables 13 (upper teeth) and 16 (lower teeth) show that the prehistoric teeth are fully within limits of *Trachypithecus cristatus pyrrhus,* and smaller than the Pleistocene teeth of this species from Java. The height of the corpus at middle of M_3 varies from 19 to 23 mm in the ♀♀, and from 21 to 26 mm in the ♂♂ of *Trachypithecus cristatus pyrrhus* (table 5); Coll. Dub. no. 10043a, therefore, is of a female individual.

TABLE 15

Measurements of cave teeth of *Trachypithecus* from Java

	Coll. Dub. no. 10041				Coll. Dub. nos.			
	a ♀	b ♂	c		10043a ♀	1457a	1457b	1457c
C, tr.	5.3	6.4	—	P_3, tr.	—	—	—	4.2
P^3, tr.	5.8	6.6	—	P_4, tr.	—	—	—	4.7
P^4, tr.	6.3	6.8	6.5	M_1, tr.	5.4	—	—	5.7
M^1, tr.	6.7	6.5	6.4	M_2, tr.	6.1	—	5.5	6.1
M^2, tr.	7.3	—	—	M_3, ant. post.	—	8.2	—	—
M^3, tr.	6.2	—	—	M_3, tr.	5.8	5.5	—	—
P^4-M^3	24	—	—	Height corpus at M_3	20	—	—	—

The measurements in table 15 indicate that by the time of formation of the deposits in Goea Djimbe and Wadjak cave *Trachypithecus cristatus* had already been reduced in size to such an extent as to be indistinguishable from the form now living in Central and Eastern Java.

CAVE MATERIAL OF TRACHYPITHECUS FROM SUMATRA

In the Sumatran cave collections made by Dubois there are mainly isolated teeth, but exceptionally there is a jaw or bone that has not been eaten by porcupines. Such an exceptional specimen is the left corpus and part of the ramus of a mandible from the Sibrambang cave, Coll. Dub. no. 11688 (pl. I fig. 4; pl. II fig 8). This specimen is clearly a *Trachypithecus* from what is left of the powerful ramus ascendens; it belonged to a female individual as shown by the canine. The present-day Sumatran races of *Trachypithecus cristatus* are smaller-toothed than the larger race of Java *Trachypithecus cristatus pyrrhus.* The measurements in table 16 show that the subfossil

TABLE 16

Measurements of recent males and females of *Trachypithecus* and of subfossil female from Sumatra

	Java		Coll. Dub.	Sumatra	
	T. cristatus pyrrhus		11688	*T. c. cristatus* & *ultimus*	
	♂♂	♀♀	♀	♂♂	♀♀
C, tr.	4.5-5.2	3.6-4.4	4.3	4.1-4.5	3.2-4.2
P_3, tr.	4.2-4.7	3.7-4.5	4.2	3.8-4.5	3.2-4.2
P_4, tr.	4.2-4.7	4.0-4.8	4.8	3.8-4.5	3.8-4.7
M_1, tr.	5.2-5.5	4.8-5.7	5.6	4.4-5.0	4.5-5.3
M_2, tr.	6.0-6.6	5.2-6.5	6.3	5.2-5.9	5.0-6.0
M_3, ant. post.	8.3-9.8	7.5-9.0	9.2	7.3-8.6	7.1-9.0
M_3, tr.	5.7-6.3	4.9-6.2	6.2	4.8-5.5	4.8-5.7
P_4-M_3	27-30	23-29	29	24-26	23-26
Height corpus at $P_{3/4}$	19-23	15-20	18	17-20	14-18
Idem at M_3	21-26	19-23	22	20-25	17-21

female is above the range of variation in dimensions of the recent subspecies of *Trachypithecus cristatus* living in Sumatra (*cristatus* and *ultimus* have been lumped as there is no difference in the teeth between the two subspecies), but that it is within, and even near the upper limits of the range found for the females of the largest race of Central and Eastern Java, *Trachypithecus cristatus pyrrhus*. The M_3 of the subfossil mandible is even longer than that in the recent females from Java.

Had the Sibrambang cave specimen been a recent jaw from Java it would have been classed as *Trachypithecus cristatus pyrrhus*; now that it is a subfossil from Sumatra it indicates that there has been a reduction in size in the Sumatran *Trachypithecus cristatus* since the time of the formation of the cave deposits, and that the prehistoric Sumatran *Trachypithecus* was equal in size to the largest extant race, now living in Java. This is just another example of a very common phenomenon already referred to in the introductory chapter of the present paper. There can be no doubt that the subfossil Sumatran cave specimen represents a form directly ancestral to the living subspecies of the same island, and that it was not the same as the living Java race *Trachypithecus cristatus pyrrhus* although we are as yet unable to distinguish it from the latter subspecies on the basis of the material available. The Java subspecies, too, are the descendants of larger-sized forms such as the Pleistocene *Trachypithecus cristatus robustus* described in the present paper.

As we have seen in an earlier chapter, there are to-day some five subspecies of *Trachypithecus cristatus* in Java, Sumatra, and Borneo, which can be distinguished on external as well as cranial and dental characters, notably the

amount of sexual dimorphism. There is a Pleistocene ancestral subspecies in Java, and a more recent one in Sumatra, of which the external characters, however, are lost to us. In both islands the ancestral form is larger-toothed than the living of the same area. Subspecific differentiation of *Trachypithecus cristatus* existed in prehistoric times, and very likely originated back in the Pleistocene. Series of specimens of both sexes, Pleistocene as well as Early Holocene, from all over the present range of *Trachypithecus cristatus,* may show us in detail how the earlier forms have come down to the present-day subspecies.

Genus MACACA Lacépède

Macaca fascicularis (Raffles)

For the correct name of this, the common long-tailed or crab-eating macaque, usually referred to as *Macaca irus* F. Cuvier (*Macacus* or *Cercocebus cynomolgus* in the older literature) see Miller, 1942, p. 126/128. There is a large series of specimens in the Leiden Museum, listed below. I consider only the Java and Bali form sufficiently distinct to merit a subspecific name.

Macaca fascicularis (Raffles) subsp.

Material examined:

Infants

1. Mounted skin of male (skull inside). Pleyharie, S.E. Borneo, 20-8-1866, from J. Semmelink. L.M., cat. syst. w.
2. Skull (incomplete). Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., cat. ost. z.
3. Mounted skin of male. Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. d^2.
4. Stuffed skin and skull of male. Sumatra, from C. Blazer, 28-4-1930. L.M., reg. no. 1839.

Juveniles

5. Mounted skin (skull inside). S. E. Borneo, coll. J. H. Croockewit. L.M., cat. syst. v.
6. Mounted skin of male (skull inside). Malay Peninsula, from G. Schneider, 1875. L.M., cat. syst. h^2.
7. Skull. Sidjoendjoeng, Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 21-7-1877. L.M., cat. ost. w.
8. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., "*Macacus nemestrinus*", cat. ost. q.
9. Flat skin and incomplete skull. Roema Manoeal, S. foot of Mt. Kenepai, W. Borneo, 27-12-1893, coll. Büttikofer no. 24. L.M.
10. Flat skin and skull of male. Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo, 10-4-1894, coll. Büttikofer no. 160. L.M.
11. Stuffed skin of female. Rantau, 65 km N.E. of Bandjermasin, S. E. Borneo, coll. F. C. E. van der Putten, 10-5-1916, received 7-10-1919. L.M., reg. no. 4617.
12. Skull of female. Pangkalan, Padang Highlands, Central Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4647.
13. Skull of male. Wonosobo, Lampongs, S. Sumatra, 28-12-1924. Coll. Sody no. 60. L.M.

Subadults

14. Mounted skin of female (skull inside). S. W. Borneo, from S. Müller. L.M., cat. syst. u.
15. Mounted skin of male (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. b^2.
16. Mounted skin of female (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. c^2.
17. Skull. Malay Peninsula, from G. Schneider, 1875. L.M., "*Semnopithecus obscurus*", cat. ost. e.
18. Skeleton of male. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1883. L.M.
19. Flat skin and skull of male. Padang, W. Sumatra (imported 2-7-1915), from the Rotterdam Zoo, 30-7-1915. L.M., reg. no. 518.
20. Stuffed skin and skull of male. Padang, W. Sumatra, from the Rotterdam Zoo, 28-12-1920. L.M., reg. no. 1051.
21. Flat skin and skull of female. Sumatra, from C. Blazer, 10-4-1926. L.M., reg. no. 1479.
22. Skul of male. Pangkalan, Padang Highlands, Central Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4646.
23. Skull of male. Serang Djaja, E. Sumatra, October, 1931. Coll. Sody no. F 144. L.M.
24. Stuffed skin and skull of female. Banka. Coll. Sody no. Bk 53. L.M.

Adult males

25. Mounted skin (skull inside). S. W. Borneo, from S. Müller. L.M., cat. syst. s.
26. Mounted skin (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. x.
27. Mounted skin (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. y.
28. Mounted skin (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. z.
29. Mounted skin. Malay Peninsula, coll. P. Diard. L.M., cat. syst. f^2.
30. Skull. S. E. Borneo, coll. J. H. Croockewit. L.M., cat. ost. p.
31. Flat skin and skull. Smitau, Kapoeas river, W. Borneo, 15-12-1893, coll. Büttikofer no. 6. L.M.
32. Flat skin and skull. Roema Manoeal, S. foot of Mt. Kenepai, W. Borneo, 27-12-1893, coll. Büttikofer no. 23. L.M.
33. Flat skin and skull. Mt. Liang Koeboeng, Upper Kapoeas, Central Borneo, 18-4-1894, coll. Büttikofer no. 178. L.M.
34. Skull. Sumatra, from C. Blazer, 18-8-1930. L.M., reg. no. 1872a.
35. Stuffed skin and skull. Padang, W. Sumatra, from the Rotterdam Zoo, 1-4-1920. L.M., reg. no. 981.
36. Skull. Sumatra, from W. Groeneveldt, 3-2-1938. L.M., reg. no. 3322.
37. Skull. Benkoelen, W. Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4648.
38. Skull. Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4658.
39. Skull. Loeboek Sikaping, E. Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4659.
40. Skull. Tamiang, N. E. Sumatra, November, 1931. Coll. Sody no. F 143. L.M.
41. Skull. Djeboes, Banka. Coll. Sody no. Bk 7. L.M.
42. Stuffed skin and skull. Banka. Coll. Sody no. Bk 52. L.M.
43. Skull. Banka. Coll. Sody no. Bk 74. L.M.

Adult females

44. Mounted skin and skull. Padang Highlands, Central Sumatra, coll. J. F. Snelleman, 1878. L.M., cat. syst. e^2, cat. ost. v.
45. Mounted skin and skull. Malay Peninsula, from G. Schneider, 1875. L.M., cat. syst. g^2, cat. ost. r.

46. Mounted skin (skull inside). S.W. Borneo, from S. Müller. L.M., cat. syst. t.
47. Mounted skin (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. a^2.
48. Flat skin. Poelau, Sibau river, W. Borneo, 19-6-1894, coll. Büttikofer no. 229. L.M.
49. Skull. Sumatra, from C. Blazer, 18-8-1930. L.M., reg. no. 1872a.
50. Skull. Pangkalan, Padang Highlands, Central Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4645.
51. Skull. Pajakombo, Padang Highlands, Central Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4649.
52. Skull. Serang Djaja, E. Sumatra, 8-11-1931. Coll. Sody no. F 145. L.M.

Macaca fascicularis mordax Thomas et Wroughton

Material examined:

Infants

1. Mounted skin (skull inside). Western Java, from S. Müller and H. C. Macklot. L.M., cat. syst. f.
2. Mounted skin (skull inside). Western Java, from C. L. Blume. L.M., cat. syst. g.
3. Mounted skin (skull inside). Western Java, coll. P. Diard, 1863. L.M., cat. syst. h.
4. Skeleton of male. Western Java, from C. L. Blume. L.M., cat. ost. d.
5. Skeleton of male. Western Java, coll. P. Diard, 1863. L.M., cat. ost. e.
6. Skull. Java, from the Temminck collection. L.M., cat. ost. n.
7. Stuffed skin and skull of male. Banjoewangi, E. Java, from the Rotterdam Zoo, 16-12-1919. L.M., reg. no. 959.
8. Mounted skin of female (skull inside). Mt. Pangerango, W. Java, purchased from Schlüter and Mass, February, 1903. L.M., reg. no. 2067.
9. Skull of female. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651e.
10. Skull of female. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651f.
11. Skull of female. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651g.
12. Skull of male. Java, from C. Blazer, 2-6-1937, L.M., reg. no. 3087.
13. Skull of female. Java, from C. Blazer, 2-6-1937. L.M., reg. no. 3089.
14. Skull of male. Java, from C. Blazer, 11-6-1937. L.M., reg. no. 3106.
15. Skull of male. Java, from C. Blazer, 14-6-1937. L.M., reg. no. 3109.
16. Skull of male. Java, from C. Blazer, 23-8-1937. L.M., reg. no. 3178.
17. Skull of male. Toelong Agoeng, Central Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4655.
18. Skull of male. Gedangan, res. Samarang, Central Java, 10-2-1930. Coll. Sody. L.M.

Juveniles

19. Mounted skin and skull of female. Western Java, coll. P. Diard, 1863. L.M., cat. syst. d, cat. ost. h.
20. Mounted skin of female (skull inside). Java, from the Amsterdam Zoo, 14-12-1860. L.M., cat. syst. m.
21. Skull (incomplete). Java, coll. H. Kuhl and J. C. van Hasselt. L.M., cat. ost. m.
22. Mounted skin of male. Kawarasan, E. Java, 20-4-1895. L.M., reg. no. 2067.
23. Stuffed skin and skull of female. Java, from C. Blazer, 15-8-1936. L.M., reg. no. 2505a.
24. Stuffed skin and skull of female. Java, from C. Blazer, 15-8-1936. L.M., reg. no. 2505b.
25. Stuffed skin and skull of female. Java, from C. Blazer, 18-8-1936. L.M., reg. no. 2527.
26. Skull of female. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651b.
27. Skull of male. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651c.
28. Skull of female. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651d.

29. Skull of female. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651h.
30. Skull of male. Java, from C. Blazer, 11-5-1937. L.M., reg. no. 2651i.
31. Skull of male. Java, from C. Blazer, 2-6-1937. L.M., reg. no. 3088.
32. Stuffed skin and skull of female. Java, from C. Blazer, 3-6-1937. L.M., reg. no. 3095.
33. Stuffed skin and skull of male. Java, from C. Blazer, 3-6-1937. L.M., reg. no. 3094.
34. Stuffed skin and skull of male. Java, from C. Blazer, 4-6-1937. L.M., reg. no. 3097.
35. Skull. Java, from C. Blazer, 8-6-1937. L.M., reg. no. 3099.
36. Skull of male. Java, from C. Blazer, 11-6-1937. L.M., reg. no. 3107.
37. Skull of male. Java, from C. Blazer, 14-6-1937. L.M., reg. no. 3110.
38. Skull of male. Java, from C. Blazer, 15-6-1937. L.M., reg. no. 3113.
39. Skull of male. Java, from C. Blazer, 15-6-1937. L.M., reg. no. 3114.
40. Skull of male. Java, from C. Blazer, 15-6-1937. L.M., reg. no. 3115.
41. Skull of male. Java, from C. Blazer, 23-8-1937. L.M., reg. no. 3179.
42. Skull. Bandoeng, Java, 1937, from N. Gosselaar, 29-4-1938. L.M., reg. no. 3438.
43. Stuffed skin and skull of male. Mt. Salak (2000 m), W. Java. Coll. Sody no. A 147. L.M.
44. Stuffed skin and skull of male. Pangonan, Mt. Moeria, Central Java, 19-12-1928. Coll. Sody no. M 40. L.M.

Subadults

45. Mounted skin of female (skull inside). Java. L.M., cat. syst. k.
46. Mounted skin of male (skull inside). Java, L.M., cat. syst. l.
47. Mounted skin (albino). Java. L.M., cat. syst. n.
48. Skeleton. Western Java, coll. H. Kuhl and J. C. van Hasselt. L.M., cat. ost c.
40. Skull of male. Java, from C. Blazer, 15-6-1937. L.M., reg. no. 3115.
50. Skull of female. Java, from C. Blazer, 13-9-1937. L.M., reg. no. 3188.
51. Skull of female. Java, from C. Blazer, 22-10-1937. L.M., reg. no. 3229.
52. Skull of male. Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4644.
53. Skull of male. Toeloeng Agoeng, Central Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4651.
54. Skull of female. Toeloeng Agoeng, Central Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4653.
55. Stuffed skin and skull of female. Mt. Singkil, W. Java, coll. H. W. van der Weele, 20-7-1909. L.M., reg. no. 5919 o.
56. Skull of female. Wonokojo, Dampit, S. Malang, E. Java. Coll. Sody no. Won. 3. L.M.
57. Stuffed skin and skull of female. Gedangan, res. Samarang, Central Java, 3-10-1929. Coll. Sody no. 74. L.M.
58. Stuffed skin and skull of male. Mt. Salak (2000 m), W. Java. Coll. Sody no. A 137. L.M.
59. Stuffed skin and skull of male. Sendang, W. Bali. Coll. Sody no. E 34. L.M.
60. Stuffed skin and skull of female. Djembrana Negara, W. Bali. Coll. Sody no. E 139. L.M.

Adult males

61. Mounted skin (skull inside). Western Java, from S. Müller. L.M., cat. syst. a.
62. Mounted skin and skull. Western Java, coll. P. Diard, 1863. L.M., cat. syst. b, cat. ost. f.
63. Mounted skin and skull. Western Java, coll. P. Diard, 1863. L.M., cat. syst. c, cat. ost. g.
64. Mounted skin (skull inside). Western Java, 1870. L.M., cat. syst. e.
65. Mounted skin (skull inside). Java, from the Rotterdam Zoo, 22-8-1875. L.M., cat. syst. i.
66. Mounted skin (skull inside). Java, from Mr. Kok, 10-1-1866. L.M., cat. syst. j.
67. Skeleton, Java. L.M., cat. ost. a.

68. Skeleton, Western Java, coll. P. Diard. L.M., cat. ost. b.
69. Skull. Java, from the Temminck collection. L.M., cat. ost. j.
70. Skull. Java. L.M., cat. ost. k.
71. Skull. Java, coll. Van Aken, 1836. L.M., cat. ost. l.
72. Mounted skin (skull inside). Mt. Pangerango, W. Java, 4-7-1903. L.M., reg. no. 2067.
73. Calvarium of a captive individual, Batavia, 1933. L.M., reg. no. 2683.
74. Skull. Toeloeng Agoeng, Central Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4650.
75. Skull. Toeloeng Agoeng, Central Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4654.
76. Skull. Ngawi, Central Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4660.
77. Stuffed skin and skull. Mt. Singkil, W. Java, 20-7-1909, coll. H. W. van der Weele. L.M., reg. no. 5919p.
78. Stuffed skin and skull. Mt. Singkil, W. Java, 19-7-1909, coll. H. W. van der Weele. L.M., reg. no 5919q.
79. Skull. Gedangan (65 m), res. Samarang, Central Java, November, 1930. Coll. Sody no. V 1. L.M. Left I_2, C and P_3 missing; left upper C overgrown.
80. Skull. Gedangan (65 m), res. Samarang, Central Java, October, 1931. Coll. Sody. L.M.
81. Skull. Gedangan (65 m), res. Samarang, Central Java, April, 1931. Coll. Sody. L.M.
82. Skull. Gedangan (65 m), res. Samarang, Central Java. Coll. Sody no. V 10. L.M.
83. Skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 12. L.M.
84. Flat skin and skull. Batoeraden, Mt. Slamat (700 m), Central Java. Coll. Sody no. 89C. L.M.
85. Stuffed skin and skull. Mt. Salak, W. Java, November, 1931. Coll. Sody no. A 221. L.M.
86. Stuffed skin and skull. Sendang, W. Bali. Coll. Sody no. E 64. L.M.
87. Stuffed skin and skull. Sendang, W. Bali. Coll. Sody no. E 74. L.M.
88. Stuffed skin and skull. Mt. Agoeng, E. Bali. Coll. Sody no. E 85. L.M.
89. Stuffed skin and skull. Djembrana Negara, W. Bali. Coll. Sody no. E 136. L.M.

Adult females

90. Skull. Java. L.M., cat. ost. i.
91. Skull. Java, from the Soerabaja Zoo, August, 1934, from Jhr. W. C. van Heurn. L.M., reg. no. 2684.
92. Skull. Toeloeng Agoeng, Central Java, from the collection of E. Dubois, 1941. L.M., reg. no. 4652.
93. Stuffed skin and skull. Mt. Tiloe, W. Java, 6-5-1910, coll. H. W. van der Weele. L.M., reg. no. 5919n.
94. Skull. Gedangan (65 m), res. Samarang, Central Java. Coll. Sody no. V 9. L.M.
95. Stuffed skin and skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 13f. L.M.
96. Stuffed skin and skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 26f. L.M.
97. Stuffed skin and skull. Tjeringin, near Bandjar, W. Java. Coll. Sody no. 25f. L.M.
98. Stuffed skin and skull. Tjandiroto (600 m), Central Java, 20-6-1929. Coll. Sody no. 107 B. L.M.
99. Skull. Wonokojo, Dampit, S. Malang, E. Java. Coll. Sody no. Won. 4. L.M.
100. Skull. Wonokojo, Dampit, S. Malang, E. Java. Coll. Sody no. Won. 5. L.M.

Macaca nemestrina nemestrina (L.)

The large, pig-tailed macaque from the Malay Peninsula (North to about Trang), Sumatra, Banka, and Borneo, is here taken to represent the typical race (cf. Chasen, 1940, p. 65). The material examined is listed below.

Infants

1. Skull. 1889. A.M., no. S 156.
2. Skull. From the Amsterdam Zoo, 1890. A.M., no. S 246.

Juveniles

3. Mounted skin of male (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. c.
4. Mounted skin of male (skull inside). Sumatra, from the Rotterdam Zoo, 12-9-1879. L.M., cat. syst. d. Albino.
5. Mounted skin of male (skull inside). From the Amsterdam Zoo, 16-10-1879. L.M., cat. syst. k. Albino.
6. Mounted skin of male (skull inside). Coll. Van Aken, 1834. L.M., cat. syst. j.
7. Skeleton. S. E. Borneo, from S. Müller, 1836. L.M., cat. ost. f.
8. Flat skin and skeleton of female, received 29-10-1910. L.M., reg. no. 254.
9. Skull. 1888. A.M., No. S 141.
10. Skull. 1890. A.M., no. S 231.

Subadults

11. Mounted skin (skull inside). Kapoeas river, W. Borneo, coll. L. A. C. M. Schwaner, May, 1845. L.M., cat. syst. e.
12. Mounted skin of female (skull inside). From the Rotterdam Zoo, 14-6-1875. L.M., cat. syst. i.

13a. Skull of female. Borneo, from C. G. C. Reinwardt. L.M., *"Semnopithecus nasica"*, cat. ost. e.

13b. Skull. L.M., cat ost. l.

14. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., cat. ost. p.
15. Skull. Roema Manoeal, S. foot of Mt. Kenepai, W. Borneo, 26-12-1893, coll. Büttikofer no. 22. L.M.
16. Skull of female. 1893. A.M., no. S. 314.
17. Mounted skin of male. Palembang, S. Sumatra, from the Rotterdam Zoo, 4-2-1921. L.M., reg. no. 1066.
18. Stuffed skin of female. From C. Blazer, 9-9-1931. L.M., reg. no. 1997.
19. Stuffed skin of male. From C. Blazer, 15-9-1931. L.M., reg. no. 2000.

Adult males

20. Mounted skin (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. a.
21. Mounted skin and skeleton. From the Rotterdam Zoo, 23-3-1875. L.M., cat. syst. g, cat. ost. a.
22. Skeleton. From the Amsterdam Zoo, 6-1-1862. L.M., cat. ost. b.
23. Skeleton. Coll. Van Aken. L.M., cat. ost. c.
24. Skeleton. From the Rotterdam Zoo, 30-10-1866. L.M., cat. ost. d.
25. Skeleton of a menagerie specimen. L.M., cat. ost. e.
26. Skull. Pontianak, W. Borneo, coll. P. Diard. L.M., cat. ost. k.
27. Skull. Padang Besi, Sumatra, from S. Müller. L.M., cat. ost. h.
28. Skull. Padang Highlands, Central Sumatra, from S. Müller. L.M., cat. ost. i.
29. Skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., cat. ost. n.
30. Incomplete skull. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1882. L.M., cat. ost. o.
31. Flat skin and skull. Solok, Padang Highlands, Central Sumatra, from P. O. Stolz, 17-7-1915. L.M., reg. no. 513.
32. Mounted skin and skull. From the Rotterdam Zoo, 20-2-1920. L.M., reg. no. 975.
33. Flat skin and skeleton. Sumatra, from C. Blazer, 17-9-1929. L.M., reg. no. 1776. Malformed M_3 dext.
34. Flat skin and skeleton. Sumatra, from C. Blazer, 23-4-1936. L.M., reg. no. 2452.
35. Skull. From the collection of E. Dubois, 1941. L.M., reg. no. 4656.

36. Skull. 1859. A.M., no. S 99.
37. Skull. From the Amsterdam Zoo, 14-10-1890. A.M., no. S 102.

Adult females

38. Mounted skin (skull inside). Padang, W. Sumatra, from S. Müller, 1836. L.M., cat. syst. b.
39. Mounted skin skull. Pontianak, W. Borneo, coll. P. Diard. L.M., cat. syst. f, cat. ost. g.
40. Mounted skin and skull. From the Rotterdam Zoo, 24-12-1870. L.M., cat. syst. h, cat. ost. m.
41. Skull. Padang Highlands, Central Sumatra, from S. Müller. L.M., cat. ost. j.
42. Skeleton. Tandjoeng Morawa, N. E. Sumatra, coll. B. Hagen, 1883. L.M.
43. Stuffed skin and skull. From C. Blazer, 28-12-1928. L.M., reg. no. 1721.
44. Stuffed skin and skull. From C. Blazer, 9-1-1929. L.M., reg. no. 1725.
45. Skull. Benkoelen, W. Sumatra, from the collection of E. Dubois, 1941. L.M., reg. no. 4657.
46. Skull. A.M., no. S 101.

Skull measurements of adult males and females are given in tables 17-19. It will be noticed that the Java race (*mordax*) exceeds the Sumatran and Bornean form of *Macaca fascicularis* in size. There is a marked sexual dimorphism, and the males are more variable than the females: the variation coefficients average 6.4 for the males of Sumatra and Borneo against 7.1 for the males of Java, as opposed to 5.1 for the females of Sumatra and Borneo, and 5.9 for the females of Java. The mandible is more variable than the calvarium, as usual. *Macaca nemestrina nemestrina* is slightly more variable than the Java race of *Macaca fascicularis* (average of C 7.5 in the males, 6.2 in the females), and the sexes differ even more in skull size than they do in the smaller species.

PLEISTOCENE REMAINS OF MACACA FROM JAVA

Macaca is represented in the Dubois collection from Pleistocene sites in Java by the following specimens:

1. Coll. Dub. no. 3785 (Bangle), P^3-M^3 dext., associated; also parts of I^{1-2} and root of upper C, large, of the male type.
2. Coll. Dub. no. 3792 (Trinil), M^3 dext., crown only, base incomplete.
3. Coll. Dub. no. 3790 (Trinil), I_1 sin., much worn; also left lower male C.
4. Coll. Dub. no. 3794 (Trinil), P_3 sin. of female individual.
5. Coll. Dub. no. 3787 (Trinil), P_4 dext.
6. Coll. Dub. no. 3791 (Trinil), P_4 sin.
7. Coll. Dub. no. 3788 (Trinil), M_{2-3} sin.
8. Coll. Dub. no. 3786 (Bangle), parts of right and left corpora of mandible with M_{1-3} dext. and sin. (pl. II fig. 9).

9. Coll. Dub. no. 3793 (Bangle), part of left corpus and ramus of subadult mandible with M_{1-2}.

10. Coll. Dub. no. 3789 (Trinil), M_3 dext. (pl. II figs. 4-5).

The best specimen, Coll. Dub. no. 3785, the teeth of which are slightly displaced from their natural relative positions, clearly belongs to a male, for the canine root is at least 9 mm in anteroposterior diameter near the base of the crown (which is lost). Comparison with recent macaques from Java shows that, whereas the premolars are within recent limits of size, the molars are disproportionally large, especially M^2 and M^3 (table 20). Such a difference is to be expected in a comparison of a fossil with the living form, reduction of the last molars being less advanced in the former than in the latter. In the Pleistocene specimen, M^3 is only slightly narrower than M^2, and distinctly wider than M^1.

TABLE 17

Skull measurements of adult males and females of *Macaca fascicularis* subsp.

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	14	100-122	111	5.8	5.2	5	96-103	100	3.6	3.6
2	14	69-86	80	4.8	6.0	5	65-71	69	2.9	4.2
3	14	47-55	51	2.3	4.5	5	47-51	49	1.6	3.3
4	14	52-57	55	1.9	3.5	6	51-54	53	1.2	2.3
5	14	53-69	62	4.8	7.7	6	51-56	53	1.7	3.2
6	14	38-42	40	1.5	3.8	6	38-40	39	0.8	2.1
7	14	42-50	46	2.1	4.6	6	43-46	45	1.2	2.7
8	14	72-89	81	4.8	5.9	6	66-74	70	3.6	5.2
9	14	22-29	26	2.0	7.7	6	19-23	21	1.6	7.6
10	14	54-65	61	3.3	5.4	6	54-56	55	0.9	1.6
11	14	23-32	27	2.6	9.6	6	21-26	23	1.7	7.4
12	14	15-20	18	1.6	8.9	6	14-17	15	1.3	8.1
13	14	15-19	17	1.3	7.7	6	12-16	15	1.4	9.3
14	14	26-34	31	2.9	9.4	6	23-31	29	2.9	10.0

In recent males of *Macaca fascicularis mordax*, M^3 is either narrower or slightly wider than M^2, but it is never more than 1.3 mm wider than M^1 (in 17 specimens out of the recent series in which the three upper molars can be measured M^3 is, on an average, 0.7 mm wider than M^1), while in the fossil specimen M^3 is 1.6 mm wider than M^1.

Molar widths such as those found in Coll. Dub. no. 3785 occur in recent *Macaca nemestrina nemestrina*, but in this form the premolars are larger relative to the molars than in *M. fascicularis mordax* and in the fossil specimen, and M^3 is less reduced in size, characters that militate against the fossil specimen being an ancestral form of *Macaca nemestrina*.

TABLE 18

Skull measurements of adult males and females of *Macaca fascicularis mordax*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	22	111-135	123	6.8	5.5	11	101-114	107	4.0	3.7
2	19	82-100	91	5.7	6.3	11	67-82	75	4.2	5.6
3	21	51-58	55	2.2	4.0	11	48-53	51	1.6	3.1
4	24	54-63	58	2.6	4.5	11	53-59	55	2.1	3.8
5	24	56-82	67	5.5	8.2	10	53-69	56	3.0	5.4
6	24	36-43	40	1.9	4.8	10	38-42	40	1.2	3.0
7	21	44-54	49	2.7	5.5	11	44-49	46	1.7	3.7
8	23	81-103	92	6.5	7.1	11	69-84	77	4.7	6.1
9	23	26-34	29	2.7	9.3	11	19-26	23	2.1	9.1
10	22	60-74	69	3.7	5.4	11	54-69	61	3.9	6.4
11	22	26-37	32	2.9	9.1	11	20-27	24	2.2	9.2
12	23	17-25	21	2.2	10.5	11	15-18	17	1.0	5.9
13	23	17-23	20	1.7	8.5	11	14-10	17	1.6	9.4
14	23	28-41	36	3.6	10.0	11	28-39	34	2.9	8.5

TABLE 19

Skull measurements of adult males and females of *Macaca nemestrina nemestrina*

	males					females				
No.	n	R	M	σ	C	n	R	M	σ	C
1	17	143-168	150	9.5	6.3	8	114-135	125	6.2	5.0
2	17	93-128	112	9.6	8.6	7	80-95	86	4.5	5.2
3	16	60-66	63	1.9	3.0	7	52-60	56	2.5	4.5
4	17	63-70	67	1.9	2.8	8	63-70	65	2.5	3.8
5	17	70-93	80	7.6	9.5	8	61-76	66	5.2	7.9
6	16	47-54	51	2.0	4.0	8	45-51	48	2.1	4.4
7	16	52-57	55	1.7	3.1	7	49-55	51	2.3	4.5
8	17	97-125	111	9.0	8.1	7	86-96	89	3.7	4.2
9	17	28-40	33	3.8	11.5	7	24-31	26	2.3	8.8
10	17	71-88	78	4.3	5.5	7	65-78	70	5.0	7.1
11	17	30-49	41	5.0	12.1	8	25-34	31	2.7	8.7
12	17	22-29	26	2.7	10.4	8	20-25	22	1.8	8.2
13	17	19-27	23	2.5	10.9	8	16-21	18	1.4	7.8
14	17	36-47	41	3.5	8.5	7	34-42	37	2.7	7.3

Consequently, the Pleistocene macaque from Bangle would appear to belong to *Macaca fascicularis,* differing from the living form of the island in the larger size of its molar teeth. In this it only conforms to the general rule. In the absence of further remains of the upper dentition of known sex we are as yet unable to determine the variation limits of size of the Pleistocene *Macaca fascicularis* (Raffles) subsp., which undoubtedly overlapped with recent ranges.

TABLE 20

Tooth measurements of Pleistocene and recent male *Macaca*

	Coll. Dub. no. 3785	*M. fascicularis mordax* ♂♂		*M. n. nemestrina* ♂♂	
	♂	Range	Mean	Range	Mean
P^3, transverse	5.9	5.1-6.4	5.8	5.8-8.5	6.8
P^4, transverse	6.9	5.5-6.9	6.2	6.5-7.9	7.3
M^1, transverse	7.6	6.0-7.2	6.8	6.9-7.8	7.4
M^2, transverse	9.4	7.0-8.6	7.7	7.6-9.3	8.6
M^3, transverse	9.2	6.5-8.5	7.6	7.5-9.7	8.7

The isolated M^3 from Trinil (Coll. Dub. no. 3792) is incomplete at the base of the crown, which measures at least 6.7 mm transversely, within the recent range.

The mandibular teeth of *Macaca* from the Pleistocene of Java are known from a number of specimens enumerated above. The canine (Coll. Dub. no. 3790) is certainly male, the anterior premolar (Coll. Dub. no. 3794) of the opposite sex. Neither of them is outside the range of the recent homologous teeth (table 21). The sex of the individuals to which the remaining fossil specimens of the mandible belonged is, of course, uncertain; all but one of them are above the limits found in recent females of *Macaca fascicularis mordax*. Since it is probable that at least some of the fossil specimens are of the female sex, this material is suggestive, again, of the fossil macaque being somewhat larger-toothed than the living Java macaque.

TABLE 21

Tooth measurements of Pleistocene and recent *Macaca*

Coll. Dub. nos.	3790	3794	3787	3791	*Macca fascicularis mordax*	
	♂	♀			♂♂	♀♀
Lower C, ant. post.	8.7	—	—	—	7.7-11.3	5.3- 7.0
transverse	5.3	—	—	—	4.7- 6.2	2.9- 3.7
P_3, height [1])	—	7.9	—	—	9.7-14.5	7.0- 8.6
transverse	—	4.1	—	—	4.0- 4.9	3.5- 4.1
P_4, transverse	—	—	5.4	5.5	4.5- 5.7	4.4- 5.4
Coll. Dub. nos.	3788	3786	3793	3789		
M_1, transverse	—	6.2	5.9	—	4.8- 6.3	5.2- 5.8
M_2, transverse	6.6	7.3	6.5	—	6.0- 7.6	5.8- 6.9
M_3, ant. post.	10.4	11.1	—	10.2	8.7-12.5	9.0-10.7
transverse	7.6	7.2	—	7.2	5.7- 7.9	6.0- 7.0

1) The height of P_3 is measured from the base of the antero-external enamel extension to the posterior border of the crown. It differs significantly in males and females, and is of value in sexing specimens (Hooijer, 1950, p. 51).

The fossil M_3 from Trinil described and figured by Stremme (1911, pp. 140-141, pl. XVII figs. 9-11) measures 9.0 mm anteroposteriorly and 6.5 mm transversely, and thereby is somewhat smaller than the Dubois Collection specimens from the same site and Bangle; it is within the range of the recent female as well as male M_3. In his discussion of the specimen, Stremme aptly points out that it differs from "*Semnopithecus*" in the valleys between the cusps being less deep internally (as shown in Stremme's pl. XVII fig. 9), and that it is decidedly closer to *Macaca fascicularis*. Of this species, Stremme had specimens from Sumatra and Borneo only, which, as we shall see further on, are smaller than those from Java. He notes that the recent Sumatran and Bornean M_3 are as a rule slightly shorter and narrower than the fossil Trinil specimen; as can be seen from his table only the males approach or equal the Trinil specimen in size. The accessory internal tubercle to the talonid is a variable character, occurring more often in large than in small M_3. The Trinil M_3 described by Stremme is a true *Macaca fascicularis,* conspecific with the living form of Java but with teeth that average larger than those in *Macaca fascicularis mordax* as indicated by the remains recorded in the present chapter.

It is impossible to judge the validity of two further species of *Macaca* from the Pleistocene of Java provisionally named I and II by Von Koenigswald (1940, p. 64). The former is stated to have a strong, the latter an almost entirely reduced talonid to M_3. The talonid may be absent in the M_3 of the living *Macaca fascicularis,* and varies in development even in one and the same individual. Such variations may be expected to occur in the Pleistocene form as well, and need not be of specific value.

The fossil mandible from Saradan described by Deninger (1910) as belonging to *Macaca nemestrina* was stated to differ from recent material of that species in its narrow symphysial portion and smaller canine. However, these are the points in which *Macaca fascicularis* differs from *Macaca nemestrina,* and the Saradan specimen should have been referred to the Java macaque instead, as already noticed by Von Koenigswald (1940, p. 64). The fossil mandible, which is that of a male individual as follows from the dimensions of the C (anteroposterior diameter 9 mm, transverse diameter 4.5 mm) and the great height of P_3, does not fall outside the variation limits of recent males of *Macaca fascicularis mordax*, although it is a rather large specimen.

CAVE MATERIAL OF MACACA FROM JAVA

The following specimens of the upper jaw are available from Goea Djimbe:

Coll. Dub. no. 10046a, right palate with C-M^3 of female.

Coll. Dub. no. 10046b, left palate with P^4-M^3.

Coll. Dub. no. 10046c and d, right and left palate with P^3-M^2, M^3 erupting.

Coll. Dub. no. 10046e, right palate with P^3-M^1.

Coll. Dub. no. 10046f, left palate with M^{1-2}.

Coll. Dub. no. 670a, right upper male C.

Coll. Dub. no. 10043b, right palate with I^2-P^4 (broken) and M^{1-2} of female.

Coll. Dub. no. 10043c, right palate with P^4 and M^1.

From the Goea Ketjil originates Coll. no. 10028, a right palate with P^3-M^3. A right palate with P^4-M^2 (broken) and M^3 is from a cave near Wadjak: Coll. Dub. no. 10014.

The measurements of the above specimens will be found in table 22.

TABLE 22

Measurements of cave teeth of *Macaca* from Java

Coll. Dub. nos.	10046					670	10043		10028	10014	*Macaca*	
	a	b	c	e	f	a	b	c			*fascicularis*	*mordax*
	♀					♂	♀				♂ ♂	♀ ♀
Upper C, ant. post.	—	—	—	—	—	10.6	—	—	—	—	8.5-11.2	4.7-6.3
transverse	4.9	—	—	—	—	6.4	—	—	—	—	5.7- 7.9	3.9-5.3
P^3, transverse	5.9	—	6.1	5.6	—	—	—	—	5.5	—	5.1- 6.4	5.0-6.5
P^4, transverse	6.8	6.9	6.5	6.5	6.6	—	—	6.8	6.1	—	5.5- 6.9	5.5-6.9
M^1, transverse	6.9	7.3	6.7	6.7	7.4	—	7.3	7.3	6.4	—	6.0- 7.2	6.0-7.5
M^2, transverse	8.2	8.4	7.7	—	—	—	7.8	—	7.3	—	7.0- 8.6	6.7-8.2
M^3, transverse	7.6	7.9	—	—	—	—	—	—	6.6	8.3	6.5- 8.5	6.5-7.7
Length P^4-M^3	26	28	—	—	—	—	—	—	26	28	25-32	26-28

Specimens of the mandible are more common in the Java cave collections; the following are from Goea Djimbe and belong to male individuals:

Coll. Dub. no. 10046g, left body of mandible and part of right, holding the C and P_3 of both sides, and P_3-M_3 sin., much worn down.

Coll. Dub. no. 10046h and i, two left lower C.

Coll. Dub. no. 10046j, P_3 sin.

Coll. Dub. no. 10046k, symphysis and right body of mandible with left C (broken) and P_4-M_3.

Coll. Dub. no. 10046l, right body of mandible with C and P_4-M_3.

Coll. Dub. no. 10046m, right body of mandible with P_4, M_1 (broken), M_{2-3}.

Coll. Dub. no. 10046n, right body of mandible with P_3-M_2.

Coll. Dub. no. 10046 o, right body of mandible with P_4-M_3.

Coll. Dub. no.10046p, left body of mandible with M_3.

Coll. Dub. no. 670b, P_3 sin.

Coll. Dub. no. 820a, right body of mandible with P_3-M_3.

Coll. Dub. no. 10043d, right body of mandible with C and P_3.

Mandible portions belonging to females are less numerous in Goea Djimbe:

Coll. Dub. no. 10046q, symphysis and left body and ramus of mandible with I and C (broken) and P_3 of both sides, and P_4-M_3 sin.

Coll. Dub. no. 10046r, right body of mandible with P_3-M_3.

Coll. Dub. no. 10046s, right body and part of ramus of mandible with C-P_4 and M_{2-3}.

Coll. Dub. no. 10046t, right body of mandible with P_3-M_3.

Coll. Dub. no. 10046u, right body and ramus of mandible with M_{1-2}.

TABLE 23A

Measurements of cave teeth of *Macaca* from Java (males)

Coll. Dub. nos.	10046							670b	820a	10043
	g	h, j	i, k	l	m, n	o	p			d
	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂
Lower C, ant. post.	7.1	9.4	9.7	8.1	—	—	—	—	—	8.6
transverse	4.6	5.3	5.3	4.8	—	—	—	—	—	5.4
P_3, height	9.9	12.4	—	—	9.7	—	—	10.8	12.2	10.0
transverse	4.4	4.3	—	—	4.3	—	—	4.5	4.5	4.2
P_4, transverse	4.7	—	4.7	4.8	4.9	4.7	—	—	4.7	—
M_1, transverse	5.5	—	5.2	5.4	5.6	5.0	—	—	5.3	—
M_2, transverse	—	—	6.4	6.8	7.2	6.4	—	—	6.7	—
M_3, ant. post.	9.3	—	9.8	9.5	—	9.3	10.5	—	10.4	—
transverse	5.7	—	6.1	6.4	7.1	6.2	6.7	—	6.2	—
Length P_4-M_3	29	—	30	31	—	30	—	—	33	—
Height corpus at P_4	23	—	21	—	—	22	—	—	—	—
Height corpus at M_3	—	—	21	20	23	21	22	—	20	—

The upper teeth from Goea Djimbe do not exceed their recent homologues in size. The lower teeth, with a few exceptions, do not either. Comparison of tables 23 A and B with table 21 shows that the male mandible Coll. Dub. no. 10046g has a C smaller than that in any of the recent males compared, although it is definitely wider than a female C. Of the female mandibles, Coll. Dub. no. 10046r has P_3 and M_1 wider than those in any of the recent females. The remaining material is within recent limits in all dimensions taken. The length P_4-M_3 varies from 27 to 36 mm in recent males, and from 28 to 32 mm in recent females of *Macaca fascicularis mordax*. The height of the corpus at P_4 and M_3 is greater in males than in females (table 18, measurements 12 and 13), and the cave specimens show the same disparity in size in the two sexes.

TABLE 23B

Measurements of cave teeth of *Macaca* from Java (females)

Coll. Dub. nos.	10046				
	q	r	s	t	u
	♀	♀	♀	♀	♀
Lower C, ant. post.	—	—	6.3	—	—
transverse	—	—	3.5	—	—
P_3, height	7.5	8.0	7.6	7.5	—
transverse	3.6	4.4	4.0	—	—
P_4, transverse	4.6	5.0	4.9	4.8	—
M_1, transverse	5.2	6.0	—	5.6	5.6
M_2, transverse	6.0	6.8	6.9	6.8	6.8
M_3, ant. post.	—	9.4	—	—	—
transverse	—	—	6.8	6.9	—
Length P_4-M_3	—	30	—	—	—
Height corpus at P_4	16	—	15	15	—
Height corpus at M_3	16	—	16	17	—

In conclusion, therefore, the Early Holocene *Macaca* teeth from Java has the dimensions of those of the living form or the same island. This material does not carry the suggestion of larger tooth size that we found in the Pleistocene *Macaca*.

CAVE MATERIAL OF MACACA FROM SUMATRA

There are two species of *Macaca* living at present in Sumatra, viz., *M. fascicularis,* and *M. nemestrina*. The same two species also live in the Malay Peninsula and in Borneo. In Java the situation is different: only *Macaca fascicularis* lives there, and the Java race is larger than the form from Sumatra and Borneo. There is neither recent nor fossil evidence for the presence of *Macaca nemestrina* in Java.

Unfortunately the material of *Macaca* from the Central Sumatran caves in the Dubois collection consists of isolated teeth only; there are no associated teeth or remains of the skull. There is a considerable range in dimensions of the teeth of the two Sumatran *Macaca* species (table 24). The smallest teeth are found in the females of *M. fascicularis* (first column), but, the C and P_3 excepted, they widely overlap the ranges of the male teeth of the same species. Whereas there is little, if any, overlap between the dimensions of the male teeth of *M. fascicularis* and those of *M. nemestrina* (second and fourth columns), the female teeth of *M. nemestrina,* with the exception of the C and P_3, overlap with both ranges. Therefore, in a collection comprising only isolated teeth of the two sexes of both *M. fascicularis* and *M. nemestrina,* the only specimens that may profitably be studied are those of

TABLE 24

Tooth measurements of *Macaca* from Sumatra and Borneo

	Macaca fascicularis		*Macaca nemestrina*	
	♀♀	♂♂	♀♀	♂♂
Upper C, ant. post.	4.8-5.5	8.1-10.0	6.1-8.0	11.8-14.3
transverse	3.7-4.6	5.4-6.7	4.9-6.7	6.3-9.2
P^3, transverse	4.6-5.7	4.7-6.0	5.5-6.7	5.8-8.5
P^4, transverse	5.2-5.9	5.1-6.3	6.3-7.0	6.5-7.9
M^1, transverse	5.2-6.3	5.7-6.7	6.5-7.3	6.9-7.8
M^2, transverse	5.6-7.2	6.0-7.8	7.6-8.7	7.6-9.3
M^3, transverse	5.6-6.5	5.8-7.9	7.2-8.8	7.5-9.7
Length P^4-M^3	22-25	23-27	28-31	29-34
Lower C, ant. post.	4.8-6.5	7.2-9.5	5.9-8.4	9.8-12.5
transverse	2.7-3.6	4.6-5.5	4.0-4.9	5.7-7.8
P_3, height	6.3-8.7	9.3-13.6	8.8-10.7	12.8-19.5
transverse	3.0-4.3	3.6-4.7	4.0-4.6	4.8-7.7
P_4, transverse	4.0-4.8	4.0-5.0	4.8-5.7	5.0-7.8
M_1, transverse	4.3-5.2	4.5-5.5	5.4-6.3	5.5-7.4
M_2, transverse	5.0-6.1	5.4-6.5	6.4-7.8	6.5-9.2
M_3, ant. post.	7.4-8.5	7.6-10.5	9.8-11.8	10.0-13.8
transverse	4.9-5.8	5.3-6.8	6.4-8.6	7.4-9.5
Length P_4-M_3	24-27	26-31	31-35	31-41

which the sex can be determined: the upper and lower canines and the anterior lower premolars. The last lower molars will be considered for good measure.

There are 18 specimens of male upper C of *Macaca* in the Sumatran cave collection that are preserved well enough for measurements at the crown base to be taken (Coll. Dub. no. 11689/1-18). Nos. 1-9 are from the right side, nos. 10-18 from the left. Nos. 1, 2, 4-6, 11-15 and 17 are from the Sibrambang cave, no. 9 is from the Lida Ajer cave, nos. 3, 7-9, 16 and 18 are from the Djamboe cave; the locality of no. 10 is not recorded. In a number of specimens wear has reached the posterior crown base so that the full anteroposterior diameter cannot be given; the transverse diameter at the base of the crown can be measured in all specimens.

Table 25 shows that two specimens (nos. 3 and 13) exceed in anteroposterior diameter the maximum found in the recent series of *Macaca nemestrina* (14.3 mm; table 24). All of the cave specimens are larger than the male upper C of the recent Sumatran *M. fascicularis*. There is a possibility, however, that some of the small-sized cave specimens belong to *M. fascicularis,* for in the recent Java form (table 22) the male upper C ranges upward to 11.2 mm in anteroposterior, and to 7.9 mm in transverse diameter at base, and it is likely that the cave form of *M. fascicularis* from Sumatra had teeth larger than the living form of the same island.

The female upper C of *Macaca* is represented in the Sumatran cave col-

TABLE 25

Measurements of male upper C of *Macaca* from Sumatran caves

No. of specimen	1	2	3	4	5	6	7	8	9
Anteroposterior	13.9	12+	15.0	14+	13.3	13+	13.2	11.3	11+
Transverse	7.1	8.4	7.8	7.0	7.8	6.2	7.1	7.4	7.2
No. of specimen	10	11	12	13	14	15	16	17	18
Anteroposterior	12+	13.7	12.2	14.6	12.6	12.7	13.5	13.4	10+
Transverse	6.7	6.8	8.8	7.7	8.3	7.8	8.3	7.1	6.4

lection by 20 specimens (Coll. Dub. no. 11690/1-20). Nos. 1-11 are from the right, nos. 12-20 from the left side. Nos. 1-7, 9, 12-14 and 17-20 originate from the Sibrambang cave; no. 15 is from the Djamboe cave; the cave of nos. 8, 10, 11 and 16 is unknown. There is one specimen among these cave canines (no. 3 in table 26) that exceeds its recent homologues in *Macaca*

TABLE 26

Measurements of female upper C of *Macaca* from Sumatran caves

No. of specimen	1	2	3	4	5	6	7	8	9	10
Anteroposterior	7.4	7.5	8.3	7.4	6.7	7.5	6.7	5.9	6.3	6.2
Transverse	5.2	5.8	6.2	6.0	5.7	5.2	5.6	4.9	5.2	4.8
No. of specimen	11	12	13	14	15	16	17	18	19	20
Anteroposterior	5.2	7.2	7.8	7.2	7.8	7.3	7.8	5.9	5.9	6.3
Transverse	4.5	5.3	5.4	5.6	5.0	5.3	6.1	4.7	4.7	4.9

nemestrina in anteroposterior diameter, while only one (no. 11) is within the limits of the female upper C of the recent Sumatran form of *M. fascicularis*. Six further specimens (nos. 8-10 and 18-20) are still within the limits of the female upper C in the recent Java form of *M. fascicularis* (table 22), and may represent either large *M. fascicularis* or small *M. nemestrina* canines.

Twenty-nine specimens of male lower C of *Macaca* are present in the Sumatran cave collection (Coll. Dub. no. 11691/1-29). Nos. 1-15 are from the right side, and nos. 16-29 from the left. Nos. 1, 2, 5, 9, 10, 13, 14, 17, 19, 21-24 and 27-29 are from the Sibrambang cave, nos. 3, 4 and 16 from the Lida Ajer cave, nos. 6, 11 and 15 from the Djamboe cave, while of the remaining specimens there is no record for the locality. The measurements (table 27) give the familiar picture: a few specimens are larger anteroposteriorly than the recent form of *M. nemestrina* (nos. 1-3, 6 and 24), another few within the limits of the recent Sumatran form of *M. fascicularis* (nos. 4, 10 and 23). There are several others (nos. 16, 20, 25 and 27) that are near the lower end of the range of variation in size of the male lower C in recent *M. nemestrina*; these may represent *M. fascicularis* as well.

TABLE 27

Measurements of male lower C of *Macaca* from Sumatran caves

No. of specimen	1	2	3	4	5	6	7	8	9	10
Anteroposterior	12.6	12.7	12.8	9.4	10.3	13.2	10.4	11.0	11.9	8.2
Transverse	7.4	6.7	7.6	5.4	6.0	7.7	6.5	6.4	6.4	5.1
No. of specimen	11	12	13	14	15	16	17	18	19	20
Anteroposterior	10.5	10.3	10.4	10.1	10.5	9.9	10.3	12.1	12.5	9.6
Transverse	7.0	6.0	6.3	6.7	6.6	5.7	6.7	6.5	7.5	5.8
No. of specimen	21	22	23	24	25	26	27	28	29	
Anteroposterior	11.3	12.4	9.1	13.7	10.2	10.1	10.3	10.5	10.4	
Transverse	6.0	7.4	5.7	7.1	5.8	7.0	5.8	6.5	6.2	

Only four specimens of female lower C of *Macaca* have been found in the Sumatran cave collection, one right and three left specimens (Coll. Dub. no. 11692/1-4). Nos. 1, 2 and 4 are Sibrambang cave specimens, no. 3 is of unknown origin. These few specimens (table 28) are within the range of their recent homologues in *Macaca nemestrina* (table 24) but for one specimen (no. 2) that is slightly longer anteroposteriorly. No *M. fascicularis* appears to be present.

TABLE 28

Measurements of female lower C of *Macaca* from Sumatran caves

No. of specimen	1	2	3	4
Anteroposterior	7.2	8.7	8.0	6.9
Transverse	4.3	4.6	4.2	4.5

The anterior lower premolar, P_3, of *Macaca* is represented in the Sumatran cave collection by 21 specimens, 9 right and 12 left specimens, of which the height (from base of antero-external enamel extension to posterior border of crown) can be measured. All of these belong to male individuals (Coll. Dub. no. 11693/1-21). Nos. 1-3, 6-8, 10-12 and 17-21 originate from the Sibrambang cave, nos. 4, 5 and 15 are from the Lida Ajer cave, no. 16 is from the Djamboe cave; the name of the cave from which nos. 9, 13 and 14 came is not on record.

Measurements in table 29 indicate that all specimens are between the

TABLE 29

Measurements of P_3 (male) of *Macaca* from Sumatran caves

No. of specimen	1	2	3	4	5	6	7	8	9	10
Height	17.5	17.3	15.9	16.2	18.2	15.5	17.5	19.0	17.7	18.8
Transverse	5.4	5.5	5.4	5.6	5.4	5.2	5.7	6.7	5.6	5.6
No. of specimen 11	12	13	14	15	16	17	18	19	20	21
Height 17.4	16.6	16.0	18.1	15.9	18.4	14.2	17.5	16.3	17.1	17.6
Transverse 5.8	5.7	5.3	5.6	5.6	5.7	5.4	6.1	5.1	5.0	5.6

limits of size found in recent male P_3 of *Macaca nemestrina* as given in table 24. Of the smaller species *M. fascicularis* no material is apparently present.

The last lower molar of *Macaca*, 32 specimens of which are in the Sumatran cave collection (Coll. Dub. no. 11694/1-32), is rather variable in the development of the talonid, which is usually well-marked but which may be so small as to be practically absent, thereby greatly reducing the length of the tooth. Of the cave specimens, nos. 1-17 are from the right side, and nos. 18-32 from the left. All originate from the Sibrambang cave except no. 18, which is from the Lida Ajer cave, and no. 15, of which the origin is unknown. The variation in size is considerable (table 30), and, although none exceeds

TABLE 30

Measurements of M_3 of *Macaca* from Sumatran caves

No. of specimen	1	2	3	4	5	6	7	8	9	10
Anteroposterior	11.8	13.0	12.5	12.0	11.5	11.5	11.8	10.5	10.2	11.0
Transverse	8.8	8.7	8.0	8.3	7.7	8.4	7.6	7.6	7.5	8.1
No. of specimen	11	12	13	14	15	16	17	18	19	20
Anteroposterior	11.6	10.8	11.6	11.6	11.2	9.3	9.0	13.2	13.5	11.7
Transverse	8.4	7.1	8.7	8.2	8.5	5.7	5.7	9.4	9.3	9.2
No. of specimen	21	22	23	24	25	26	27	28	29	30
Anteroposterior	11.3	12.1	11.3	11.5	12.3	12.0	11.2	11.3	9.6	9.7
Transverse	8.7	9.2	8.2	8.2	8.3	8.1	7.8	7.9	7.8	7.5
No. of specimen	31	32								
Anteroposterior	9.3	10.1								
Transverse	5.8	7.5								

the maximum found in recent *Macaca nemestrina*, some are close to this limit. No. 29 has a very small talonid but has the great width of *M. nemestrina*. There are a few specimens (nos. 16, 17 and 31) that are much narrower-crowned and shorter than the others; it seems that these can be confidently referred to *Macaca fascicularis*. Nos. 8, 9, 12, 30 and 32, however, are very close to the lower limit of the size range in *M. nemestrina* and may be *M. fascicularis*, too. Teeth of this size occur in the recent males of *Macaca fascicularis mordax* (table 21) as well as in the females of *Macaca nemestrina* (table 24). The sex of the cave specimens cannot be determined, however, since these are isolated specimens, and the specific identity of the small cave M_3 remains uncertain.

In conclusion, then, the *Macaca* material from the Sumatran caves is mainly *Macaca nemestrina*, and occasionally the cave teeth exceed their recent homologues in size. *Macaca fascicularis* appears to be present in the Sumatran cave deposits, too, but is much less common than the larger species. The fragmentary nature of the cave material does not permit of specific determination

in all cases, but it is likely that the cave form of *M. fascicularis* is slightly larger-toothed than the living form of Sumatra, as is true in the cases of the orang-utan, the gibbons, the silvered leaf monkey, and the pig-tailed macaque of the same deposits.

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EXPLANATION OF THE PLATES

Plate I

Figs. 1-3, *Trachypithecus cristatus robustus* nov. subsp., calvarium (holotype), Coll. Dub. no. 3778, Tegoean, Java; fig. 1, front view; fig. 2, dorsal view; fig. 3, left view.

Fig. 4, *Trachypithecus cristatus* (Raffles) subsp., left corpus and part of ramus of mandible with I_2-M_3, Coll. Dub. no. 11688, Sibrambang cave, Sumatra, outer view.

All figures natural size.

Plate II

Figs. 1-3 and 6, *Trachypithecus cristatus robustus* nov. subsp.; fig. 1, calvarium (holotype), Coll. Dub. no. 3778, Tegoean, Java, ventral view; figs. 2-3, M_3 dext., Coll. Dub. no. 3783, Trinil, Java; fig. 2, lingual view; fig. 3, crown view; fig. 6, right half of palate with I^1-M^3, Coll. Dub. no. 3781, Bangle, Java, ventral view.

Figs. 4-5 and 9, *Macaca fascicularis* (Raffles) subsp.; figs. 4-5, M_3 dext., Coll. Dub. no. 3789, Trinil, Java; fig. 4, lingual view; fig. 5, crown view; fig. 9, left corpus of mandible with M_{1-3}, Coll. Dub. no. 3786, Bangle, Java, crown view.

Fig. 7, *Presbytis aygula* (L.) subsp., part of right palate with P^3-M^2, Coll. Dub. no. 3780, Soember Kepoeh, Java, ventral view.

Fig. 8, *Trachypithecus cristatus* (Raffles) subsp., left corpus and part of ramus of mandible with I_2-M_3, Coll. Dub. no. 11688, Sibrambang cave, Sumatra, crown view.

Figs. 1 and 6-9, natural size; figs. 2-5, twice natural size.


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