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SOME REMARKS ON THE SUBSPECIES OF PHALANGER URSINUS (TEMMINCK) AND OF LENOMYS MEYERI (JENTINK) FROM CELEBES

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In connection with a study of an extensive collection of prehistoric mammals from Toalian caves in Southwestern Celebes, a certain number of recent mammal species from Celebes and adjacent islands have been examined. In most cases the recent material for comparison available of a given species was adequate to determine the status of the corresponding cave form. Some of the cave animals (*Phalanger celebensis* (Gray), *Macaca maura* (Geoffr. et F. Cuvier), *Macrogalidia musschenbroekii* (Schlegel), *Sus celebensis* Müller et Schlegel, and *Babyrousa babyrussa* (L.)) could be shown to be subspecifically distinct from the living forms (Hooijer, 1950 a). In all of these cases the time that has elapsed since the deposition of the material in the prehistoric caves has been sufficient for a subspecific differentiation to have taken place.

In some cases examined, however, the recent material available to me at the time was rather poor, and additional material was greatly needed. Since the preparation of the cave report (Hooijer, 1950 a) more recent specimens have been examined while visiting various natural history museums in the United States. It is a great pleasure to thank the curators of mammals, Dr. George H. H. Tate of the American Museum of Natural History, Dr. David H. Johnson of the United States National Museum, and Dr. Colin C. Sanborn of the Chicago Natural History Museum, for their kind cooperation and permission to study the material in the collections under their charge.

The present paper contains observations on *Phalanger ursinus* (Temminck) and *Lenomys meyeri* (Jentink), two species which are represented

in the cave collection and which I have dealt with before on the basis of much less material than is at present available.

In the text the following abbreviations have been used: A.M.N.H. for American Museum of Natural History, New York, U.S.N.M. for United States National Museum, Washington, and C.N.H.M. for Chicago Natural History Museum. The measurements given are all in millimeters.

Phalanger ursinus (Temminck), the large bear cuscus of Celebes, was reviewed some years ago by Tate (1945). Much emphasis in the distinction of subspecies is placed on the size and shape of the outer upper incisor, I^3, which are considered to provide probably significant race characters. Tate's observations can be restated thus: In *Phalanger ursinus ursinus* from North Celebes and Peleng Island, off the coast of Central Celebes, I^3 has a relatively straight crown and blade-like cutting edge; in *Ph. u. furvus* from Central and South Celebes the crown of I^3 is longer but similar in shape to that of the typical race, while in the majority of the specimens of *Ph. u. togianus* from the Togean Islands, in the Gulf of Tomini, Northern Celebes, I^3 has a notched crown, the posterior third being separated as a distinct cusp by vertical grooves on the inner and outer sides of the tooth, thus making it practically bicuspid. In the Togean Islands race the crown length, like that in *Ph. u. furvus,* exceeds that in *Ph. u. ursinus* (Tate, 1945, pp. 27-29).

Observations on the cotypes of *Ph. u. ursinus* in the Leiden Museum (Hooijer, 1950 a, p. 14) showed me that the crown length of I^3 does not furnish a distinguishing character, the variation in topotypical *Ph. u. ursinus* being thus that the range overlaps completely that found for *Ph. u. furvus* and *Ph. u. togianus,* while according to Tate's figures (Tate, 1945, p. 28) these ranges would be sharply distinct.

As first observed by Tate (1945, pp. 4, 27-29), the shape of the crown of I^3 is of value as a distinguishing character. However, this serves only to differentiate a small majority of the Togean Islands specimens from those of Celebes proper. When re-examining the beautiful series of adult male and female skulls of *Ph. u. togianus* in the American Museum, a list of which is given below, it was found that the I^3 has a bicuspid crown, on both sides , only in six of the thirteen males; in two males (A.M.N.H. nos. 153359, 153360) only the right I^3, in three others (nos. 153365, 153370, 153371) only the left I^3 has a bicuspid crown, while no. 153367 does not have bicuspid I^3 crowns at all (one male skull, no. 153381, has the left I^3 broken off, but the right one shows the simple undivided crown of the Celebes mainland form).

Among the eleven adult females from the Togean Islands there are only five that show a bicuspid I^3 crown more or less clearly on both sides; no. 153378 has a bicuspid crown in the right I^3 only, while the five remaining specimens (nos. 153361, 153362, 153368, 153372 (the left I^3 is broken in this one), and 153380) have the I^3 crowns undivided.

Thus, these bicuspid I^3 crowns occur on both sides about as many times in the Togean Islands specimens as they do not, and there are at least six skulls that show this condition on one side and not on the other. We may, however, certainly speak at least of a tendency toward grooved and bicuspid I^3 crowns in the Togean Islands form, and it may be used as a character for separating this subspecies. Externally, as already remarked by Tate (1945, p. 4), the Togean Islands race is very like *Ph. u. ursinus* from the Celebes mainland.

Unfortunately, no specimens of I^3 have been found among the subfossil material of *Phalanger ursinus* from the Toalian caves so that we cannot check this point in the prehistoric form.

I have paid special attention to the size of the teeth in the recent races of *Ph. ursinus,* as this often is the only distinction that can be made between fossil or subfossil and recent specimens of the same species. The former almost invariably tend to be larger than the latter (cf. Hooijer, 1950 b). In my previous study I had material of recent *Ph. u. ursinus,* including the cotypes in the Leiden Museum, but nothing of *Ph. u. furvus* or of *Ph. u. togianus* which was unfortunate especially with a view to the fact that *Ph. u. furvus* in the original description (Miller and Hollister, 1922) was stated to have larger teeth than *Ph. u. ursinus*. As will be seen from the lists that follow I am in a far better position now.

Phalanger ursinus ursinus (Temminck)

Material examined:

Juveniles

1. Skull of female; M3 not yet erupted. Paleleh, North Celebes, coll. H. C. Raven, August 19, 1914. U.S.N.M. no. 199749.

Subadults (M4 not erupted)

2. Flat skin and skull of male. Laboea Sore, North Celebes, coll. H. C. Raven, November 15, 1916. U.S.N.M. no. 218039.
3. Stuffed skin and skull of female. Kwandang, North Celebes, coll. H. C. Raven, October 19, 1914. U.S.N.M. no. 199750.
4. Stuffed skin and skull obtained at Macassar, Celebes, coll. National Geographic-Smithsonian Sumatra Expedition, 1937. U.S.N.M. no. 267391.

Adult males

5. Stuffed skin and skull. Kwandang, North Celebes, coll. H. C. Raven, October 31, 1914. U.S.N.M. no. 199751.
6. Flat skin and skull. Batoe Hangoes Baroe, Northeastern Celebes, coll. H. C. Raven, June 8, 1916. U.S.N.M. no. 217575.
7. Flat skin and skull. Pinepada, Central Celebes, coll. H. C. Raven, February 2, 1918. U.S.N.M. no. 219474.
8. Skull. Pinepada, Central Celebes, coll. H. C. Raven, February 5, 1918. U.S.N.M. no. 219475.
9. Flat skin and skull. Lembeh Island, off the coast of Northeastern Celebes, coll. H. C. Raven, June 16, 1916. U.S.N.M. no. 217577.
10. Stuffed skin and skull obtained at Macassar, Celebes, coll. National Geographic-Smithsonian Sumatra Expedition, 1937. U.S.N.M. no. 267390.
11. Flat skin and skull. Lembeh Island, Northeastern Celebes, coll. F. C. Wonder, Crane Pacific Expedition, June 19, 1929. C.N.H.M. no. 31724.
12. Stuffed skin and skeleton. Lembeh Island, Northeastern Celebes, coll. R. C. Andrews, November 12, 1909. A.M.N.H. no. 30596.
13. Flat skin and skeleton. Peleng Island, off the coast of Central Celebes, coll. J. J. Menden, July 23, 1938. A.M.N.H. no. 108794.
14. Flat skin and skeleton. Peleng Island, Central Celebes, coll. J. J. Menden, July 23, 1938. A.M.N.H. no. 109233.

Adult females

15. Flat skin and skull. Kwandang, North Celebes, coll. H. C. Raven, October 31, 1914. U.S.N.M. no. 199752.
16. Flat skin and skull. Batoe Hangoes Baroe, Northeastern Celebes, coll. H. C. Raven, June 8, 1916. U.S.N.M. no. 217574.
17. Flat skin and skull. Koela Prang, Northeastern Celebes, coll. H. C. Raven, June 14, 1916. U.S.N.M. no. 217576.
18. Stuffed skin and skull. Toli Toli (Naloe), North Celebes, coll. H. C. Raven, December 30, 1914. U.S.N.M. no. 199754.
19. Stuffed skin and skull. Paleleh, North Celebes, coll. H. C. Raven, August 19, 1914. U.S.N.M. no. 199748.
20. Flat skin and skull. Boemboelan, North Celebes, coll. J. J. Menden, October 13, 1939. A.M.N.H. no. 152884.
21. Flat skin and skull. Lembeh Island, off the coast of Northeastern Celebes, coll. F. C. Wonder, Crane Pacific Expedition, June 20, 1929. C.N.H.M. no. 31726.
22. Mounted skin and skull. Lembeh Island, Northeastern Celebes, coll. F. C. Wonder, Crane Pacific Expedition, June 20, 1929. C.N.H.M. no. 31727.
23. Flat skin and skull. Lembeh Island, Northeastern Celebes, coll. F. C. Wonder, Crane Pacific Expedition, June 19, 1929. C.N.H.M. no. 31725.
24. Flat skin and skeleton. Peleng Island, off the coast of Central Celebes, coll. J. J. Menden, July 23, 1938. A.M.N.H. no. 108796.
25. Flat skin and skull. Peleng Island, Central Celebes, coll. J. J. Menden, July 23, 1938. A.M.N.H. no. 108797.

In this series of skulls there is one with a dental anomaly: in skull no. 12 from Lembeh Island the right I^3 is congenitally absent. All of the specimens from Lembeh Island which I found are indistinguishable from the present subspecies previously recorded from Celebes and Peleng Island.

Phalanger ursinus furvus Miller et Hollister

Material examined:

1. Stuffed skin and skull of subadult female. Rano Rano, Central Celebes, altitude about 1800 m, coll. H. C. Raven, December 21, 1917. U.S.N.M. no. 219471.
2. Flat skin and skull of adult male. Rano Rano, Central Celebes, altitude about 1800 m, coll. H. C. Raven, January 5, 1918. U.S.N.M. no. 219473. This is the type of *Phalanger furvus* Miller et Hollister.
3. Stuffed skin and skull of adult female. Rano Rano, Central Celebes, altitude about 1800 m, coll. H. C. Raven, December 21, 1917. U.S.N.M. no. 219472.
4. Stuffed skin and skull of adult female. Lombasang, Lompobatang, Southwestern Celebes, altitude 1100 m, coll. G. Heinrich, September 24, 1931. A.M.N.H. no. 100981.
5. Stuffed skin and skull of adult female. Wawokaraeng, Lompobatang, Southwestern Celebes, altitude 2000 m, coll. G. Heinrich, September 18, 1931. A.M.N.H. no. 100982.
6. Stuffed skin of adult male. South Celebes, coll. G. Heinrich. A.M.N.H. no. 100983.

One dental variation to be noticed in the series of specimens is that the type skull (no. 2) lacks one of the intermediate teeth between C and P_4 on both sides of the mandible, there being only one small tooth present instead of the normal number of two.

Phalanger ursinus togianus Tate

Material examined:

Adult males

1-13. Flat skin and skull (nos. 9 and 10 are flat skin and skeleton). Malenge, Togean Islands, in the Gulf of Tomini, North Celebes, coll. J. J. Menden, November 22-December 27, 1939. A.M.N.H. nos. 153377 (type), 153358-153360, 153363-153365, 153367, 153370, 153371, 153374, 153379, 153381.

Adult females

14-24. Flat skin and skull (no. 19 is flat skin and skeleton). Malenge, Togean Islands, in the Gulf of Tomini, North Celebes, coll. J. J. Menden, November 26-December 26, 1939. A.M.N.H. nos. 153361, 153362, 153366, 153368, 153369, 153372, 153373, 153375, 153376, 153378, 153380.

In this series of skulls one dental variation was noticed, viz., in no. 22, a specimen that has only one intermediate tooth in the left mandibular ramus between C and P_4, the right side being normal.

The measurements of the mandibular teeth of the specimens listed above are given in tables 1-3 (abbreviations: ap., anteroposterior diameter; tr., transverse diameter).

TABLE 1

Phalanger ursinus ursinus

No.	2	5	6	7	8	9	10	11	12	13	14
P_4 ap.	6.4	6.0	6.5	6.7	6.4	6.0	6.1	6.6	6.1	6.3	5.9
tr.	4.4	4.5	4.0	4.4	4.5	4.4	4.3	4.4	4.3	4.2	3.9
M_1 ap.	6.8	7.0	7.0	7.4	7.5	7.0	7.3	7.5	7.0	7.2	6.7
tr.	4.1	4.3	4.0	4.4	4.7	4.2	4.6	4.4	4.1	4.4	4.3
M_2 ap.	7.0	6.9	6.9	7.4	7.2	6.8	7.0	6.8	6.8	6.4	6.8
tr.	4.4	4.8	4.5	4.8	5.2	4.5	4.9	4.7	4.7	4.9	5.0
M_3 ap.	7.0	6.5	6.5	6.7	6.6	6.5	6.9	6.8	6.5	6.6	6.8
tr.	4.8	5.1	4.7	4.7	5.1	4.5	5.2	4.9	4.7	4.8	5.1
M_4 ap.	—	6.1	6.4	6.4	6.2	6.0	6.4	6.0	6.0	5.7	6.1
tr.	—	4.7	4.4	4.4	4.5	4.0	4.9	4.6	4.3	4.2	4.6
Height at P_4	—	16.5	15.5	16.4	15.8	16.5	14.9	17.8	14.8	15.9	13.7
Length P_4-M_4	—	32.7	33.2	34.4	34.2	32.0	33.4	33.8	32.7	31.8	32.3

No.	15	16	17	18	19	20	21	22	23	24	25
P_4 ap.	6.1	6.2	5.9	6.3	6.6	6.2	6.5	6.8	6.4	5.7	5.9
tr.	4.5	4.4	4.1	4.2	4.3	4.0	4.3	4.5	4.1	4.0	3.6
M_1 ap.	7.5	7.5	6.8	7.2	7.3	6.7	7.7	7.4	7.2	7.1	7.2
tr.	4.4	4.4	4.4	4.2	4.2	4.0	4.3	4.3	4.2	4.3	4.0
M_2 ap.	6.7	7.1	6.6	6.7	7.4	6.4	7.3	6.9	6.7	7.0	6.8
tr.	4.7	5.0	4.8	4.7	4.7	4.6	4.8	4.8	4.7	5.0	4.4
M_3 ap.	6.6	6.8	6.6	6.7	7.1	6.5	6.8	6.9	6.6	7.0	6.7
tr.	4.7	5.0	5.0	4.9	5.0	4.8	5.1	4.9	5.1	5.1	4.6
M_4 ap.	6.2	6.4	6.0	6.1	6.6	5.9	6.3	6.6	6.2	6.4	5.6
tr.	4.4	4.6	4.4	4.5	4.8	4.1	4.8	4.7	4.5	4.4	4.0
Height at P_4	14.7	16.1	15.6	15.2	16.1	16.7	14.7	16.2	17.7	14.8	14.8
Length P_4-M_4	33.0	33.9	32.2	32.8	34.8	31.5	34.4	34.3	33.1	32.7	**31.5**

TABLE 2

Phalanger ursinus furvus

No.	1	2	3	4	5
P_4 ap.	—	6.8	6.8	6.3	6.3
tr.	—	5.2	5.3	5.3	4.7
M_1 ap.	7.3	8.2	7.5	7.8	7.9
tr.	4.8	5.3	4.9	5.2	4.7
M_2 ap.	7.4	7.7	7.4	7.5	7.2
tr.	5.2	5.5	5.3	5.3	5.0
M_3 ap.	7.4	7.5	7.2	7.0	6.8
tr.	5.3	5.4	5.3	5.4	5.3
M_4 ap.	—	6.5	6.7	6.8	6.3
tr.	—	5.0	5.1	5.3	5.0
Height at P_4	—	17.4	18.4	18.0	18.1
Length P_4-M_4	—	36.2	34.8	34.6	33.5

TABLE 3

Phalanger ursinus togianus

No.	1	2	3	4	5	6	7	8	9	10	11	12
P_4 ap.	6.5	6.5	6.2	6.4	6.4	6.8	6.4	6.8	6.3	6.2	6.5	6.6
tr.	4.8	4.5	4.5	4.3	4.5	4.2	4.5	4.3	4.3	4.5	4.5	4.1
M_1 ap.	7.5	6.8	6.7	6.8	7.0	7.1	6.8	6.8	7.2	7.1	7.1	7.0
tr.	4.6	4.3	4.4	4.7	4.4	4.5	4.4	4.5	4.5	4.3	4.5	4.5
M_2 ap.	7.3	6.7	6.5	6.8	6.6	6.8	6.4	6.9	7.1	6.5	6.8	6.8
tr.	4.8	4.9	4.5	4.9	4.7	4.7	4.7	4.8	4.8	4.6	4.7	4.8
M_3 ap.	7.1	6.8	6.5	6.5	6.7	6.6	6.3	6.7	6.6	6.8	6.7	6.6
tr.	5.0	5.0	5.0	5.1	5.0	4.9	4.9	5.2	5.1	5.0	5.0	4.9
M_4 ap.	6.1	6.3	6.0	5.9	5.8	5.9	6.0	6.2	5.8	5.8	6.0	6.2
tr.	4.7	4.4	4.6	4.4	4.5	4.6	4.6	4.9	4.4	4.4	4.6	4.4
Height at P_4	15.7	16.6	17.3	15.2	14.1	15.3	17.4	16.5	15.7	14.3	15.6	15.6
Length P_4-M_4	33.0	32.8	32.3	32.8	33.0	32.9	31.6	33.8	32.4	32.0	32.8	33.2

No.	13	14	15	16	17	18	19	20	21	22	23	24
P_4 ap.	6.4	6.4	6.6	6.3	6.4	6.6	6.4	6.6	6.7	6.1	6.4	6.0
tr.	4.5	4.3	—	4.5	—	4.2	4.2	4.4	—	—	4.3	4.2
M_1 ap.	6.8	7.0	—	6.7	—	6.8	7.4	6.9	7.3	6.9	6.8	6.5
tr.	4.3	4.4	4.5	4.3	4.3	4.3	4.3	4.5	4.7	4.4	4.4	4.1
M_2 ap.	6.4	6.9	—	6.7	—	6.4	6.9	6.7	6.9	6.5	6.6	6.2
tr.	4.8	4.7	4.8	4.7	4.9	4.8	4.6	4.8	5.1	4.7	4.8	4.5
M_3 ap.	6.7	6.8	—	6.4	—	6.7	6.4	6.7	6.7	6.5	6.4	6.4
tr.	5.0	4.9	—	4.7	—	5.0	4.7	4.8	5.2	4.9	4.9	4.6
M_4 ap.	6.1	6.0	—	6.2	—	6.1	5.8	6.1	6.3	6.0	5.9	6.0
tr.	4.3	4.2	4.7	4.3	4.5	4.5	4.3	4.6	4.8	4.3	4.5	4.3
Height at P_4	16.4	14.4	17.7	17.0	16.7	16.0	16.3	16.3	18.5	17.3	16.3	16.4
Length P_4-M_4	31.9	33.3	32.4	32.4	32.0	32.4	32.7	33.3	33.9	32.3	32.6	30.4

Various specimens of subfossil mandibles of *Ph. ursinus* are present in a small collection of mammalian remains sent to me by Mr. H. R. van Heekeren after the cave report had already been published. These specimens originate from the Leang PattaE, Turikale district, Maros, Southwestern Celebes, and the measurements are given in table 4 together with those recorded previously from other Toalian sites (Hooijer, 1950 a, p. 17).

The means of the various measurements found for the recent subspecies and for the Toalian cave form can be found in table 5. Those of the recent subspecies are given for the males and females separately; the table shows that in *Ph. u. ursinus* and in *Ph. u. togianus* there is no real difference in average tooth size between the two sexes, although the female tends to be a trifle smaller than the male. It is also evident that there is no difference in size between *Ph. u. ursinus* and *Ph. u. togianus*.

TABLE 4

	Bola Batoe	Panisi Ta'boettoe	Batoe Edjaja	Panganrejang Toedeja		Leang PattaE	
P_4 ap.	—	6.1	6.4	6.4	6.5	6.5	6.5
tr.	—	4.8	4.9	4.6	4.5	5.2	5.0
M_1 ap.	8.1	7.3	7.7	—	8.3	—	—
tr.	4.9	—	4.8	—	4.9	—	—
M_2 ap.	—	7.0	7.7	—	—	—	7.4
tr.	—	—	5.2	—	—	—	5.3
M_3 ap.	—	6.5	7.0	—	—	7.2	7.3
tr.	—	5.2	5.4	—	—	5.1	5.2
M_4 ap.	—	6.3	6.2	—	—	—	—
tr.	—	4.8	4.7	—	—	—	—
Height at P_4	—	18.5	18.0	18.8	—	—	—
Length P_4-M_4	—	33.8	34.6	—	—	—	—

When the figures for *Ph. u. furvus* are compared it will be seen that this mountain form has teeth that are decidedly larger than those in the other recent races compared. The type and only male of *Ph. u. furvus* (no. 2 in table 2) is the largest of all, although it is exceeded in a few dimensions by the topotypical female no. 3. The Lompobatang Mt. specimens (nos. 4 and 5, both females) agree well with the former in this respect; M_4 in no. 4 even shows an excess in size over the corresponding tooth in the Central Celebes specimens.

TABLE 5

	Ph. u. ursinus		*Ph. u. togianus*		Toalian caves	*Ph. u. furvus*	
	male	female	male	female		male	female
P_4 ap.	6.3	6.2	6.5	6.4	6.4	6.8	6.5
tr.	4.3	4.2	4.4	4.3	4.8	5.2	5.1
M_1 ap.	7.1	7.2	7.0	6.9	7.8	8.2	7.6
tr.	4.3	4.2	4.5	4.4	4.9	5.3	4.9
M_2 ap.	6.9	6.9	6.7	6.6	7.4	7.7	7.4
tr.	4.7	4.7	4.7	4.8	5.2	5.5	5.2
M_3 ap.	6.7	6.8	6.7	6.6	7.0	7.5	7.1
tr.	4.9	4.9	5.0	4.9	5.2	5.4	5.3
M_4 ap.	6.1	6.2	6.0	6.0	6.3	6.5	6.6
tr.	4.5	4.5	4.5	4.5	4.8	5.0	5.1
Height at P_4	15.8	15.7	15.8	16.6	18.4	17.4	18.2
Length P_4-M_4	33.0	33.1	32.7	32.5	34.2	36.2	34.3

None of the teeth in the specimens of *Ph. u. ursinus* or of *Ph. u. togianus* is above the maximum observed in the series of *Ph. u. furvus*. There even are very few female specimens of the former races that are above the average

of the female of *Ph. u. furvus,* and in these cases only the anteroposterior diameter of P_4 is concerned.

Thus it is quite evident that *Ph. u. furvus* is characterized by its large teeth, which sets this mountain form off from the other living races of *Ph. ursinus.*

We can return now to the subfossil material from the Toalian caves. From table 5 it will be clear that the means of the tooth dimensions are larger than those of *Ph. u. ursinus* and *Ph. u. togianus,* but that the teeth of *Ph. u. furvus* still show an excess in size over the subfossil specimens. In fact, the cave form is not very different, on the average, from the female of *Ph. u. furvus,* but the type of *Ph. u. furvus* (male) has dimensions which are about as much above the average of the Toalian cave specimens as those of the other recent subspecies are below the latter. Consequently, the cave form of *Ph. ursinus* appears to be truly intermediate in size between the large *Ph. u. furvus* on the one hand, and *Ph. u. ursinus* and *Ph. u. togianus* on the other. It is apparently not identical with any of these living subspecies. For this reason I consider the Toalian cave form as subspecifically distinct:

Phalanger ursinus intermedius nov. subsp.

Diagnosis: Teeth identical in specific characters to those of recent *Phalanger ursinus* (Temminck) but intermediate in size between *Ph. u. ursinus* (Temminck) and *Ph. u. togianus* Tate on the one hand, and *Ph. u. furvus* Miller et Hollister on the other.

Holotype: A right horizontal ramus of the mandible with I (broken), alveoli of two intermediate teeth, and well preserved P_4-M_4, described and figured in Hooijer, 1950 a, p. 18, pl. I fig. 4. Collected by Dr. P. V. van Stein Callenfels and Dr. W. J. A. Willems in 1937.

Locality: Batoe Edjaja cave, near Bonthain, on the South coast of the Southwestern peninsula of Celebes.

Age: Early Holocene.

Lenomys meyeri (Jentink), one of the gigantic rats of Celebes, was dealt with at length in my previous paper (Hooijer, 1950 a, pp. 75-78). Tate (1936, p. 616) distinguishes between two species of *Lenomys,* viz., *Lenomys meyeri* (Jentink) and *Lenomys longicaudus* Miller et Hollister. The former species is divided into two subspecies, *L. m. meyeri* (Jentink) from North Celebes, and *L. m. lampo* Tate et Archbold (1935, p. 5) of Southwestern Celebes. *Lenomys longicaudus* Miller et Hollister (1921, p. 95) originates from Central Celebes.

As a brief restatement of my earlier observations it can be said that the Northern and the Southern subspecies of *Lenomys meyeri* are practically indistinguishable, and that the Toalian cave form tends to be larger and more complex-toothed than the living. Although my recent series for comparison included the type specimen of *Lenomys meyeri* from North Celebes in the Leiden Museum, I had no material of *L. m. lampo* for direct comparison with the cave remains, which consist only of mandibles, and also I had not seen *Lenomys longicaudus*. Now I have studied the following specimens:

Lenomys meyeri meyeri (Jentink)

Material examined:

1-3, vide Hooijer, 1950a, p. 76.
4. Stuffed skin and skull of adult female. Gimpoe, S.W. of Lake Lindoe, Central Celebes, coll. H. C. Raven, September 1, 1917. U.S.N.M. no. 219712 (type of *Lenomys longicaudus* Miller et Hollister, 1921, p. 95).

Lenomys meyeri lampo Tate et Archbold

1. Calvarium. Pare Pare, Southwestern Celebes, coll. M. Weber, 1888. Leiden Museum (vide Hooijer, 1950a, pp. 75-76).
2. Stuffed skin and skull of adult female. Wawokaraeng, Lompobatang, Southwestern Celebes, altitude 2200 m, coll. G. Heinrich, September 13, 1931. A.M.N.H. no. 101128. This is the type of *Lenomys meyeri lampo* Tate et Archbold.
3. Stuffed skin and skull of adult male. Wawokaraeng, Lompobatang, Southwestern Celebes, altitude 2200 m, coll. G. Heinrich, September 11, 1931. A.M.N.H. no. 101125.
4. Stuffed skin and skull of adult male. Wawokaraeng, Lompobatang, Southwestern Celebes, altitude 2200 m, coll. G. Heinrich, September 8, 1931. A.M.N.H. no. 101124.
5. Stuffed skin of adult female (skull not preserved). Wawokaraeng, Lompobatang, Southwestern Celebes, altitude 2200 m, coll. G. Heinrich, September 15, 1931, A.M.N.H. no. 101129.
6. Stuffed skin and skull of adult female. Wawokaraeng, Lompobatang, Southwestern Celebes, altitude 2200 m, coll. G. Heinrich, September 13, 1931. A.M.N.H. no. 101127.
7. Stuffed skin and skull of adult female. Wawokaraeng, Lompobatang, Southwestern Celebes, altitude 2200 m, coll. G. Heinrich, September 11, 1931, A.M.N.H. no. 101126.

Lenomys longicaudus was described by Miller and Hollister (1921, p. 95) on the evidence of a skin and skull of an adult female from Central Celebes. After having carefully studied this type specimen in the United States National Museum at Washington I can see no reason why this form, which Tate (1936, p. 616) maintains as a good species under the name *Lenomys longicaudatus*, should be recognized even only as a subspecies of *Lenomys meyeri* other than the typical race. For this reason, I have listed the specimen above under *Lenomys meyeri meyeri*. Miller and Hollister (1921, pp. 95-96) discuss this specimen at some length, and the evidence will be reconsidered in the following paragraphs.

The measurements of the above listed specimens are recorded in table 6.

TABLE 6

	Lenomys meyeri meyeri				*Lenomys meyeri lampo*					
No. of specimen	1	2	3	4	1	2	3	4	6	7
M^1 tr.	3.3	3.4	3.3	3.4	3.4	3.3	3.7	3.5	3.3	3.3
M^2 tr.	3.0	3.2	3.2	3.2	3.2	3.0	3.7	3.2	3.0	3.1
M^3 tr.	—	2.5	2.6	2.6	2.5	2.6	2.9	2.9	2.6	2.8
M^{1-3}	—	12.1	11.2	10.9	10.5	11.0	12.0	11.6	11.0	11.5
Lower I ap.	—	2.8	—	2.6	—	2.5	2.3	2.7	2.5	2.5
id. tr.	—	1.9	—	1.7	—	2.0	1.9	2.0	1.9	1.8
M_1 tr.	3.0	3.4	3.0	3.0	—	3.1	3.2	3.3	3.0	3.1
M_2 tr.	2.9	3.4	3.1	3.0	—	3.0	3.2	3.2	3.0	3.0
M_3 tr.	—	3.0	2.6	2.7	—	2.8	3.1	3.0	2.7	3.0
M_{1-3}	—	11.4	10.9	10.4	—	10.4	11.2	11.0	10.7	10.7
Height of ramus	—	9.5	9.1	9.5	—	10.5	9.3	10.3	10.2	9.0
Length front to condyle	—	34.0	30.5	33.3	—	35.4	35.1	34.8	34.9	33.5
Length M_1 to condyle	—	26.2	22.9	25.0	—	25.3	26.1	25.2	25.8	24.6

Miller and Hollister give the colour of the fur of *Lenomys longicaudus* as being more greyish and less tawny than that in the Northern and typical form. With a view to Meyer's observation, however, that the colour in the Northern form varies between greyish and brownish (Meyer, 1899, p. 27) this is evidently not a good distinguishing character.

The character that gave *longicaudus* its name does not seem to be a valid one either. Miller and Hollister, in copying Mr. Raven's measurements taken from the animal in the flesh, write that the tail (280 mm) is longer than head and body (235 mm), but Tate (1936, p. 714, table, last column) measured the dried and stuffed museum skin, and found head and body to be equal in length to the tail, viz., both 260 mm. Now the length of the tail of an animal still in the flesh is usually measured from the point where the tail bends forward, that is, at the end of the fused sacral vertebrae. After the animal has been skinned this point cannot be located any more. I measured the type skin, too, and found the root of the tail to be about halfway between the tip of the nose and the tip of the tail as the skin is now stuffed. Be this as it may, these differences of a few cm in an animal that is more than 50 cm long overall are unimportant anyway, and moreover Sody (1941, p. 318) mentions two specimens of Northern *Lenomys meyeri* as having the tail 2½ cm longer, and shorter respectively than head and body.

There also seems to be no base for Miller and Hollister's statement that *Lenomys longicaudus* has teeth smaller than *Lenomys meyeri.* As can be seen from table 6, in which *Lenomys "longicaudus"* appears as no. 4 under

Lenomys meyeri meyeri, the upper and lower molar series are slightly shorter, 0.3 mm and 0.5 mm respectively, than those in the smallest of the Northern specimens, but this is a difference of no importance since we always have to account for different degrees of interproximal wear of the molars. This mode of wear, with advancing age, does reduce the overall length of the molar series not inconsiderably. The transverse diameters of the crowns of the molars only can be fully relied upon, and these are well within the limits of variation found for the Northern race.

Miller and Hollister furthermore note that in the upper molars of *Lenomys longicaudus* cusp "x" is small, that there is no corresponding inner tubercle to loph 1, and no small postero-external cusp in M^2. It is, however, just the same in *Lenomys meyeri* proper (see, e.g., Tate, 1936, p. 613 fig. 28 C). The crucial postero-internal cusp of the upper molars, the third and innermost tubercle on the posterior loph of M^1 and of M^2, though not very distinct, is unmistakably present, thereby proving that *Lenomys longicaudus* does not belong to the genus *Eropeplus* (cf. Hooijer, 1950 a, p. 75).

As far as the type and only available specimen of *Lenomys longicaudus* goes, this Central Celebes form is indistinguishable from the Northern form, *Lenomys meyeri meyeri,* and hardly different from the Southern form, *Lenomys meyeri lampo.* According to the measurements published by Tate (1936, pp. 714-715) the Northern race would have shorter palatal foramina (7.1 mm long in the type specimen in the Leiden Museum) than the Southern race (length of palatal foramina 8.6-8.8 mm, based on two specimens in A.M.N.H.). This is now considered by Tate to be the major skull difference between the two races. The variation ranges in palatal opening length of the Northern and the Southern Celebes skulls are 7.0-8.1 mm, and 8.6-8.8 mm respectively (Hooijer, 1950 a, p. 76), and this is also the only skull difference that I can find. Small as the difference may be, again it links the Central Celebes specimen, which has a palatal opening length of 6.8 mm, with the Northern rather than with the Southern race. One of the five Southern specimens in A.M.N.H. (no. 101124) even has a palatal opening length of 9.7 mm.

The range of *Lenomys meyeri meyeri* must be taken as extending from the Northeastern peninsula Southwestward into Northern Central Celebes, and the only other race is *Lenomys meyeri lampo.*

The cave collections from Southwestern Celebes which I have studied contain several mandible fragments belonging to the present species. One of the specimens, viz., a left mandible from the bottom layer (C-D) of the Panganrejang Toedeja cave near Bonthain, South coast of Southwestern

Celebes, has been stated by Dammerman (1939, p. 71) to be rather large, and is was even suggested that it might represent a new species. I figured this specimen (Hooijer, 1950 a, pl. III fig. 11), and noted that the accessory tubercles on the outer side between lophs 2 and 3 of M_1, and between lophs 1 and 2 of M_2 are bigger than seemed usual for the recent form (Hooijer, l.c., p. 78). However, with the extended series of recent mandibles now available it is evident that there is neither a difference in size, nor a difference in development of accessory tubercles between the cave form and the recent. The measurements of the various cave mandibles have been given (Hooijer, 1950 a, p. 77), and comparison with those presented in table 6 of the present paper will show that there is no differentiation in size between the recent and the cave form of the present species.

Since the external characters of the Toalian cave rat are lost forever, we cannot decide whether the subfossil form is closer to *L. m. meyeri* (including *Lenomys longicaudus*) or to *L. m. lampo*. At the moment we cannot find a single character to distinguish between the cave form and the living of *Lenomys meyeri,* and such a distinction must await further study at a future date.

ABSTRACT

In the course of identifying subfossil cave remains of various mammals from Southwestern Celebes (Hooijer, 1950 a) it was felt that more recent material was needed, and this became available to the author while recently visiting various American natural history museums. Some of the results of these studies are presented in this paper. The examination of extensive series of *Phalanger ursinus* brought out the fact that too much emphasis has been placed on the size and shape of I^3 as a differential character: thus, *Ph. u. togianus* is not as distinct from the typical race as was accepted before. Furthermore, *Ph. u. furvus* is now shown to be well differentiated from the other races by its larger teeth. Specimens from Lembeh Island, off the shore of Northeastern Celebes, are found to be indistinguishable from those of the typical race. The cave remains of *Phalanger ursinus,* some newly acquired specimens of which are now placed on record, prove to be intermediate in tooth size between *Ph. u. furvus* on the one hand, and *Ph. u. ursinus* and *Ph. u. togianus* on the other. They are distinguished in the present paper as *Phalanger ursinus intermedius* nov. subsp.

The study of the type specimen of *Lenomys longicaudus* from Central Celebes shows that it can be merged with *Lenomys meyeri* from Northern Celebes; there is no valid reason to maintain the former as a distinct species. Moreover, the differentiation between the Northern and the Southern Celebes subspecies of *Lenomys meyeri* is shown to be weaker than was accepted before. The subfossil remains of *Lenomys meyeri* from Southwestern Celebes cannot at present be distinguished from any of the living races of this species.

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