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Results of the Archbold Expeditions. No. 93. Reidentification and Reallocation of *Mus callitrichus* and Allocations of *Rattus maculipilis, R. m. jentinki,* and *R. microbullatus* (Rodentia, Muridae)

By Guy G. Musser[1]

Mus callitrichus was described and named by F. A. Jentink in 1879 on the basis of 12 specimens obtained from northeastern Celebes. The name was applied to a rat of large body size, and at the time the generic name *Mus* was used by taxonomists to apply to house rats, house mice, and a variety of mouselike and ratlike species. From 1879 to 1969, the name *callitrichus* was removed from *Mus* and reallocated at different times to the genus *Rattus,* then to *Lenomys,* and finally to *Eropeplus.*

This shuffling of the name *callitrichus* from one genus to the other points up the inadequacies of Jentink's description—one that lacks a diagnosis, is imprecise in definition, and is incomplete in description—and highlights the facts that few of the persons who allocated the name ever examined the types; that F. A. Jentink misidentified specimens he had compared with the type-specimens and was partly responsible for misleading later workers who attempted to identify the name; and that the type series of *M. callitrichus* actually consists of five species, not just one as Jentink thought.

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In my studies on taxonomy and geographic distribution of Indo-Australian rodents, I have examined almost all type-specimens of taxa known from Celebes, including the type series of *M. callitrichus*. In the present report, I show that this name is properly allocated to the genus *Rattus,* as was pointed out by Oldfield Thomas (1921b) and John R. Ellerman (1941, 1949), and not to the genus *Eropeplus* as was mistakenly noted by myself in the most recent attempt to allocate the name (Musser, 1969); and that the names, *Rattus maculipilis* and *R. m. jentinki* (Laurie and Hill, 1954 and *R. microbullatus* (Tate and Archbold, 1935a) should be associated with the species, *Rattus callitrichus*. The results reported here focus only on the allocations of these names and not on the morphological and zoogeographical relationships of *R. callitrichus*.

ABBREVIATIONS AND METHODS

The specimens discussed in the present paper are in the collections of the American Museum of Natural History (A.M.N.H.), the British Museum (Natural History) (B.M.), the Rijksmuseum van Natuurlijke Historie (R.M.N.H.), and the personal collection of H. J. V. Sody (these specimens are housed in the Rijksmuseum van Natuurlijke Historie and are gradually being catalogued and incorporated into the main collection of the museum. Most of Sody's specimens, however, are still uncatalogued and these are designated in the present paper as "Sody No.," a notation that Sody used in his publications to refer to specimens in his collection), and the National Museum of Natural History of the Smithsonian Institution (U.S.N.M.).

Measurements of the length of head and body and tail length are those of the collectors and were taken from labels attached to study skins. I measured the length of hind foot of all the specimens from the dry study skins. Cranial measurements were taken with dial calipers graduated to tenths of millimeters. The limits of most of these measurements are explained elsewhere (Musser, 1970). I measured the greatest length and the greatest breadth of each tooth with the calipers under a dissecting microscope.

Latitudes and longitudes for the localities mentioned in this report were taken from gazetteers published in Laurie and Hill (1954), Fooden (1969), and from a gazetteer of Celebes issued by the Hydrographic Office of the United States Navy Department (1944).

HISTORICAL USAGE OF THE NAME *MUS CALLITRICHUS*

The name *Mus callitrichus* was based on 12 specimens. These were part of a collection of mammals and birds that S. C. I. W. van Musschen-

broek had obtained from the vicinity of Menado, northeastern Celebes, and given to the museum at Leiden. Fredericus A. Jentink studied the mammals and reported his results in volume 1 of "Notes from the Royal Zoological Museum of the Netherlands at Leyden," published in 1879. *Mus callitrichus* was one of the taxa proposed in that report; Jentink's description of it, like so many of his original descriptions, is short and vague:

"Upper parts bright brown. Woolly hairs slate-coloured with light brown tips; before the tip a brown ring. Longer and more solid hairs, slate-coloured with long brown tips are intermixed with them. Throat, chest, belly and inside of legs covered with short hairs, slate-coloured with bright yellowish-brown tips. Lips with pure white hairs. Tail shorter than head and body, white towards the tip, for the rest black, with a few hairs. Whiskers entirely brown or white tipped.

"Ears very widely opened, broad, rounded.

"Upper cutting-teeth orange, the lower ones lighter coloured." Jentink listed measurements for "Head and body" (240 mm.), "Tail" (210 mm.), "Ear" (20 mm.), "Hind foot" (46 mm.), "Length upper molar series" (10 mm.), "Distance between incisor and first lower molar" (7 mm.). Jentink did not identify which specimen he measured, nor did he select a holotype from the 12 individuals.

Two years later, Edouard Louis Trouessart listed the name *callitrichus* as No. 1464 in his "Catalogue des Mammifères vivants et fossiles" published in 1881 (p. 119). He listed it within the genus *Mus,* but under his newly formed subdivision, *Epimys,* of that genus.

Nine years after his description of *M. callitrichus* was published, F. A. Jentink listed the 12 type-specimens in his "Catalogue Systématique des Mammifères." They were entered as specimens "*a*" to "*l*" under the heading, "*Mus callithrichus,*" as follows (1888, p. 65):

"*a, b.* Individus adultes montés, types de l'espèce. Célèbes, Ménado-Kakas. Des collections de M. van Musschenbroek, Septembre 1875. (Crs. *a* et *b* du Cat. Ost.).

"*c, d.* Individus adultes montés, types de l'espèce. Ménado-Langowan. De M. van Musschenbroek, Septembre 1875. (Crs. *c* et *d* du Cat. Ost.). Dans N° *d* la queue manque.

"*e-l.* Individus adultes et à-peu-près adultes montés, types de l'espèce. Ménado-Langowan. De M. van Musschenbroek, Septembre 1875."

The skulls had been extracted only from specimens "*a*" to "*d*" and these individuals had been listed in Jentink's Catalogue Ostéologique des Mammifères," published in 1887. There Jentink indicated that the four skulls were very incomplete (p. 212).

From 1888 to 1969, the name *callitrichus* was first listed in published checklists as a subspecies of *Mus,* then eventually became associated at different times with three genera; *Rattus, Lenomys,* and *Eropeplus.* Furthermore, specimens of other species were misidentified in the literature as *M. callitrichus.* Even Jentink, the original describer of the taxon, misidentified specimens that he had presumably compared with the type series of *M. callitrichus.* Historical highlights of these allocations and identifications are documented below.

In 1890 a report on the mammals collected by Max Weber from the Malay Archipelago was published in two parts in "Zoologische Ergebnisse einer reise in Niederlandisch Ost-Indian." In Part I Max Weber discussed the primates, dermopterans, carnivores, artiodactyls, edentates, and marsupials collected during his expedition. He also provided a list of all the species that were obtained and included the form, "*Mus callithrichus*" (a slightly different spelling than the original "*callitrichus*" used by both Weber and Jentink in some of their publications) in that list. In Part II Jentink reported on the insectivores, bats, and rodents that were obtained by Weber. He identified one rodent that had been obtained at Pare Pare, southwestern Celebes, as "*Mus callithrichus.*" The specimen consisted of only a cranium without the mandibles. Jentink's allocation of this specimen proved to be significant for his action misled later workers into associating the name *callitrichus* with the genus *Lenomys.* Here is an excerpt from his discussion of the cranium (p. 120):

"This skull agrees so exactly with the same bony parts of our typical specimens of this species, described by me in the Notes from the Leyden Museum, 1879, p. 12, that I do not hesitate a moment in bringing it under the named head. It is very easy to distinguish *Mus callithrichus* from the other large-sized Celebean-mice by the skull alone." The dorsal, ventral, and side views of the cranium were figured in plate 10 (figs. 4–6), which accompanied the text.

The cranium from Pare Pare represents a specimen of the genus *Lenomys.* Jentink's association of the cranium with *M. callitrichus,* and the fact that his figures are obviously an example of *Lenomys,* probably led G. S. Miller, Jr. and N. Hollister to regard the name *callitrichus* to apply to a species of *Lenomys*—a species that was represented in southwestern Celebes by the cranium collected at Pare Pare and in northeastern Celebes by the type series of *M. meyeri* and *M. callitrichus.* In 1921 Miller and Hollister named and described 20 new taxa that were based upon specimens collected by H. C. Raven in Celebes. They described a new species of *Lenomys* from one specimen obtained in middle Celebes and remarked (p. 96): "The Middle Celebesian form of *Lenomys* appears to be

specifically distinct from *Lenomys meyeri* and *Lenomys callitrichus* (Jentink), both from Menado. The two northern species have the tail described as shorter than head and body."

Fifteen years later, however, G. H. H. Tate pointed out that the cranium from Pare Pare was a specimen of *Lenomys meyeri* and further stated (1936, p. 616): "It seems probable that the skull figured by Jentink which came from Pare-Pare should also be referred to *lampo*." This taxon is a subspecies of *L. meyeri* that had been named and described by Tate and Archbold in 1935. Later, D. A. Hooijer (1950, p. 75; 1952, p. 242) examined the specimen from Pare Pare and also concluded that it was an example of *L. m. lampo*. The cranium is in the collection at the Rijksmuseum van Natuurlijke Historie and is catalogued as No. 18303. After studying it, I concur with the identifications of both Tate and Hooijer.

In 1892 Jentink reported "On a new species of Rat from the island of Fores," in which he named and described "*Mus armandvillei*" and mentioned the name, "*Mus callithrichus*" as one of the "so-called yellow-tailed big rats from the Sunda-Islands, the Moluccas, New Guinea and Australia" (p. 78).

Two years later, in a report on "Susswasser-Fische" of the Indonesian Archipelago, Weber published a list of the land mammals then known to occur on Celebes which included "*Mus callithrichus* Jent." (1894), p. 474).

In 1896 Oldfield Thomas reported on the collection which included mammals obtained from northeastern Celebes by Charles and Ernest Hose, and specimens from southwestern Celebes collected by Alfred Everett. The material collected by the Hose brothers was mostly from Roeroekan. They obtained several specimens of "*Mus*" which up to that time had been unrepresented in the collection of the British Museum (Natural History): *hellwaldii, musschenbroekii, meyeri, celebensis, xanthurus, neglectus, ephippium,* and *callitrichus* (1896, p. 246). The two specimens of "*M. callitrichus*" were catalogued in the British Museum as Nos. 97.1.2.26 and 97.1.2.27. This identification is written on the labels attached to the study skins in Thomas' handwriting. John R. Ellerman accepted Thomas' identification and his knowledge of *Rattus callitrichus* was based on these two specimens (1941, p. 216). The same specimens, however, eventually formed the holotype and paratype of *R. maculipilis,* a taxon described in 1954 by E. M. O. Laurie and J. E. Hill.

Trouessart (1897, p. 479), listed the name *callitrichus* as No. 2754; it was placed under the subdivision *Epimys* of the genus *Mus*. Seven years later, in 1904 (p. 371), Trouessart listed the name as No. 3635. The name was included within the genus *Mus,* listed under the subdivision *Epimys,* placed within the section "*Rattus*" of that subdivision, and

finally, under the subsection "Chrysocomus." Included in this subsection were the names, *chrysocomus, ruber, baluensis, fratrorum, datae,* and *minahassae.* Except for the names *callitrichus* and *minahassae,* the contents of this subsection were taken from the work of J. Lewis Bonhote (1903). It was in 1903 that Bonhote reported on the mammals obtained from Malaysia in 1901–1902. Bonhote tried to group the various species of oriental rats and brought the five forms mentioned above together to form a "Chrysocomus Group." He did not include the name *callitrichus* in that group, nor did he mention it anywhere in his paper.

The six taxa that Trouessart grouped with *callitrichus* are now differently allocated. The name *minahassae* applies to the species of the genus *Haeromys* known from Celebes (Laurie and Hill, 1954); *datae* is valid for one of the species within the genus *Apomys* (see Sanborn, 1952, for comments on the name *datae;* and Misonne, 1969, for the status of *Apomys*). The names *chrysocomus, fratrorum, ruber,* and *baluensis* are associated with the genus *Rattus* (see Thomas, 1896, and Sody, 1941, for the status of *chrysocomus* and *fratrorum;* Tate, 1951, for the use of *ruber;* and Chasen, 1940, for the allocation of *baluensis*).

In 1899 the second part of Meyer's, "Säugethiere von Celebes-und Philippinen-Archipel," appeared and in it Meyer recognized *Mus callitrichus* as a valid species of the rodent fauna of Celebes (pp. 24–25). Meyer also considered both *Mus chrysocomus,* named and described by B. Hoffmann (1887), and *Mus fratrorum,* a taxon proposed by Thomas (1896), to be synonyms of *M. callitrichus.* This action was based on Meyer's study of four specimens in the museum at Dresden. Meyer stated that these had been compared with the type series of *M. callitrichus* for him by Jentink, and that Jentink had claimed they were identical with *M. callitrichus.* Meyer's text is accompanied by a color plate (plate 7, fig. 1) of a specimen of *M. callitrichus* drawn in a lifelike pose.

One year later, in 1900, Paul Matschie described a specimen from "Minahassa" under the name, "Mus (Gymnomys) callitrichus" (p. 280). Sody thought this specimen to be an example of *Rattus taerae,* a species he described in 1932 (p. 158). In that original description Sody remarked, "Apparently this is not the first time this species [*R. taerae*] has been collected and examined by a zoologist. There can be little doubt that the Menado specimen described at length by Matschie . . . under the name of '*Mus* (*Gynomys*) *callitrichus*' was this species and not *R. callitrichus.*" George H. H. Tate also doubted Matschie's identification for when Tate discussed whether the name *callitrichus* might apply to the *chrysocomus*-group of *Rattus* or to the genus *Lenomys,* he stated (1936, p. 553): "On the other hand '*callitrichus*' of Matschie, whose detailed measurements

he listed, conforms neither to *Lenomys* nor to the *Rattus chrysocomus* group." I have not had the opportunity to examine the specimen described by Matschie. Judged from his description, it could be an example of *R. taerae* or it could be a young adult of *R. callitrichus*.

Apparently Jentink's name, *callitrichus,* was first associated with the genus *Rattus* in 1921. In that year Thomas (1921b, p. 110) listed the species of *Rattus* with "white-ended tails" that were found in northern Celebes, mentioned *Rattus callitrichus* as one of these, and presented a few descriptive features of that species. Thomas considered the name *callitrichus* to represent a valid species for on page 111 he stated: "In his large paper on the mammals of Celebes . . . Dr. A. B. Meyer has placed both *chrysocomus* and *fratrorum* as synonyms of *R. callitrichus,* Jent., but all these are perfectly distinct, differing considerably in size and having quite appreciable diagnostic skull characters."

Eleven years later, Sody, writing about "Six New Indo-Malayan Rats," named and described *Rattus taerae* as a new species from Celebes (1932, p. 158). He thought *R. taerae* was most closely allied to *R. callitrichus* and compared it with that species.

In his report (1936) Tate concluded that the name *callitrichus* was probably best allocated to *Lenomys*. He discussed his reasons for this position in two places in that report. On page 553, the name *callitrichus* was considered in its possible application to the *chrysocomus*-group of *Rattus*. Tate remarked that, "The generic position of the original *callitrichus* Jentink . . . is a point of importance in the systematic arrangement of the allies of *chrysocomus*. If *callitrichus,* which was described before *chrysocomus,* is a *Rattus* rather than a *Lenomys* then the whole group now called the *chrysocomus* group ought to bear the name *callitrichus* group.

"In spite of Meyer's opinion that *chrysocomus* and *callitrichus* are synonymous, the impression to be gained from Jentink's few published measurements . . . favors the probability that *callitrichus* was a *Lenomys*. . . . For purposes of this paper *callitrichus* Jentink will be considered a *Lenomys*."

On pages 615 and 616 Tate discussed the name *callitrichus* under the genus *Lenomys,* and after presenting the views of Miller and Hollister (1921b), the identification of the cranium from Pare Pare figured by Jentink (1890), and the opinion of Meyer (1899) regarding *M. callitrichus,* Tate emphasized that "From his text it is clear that Meyer went into the question of the status of *callitrichus* very thoroughly; and his conclusions that *callitrichus* was a *Rattus* rather than a *Lenomys,* if correct, prove that Jentink erred in figuring a *Lenomys* skull as that of *callitrichus*. Yet on account of the large size of the hind foot and of the teeth . . . it must be assumed that *callitrichus* Jentink was truly a *Lenomys* and not a member

of the *chrysocomus* group of *Rattus*. The point can be cleared up readily if the type is in existence and identifiable."

So Tate tentatively associated the name *callitrichus* with the genus *Lenomys,* but at the same time he realized that an examination of the type-specimens was necessary before the name could be correctly allocated. Up to the time of Tate's report in 1936, there is no indication in the literature that any American mammalogist had examined the type series of *M. callitrichus*. Then in the summer of 1937, Tate visited the Rijksmuseum van Natuurlijke Historie in Leiden and studied the 12 type-specimens of *M. callitrichus* and photographed the skulls. His manuscript notes and photographic prints are in the files of the Department of Mammalogy at the American Museum of Natural History in New York. In 1940 he published what were essentially his sketchy notes in an important paper on, "Notes on the Types of Certain Early Described Species of Monotremes, Marsupials, Muridae and Bats from the Indo-Australian Region." In that report Tate associated the name *callitrichus* with *Eropeplus,* a genus proposed by G. S. Miller, Jr. and N. Hollister in 1921 (1921b, p. 94). Tate noted that of the 12 individuals, "specimens 'a,' 'b,' 'c,' 'e,' 'f,' 'h,' 'j,' and 'k' are referable to *Eropeplus* Miller; specimens 'd,' 'g,' and 'l' to *Rattus*." Tate designated specimen "*a*" as lectotype for *M. callitrichus*. Apparently Tate's publication received poor distribution, probably because of World War II, for his allocation of the name *callitrichus* was overlooked by later reports dealing with Indo-Australian rats (Ellerman, 1941, 1949; Laurie and Hill, 1954). In fact, during the period from 1940 to 1969, I could find the combination, *Eropeplus callitrichus,* used only once in the literature: Hooijer (1950, p. 75) mentioned it in his report on "Man and other Mammals from Toalian Sites in South-Western Celebes."

In volume two of "The Families and Genera of Living Rodents," published in 1941, John R. Ellerman listed the name *callitrichus* as a valid species of the genus *Rattus,* and a species that he placed within his "*xanthurus* Group" (p. 189). He did not consider the name *callitrichus* to apply to a species of the genus *Lenomys,* for in his description of that genus Ellerman stated that (p. 83), "In this genus Tate includes, provisionally, the species *callitrichus*. The few skulls bearing this name in London may be wrongly identified; they certainly agree with *Rattus* in all respects, and do not belong to the present genus *Lenomys*."

At the end of his classification of the genus *Rattus,* Ellerman discussed a large collection of rodents that had been obtained from Celebes by W. J. C. Frost in 1938. Two of these specimens were identified by Ellerman as *R. callitrichus* (p. 219). Both were collected in middle Celebes and

were catalogued in the collection of the British Museum (Natural History) as Nos. 40.388 and 40.389. In discussing these specimens, Ellerman had this to say about *R. callitrichus* (p. 216): "Miller and Tate refer the form *callitrichus* to the genus *Lenomys*. I have not seen the type of *callitrichus;* but forms bearing this name in the B. M., and including some specimens collected by Mr. Frost, are certainly not *Lenomys,* but definitely *Rattus,* in dental characters. Jentink's description is hopelessly inadequate. This Rat has no posterointernal cusp in M.1 and M.2, as *Rattus;* the fur is thicker and softer than in *celebensis;* the bullae appear to be smaller than is usual in *xanthurus* group Rats (not including *dominator*); the tooth row is about 19 per cent of the condylobasal length. The tail is longer than the head and body (slightly), though not so in Jentink's description; but this seems a rather variable character. The palate reaches slightly behind the last molars; the molars are broad and heavy. Tail coloured as usual in *xanthurus* Rats. The ear is rather large. Until the type of *callitrichus* can be examined, the name must remain doubtful."

In 1947 Ellerman published a "brief summary of certain alterations and revisions which I am noting in much greater detail in my forthcoming third volume of the 'Families and Genera of Living Rodents.'" In this report he continued to view the name *callitrichus* as representing a valid species of *Rattus,* but he disassociated it from the "*xanthurus* Group" where he had placed it in his earlier classification (1941), and listed it within the subgenus *Stenomys* instead (p. 263).

When volume three was finally published in 1949, Ellerman listed *R. callitrichus* again under the subgenus *Stenomys* and within the "*callitrichus* Group" of that subgenus (p. 69). He also mentioned (p. 43) that, "*Rattus callitrichus* . . . has been referred by Miller and Tate to *Lenomys*. If our material is rightly identified, it is a *Rattus* and the Bornean form *infraluteus* is most likely a very distinct race of it, or a near ally."

Apparently Ellerman was not aware that Tate had examined the type series of *M. callitrichus* and had allocated the name to the genus *Eropeplus* in 1940. Tate's report was also overlooked by Laurie and Hill (1954). They followed Tate's allocation of 1936 and associated the name *callitrichus* with the genus *Lenomys* (1954, p. 97). Furthermore, they named and described two new forms of *Rattus: R. maculipilis* and *R. m. jentinki* (p. 115). *Rattus maculipilis* was based upon the two specimens from Roeroekan collected by Charles and Ernest Hose in 1895 and originally identified as *Mus callitrichus* by Thomas in 1896. These two specimens, B.M. Nos. 97.1.2.26 and 97.1.2.27, formed the basis of Ellerman's concept of the species, *R. callitrichus*. In fact, Laurie and Hill stated that, "These two specimens and the two specimens of the race described

below had been wrongly identified as *Mus callitrichus* Jentink and so led Ellerman to refer *callitrichus* to *Rattus* instead of to *Lenomys* to which it appears to belong (Tate (1936))." *Rattus maculipilis jentinki,* in turn, was based upon the two individuals, B.M. Nos. 40.388 and 40.389, obtained by Frost from middle Celebes and originally identified as *R. callitrichus* by Ellerman (1941).

In 1969, Xavier Misonne listed *Rattus maculipilis* as a member of the subgenus *Bullimus* in his report on murid rodents of the African and Indo-Australian regions. He also noted (p. 143) that, "*R. maculipilis* seems to be very close to *R. celebensis.*"

The latest opinion regarding the allocation of the name *callitrichus* was mine (1969, p. 5). I had examined Tate's paper of 1940, as well as his manuscript notes and photographic prints, and from these sources concluded that Tate correctly associated the name *callitrichus* with the genus *Eropeplus.* At that time I had examined the holotype and two other examples of *E. canus,* but my knowledge of the type series of *M. callitrichus* was based only on Tate's notes and photographs.

During the fall and winter months of 1969, I was able to examine the type-specimens of *Rattus maculipilis* and *R. m. jentinki* at the British Museum (Natural History), London, and had the opportunity to study the 12 type-specimens of *M. callitrichus* at the Rijksmuseum van Natuurlijke Historie, Leiden. From these studies I learned, much to my embarrassment, that the name *callitrichus* does not apply to a species of either *Lenomys* or *Eropeplus* and that Thomas, in 1896, had correctly identified the two specimens obtained by the Hose brothers from Roeroekan as *Mus callitrichus,* and Ellerman was right in recognizing the taxon as a valid species of *Rattus* in his classifications of 1941 and 1949. Reasons for these conclusions are presented below.

IDENTITIES OF THE 12 TYPE-SPECIMENS OF *MUS CALLITRICHUS*

Each of the 12 type-specimens of *Mus callitrichus* is mounted in a lifelike pose and attached to a wooden base. The skins are dirty and in poor condition; the tails are broken or missing in some and large patches of fur are gone from the skins of others. The color of their pelage has been altered from the original hues; all are a dull, grayish, straw-brown, a color common to old mounted specimens of rats. At the time I examined the series, all skulls had been extracted from the mounted skins and cleaned. Each consists of mandibles and an incomplete cranium. The posterior half of the cranium and the zygomatic arches are either incomplete or missing from each specimen and two individuals are represented

only by fragments of the palatal and rostral regions. I was unable to determine the sex of any individual in the series.

The 12 specimens actually represent five species, not just one as Jentink had supposed. Jentink's alphabetical designation of each specimen, its corresponding catalogue number in the Rijksmuseum van Natuurlijke Historie, its age, place of capture, and the species it represents are listed in table 1. Cranial measurements of each specimen, at least those measurements that could be obtained from such fragmented skulls, are listed in table 2.

TABLE 1

IDENTITIES OF THE 12 COTYPES OF *Mus callitrichus*

Jentink's Type-Specimens	R.M.N.H. No.	Age	Locality in Northeastern Celebes	Species of *Rattus*	Author of Name and Date of Publication
"a"	21275	Adult	Kakas	*R. callitrichus*	F. A. Jentink, 1879
"e"	21276	Adult	Langowan		
"f"	21277	Juvenile	Langowan		
"c"	21282	Juvenile	Langowan	*R. dominator*	O. Thomas, 1921a
"d"	21283	Adult	Langowan	*R. chrysocomus*	B. Hoffmann, 1887
"i"	21284	Adult	Langowan		
"l"	21285	Adult	Langowan		
"b"	21278	Young adult	Kakas	*R. fratrorum*	O. Thomas, 1896
"g"	21279	Adult	Langowan		
"h"	21280	Young adult	Langowan		
"j"	21281	Juvenile	Langowan		
"k"	21286	Young adult	Langowan	*R. hoffmanni*	P. Matschie, 1900

SPECIMENS *"a,"* *"e,"* AND *"f"*

Only three of the 12 are examples of what Jentink originally described as *Mus callitrichus:* specimens *"a,"* *"e,"* and *"f."* Specimen *"a"* is a good adult; its teeth are worn but the patterns of the cusps are not obliterated. Specimen *"e"* is also an adult, but it is younger than specimen *"a."* Specimen *"f"* is a juvenile.

Tate (1940, p. 7) had designated specimen *"a"* as lectotype of *M. callitrichus*. External features of that specimen certainly resemble Jentink's description; the differences I noted are those due to discoloration of the pelage. Furthermore, the measurements listed by Jentink in his original description were probably obtained from specimen *"a."* His measurements of the "Length upper molar series" and the "Distance

between incisor and first upper molar," were 10 mm. and 13 mm., respectively. I obtained 10.7 mm. for the alveolar length of the maxillary tooth row. When I measured the distance between the front surface of the first molar and the rear surface of the third molar, I obtained 10.0 mm., however. I repeated the measurement several times and consistently obtained the same figure. I also measured length of the diastema several times and consistently obtained 13.0 mm., the same figure given by Jentink. These figures are not duplicated in any of the other 11 type-specimens for the same two measurements. Specimen "*a*" should be retained as lectotype of *Mus callitrichus* Jentink; specimens "*e*" and "*f*" are then paralectotypes of that taxon.

Specimen "*c*"

Specimen "*c*" is a juvenal example of *Rattus dominator*. The first and second pairs of teeth are fully erupted, and the third pair had erupted above the alveolar surface, but their crowns had not reached the height of the second molars when the animal was killed. The skin is clothed in typical juvenal pelage.

I have examined more than 60 specimens of this species from northeastern Celebes (including the holotype, B.M. No. 97.1.2.24) that are in the collections at Leiden, London, and Washington, D.C. These specimens include ages that range from juveniles to adults. The palatal region and teeth are diagnostic features in juveniles of *R. dominator*. The incisive foramina are short relative to length of the diastema and their posterior margins are situated well in front of the anterior alveolar margins of the upper pair of first molars. The bony palatal bridge is conspicuously longer than the tooth rows, and its posterior edge lies several millimeters behind the posterior alveolar margins of the upper third molars. The teeth are large (the length of the first molar always exceeds 4.0 mm.; its breadth usually exceeds 3.0 mm.), the tooth rows are long (all are greater than 9 mm. in length and usually exceed 10 mm.), and the incisors are strongly ophisodont. All these features are shared by the cranium of specimen "*c*." External features of that specimen, except for the altered color of the pelage, are also similar to specimens of *R. dominator* of comparable age.

Specimens "*d*," "*i*," and "*l*," and "*b*," "*g*," "*h*," and "*j*"

These seven specimens represent two species: *Rattus chrysocomus* and *R. fratrorum*. *Rattus chrysocomus* was originally named and described as a species of *Mus* by B. Hoffmann in 1887 from a skin and skull obtained by F. von Faber from Amurang, northeastern Celebes. The holotype

TABLE 2

CRANIAL MEASUREMENTS (IN MILLIMETERS) OF THE 12 COTYPES OF "*Mus callitrichus*"

	R. callitrichus			*R. dominator*	*R. chrysocomus*			*R. fratrorum*				*R. hoffmanni*
	Specimen "*a*"	Specimen "*e*"	Specimen "*f*"	Specimen "*c*"	Specimen "*d*"	Specimen "*i*"	Specimen "*l*"	Specimen "*b*"	Specimen "*g*"	Specimen "*h*"	Specimen "*j*"	Specimen "*k*"
Zygomatic breadth	—	—	—	—	—	—	—	—	—	—	—	17.7
Interorbital breadth	7.0	7.1	6.8	7.1	—	—	6.1	—	6.5	6.4	—	5.6
Length of nasals	20.8	20.3	17.4	19.0	—	14.7	15.8	—	17.6	17.9	—	13.4
Length of rostrum	15.9	15.3	13.3	16.2	—	—	—	—	15.0	15.0	—	11.1
Breadth of rostrum	8.8	—	—	8.4	—	6.7	—	—	8.1	7.9	—	6.4
Breadth of zygomatic plate	5.4	5.5	4.6	6.1	3.3	2.9	3.0	3.8	3.8	3.8	2.6	3.8
Breadth across incisor tips	3.9	3.8	2.7	2.8	—	1.8	—	—	2.8	2.8	1.9	2.2
Length of diastema	13.0	12.6	10.6	12.5	—	10.2	10.8	11.2	11.3	11.0	10.0	8.8
Palatilar length	—	23.1	19.5	—	—	17.0	—	—	18.9	18.5	18.9	16.9
Palatal length	—	26.3	22.3	—	—	19.3	—	—	21.9	21.0	16.9	19.3
Length of incisive foramina	8.2	8.2	6.7	6.4	—	6.8	—	7.2	7.8	6.9	6.8	6.7
Breadth across incisive foramina	3.1	2.9	2.6	2.4	—	2.4	—	—	2.9	2.8	2.5	2.4
Length of palatal bridge	—	10.6	9.0	—	—	7.2	7.2	—	7.5	7.7	6.9	7.4
Breadth of palatal bridge at M^1	3.3	3.3	3.0	3.9	—	3.4	—	—	3.9	3.4	2.7	3.5
Breadth of palatal bridge at M^3	—	4.5	4.4	5.2	—	4.1	—	—	5.1	4.9	—	4.8
Breadth of mesopterygoid fossa	—	2.9	2.9	—	—	—	—	—	3.8	3.3	2.5	2.3
Alveolar length of M^{1-3}	10.7	10.5	9.7	10.3	6.6	6.6	6.8	8.4	7.4	8.0	8.0	7.4
Length of M^1	4.6	4.8	4.8	4.7	3.1	3.3	3.3	4.3	3.8	3.9	4.2	3.6
Breadth of M^1	3.1	3.1	3.1	3.0	2.1	2.1	2.2	2.5	2.3	2.5	2.5	2.4

TABLE 3

CRANIAL MEASUREMENTS (IN MILLIMETERS) OF ADULT SPECIMENS OF *Rattus chrysocomus* AND *R. fratrorum* FROM NORTHEASTERN CELEBES

	R. chrysocomus				*R. fratrorum*			
	Holotype[a]	Specimen "d"	Specimen "i"	Specimen "l"	Holotype[b]	Specimen "g"	Specimen "h"	Ranges of 26 males from Temboan[c]
Interorbital breadth	6.2	—	—	6.1	6.4	6.5	6.4	5.9–7.0
Length of nasals	15.7	—	14.7	15.8	19.4	17.6	17.9	16.2–19.2
Breadth of zygomatic plate	3.1	3.3	2.9	3.0	3.5	3.8	3.8	3.0–4.6
Breadth across incisor tips	—	—	1.8	—	2.8	2.8	2.8	2.4–2.9
Length of diastema	10.5	—	10.2	10.8	11.8	11.3	11.0	10.2–12.2
Palatilar length	—	—	17.0	—	19.1	18.9	18.5	17.7–19.9
Palatal length	20.0	—	19.3	—	21.6	21.9	21.0	20.1–22.5
Length of incisive foramina	6.2	—	6.8	—	7.4	7.8	6.9	6.4–8.0
Breadth across incisive foramina	2.3	—	2.4	—	3.3	2.9	2.8	2.4–3.1
Length of palatal bridge	—	—	7.2	7.2	8.2	7.5	7.7	7.8–9.1
Breadth of palatal bridge at M^1	—	—	3.4	—	3.9	3.9	3.4	3.2–4.4
Breadth of palatal bridge at M^3	—	—	4.1	—	5.3	5.1	4.9	4.3–5.5
Alveolar length of M^{1-3}	6.8	6.6	6.6	6.8	8.2	7.4	8.0	7.4–8.1
Length of M^1	3.6	3.1	3.3	3.3	4.0	3.8	3.9	3.7–4.4
Breadth of M^1	2.2	2.1	2.1	2.2	2.5	2.3	2.5	2.3–2.5

[a] Taken from Sody (1941, p. 317).

[b] B.M. No. 97.1.2.28.

[c] U.S.N.M. Nos. 217616, 217623, 217624, 217625, 217628, 217637, 217640, 217641, 217643, 217645, 217648, 217655, 217656, 217662, 217663, 217666, 217670, 217857, 217866, 217868, 217869, 217881, 217883, 217884, 217887, and 217895.

was housed in the Staatliche Museum für Tierkunde in Dresden; the skin was catalogued as No. 612/1707 and the skull as No. 1727. *Rattus fratrorum* was proposed by Thomas in 1896; it too was originally described as a species of *Mus*. The holotype was collected by Charles and Ernest Hose at Roeroekan, northeastern Celebes, and was catalogued in the collection of the British Museum (Natural History) as No. 97.1.2.28. In his original description of "*M. fratrorum*" Thomas pointed out that the species was distinctive and quite different from "*M. chrysocomus*." His evaluations of these taxa were later reinforced by Tate (1936) and Sody (1941), both of whom regarded the names *fratrorum* and *chrysocomus* to apply to two valid species of *Rattus*. Ellerman (1949) and Laurie and Hill (1954), however, listed the name *fratrorum* as a synonym of *R. chrysocomus*.

I am preparing a report on taxonomy and geographic distribution of the *chrysocomus*-group of *Rattus*, and have had the opportunity to examine and measure most specimens of this group that are in collections of museums, as well as holotypes of all named forms belonging to it, except for the holotype of *M. chrysocomus*. In an attempt to locate that specimen, I wrote to Helmut Richter at the Staatliche Museum für Tierkunde in Dresden, in February of 1970, and asked him if the holotype was still housed there. Unfortunately, it had been misplaced and could not be found, for Richter replied: "Das gesuchte Stück, die Holotype mit der Balg-Nr. 612/1707 und der Schädel-Nr. 1727 von Amurang, Minahassa, Nordcelebes, leg. v. Faber, 1877, ist nich mehr in Museum in Dresden vorhanden. Die meisten Typen waren in den letzten Kriegsjahren ausgelagert und sind seither verschollen."

Sody was the last person I know of who examined the holotype. Consequently, the only information available other than that documented in Hoffmann's original description is contained in Sody's unpublished notes and in his few published comments (1941).

At the Rijksmuseum van Natuurlijke Historie, Leiden, A.M. Husson allowed me to examine many of Sody's unpublished notes and measurements. Among Sody's documents was a short description of the holotype of *M. chrysocomus,* notes which were made apparently when Sody had skin and skull before him. Here are pertinent excerpts from them: "On my request Dr. W. Meise of the Staatliche Museum für Tierkunde and Volkerkunde at Dresden, was so kind as to send me the type of Hoffmann's *Mus chrysocomus* . . . I made up a very exact description of the skin, but it is hardly necessary to publish it, as Hoffmann's original description may be called excellent. Only a few alterations and additions seem necessary to me. The maximum length of the bristles on the posterior part of the back is 23 mm. There truly are 'spiny hairs,' to be recognized by their colour, though certainly Hoffmann is right if he means to say that these hairs do not show the least spiny character. Certainly the 'rostbraune Flecke' on the belly side, mentioned by Hoffmann, are only adventitious. The tail is black. Also the figure of the skull may be called good: only the bullae (which hang loosely on the skull, the whole occipital part thereof wanting) are sketched in a wrong position!" Sody then listed measurements of the skin and skull and these were later published in 1941 (p. 317). In that report he agreed emphatically with Oldfield Thomas that the names *chrysocomus* and *fratrorum* represent different and valid species. That Sody was very familiar with the characteristics of *R. fratrorum* is evident from his description and discussion of this species based on 74 specimens, 52 of which were in his personal collection (1941,

p. 316). I have examined all 52 of these specimens (R.M.N.H. Nos. 21087–21123 and 21125–21139) and they are indeed examples of *R. fratrorum.*

Measurements of the holotype of *M. chrysocomus* that were taken by Sody are very similar to my measurements of specimens "*d*," "*i*," and "*l*." In my opinion these three individuals are examples of *Rattus chrysocomus.* Furthermore, *R. chrysocomus* is the oldest name for the group of populations now known by the names, *nigellus* and *rallus* (Miller and Hollister, 1921a), and *brevimolaris* (Tate and Archbold, 1935a), and *koka* (Tate and Archbold, 1935b). Specimens "*d*," "*i*," and "*l*" are very similar in cranial dimensions and configurations to samples of these taxa. The forms, *nigellus* and *rallus,* were described from samples obtained in middle Celebes; the names *brevimolaris* and *koka* apply to samples collected in southeastern Celebes. *Rattus chrysocomus* occurs together with *R. fratrorum* in northeastern Celebes for specimens of each, as represented by the seven examples that were originally part of the type series of *M. callitrichus,* were obtained from the same locality, Langowan.

Specimens "*b*," "*g*," "*h*," and "*j*" are clearly examples of *R. fratrorum.* This species is now known to occur only in northeastern Celebes where it must be a common element of the rodent fauna of that region, if specimens in collections of museums are an index of its abundance.

Detailed descriptions of *R. chrysocomus* and *R. fratrorum,* as well as the morphological and geographical relationships between them and other species in the *chrysocomus*-group of *Rattus,* will be documented in a future report. For the present I need to point out only that the two species differ most conspicuously in size and proportional features; specimens of *R. chrysocomus* are smaller versions of *R. fratrorum.* Differences in cranial dimensions can be seen in table 3 where Sody's measurements for the holotype of *R. chrysocomus* and those for specimens "*d*," "*i*," and "*l*" are contrasted with measurements of the holotype of *R. fratrorum,* specimens "*g*" and "*h*" (the most complete of Jentink's four specimens), and 26 adults from Temboan, northeastern Celebes.

Specimens of *R. chrysocomus* and *R. fratrorum* of comparable age are easily distinguished by cranial dimensions. Differences between the two species in lengths of the maxillary tooth rows, size of the individual teeth, and breadths across tips of the incisors are especially conspicuous and diagnostic. For example, my measurements of the alveolar lengths of maxillary tooth rows in more than 50 specimens of *R. chrysocomus* from northern, middle, and southeastern Celebes range from 5.7 mm. to 6.8 mm. These specimens include animals that range from juveniles to old adults. On the other hand, measurements of the tooth rows from

more than 200 specimens of *R. fratrorum* from northeastern Celebes extend from 6.9 mm. to 8.5 mm., a sample containing a similar range in age. The individual teeth in *R. fratrorum* are larger and more massive than those in *R. chrysocomus*; the magnitude of this difference between the two species is evident in table 3. Also, the difference noted there in breadth across tips of incisors is typical; specimens of *R. fratrorum* have significantly wider (one to two millimeters) incisors than examples of *R. chrysocomus*.

Specimen "*k*"

Specimen "*k*" is an example of *Rattus hoffmanni*. Specimens of this species have brownish upper parts, grayish brown underparts, and monocolored, dark brown tails. Dimensions of the head and body are similar to those of the house rat, *Rattus rattus*. The length of the tail is either the same length as the head and body or slightly longer. Morphological features of the skull also resemble those of *R. rattus*, but the teeth are conspicuously wider and more massive. The breadth of each first upper molar exceeds 2.0 mm. in *R. hoffmanni*; this dimension is rarely greater than 1.9 mm. in specimens of *R. rattus*.

I have not seen the holotype of *R. hoffmanni*, but I have examined more than 50 specimens in the collections of various museums that were obtained from northeastern Celebes and that are correctly identified as *R. hoffmanni*. In fact, I compared specimen "*k*" with a series of 19 individuals housed in the Rijksmuseum van Natuurlijke Historie (R.M.N.H. Nos. 21213–21231); all were collected in northeastern Celebes. External morphology of specimen "*k*" and shape and dimensions of its skull and dentition, fit within the range of variation seen in specimens of comparable age in that large series. For example, my measurements of the lengths of first upper molars for 17 males and females—specimens ranging in age from young to old adults—range from 3.4 mm. to 4.1 mm.; the breadths of these teeth vary from 2.2 mm. to 2.6 mm. The first upper molar of specimen "*k*" is 3.6 mm. long and 2.4 mm. wide.

ALLOCATION OF *MUS CALLITRICHUS*

Use of the generic name *Mus*, applied originally to house rats, house mice, and a variety of ratlike and mouselike species, was restricted to house mice and their allies by Gerrit S. Miller, Jr. in 1910. After Miller's action, the name *callitrichus* was never associated with *Mus*, but instead was allocated at different times to the genera *Lenomys*, *Eropeplus*, and *Rattus*. In the following discussion, specimens of *M. callitrichus* are com-

pared first with those of *Lenomys,* then with examples of *Eropeplus,* and finally with species in the genus *Rattus.*

Comparisons Between Specimens of *Mus callitrichus* and *Lenomys meyeri*

The genus *Lenomys* is endemic to Celebes and contains one species, *Lenomys meyeri.* Two subspecies of *L. meyeri* are now recognized: the name *L. m. meyeri* is applied to samples from northern and middle Celebes, and samples from southwestern Celebes are known as *L. m. lampo* (Hooijer, 1952). The latter form is known from skins and skulls, as well as subfossil fragments (Hooijer, 1950). There are few specimens of *L. meyeri* in collections of museums; the geographic origins and catalogue numbers of those I have examined are listed below.

Lenomys meyeri meyeri (10 specimens)

Amurang (1° 11′ N., 124° 34′ E.): B.M. No. 21.2.9.4.
Langowan (1° 09′ N., 124° 49′ E.): R.M.N.H. No. 18302 (holotype).
Mt. Masarang (1° 19′ N., 124° 51′ E.) B.M. No. 97.1.2.20.
Roeroekan (1° 21′ N., 124° 52′ E.): B.M. No. 97.1.2.19.
Tomohon (1° 19′ N., 124° 53′ E.): B.M. No. 99.10.1.9.
Waremboengan (1° 25′ N., 124° 54′ E.): R.M.N.H. No. 2797.
Northeastern Celebes: R.M.N.H. Nos. 18304 and 21233.
Boemboelan (0° 29′ N., 122° 04′ E.): A.M.N.H. No. 153011.
Gimpoe (1° 38′ S., 120° 03′ E.): U.S.N.M. No. 219712 (holotype of *Lenomys longicaudus* Miller and Hollister, 1921b, p. 95).

Lenomys meyeri lampo (7 specimens)

Pare Pare (4° 01′ S., 119° 37′ E.): R.M.N.H. No. 18303.
Wawokaraeng, Mt. Lompobatang (5° 21′ S., 119° 56′ E.): A.M.N.H. Nos. 101124–101127, 101128 (holotype), and 101129.

Specimens of *Lenomys meyeri* and *Mus callitrichus* are distinguishable in features of body size, pelage, and skull. *Lenomys meyeri* is a larger and more chunky animal than *M. callitrichus.* The hind feet are about the same length in the two species, but the feet of *L. meyeri* are much wider and appear more massive and stronger than the long, thin, and somewhat delicate feet of *M. callitrichus.* The upper parts of *L. meyeri* are gray; hairs of the pelage are gray for most of their lengths and tipped with white. The guard hairs have gray bases and pale brown tips. The dorsal surfaces of the front and hind feet are grayish brown. The underparts are whitish; the tones range from silver-white to whitish gray or cream. The hairs have pale gray bases and either white or cream tips. In contrast, pelage covering the upper parts of *M. callitrichus* is dark brown,

suffused with dark gray, and speckled with buff. Most hairs are dark gray for most of their lengths and tipped with buff. The guard hairs have dark gray bases and either dark brown or black tips. The underparts are dark gray and sometimes washed with buff; the hairs are dark gray for most of their lengths and tipped with either white or buff.

The two species are strikingly dissimilar in cranial and dental features, differences that are evident from even casual inspection of figure 1, where some conspicuous contrasts between the two species are illustrated. *Lenomys meyeri* has a much larger and more massive skull. Its zygomatic notches, as seen in dorsal view, are shallower, compared with the deep indentations seen in *M. callitrichus*. The interorbital region of *L. meyeri* is shaped like an hourglass and its edges are thrown into high ridges. These elevations widen into prominent shelves behind the interorbital constriction and extend backward along the dorsolateral margins of the braincase to the occiput. In *M. callitrichus* the interorbital region is not hourglass-shaped; the elevations along its dorsal edges are low and they sweep back like the sides of a triangle and soon fade out along the dorsolateral margins of the braincase. *Mus callitrichus* does not have prominent lateral shelves in the region where the frontals and parietals join.

The two species are unlike in features of the palatal region. *Lenomys meyeri* has short incisive foramina; their posterior edges are situated well in front of the alveolar margins of the first molars. The bony palate is long and arched along the longitudinal axis of the skull. In contrast, the incisive foramina of *M. callitrichus* are long and slender; their posterior margins either reach or penetrate beyond the anterior alveolar borders of the first molars (at least in specimens from northeastern Celebes). The bony palatal bridge is shorter and flat.

The incisors of *L. meyeri* are wider and appear stronger than those of *M. callitrichus*. In *L. meyeri* the tooth rows are longer, the topography of the crowns are much more complex, and the third upper molar is significantly longer than wide. For example, the alveolar lengths of the maxillary tooth rows of eight specimens of *L. meyeri* that I measured range from 10.6 mm. to 13.3 mm. with a mean of 12.1 mm. Age composition of the series ranges from juveniles to old adults. The measurements of this dimension obtained from six examples of *M. callitrichus,* comprising the same range in age, vary from 9.7 mm. to 10.7 mm. with a mean of 10.2 mm. Three distinct rows of cusps are evident in the teeth of *L. meyeri*; the labial and lingual cusps are distinct and well set off from the middle row. The complexity of the dental pattern in this species is illustrated by Tate (1936, p. 613) and Misonne (1969, pl. 1, fig. 2). In *M. callitrichus* the teeth have more of a laminate configuration, some

FIG. 1. Dorsal (top) and ventral (bottom) views of crania. Left to right: *Lenomys meyeri* (A.M.N.H. No. 153011), Boemboelan, northern Celebes; *Rattus callitrichus* (R.M.N.H. No. 21255), northeastern Celebes; and *Eropeplus canus* (A.M.N.H. No. 196592), Latimojong Mts., middle Celebes. All are adult males. All natural size.

of the labial and lingual cusps are absent, and those present are joined broadly with the middle series, which produces the laminate appearance. The upper third molar in A.M.N.H. No. 153011 (the cranium illustrated

in fig. 1) is 3.2 mm. long and 2.5 mm. wide; the shape of the tooth indicated by these figures is characteristic of *Lenomys*. In *M. callitrichus* each upper third molar is actually smaller than those of *L. meyeri,* and its length and breadth are equal. For example, my measurements of both length and breadth of the tooth in R.M.N.H. No. 21255 is 2.4 mm.

Comparisons Between Specimens of *Mus callitrichus* and *Eropeplus canus*

Eropeplus is another monotypic genus that is endemic to Celebes. The single species, *E. canus,* is known from only five specimens; all were obtained from elevations above 5000 feet in middle Celebes. Their places of capture and catalogue numbers are as follows:

Goenoeng Lehio (1° 33′ S., 119° 53′ E.): U.S.N.M. No. 218707 (holotype).
Rano Rano (1° 30′ S., 120° 28′ E.): U.S.N.M. No. 218711.
Latimojong Mountains (3° 23′ S., 120° 03′ E.): A.M.N.H. No. 196592.
Rantekaroa, Quarles Mountains (2° 50′ S., 119° 50′ E.): B.M. Nos. 40.386 and 40.387.

The five specimens are in adult pelage and the morphological differences observed between them are primarily those due to age. The holotype, U.S.N.M. No. 218707, is the youngest of the five; it is a very young adult. The oldest is B.M. No. 40.387; its teeth are worn down to their roots. The other three specimens lie between these extremes in age. Ellerman (1941, p. 141) thought the two specimens from Quarles Mountains might represent a new subspecies, but the features he considered distinctive, namely those dealing with size, represent variations due to age; the two specimens from Quarles Mountains are the oldest of the five individuals.

Specimens of *Eropeplus canus* and *Mus callitrichus* are similar in body size and in features of the pelage. They differ primarily in color and texture of pelage. The upper parts of *E. canus* are gray and have a pale brown suffusion along the back; the color closely resembles the upper parts of *Lenomys meyeri* and is strikingly different from the speckled, dark brown pelage of *M. callitrichus*. In *E. canus* the pelage covering the upper parts is soft and long (the hairs of the underfur reach 25–30 mm.) and has a woolly texture. That of *M. callitrichus* is shorter (the hairs are 15–20 mm. in length), slightly harsher, and its texture is more silky than woolly. The two species are similar in colors of feet, tail, and underparts.

Eropeplus canus and *M. callitrichus* are dissimilar in characters of the skull and dentition (fig. 1). The skull of *E. canus* is smaller and appears more delicate than that of specimens of *M. callitrichus* of comparable age. Compared with *M. callitrichus,* the rostrum of *E. canus* is shorter and nar-

rower and the zygomatic notches are shallow. The interorbital region of *E. canus* is shaped like an hourglass; the ridges along its dorsal edges extend backward where they expand to form wide shelves over the orbital region in the vicinity of the union of frontals and parietals, then sweep backward along the dorsolateral sides of the braincase. The ridging of the interorbital region and braincase resembles the configuration seen in *Lenomys meyeri* and is quite different from that in *M. callitrichus*.

The two species can also be distinguished by configurations of the palatal regions. In *E. canus* the incisive foramina are short and their posterior edges lie well in front of the anterior alveolar margins of the first pair of molars; in contrast, the foramina either extend to, or beyond, the front margins of the tooth rows in *M. callitrichus*. In *E. canus* the bony palatal bridge is long and arched along the longitudinal axis of the cranium, and the bridge terminates well in front of the posterior alveolar margins of the third molars. The palatal bridge is flat in *M. callitrichus* and its posterior edge is even with the posterior alveolar margins of the third molars.

Differences between the dentitions of *M. callitrichus* and *E. canus* are neither as great nor as conspicuous as they are between *M. callitrichus* and *L. meyeri*. Alveolar dimensions of the tooth rows, for example, are similar in *M. callitrichus* and *E. canus*. My measurements of alveolar lengths of maxillary tooth rows for five adults of *E. canus* range from 10.1 mm. to 11.0 mm. with a mean of 10.4 mm. The range of this dimension for five adult *M. callitrichus* extends from 9.8 mm. to 10.7 mm. with a mean of 10.3 mm. The two species can be distinguished, however, by size of the third upper molars. The third molar of the specimen of *E. canus* illustrated in figure 1 is 2.9 mm. long and 2.4 mm. wide. This shape, in which the tooth is conspicuously longer than wide, is characteristic of all five specimens of *E. canus*; it is a consistent dental feature in *Eropeplus* and such genera as *Lenomys* and *Lenothrix,* for example (Misonne, 1969). In contrast, each of the third upper molars in *M. callitrichus* is about as long as it is wide, a configuration typical of species in the genus *Rattus*.

The two species are also distinguishable in morphology of the upper crowns. In *E. canus* the labial and lingual cusps are prominent and displaced posterior in relation to the middle row of cusps; the laminae of each tooth appear angularly arched in ventral view. This configuration is figured by Tate (1936, p. 613) and Misonne (1969, pl. II, fig. 11). In *M. callitrichus* the labial and lingual cusps are neither as angular nor set off as far posteriorly from the middle cusps; the laminae of each tooth appear smoothly and shallowly arched.

There are many other cranial features, such as those associated with the mandibles and lower dentitions, that distinguish specimens of *Mus callitrichus* from those of *Lenomys meyeri* and *Eropeplus canus,* but the characteristics I have discussed above are conspicuous and diagnostic and clearly indicate that *M. callitrichus* does not represent a species of either *Lenomys* or *Eropeplus.*

Association of *M. callitrichus* with *Rattus*

Thomas and Ellerman were correct in their allocation of the name *callitrichus.* The three type-specimens of *M. callitrichus* fit within the morphological framework of the genus *Rattus,* whether that framework is broadly conceived as outlined by Ellerman in his classifications of 1941 and 1949, or narrow as those delimited by Tate in 1936 and Misonne in 1969. The reader should consult these sources for discussions of the various morphological boundaries of the genus.

Thomas knew of *Rattus callitrichus* from northeastern Celebes (1921b) and Ellerman recognized that the species occurred there and in middle Celebes as well (1941). In fact *R. callitrichus* is one of the six large-bodied species of *Rattus* known from northeastern Celebes that have bicolored tails, tails in which the basal portion is brown and the distal portion is whitish; the others are *R. taerae* (Sody, 1932), *R. dominator* (Thomas, 1921a), *R. celebensis* (Gray, 1867), *R. marmosurus* (Thomas, 1921a), and *R. xanthurus* (Gray, 1867). Except for *R. taerae,* which was not described until 1932, the other four species had been recognized by Thomas as a group with "white-ended tails," but he did not think that *R. callitrichus* belonged to that assemblage (1921b, p. 110).

Rattus callitrichus is easily distinguished from *R. dominator, R. celebensis, R. marmosurus,* and *R. xanthurus* in external features alone. The underparts of these four species are either white or cream and are sharply demarcated from grayish upper parts. *Rattus callitrichus* has brownish gray upper parts and dark gray underparts; there is no sharp and conspicuous demarcation in color between upper parts and underparts.

Rattus callitrichus is similar only to *R. taerae* in external features and the two species are difficult to separate by texture and color of pelage. They are distinguishable, however, in size and cranial features. The length of the hind foot, for example, ranges from 48 mm. to 50 mm. in three adults of *R. callitrichus* that I measured; my measurements of this dimension for five adults of *R. taerae* (Sody Nos. P.72, P.5, P.67, and P.84, and A.M.N.H. No. 101244) extend from 44 mm. to 46 mm. Skulls of the two species are easily distinguished by the lengths of tooth rows and the breadths of first upper molars. For example, my measurements of the

FIG. 2. Dorsal views of crania. Top row, left to right, *Rattus c. callitrichus* (R.M.N.H. No. 21255), paratype of *R. maculipilis jentinki* (B.M. No. 40.389), and paratype of *R. m. maculipilis* (B.M. No. 97.1.2.27). Bottom row, three type-specimens of *R. microbullatus*. Holotype (A.M.N.H. No. 101108) far left, two paratypes on right (A.M.N.H. Nos. 101109 and 101218, respectively). See table 4 for age and sex of these specimens. All natural size.

alveolar lengths of maxillary tooth rows for five adults of *R. taerae* range from 9.6 mm. to 9.9 mm.; breadths of the first upper molars vary from

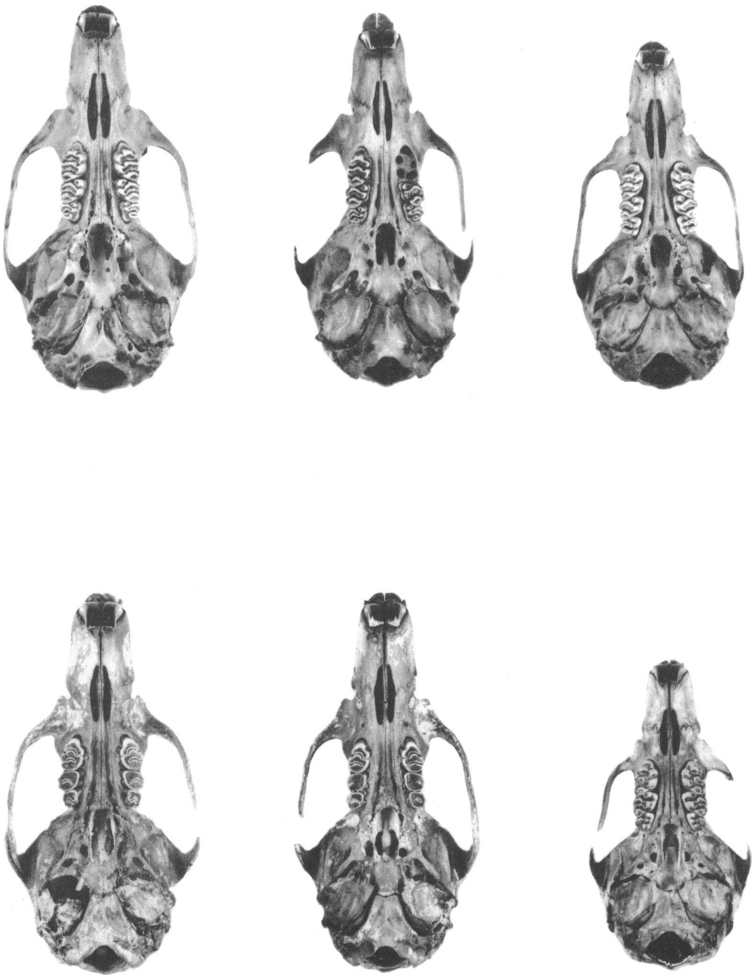

FIG. 3. Ventral views of same crania illustrated in figure 2. Top row, left to right, *Rattus c. callitrichus,* paratype of *R. maculipilis jentinki,* and paratype of *R. m. maculipilis.* Bottom row, left to right, *R. microbullatus* holotype and two paratypes. All natural size.

2.5 mm. to 2.7 mm. The measurements of tooth rows for five adults of *R. callitrichus* extend from 9.8 mm. to 10.7 mm.; the breadths of the first upper molars range from 2.9 mm. to 3.2 mm.

Rattus callitrichus is known from northeastern Celebes by few specimens; the species is represented also in middle and southeastern Celebes

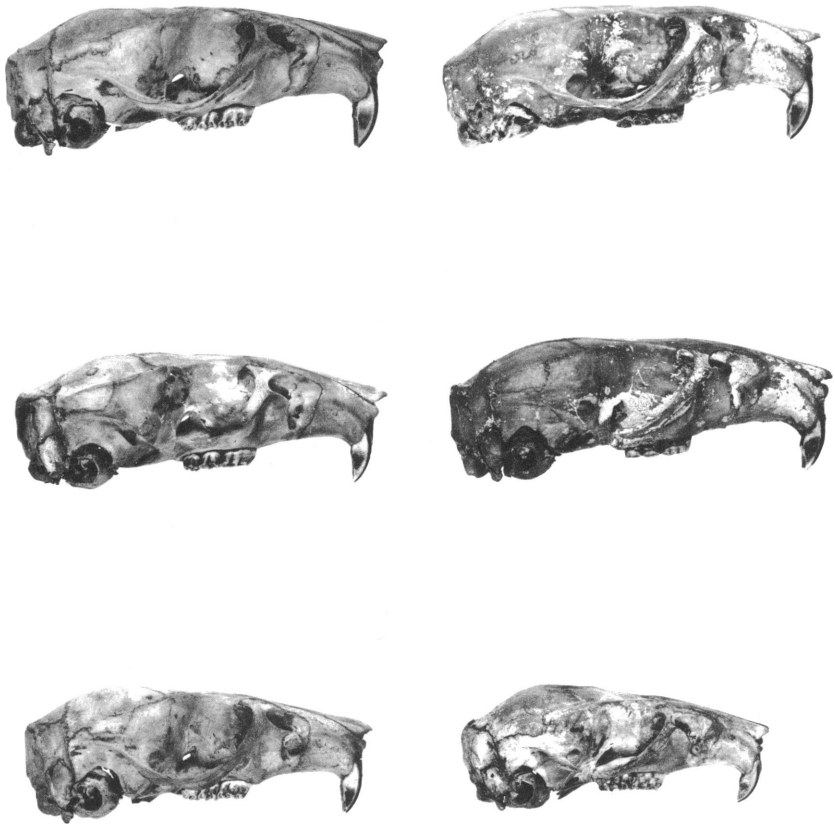

FIG. 4. Lateral views of same crania illustrated in figure 2. Left side, top to bottom, *Rattus c. callitrichus,* paratype of *R. maculipilis jentinki,* and paratype of *R. m. maculipilis.* On right side, three type-specimens of *R. microbullatus;* holotype at top, two paratypes underneath. All natural size.

by small samples that have been recorded in the literature under other scientific names and never directly associated with *R. callitrichus.* These samples are discussed in the following section.

ASSOCIATION OF *Rattus maculipilis, R. m. jentinki,* AND *R. microbullatus* WITH *R. callitrichus*

Rattus callitrichus is the oldest valid name for a species that includes the taxa, *R. maculipilis, R. m. jentinki,* and *R. microbullatus.* These taxa are now known only from their respective type series. I have examined all these individuals, as well as the three type-specimens of *R. callitrichus,* and another example of *R. callitrichus* obtained in northeastern Celebes

that was in Sody's personal collection, now R.M.N.H. No. 21255. This specimen is a good example of *Rattus callitrichus* and one of the most complete specimens I have seen from northeastern Celebes. Its skull, for example, is similar in age, dimensions, proportions, and configurations to R.M.N.H. No. 21276, the adult paralectotype of *R. callitrichus*. The external and cranial measurements of all these specimens are listed in table 4. In addition, the crania of R.M.N.H. No. 21255, the paratypes of *R. maculipilis* and *R. m. jentinki,* and the three type-specimens of *R. microbullatus* are illustrated in figures 2 to 4.

Rattus maculipilis

Laurie and Hill (1954) named and described this taxon on the basis of two specimens obtained by Charles and Ernest Hose on January 11, 1895, from Roeroekan, northeastern Celebes, at an elevation of 3500 feet. Both specimens are adults, but the holotype (B.M. No. 97.1.2.26) is larger and older than the paratype (B.M. No. 97.1.2.27). These are the same specimens that Thomas had identified as *Mus callitrichus* in 1896 (p. 246) and the same individuals upon which Ellerman had formulated his concept of the species *Rattus callitrichus* in 1941 (p. 246). I took the paratype to the Rijksmuseum van Natuurlijke Historie and there compared it with the three type-specimens of *M. callitrichus*. The paratype and holotypes of *R. maculipilis* and Jentink's three specimens of *M. callitrichus* clearly represent the same species. Laurie and Hill proposed *R. maculipilis* because they accepted Tate's allocation of the name *callitrichus* to the genus *Lenomys*; consequently they thought that the two specimens of *Rattus* in the British Museum had been misidentified, that these specimens did not fit with any other taxon, and that they required a name. But Thomas had correctly identified the two specimens; *Rattus maculipilis* is clearly a subjective synonym of *Mus callitrichus*.

Rattus maculipilis jentinki

This taxon was based on two specimens collected by Frost in 1938 from middle Celebes (Laurie and Hill, 1954). The holotype was obtained from Koelawi (latitude 1° 25′ S., longitude 119° 58′ E.), at an elevation of 2500 feet, on December 30; the paratype was collected on November 6, 1938 at Tamalanti (Laurie and Hill recorded this locality as a "Plantation between Rantekaroa and Koelawi"), from an elevation of 3300 feet. Both specimens are adults, but the holotype (B.M. No. 40.388) is larger and older than the paratype (B.M. No. 40.389). Ellerman (1941) had correctly identified these specimens as *Rattus callitrichus*.

The two specimens are morphologically distinguishable from speci-

TABLE 4

EXTERNAL AND CRANIAL MEASUREMENTS (IN MILLIMETERS) OF 11 SPECIMENS OF *Rattus callitrichus* FROM NORTHEASTERN, MIDDLE, AND SOUTHEASTERN CELEBES

	Northeastern Celebes						Middle Celebes		Southeastern Celebes		
	R.M.N.H. No. 21255	R.M.N.H. No. 21275[a]	R.M.N.H. No. 21276	R.M.N.H. No. 21277	B.M. No. 97.1.2.26[b]	B.M. No. 97.1.2.27	B.M. No. 40.388[c]	B.M. No. 40.389	A.M.N.H. No. 101108[d]	A.M.N.H. No. 101109	A.M.N.H. No. 101218
Age	Adult	Adult	Adult	Juvenile	Young Adult	Young Adult	Young Adult	Young Adult	Old Adult	Old Adult	Juvenile
Sex	♂	?	?	?	♂	♀	♂	♂	♂	♀	♀
Length of head and body	—	—	—	—	240	215[e]	210	200	203	203	154
Length of tail	—	—	—	—	226	222[e]	230	220	223	267	194
Length of white segment of tail (percent of tail length)	—	—	—	—	55	72	42	48	52	58	41
Rows of scales on tail (per centimeter)	—	—	—	—	8	9	9	8	9	9	11
Length of hind foot[e]	50	—	—	—	48	48	48	45	46	47	42
Length of ear	—	—	—	—	25	21	—	25	28	28	23
Greatest length of skull	50.9	—	—	—	49.5	46.6	49.1	49.2	50.2	50.0	40.6
Zygomatic breadth	24.9	—	—	—	25.8	22.6	24.9	23.5	25.0	24.4	20.7
Interorbital breadth	7.4	7.0	7.1	6.8	6.8	6.9	6.9	6.8	6.8	6.8	6.3
Length of nasals	20.7	20.8	20.3	17.4	20.8	18.5	19.2	19.5	20.4	20.6	15.1
Length of rostrum	16.0	15.9	15.3	13.3	15.6	14.8	15.2	15.2	16.2	16.8	12.5
Breadth of rostrum	8.5	8.8	—	—	8.4	—	9.1	8.5	9.1	—	7.5
Breadth of zygomatic plate	5.4	5.4	5.5	4.6	5.6	4.9	5.4	5.4	5.9	5.6	4.3
Breadth across incisor tips	3.3	3.9	3.8	2.7	3.5	3.1	3.4	3.3	3.8	4.0	2.6
Breadth of brain case	19.3	—	—	—	18.7	19.6	19.6	19.2	18.7	18.4	17.4

TABLE 4—(*Continued*)

	Northeastern Celebes						Middle Celebes		Southeastern Celebes		
	R.M.N.H. No. 21255	R.M.N.H. No. 21275[a]	R.M.N.H. No. 21276	R.M.N.H. No. 21277	B.M. No. 97.1.2.26[b]	B.M. No. 97.1.2.27	B.M. No. 40.388[c]	B.M. No. 40.389	A.M.N.H. No. 101108[d]	A.M.N.H. No. 101109	A.M.N.H. No. 101218
Height of brain case	14.2	—	—	—	14.0	13.6	14.1	13.3	14.9	13.6	12.3
Length of diastema	13.0	13.0	12.6	10.6	13.3	11.7	12.2	12.1	14.2	14.5	10.0
Palatilar length	23.8	—	23.1	19.5	22.7	21.6	22.8	22.4	24.0	23.9	18.2
Palatal length	27.2	—	26.3	22.3	25.8	24.6	25.9	25.4	26.9	26.5	20.9
Length of incisive foramina	8.6	8.2	8.2	6.7	8.1	7.6	8.2	7.6	7.0	7.4	5.8
Breadth across incisive foramina	3.0	3.1	2.9	2.6	2.8	2.6	2.8	2.5	2.6	2.6	2.5
Length of palatal bridge	10.9	—	10.6	9.0	10.5	10.2	11.0	10.7	11.4	11.1	9.2
Breadth of palatal bridge at M^1	3.2	3.3	3.3	3.0	3.6	3.2	2.9	3.1	3.9	3.6	2.5
Breadth of palatal bridge at M^3	4.9	—	4.5	4.4	5.2	5.4	5.6	5.4	5.2	5.1	3.7
Breadth of mesopterygoid fossa	3.3	—	2.9	2.9	3.1	3.3	3.3	3.1	3.3	3.2	2.7
Alveolar length of M^{1-3}	10.6	10.7	10.5	9.7	9.8	9.8	10.1	10.0	9.3	9.2	9.5
Length of M^1	4.9	4.6	4.8	4.8	4.3	4.0	4.8	5.2	4.3	4.0	4.6
Breadth of M^1	3.2	3.1	3.1	3.1	2.9	2.9	3.1	3.0	2.9	2.8	2.9
Length of bulla	6.2	—	—	—	6.6	6.4	—	6.5	6.4	6.6	6.1
Breadth of bulla	6.9	—	—	—	6.3	6.1	—	5.7	6.1	6.8	6.0
Height of bulla	5.6	—	—	—	6.2	5.9	—	5.5	5.7	5.7	5.2

[a] Lectotype of *Mus callitrichus* Jentink.

[b] Holotype of *Rattus maculipilis* Laurie and Hill.

[c] Holotype of *Rattus maculipilis jentinki* Laurie and Hill.

[d] Holotype of *Rattus microbullatus* Tate and Archbold.

[e] Measured on the dry study skin.

mens obtained in northeastern Celebes in the features pointed out by Laurie and Hill in their original description of *R. maculipilis jentinki*. Compared with specimens from northeastern Celebes, the two individuals from middle Celebes have darker and grayer upper parts, longer and softer pelage, and lighter underparts (whitish gray instead of either dark or buffy gray). The two samples also differ in some external and cranial dimensions. These, and the differences in pelage, are slight, however, and specimens from the two regions closely resemble each other in most other external and cranial features. The name *jentinki* is provisionally valid as a subspecies of *Rattus callitrichus*.

Rattus microbullatus

Tate and Archbold described and named this taxon from three specimens collected by Gerd Heinrich on January 4 and 5, 1932. Heinrich obtained them on Goenoeng Tanke Salokko (latitude 3° 30′ S., longitude 121° 21′ E.) at an elevation of 1500 meters on the eastern slopes of Mengkoka Gebirge in southeastern Celebes. The holotype (A.M.N.H. No. 101108) and one of the paratypes (A.M.N.H. No. 101109) are old adults; the other paratype (A.M.N.H. No. 101218) is a juvenile.

Since the original description was published, the taxon has been associated with two different groups of species within the genus *Rattus*. In 1941 Ellerman listed *R. microbullatus* in the "*xanthurus* Group" of *Rattus* (p. 190), but in his revised classification of the genus, he placed it in the "*dominator* Group" (1949, p. 70). Laurie and Hill listed *R. microbullatus,* along with *R. dominator* and *R. frosti,* in the subgenus *Paruromys,* a category proposed by Ellerman (in Laurie and Hill, 1954).

The three type-specimens of *R. microbullatus* represent the same population, but that population appears to be a distinctive form of *R. callitrichus*. I took the adult paratype to London and Leiden and compared it with the type-specimens of *R. maculipilis, R. m. jentinki,* and *Mus callitrichus*. Color of pelage, ears, feet, and tails of *R. microbullatus* closely resembles that of the two specimens of *R. callitrichus jentinki* from middle Celebes and I could not detect any significant differences in these features between the two samples. The specimens from southeastern Celebes are slightly smaller than those from middle and northeastern Celebes, as judged by length of the head and body and length of the hind foot. The collector's measurements of length of the tail may be inaccurate and I cannot evaluate differences between the samples in this dimension.

Skulls of the three specimens from southeastern Celebes resemble those from middle and northeastern Celebes in configurations (figs. 2–4) and in most dimensions (table 4). Of the 25 cranial and dental dimen-

sions that I measured, the three samples either overlap or are very similar in all but three measurements and the differences in these measurements may be significant. Compared with samples from middle and northeastern Celebes, each of the three specimens from southeastern Celebes have a longer diastema, shorter incisive foramina, and shorter maxillary tooth rows. The three specimens of *R. microbullatus* stand apart from the other samples in these features. The cranial similarities and differences, as with some of the external dimensions, are difficult to evaluate, however, because the samples from middle and northeastern Celebes do not contain specimens that are of the same age as those in the series from southeastern Celebes. Nevertheless, there is no question that the three specimens of *microbullatus,* the sample of *jentinki* from middle Celebes, and the examples of *callitrichus* from northeastern Celebes represent the same species; the name *microbullatus* should be applied as a subspecies of *R. callitrichus.*

SUMMARY

The historical usage of the name *callitrichus* and the allocations of taxa associated with it can be summarized as follows:

Rattus callitrichus callitrichus (Jentink)

Mus callitrichus JENTINK, 1879, p. 12. TROUESSART, 1881, p. 119. THOMAS, 1896, p. 246. TROUESSART, 1897, p. 479. MEYER, 1899, p. 24. TROUESSART, 1904, p. 371.

Mus callithrichus: JENTINK, 1887, p. 212; 1888, p. 65; 1890, p. 120. WEBER, 1890, pp. 95 and 97. JENTINK, 1892, p. 78. WEBER, 1894, p. 474.

Rattus callitrichus: THOMAS, 1921, pp. 110 and 111. SODY, 1932, p. 158. ELLERMAN, 1941, pp. 83, 159, 171, 189, 216, and 219; 1947, p. 263; 1949, pp. 38, 43, 50, 51, 52, 66, 69, and 80.

Lenomys callitrichus: MILLER AND HOLLISTER, 1921, p. 96. TATE, 1936, pp. 553 and 615. LAURIE AND HILL, 1954, p. 97.

Eropeplus callitrichus: TATE, 1940, p. 6. HOOIJER, 1950, p. 75. MUSSER, 1969, p. 5.

Rattus maculipilis LAURIE AND HILL, 1954, p. 115 MISONNE, 1969, p. 143.

Rattus callitrichus jentinki Laurie and Hill

Rattus maculipilis jentinki LAURIE AND HILL, 1954, p. 115. ELLERMAN, 1941, pp. 216 and 219.

Rattus callitrichus microbullatus Tate and Archbold

Rattus microbullatus TATE AND ARCHBOLD, 1935a, pp. 8 and 9. ELLERMAN, 1941, pp. 190 and 217; 1949, p. 70. LAURIE AND HILL, 1954, p. 117.

I have omitted Matschie's (1900, p. 280) reference to the specimen he described under the name "Mus (Gymnomys) callitrichus" from this

synonymy because I have not seen the specimen and I cannot be certain of its identity.

The treatment of the three subspecies of *R. callitrichus* listed above should be taken as provisional. My main purposes in this report are to allocate the name *callitrichus* to *Rattus* and to associate the names *maculipilis, jentinki,* and *microbullatus* with *Rattus callitrichus.* There are not enough specimens, and consequently inadequate data, to determine the actual geographic distribution and the individual and geographic variation in populations of *R. callitrichus* from northern, middle, and southeastern Celebes. Of the three sets of samples, the specimens from middle and southeastern Celebes are alike in color of pelage, and both contrast with the sample from northeastern Celebes. On the other hand, the samples from northeastern and middle Celebes are closely similar in dimensions, proportions, and configurations of skulls and teeth; the specimens from southeastern Celebes are conspicuously set apart from the two other series in these features. The significance of these external, cranial, and dental differences, however, cannot be realistically evaluated with the small samples that are now available for study.

Nor can I comment now on the morphological and zoogeographical relationships of *R. callitrichus* to other species of *Rattus.* Ellerman (1949) thought that *R. callitrichus* was the counterpart on Celebes of *R. infraluteus,* a species allied to *R. mülleri* and known from Borneo, Sumatra, and Java (Chasen, 1940). Laurie and Hill compared the two specimens of *R. maculipilis* with *R. infraluteus* and pointed out the close cranial resemblances between the two species. The association between these two species needs to be tested further, however, and I hope to present more information on the relationships of *R. callitrichus* in a future report on the taxonomy and geographic distribution of rodents of Celebes.

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The present paper is one of a series of taxonomic reports dealing with rodents of Celebes. I could not have reported the results presented in it without the aid of Dr. A. M. Husson of the Rijksmuseum van Natuurlijke Historie, Leiden, Mr. John Edwards Hill of the British Museum (Natural History), London, and Dr. Charles O. Handley, Jr., of the National Museum of Natural History, Smithsonian Institution, Washington, D. C. Through the efforts of these three persons, I had the opportunity to study specimens and documents in the collections under their care. Mr. Robert E. Logan, a staff photographer of the American Museum of Natural History, is responsible for the excellent photographs. Mr. Richard Archbold, of the Archbold Expeditions, the American Museum of

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