Some Muridae of the Indo-Australian Region

By G. H. H. Tate

BULLETIN

OF

THE AMERICAN MUSEUM OF NATURAL HISTORY

Vol. LXXII, Art. VI, pp. 501–728

New York

Issued December 31, 1936

Article VI.—SOME MURIDAE OF THE INDO-AUSTRALIAN REGION[1]

By G. H. H. Tate

Text Figures 1 to 32

TABLE OF CONTENTS

[1] This paper forms number 13 of the series entitled 'Results of the Archbold Expeditions.' Other articles dealing with mammals have appeared in American Museum Novitates, Nos. 801–804, 810.

INTRODUCTION

Through the energy and generosity of Mr. Richard Archbold, New York, several large collections of mammals from New Guinea, Celebes, Java, and Sumatra have recently been assembled for study at The American Museum of Natural History. In addition, the Museum has on hand the unworked mammalian material gathered by the collectors of the Whitney South Sea Expedition in New Guinea and the Solomon Islands. The above-mentioned collections, comprising several thousand specimens, are being identified with a view to publishing a series of reports on the several mammalian orders represented, the new forms being described from time to time in advance of the principal reports as they are discovered. The present paper on the Muridae represents the first full report of the projected series.

MATERIAL AND ACKNOWLEDGMENTS

From the New Guinea region material available for study includes (1) collections made by the 1933 Archbold Expedition to Papua, which worked in the highlands of the Central Division and near the mouth of the Fly River in the Western Division[1]; (2) scattered collections made by members of the Whitney Expedition in the Solomon Islands, Bismarck Archipelago, Huon Peninsula, Humboldt Bay, and Vogelkop; (3) a small lot of mammals taken by F. Shaw Mayer at the Weyland Mountains, Dutch New Guinea; (4) sundry specimens collected by G. Stein at the Weyland and Arfak Mountains and on the Island of Japen, Dutch New Guinea.

The fine collections from north, south, and southeast Celebes were assembled by G. Heinrich, and additional material from the Latimodjong Mountains, Celebes, loaned to Mr. Archbold by the authorities of the Buitensorg Museum, Java, has proved extremely helpful. Finally, the large collections from Java and Sumatra are the fruits of the enterprise of J. J. Menden.

In working out the material, liberal use has been made for purposes of comparison not only of the mammals of the American Museum but also of the important series contained in the U. S. National Museum, together with certain specimens in the Field Museum and Museum of Comparative Zoölogy. Accordingly I wish here to acknowledge my great indebtedness to Dr. H. E. Anthony, Mr. Gerrit S. Miller, Jr., Dr. W. H. Osgood, and Dr. G. M. Allen, who, respectively, have the mammal col-

[1] For the field narrative see 1935, Bull. Amer. Mus. Nat. Hist., LXVIII, pp. 527–579.

lections of those institutions in their care, for loans, for access to specimens, and for valued advice.

Although by no means every murid genus to be found in New Guinea and Celebes and none from the Philippines is represented in the Archbold collection, and many species are yet to be secured, it has been considered desirable, from the scattered nature of the literature bearing upon the mammals of the regions treated, to attempt to a certain degree to correlate and summarize the taxonomic situation within each genus successively as it has been taken up. With this object in view, an attempt has been made to work out a systematic arrangement based upon the anatomical features observable from our material, which will help bring the present large number of genera and their many species into reasonable order.

In general, the information extant for each genus has been summarized as regards the number of species and subspecies. When warranted, maps have been prepared to demonstrate distribution as known at present, and a number of line drawings of teeth and skulls and tables of measurements have been made to illustrate and support the discussions.

Unless otherwise stated, all measurements are given in millimeters, all altitudes in meters, and all names of colors are drawn from Ridgway, 'Color Standards and Nomenclature,' 1912.

Preparation of this MS. was completed December 5, 1935.

MURIDAE

The rats of southern Asia and the Papuan and north Australian region present a great complexity of forms whose relationships to one another can be determined only with difficulty. As in many other highly evolved and complicated groups of animals, convergence and parallelism have so greatly obscured the phylogenetic picture that working out the true affinities of these Muridae is found to be a highly intricate problem. Various anatomical criteria successively considered offer apparently conflicting evidence and much difficulty is encountered in discriminating between true phylogenetic likenesses and similarities due only to convergence. In the broadest sense three major stocks, which are without question of very ancient origin and widely distributed, can be distinguished in the region between the Sunda Islands and north Australia:

1.—Muridae with simple *Rattus*-like molar teeth, exemplified by *Rattus*, *Bandicota*, *Bunomys*, *Echiothrix*, *Uromys*, *Melomys*, *Solomys*, and *Hyomys*. This stock, which is represented by one or several of its component genera throughout the region, besides preponderating greatly in numbers of species, is apparently of more recent development than the two stocks following, and is generally dominant wherever it comes into competition with them. In general it represents the subfamily Murinae of Trouessart and others. See p. 511.

2.—Muridae with complexly folded molars, represented by such genera as *Lenomys*, *Mallomys*, *Pogonomys*, *Chiropodomys*, *Phlaeomys*, and *Crateromys*. Perhaps this stock is polyphyletic. The great structural diversity of the included genera suggests either that such is the case or that the aggregation is sufficiently ancient for the present degree of divergence to have been accomplished. The member genera, existing for the most part high in the mountains of the remoter islands of the East Indian region present the appearance of a relict fauna. *Chiropodomys*, however, is distributed from Burma to Borneo, and *Pogonomys* occurs throughout New Guinea and northern Australia. Possibly the subfamily name Phlaeomyinae of Trouessart should be expanded to embrace this entire assemblage. See p. 612.

3.—Muridae with specialized multi-rooted (in *Hydromys*) molars having basin-like depressions with raised edges, a definite tendency for non-development or loss of the third molars, and a trend in the direction of an aquatic habitus. Examples are *Chrotomys*, *Xeromys*, *Pseudohydromys*, *Leptomys*, *Parahydromys*, and *Hydromys*. In his recent paper Raven[1] regards these rats as "coming from the Philippine Islands" but it seems equally probable that the stock originated in southern Asia whence it spread eastward to occupy its present range—Philippines, New Guinea, and Australia —afterwards becoming extinct (?) in its ancestral habitat. Like the preceding stock it has the appearance of a relict group. Its characteristic dentition permitted its early recognition by systematists as a separate subfamily, the Hydromyinae. See p. 636.

Of the stocks just outlined, the first is unquestionably dominant and many of its generic branches appear to be developing species rapidly.

[1] Raven, 1935, Bull. Amer. Mus. Nat. Hist., LXVIII, p. 187.

The second and third on the contrary are senescent: their component genera are remote from one another anatomically and represent in most cases mere terminal twigs of what may once have been flourishing groups of genera. From their somewhat similar patterns of distribution and the fact that they appear to have reached similar stages of decline it may perhaps be inferred that they constitute the remnants of a single fauna.

The assumption is made in this paper that since the development of the Himalaya mountain system, that part of southern Asia now called Burma has been the primary center for evolution and emigration of the Muridae. From that region successive waves of murid colonization have followed one another outwards, that colonization wave represented by the Murinae (first listed above) being the most recent and today the most vigorous. Quite distinct though probably much older murid offshoots such as the Gerbillinae, the Lophiomyinae, the Cricetinae, *Golunda*, *Vandeleuria*, and even *Mus* (*s. str.*),[1] have in general a northern or western distribution in relation to Burma: at least none has passed through the Burmese area and out into the Sunda-Borneo territories[2]; but then the more divergent of the above-mentioned subfamilies probably evolved before the establishment of the modern Himalayan barrier and the present Burmese dispersal area in an earlier dispersal area of their own belonging in a more ancient geological horizon which perhaps was situated farther to the west and north of Burma.

Just as the Gerbillinae failed to pass eastwards to the Sunda Islands, so the Hydromyinae and Phlaeomyinae were prevented (seemingly) from crossing westwards into India. The enormously developed genus *Rattus*, however, has radiated in almost all directions, and in certain instances seems to have become sufficiently specialized locally to justify recognition of its descendants as distinct genera. Possible examples of such conditions in the Indo-Australian area are: *Bunomys*, derived and barely separable from the *chrysocomus* group of *Rattus* (Celebes); *Echiothrix*, an insectivore-like form with reduced teeth, derived from the *xanthurus* group of *Rattus*; *Eropeplus*, with narrowed palate, leading to *Lenomys* (according to Miller), possibly derived also from the *xanthurus* group (Celebes); *Haeromys*, with opposable (?) hind toe, an offshoot of the *cremoriventer* group of *Rattus* (Malaysia, Borneo, Celebes).

Of the long-snouted rats, Trouessart, in the 'Catalogus' separated *Rhynchomys* of the Philippines from other Muridae in a special sub-

[1] *Mus commissarius* (Philippines) may form an exception.
[2] *Bandicota*, present in Malaysia and Java, is held to have its headquarters in India.

family, Rhynchomyinae. *Echiothrix* of Celebes on the other hand was properly retained in the Murinae. Taylor[1] has included *Rhynchomys* with the Murinae and Raven[2] considers *Rhynchomys* and *Echiothrix* "allied forms." Thomas,[3] in his detailed account of *Rhynchomys*, merely suggested its possible relationship to *Echiothrix*. *Melasmothrix* of Celebes was held by Miller[4] to be only superficially like *Echiothrix*. In the drawing of the molars of *Echiothrix* (Fig. 21) the general relationship of that genus to *Rattus* is fairly obvious, and is analogous to that of *Hyosciurus* to *Sciurus* among the squirrels. *Melasmothrix* has not been examined for this paper. Thomas's plate (*loc. cit.*) shows by the basined form of the molars and the loss of m^3 that *Rhynchomys* is widely separated both from *Rattus* and from *Echiothrix*. It seems that the long-snouted condition in these genera indicates no close relationship. *Rhynchomys*, although it has no specialized zygomatic plate, may after all prove to be an aberrant member of the Hydromyinae.

An attempt has been made by means of the accompanying diagrams (Fig. 1, A–D) to show possible eastward colonization tracks taken by murid radiations. The first two diagrams indicate the Hydromyinae and Phlaeomyinae (or complex-toothed genera). These may have occurred together or successively. The third chart depicts possible early radiations of the Murinae. The settlement of the New Guinea-Australian territory by the *Uromys* group of genera possibly anteceded the arrival in Celebes of the ancestors of *Echiothrix* and in the Philippines of those of *Apomys*. Colonization movements which appear at the present time to be at their very peak are those by the *concolor* and *rattus* groups of *Rattus*. Representatives of these two groups are present on practically every islet in the East Indies. The fourth diagram shows the progress of what (but for probable human interference) might become a vigorous, new burst of speciation and penetration.

The ancestral form of the rat-like Muridae may be sought either in some generalized *Rattus*-like form with teeth after the plan of *Rattus rattus*[5] or in some animal with teeth formed according to the plan of *Hapalomys* (Fig. 22A).

The three tubercles of the first and second lophs of *Rattus* show a strong tendency to assume a crescentic arrangement, the horns of the crescents (formed by the outer and inner tubercles) pointing backwards

[1] Taylor, 1934, 'Philippine Land Mammals,' p. 404.
[2] Raven, 1935, Bull. Amer. Mus. Nat. Hist., LXVIII, pp. 188–189.
[3] Thomas, 1898, Trans. Zool. Soc. London, XIV, p. 396.
[4] Miller, 1921, Proc. Biol. Soc. Wash., XXXIV, p. 93.
[5] The teeth of this animal were described in detail by Hoffmann, 1887, Abh. Dresden Mus., No. 3, pp. 11–12.

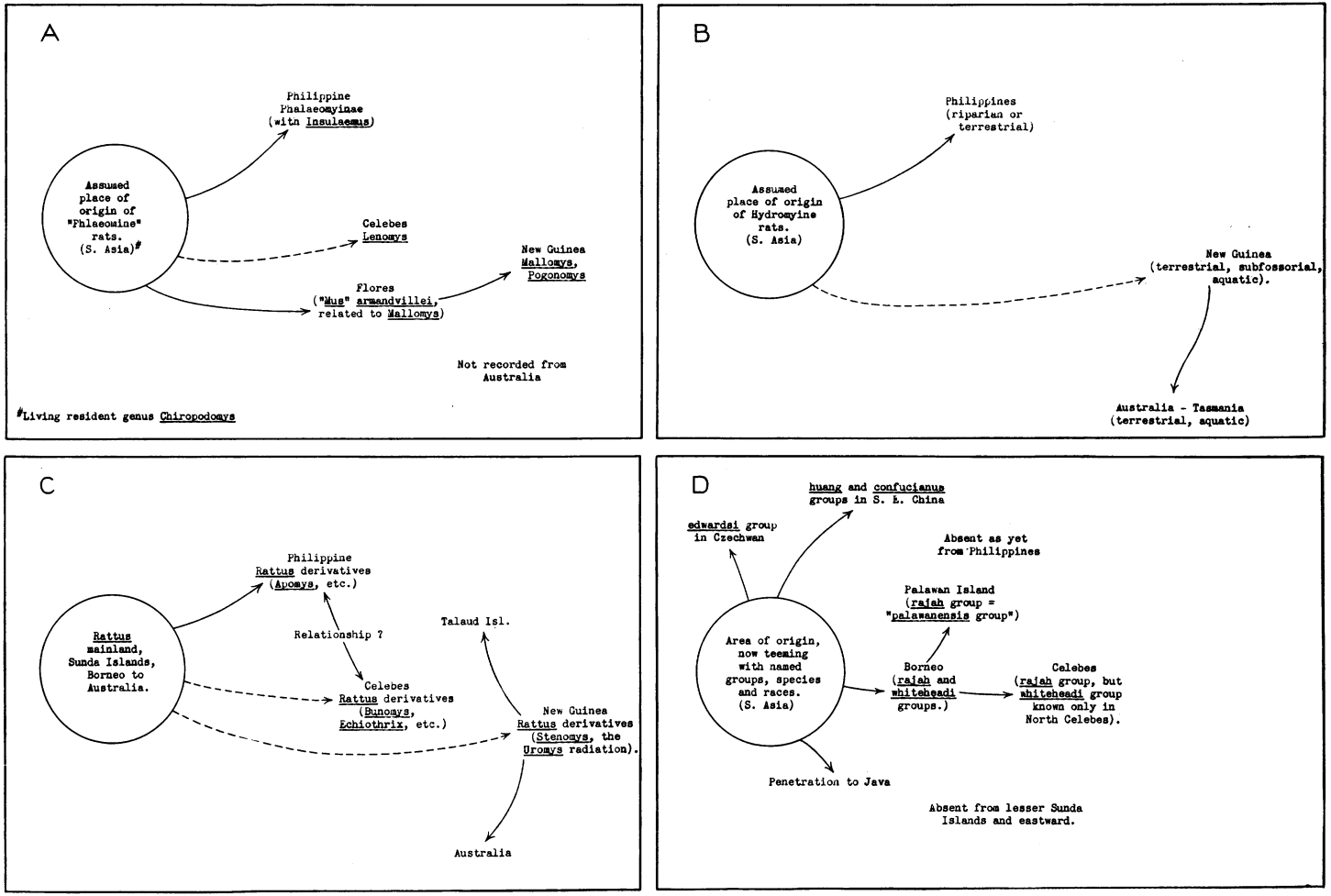


Fig. 1. Dispersal tracks from an assumed region of origin in southern Asia followed by the Phlaeomyinae (A), Hydromyinae (B), and the more ancient lines of Murinae (C). Diagram D shows the geographical radiation of a supposed recent efflorescence of *Rattus*, the *huang-hell-wal[illegible]-alb[illegible]rus* division.

in the toothrow and successively embracing the middle tubercle of the loph next behind. The inner horn of the crescent commonly extends farther backwards than the outer.

Occasional new structures, commissures and small accessory tubercles, arise between the lophs both at the inner and outer sides of the teeth, tending greatly to complicate the enamel pattern when exposed by wear. Teeth with essentially the above pattern vary considerably from species to species in absolute size; in the ratio of length to width; in progressive reduction in size from front to back of the three teeth in the row; in relative hypsodontism; and in the degree of convergence of the toothrows as a whole.

Hapalomys (skull, Fig. 30G) presents greater completeness than *Rattus* in regard to the elements of each tooth and also extreme regularity of dental pattern, which facts may possibly indicate its greater primitiveness. In that genus the backward-enveloping or crescentic arrangement of the tubercles of each loph is not to be observed; nor are the internal tubercles of the 3rd lophs of m^1 and m^2 absent, yet in m^3, apart from a broad cingulum ridge along its outer side, there is no structure to function as an external tubercle. The teeth of *Hapalomys* (Fig. 28A) present a degree of completeness and of regularity of arrangement of their tubercles not even approached in any other genus now under consideration. Were it not for the reduced mammary formula and the extreme specialization of the *Hapalomys* foot which show that the genus is by no means primitive, one would be tempted to try to derive murid teeth from it by postulating various losses and distortions of the tooth parts. But for the present the teeth of *Rattus* have been assumed to represent the archaic murid tooth form.

From a *Rattus*-like molar series the most natural step in the direction of the complicate-toothed rats appears through *Eropeplus* (Fig. 28B). In that genus m^1, though somewhat shortened, retains the tubercle and loph pattern of *Rattus*, except for a narrow internal commissure from loph 2 to loph 3. M^2 remains unmodified excepting also the presence of an internal commissure between loph 2 and loph 3. M^3 shows a commissure linking the single (interior) tubercle of loph 1 with the medial tubercle of loph 2; but the tooth is definitely wider in proportion than m^3 of *Rattus*, due to the presence of external tubercles on lophs 2 and 3.

Even though it seems possible that Phlaeomyine molars may be traced from Murine molars, the origin of the teeth of the Hydromyinae appears entirely problematical. An intensive study of more material (particularly juvenal specimens) is required before any answer to the

question of the history and manner of origin of the Hydromyine dentition (Figs. 31, 32) can be hazarded.

Although it is not possible to decide definitely upon the primitive arrangement of the mammary formula of the Muridae treated, it is probable that the primitive number was either three pairs of pectoral and two pairs of inguinal mammae or three of pectoral and three of inguinal. In the latter event the formula 3–3 of *norvegicus* and its allies and the great increase in the African rats, *Mastomys*, might be accounted for by some process analogous to "polyisomerism" of Gregory.[1] There is throughout all three of the above-mentioned groups of rats a tendency for the mammary formula to be reduced and indeed in one of them only—the more typical murinae with *Rattus*-like dentition—is the original formula maintained. In the group possessing complex molars the highest mammary number reached is one pair of pectoral and two of inguinal. In the Hydromyinae the formula, so far as can be told at present, is 0 pectoral and 2 pairs of inguinal mammae.

The normal arrangement of the scales and hairs of the tail in *Rattus*-like animals comprises squarish scales each of which is accompanied by three hairs varying in length from one to three scale lengths. The median hair of the three is slightly longer than the two laterals. In one subdivision of this same group (characterized by such genera as *Uromys*, *Melomys*, and their allies) a remarkable change is seen in the usually complete suppression of the two lateral hairs and reduction of the median hair to less than one scale length. In the group with complex teeth there is a strong tendency for the scales of the tail to be rounded or rhomboid and somewhat keeled, the scale hairs varying in length in various genera but often becoming very short. The aquatic genera of the Hydromyinae possess scale hairs which range from six to eight times the length of a single scale.

The three subfamilies of Muridae dealt with in the pages of this paper are distinguished from each other by their several plans of dentition. Other systems and structures, such as mammary formulae, adaptations of feet and tail, certain morphological changes in the skull in relation to habits, food, etc., though often of help in distinguishing genera and "groups" are seldom consistently valid when applied to families and subfamilies. Furthermore, the usefulness of such characters varies with the genus under consideration. The mammary formula is variable in the *xanthurus* group of *Rattus*, but so far as is known is constant for the *mülleri* group. In the African *Mastomys* it appears to be highly vari-

[1] 1934, Proc. Amer. Philos. Soc., LXXIII, p. 213.

able. In this connection the non-function or obsolescence of individual mammae should not be confused with non-development. Convergence of structure and function is well shown in the hind foot: a scansorial foot with opposable first digit appears in three genera of rats, *Hapalomys*, *Haeromys*, and *Chiropodomys*, which are certainly widely separated from each other if judged on the basis of their dentition. The present treatment of molar systems as indicative of subfamily differences of absolute value is open to criticism. Convergence and parallelism may well have played as large a part in dental structure as in foot structure. Wood[1] studying the Heteromyidae (pp. 250–251), found endless parallelism in "all parts of the body." Consequently the present arrangement may still be primarily one of convenience.

MURINAE

Muridae with Essentially *Rattus*-like Molars

The subfamily Murinae of Trouessart's 'Catalogus' includes a large number of genera of rats and mice not dealt with in the present discussion. Only those groups of genera which are dominant in or endemic to the Indo-Australian region have been considered, and primarily extra-territorial genera as *Golunda* and *Leggada* or northern genera like *Micromys* and true *Mus* have been disregarded. Most of the specialized murine genera of the Philippines and of southern Australia have also been omitted for the present paper. This leaves for consideration only the genus *Rattus* with its specialized derived genera; the *Uromys* group of genera; *Bandicota;* and a few further genera of doubtful position as, for instance, *Macruromys*.

Eropeplus has been retained in the Murinae, it will be noted. Miller[2] was inclined to regard it as the form from which *Lenomys* might have developed. The narrowing of the palate lends support to such a view, but the molars are essentially *Rattus*-like and present relatively little deviation in the direction of the trefoil pattern with complex enamel loops to be observed in the teeth of *Lenomys*. If *Lenomys* were derived from ancestral *Eropeplus* that fact would tend to confirm the view that the group of relict genera in this paper placed in the Phlaeomyinae was polyphyletic, for one would scarcely venture to suggest the derivation of the New Guinea *Pogonomys* and *Mallomys* and the Philippine *Crateromys* as well as *Lenomys* from *Eropeplus*.

[1] 1935, Ann. Carnegie Mus., XXIV.
[2] Miller and Hollister, 1921, Proc. Biol. Soc. Wash., XXXIV, p. 94.

The *Uromys* group of genera, though remarkably similar in most respects to *Rattus* yet presents certain rather striking differences. Principal among these are the modifications of the hairs at the bases of the tail scales; the simple form of the dental laminae together with the (often) elongate, narrow outline of the body of the anterior molars; and the fact that its distribution pattern is distinctly peripheral to that of *Rattus* and is essentially like that of the Hydromyinae and Phlaeomyinae. For though not known from Celebes and the Philippines, the *Uromys* group is represented from the Talaud Islands (*Melomys*) to north Australia and in the Solomon Islands has given rise to certain moderately specialized genera (see also p. 587).

Even in *Rattus* proper there seem to have been early attempts at colonization of the East Indian islands from the south Asiatic mainland, the descendants of which are preserved today as the *xanthurus*, *chrysocomus*, and *hoffmanni* groups of *Rattus* of Celebes and the Philippines and their generically specialized derivatives. Perhaps the *tunneyi* and *assimilis* groups of *Rattus* in Australia belong in a similar category.

"*Mus*" *nativitatis* from Christmas Island, Indian Ocean, of which the skin alone has been examined, has the claws peculiarly spatulate and the tail remarkably short. It is quite unlike the second species of the island, *macleari*, which is referable to the *Rattus xanthurus* group, and it may be expected to show cranial peculiarities. It may prove to be a remnant of the *Uromys* or *Lenomys* colonization waves.

RATTUS FISCHER

Mus LINNAEUS, 1758, 'Syst. Nat.', 10th Ed., p. 61.
Rattus FISCHER, 1802, Nat. Mus. Naturg., Paris, II, p. 128 [mis-printed *Ruttus*].
Musculus RAFINESQUE, 1814, Pres. Decouv. Trav. Somiologique, p. 13.
Epimys TROUESSART, 1881, Bull. Soc. Etudes Sci. Angers, X, p. 117.
GENOTYPE.—By absolute tautonymy, *Mus rattus* Linnaeus.

Since the appearance of the original descriptions of the European species of *Rattus*, so large a number of forms have been added to the genus from the general region of southern Asia and adjoining territories that doubt that southern Asia represents the distributional center and land of origin of *Rattus* can scarcely be entertained. Such being the case, the fact of the geographically peripheral European black rat being type of the genus is somewhat regrettable. A species from the Burma region would have been preferable as genotype.

The geographical scope of the present inquiry into the genus is limited chiefly to the rat faunas of south Sumatra, Java, Celebes, and New Guinea, special attention being directed to the last. In addition

certain collateral remarks may bear upon the south Asiatic mainland *Rattus* as well as some Bornean, Philippine, and Australian species. Although a preliminary grouping of species into more obvious Artenkreise has been attempted, this paper must in no sense be considered a generic revision, for little attention has been paid to the species inhabiting China, and moreover material representing *Rattus* from India is almost completely lacking from the collections of the American Museum.

Earlier discussions treating the genus from the systematic and evolutionary standpoint are rare. Faunal papers usually deal with a succession of species, their authors having made little effort to bind those species into groups and such groups into aggregates of higher order. Perhaps the most important effort at such systematic organization of species was that of Bonhote,[1] who proposed the group names *jerdoni* = [*fulvescens*[2]], *whiteheadi*, *xanthurus*, *mülleri*, *bowersi* (not dealt with in the present paper), *rattus*, *chrysocomus*.

Bonhote's *jerdoni* group included six subgroups: *edwardsi*, *sabanus*, *jerdoni*, *niveiventer*, *rajah*, and *cremoriventer*, each subgroup provided with a short definition to embrace the species listed under it. In our present paper Bonhote's groups, *edwardsi* and *sabanus*, are combined under the name *edwardsi-sabanus* group; his *jerdoni* and *niveiventer* groups are united as the *huang* group; his *rajah*, *cremoriventer*, and *whiteheadi* groups are continued as such, although not all of the species then assigned remain in them. The foregoing have been combined in the present paper into a major division termed the *huang-hellwaldii-sabanus* division (p. 563).

Of Bonhote's remaining groups, *xanthurus*, *mülleri*, *rattus*, and *chrysocomus*, the *rattus* group only was subdivided by him, the subgroups being named *rufescens*, *pyctoris*, and *griseiventer*, or "tree-rats," "hill-rats," and "house-rats." The first of these is largely beyond the geographical range of the present paper. The second included the white-bellied *jalorensis* of Malay and Java and *neglectus* (with, of course, *diardii*). In the third subgroup Bonhote listed a number of the species shown now on pages 523 and 524. For our treatment of the *rattus* group see page 523.

Following the plan of Bonhote, Trouessart[3] rearranged his south Asiatic rats in the supplement of his mammal catalogue (1904). Occasional reference of newly named species to one or another of Bonhote's species-groups is to be noted in the writings of Thomas, Miller, and Kloss,

[1] 1903, 'Fasciculi Malayensis,' I, pt. 1, pp. 31–38.
[2] See Osgood, 1932, Field Mus. Nat. Hist., Zool. Ser., XVIII, No. 10, p. 304.
[3] 1905, Cat. Mamm. viv. foss., Suppl., pp. 364–383.

particularly in the case of the second author[1]; also certain single groups have been treated, i.e., the *fulvescens* group by Wroughton[2] and the Indian house-rats by Hinton[3]; but since Bonhote the species-groups of the genus *Rattus* have not been reconsidered comprehensively.

The present arrangement is intended to represent a phylogenetic picture (see diagram, Fig. 2). Like most other such attempts, in spite of very full representation of the numerous genetic lines by living forms, parts of the picture are weakened or made inconclusive by gaps in the evidence and particularly by the lack of fossil evidence. Less confidence

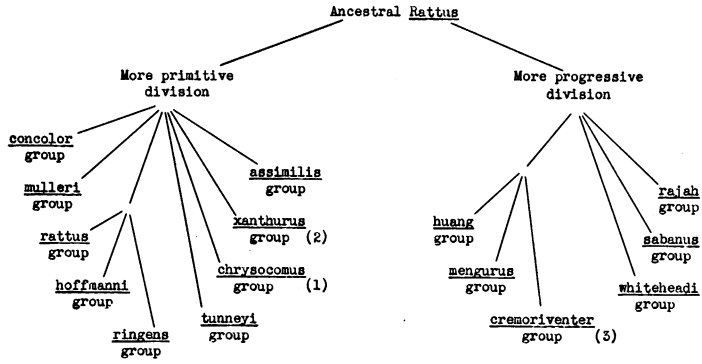


Fig. 2. Principal lines of descent of the groups of the genus *Rattus*.

is felt in the unity of the *xanthurus* group which seems to be relatively ancient and decidedly diversified, than in the *hellwaldii-rajah* complex, or the *sabanus-edwardsi* group, which with a reasonable degree of certainty represent single Artenkreise, so to say, in full flower. In spite of such shortcomings, it is hoped that the present contribution will have accomplished a little towards further sorting out and pigeon-holing the mass of species currently assigned to *Rattus*.

In one so large and widespread as the present genus, but whose members yet follow a common anatomical plan so closely, there appears necessarily a great deal of parallelism and convergence between some of the

[1] For example, Miller, 1921, Proc. Biol. Soc. Wash., XXXIV, pp. 67–75, 96–98.
[2] 1916, Journ. Bombay Nat. Hist. Soc., XXIV, pp. 426–429.
[3] 1919, Journ. Bombay Nat. Hist. Soc., XXVI, pp. 59–88.

species which, although appearing at first sight much alike, may actually have been derived from somewhat widely separated origins. The detection of characters likely to indicate those remoter origins constitutes one of the major problems in the study of *Rattus*. Clues to the recognition of those original main branches in the evolution of the genus have been sought among all sorts of criteria, among which may be mentioned mammary formula, foot form, anatomical features of the skulls, and dentition. As a result of that study, two very large divisions of species are thought to have been discovered and several quite small ones, some of which last possibly represent outlying members of other large divisions in India (not studied). Those divisions are:

1.—*R. rattus* division, with the lengths (and sizes) of the molars forming a moderate dimensional gradient so that the crown length of m^3 is more than 50% of the length of m^1, and the palatilar length from 43 to 51% of the occipito-nasal length. The species commonly have normal terrestrial (scampering) feet. (For exceptions and detailed discussion see page 519.)

2.—*R. huang-hellwaldii-sabanus* division, a progressive (?) group with mammae never exceeding 2–2, various locomotor adaptations, and the dental gradient increased so that the crown length of m^3 is less than 50% of that of m^1 and the palatilar length from 35 to 46% of the occipito-nasal length. (See page 563.)

It will be recognized at once that the majority of species of *Rattus* in the region under treatment are referable either to division 1 or division 2. But in addition to the above attempted arrangement of *Rattus*, there are indications that certain rats now regarded as distinct generically are the specialized descendants of definite "groups" of the genus *Rattus*. Examples are: the two divergent lines *Echiothrix* and *Eropeplus* from the *R. xanthurus* group; *Bunomys* from the *chrysocomus* group; *Haeromys* from the *cremoriventer* group.

In the present study much attention has been paid to proportions of various anatomical parts. This practice has been established largely in order to substitute percentages for such terms as "larger," "shorter," "wider," etc., but it has also been found valuable as offering indices of what are believed to be true relationships. The point will become clearer, it is hoped, as the scheme of classification unfolds.

The parallelisms before alluded to occur in various single characters in skulls of species belonging to different groups of *Rattus*. For example, the size of the bulla, length of palatal foramina, width of zygomatic plate, are characters which, although they may form good species indicators within some given group, can rarely be assigned higher value. To a limited degree this statement is also applicable to foot-structure.

If the skulls of numerous species of *Rattus* are examined in detail,

they are seen to resemble one another closely in all major structures but to differ slightly in degree as regards the proportional sizes and shapes of those structures. The skull parts which are most obviously variable are the teeth, the palate, the anterior zygomatic root, the audital bullae. The species group *rattus* (with *alexandrinus, diardii*, etc.) has been chosen to serve as a standard against which other species groups may be compared. Seven significant ratios have been compared throughout the groups, namely (1) length of combined molar crowns/occipito-nasal length of skull; (2) length of bulla/occipito-nasal length of skull; (3) length of molar crowns/length of bulla; (4) length of diastema/length molar crown series; (5) palatilar length/length molar crown series; (6) length of diastema/palatilar length; (7) palatilar length/occipito-nasal length of skull. In normal *R. rattus* groups the first two ratios vary from 16 to 19% and 17 to 20%, respectively, the third from 80 to 105%, the fourth from 170 to 200%, the fifth from 260 to 340%, the sixth from 52 to 58%, and the seventh from 46 to 50%. When other species groups of *Rattus* are compared with respect to those proportions it appears that for the ratio, molar teeth/skull length, all of the members of the *rattus* division come within the range of the *rattus* group, i.e., 16 to 19%.

In regard to the size of the bulla, however, greater range of variation is to be observed, only certain members of the *xanthurus* and *ringens* groups having the lengths of bullae proportioned to the length of skull as in the *rattus* group. In the *hoffmanni* and *chrysocomus* groups that proportion is 15 to 17% and in the *mülleri* group as low as 12 to 14% in *dominator* of the *xanthurus* group it is 12 to 13%. In the third ratio (length of molar toothrow/length of bulla) the differences stand out yet more sharply. The typical *rattus* rats have the bullae moderately large, the above proportion working out at 80 to 105%. The *concolor* rats, having also rather large bullae, show much the same ratio. The *hoffmanni* and *chrysocomus* groups vary from 95 to 110%. The *tunneyi* group, in which both molars and bullae are large, shows a ratio similar to that in the *rattus* group. The widely variable *xanthurus* group shows a variation from 85 to 140%. Finally in the *mülleri* group the reduced bulla results in the proportion, molar crowns/length of bulla = 135 to 150%.

In the *rattus* division of rats in almost all cases the relation, length of diastema/palatilar length is less than 60%. It varies between 52 and 59% in the groups *rattus, mülleri, ringens, hoffmanni, tunneyi*, in rather marked contrast to the majority of the members of the *huang-salanus* division, in which it ranges between 61 and 70%. Occasional members

of the *concolor* group have the diastema as high as 62% of the palate and the long-snouted members of the *chrysocomus* and *xanthurus* groups readily transgress the general rule. In the *huang-surifer* division certain *whiteheadi* and *sabanus* rats have the proportion less than 60%.

For the ratio palatilar length/length of toothrow (crowns), the reverse is the case, the results running generally from 260 to 300% in the *rattus* division and from 230 to 280% in the *huang-surifer* division. Besides the obvious overlap there are members of both groups whose proportions transgress the above figures considerably, the outside ranges for the *rattus* division being between 240 and 340% and for the *huang-surifer* division 220 and 300%.

But when the two divisions are compared for definite divergence in the ratio, diastema/toothrow, no such divergence can be discerned: both groups range from 130 to 200% in that respect. It follows therefore that the variable factor in the two previous ratios must in most

SIGNIFICANT CRANIAL RATIOS IN THE GENUS *Rattus*

	$\frac{m^{1-3}}{\text{occ.-nas.}}$ %	$\frac{\text{bulla}}{\text{occ.-nas.}}$ %	$\frac{m^{1-3}}{\text{bulla}}$ %
rattus division			
Rattus alexandrinus *Rattus diardii* *Rattus jalorensis*, etc.	16–19	17–20	81–102
Rattus concolor group	17–19		84–95
Rattus mülleri group	16–19	12–14	135–150
Rattus ringens group	16–18	15–18	105–115
Rattus hoffmanni group	16–17	15–17	95–110
Rattus tunneyi group		20–22	75–100
Rattus chrysocomus group	16–19	15–17	90–115
Rattus xanthurus group	16–18	16–18	85–140
Rattus dominator group		12–13	120
hellwaldii division			
Rattus whiteheadi group	15	12–13	130–140
Rattus surifer group	15–17	11–14	100–140
Rattus huang group	?		
Rattus cremoriventer group	16	15–17	120
Rattus beccarii group	14	14	105
Rattus sabanus-edwardsi group	17–18	9–11	160–170
Rattus bartelsii	14–15	12–14	100–110
Rattus lepturus	18–19	12–14	135–145

FURTHER CRANIAL RATIOS IN THE GENUS *Rattus*

	diastema / tootbrow %	palatilar / toothrow %	diastema / palatilar %	palatilar / occ.-nas. %
Rattus alexandrinus	170–200	260–340	52–58	46–50
Rattus concolor	140–180	260–300	55–62	44–48
Rattus mülleri	140–170	250–280	56–58	45–47
Rattus ringens	160–175	260–300	53–59	47–49
Rattus hoffmanni	140–180	270–310	57	48–50
Rattus brachyrhinus	150–170	240–270	59	48–49
Rattus chrysocomus	150–180	240–300	57–63	
Rattus xanthurus	130–190	250–300		44–49
Rattus huang	170	240–280	60–62	43–44
Rattus beccarii	190–200	280	66	42–43
Rattus whiteheadi	150	230–280	57–64	35–40
Rattus musschenbroekii	150	220–250	63–64	37–40
Rattus rajah	170–200	260–300	64–69	37–40
Rattus sabanus	140–170	240–280	59–62	42–46
Rattus bartelsii	190–200	280–290	70	39–42
Rattus lepturus	140–160	220–240	56–57	41–44

cases be the length of the palate, i.e., that the *rattus* division comprises rats with long palates and the *huang-surifer* division rats with short palates. And because the "palatilar" length rather than the "palatal" length has been employed in the present inquiry, the difference in length must generally lie in the posterior part of the palate, probably in the degree of prolongation beneath the posterior nares. That such is really the case can be discerned from the generally rounded and excavated posterior margin of the palate in the *huang-surifer* division.

The shorter palate of the *huang-surifer* division is readily confirmed by a glance at the ratio palatilar length/occipito-nasal length. In the *rattus* division this varies from 43 to 51%; in the *huang-surifer* rats from 35 to 46%, excessive shortness being shown in the *whiteheadi*, *rajah*, and *beccarii* groups.

The form of zygomatic plate and the size of the incisive foramina seem not to be sufficiently stable characters to serve for the distinction of *rattus* rats from *huang-surifer* rats. (Note however that the peculiar form of the foramina of the *hellwaldii* and *cremoriventer* groups is unknown among the rats of the *rattus* division.)

It is understood that the foregoing discussion on proportions of the skulls of *Rattus* species applies only to adult material. Again, the above

is no more than a preliminary survey of this particular line of approach to the problem of the phylogeny of the rats. But the results observable appear to offer promise of rather satisfactory results if carefully and fully worked out, while keeping in view the other numerous factors involved in the analysis of species.

Rattus rattus Division with Synopsis of Groups

This division includes the most typical of the rats, in contradistinction to the generally more specialized members of the *huang-hellwaldii-sabanus* division (p. 563) or others. It is distinguished by the fact that the crown length of m^3 is not greatly reduced, but varies from about 50 to 62% of the crown length of m^1. From it the *sabanus* rats are separated by their long slender rostra, much reduced bullae, and, usually, elongated tails.

The characteristics of the *Rattus* division may be summed up, with few exceptions, as follows:

Form typically rat-like, rather heavy, seldom slender; feet of normal scampering, terrestrial form (exc. *chrysocomus* group in which they may be slender), never scansorial; claws normal in most groups, becoming somewhat enlarged in *mülleri* group; tail variable in length, never with pencil of hairs; skull usually heavily built, with rostrum rather short (exc. *chrysocomus* group and some *xanthurus* rats); profile of the top of skull rather evenly arched (somewhat flattened anteriorly in *chrysocomus* group and in some *xanthurus*); palate rather elongate; margin of interpterygoid fossa not horseshoe-shaped, its sides sub-parallel; bulla longer than toothrow (exc. *mülleri*, *ringens*, and part of *chrysocomus* and *xanthurus* groups). A list of the major groups is first shown:

		Distribution in East Indies
1.—*Rattus rattus* group	(Mammae 3–3 or 2–3)	General
2.—*Rattus concolor* group	(Mammae 2–2)	General
3.—*Rattus ringens* group	(Mammae 2–2, 1–2 or 0–2 (?))	New Guinea
4.—*Rattus mülleri* group	(Mammae 2–2)	Malay Region
5.—*Rattus hoffmanni* group	(Mammae 1–3)[1]	Celebes
6.—*Rattus tunneyi* group	(Mammae 3–3 or 2–3)	S. New Guinea, Australia
7.—*Rattus chrysocomus* group	(Mammae 0–2 (?))	Celebes and Philippines
8.—*Rattus xanthurus* group	(Mammae 2–2, 1–2 or 0–2)	Celebes and Philippines
9.—*Rattus assimilis* group	(Mammae 0–2 (?))	Australia

[1] Hoffmann found only 1–3 mammae in his type specimen. We find the same in four females.

The central group of the *Rattus* division in the morphological sense is probably the *R. rattus* group. Closely allied to it, but distinguished by reduction of the mammary formula comes the small *concolor* rats and the large *mülleri* rats. The *hoffmanni* group of Celebes combines the skull profile of the *rattus* group with a much heavier type of dentition and soft pelage. The *tunneyi* group of Australia though retaining a high mammary formula, has the palate specialized. The *chrysocomus*, *ringens*, and *assimilis* groups may be closely allied to one another, the *ringens* group on account of its 2–2 or 1–2 mammary formula being perhaps the more primitive. The diversified *xanthurus* group (if monophyletic) is of rather remote origin and more specialized.

A curious phenomenon in this division of *Rattus* is the frequent development of a strong over-wash of russet in the region of throat and chest. This may be observed in the *ringens* group of New Guinea (*ringens* and *mordax*) and in the *chrysocomus* group of the Philippines.

A tentative synopsis of each group is next shown:

R. rattus Group.—A very large assemblage of named forms with mammary formula 2–3 or 3–3, extending from Europe and western Asia to Australia. Pelage coarse to moderately fine, guard hairs sub-terete, wool hairs variable in quantity, almost no flattened spines. Underparts variable according to species and Formenkreis. Ears small. Tail variable, seldom markedly bicolored. Feet of normal terrestrial type (p. 519); (length of foot, s.u., about 20% of head and body length, 75% of occipito-nasal length; width at base of 5th metatarsal 15–16% of foot length; length of digit 3 about 30–33% of foot length); adult skull usually well arched anteroposteriorly, with moderately widened zygomata; interorbital region somewhat narrow (29% of zygomatic breadth); interparietal large, well developed; nasals, predental palate, and diastema a little shortened; zygomatic plate moderately broad, not sloping (its width about 37% of diastema); palatal foramina moderately long (about 40% of palatilar length, 19% of occipito-nasal length); bullae rather large (length about 17–18% of occipito-nasal length, 39% of palatilar length, 100–125% of length of molar crowns), covering almost all of periotics (partly exposed in some groups); molars small (crown series about 14–15% of occipito-nasal length; m^1 crown length 45% of crown length of molar series; m^3 crown length 25% of molar crown series, 55% of m^1 crown length; m^1 crown width 28% of length of molar crown series, 42% of length of crown of m^1). First molar with anterior root commonly extended far in advance of crown.

In this group are placed the Norway rats (mammae 3–3), Alexandrian and black rats (mammae 2–3), the *diardii-neglectus* class of rats (2–3), the pure white bellied *jalorensis* rats (3–3), the species *doriae*, *vanheurni*, and *gestri* of New Guinea (all 2–3). The names just mentioned are merely a sampling of names to represent the many closely related species which seem to belong in this group. Doubtless numerous species of the Indian, Chinese, and Philippine rats should also be referred here. (See page 523 for species.)

R. concolor Group.—Size much less than *R. rattus* group. Pelage coarse to fine; guard hairs present, often scarce; commonly a strong admixture of flattened, channeled spines with the wool hairs, but spines may be obsolescent in mountain-inhabiting species (also in some Pacific Island races). Ears small. Tail almost always longer than body. Feet of terrestrial type (many of the species are good climbers, though). Mammae 2–2. Skull essentially after the fashion of *R. rattus* group, but braincase and interorbital region, as often in small forms, proportionately larger.

In a recent summary of the Pacific members of the *concolor* group[1] a suggestion of its variation and distribution has been made. The group was compared in that paper with groups of equally small-sized rats *cremoriventer* and *asper* (= also *whiteheadi* group), which belong in the present *huang-surifer* division, but the point was not made at that time that the nearest ally of the *concolor* group was apparently the *R. rattus* group. (See page 530 for species.)

Rattus mülleri Group.—Large, heavy-bodied Malaysian rats with mammary formula 2–2. Colors broadly speaking white-flecked iron-gray above, sometimes with a brownish wash, beneath self-colored (usually) white or buff. Pelage coarse and bristly, with admixture of wool hairs in northern regions; no flat spines. Ears small. Feet terrestrial, tending to be proportionately longer and provided with strong claws. Skull of general *rattus* type, heavily built, well arched, but with rather small bullae (12–14% of occipito-nasal length; about 70% of molar crown length), partly exposing periotic; and quite heavy dentition, incisors being stout and thick, molars large and wide (crown of m^1, 4.3 × 2.8 in *mülleri* subsp., 4.4 × 2.8 in *firmus*). (For species see page 541.)

R. ringens Group.—A local section of *Rattus* in New Guinea with mammae 2–2 or 1–2. Pelage coarse and often thin; feet of terrestrial type, rather heavy; tail longer or shorter than body. Skull much as in *R. rattus* group but with interparietal reduced antero-posteriorly and raised temporal ridges scarcely developed on frontals; bullae smaller (only about 15–16% of occipito-nasal length); incisors heavy, opisthodont; m^3 crown length about 55% of length of crown of m^1. (See page 543.)

Rattus hoffmanni Group.—Apparently restricted to Celebes, this group comprises rats which possess the short muzzle and arched cranial facies of the *R. rattus* group in combination with smaller bullae and larger, broader molar teeth, such as appear in the *chrysocomus* group. Pelage only moderately coarse, often long, soft, and fine. Feet of terrestrial type. The mammary formula is (apparently) 1–3. The hairs of the tail tend to be longer than in the *R. rattus* group, each hair reaching about two scale-lengths. (See page 547.)

Rattus tunneyi Group.—Coarsely haired, medium-sized rats with small ears. Color above of the usual ticked character, brownish hair tips over gray bases. Underparts in most Australian members without gray bases, buffy; in the New Guinea species *brachyrhinus* the ventural hairs have gray bases. Feet normal terrestrial in type. Mammae 3–3 or 2–3. Skull differing from *rattus* group by following characters: maximum degree of arching; general narrowing of braincase, interparietal

[1] Tate, G. H. H., 1935, Bull. Amer. Mus. Nat. Hist., LXVIII, p. 163.

and basioccipital; shortening of nasals so as barely to exceed premaxilla anteriorly; decided enlargement of bullae (19% or more of occipito-nasal length; 110% of length of molar crowns); long, slit-like character of palatal foramina (43–44% of palatilar length). Treatment of this group is limited to the form found in New Guinea, north Australian material being referred to primarily for purposes of comparison. (See page 549.)

Rattus chrysocomus Group.—Probably an ancient derivative of *Rattus* which, like the succeeding *xanthurus* group, is now restricted to Celebes and the Philippines. Principal characters are its usually long, soft pelage, sub-uniform in length, and almost invariably gray-based underparts; rather large ears; distinctly bicolored tail (in most species); tendency to develop the hopping-type of foot, with long narrow metapodial part and short toes; and mammary formula 0–2. Skull from parietals to tip of rostrum often flattened, from parietals to occiput commonly arched; rostrum long, in old specimens often becoming wide and heavy, nasals then widened at tips; cerebellum portion of braincase often rather fuller than in *rattus* group; zygomatic plate rather narrow and sloping; interdental palate, due to quite heavy dentition, narrowed; foramina in outline much as in *R. rattus* group; bullae small to moderate in size; molars very much heavier than in *rattus;* length of m^3 crown about 50% of the length of m^1 crown, the whole series usually nearly 40% of palatilar length (in *rattus* group rarely more than 34%); combined with the unusual length of the series is the width of m^1, 2.3 to 2.5 or from 60 to 70% of its length. (For species see page 550.)

Rattus xanthurus Group.—An assemblage probably quite as old as the *chrysocomus* group. Known only from Celebes and the Philippines, unless *macleari* of Christmas Island is included here. All species are moderately large to very large rats, having mixed wool and guard pelage, but totally lacking channeled spines. The guard hairs in some species become exceptionally long. Ventrally both self-colored and gray-based pelages occur. Ears small to rather large. Tail very commonly particolored. Feet terrestrial in type, rather large and heavy, digits rather long. Mammary formula 2–2, 1–2, or 0–2. The morphology of the skulls indicates that the group is already quite diversified. Three well-marked types can be noticed: the *bontanus* type which approaches the *rattus* group in its arched skull, but nevertheless differs by its large teeth, long palatal foramina, and small bullae; the *xanthurus* type with smaller teeth, larger bullae, and large foramina; and the *dominator* type with moderately large teeth, small bullae, and quite small foramina. This group, called by Miller[1] "composite" (and well it may be) appears to have run riot, in a morphological sense, in the Celebes. The Philippine members cannot now be correlated with Celebes representatives. (See page 555.)

Rattus assimilis Group.—Australian rats (not recorded from New Guinea) having very long soft hair, fuscous-based and brown tipped dorsally, and ventrally buffy tipped gray-based fur so long as to make a check of the mammary formula difficult. Many specimens have median patches of white (to the base) hairs. Ears rather small. Feet terrestrial but somewhat narrower than those of the *rattus* group.

[1] 1921, Proc. Biol. Soc. Wash., XXXIV, p. 97.

Tail lightly pigmented, unicolorous. Mammary formula 0–2. Skull diverging from that of the *rattus* group as follows: rostrum generally heavier; bullae decidedly smaller (15–16% of occipito-nasal length; 90% of length of molar crowns); molars decidedly larger (molar series 36% of palatilar length; m^3 crown 50–52% of crown length of m^1; width of m^1 crown 2.2 or 63% of its crown length). Palatal foramina rather long but not narrowed and slit-like as in the *tunneyi* group (about 39% of palatilar length).

The *assimilis* group thus has a number of characters in common with the less specialized (in regard to foot structure) members of the *chrysocomus* group. No subsequent remarks will be offered on this group, which is apparently restricted to Australia and Tasmania.

Rattus rattus Group

A preliminary statement characterizing the group has just been made (p. 520). For the sake of easy consultation it has seemed well to list the named forms referable to this group under a geographical arrangement.

Rattus rattus Species Geographically Arranged (by Type Localities), Excluding Species of the Mainland North of Malay Peninsula (Numbers in parentheses indicate published mammary formulae)

Malay Peninsula Region:
- Perak—*griseiventer, annandalei, r. rumpia*
- Jalor—*jalorensis* (2–3)
- Johore—*tingius, roa*
- Mergui—*r. dentatus, r. exsul, r. fortunatus, r. insulanus*
- Tioman—*tiomanicus*
- Str. Malacca—*r. jemuris, r. moluccarius* (2–3), *r. payanus*
- Lankawi—*r. viclana*
- Siantan Isl.—*siantanicus*
- Simalur Isl.—*simalurensis simalurensis* (2–3)
- Babi Isl.—*simalurensis babi*
- Lasia Isl.—*simalurensis lasiae*

Sumatra and Islands:
- West Sumatra—*korinchi, r. argentiventer*
- East Sumatra—*r. palembang* (2–3)
- Pagi Isl.—*lugens*
- Nias Isl.—*maerens*
- Butang Isl.—*panellus, pannosus*
- Sipora Isl.—*r. mentawi* (2–3)
- Tambelan Isl.—*tambelanicus*
- Rhio Archip.—*r. rhionis, r. batin, r. kunduris*
- Rupat Isl.—*bullatus*

Between Sumatra and Borneo:
- Natuna Isl.—*r. pauper*

Java and Islands:
West Java—*diardii*
Middle Java—*r. brevicaudatus, r. roquei*
Banda-Neira—*r. septicus* (2–3)
Bali—*r. bali* (3–3), *r. samati*
Soemba—*r. santalum, r. sumbae*
Borneo and Islands:
Mt. Kinabalu—*baluensis* (2–3)
Maratua Isl., S. E. Borneo—*mara, tua*
S. E. Borneo—*neglectus neglectus, rattus turbidus*
Borneo—*neglectus ducis*
Lamukotan Isl., W. Borneo—*neglectus lamucotanus*
Banguey Isl., N. Borneo—*rattus banguei* (2–3)
Mangalum Isl., N. W. Borneo—*rattus mangalumis* (2–3)
Celebes and Islands: *dammermanni* (3–3), *pesticulus* (3–3), *decumanus praestans*
Philippines:
Mindanao—*kelleri, mindanensis mindanensis, zamboangae, magnirostris*
Tablas—*mindanensis tablasi*
Mindoro—*mindorensis*
Cagayan—*rubiginosus*
Basilan—*coloratus*
New Guinea: *vanheurni* (2–3), *gestri* (2–3), *doriae* (2–3)

NOTE.—Australian representatives of the *R. rattus* group may be merely ships' rats. The native Australian *Rattus* belong to the *tunneyi-assimilis* groups, etc.

It can scarcely be doubted that the large number of names above listed really represents a mixture of several subgroups of species. For example, the large rats *lugens, pannellus, tambelanicus, batin, bullatus,* etc., whether themselves members of a single Formenkreis or not, are surely NOT members of that compact subgroup to which belong the smaller *diardii* of Java and *neglectus* of Borneo. But the working out of such subgroups must be deferred until types can be examined. At present, only those species which are represented in the Archbold collections will be reviewed. They have been grouped as follows:

Mammae 2–3:
1.—*R. diardii, R. neglectus,* and the Sumatran *R. palembang,* very closely allied species leading to *gestri,* etc., of New Guinea.
2.—*R. jalorensis.* Javanese, (and mainland ?) rats with white, gray-based belly hairs.
3.—Large, thin-haired rats with normal feet, somewhat resembling those of the *hoffmanni* group in the form of the skull, but differing in the mammary formula.
Mammae 3–3:
4.—*R. argentiventer* (and allies).

5.—*R. pesticulus, dammermanni,* and (?) *praestans* of north Celebes. It is uncertain how closely these forms are related to each other. Only *pesticulus* occurs in the Archbold collection.

Rattus rattus diardii (Jentink)

Mus diardii Jentink, 1879, Notes Leyden Mus., II, p. 13.

Material.—An extensive series of 29 assorted males and females, from Cheribon, north coast of Java, lat. 108½° east.

An extensive literature, much of which comes from the pens of Dutch naturalists, dealing with this common Javanese rat has grown up. The consensus of opinion is that the species is somewhat variable

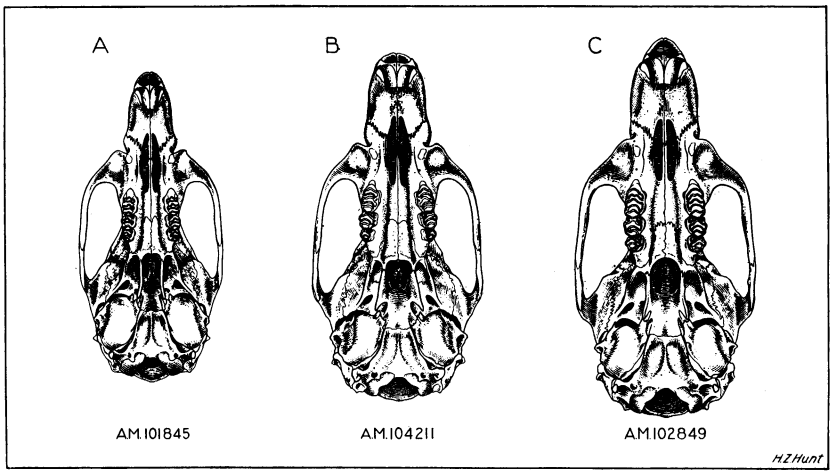


Fig. 3. Ventral view of skulls of *Rattus rattus diardii, Rattus ringens mordax, Rattus mülleri.* Natural size.

and about seaports may hybridize with exotics such as *alexandrinus* and *rattus.*

Measurements.—Representative dimensions are shown on page 646.

American specimens of *Rattus alexandrinus* have been employed for comparison with the *rattus* rats of the present collections. In all proportions of moment, skulls of the Javanese *diardii* and other forms belonging in the group agree very closely with *alexandrinus.* The small percentage table following will illustrate how slight are the morphological deviations which can be detected:

Percentages

	m^1 / palatilar l.	molar series / palatilar l.	m^1 width / m^1 length	pal. for. / bulla	nasal / occ.-nas.	h and b / tail
R. alexandrinus	14.1	31	62	104	36.4	81
R. diardii	14.4–15	31.8–32.5	60–64	107–120	34.5–36.4	80–99

On that account one is compelled to turn in most instances to minor characters, namely size, color, texture of pelage, etc., for determining many of the very uniform members of the *R. rattus* group.

ILLUSTRATIONS.—Skull, Figs. 3A, 4A; teeth, Fig. 5A.

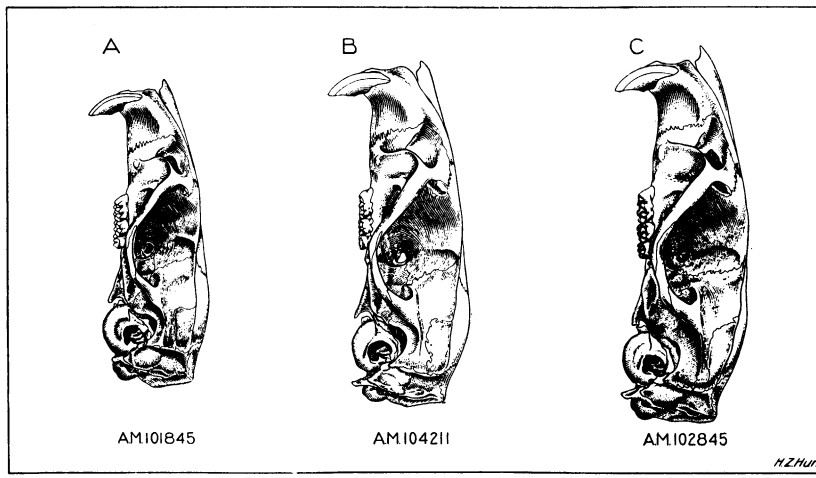


Fig. 4. Lateral view of skulls of *Rattus rattus diardii*, *Rattus ringens mordax*, *Rattus mülleri*. Natural size.

Rattus rattus palembang Tate and Archbold

Rattus rattus palembang TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, pp. 1–2.

From south Sumatra (Palembang) comes a series of rats whose skins differ from those of *diardii* only in their slightly brighter coloring. The field collector had marked them *neglectus* (which is Bornean). Certainly they are very closely related to *neglectus*, for as pointed out by Dammermann,[1] the type of *neglectus* is not distinguishable from *diardii*. (But *diardii* takes page priority.)

[1] 1928, Treubia, X, p. 308.

A detailed comparison has been made with the descriptions of the species listed (p. 523) from the Sumatran-Javanese area. The only other species whose description and measurements approach our Palembang series is *R. r. pauper* Miller from the Natunas. From true *diardii*, in addition to color, slight cranial differences can be made out.

Measurements of *palembang* appear on p. 648.

The subgroup *diardii* seems to be represented from southern Sumatra, through Java, eastward for some way along the Dutch East Indian islands. Also in Borneo (*neglectus*, etc.). None of our material from Celebes exactly represents it, for the northern specimens with small teeth (*pesticulus*) have the mammary formula 3–3. In the same way the forms *gestri* and *doriae* are not perfectly referable to the *diardii* sub-

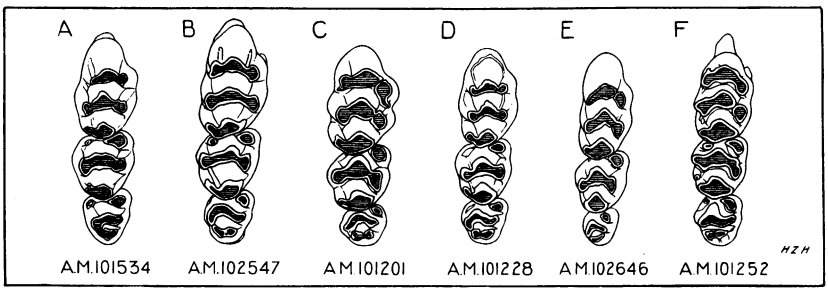


Fig. 5. Crown view of right upper molars of *Rattus diardii*, *Rattus mülleri*, *Rattus penitus*, *Rattus mengkoka*, *Rattus lepturus*, *Rattus dominator dominator*. Note in *R. lepturus* the large size of m^1 in proportion to m^3. Scale: A × 7/2; B × 3; C × 3; D × 7/2; E × 7/2; F × 5/2.

group, for although their mammary formula and size are in general agreement, their dorsal pelage is nearly concolorous.

Three species of rats with mammary formula 2–3 = 10 have been described from various parts of New Guinea:

R. doriae Trouessart (new name for *beccarii* Peters and Doria, 1880, a homonym)	Sorong, (west Vogelkop), Dutch New Guinea, 120 m.
R. gestri Thomas	Kapa Kapa, 30 miles S.E. of Port Moresby, Paqua. Sea level
R. vanheurni Sody	Manokwari (west Vogelkop), Dutch New Guinea, near sea level

Such measurements as have been published of the above species appear compared on the table, p. 651, together with those of F. M. 31842 which not improbably is a topotype of *vanheurni*. It is clear in spite of the lack of cranial measurements that *doriae* is a species quite distinct

from *vanheurni* and *gestri*. Perhaps *doriae* will be demonstrated to represent one of the larger *Rattus* of the Malay region. *Gestri* and *vanheurni* on the other hand are closely alike both from the standpoint of available measurements and their authors' descriptions. When describing *gestri* Thomas linked it with *greyi* of south Australia. In spite of Sody's hesitancy concerning the mammary count of *vanheurni* there seems to be no reason to doubt its mammary formula (2–3 = 10). Perhaps Sody believed that it could be thrown in with the *concolor* group (formula, 2–2 = 8).

The descriptions of the rats *gestri* and *vanheurni* differ slightly as to consistency and color of the pelage but not sufficiently that differences in viewpoint on the parts of the describers could not adequately account for the discrepancies. It is suggested therefore that *vanheurni* may be a race of *gestri*.

On the evidence of the F. M. specimen (Archbold secured no specimens of *gestri*) the above rats are considered allied to the *diardii-neglectus* subgroup.

There remain of the Archbold material other subgroups of the *rattus* group, namely *jalorensis* with white belly hairs having pale gray bases and with mammary formula 2–3; south Celebes rats with mammary formula 2–3, whitish underparts and rather heavy molars, *lalolis; brevicaudatus* with belly hairs pure white to their bases and with mammary formula 3–3; and the Celebes rats with formula 3–3, *pesticulus, dammermanni*, and (?) *praestans*.

Rattus rattus jalorensis (Bonhote)

Mus jalorensis Bonhote, 1903, 'Fasciculi Malayensis,' I, pt. 1, pp. 28–29.

Rattus rattus roquei Sody, 1929, Natuurk. Tijdschr. Nederl. Indie, LXXXIX, p. 163.

Material.—From Java: Cheribon, 2 ♀s; Indiamajoe, 1 ♀. Also from extreme southeast Sumatra: Kalianda, 2 rather young ♂s.

Recently de Raadt[1] has attempted to show specific indentity between *jalorensis* Bonhote and *rufescens* Gray. Gray's description "Fur pale brown; beneath, yellowish gray. Under fur lead-colored, with numerous slender brown bristles. . ." is so different from Bonhote's "Under parts pure white, sometimes with a slightly yellowish tinge. . .," for *jalorensis*, and Sody's[2] characterization for *roquei*, "belly white, in the young snow-white, later somewhat cream-white, never grayish white. Hairs over the whole length white. Sometimes a bright yellow throat

[1] 1931, Zool. Med. Mus. Leiden, XIV, pp. 43–47.
[2] 1930, Zool. Med. Mus. Leiden, XIII, p. 120.

spot. Other times (exceptionally) a median gray pectoral stripe," that such identity is inadmissible. *Rufescens* can well be allowed as a race of the *Rattus rattus* group but considering the decided divergence shown by the above quotations one cannot believe that *rufescens* should be made synonymous with *jalorensis* (= *roquei*). Mammary formula, 2–3.

The distribution of *jalorensis* seems to be Java, Sumatra, and the Malay Peninsula.

MEASUREMENTS.—See p. 467.

Rattus lalolis Tate and Archbold

Rattus lalolis TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, pp. 2–3.

The short series of rats of south Celebes grouped under this name appears to be transitional between the *rattus* and *hoffmanni* groups. They are superficially like house rats, have long tails, dull whitish underparts, and the mammary formula 2–3. Their molar teeth however are decidedly heavier and wider than those of house rats. From the *hoffmanni* rats they can be separated by the higher mammary count.

MEASUREMENTS.—See p. 651.

Rattus rattus brevicaudatus de Raadt and Horst

Rattus rattus brevicaudatus DE RAADT AND HORST, 1918, Zool. Mededeel., IV, p. 69.

MATERIAL.—From Cheribon, Java, 5 ♂s, 7 ♀s.

There seems no doubt that *brevicaudatus* is a form very distinct from *diardii* and, as indicated by Chasen,[1] allied to *jalorensis*. The several definitely constant characters mentioned below indicate that these rats represent a race whose genetic integrity is well-preserved. From the table of comparative measurements of *diardii* and *brevicaudatus* (pp. 646 and 648–649) there can be noted: (1) difference in foot length, 34–37 and 30–31; (2) in length of bulla, 6.5–7.0 and 7.0–7.3; (3) in length of molar crowns, 6.2–6.6 and 6.6–6.9; (4) in crown area of m^1, *diardii* 2.8 × 1.8 to 3.0 × 1.8, *brevicaudatus* 2.9 × 1.9 to 3.2 × 2.0. Such a set of small differences, coupled with constant color difference and different mammary formula constitute a series of characters far better than can be distinguished, for example, between *alexandrinus* and *diardii*, or between descriptions of *diardii* and *neglectus* of Dutch Borneo.[2] And even though the forms should occasionally hybridize, that fact need in no way invalidate the distinctness of the two races.

[1] 1933, Bull. Raffles Mus., No. 8, pp. 5–24.
[2] But see Dammermann's remarks, p. 526.

Rattus pesticulus Thomas (?)

Rattus pesticulus THOMAS, 1921, Ann. Mag. Nat. Hist., (9) VII, p. 248.

MATERIAL.—Roeroekan, N. Celebes, 1 ♂, 2 ♀s.

The measurements of the two females shown (pp. 650–51) run somewhat larger than those published of the type. Possibly our animals represent one of the Bornean races but the point cannot at present be verified. The mammary formula of our specimens agrees with that of *pesticulus* (3–3).

Rattus rattus, subspecies

MATERIAL.—From British North Borneo: Sandakan (F. M. 33052) 1 adult ♀.

This specimen belongs to the dull-colored-bellied rats near *diardii* and *neglectus* so widely distributed through the East Indies. It has not been possible from the literature alone to ascertain to which of the several races of *diardii* (= *neglectus*) this specimen should be referred. Sandakan is on the northwest coast.

Rattus concolor Group

A short diagnosis of the group appears on p. 521. At this time it is proposed to exclude discussion of those species of *concolor* rats to be found on the Pacific Islands and to review, in a preliminary way only, those known from the East Indian Archipelago. (See map, Fig. 6.)

The closer one studies the group, the more convinced one becomes of its essential unity of origin. Under a large number of technical names, it appears to be present, as shown by the accompanying list, between sea level and 2500 meters, on practically all islands. However, it is seemingly absent from southern New Guinea and from Australia. In Sumatra, Java, Celebes, Borneo, Philippines, and New Guinea it enters the 1000–2000 meter zone, and in Sumatra (*stragulum*), south Celebes (not separately named), and Philippines (*querceti, negrinus, vulcani*) it reaches altitudes between 2000 and 3000 meters.

If a broad grouping of the varieties is attempted, using as a basis the quality and color of the pelage, the following categories can be distinguished:

1.—All colors dull, underparts with hair tips brownish to smoky brown, and bases gray—typical *concolor*.

2.—Dorsal colors brownish, underparts with hair-tips dull silvery white, bases gray, which show through to a certain extent—*ephippium*.

3.—Dorsal color dull grayish brown, underparts yellowish white, the bases of the hairs pale gray—*luteiventris* (closely allied to *browni* ?).

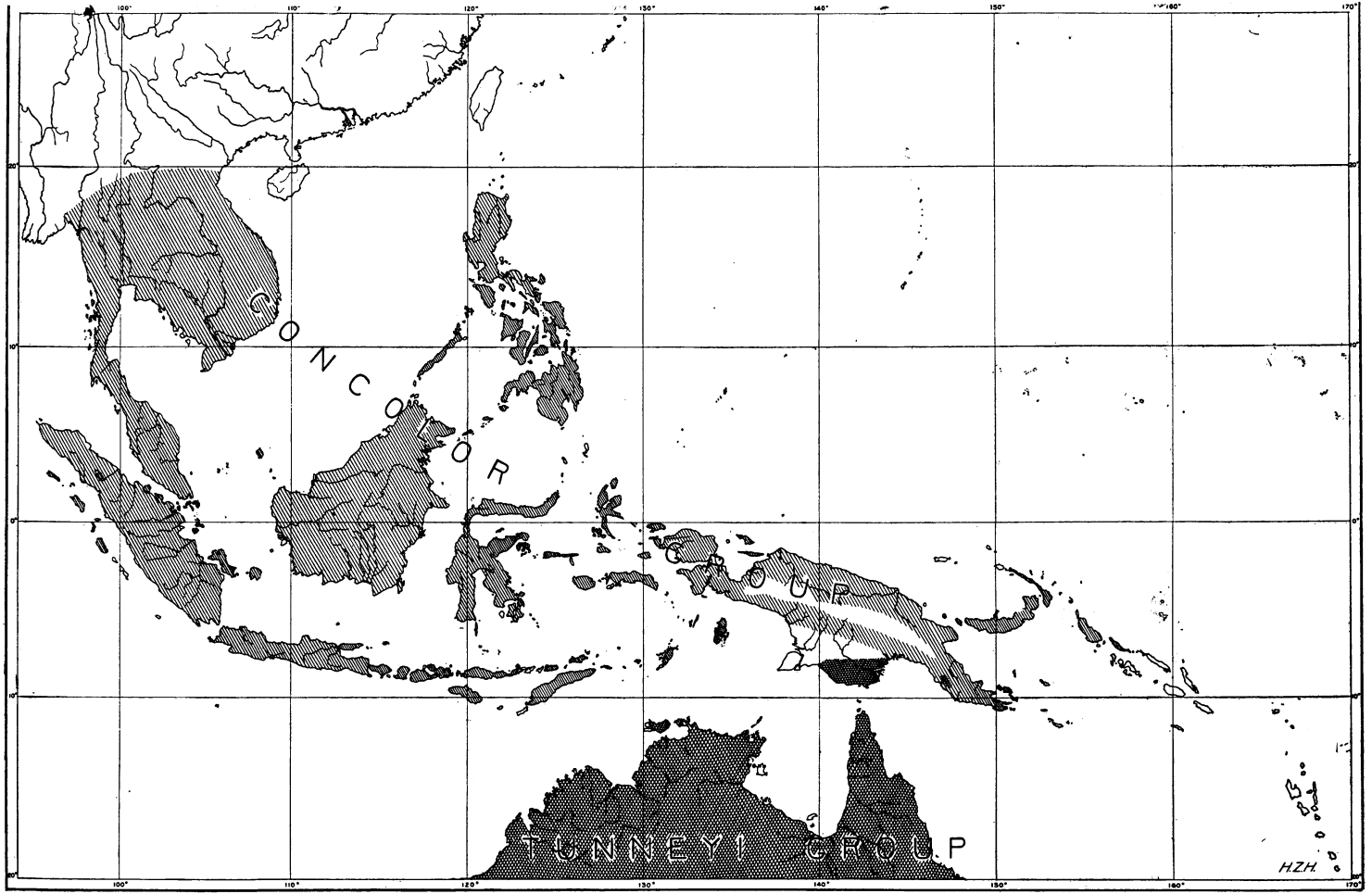


Fig. 6. Distribution of the *concolor* and *tunneyi* groups of *Rattus*.

TABLE TO SHOW DISTRIBUTION OF *Rattus concolor* GROUP (EXCLUDING PACIFIC ISLAND FORMS), BASED UPON TYPE DESCRIPTIONS, IDENTIFIABLE RECORDS IN LITERATURE, AND COLLECTIONS EXAMINED

	Sea level to 1000 m.	1000–2000 m.	2000–3000 m.
Malay Region			
Tenasserim	*concolor*		
Tiaman Isl.	*pullus*		
Mergui Arch.	(J. Linn. Soc. Ldn., XXI, p. 341, 1889)		
Sumatra	*ephippium*		
	Palembang and Kalianda series		
N.W. Sumatra			*stragulum*
Simalur Isl.	*surdus*		
Banka Isl.	*clabatus*		
Anambas Isl.	(J. Malay Branch, R. As. Soc., VI, p. 37, 1928)		
Java	*otteni*	*equile*	
	Cheribon series		
Bali	(Tijdschr. Ned. Ind., pt. 1, XCIII, p. 85, 1933)		
	West Bali series		
Soemba	(Treubia, X, p. 310, 1929)		
Flores	*wichmanni*		
Savu	(Nov. Zool., IV, p. 263, 1897)		
Wetar (Uhak)	1 specimen		
Celebes, North	*eurous*		
	raveni		
	Roeroekan series		
	Ile Ile series		
	(Abh. Dresden Mus., VII, No. 7, p. 23, 1899)		
Celebes, South	(Zool. Anz. XXXVII, p. 514, 1911)	(Mayer, 1899) Lampobatang series	Lampobatang series
	Lalolis series		
Saleyer	*aemuli*		
Borneo	*schuitemakeri*		
Kina Balu Mt.	P. Z. S., p. 235, 1889		
Natuna Isl.	(Nov. Zool. II, p. 492, 1895)		
Philippines	*basilanus*	*calcis*	*negrinus*
	leucophaeatus	*mayonicus*	*querceti*
	ornatulus	*todayensis*	*vulcani*
	pantarensis	*vigoratus*	

	Sea level to 1000 m.	1000–2000 m.	2000–3000 m.
Palawan Isl.	*luteiventris* (Phil. J. Sci., VII-D, p. 28, 1912)		
Gililo Islands Halmahera Batjan	series (Matschie, Säug. Halmahera, Batjan, etc., p. 280, 1900)		
S. Moluccas Buru	*buruensis* (Treubia, VII, p. 156, 1929)		
Ceram	(Ann. Mag. Nat. Hist., (9) VI, p. 425, 1920)		
New Guinea	Sepik series Baroka series Mafulu series	*lassacquerei* Huon specimens	
Kei Islands	*manoquarius* (Treubia, III, p. 422, 1923)		
Solomon Islands	*browni*		
Fergusson Isl.	Bougainville Isl. series (Nov. Zool., II, p. 164, 1895)		

4.—Dorsal color brownish gray; underparts rather pure white, the bases with little or no gray—*wichmanni* and (?) *aemuli*.[1]

5.—Dorsal color dark brown, a suggestion of a longitudinal dorsal stripe, underparts as in *luteiventris* yellowish white—*browni*.

6.—Dorsal colors somewhat warmer, shot with additional reddish and black shades, ventral hairs buffy, with gray bases—mountain species such as *calcis*, *negrinus* and the form high up on Lampobatang of S. Celebes.

Sody[2] states that in all subspecies of *concolor* the tail-length exceeds the body length. His exception occurs in *R. c. manoquarius*, though even in that race one specimen of the series of four is long-tailed. He omits to state whether the measurements given are truly field measurements. It becomes necessary to retract the statement made earlier[3] to the effect that the tail is "usually" shorter than the body. A careful check reveals the reverse, namely that the tail in almost all cases slightly

[1] *Aemuli* was compared by Thomas with *beccarii* of North Celebes, which may belong with the *cremoriventer*-like rats (see p. 567). The foot length of *aemuli* (30 mm.) is rather too large for *concolor* rats. Its mammary formula (2–2) distinguishes it from the *brevicaudatus* section of the *rattus* group.

[2] 1934, Natuurk. Tijdschr. Ned.-Indie, Afh. 2, XCIV, pp. 175–176.

[3] Tate, 1935, Bull. Mus. Nat. Hist., LXVIII, Art. 3, p. 163.

exceeds the body length. Numerous cases are extant[1] giving the opposite of this, but in almost every one of such it will be found that the measurements were not made in the field on fresh specimens before skinning, in consequence of which the stretched body skin appeared unduly large. Even in the case of material collected in the Philippines for the United States National Museum by Mearns, it can be noted that for species with apparently short tails no FIELD measurements are recorded on the labels.

The pelage is quite variable in the *concolor* group as to the quantity of channeled spines, the length of the guard and wool hairs, and the color. In low-country forms spines are plentiful and the wool hairs scanty. The color is often dull brownish. The underparts may be dull brownish buff, gray-based (*concolor*); yellowish white, gray-based (*luteiventris* and *browni*); almost pure white, the gray bases much reduced (*wichmanni* and *?aemuli*). A second series of forms found in forested lowlands and foothills includes slightly redder species in which the spines are few and the underparts whitish or buffy with gray bases (*basilanus, pantarensis, leucophaeatus, ornatulus, raveni, eurous*). Approaching the last-mentioned category in all but the dorsal color which is grayer and less reddish, are the Javanese *ephippium* and the New Guinea form *manoquarius*. Finally there are the soft-furred mountain races *equile* (Java); *stragulum* (Sumatra); *negrinus, querceti, vulcani*, etc., (Philippines); *lassacquerei* (Dutch New Guinea); and two specimens from Lampobatang (= Mt. Bonthian) at 2500 meters at the extreme south of Celebes.

An attempt was made recently to sort out the Pacific races by means of cranial characters.[2] Best results were obtained from the form of the audital bullae. In the present paper the length of bullae, length of molar crowns, and length of palatal foramina have been compared in the table (pp. 539–40) for the whole range of the group as fully as our material will allow. Percentages of the bulla and of the palatal foramina have been calculated in terms of the molar toothrow (table, pp. 539–40), the latter being less subject to growth changes on account of the pre-formation of the molars. The total range in length of bulla is from 5.1 to 6.4 mm. and from 100 to 130% of the molar series; corresponding figures for palatal foramina are 5.0 to 6.5 and 99 to 126%. The toothrows themselves vary from 4.6 to 5.8 mm. Certain anatomically homogeneous types can be seen in the group, thus:

[1] Type descriptions of *exulans, ephippium, leucophaeatus, mayonicus, negrinus, schuitemakeri, wichmanni.*

[2] Tate, *loc. cit.*, pp. 150–152.

Most animals from Celebes have molars less than 5.0 mm., rather short bullae varying from 5.3 to 5.9, and palatal foramina from 5.3 to 5.7. Such may be considered equal to *raveni* and *eurous* (which seem nearly inseparable). Exceptions occur in Celebes, however, which may represent intrusions of other strains.

Another somewhat outstanding type is represented by our series of *browni* from Bougainville Island, Solomon Islands. These rats possess large molars (crowns 5.3 mm. or more), long palatal foramina, 5.5 or more, and long bullae, 5.5–6.4. *R. luteiventris* of Palawan and A. M. 58456 from Batjan seem to belong to the same general type of rats.

A further distinctive class seems to be represented by the white-bellied form of Bali (*wichmanni* ?) which, although it has rather small teeth, possesses bullae and palatal foramina as large as those of *browni*.

The generally distributed *concolor-ephippium* rats have small teeth, not as a rule exceeding 5.3, small rather rounded bullae not exceeding 5.8, and rather short foramina seldom surpassing 5.7 mm. in length. To this section belong the Sumatran, Javanese, Bornean, and at least some New Guinean lowland rats.

Among the Philippine forms, most of which tend towards reddish coloration, *luteiventris* has been likened already to *browni*. Of the others, the shortest molar toothrows appear in *calcis* and *querceti* (5.0); the longest in *vigoratus* (5.4). All three are mountain or foothills species. In the lowland species, *basilanus*, *leucophaeatus*, *ornatulus*, and *pantarensis*, toothrows of 5.1 to 5.3 are noted which fact suggests the *ephippium* rats rather than the *raveni* rats as their nearest allies. The characters of bullae and palatal openings are in these cases not clearly indicative of their affinities. In general, it must be admitted that little really conclusive evidence is to be gathered from the tabulation (p. 540).

One or two exceptional specimens may next be mentioned. A. M. 101263, ♀, from Roeroekan, N. Celebes, differs from the characteristic *raveni* of the region in possessing much larger teeth and longer foramina. A. M. 100992, ♀, from Mt. Lampobatang, 2500 meters, has large bullae (6.0), long foramina (5.8), but the molar crown series is only 4.6 mm. Such a short toothrow is equaled only by one specimen of *ephippium*, A. M. 102671, ♂, of East Sumatra.

In conclusion one may consider the *concolor* group composed of the following faintly distinguishable sections:

A.—*concolor* Siam to Sumatra and Java. Also western New Guinea.[1]

[1] Sody, 1933, Ann. Mag. Nat. Hist., (10) XII, p. 435.

B.—*ephippium*, Sumatra, Java, Borneo to New Guinea, with most of the Philippine lowland forms derived from it.

C.—*wichmanni*(?), A white-bellied form reaching from Bali to Flores. ? and *aemuli* of Saleyer.

D.—*browni*, *luteiventris*, Large, spinous, dull-colored group. Solomon Islands, (possibly the Sepik area of New Guinea), Batjan(?), Palawan.

E.—*raveni*, A small-toothed off-shoot of the ephippium section, apparently indigenous to Celebes.

F.—Assorted mountain-inhabiting races, for the most part derived from nearby lowland stock. Possibly a residual fauna, however.

Rattus concolor Group in the New Guinea Area

For long the *concolor* group was supposedly limited in the New Guinea region to *browni* (syn. *echimyoides*) with type locality Duke of York Island, Bismarck Archipelago. Under that name animals have been reported from the mainland and outlying islands by Thomas (Manus, Trobriand, Central Division of Papua), by Jentink (north Dutch New Guinea), and by Dollman (Arfak Mts.). Sody (1933) has concluded that in the region about Manokwari true *concolor* is present (lately imported) and believes it to be distinct from *browni*. He has recently described *R. c. lassacquerei* from 1800 meters and *R. c. manoquarius* from sea level. In a paper just published,[1] the distribution of the *concolor* group has been touched upon, and the view advocated that the New Guinea members of the group represent a line somewhat divergent from the Pacific Island members, both, however, being derived from the Malay region. As Dr. Sody[2] has suggested, it is perfectly possible that true *concolor* has recently been brought into western New Guinea.

The Archbold and Whitney collections contain specimens from Bougainville, Solomon Islands, from the Central Division of Papua, and one from the Cromwell Mts., Huon Peninsula. In addition, through the kindness of Dr. W. H. Osgood, a series collected by the Crane expedition at the mouth of the Sepik River and deposited with the Field Museum has been available for examination.

The published measurements of the types of *browni*, *lassacquerei*, and *manoquarius* have been tabulated against representatives of the series from Bougainville Island, Sepik River, and Central Division of British New Guinea. From that table (pp. 654–657) a considerable size difference can be noted between fully adult animals with well-worn molars and young adults with the molars little worn. Thus in the Sepik series there occurs only one male (F. M. 31832) which can be held to be

[1] Tate, 1935, Bull. Amer. Mus. Nat. Hist., LXVIII, Art. 3.
[2] 1933, Ann. Mag. Nat. Hist., (10) XII, p. 435.

fully matured. On that account the type of *manoquarius* (as expressed by Sody's published measurements) is thought to be a young adult; that of *lassacquerei* (♀) was probably an older animal.

Although the molar series of the Bougainville animals seems to average a little larger than that in mainland animals, no other skull character seems to be certainly significant. When the skins are compared, the Bougainville animals are distinctly darker with the median line of the back darkest, shading off to paler along either side. Not every specimen shows this character at its optimum, however. The animals from the Sepik River and from Papua, though the darkest part of the dorsal region is along the mid-line, do not show the general dark tone of Bougainville specimens, which approaches bone brown. Ventrally, too, the Bougainville animals have a yellowish tinge in comparison with the brownish gray of Sepik specimens.

As regards altitudinal distribution, the highest record for our Papuan material is Mafulu, 1250 meters. The Huon Peninsula animal came from Sevia, 1700 meters. Sody's *lassacquerei* was taken at 1800 meters. Though our mountain specimens have pelage slightly softer than that of the lowland animals, they can in no sense be considered indicative of a mountain habitat such as can be noted for some Philippine members of the *concolor* group.[1] The color of our mountain specimens is not different from that of lowland rats.

If the Bougainville series is typical of *browni*, the mainland form may conceivably be separated as a race. In that case Sody's name *manoquarius* should perhaps be applied to it. If *manoquarius* be considered a subspecies of *concolor* then *browni* too should be so considered.

Rattus concolor ephippium (Jentink)

Mus ephippium Jentink, 1879, Notes Leyden Mus., II, p. 15.

Material.—East Sumatra: Macarah Doewa (Palembang), 10 ♂s, 9 ♀s; Kalianda, 4 ♂s, 1 ♀.

This considerable series is preponderantly made up of rats with dull grayish-brown upperparts and silvery-white, gray-based underparts. In a few examples the *concolor*-type pelage occurs, the ventral hairs then having dull buffy instead of silvery white tips.

The only other Sumatran forms of the *concolor* group are *clabatus* from Banka Island, *stragulum* from high on Mt. Korinchi, west Sumatra, and *surdus* from Simalur Island, west of north Sumatra.

Measurements of this race have been published by Lyon (1907),

[1] Tate, *loc. cit.*, p. 166.

Robinson and Kloss (1918, 1919), etc., in consequence of which no dimensions of our material have been tabulated.

A series from north Borneo (Field Museum) is tentatively referred to *ephippium*, of which measurements of one specimen appear on p. 652.

Rattus concolor otteni de Raadt?

Rattus concolor otteni DE RAADT, 1931, Zool. Mededeel., Mus. Leiden, XIV, pp. 184–185.

MATERIAL.—Java, Cheribon, 1 ♂, 1 ♀.

These specimens, which on account of their dark underparts closely resemble true *concolor* of the Malay mainland, are apparently referable to de Raadt's *otteni*. The author of the form discussed its relationships at considerable length.

Rattus concolor manoquarius Sody?

Rattus concolor manoquarius SODY, 1934, Natuurk. Tijdschr. Ned.-Indie, Afh. 2, XCIV, pp. 175–176.

MATERIAL.—Huon Peninsula, New Guinea: Sevia, A. M. 79753; Central District, Papua: Baroka, A. M. 104375, 104236, 104220, Inauavui, A. M. 104285, Bioto, A. M. 104237, Mafulu, A. M. 104241, 104247, 104250.

The race represented by the above animals is referred only with doubt to *manoquaris* of Manokwari, in western Dutch New Guinea. The animals are grayish brown, not reddish as Celebes and Philippine forms are; their pelage is somewhat longer and softer than a series in the Field Museum from the Sepik River. The shortness of the tail in many specimens also favors their relationship with *manoquarius*.

MEASUREMENTS.—See pp. 655–656.

The series from the Sepik River are in some respects closer to the form on the Solomon Islands, now called *browni*. Their pelage is shorter and thinner than our other mainland material.

Rattus browni (Alston)

Mus browni ALSTON, 1877, Proc. Zool. Soc. London, pp. 123, 743.
Mus echimyoides RAMSAY, 1877, Proc. Linn. Soc. N. S. W., II, p. 15.

MATERIAL.—Bougainville Island, Solomon Islands: A. M. 79814–21.

These rats are relatively large for the *concolor* group and possess dark-colored, strongly spinous pelage with little wool-hair. Their underparts are yellowish-white, gray-based, also rather spinous.

MEASUREMENTS.—See pp. 656–657.

Rattus raveni eurous Miller

Raitus raveni eurous Miller, 1921, Proc. Biol. Soc. Wash., XXXIV, p. 69.

Material.—N. Celebes: Roeroekan, 200–800 meters, 3 ♂, 3 ♀; S. Celebes: Mt. Lampobatang, Lambasang, 1100 meters, 4 ♂, 4 ♀; Warra Karaing, 2500 meters, 2 ♂; S. E. Celebes: Lalolis, 300 meters, 3 ♂, 1 ♀.

It appears probable that the small *eurous* type of rat is indigenous over most of Celebes. Our material from Roeroekan is nearly topotypical. As will be seen by the measurements (pp. 652–653) of the southern material, that also approaches *eurous*. Furthermore in color the whole of our series matches the "grizzled sudan brown" of *eurous* far more closely than "grizzled ochraceous tawny" of *raveni raveni*. The hind foot of the type of *raveni* was given as 27 mm., the average of ten adult males as 26 mm. Those measurements, however, included the claws. No specimen of our series has the hind foot exceeding 24.5 (s.u.). The hind foot of *eurous* type was 24 (c.u.) and of an average of ten adult males, 24.2 (c.u.). Thus it appears that *raveni raveni* may be a pale colored race of restricted range and *raveni eurous* a darker, smaller race of extensive distribution.

Ratio of Bulla and Palatal Foramina to Molar Crowns in the *Rattus concolor* Group

	Length molar crowns	Length bulla	%	Length palatal foramina	%
Cheribon (*concolor otteni*)					
102004 ♀	5.1 mm.	5.8 mm.	114	5.5 mm.	108
102007 ♂	5.0	5.3	106	5.5	110
Palembang (*ephippium*)					
102689 ♂	5.1	5.1	100	5.2	102
102609 ♂	4.6	5.4	118	5.6	122
102671 ♂	4.9	5.4	110	5.3	108
102672 ♀	...	5.7	...	5.4	...
102684 ♀	5.0	5.5	110	5.3	106
Bali					
102154 ♀	5.4	6.1	113	6.3	117
102159 ♂	5.3	6.1	115	6.4	121
Lalolis					
101048 ♂	5.2	5.9	113	5.7	110
101046 ♀	4.8	5.5	115	5.5	115
Lambasang					
100989 ♂	4.9	5.8	118	5.5	112

	Length molar crowns	Length bulla	%	Length palatal foramina	%
101190 ♂	5.0 mm.	5.8 mm.	116	5.5 mm.	110
Warra Karaing					
100990 ♂	4.7	5.3	113	5.0	106
100992 ♀	4.6	6.0	130	5.8	126
U. S. 199950 ♂ (*raveni*)	4.9	5.4	110	5.3	108
U. S. 199923 ♂ (*eurous*)	4.95	5.6	113	5.3	107
Roeroekan					
101270 ♂	4.9	5.3	108	5.4	110
101265 ♂	4.8	5.6	117	6.0	125
101263 ♀	5.4	5.8	107	6.2	115
101262 ♂	4.9	5.4	110	5.3	108
Sepik River					
F. M. 31828 ♀	5.1	5.8	114	5.7	112
Sevia					
79753 ♂	5.3	5.7	108	5.4	102
Baroka					
104220 ♂	5.0	6.0	120	5.7	114
Mafulu					
104247 ♀	4.8	6.0	125	5.6	107
Bougainville					
79821 ♂	5.6	6.0	107	6.5	116
79815 ♂	5.8	6.4	110	6.3	109
N. Borneo					
F. M. 33053 ♂	5.25	5.6	107	5.2	99
F. M. 33054 ♀	5.0	5.4	108	...	...
F. M. 32684 ♀	4.8	5.6	117	5.4	113
Batjan					
54856 ♂	5.6	6.3	113	6.5	116
Palawan (*luteiventris*)					
29715	5.4	...	...	5.9	109
Philippines					
U. S. 145774 (*calcis*)	5.0	5.5	110	5.1	102
U. S. 144634 (*basilanus*)	5.3	6.0	113	5.3	100
U. S. 144639 (*vigoratus*)	5.4	5.8	108	5.7	106
U. S. 125227 (*todayensis*)	5.2	6.0	115	6.0	115
U. S. 145831 (*querceti*)	5.0	5.3	106	5.0	100
U. S. 125219 (*vulcani*)	5.1	5.75	113	5.7	112
F. M. 24376 (*hawaiiensis*)	5.0	5.7	114	5.7	114

Rattus wichmanni (Jentink) ?

Mus wichmanni JENTINK, 1890, Weber's 'Zool. Ergebniss,' I, p. 120.

MATERIAL.—West Bali: Banjoe Nedan, ad. ♂; Goenung Linken, ad. ♀.

The above specimens, which have been mentioned in the discussion of the *concolor* group as a whole (pp. 530–537) can be referred to *wichmanni* only with doubt. The chief reason for comparing them with that species is their white underparts, the hairs of which have almost no gray at their bases. The only species which agree in that respect are *wichmanni* and *aemuli*. The former is smaller, the latter larger than our Bali specimens.

MEASUREMENTS.—See p. 652.

Rattus mülleri Group

A short characterization of this group appears on page 541. The center of speciation seems to be the Malay region, whence the group reaches Java, Borneo, and the Philippines. Northwards it is represented in Siam, and (by a species not yet identified) in Indo China. Its range into Burma and India has not been ascertained. (See map, Fig. 7.)

The list of names of species arranged geographically is included below purely as a preliminary sorting out of the group. Our own collections do not contain adequate representation for us to accomplish anything further. The types of *firmus* and fourteen other forms have been examined at Washington.

Rattus mülleri-firmus Group, Arranged Geographically

1.—Mainland forms, excluding Malay Peninsula:		
Lower Siam	*R. validus*	
1*a*.—Malay Peninsula:		
Pahang	*R. victor*	
Upper Perak	*R. mülleri foedens*	
2.—Islands off East Coast of Malay Peninsula:		
Jarak Isl.	*R. jarak*	
3.—Sumatra and its western islands:		
West Sumatra	*R. mülleri campus*	
Mansalar Isl.	*R. domitor*	2–2
Mt. Lingalong	*R. mülleri mülleri*	2–2
Banja Isl.	*R. potens, R. valens*	
Batu Isl.	*R. pinatus, R. balmasus*	
East Sumatra	*R. virtus*	
4.—Between Malay Peninsula and Borneo:		
Linga Archip.	*R. firmus, R. jombolus*	
Anambas Isl.	*R. validus terempa*	(2–2, *firmus*)
Natunas Isl.	*R. integer*	2–2
Banka Isl.	*R. pollens*	

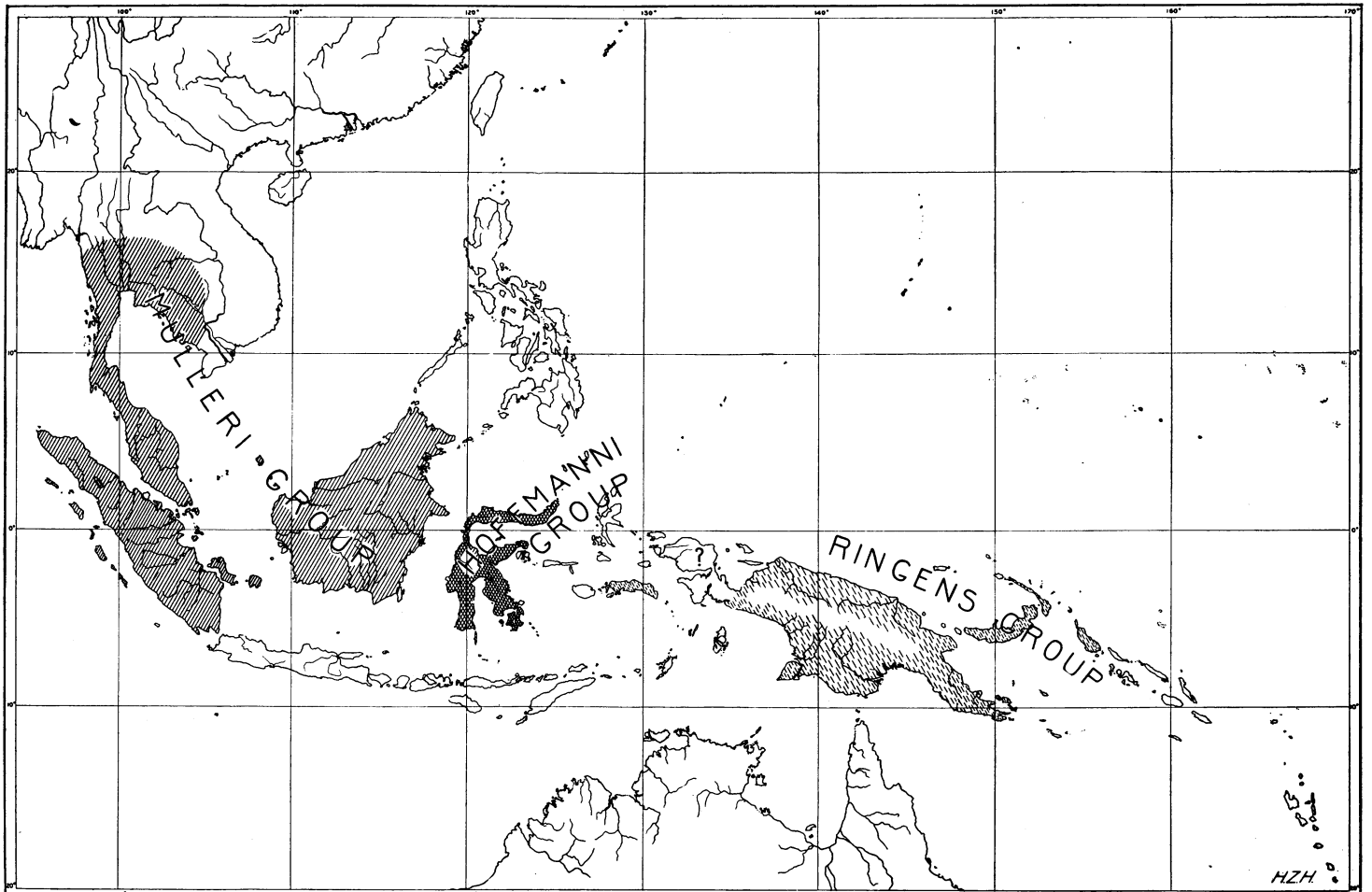


Fig. 7. Distribution of the *ringens*, *hoffmanni*, and *mülleri* groups of *Rattus*.

5.—Borneo and outliers:

Borneo	*R. sebucus, R. infraluteus*[1]	
S. E. Borneo	*R. borneanus*	2–2
West Coast	*R. crassus*	
Balambangan Isl.	*R. mülleri otiosus*	

Rattus mülleri near **campus** (Robinson and Kloss)

Epimys mülleri campus Robinson and Kloss, 1916, Journ. Straits Branch R. Asiatic Soc., No. 74, p. 275.

Material.—From Mocarah Doewa (Palembang), 50 miles inland from east coast of south Sumatra, opposite Banka Island, 1 ad. ♂, 1 ad. ♀, 1 y. ad. ♂; from Kalianda, extreme southeastern tip of Sumatra, opposite Java, 1 ad. ♂, 5 ad. ♀, 1 y. ad. ♀.

Careful comparison with the rats shown in the foregoing list as belonging to the *mülleri* group reveals few which from their descriptions coincide closely with the above series. Except for the "weak anterior portion of the zygoma" our animals are in close agreement with *pollens* from Banka Island. *Virtus* from eastern Sumatra is apparently a far larger animal. Of true *mülleri* the molar series is too long. The island forms are in disagreement with one minor character or another (often they are too small). So in view of our lack of comparative material the above identification should be considered provisional. In three of our specimens the hairs of the underparts between chest and lower belly are gray-based.

Measurements.—See pp. 657–658

Illustrations.—Skull, Figs. 3C, 4C, teeth, Fig. 5B.

Rattus ringens Group

This group forms a characteristic and integral part of the fauna of New Guinea. See map, Fig. 7. The rats belonging to it may be described as heavy-bodied and generally similar to *norvegicus*, but most species are somewhat smaller. The tail may be longer or shorter than the body. The pelage varies from coarse to very coarse, being composed of a mixture of hair and channeled spines, and often a few long guard hairs. A striking feature is the heavy wash of russet on the throat and chest in both sexes of true *ringens* (see p. 520).

The skulls of the group are characterized by their moderately to considerably shortened rostra, long palatal foramina, rather wide zygomata, strongly marked temporal ridges, and generally fairly heavy build which

[1] Considered allied to the *mülleri* group by Bonhote, 1903, 'Fasciculi Malayensis,' pt. 1, I, p. 37.

calls to mind the Norway-rat type of skull. On the basis of a careful comparison of published measurements (see table, pp. 658–663) of these animals and study of the general descriptions, the tentative conclusion has been reached that *ringens* Peters and Doria, *ratticolor* Jentink, *praetor* Thomas, *mordax* Thomas, and *tramitius* Thomas form a natural group of forms. An interesting coincidence may be noted in the fact that the types of all five species were female animals.

Ringens appears to be closely related to *mordax* and the latter should probably be made a subspecies of the former. The hind foot as described by Peters and Doria is larger, however. The value of a very fine series of almost topotypical *ringens* secured by Archbold at the Oriomo River was sadly marred by the fact that the wires attaching the labels to the skulls became decomposed and all but one of the skulls arrived disassociated from their numbered tags. In consequence, only separate sets of measurements for skins and skulls can be given, the latter not marked for sex (table, pp. 658–660). The whole of the structure and appearance of the animals believed to be *ringens* agrees closely with the somewhat larger *mordax*.

In addition to *ringens* and *mordax* the following forms appear in Archbold's collection:

1.—From Loloki River, Central Division of Papua, 100 meters, 2 males, 2 females of a large coarsely haired *Rattus* with rather small bullae: palatal foramina like those of *mordax;* feet with width at base of 5th metatarsal/length of foot, s.u., 5.4/37.5 or about 14%; mammae 1–2 = 6; one with particolored tail.

2.—From Oriomo River, Western Division, 30 meters, a series of 11 specimens of *Rattus* with skulls disassociated, the structure of the skull, however, very close to that of the form previously mentioned; pelage equally bristly; tail particolored; underparts clothed thinly with bristly hairs whose bases are not gray; cheeks and inferior vibrissae buffy white; mammae, 1–2 = 6.

3.—From Mafulu, Central Division, 1200 meters, 16 specimens having longer, softer pelage than either of the foregoing (but still bristly); ventral hairs gray-based; tail usually without white (a little in two individuals); bullae as in two previous forms; palatal foramina longer and more widely opened; hind foot, ratio of width at 5th metatarsal to length, 5.1/32.5 or about 16%; individuals with a little russet on throat and chest, less intense than *mordax;* mammae 2–2 = 8.

4.—From Mt. Tafa, 2400 meters, a single male perhaps related to the last, but underparts washed with clay color. Hind foot rather densely haired on the back, 5.4/31.5 or 17% and thus a decidedly heavier foot than in any one of the *Rattus* just discussed. Vibrissae also very long and ear small.

5.—An individual male with very long pelage and hind foot 32 mm. from Sevia, Saruwaged Mts., Huon Peninsula, 1700 meters, is possibly true *praetor*. This specimen is closely allied to the previous one from Mt. Tafa.

6.—From Weyland Mts., Dutch New Guinea, 1500 meters, there is a single fe-

male, A. M. 101964, identified by Dollman[1] as *tramitius*. It may be distinguished from other species in the collection by its long tail (195), which exceeds the body length (181). The hind foot too measures 40 (s.u.), and the percentage width at the base of the 5th metatarsal is 13.5. The mammary formula is 2–2 = 8. The characters of the skull agree closely with those of the several races of *Rattus* just commented upon. The animal seems to fall between *tramitius* and *coenorum*. Its occipito-nasal length is 44. If the rat in question is truly *tramitius*, it is doubtful whether *tramitius* can longer be regarded as a subspecies of *mordax*.

Although none of the forms treated under the first five heads can be referred *with assurance* to existing named species, it is probable that the five "forms" just listed can be placed under the specific name *praetor*. *Praetor* whose type locality is near Guadalcanar, Solomon Islands, is described as having a somewhat larger foot and shorter toothrow than any of our forms. *Tramitius* from northwest Dutch New Guinea (of which we list one specimen) also differs from them in possessing a longer tail and foot. *Ratticolor*, whose type locality was on the Noord River, may possibly be identifiable with one or another of our forms. The type was said to be a young female with mammae 0–2 = 4 and hind foot 37. Head and body/tail were given as 160/135. Such dimensions of the hind foot agree with none of our doubtful material, and *ratticolor*, when adults are available, may be shown as related to the larger *coenorum*, also from Dutch New Guinea, but farther north. Of the very large *bandiculus* and *coenorum* little can be said since a skin lacking a skull (of *coenorum*) alone is at hand for examination. It seems, however, on the basis of the above skin, of the described wide zygomatic expanse and very large, palatal foramina of their skulls that they may be two large-sized, well differentiated species of the *ringens* group. The mammary formula of *coenorum* is 2–2 = 8, but that of *bandiculus* has not been published. A further member of the same assemblage is probably to be seen in *feliceus* of Ceram.

Frechkop,[2] without citing his authority, has included in his list of *Rattus* of New Guinea a number of Australian species which considerable search of the literature has failed to substantiate.

Rattus ringens (Peters and Doria)

A very coarsely-haired species often having the gular region strongly suffused with russet. Skull with rather long rostrum; large, wide palatal foramina, pointed in front and rounded behind; medium-sized bulla; moderately constricted interorbital region, and moderately developed temporal ridges (Figs. 3, 4). Mammae, 2–2 = 8.

[1] 1933, Proc. Zool. Soc. London, p. 215.
[2] 1932, Bull. Mus. Roy. d'Hist. Nat. Belgique, VIII, No. 28, pp. 4 and 5.

Two slightly divergent forms can be distinguished:

1.—From southern New Guinea. A slightly smaller race with the tail commonly particolored and the palatal foramina relatively wider and shorter. (For other differences see table, pp. 658–660.) ..... *ringens ringens.*

2.—From eastern New Guinea. Slightly larger. Tail never (apparently) particolored. Palatal openings a little longer and narrower..... *ringens mordax.*

Rattus ringens ringens (Peters and Doria)

Mus ringens PETERS AND DORIA, 1880, Ann. Mus. Civ. Genova, XVI, p. 700.

MATERIAL.—From Wuroi, Oriomo R., S. New Guinea: A. M. 104526, ad. ♂, skin and skull, 3 ad. ♂, skins only (A. M. 104531, 28, 29); 3 ad. ♀, skins only (A. M. 104518, 38, 39); 6 ad. skulls, unsexed but unquestionably from the Oriomo River.

MEASUREMENTS.—See pp. 658–660.

Rattus ringens mordax (Thomas)

Mus mordax THOMAS, 1904, Ann. Mag. Nat. Hist., (7) XIV, p. 398.

MATERIAL.—From Baroka, near mouth of Angabunga (= St. Joseph's) River, Central District, Papua: 2 adult males (A. M. 104211, 14); 2 young adult males (A. M. 104207–08); 2 adult females (A. M. 104213, 23); 1 female without skull (A. M. 104221).

MEASUREMENTS.—See p. 660.

ILLUSTRATIONS.—Skull, Figs. 3B, 4B.

Rattus praetor (Thomas) ?

Mus praetor THOMAS, 1888, Proc. Zool. Soc. London, p. 481.

Mus praetor THOMAS, 1888, Ann. Mag. Nat. Hist., (6) I, p. 158.

MATERIAL.—Loloki River, Central Division, 2 ♂, 2 ♀; Mafulu, Central Division, 16 specimens; Mt. Tafa, Central Division, 1 ♂; Oriomo River, Western Division, 11 specimens; Sevia, Saruwaged Mts., Huon Peninsula, 1 ♂.

The diversified nature of the material has been discussed already (pp. 545–5). All, however, may be separated from *ringens* (and *mordax*) and from *brachyrhinus* (of the *tunneyi* group) by their much longer, slenderer rostra, and smaller teeth and bullae.

Distinction of local races of these rats must await opportunity to examine the types as well as series of specimens from more numerous and diverse localities.

MEASUREMENTS.—See pp. 662–663.

Rattus coenorum Thomas

Rattus coenorum Thomas, 1922, Ann. Mag. Nat. Hist., (9) IX, p. 262.
Rattus coenorum Thomas, 1922, 'Nova Guinea,' XIII, p. 727.

Material.—Wasior, N. W. New Guinea, A. M. 100878, ♀; collected by E. Mayr; field no. 1646.

Unfortunately no skull has been located for this specimen. The large size (h. ft. 43), and general characters, however, leave no doubt that it should be referred to the present species. Mammae, 2–2 = 8.

Rattus hoffmanni Group

The following species are tentatively referred to the group, which has been previously (p. 521) shortly diagnosed:

hoffmanni hoffmanni	North Celebes
hoffmanni linduensis	Middle Celebes
hoffmanni subditivus	Middle Celebes
hoffmanni mengkoka	S. E. Celebes
mollicomus	N. E. Celebes
mollicomulus	Southern Celebes

The placing of *hoffmanni* in conjunction with *mollicomus* and its separation from the *chrysocomus* group requires explanation.

Mus rattus var. *celebensis* Hoffmann, a homonym of *Mus celebensis* Gray was renamed *Mus hoffmanni* by Matschie, who, however, further described "*hoffmanni*" on the assumption that a specimen before him from Minahassa was identical to it. That such was not the case is shown by the following dimensions in each specimen:

	celebensis Hoffmann	*hoffmanni* Matschie
Palatal foramina	8.4	7.4
Length of molars	8.6	7.4
Inner width across palate between m^1–m^1	4.9	4.3

In addition, Hoffmann gave the width of m^1 of his animal as 2.4; whereas Matschie indirectly (external width of palate across m^1–m^1 minus the internal width of ditto or 8.8 − 4.9 = 3.9, divided by 2) gave the width of m^1 of his specimen as 1.85. Now dimensions between 1.8 and 2.0 represent the normal narrow m^1 in the lowland *R. rattus* group throughout the eastern islands; 2.4 is characteristic of the *chrysocomus* group.

It has not been possible as yet to identify Hoffmann's species with any specimens in our collection, but Hoffmann's illustration showing the

basal view of the skull supports this opinion of their relationships given above.

Miller's *linduensis* and *subditivus*, on the other hand, which were proposed as subspecies of *hoffmanni* appear also to be large-toothed rats and consequently share the position of *hoffmanni*.

The male rat discussed by Matschie under the name *hoffmanni* was almost certainly a member of the *R. rattus* group in the strict sense. With narrow m^1 ($\pm$ 1.8), short muzzle, etc., it would seem to fall in with the *diardii-neglectus* rats, or if the mammary formula were 3–3, then near *pesticulus* Thomas.

The *hoffmanni* rats of the Archbold collection extend from nearly sea-level to as high as 2200 meters, and represent less than eight collecting stations, all of which except the Latimodjong Mountains are remote from the type localities of the named members of the group. For distribution see map, Fig. 7.

Rattus hoffmanni, race

Mus rattus var. *celebensis*, HOFFMANN, 1886–1887, Abh. Mus. Dresden, No. 3, pp. 18–19.

Mus hoffmanni MATSCHIE, 1900, Säug. Halmahera, Batjan und Nord-Celebes gemachten Ausbeute, p. 281.

MATERIAL.—Four females from Bantimoerang, near Macassar, Celebes.

These specimens, though members of *hoffmanni*, do not agree entirely with Hoffmann's description and plate. The pelage is crisp and rather short. The mammary formula is 1–3 = 8.

MEASUREMENTS.—p. 664.

Rattus hoffmanni mengkoka Tate and Archbold

Rattus hoffmanni mengkoka TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, p. 3.

As shown in the preliminary description, *mengkoka* represents *hoffmanni* at the lower levels (0–1500 meters) about the region of the Mengkoka Mts.

MEASUREMENTS.—See p. 664.

ILLUSTRATIONS.—Teeth, Fig. 5D.

Rattus mollicomulus Tate and Archbold

Rattus mollicomulus TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, p. 4.

A mountain-inhabiting, small-sized species of the *hoffmanni* group of *Rattus* living in south Celebes.

MEASUREMENTS.—See pp. 664–665.

Rattus tunneyi Group

For preliminary diagnosis of this group see pages 521–522.

In working out the *tunneyi* group, a check-up was made of the Queensland species of *Rattus* both from the literature and by examination of material collected for the American Museum by Raven and for the U. S. National Museum by Hoy. The New Guinea *brachyrhinus* (below) was found to be a member of the *tunneyi* group of rats which includes, besides *tunneyi*, the species *melvilleus*, *culmorum*, and others, all characterized by possessing skulls with very large bullae, long narrow palatal foramina, narrow median pterygoid fossae, narrowed but heavily ridged interorbital regions, short nasals which scarcely extend beyond the anterior tip of the premaxillae, and narrow interparietals. A divergence from normal is to be noted in the fact that in *brachyrhinus* the mammary formula is 3–3 = 12 as against 2–2 = 8 or 2–3 = 10, which is reported for the Australian members of the *tunneyi* group. Many members of the group occur in arid habitats. It seems not improbable that *brachyrhinus* may constitute the northernmost representative of the group. (See map, Fig. 6.)

Rattus brachyrhinus Tate and Archbold

Rattus brachyrhinus Tate and Archbold, 1935, Amer. Mus. Novit. No. 802, p. 4.

This species, which is apparently present in New Guinea only in the drier parts of the south, has been discussed fully in regard to several faintly distinguishable local races in the article in which it was first described.

Brachyrhinus of New Guinea with mammary formula 3–3 = 12 is not improbably related closely to an unidentified form occurring in North Queensland, referred to in the description of the New Guinea species (*loc. cit.*). The short nasals, narrow interorbital region, large bullae, and long narrow palatal foramina are the outstanding features of the skull.

Brachyrhinus, with short palate and nasals, narrowed interorbital region, large bullae, and long, slit-like palatal foramina is represented in the present collection from the following localities:

Baroka, near the mouth of the Angabunga River, 30 m., 7 males, 1 female
Rona, Loloki River, east of Pt. Moresby, 450 m., 3 males, 2 females
Wuroi, Oriomo River, 450 miles west of Pt. Moresby, 50 m., a large series

In its typical facies this is apparently a lowland form. It resembles a small Norway rat quite closely, and is possibly, though not probably,

the species to which Jentink gave the name *ratticolor* (see, however, p. 545) from its general similarity to the house rat. Its pelage seems never to become extremely harsh as in *mordax* and *ringens*, though as between animals from the three localities the fur of the Oriomo rats is rather coarser. There appears a certain difference in the quality of the fur of

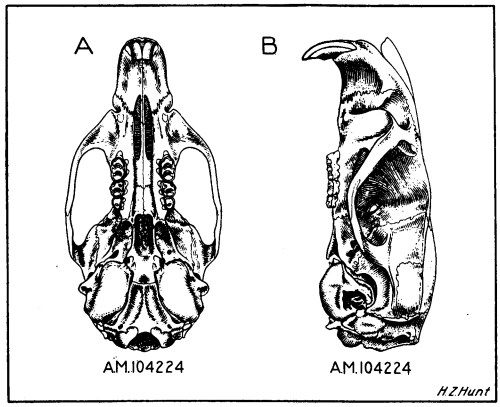


Fig. 8. Skull of *Rattus brachyrhinus* (*tunneyi* group) to show the short nasals, long incisive foramina, and very large bullae. Natural size.

the animals from Rona and Baroka. No specimen has the tail partly white. The hind foot apparently does not exceed 33 mm. (s.u.). The ratio of width at base of 5th metatarsal to length of foot, s.u. (in adults) varies from 13 to 16%.

MEASUREMENTS.—See pp. 665–668.

ILLUSTRATIONS.—Skull, Fig. 8A, B.

Rattus chrysocomus Group

A short characterization has been given for this group of *Rattus* on page 550. Named forms referable to the group are as follows:

North Celebes	*chrysocomus, fratrorum*
Middle Celebes	*nigellus, penitus, sericatus, rallus, adspersus*
Southeast Celebes	*andrewsi, inferior, brevimolaris*
South Celebes	*heinrichi*

Rallus and *nigellus* can be grouped together as small species (h. ft. 32–34; length of molar alveoli 6.3–6.5). *Chrysocomus* (type) had the hind foot 32 and the molar series (crowns ?) 6.6. But as drawn by Hoffmann (Pl., Fig. 1 b) the crowns reach about 7.5. The same dimensions of *fratrorum*, currently synonymized with *chrysocomus* are h. ft. 38.8, molar crowns 7.6.

Penitus and *sericatus* are larger species with h. ft. 40–41; length of molar alveoli 7.8–8.1. *Andrewsi* has h. ft. 35–38, molar crowns 7.2–7.6.

The forms comprising the group are clearly very closely allied, so closely that considerable difficulty is felt in working out their relationships. In a general way a high mountain section of large sized rats including *penitus, sericatus, inferior* and *heinrichi* (on the Latimodjong, Mengkoka and Lampobatang groups of mountains), and *adspersus* can be recognized. Possibly *fratrorum* is to be linked with the foregoing rats. The large-snouted condition in *penitus* pointed out by Miller seems to be, at least in part, a growth character, which may be accentuated in mountain animals. All of the above rats may be regarded as mere local forms of a rather widespread highland species which in the absence of definite information regarding *fratrorum* is named *penitus* Miller. The series from Latimodjong which has darker, softer and longer pelage than the rest is referable to the race *sericatus*. This large species is represented on the lower slopes of the Mengkoka Mts. (Masumbo, 500 meters and Warro 50 meters) by *inferior*, with somewhat coarser hair, which lacks the whitened tip of the tail (of true *penitus*). Its large skull and teeth, however, proclaim its relationship.

Brevimolaris, the representative of the group at Lalolis, a score of miles southeast of the Mengkoka Mts., is much smaller, has very much smaller teeth and probably is related to *nigellus* and *rallus*. It is, however, a lowland species externally like *andrewsi* (which has large teeth like *penitus*).

The large series of *heinrichi* from south Celebes (Lampobatang) most closely resembles *inferior* from Masumbo in the quality of its fur. Its tail likewise lacks the white tip of true *penitus*. Its skull and teeth are large. In conclusion then, the *chrysocomus* group may be arranged as follows:

Large-toothed rats:

R. penitus penitus	Middle Celebes
R. penitus sericatus	Middle Celebes
R. penitus inferior	Mengkoka Mts.
R. penitus heinrichi	Mt. Lampobatang
R. penitus adspersus	Middle Celebes
R. andrewsi	S. E. Celebes
Possibly *R. fratrorum*	N. Celebes

Small-toothed rats:

R. nigellus	Middle Celebes
R. rallus	Middle Celebes
R. brevimolaris	Southeast Celebes
Possibly *R. chrysocomus*	N. Celebes

There is little doubt that *Bunomys* (if our identification of long-

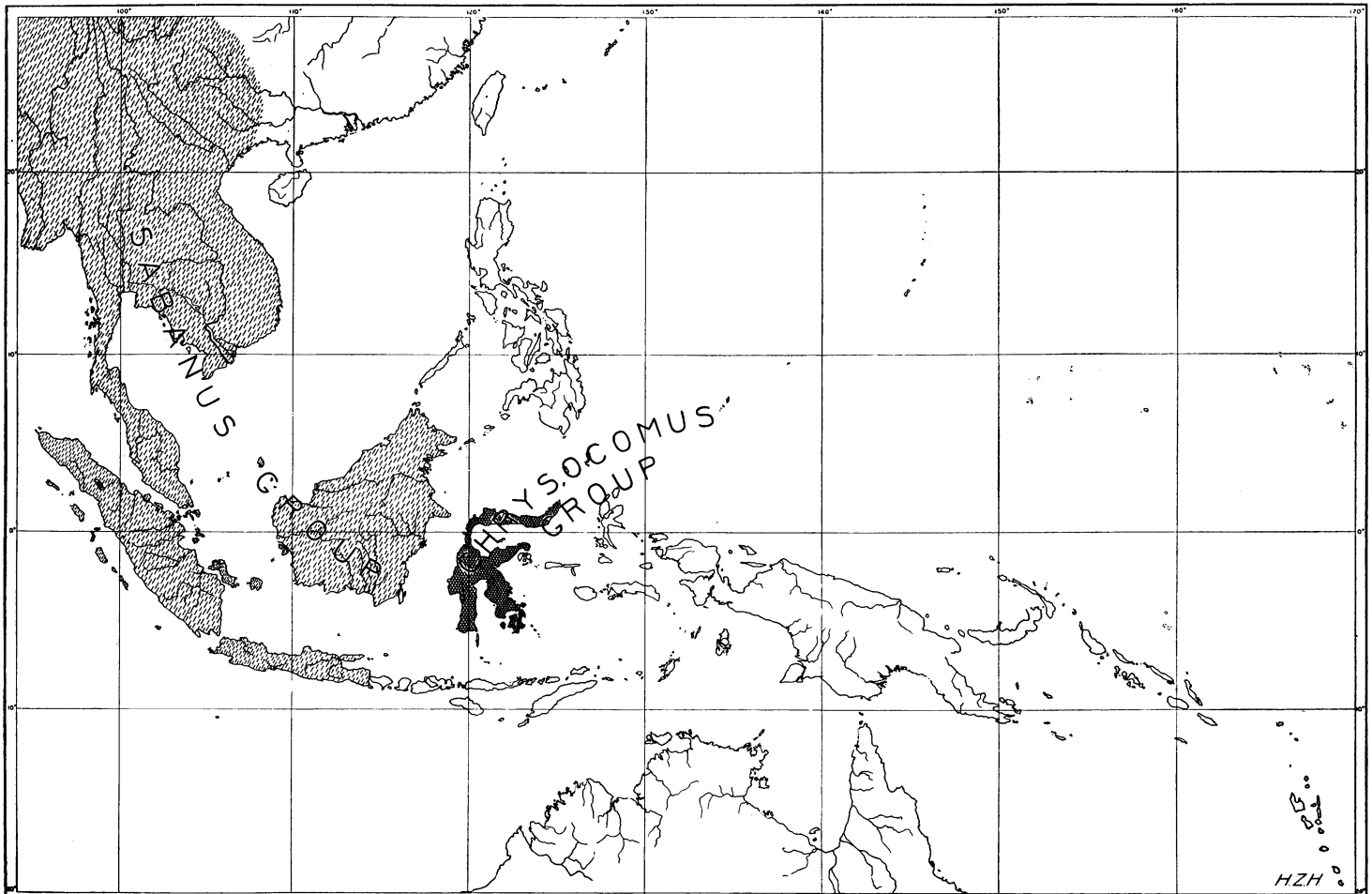


Fig. 9. Distribution of the *chrysocomus* and *sabanus* groups of *Rattus*.

clawed *chrysocomus*-like rats with that genus is correct) is derived directly from the *chrysocomus* group. It differs from that group only by the apparently fossorial adaptation of the claws (see p. 580), for enlargement of the muzzle can be seen also in old specimens of the *chrysocomus* group.

The generic position of the original *callitrichus* Jentink[1] as mentioned under *Lenomys* (p. 615) 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[2] that *chrysocomus* and *callitrichus* are synonymous, the impression to be gained from Jentink's few published measurements, "hind foot, 46; length of upper molar series, 10; distance between incisor and first upper molar, 13," favors the probability that *callitrichus* was a *Lenomys* (see also table, p. 716). On the other hand "*callitrichus*" of Matschie,[3] whose detailed measurements he listed, conforms neither to *Lenomys* nor to the *Rattus chrysocomus* group. For purposes of this paper *callitrichus* Jentink will be considered a *Lenomys*.

DISTRIBUTION OF *chrysocomus* GROUP.—See map, Fig. 9.

Rattus penitus penitus Miller

Rattus penitus MILLER, 1921, Proc. Biol. Soc. Wash., XXXIV, p. 72.

MATERIAL.—Tanko Salocco, Mengkoka Mts., S. E. Celebes, 1500 meters. 11 males, 12 females.

Though rather distant from the type locality (Lehio, southwest of Lake Lindoe, 1900 meters), the material appears to fit Miller's species very closely. Its measurements (p. 669) are approximately in agreement, and in particular the character of the white distal third of the tail (although the white part is in instances reduced to one-fifth).

ILLUSTRATIONS.—Teeth, Fig. 5C.

Rattus penitus sericatus Miller

Rattus sericatus MILLER, 1921, Proc. Biol. Soc. Wash., XXXIV, p. 73.

MATERIAL.—Latimodjong Mts., S. Celebes, 2200 meters. 5 males, 8 females, 2 sex undetermined.

The above specimens are referred to *sericatus* provisionally on the basis of similarity of cranial proportions, size, and their long, dark

[1] 1879, Notes Leyden Mus., I, p. 12.
[2] 1899, Abh. Mus. Dresden, VII, No. 7, p. 24.
[3] 1900, Säuget. Halmahera Batjan, und Nord-Celebes gemachten Ausbeute, p. 280.

pelage. None of our specimens (a series obtained from the Buitensorg Museum) has the tip of the tail white.

MEASUREMENTS.—See pp. 670–671.

Rattus penitus inferior Tate and Archbold

Rattus penitus inferior TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, p. 6.

Inferior represents the species *penitus* in the lowlands and lower slopes about the Mengkoka Mountains, southeastern Celebes.

Old males of this race frequently develop a strong chestnut suffusion over the hairs of the throat and chest (see p. 520).

MEASUREMENTS.—See p. 671.

Rattus penitus heinrichi Tate and Archbold

Rattus penitus heinrichi TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, pp. 6–7.

This race has hitherto been recorded only on Lampobatang, S. Celebes, at an altitude of 1100 meters.

MEASUREMENTS.—See p. 670.

Remarks Upon the Type of *Rattus adspersus* Miller and Hollister

Rattus adspersus MILLER AND HOLLISTER, 1921, Proc. Biol. Soc. Washington, XXXIV, pp. 71–72.

The skull of this form unquestionably indicates its affinity to the *chrysocomus* group. The lengthened rostrum, sloping zygomatic plate, slightly widened cerebellum region, and the thinness of the edge of that part of the maxillary and premaxillary margining the incisive foramina are characters supporting that view. Though worn, the molar teeth are seen to possess the characters attributed (pp. 517, 522) to the *chrysocomus* group. In the skin, the tail is relatively short and shows little of the bicolored characters often present in the group, and lacks all suggestion of white at its tip, but the hind foot has a relatively elongate plantar region and short toes. The ear is rather large, as usual in the group.

Rattus brevimolaris Tate and Archbold

Rattus brevimolaris TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, p. 7.

The species is intermediate in size and locality between *inferior* of the Mengkoka Mts. and *andrewsi* of Buton Island, southeast of Celebes. Its nearest relatives, however, on account of its small skull and teeth, should be sought in *nigellus* and *rallus* of Middle Celebes.

Rattus xanthurus Group

The majority of the species of this group, of which a synopsis is given on page 522, are of large size. As pointed out then the group appears to be considerably diversified and to represent a residual fauna of Celebes and the Philippines (see map, Fig. 10). Besides the Celebean species given beyond, *albigularis, everetti, gala, luzonicus,* and *tagulayensis* of the Philippines are apparently members of the group. The independent derivation of *Eroepeplus* and *Echiothrix* from the present stock is to be considered a distinct possibility.

In working with the Celebean giant rats the two earliest described forms, *celebensis* and *xanthurus,* must be distinguished. The descriptions by Gray are very inadequate (*celebensis,* ♀ ; length 250, tail 275, h. f. 49; for *xanthurus* he gave no measurements), no cranial particulars of value being listed. Under *macleari,* Thomas[1] compared the two as follows:

	celebensis Gray	*xanthurus* Gray
Mammae	1–2 = 6	1–2 = 6
Pelage	No dorsal piles	Long dorsal piles present
Anterior zygoma root	Front edge not projecting	Front edge but little projecting
Palatal foramina	Short	Long

Later Thomas[2] gave further information concerning these two species:

celebensis Gray	*xanthurus* Gray
Skull length about 50 mm.	"size as last"
Incisors	orthodont
Supraorbital ridges light	heavy

Matschie's[3] analysis of "*xanthurus*" (from Minahassa) refers to an animal (probably *marmosurus*) very much smaller than the one from which Thomas drew the information given above. The hind feet measured only 37 mm. and the basilar length only 36, but the palatal foramina reached 8.8 mm.

Our collections include 3 males and a female from Roeroekan, 800–900 meters, whose dimensions (page 672) and general characters conform to the type description of *xanthurus* by Gray and the additional data furnished by Thomas.

[1] 1887, Proc. Zool. Soc. London, pp. 513–514.
[2] 1921, Treubia, II, p. 110.
[3] 1900, Säuget. Halmahera, Batjan, und Nord-Celebes gemachten Ausbeute, p. 288,

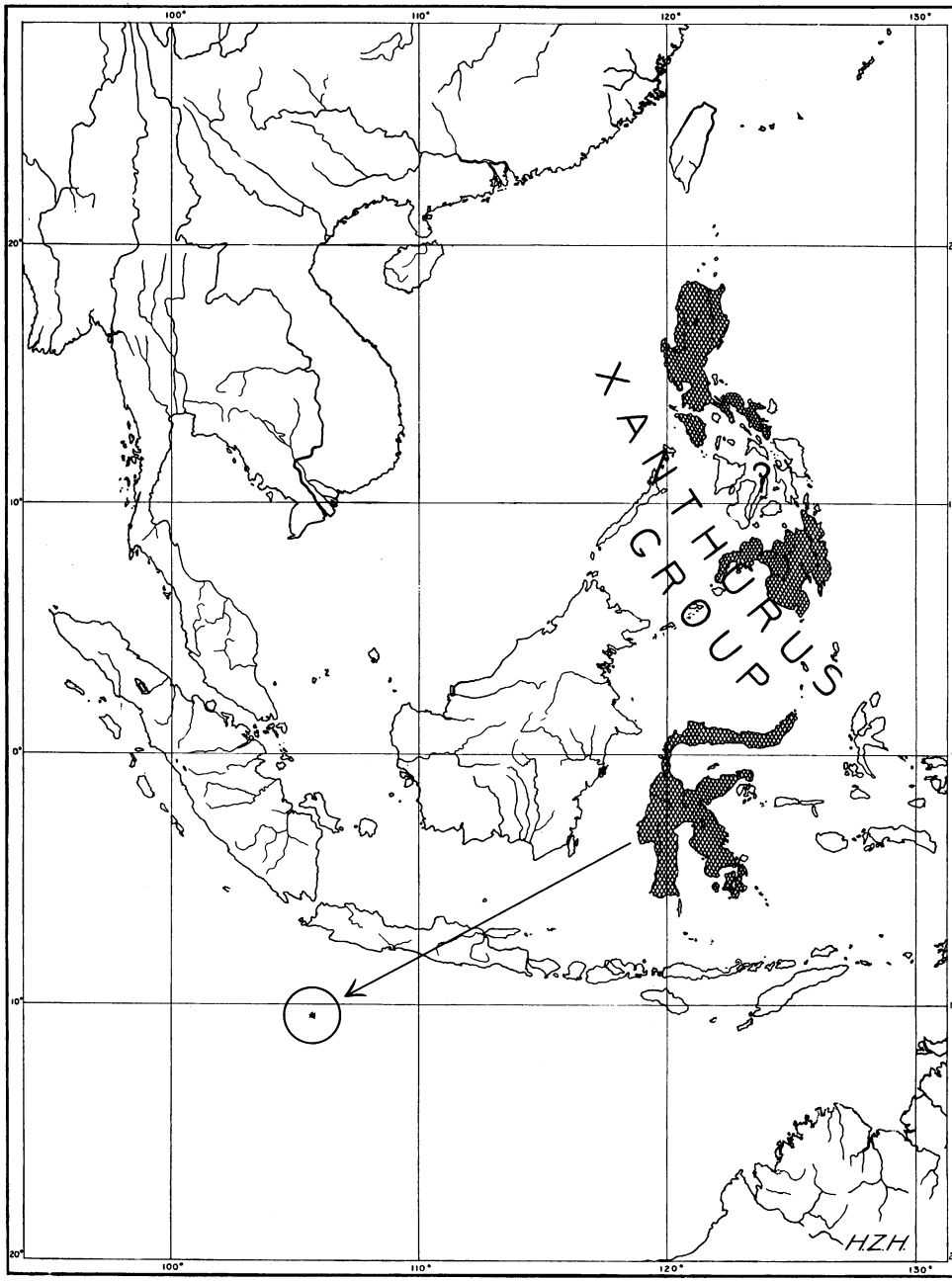


Fig. 10. Distribution of the *xanthurus* group of *Rattus*.

Besides the above-named two species, *dominator, marmosurus, taerae,* and *tondanus* have been described from north Celebes. *Dominator* is readily separated from *celebensis* (as described) through the prominent anterior edges of its zygomatic plates and its massive rostrum. *Marmosurus* is a much smaller species with molar crowns only 6.8 mm. or thereabouts. *Tondanus* too seems from Sody's description to be far too small to be confused with *celebensis. Taerae* has gray-based ventral pelage and palatal foramina reaching 9.2 mm. (i.e. about as in *xanthurus*). True *celebensis* Gray is not contained in the Archbold collection.

The rats of this group present certain characters (summarized in table, p. 559) varying from species to species, of which the following are among the most important:

Molars.—Length of toothrow and width of molars. The extremes in this respect seem to occur in *bontanus* of south Celebes with proportionately heavy broad molars (width of m^1, 3 mm.) and such a species as the large *xanthurus* in the north with small, narrow molars (width of m^1 only 2.5). On the above basis *hamatus* which has also heavy dentition may come near *bontanus*. The big *dominator* rats have only moderately heavy teeth.

Palatal Foramina.—Extremes here run from *dominator* in the north with small openings (about 31 to 33% of palatilar length, but in some southern specimens as short as 24%) and *bontanus* with long foramina (around 45% of palatilar length). Characteristic forms of the openings are also to be noted.

Zygomatic Plate.—Widest probably in the *dominator* group (45–53% of diastema); narrowest in such types as *xanthurus* (25–29% of diastema) and *marmosurus* (30% of diastema).

Bulla, Length.—Greatest proportional length found in *bontanus* (in which it exceeds length of molars and attains 37 to 40% of palatilar length); least length in southern *dominator* (25–30% of palatilar length).

Ventral Pelage.—The early-described forms had the ventral pelage white or buff, without gray bases. Recently Sody has described *taerae* from North Celebes with gray-based ventral pelage and in our collection from the south there are three distinct forms which have gray-based hairs throughout. *Hamatus* and *punicans* of Middle Celebes are also thus colored.

On the basis of the above characters the following arrangement of species is offered as possibly but not probably representing a phylogenetic arrangement:

Artificial Key to the *R. xanthurus* Group in Celebes

1.—Molars short and broad $\left(\frac{\text{length}}{\text{breadth}}\right.$ of crown of m^1 about $= 1.5/1.0$).....2.

Molars longer and in proportion narrower $\left(\frac{\text{length}}{\text{breadth}}\right.$ of crown of m^1 about $= 2/1$) (bulla always shorter than molar series).....8.

2.—Bulla very large, exceeding crown length of toothrow.....3.

Bulla smaller, shorter than crown length of toothrow.....5.
3.—Molar crowns 8.4 to 8.9; width zygomatic plate, 4.7 to 5.2.....*bontanus*.
Molar crowns about 7.7; width zygomatic plate 4.0 to 4.8.....4.
4.—Size large; hind foot 45 to 48; muzzle long, nasals 18 to 20.....*xanthurus*.
Size smaller; hind foot 38 to 40; muzzle blunt, nasals 16 to 17.....*salocco*.
5.—Size large; molar crowns 9.0; occipito-nasal length 50.....*microbullatus*.
Size smaller; molar crowns 7.5 or less; occipito-nasal length 45 or less (*marmosurus*, *facetus*, and *tondanus*).....6.
6.—"Skull . . . short and broad; nasals broadened anteriorly".....*tondanus*.
Skull and nasals normal.....7.
7.—Auditory bulla 7.0 to 7.5; tail hairs about 2 scale lengths.....*marmosurus*.
"Much smaller auditory bullae"; "more hairy tail".....*facetus*.
8.—Ventral pelage self-colored.....*dominator*.
Ventral pelage gray-based (*taerae*, *hamatus*, *arcuatus*).....9.
9.—M^1 with accessory cuspule anterior to 1st loph.....*hamatus*.
M^1 without such cuspule.....10.
10.—Skull strongly arched at fronto-nasal suture; interparietal 4 × 9.....*taerae*.

NOTE.—*Celebensis* and *orientalis* have been excluded from the foregoing owing to uncertainty regarding many of their main characters. *Tondanus* is merely ASSUMED to have short m^1 and bullae shorter than the toothrows; its author gives no such particulars. *Punicans*, "not referable to any recognized species groups" (Miller and Hollister), comes nearest to the *xanthurus* group.

Rattus bontanus Thomas

Rattus bontanus THOMAS, 1921, Ann. Mag. Nat. Hist., (9) VII, p. 245.

MATERIAL.—From S. Celebes, Mt. Lampobatang, 2200 meters, 10 males, 2 females.

The type locality of the species was on the slopes of the same mountain but lower down (600 meters above sea level). In spite of slight discrepancies in certain measurements, one can hardly doubt that our series is referable to the single specimen which Thomas named. The characters of the tail given by him are scarcely constant; indeed both length of tail and extent of the white area varies considerably. The scale hairs are 2 scales in length about the middle of the tail and from 3 to 4 scales in length near the tip. Thomas suggested that *bontanus* might be equal to *orientalis* Revilliod. It may. But because a number of other forms exist in south and southeast Celebes that point must remain unanswered at present, for Revilliod's description is of little value.

MEASUREMENTS.—See table (p. 675).

ILLUSTRATIONS.—Skull, Figs. 11C, 12 C.

ANALYSIS OF CHIEF CHARACTERS OF RATS OF *R. xanthurus* GROUP IN CELEBES DESCRIBED PRIOR TO 1935

	Teeth	Bulla	Palatal foramina	Zygomatic plate	Ventral pelage	Size of animal (h. ft.)	Rostrum
bontanus	broad and heavy	very large	very long	narrow	white-based	large (43 mm.)	blunt and broad
microbullatus	heavy	small	medium	medium	gray-based	large (42–46)	blunt and broad
salocco	mod. heavy, broad	large	medium	narrow	white-based	large (46)	blunt
arcuatus	mod. heavy, m^1 long	medium	r. short	medium	gray-based	large (45)	tapered anteriorly
dominator	mod. long, m^1 long	small	short	very broad	white-based	very large (50)	//-sided, massive
camurus	moderate	v. small	short	broad	white-based	very large (50)	//-sided, massive
celebensis	?	?	short	v. narrow	white-based	large (49)	?
xanthurus	light and small	medium	mod. long, broad	narrow	whitish-based	large (46)	blunt and broad
taerae	light and small	small	mod. long, broad	medium to narrow	gray-based	large (44)	tapering anteriorly
orientalis					white-based		
facetus (as *marmosurus*)						v. small (33)	
marmosurus	mod. wide, not heavy	mod. large	mod. long	v. narrow	white-based	small (38)	r. tapered
hamatus	heavy, m^1 long	small (mod.)	mod. long	mod. broad	gray-based	small (39)	tapered long
tondanus						small (41)	

Rattus xanthurus (Gray)

Mus xanthurus GRAY, 1867, Proc. Zool. Soc. London, p. 598.

MATERIAL.—From Roeroekan, N. Celebes, 800 meters, 3 males, 1 female.

On the basis of Gray's original description and the subsequent comments of Thomas and others (see p. 555) the above material can be referred to *xanthurus* with some degree of confidence. As shown in the key (pp. 557–558), the specimens belong in the section with short molars. They have large bullae, rather long, well-opened palatal foramina, and narrow zygomatic plates.

It is unlikely that *orientalis* will be retained as a race of *xanthurus*.

MEASUREMENTS.—See table (p. 672).

ILLUSTRATIONS.—Skull, Figs. 11B, 12B.

Rattus salocco Tate and Archbold

Rattus salocco TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, pp. 7–8.

A large species with self-colored whitish underparts, short hind feet, large audital bullae and wide molar teeth, known only from the Mengkoka Mts., southeastern Celebes.

MEASUREMENTS.—See p. 677.

Rattus microbullatus Tate and Archbold

Rattus microbullatus TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, pp. 8–9.

This species, as its name implies, has quite small bullae. The underparts have gray-based hair. It occurs on the Mengkoka Mts., southeastern Celebes, at 1500 meters.

MEASUREMENTS.—See p. 678.

Rattus marmosurus Thomas

Rattus marmosurus THOMAS, 1921, Ann. Mag. Nat. Hist., (9) VII, p. 246.

MATERIAL.—From northern Celebes, Roeroekan, 800 meters, 2 males, 1 female, all adults but rather young.

These specimens clearly fit into the section in which at present may be included *facetus*, *tondanus*, and *marmosurus*. They lack the broad muzzle of *tondanus* and their dimensions are decidedly larger than the type measurements of *facetus* of Middle Celebes.

As stated before (p. 555) Matschie's "*xanthurus*" was probably *marmosurus*.

MEASUREMENTS.—See table (pp. 672–673).

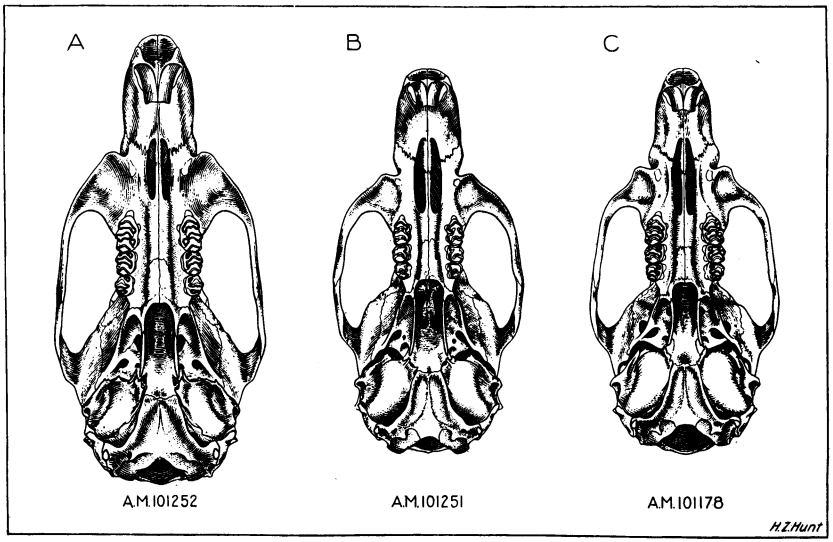


Fig. 11. Ventral view of skulls of *Rattus dominator*, *Rattus xanthurus*, *Rattus bontanus*. Note wide divergence respecting the zygomatic plates, palatal openings, and bullae. See also Fig. 12. Natural size.

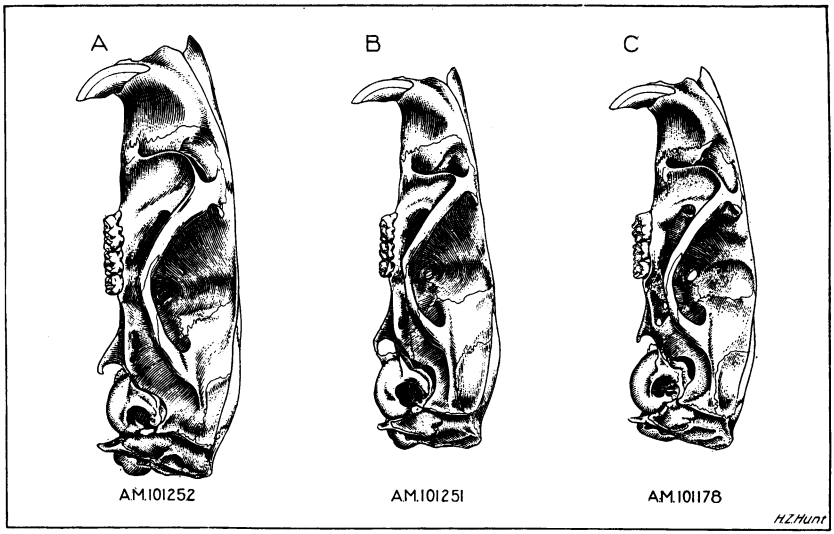


Fig. 12. Lateral view of skulls of *Rattus dominator*, *Rattus xanthurus*, *Rattus bontanus*. Natural size.

Rattus dominator Thomas

Rattus dominator THOMAS, 1921, Ann. Mag. Nat. Hist., (9) VII, p. 244.

MATERIAL.—N. E. Celebes, Roeroekan, 500–1000 m., 1 female; S. E. Celebes, Mengkoka Mts., Tanka Salocco, 1500–2000 m., 6 females; S. E. Celebes, Mengkoka Mts., Warro, 50 m., 3 females; S. Central Celebes, Latimodjong Mts., 2200 m., 1 female; S. Celebes, Lampobatang Mt., Warra Karaing, 2200 m., 15 males, 5 females.

The female from north Celebes seems to be perfectly in agreement with Thomas's description of *dominator* from Mt. Masarang. The tail hairs are one scale in length, becoming near the tip one and one-half scale lengths. In no point does the skull differ from that in the description.

Our series from the south shows certain pelage differences, the lowland animal from Warro having thinner pelage than typical, the highland ones both from the Lampobatang and from Mengkoka ranges having the fur longer and denser. The individual from the Latimodjong Mts. is particularly soft-furred and its underparts are exceptionally pure white. In Lampobatang animals the ears are rather smaller than in either *dominator* or *camurus*.

In the skulls the differences may not be constant. But in Lampobatang specimens the zygomatic plate runs slightly narrower and in individuals, especially the one from Latimodjong Mts., the palatal foramina are more reduced than in normal *dominator*.

MEASUREMENTS.—See table (pp. 673–674).

ILLUSTRATIONS.—Skull, Figs. 5F, 11A, 12A.

Rattus taerae Sody

Rattus taerae SODY, 1932, Overdr. Natuurh. Maandbl. (Limburg), No. 12, p. 158.

MATERIAL.—From N. Celebes, Roeroekan, 800 meters, 1 ♀.

The type locality of *taerae*, Lembean, east of Tondano, is comparatively near Roeroekan. It will be noted that after allowing for slight variations due to differences in sex and age, our specimen matches the type as closely as a certain lack of dimensional description in Sody's account will allow.

The species is as yet too rare in collections for any conclusions as to its range to be hazarded.

MEASUREMENTS.—See table (p. 676).

Rattus arcuatus Tate and Archbold

Rattus arcuatus Tate and Archbold, 1935, Amer. Mus. Novit. No. 802, p. 9.

Ventral pelage gray-based, thus resembling *taerae* and *microbullatus*. Skull strongly arched from front to back; muzzle long and narrow. Known only from Mengkoka Mts., southeastern Celebes, 1500 meters.

Measurements.—See p. 677.

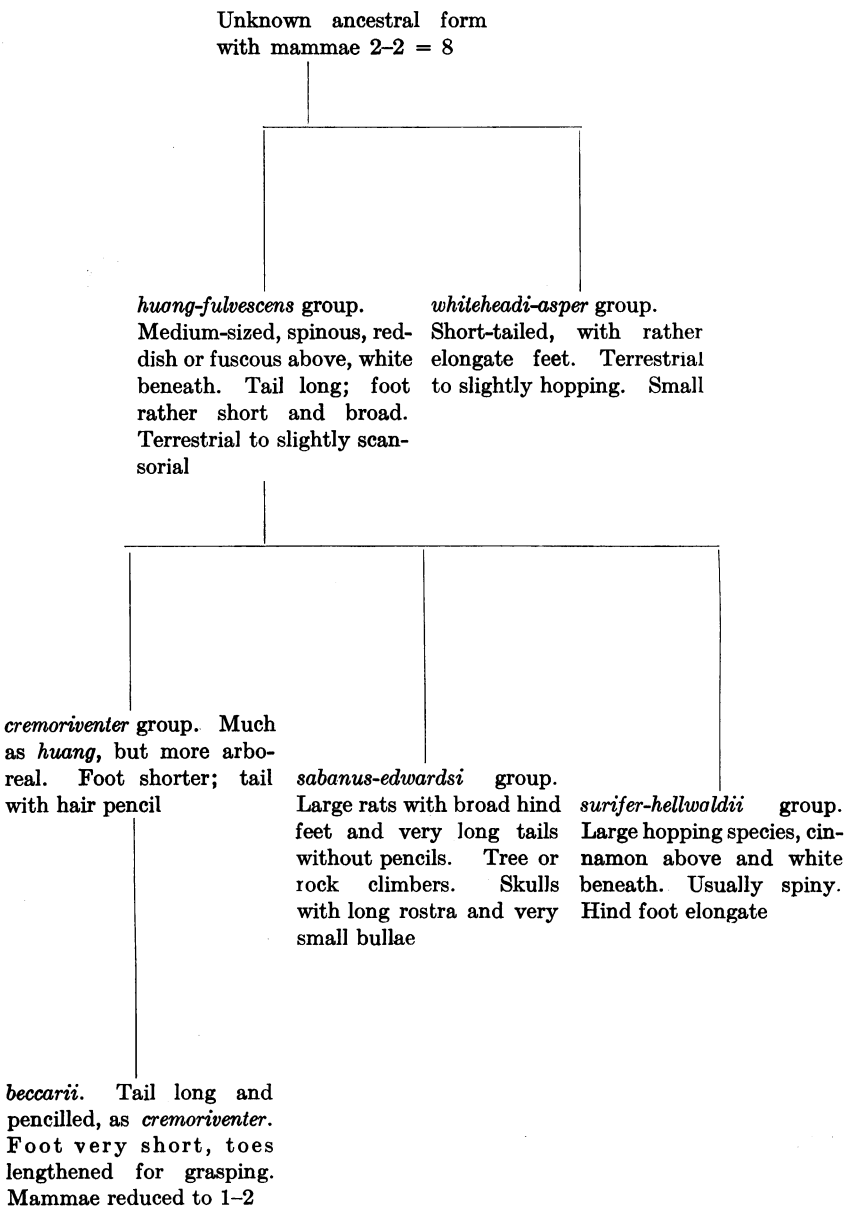
Rattus–huang–helwaldii–sabanus Division

In southern Asia, as suggested earlier (p. 515) a very large complex of species with mammary formula 2–2, has evolved, comprising, besides several morphologically generalized species such as *whiteheadi* and *asper*, a number of specialized groups of species (see Fig. 2). One such offshoot extends by way of the *huang-fulvescens* group to the long, narrow-footed, short-toed group comprising *helwaldii*, *rajah*, and *surifer;* another to the *sabanus-edwardsi* rats; a third by way of the *cremoriventer* group to the long-toed, arboreal *beccarii* and probably even to *Haeromys*. *Rattus lepturus* and *bartelsii* (mammae 1–2), remote from each other and from the foregoing, are possibly members of genetic lines which are otherwise unrepresented in our area but occur in northern Burma or India. These species, nevertheless, both appear to be more closely related to the present division than to the *rattus* division.

In this division of *Rattus* there may be noted, besides the generally constant mammary formula, additional trends, namely: varyingly marked degrees of reduction of m^3 (the length of the crown of m^3 from 38 to 50% of length of the crown of m^1) with a correspondingly larger part of the toothrow occupied by m^1; marked reduction in the size and change in form of the bullae, which rarely exceed 15% of the occipito-nasal length; generally lyrate or horseshoe form of the palato-pterygoid margins of the median pterygoid fossa (except in *sabanus* group); tendency towards development of short palatal foramina, pointed at the front and widely rounded behind (especially to be noted in *cremoriventer* and *hellwaldii* groups); trend towards a low, flat, little-arched type of skull.

For the most part the range of these rats is slightly to the north of the area from which most of our material comes. As a consequence, comparatively few of the many included species are contained in our collection. As suggested previously (p. 508) this division may well represent a comparatively new outburst of species making. For although it must be old enough to have achieved present completion of the divergence of its principal branches, it has not as yet been able to spread over nearly such an immensity of territory as has the *rattus* division.

In the following diagram an attempt has been made to work out the several evolutionary lines of this division of *Rattus:*



Regarding the distribution of its several component groups, the *huang-fulvescens* group covers the mainland from India to China and Formosa and reaches Sumatra and Borneo; the *helwaldii-surifer* group has a very similar range, but though seemingly excluded from most of India enters Java and is found all over Celebes. It is also present on Palawan. *Musschenbroekii* of Celebes may be regarded as intermediate between the above two groups. The *sabanus-edwardsi* group is represented by brownish forms in the Malay region, Sumatra, Java, and Borneo, and by grayish forms in the mountains of Indo-China, Burma, and Czechwan; the *cremoriventer* group occurs throughout the Malay-Siam region and extends through Sumatra and Java to Borneo and Bali. From it in all probability is derived *beccarii* and the (chiefly) Bornean genus *Haeromys;* the *whiteheadi-asper* group ranges from Siam through Sumatra (and probably Java) to Borneo. It thus becomes apparent that members of the division have rarely reached Celebes and never entered the Philippine Islands.

The northern and particularly the western limits of the above groups are as yet not satisfactorily worked out. The Himalaya system no doubt serves as a northern barrier for some groups, but a number have passed around its eastern ends into China and at least one (*edwardsi*, etc.) has developed races adapted to life at high altitudes. Concerning the extension of the groups into India information is vague or lacking.

Rattus huang-fulvescens Group

Relatively unspecialized forms of rather small size, commonly spinous pelage, with tail length exceeding body length and hind foot only moderately elongated. Skulls with small, rather rounded bullae; the lyrate form of the margins of the pterygoid fossa only incipient (see p. 518, 563); palatal foramina with the peculiarly specialized form to be seen in the *cremoriventer* and *hellwaldii-rajah* groups only slightly developed; teeth small, having the ratio $\frac{m^3}{m^1}$ crown lengths already decidedly less than that in the *rattus* division.

The group comprises two sections which are rather easily separated on the basis of pelage: the more typical, containing *huang* (Fig. 15A) and *fulvescens*, etc., has mixed black and cinnamon colored upper pelage with self-colored whitish underparts; the other, *confucianus* and allies, which occurs only in the northern part of the range of the group (China) has fuscous upperparts and beneath is white.

The cinnamon colored section embraces a relatively large number of forms, examples of which are:

Fukien, China	*huang* (= *flavipilis* Shih)
Burma-Chinese boundary	*vulpicolor*
Tonkin	*indosinicus*
Sikkim	*jerdoni*[1]
Nepal	*fulvescens*[1]
Tenasserim	*gracilis, pan, lepidus*
Koh Chang Isl., Siam	*marinus*
Batam Isl., Malay Pen.	*batamonus*
Sumatra	*hylomyoides, mandus*
Nias Isl., Sumatra	*barussanus*
Borneo	*rapit, spatulatus, trachynotus*

Rattus near **hylomyoides** (Robinson and Kloss)

Epimys hylomyoides Robinson and Kloss, 1916, Journ. Straits Branch R. Asiatic Soc., No. 74, p. 273.

Material.—Sumatra, Macarah Doewa (Palembang), 100 meters, 2 males, 1 female; Kalianda, 100 meters, 1 male, 2 females.

Although the animals of the above series are referred now to *hylomyoides* of western Sumatra, they may represent something new. The eastern species of the group, *mandus*, is much larger, having a hind foot length of 32–37 mm. One specimen (A. M. 102666) has the scattered long guard hairs of the back pure white.

For measurements of the above series see p. 678.

Rattus cremoriventer Group

This group of small rats which has the appearance of a scansorial off-shoot from the *huang-fulvescens* group may be recognized broadly by the following characters: brownish red dorsal pelage with white underparts; tail longer than body, with a fairly well-developed terminal tuft of hairs; foot rather broad and short; skull with lyrate margins to interpterygoid fossa; palatal foramina rather pointed in front and rounded behind.

Like the *fulvescens* group, this present one contains a large number of species. It seems to extend less into China and farther eastward among the islands. The list of species following gives a general view of its distribution and indicates its absence from the Philippine Islands:

[1] Osgood (1932, Field Mus. Nat. Hist., Zool. Ser., XVIII, No. 10, p. 304) considers *jerdoni* a synonym of *fulvescens*.

Fukien	*ling* (= *minor* Shih)[1]
Indo-China	*mekongis*
S. Annam	*langbianis*
Lower Siam	*cremoriventer*
Mergui Archipelago	*gilbiventer*
Tenasserim	*blythi* (= *cinnamomeus* Blyth)
Terutan, W. Coast Malay Pen.	*solus*
W. Sumatra	*fraternus*
Anambas Isl.	*flaviventer*
Billiton Isl.	*mengurus*
W. Java	*cretaceiventer*
Borneo	*kina*
Mallewalle Isl., Borneo	*malawali*
Celebes	*beccarii* (= *thysanurus* Sody?)

Rattus beccarii (Jentink)

Mus leucopus JENTINK, 1879, Notes Leyden Mus., I, p. 8 (homonym of *leucopus* Gray).

Mus beccarii JENTINK, 1880, Notes Leyden Mus., II, p. 11 (new name for *leucopus* Jentink).

Rattus thysanurus SODY, 1932, Overdr. Natuurh. Maandbl. (Limburg), No. 12, p. 157.

MATERIAL.—N. Celebes, Roeroekan, 800 meters, 1 ♀.

This individual, contrary to the fact in most species of the *cremoriventer* group, has a distinctly grayish cast of pelage, due apparently to its inhabiting a semi-arid region.

The conclusion has been reached that it is referable to the rat which has successively been named *beccarii* Jentink and *thysanurus* Sody. The three specimens agree in general color description and particularly in the presence of fine ventral spines. It is true that the "head and body" measurement of *beccarii* is too great, but probably the dimension was taken from a stretched skin. The type of *thysanurus* was a rather larger animal than our specimen. Compare the measurements (page 679).

The mammary formula of our specimen is 1–2 = 6, a specialized reduction of the usual 2–2 = 8.

ILLUSTRATIONS.—Skull, Figs. 13B, 14B.

Rattus whiteheadi–asper Group

The named members of the present group are few, small in size, and little specialized. The tail is shorter than or about equal to the body in length, the pelage commonly spinous (exc. *aspinatus*). The hind feet

[1] From the description it is hard to decide whether *ling* belongs with the *huang* group or with the present one.

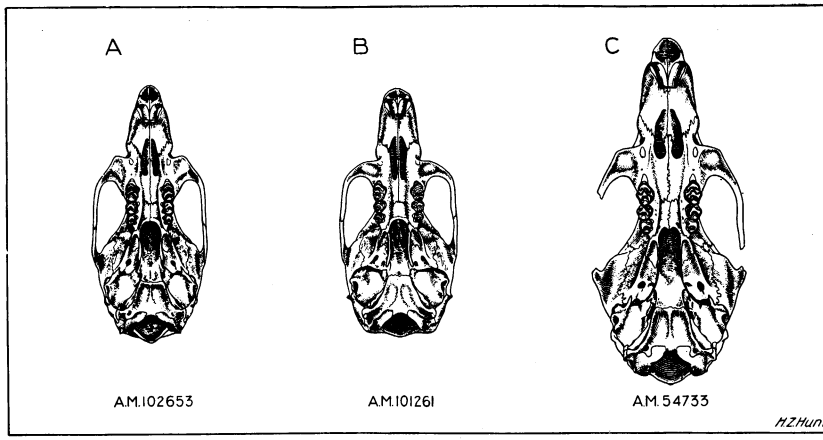


Fig. 13. Ventral view of skulls of *Rattus whiteheadi, Rattus beccarii, Rattus surifer*. Note extreme breadth of mastoid and cerebellum areas of *R. beccarii* (B), which species perhaps ought to be referred to *Haeromys*. The characteristic form of the palatal foramina of the *rajah* group (C) is well shown. Natural size.

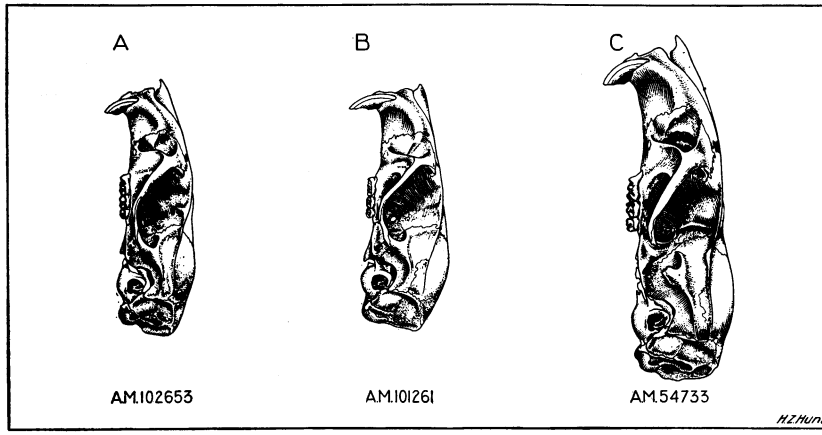


Fig. 14. Lateral view of skulls of *Rattus whiteheadi, Rattus beccarii, Rattus surifer*. Note the flatness of the audital bullae in all three examples. Natural size.

are not elongated. The skulls present only the general characters of the *huang-sabanus* division, i.e., quite small bullae, teeth, etc., (see p. 563). The *whiteheadi* type of rats of Borneo and Sumatra has the underparts colored near pinkish buff with the bases gray; the rather more numerous *asper* type has the underparts self-colored buffy white. The distribution follows very much the pattern of the two previous groups:

E. Siam	*sakeratensis*
Lower Siam	*asper*
Perak	*inas*
S. Johore	*klossi*
Batu Isl., Sumatra	*batus*
Borneo	*whiteheadi, perluteus, melinogaster,* and (?) *baeodon*
N. Celebes	*aspinatus*

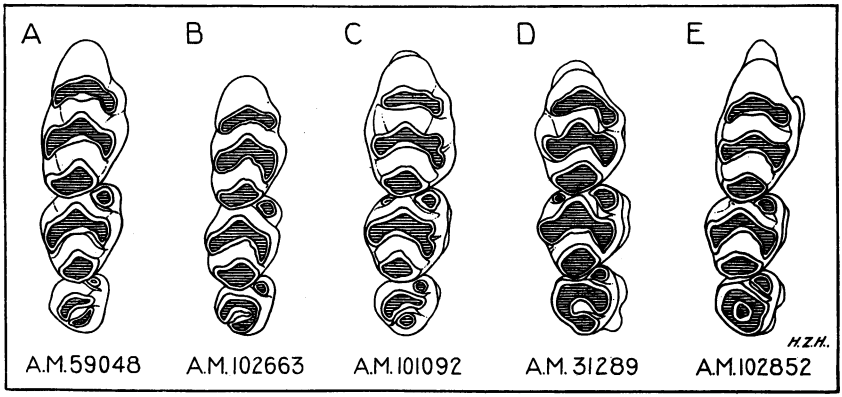


Fig. 15. Crown view of right upper molars of *Rattus huang, Rattus whiteheadi, Rattus hellwaldii, Rattus rajah, Rattus sabanus tapanulius.* A general tendency to simplify the laminae appears in the present division of *Rattus,* four groups of which are represented. *Rajah* and *hellwaldii* (D and C) are members of the same group. Scale: A × 20/3; B × 6; C × 6; D × 16/3; E × 4.

Rattus whiteheadi (Thomas)

Mus whiteheadi Thomas, 1894, Ann. Mag. Nat. Hist., (6) XIV, p. 452.

Material.—Sumatra, Macarah Doewa (Palembang), 100 meters, 10 ♂s, 3 ♀s. Sumatra, (south), Kalianda, 100 meters, 2 females.

The color scheme of the *whiteheadi* rats appears rather highly characteristic, namely rufous, lined with black, shading off gradually into the pinkish buff of the underparts, there being no trace of a line of demarcation. The gray bases of both dorsal and ventral pelage together with

the admixture of spines dorsally is normally a character of the *whiteheadi* group. It is desirable that the head and body/tail ratio be checked for true *whiteheadi* of Borneo, for in most members of the group the tail is shorter than the body.

The present series is in close agreement with true *whiteheadi*, except in the above-mentioned particulars and in the possession of rather shorter palate, nasals, and diastema (i.e., a shorter rostrum).

ILLUSTRATIONS.—Skull, Figs. 13A, 14A; teeth, Fig. 15B.

Rattus aspinatus Tate and Archbold

Rattus aspinatus TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 802, pp. 9–10.

Since the first description was published the skull of the male paratype has been discovered.

Rattus hellwaldii–rajah Group

Characteristically the animals belonging to this group are large (body 150 to 220), spinous, reddish-brown rats with self-colored white or buff underparts; tail length subequal to body length, the tail pale beneath; feet with long narrow metatarsal portion and rather short toes $\left(\frac{\text{longest toe}}{\text{foot length}} = \text{about } 23\%\right)$, which suggested that the animals can leap somewhat. The mammae number 2–2 = 8. The skull is elongate, with long rostrum, moderately widened braincase. The bullae are quite small, smoothly rounded and rather flat beneath, with proportionately large eustachian canals, the bullae being widely separated by a broad basi-occipital and showing a considerable exposure of the periotic bone between each bulla and the edge of the basi-occipital. The palatal foramina are characteristic: short, widely arched behind, narrowly pointed in front. The median pterygoid fossa is widely lyrate. The teeth are proportionately small. The following ratios are approximate: $\frac{\text{molar series}}{\text{palatilar length}}$ about 37%; $\frac{\text{molar series}}{\text{palatal foramina}}$ about 100%; $\frac{\text{molar series}}{\text{length bulla}}$ about 120%.

A very large number of forms directly assignable to this group have been described, their inclusive range extending from Cochin-China southwards through the Malay region, Sumatra, Java, Celebes, Borneo, as far as Palawan, though they are seemingly absent from the rest of the Philippine Islands (see map, Fig. 16).

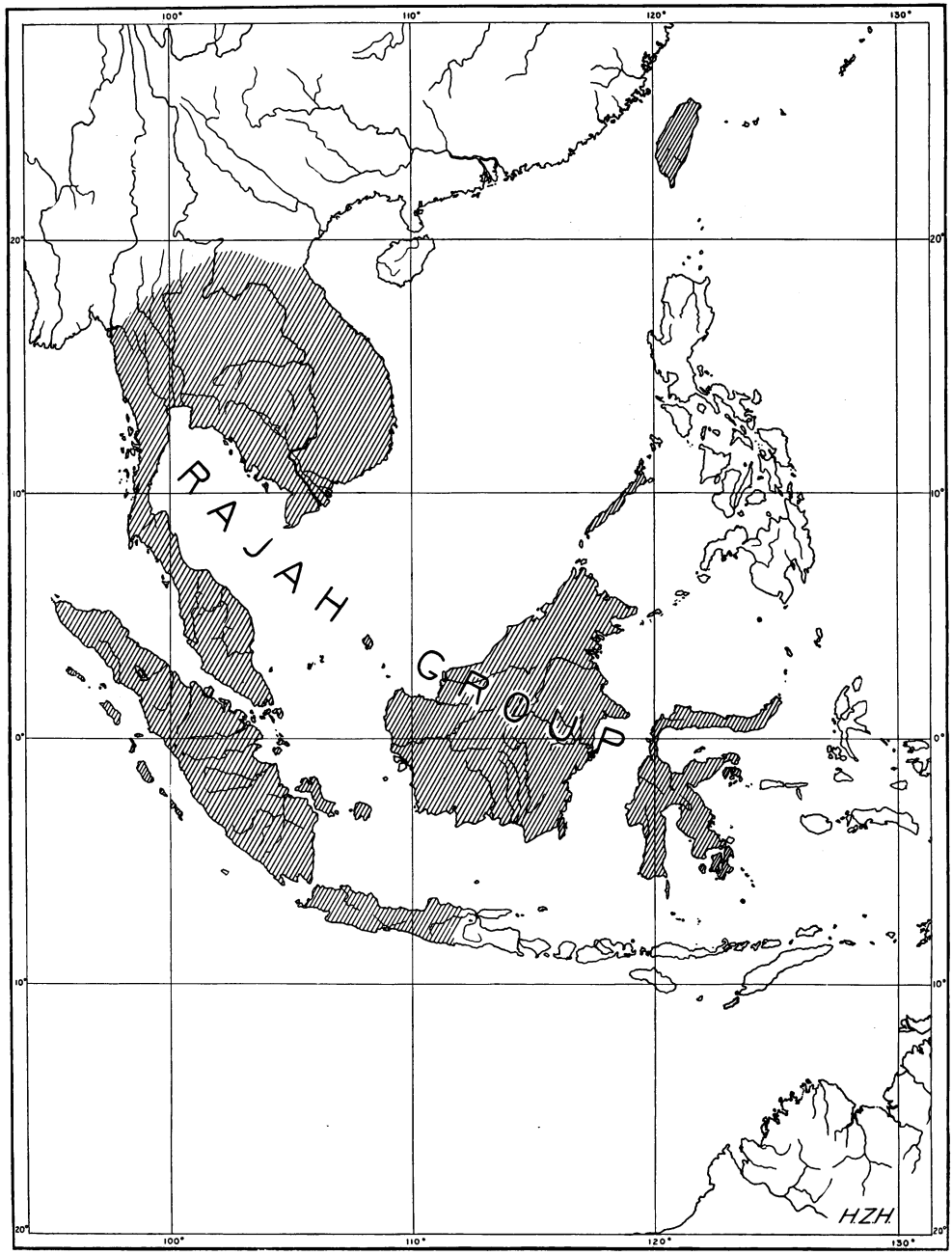


Fig. 16. Distribution of *rajah* group of *Rattus*.

Certain members of the group lack the usual mixture of spines with the pelage almost completely. This is especially noticeable in *hellwaldii* of Celebes and the race of *surifer*[1] which occurs at Laos, Indo China. The condition in the latter form may be a seasonal phenomenon or it may be that that race of *surifer* never has spines. Until some one writes authoritatively on the moulting process among the *surifer* rats to settle the point whether their spinous pelage is gradually shed and replaced, or whether there occurs a period in their annual life-cycles when spines are completely lost, that question must remain unanswered. It seems that in *hellwaldii* spines are lacking at all seasons.

The *rajah-hellwaldii* rats may be listed for convenience according to the following geographical grouping (at present no opinion is offered regarding possible synonyms even when as many as 5 species are listed from the same group of islands, i.e. Mergui Archipelago).

1.—Mainland forms, excluding the Malay Peninsula:	
Southern Annam	*moi*
Eastern Siam	*rajah koratis*
Lower Siam	*pellax, surifer surifer, surifer butangensis*
Western Siam	*rajah siarma*
2.—Islands off coast of Siam:	
Koh Kram	*rajah kramis*
Koh Chang	*surifer changensis*
Koh Mak	*surifer connectens*
Koh Kra	*surifer eclipsis*
Koh Menao	*surifer finis*
Koh Kut	*surifer kutensis*
Koh Rang	*surifer pelagius*
Koh Klum	*surifer tenebrosus*
3.—Islands off east coast of Malay Peninsula:	
Pennan Isl.	*surifer manicalis*
Samui Isl.	*surifer spurcus*
Perhentian Isl.	*surifer flavigrandis*
Redang Isl.	*surifer grandis*
Tioman Isl.	*surifer binominatus, microdon*
Permangil Isl.	*surifer permangilis*
Aor Isl.	*surifer aoris*
Singapore Isl.	*surifer leonis*
4.—Islands off west coast of Malay Peninsula (excl. Sumatra):	
Mergui Archipelago	*bentincanus, casensis, domelicus, luteolus, umbridorsum*
Lankawi Isl.	*surifer flavidulus*
5.—Sumatra and its western islands:	
West Sumatra	*ravus, similis*

[1] See Osgood, 1932, Field Mus. Nat. Hist., Zool. Ser., XVIII, No. 10, p. 309.

Mansalar Isl.	*catellifer*
Banjak Isl.	*lingensis banacus, lingensis antucus, lingensis mabalus*
Batu Isl.	*lingensis pinacus*
Pagi Isl.	*pagensis*
6.—Between Malay Peninsula and Borneo:	
Linga Archipelago	*lingensis lingensis*
Anambas Isl.	*anambae*
Natuna Isl.	*rajah hidongis*
7.—Borneo and outliers:	
North Borneo	*perflavus, saturatus, bandahera, rajah rajah*
Karimata Isl. (S. W. Borneo)	*carimatae, serutus*
Sebuku Isl. (S. E. Borneo)	*ubecus*
Palawan Isl. (N. E. Borneo)	*panglima, palawanensis*
8.—Java (middle):	
	rajah verbeeki
9.—Celebes:	
	hellwaldii hellwaldii, h. cereus, h. localis

Such a list as the foregoing is formidable and its evaluation as a whole can be accomplished only by studying the entire group intensively. It shows sufficiently the wide extent of the range of the group of rats under discussion. Note that *coninga* Swinhoe (1864) from Formosa is stated by Bonhote[1] to belong in the same group as *rajah*. Recently, too, a form from the Liu-chu Islands has been described by the Japanese.

The collections in this Museum contain besides the series of *hellwaldii* already mentioned, representatives of one of the many races of *surifer* from southern Sumatra near sea level; a couple of individuals from Borneo; and a small series taken by the Sage Indo-China Expedition at Laos.

Dr. E. H. Taylor of Kansas University has been kind enough to loan the co-types of his *palawanensis* for examination. He had concluded that the species represented a new group of *Rattus* and named it the "*palawanensis* group." Actually *palawanensis* seems to be a synonym of *panglima* Robinson from Palawan Island, which Taylor did not mention in his paper.[2]

Musschenbroekii, the species immediately following, seems intermediate in foot-structure between the *huang-fulvescens* group and the present group.

[1] 1905, Proc. Zool. Soc. London, p. 386.
[2] Taylor, 1934, 'Philippine Land Mammals,' p. 416.

Rattus musschenbroekii (Jentink)

Mus musschenbroekii JENTINK, 1879, Notes Leyden Mus., I, p. 10.

MATERIAL.—North Celebes: Ile-Ile, 500–1700 meters, 2 ♂s, 2 ♀s, 1 ?; Roeroekan, 800 meters, 2 ♂s. Southeast Celebes: Mengkoka Mts., Tanka Salocco, 2000 meters, 10 ♂s, 9 ♀s; Mengkoka Mts., Masumbo, 550 meters, 1 ♂, 1 ♀; Mt. Lampobatang, Warra Karaing, 2300 meters, 2 ♂s, 1 ♀; Mt. Lampobatang, Lambasang, 1100 meters, 1 ♀; Batinoeroereng, 1 ♀.

Specimens of *musschenbroekii* from Ile-Ile show very marked change in pelage as they pass from near sea level upwards. Those from the lower levels are heavily spinous as compared with the softer fur and comparatively few and weak spines of the material from higher altitudes. The skulls on the other hand seem not readily separable (see table of measurements, pp. 680–681). In general size they come nearest to the few measurements of true *musschenbroekii* published by Jentink and to those of the individual from Minahassa recorded by Matschie (1900).

Our much larger series from south Celebes averages, if anything, rather smaller than *musschenbroekii* of the north. Its individuals are very similar to the mountain phase of the latter, even though occurring as low as 500 meters. The pelage of Masumbo animals, however, is decidedly more spinous than that of specimens from higher levels.

The lowland Ile-Ile (north Celebes) specimens almost lack the somewhat rufous color which is normal for the species; perhaps this is due to wear of pelage.

The form *tetricus* Miller and Hollister is apparently slightly larger than any of those measured by us. It must be remembered though, that the foot measurement of *tetricus* includes the claws.

Rattus hellwaldii (Jentink)

Mus hellwaldii JENTINK, 1879, Notes Leyden Mus., I, p. 11.

MATERIAL.—Mengkoka Mts.: Warro (50 meters), 2 ♂s, 8 ♀s, Jan., 1932; Masumbo (550 meters) 3 ♂s, 6 ♀s, Jan., 1932; Tanko Salocco (1500 meters) 4 ♂s, 5 ♀s, Jan., 1932. Mt. Lampobatang, Lambasang (1100 meters), 1 ♀, Oct., 1931.

With the exception of *coninga* (see p. 573), *hellwaldii* was the first of that section of *Rattus* commonly termed the "*rajah-surifer* group" to be described, and, with its two races *cereus* Miller and Hollister and *localis* Miller and Hollister, appears to be widely distributed in Celebes. The present series extends its range from middle and north Celebes to south

and southeast Celebes and its altitudinal range from practically sea level to 1500 meters. (For measurements, see page 682.)

ILLUSTRATIONS.—Teeth, Fig. 15C. For comparison with allied *rajah* from Borneo, Fig. 15D.

Rattus surifer lingensis (Miller)

Mus lingensis MILLER, 1900, Proc. Wash. Acad. Sci., II, p. 206.

MATERIAL.—Sumatra, Morcarah Doewa (Palembang), 100 meters, 10 ♂s, 10 ♀s, 1 juvenal ♂, 4 juvenal ♀s, taken in June, 1934.

In attempting to identify this series of rats, comparisons have been made with descriptions of the following species whose type localities are near southern Sumatra: *ravus* and *similis* of west Sumatra, *catellifer* from Mansalar Isl., *banacus*, *antucus*, and *mabalus* from Banjak Isl., *pinacus* from Batu Isl., *pagensis* from Pagi Isl., *lingensis* from Linga Archip., also *verbeeki* from Central Java.

The four specimens, whose dimensions are shown (pp. 683–684), are selected fully adult animals with well worn teeth. Therefore *pagensis*, *pinacus*, *ravus*, *banacus*, *similis*, *mabalus*, and *verbeeki* can all be disregarded as being too large. This leaves *catellifer*, *antucus*, and *lingensis* for consideration. Of these, *antucus* (tail "135 to 160") and *catellifer* (tail 146) are short-tailed forms; *lingensis*, though slightly larger than our series, seems to come very close to it. Its measurements are given in the table (p. 683).

The 20-odd specimens of our series comprise brightly-colored rats with yellowish-white underparts. Eight of them have narrow brown collars across the base of the ventral surface of the neck (see collars of *banacus* and *antucus* Lyon, 1917).[1]

ILLUSTRATIONS.—Skull of *R. surifer* subsp., Fig. 13C, 14C; teeth of *R. rajah*, Fig. 15D.

Rattus edwardsi–sabanus Group

The rats which come under this heading show great structural homogeneity. Their common characteristics are: large to very large size; pelage coarsely to finely haired, with a variable mixture of wool hairs and rather short over hairs. Flattened spines little developed. Foot quite large and heavy (16 to 20% of head and body length, 77–81% of occipitonasal length; its width at base of 5th metatarsal 15–17% of its length). Skull long, flattened and little arched with long rostrum; bullae small as in *huang-surifer* division; palatal foramina often quite short, some-

[1] Lyon, 1916, Proc. U. S. Nat. Mus., LII, p. 449.

what as in *dominator* (about 32–39% of palatilar length). The crown length of m^3 is from 40 to 49% of crown length of m^1. (See discussion pp. 563–565.)

The range of the *sabanus–vociferans* group extends from Darjeeling, Czechwan, and Fukien southwards through the Malay region to Sumatra, Java, and Borneo. As yet it seems to be unrecorded either from Celebes or from the Philippines (see map, Fig. 9).

Rattus edwardsi–sabanus–vociferans Group, Geographically Arranged

1.—India, Burma, China, Siam, etc., (excl. Malay Peninsula):	
Darjeeling	*listeri*
China	*edwardsi, melli, bowersii*
S. Annam	*edwardsi milleti, sabanus revertens*
Siam	*vociferans herberti, lactiventer, kennethi*
Lower Siam	*vociferans vociferans, ferreocanus*
Assam	*listeri garonum*
2.—Malay Peninsula:	
Perak	*ciliatus*
3.—Islands east of Malay Peninsula:	
Tioman Isl.	*stridens*
4.—Islands west of Malay Peninsula:	
Mergui	*lucas, matthaeus, stentor, stridulus, vociferans clarae, vociferans insularum*
Lankawi Isl.	*vociferans lancavensis, tersus*
5.—Sumatra and western islands:	
West Sumatra	*setiger, ululans, vociferans tapanulius*
Mansalar Isl.	*fremens mansalaris*
Banjak Isl.	*fremens tuancus*
Batu Isl.	*masae, balae*
Pagi Isl.	*soccatus, siporanus*
Sinkep Isl.	*fremens fremens*
6.—Between Malay, Sumatra, and Borneo:	
Anambas Isl.	*strepitans*
7.—Borneo and outliers:	
Borneo	*nasutus*
Mt. Kinabalu	*sabanus sabanus*
Laut Isl.	*luta*
8.—Java, west (female, type), east (male)	*sabanus mayapit*

At least some of the members of the group would seem to be markedly vocal, from the frequent occurrence of names such as *vociferans, stridens, stridulus, stentor, strepitans, ululans.* Whether those names were applied solely because of the naturally greater noise made by large rats than small ones or whether the animals actually use their voices more freely, is not known.

Rattus sabanus tapanulius Lyon

Rattus vociferans tapanulius Lyon, 1916, Proc. Biol. Soc. Wash., XXXIX, p. 209.

Material.—Kalianda, southern tip of Sumatra, 4 adult ♂'s.

These specimens represent one of the small-sized long-tailed races of the *sabanus-edwardsi* group, as shown by the dimensions of the tail, hind feet, skulls, and toothrows. A number of forms from the surrounding islands, which have received names, agree very closely with our material, but on account of their very long tails combined with molar series 10 mm., our series is referred to *tapanulius*, whose type locality is the west coast of Sumatra. *Tapanulius* was described by Lyon as a subspecies of *vociferans* (from Lower Siam) but by Robinson and Kloss[1] both *tapanulius* and *vociferans* were made subspecies of *sabanus*.

The forms *sabanus*, *strepitans*, *tapanulius*, *fremens*, and *tuancus*, as shown by the set of selected measurements in the subjoined table, are nearly related to our material (see also measurements, pp. 684–685). *Fremens* and *tuancus* are said to have considerable black on the head and back and may be set aside. *Strepitans* was described as having the width of m^1 3.0 mm. On the basis of the generally elongate tail of our animals and their capture in Sumatra we refer them to *tapanulius* rather than to *sabanus* of Borneo.

	Head and Body	Tail	Hind Foot	Molar Crowns	Molar Alveoli
sabanus (Borneo)	280	340	43.5	9.4	
strepitans (Anambas)	241	324	43.6		10
taponulius (N. W. Sumatra)	236	375	47 (c.u.)	10	
fremens (Sinkep)	234	324	47 (c.u.)		
tuancus (Banjak)	257	328	47 (c.u.)		

The two lists of species of the *sabanus* group which follow, though also located near south Sumatra, are respectively distinguished from our series by their large hind feet or short tails:

mayapit	h. ft.	50 mm.	*ululans*	tail	253 mm.
setiger	h. ft.	56 mm.	*balae*	tail	238 mm.
siporanus	h. ft.	52 mm.	*luta*	tail	290 mm.
soccatus	h. ft.	53 mm.	*masae*	tail	275 mm.
nasutus	h. ft.	54 mm.			

Illustrations.—Skull, Figs. 17A, 18A; teeth, Fig. 15E.

[1] 1919, Journ. Fed. Malay S. Mus., VII, pt. 4, p. 311.

Rattus Species not at Present Allocated to "Groups"

Rattus bartelsii (Jentink)

Mus bartelsii Jentink, 1910, Notes Leyden Mus., XXXIII, p. 69.

Material.—West Java, Tjerimai, 1000 meters, 16 ♂s, 9 ♀s, 1 juv. ♀.

This rat which, though allied to the *huang* complex, has yet to be assigned to a definite species-group. Its characteristics are its sub-equal tail/body proportions; long, narrow hind feet (20% of body length; width at base of 5th metatarsal divided by length of foot = about 12.5%); large ears; short, though rather dense dorsal pelage and gray-based ventral fur; and mammae 1–2 = 6. Long, narrow skull with elongate nasals exceeding premaxillae anteriorly; small bullae, long and broad palatal foramina, and quite small teeth; molar crowns 87–90% of length of palatal foramina and about 14% of occipito-nasal length of skull.

It appears to be generally distributed in Java between 1200 and 2000 meters. In 1933 Sody proposed a race *tjibunensis*, but himself reduced it to synonymy in 1934. Our series, as shown by the table of measurements (pp. 685–686) averages perhaps slightly larger than the fine series recorded by Robinson (1917). It affords ample opportunity for checking the mammary formula 1–2 = 6, the anterior pair being pectoral (just behind the axillae) not sternal (between the fore limbs).

Illustrations.—Skull, Figs. 17C, 18C.

Rattus lepturus (Jentink)

Mus lepturus Jentink, 1879, Notes Leyden Mus., II, p. 17.

Material.—West Java, Tjerimai, 2500 meters, 9 ♂s, 7 ♀s, 1 juv. ♂.

A fine series of this beautiful soft-furred species with snowy white underparts from the type locality of Sody's (1934) new race *maculipectus*, clearly represents that race. It includes animals ranging from pure white underparts to others with the transverse pectoral patch equivalent to that in *maculipectus*. Owing to lack of material the other races of *lepturus*, *besuki*, and *fredericki* cannot be reviewed.

Characteristics of *lepturus* as a species are its very long, lax fur, large ear, long tail (commonly half as long again as head and body) with a suggestion of a hair pencil; hind foot normal to perhaps slightly scansorial in proportions (width at base of 5th metatarsal/length of foot about $\frac{4.1}{30}$ or 13%), and thus a heavier type foot than that in *bartelsii;* mammary formula 2–2 = 8, the postaxillary and sternal pairs of mammae

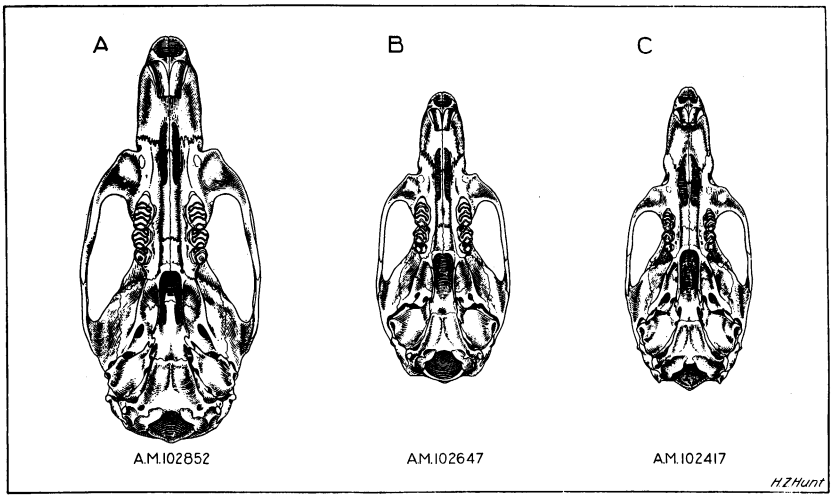


Fig. 17. Ventral view of skulls of *Rattus sabanus tapanulius*, *Rattus lepturus*, *Rattus bartelsii*. The teeth of *lepturus* appear enlarged on Fig. 5E. Natural size.

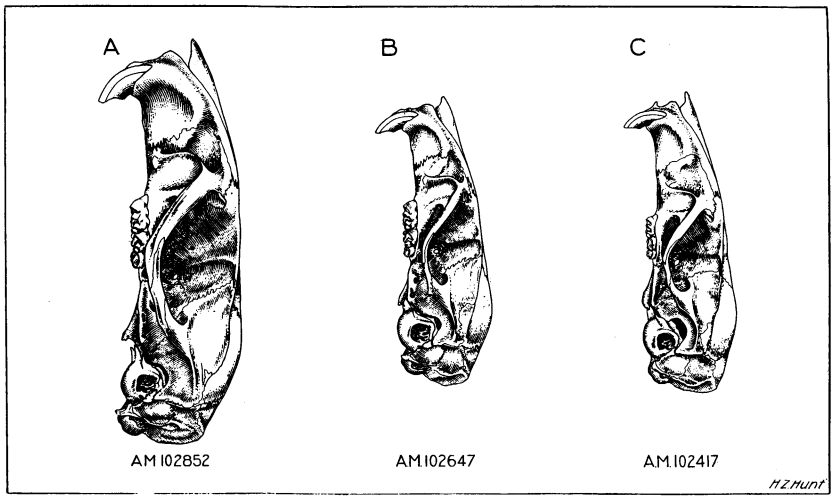


Fig. 18. Lateral view of skulls of *Rattus sabanus tapanulius*, *Rattus lepturus*, *Rattus bartelsii*. The strongly opisthodont incisors of *sabanus* are noteworthy. Natural size.

both present even though not always all functional; skull with narrow zygomatic expanse, rather heavy parallel-sided rostrum, rather narrow interorbital region, large parallel-sided palatal foramina, small rounded bullae, and long toothrow with large teeth (m^1 crown = 3.6 × 1.9, approximately; molar crowns 106–115% of palatal foramina and about 19% of occipito-nasal length).

Possibly this species is related to the *eha* rats of northern India and southern China, although no mention of unusual enlargement of m^1 in those forms has been recorded.

ILLUSTRATIONS.—Skull, Fig. 17B, 18B, teeth, Fig. 5E.

BUNOMYS THOMAS

Bunomys THOMAS, 1910, Ann. Mag. Nat. Hist., (8) VI, p. 508.

TYPE.—By original designation, *Mus caelestis* Thomas.

As stated under *Stenomys* (p. 581) that genus seems to be less closely linked with *Bunomys* than it appeared to Thomas. That the habits of *Bunomys* are semifossorial can scarcely be doubted in view of its elongated claws. But although its long muzzle, narrow, rather sloping zygomatic plate and, small bulla admittedly suggest *Stenomys*, those characters also serve to link it with the *chrysocomus* rats which it otherwise closely resembles. Reduced size of the molar teeth is a common attribute of an elongated rostrum combined with semi-burrowing habits (e.g., *Echiothrix*).

The mammary formula 0–2 = 4 is confirmed on the basis of 3 females from Mt. Lampobatang, and 4 females from Mt. Mengkoka, Celebes. The long clitoris mentioned by Thomas can be observed only imperfectly on the dried skins in our collection. The cranial characters seem to agree closely with those pointed out by the describer of genus and species.

As suggested (page 506) this genus seems to comprise merely offshoots of the *Rattus chrysocomus* group which have become slightly fossorial, as indicated by their lengthened claws. The adult skull possesses the lengthened rostrum with tendency to expansion at its anterior end and the widened posterior portion of the braincase as well as a sloping zygomatic plate, all of which characters appear in the *chrysocomus* rats.

Bunomys caelestis (Thomas)

Mus caelestis THOMAS, 1896, Ann. Mag. Nat. Hist., (6) XVIII, p. 248.
Bunomys caelestis THOMAS, 1910, Ann. Mag. Nat. Hist., (8) VI, p. 508.

MATERIAL.—S. Celebes, Mt. Lampobatang, Warra Karaing, 2200 meters, 17 ♂s, 13 ♀s; Mt. Lampobatang, Lambasang, 1100 meters, 1 ♀.

The type locality given by Thomas for *caelestis* was "Bonthian Peak, S. Celebes, 6000 feet," consequently our series from Lampobatang is nearly topotypical.

A slight but consistent difference in color tone is perceptible between the series representing the forms inhabiting these two groups of mountains, but because those of Lampobatang (with fuller, more brown-tipped pelage) were taken in September and those of the Mengkoka (with shorter fur, the brown tips less prominent) were trapped in December–January, there remains the possibility that seasonal wear may be accountable for the seeming difference.

From a comparison of measurements made on representative series of fully adult animals from each region (pp. 688–689) it appears that the Mengkoka form *koka* constitutes a geographical race differing from true *caelestis* in being smaller, with smaller hind foot and shorter claws (thus becoming annectant with the *chrysocomus* group of *Rattus*), shorter nasals, shorter and in proportion wider palatal foramina. The interparietal of *Bunomys* appears a variable structure, in some individuals reduced, in others normal.

ILLUSTRATIONS.—Skull, Figs. 19B, 20B.

Bunomys caelestis koka Tate and Archbold

Bunomys caelestis koka TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 1.

This race is at present known only from its type locality, the Mengkoka Mts., southeastern Celebes.

STENOMYS THOMAS

Mus THOMAS, 1904, Novit. Zool., XI, p. 598.

Stenomys THOMAS, 1910, Ann. Mag. Nat. Hist., (8) VI, p. 507.

GENOTYPE.—By original designation, *Mus verecundus* Thomas.

Stenomys was based originally upon a species which, in comparison with five other forms later referred to the genus, proves to be atypical, in that it is very much larger than the norm for all of its species taken together. This fact is brought out by comparing type measurements (table, pp. 689–692). It also becomes clear that *ceramicus*, separated by Thomas[1] as *Nesoromys*, and the only species not native to New Guinea is quite exceptional in the considerable backward extension of its palate. *Arrogans*, *klossi*, and *niobe* seem from their descriptions to be very closely allied to one another. The reddish *rufulus* may represent yet another race.

[1] 1922, Ann. Mag. Nat. Hist., (9) IX, p. 263.

Contrary to Thomas'[1] suggestion (1910) that "*Bunomys* is no doubt the Celebean representative of *Stenomys*" it seems more probable, in view of its narrowed and rather simplified molars, that *Stenomys* may equally well be regarded as an off-shoot of that line of rats with unreduced scale-hair arrangement of the tail which has been indicated (under the discussion of *Melomys*[2]) as possibly leading to the *Melomys-Uromys* aggregate of New Guinea rats (see p. 589). The delicately formed, slender muzzle and very narrow zygomatic plate are readily to be derived from (or lead to) the intermediate condition of those parts of the skull to be seen in some *Melomys*. Also the feet and claws are perfectly normal.

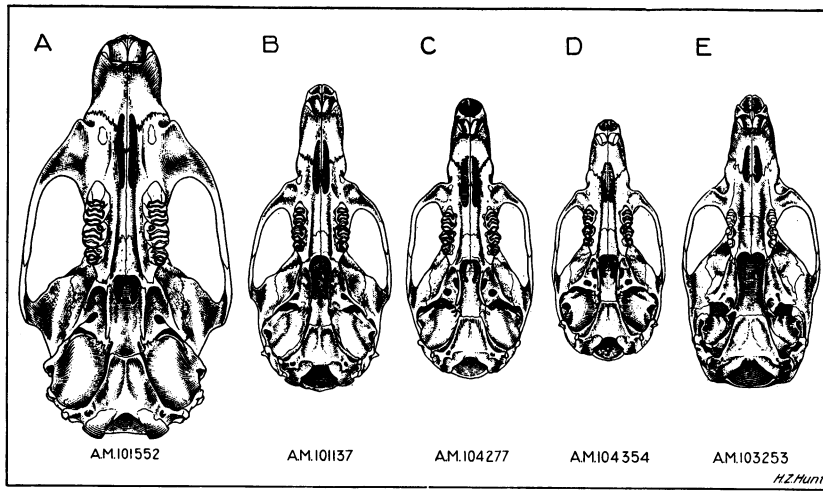


Fig. 19. Ventral view of skulls of *Bandicota setifera*, *Bunomys caelestis*, *Stenomys verecundus*, *Stenomys niobe*, *Macruromys elegans*. The divergence of *Bandicota* (A) from any other *Rattus*-like genus depicted in the present paper is obvious. The great width at mastoid and cerebellum of the skull of *Macruromys* (E) should be observed (for teeth see Fig. 21). Neither *Bunomys* (B) nor *Stenomys* (C, D) shows any great degree of divergence from the *R. chrysocomus* group. Natural size.

In *Bunomys*, on the contrary, the outstanding characters are the greatly "elongated, fossorial" claws and "long, cylindrical" muzzle. *Bunomys* furthermore must reach nearly twice the weight of any species of *Stenomys*.

Stenomys may also be derived from the same remote ancestral line as the small-toothed *Macruromys*. The two cannot, however, be con-

[1] 1910, Ann. Mag. Nat. Hist., (8) VI, p. 508.
[2] Tate and Archbold, 1935, Amer. Mus. Novit. No. 803, p. 2.

sidered at all closely related on account of the differences in their teeth and in their zygomatic plates.

Stenomys niobe (Thomas)

Mus niobe THOMAS, 1906, Ann. Mag. Nat. Hist., (7) XVII, p. 327.

MATERIAL.—From Mt. Tafa, 2000–2400 meters, 45 specimens; from Mt. Albert Edward, 3680 meters, 22 specimens.

This material, of which a representative set of measurements is shown (pp. 690–691), agrees closely with Thomas' description of the type from Owgarra, Angabunga River.

ILLUSTRATIONS.—Skull, Figs. 19D, 20D; teeth, Fig. 21C.

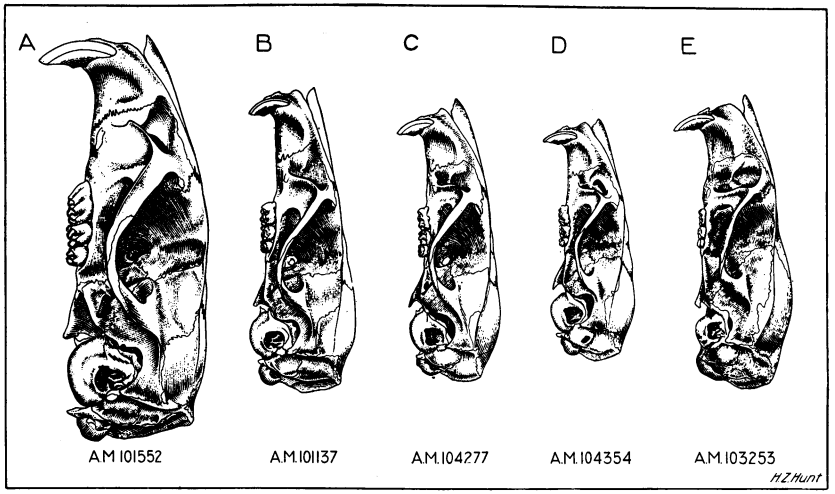


Fig. 20. Lateral view of skulls of *Bandicota setifera, Bunomys caelestis, Stenomys verecundus, Stenomys niobe, Macruromys elegans.* Note the peculiarly massive character of the skull of *Bandicota* (A) and the specialized almost *Hydromys*-like zygomatic plate of *Macruromys* (E). Natural size.

Stenomys verecundus (Thomas)

Mus verecundus THOMAS, 1904, Novit. Zool., XI, p. 598.

MATERIAL.—An old male from Matsika, Angabunga River, 950 meters; a smaller male from Mafulu, 1250 meters.

When allowance is made for difference of sex the first of the above specimens agrees with the description of the type (♀) very closely (measurements on pp. 691–692). The second animal, though smaller, appears to belong to the same species. Its teeth are only a little less

worn than those of the former. The pelage of both animals is decidedly harsher than that of the mountain-inhabiting *niobe*.

Since writing the above two female specimens (young adult) referable to *verecundus* (or at best a race of it) have been received from Stein, who took them at Weyland Mts., about 700 miles east of its type locality. The mammary count cannot be determined from these specimens.

ILLUSTRATIONS.—Skull, Figs. 19C, 20C, teeth, Fig. 21B.

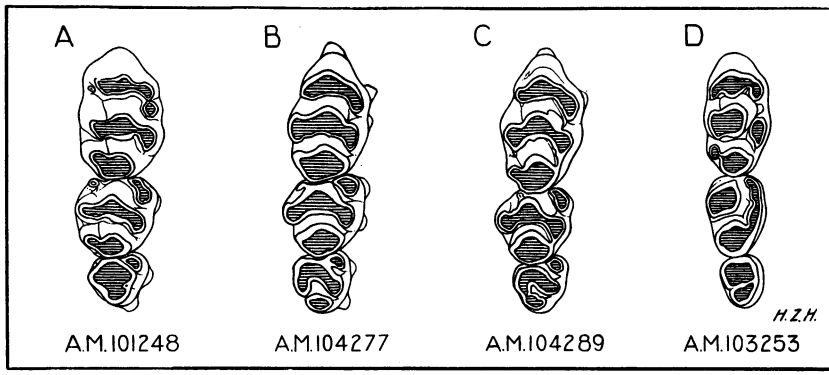


Fig. 21. Crown view of right upper molars of *Echiothrix leucura*, *Stenomys verecundus*, *Stenomys niobe*, *Macruromys elegans*. Although so much reduced in size the teeth of *Echiothrix* are closely similar to those of *Rattus* proper. *Stenomys* has teeth with simple laminae somewhat like those in the *R. huang* division or perhaps leading on to the *Melomys* molars (Fig. 23D). Those of *Macruromys*, though distinctly Murine, show evidence of extreme simplification as well as reduction in size. Scale: A × 14/3; B × 16/3; C × 6; D × 20/3.

EROPEPLUS MILLER

Eropeplus MILLER, 1921, Proc. Biol. Soc. Wash., XXXIV, p. 94.

Though sharing a number of characters in common, *Eropeplus* and *Lenomys* should not be associated unduly closely (see page 511). The principal characters present in both genera are the strongly narrowed and longitudinally folded palate and narrowed interorbital region expanding abruptly backwards to form broad temporal ridges. The greater hypsodontism of the molars of *Eropeplus* pointed out by Miller[1] is undoubted, but the teeth of the two animals examined by him show little wear, whereas in a third specimen (from the Latimodjong Mts.) they are more worn and are reduced in height. Furthermore, the hypsodontism cannot be described as more developed than in some members

[1] 1921, Proc. Biol. Soc. Wash., XXXIV, p. 94.

of the *Rattus xanthurus* group, with which group and *Lenomys*, *Eropeplus* might be held to form a connecting link. The general pattern of its molar teeth is closely in accord with that of *R. camurus* for example, and the trefoil pattern of *Lenomys*, accompanied as it is by broadening of the molars, is as yet undeveloped.

Eropeplus canus Miller

Eropeplus canus Miller, 1921, Proc. Biol. Soc. Wash., XXXIV, p. 95.

A single specimen, an adult male (Buitensorg Museum No. 2601), matches Miller's type in every particular, after due allowance is made for its greater age. The muzzle and temporal ridges are somewhat more massive, and the skull as a whole is slightly larger than either of Miller's specimens; also the narrowing of the palate is rather less pronounced. In pelage it matches the type almost exactly, both dorsally and ventrally.

The distribution of the species is apparently the Middle Celebes at about 1800 meters. So far as is known, the species is recorded from three specimens only, respectively from Lehio, Rano-Rano, and the Latimodjong Mountains (the present specimen).

Illustrations.—Skull, Fig. 29A, teeth, Fig. 28B.

Echiothrix Gray

Echiothrix Gray, 1867, Proc. Zool. Soc. London, p. 599.
Echinothrix Alston, 1876, Proc. Zool. Soc. London, p. 83 (emend.).
Craurothrix Thomas, 1896, Proc. Zool. Soc. London, p. 1018.

Genotype.—*Echiothrix leucura* Gray, by monotypy.

In view of the *Rattus*-like character of its molar teeth, *Echiothrix* must be regarded, in spite of the reduced size of those teeth and its elongate rostrum, as a strongly specialized off-shoot of the *xanthurus* group of *Rattus*. As stated already (p. 507) it is quite unrelated to *Rhynchomys* of Philippines and not improbably (in the opinion of Miller, 1921) is only superficially similar to *Melasmothrix*.

The species of *Echiothrix* which have been described hitherto are *leucura* Gray from (assumed) northern Celebes, *brevicula* Miller and Hollister from near the gulf of Tomini, Middle Celebes, and *centrosa* Miller and Hollister in the central mountainous area of Middle Celebes. In the table (pp. 692–693) the published dimensions of these animals are compared with Archbold's series (collected by Heinrich) from Roeroekan, at the extreme northeast of the Celebes and within a few miles of Menado, whence came the specimen in the Dresden Museum alluded to by Jentink.[1] The "third representant of this species" was recorded by

[1] 1883, Notes Leyden Museum, V, p. 177.

him merely as from "North-Celebes." In the absence of evidence to the contrary the type locality of *E. leucura* may be restricted to Menado, north Celebes, making our series practically topotypical.

The statement by Miller and Hollister[1] under *E. centrosa* that the molar series of *centrosa* are "about equal to that of the first and second molars of *leucura*" requires qualification. The animal considered by them to represent *leucura* was from Tamboan, north Celebes, but in our series the length of $m^1 + m^2$ equals only about 5.5 and m^3 is by no means the very small tooth which would be required to occupy the difference between 6.4 (*centrosa*) and 6.9 (*leucura* from Roeroekan).

The Tamboan material, whose colors are described as "yellowish-buff tints" above and "deep yellowish buff" ventrally, seems not to agree very closely with Gray's description of *leucura*, "dark grey brown, varied with black-tipped hairs" and "sides of nose, cheeks, throat, chest and underside of limbs white." With that latter description the Roeroekan series accords perfectly. Possibly the Tamboan rats are racially separable.

Echiothrix leucura Gray

Echiothrix leucura GRAY, 1867, Proc. Zool. Soc. London, p. 600.

MATERIAL.—Five specimens, A. M. 101245, y. ad. ♂; 101243, 101-246, ad. ♀s; 101247, y. ad. ♀; 101248, juvenal ♀, all from Roeroekan, northeastern Celebes, 800 meters, collected by Heinrich, January and February, 1931.

As stated above, the animals of this series agree very closely with the original description by Gray. The mammary formula is 1–2 = 6. Measurements of the series appear in the table following (pp. 692–693).

ILLUSTRATIONS.—Teeth, Fig. 21A.

MACRUROMYS STEIN

Macruromys STEIN, 1933, Zeitschr. f. Säugetierk., VIII, p. 94.

GENOTYPE.—*Macruromys elegans* Stein.

A female topotype of this interesting rat has just been received from Dr. Stein. In addition to Stein's published diagnosis, the following points are observable: In the skin, great length of the vibrissae (7 cm.); the two pairs of inguinal mammae; and the hind foot with long metapodial parts and short digits. In the skull, large braincase; elongate and rather slender rostrum; very narrow upright zygomatic plate, whose anterior edge is slightly emarginate; reduced palatal foramina; quite

[1] 1921, Proc. Biol. Soc. Wash., XXXIV, p. 67.

small, rounded bullae; coronoid process of mandible much enlarged and falcate. Molars rather like those of *Stenomys* in form, but proportionally very much smaller. The molar series is placed unusually far forward in the skull, to such an extent that from the back of m^3 to the occiput (17.4) is only slightly less than half of the condylo-basal length (36). In *Stenomys verecundus* those dimensions are, respectively, 17.6 and 39 mm. As in *Uromys*, the palatal foramina are contained chiefly in the premaxillae, only their posterior 1/3 or 1/4 being included by the maxillae.

The remarkable reduction in size and divergence in pattern of the molar teeth from those of *Rattus* is well shown in our figure 21D. Though obviously *Macruromys* has followed a markedly different course from that taken by *Echiothrix*, it nevertheless appears derived from the murine line rather than from Phlaeomyine or Hydromyine ancestors.

Macruromys elegans Stein

Macruromys elegans STEIN, 1933,[1] Zeitschr. f. Säugetierk., VIII, p. 95.

MATERIAL.—The female paratype referred to in the original description.

MEASUREMENTS.—Some additional dimensions of the specimen are given on p. 693.

ILLUSTRATIONS.—Skull, Figs. 19E, 20E; teeth, Fig. 21D.

The *Uromys* Genera of Murinae

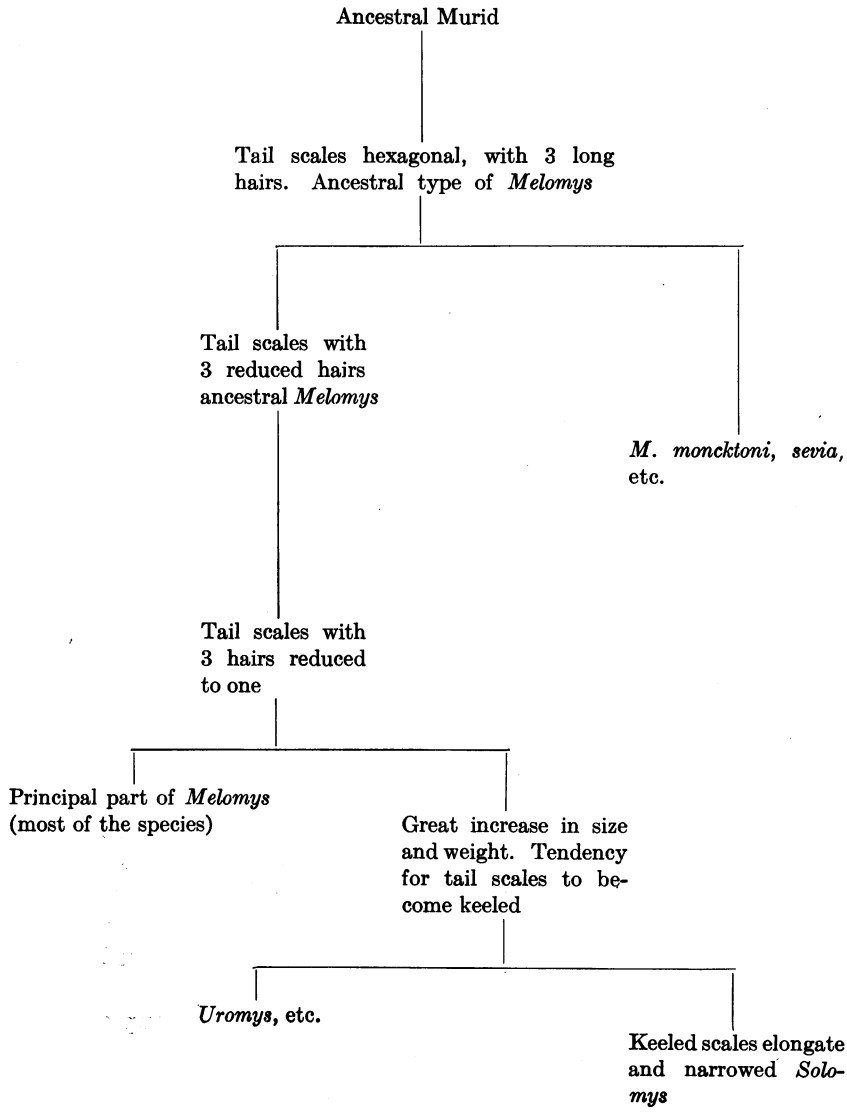
As already suggested (page 512) these rodents (*Melomys*, *Uromys*, *Solomys*, *Cyromys*) are probably the descendants of a single branch of the Murinae. In all of the genera of *Uromys* rats the characteristic simplified dental pattern occurs, together with the mammary formula 0–2 = 4, and the distinctive scale and scale-hair pattern of the tail (except a few species of *Melomys*).[2] It is usual too, on account of the shortness of the palatal foramina, to find the greater part of each palatal foramen contained in the premaxilla and the lesser part in the maxilla. The audital bullae are commonly very small; and there is some tendency, at least in those genera comprising species of large size, for the temporal muscle to be divided into anterior and posterior moieties by a bony process in the orbito-temporal fossa at or near the suture between frontal and squamosal.

In regard to dentition, there appears in the *Uromys* group of rats a

[1] Note that Stein's illustrations on Pl. XIV, figs. 1–4 are those of *Macruromys* and not of *Hyomys m. dammermanni*, as indicated (p. 95).

[2] Discussed under *Melomys*, p. 589.

slight tendency for the transversely placed tubercles (especially the median and external ones) of each lamina to fuse. This tendency may be accompanied often by a general lengthening and narrowing of the teeth and by increased backwards slope of the upper lophs. Neither of the two last changes is absolute, however.



An attempt to choose some definite dental characters for distinguishing the *Uromys* rats from the *Rattus* rats has been made, but the results are disappointing, for the two groups overlap in almost every character. The *Rattus* rats which are a far more diversified assemblage duplicate or surpass the *Uromys* rats in regard to every one of the proportional characters tested. Often there appears a tendency for the reduction of m^3 in the *Uromys* rats (duplicated in the *R. huang* division of *Rattus*) and frequently the notch in the anterior face of the lophs of m^1 and m^2 between the outer and median tubercles becomes obsolescent (this can be duplicated, however, in the *Rattus xanthurus* group); also the crescentic arrangement of the lophs is often accentuated. But generally such characters have not more than specific value, and in no characters of the teeth is the demarcation between the two sets of genera absolute.

With the possible exception of some species of *Melomys* (see p. 589), the *Uromys* group of genera may possibly have developed more or less as shown in the accompanying diagram.

MELOMYS THOMAS

Uromys PETERS, 1867, Monatsber. K. Akad. Wiss. Berlin, pp. 342–345.
Melomys THOMAS, 1922, Ann. Mag. Nat. Hist., (9) IX, pp. 260–261.

TYPE.—*Uromys rufescens* Alston, 1877, Proc. Zool. Soc. London, p. 743.

No more than a generalized summary of the conditions prevailing in *Melomys* is here attempted, partly because the problem is too complicated to be worked out from our inadequate collection and partly because Dr. Hans Rümmler is understood already to have a revision of the genus in hand.

Many of the species now included in *Melomys* were described first either under the genus *Uromys* or under "*Mus.*" Thomas's action in dividing *Uromys* into two parts, namely *Melomys* and a restricted genus *Uromys*, gives the impression that *Melomys* is a subsidiary genus to *Uromys*. Instead, from the general structure of *Melomys*, its normal size, the presence in some species of the normal arrangement of 3 hairs per tail-scale, and the relatively unspecialized skull when compared with the unusually large size and specialized tails and skulls of *Uromys*, it is to be inferred that *Melomys* is the more primitive of the two and that *Uromys* has developed from a *Melomys*-like ancestry.

The general range of *Melomys* extends from the Talaud Islands and Obi through New Guinea, d'Entrecasteaux, and the Torres Straits islands to Queensland, and southward along the east coast of Australia

to Brisbane. The genus occurs also on Melville Island, north of Australia.

Examination of the material in the present collections shows that the species of this genus can be sorted into several groups which at present cannot be defined fully. Furthermore, the description of the genotype *rufescens* is not detailed enough to permit its allocation to one of the said groups.[1] The arrangement of the scale-hairs of the tail is an important feature and that character in the genotype should be ascertained and reported upon.

Among the rats ascribed to *Melomys* which exhibit three hairs per scale are *moncktoni*[2] and *mayeri*.[3] No mention of the tail characters appears in the description of *mayeri*, but the Archbold collection contains four paratypes and a co-type in which it is plainly visible. Of *melicus*, Thomas[4] wrote that the tail hairs were "rather more numerous than usual." *Lutillus*, *muscalis*, and *sevia* have the same tail character. From a number of specimens of *M. cervinipes* taken by H. C. Raven in New South Wales and Queensland it can be seen that the tail in *cervinipes* too has 3 hairs to each scale.

The New Guinea species with three hairs per scale present further modifications: In *mayeri* the scales, which are slightly wider than long, and hexagonal, measure 1.1 mm. in length; in the small *sevia* the scales, though of the same shape as those in *mayeri* measure only 0.6 mm. in length. But the scale hairs in *mayeri* are short, 0.5 mm. whereas in *sevia* they reach 0.8 mm. Thus the proportion hair length/scale length is in *mayeri* 5/11 though in *sevia* it is 8/6. *Lutillus* and *muscalis* agree in the above proportions with *mayeri*.

Possibly therefore the forms of *Melomys* retaining three hairs per scale represent remnants of the transitional series leading from *Rattus* (?) to the one-haired forms (see tree, p. 588). Even among these three-haired *Melomys* there exists a wide difference in the degree of development of the hairs, some having them greatly reduced in length in proportion to the length of the scales as in *Melomys mayeri* and *muscalis* (also in the unrelated *Hyomys* and *Mallomys*), while others have them as fully developed as in *Rattus*, though the scales are somewhat hexagonal and keeled (*moncktoni*). Some idea of their range of variation is expressed by means of the diagram (Fig. 22).

[1] No example of *rufescens*, which comes from Duke of York Island, and is therefore marginal in relation to the general geographical distrubution of the genus, is available in America for study.
[2] Thomas, 1904, Ann. Mag. Nat. Hist., (7) XIV, p. 399.
[3] Rothschild and Dollman, 1933, Proc. Zool. Soc. London, p. 214.
[4] 1913, Ann. Mag. Nat. Hist., (8) XII, p. 215.

Among the more advanced (?) species of *Melomys* (those with but one hair for each tail-scale) there appear to be several ill-defined or incipient groups chiefly developed in the highlands of New Guinea.

The *lorentzii* group,[1] containing *lorentzii*, *lanosus*, and *mollis*, comprises large-sized, rather long-tailed species (head and body/tail = 160–170/140–160); tail dark above, pale beneath; hind feet long (about

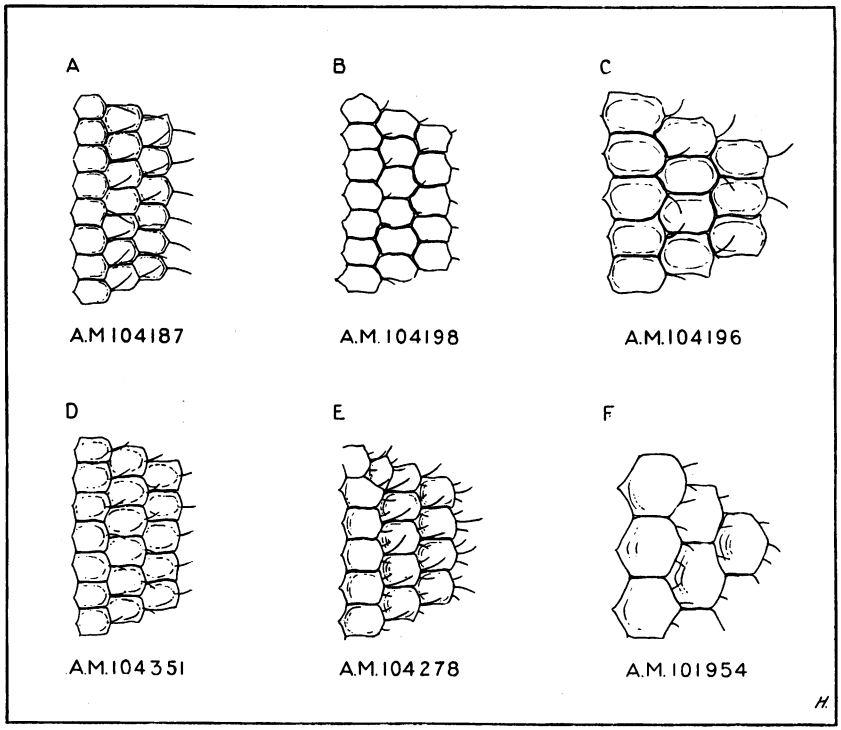


Fig. 22. Tail scales and hairs of *Melomys: gracilis, platyops, mollis, tafa, lutillus, mayeri.* Three-haired and one-haired examples of *Melomys* are shown, as well as the proportional length of hairs to scales. In general, large species have large scales, but *M. gracilis* (A) is a considerably larger animal than is *M. lutillus* (E). Scale: × 20/3.

35 mm.) and narrow; skulls long and narrow; palatal foramina long (5.5–6.5). The lowland *levipes* also with long feet may belong here.

The *rubex* group with *rubex*, *shawi*, and *tafa* includes small-sized animals of sub-tropical to lower temperate habitats. The body/tail ratio is about 1; ventral hairs gray-based, feet slender, 28–31 mm.; skull with short palatal openings.

[1] *Lorentzii* was described as a *Pogonomys* (Jentink, 1909, 'Nova Guinea,' IX, p. 8).

In addition, Archbold secured *platyops* and *gracilis* from the lowlands of the Central Division of Papua, which forms seem set off from each other as well as from other groups.

A last group, of which the species *latipes* can be considered typical, comprises *Melomys* with rather thick tails black beneath as well as above, and heavy, powerful hind feet. They apparently inhabit the gallery woods of open, semi-xerophytic lowlands. Possibly *calidior*, *leucogaster*, and *stalkeri* can be correlated with *latipes*.

On pp. 694–700 the type measurements of all species described prior to a recent paper[1] in which were proposed *M. tafa*, *shawi*, *latipes*, and *sevia* are tabulated. The species whose measurements are shown are there grouped very tentatively into species groups.

Melomys with Three-haired Tail Scales

Melomys mayeri Rothschild and Dollman[2]

Melomys mayeri ROTHSCHILD AND DOLLMAN, 1933, Proc. Zool. Soc. London, p. 214.

MATERIAL.—A male marked "co-type" (A. M. 101954 = Shaw Mayer No. 179), and four males (A. M. 101952, 53, 55, 56 = to Shaw Mayer Nos. 83, 81, 119, 174)—all adult topotypes.

When describing the skull, Dollman failed to point out the strong outward flare of the maxillary roots of the zygomata, which character, coupled with the large braincase, gives the skulls a *Pogonomys*-like appearance. The structure of the tail scales has been indicated already (p. 590). The first molars are peculiarly narrow in contrast to the width across the zygomata, 1.7/19.9 or 8.5%. Compare, for example, with the condition in *mollis*, 2.2/19.3 or 11.5%.

ILLUSTRATIONS.—Skull, Figs. 23B, 24B, 25B; tail scales, Fig. 22F.

Melomys sp. ? near **stalkeri**

Uromys stalkeri THOMAS, 1904, Ann. Mag. Nat. Hist., (7) XIV, p. 202.

MATERIAL.—A. M. 104185, ad. ♀, Bioto, near Baroka, Mekeo District, Papua. 30 meters.

A cinnamon-colored species of medium size (see measurements, table p. 702), with tail which is paler beneath than above and definitely shorter than body (119, tail/142, body). Underparts pure white to base of hairs. Backs of hands and feet with buffy-white hairs. Ears and vibris-

[1] 1935, Amer. Mus. Novit. No. 803.

[2] Possibly *mayeri* may prove to be a synonym of *Mus ruber* Jentink (1879, Notes Leyden Mus., II, p. 18) which was taken at Doreh (N. W. coast of Geelvink Bay, Dutch New Guinea).

sae moderately developed. Tail with 3 hairs per scale, the hairs equal to 2 scale-lengths. Feet of moderate length and width: length, s.u., "24.8" (25.9 rechecked on dry skin), width across base of 5th metatarsal 3.9 mm. Mammae, well developed, 0–2 = 4 (2 embryos, 1 in each horn of uterus).

Skull, whose posterior part is broken, with simple *Melomys*-type of molars which are moderately worn. Rostrum rather massive, with nasals rather wide and short. Zygomatic plate moderately wide, and moderately thrown forward.

The very short tail, small foot, white-based ventral pelage suggest relationship to *arcium* (Louisiade Archip.), *stalkeri*, and *rufescens* (Duke of York Isl.). The animal is clearly divergent, however, from *arcium* on the bases of the length of molar series and length of palatal foramina (compare tables, pp. 696 and 702). Information concerning true *rufescens* is too meager for a comparison to be attempted. To *stalkeri*, although its tail is proportionately longer, our specimen comes fairly near in regard to all characters that can be checked except the tail color. The tail color of *stalkeri* was described as "uniformly brown throughout." All five of our short-tailed specimens with uniformly brown tails belong definitely in the one hair per scale group (see p. 591), whereas the animal under consideration has three rather long hairs per tail-scale, as shown above. Until the status of the type of *stalkeri* has been made clear in this respect identification of our animal cannot be settled satisfactorily. The wide zygomatic plate precludes its possible inclusion with *Stenomys*.

Melomys sevia Tate and Archbold

Melomys sevia TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 3.

This form, which appears to be most nearly allied to *moncktoni*, is known from the type specimen only. The species has long lax reddish pelage above, and gray-based white fur beneath; tail longer than head and body.

MEASUREMENTS.—See table, p. 700.

Melomys lutillus (Thomas)

Uromys lutillus THOMAS, 1913, Ann. Mag. Nat. Hist., (8) XII, p. 216.

MATERIAL.—From Mafulu, 7 ♂'s (A. M. 104163, 64, 66, 68, 69, 97, 104278), 1 ♀ (A. M. 104279); from Rona, Soloki R., 2 ♂'s (A. M. 104002, 03), 1 ♀ (A. M. 104004).

The above series agrees closely with Thomas's description of *lutillus*

(type locality Angabunga River), except "tail uniformly brown; hairs very few; scale rings about fifteen to the centimeter." The tails of all the American Museum collection are whitish beneath and each scale is accompanied by three scarcely visible hairs of only one half a scale length.

This form and the next resemble one another closely in the form of their skulls. They differ in the size and form of the nasals, size of the teeth, width of median pterygoid fossa, etc.

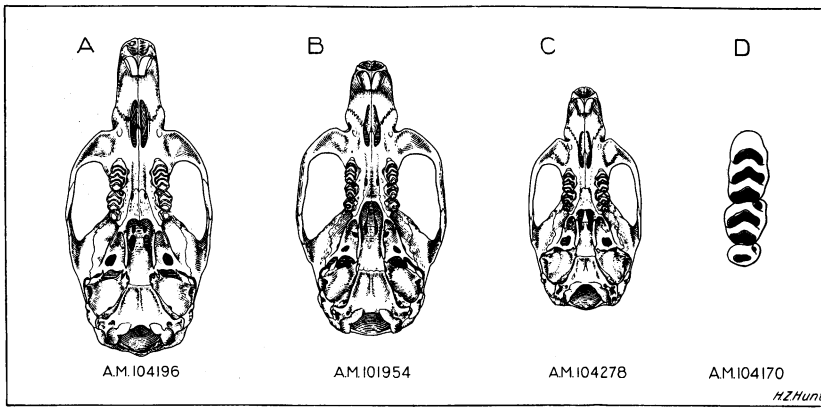


Fig. 23. Ventral view of skulls of *Melomys mollis*, *Melomys mayeri*, *Melomys lutillus*. Crown view of right upper molars of *Melomys gracilis*. Considerable diversity exists in cranial proportions, as shown by the examples of three species given above. *Mollis* (A) has one hair per tail-scale, *mayeri* (B) and *lutillus* (C) have three hairs per scale. The hairs of *mayeri* are very short, of *lutillus* longer (see Fig. 22).

The molars of *gracilis* show the extent of simplification often reached in *Melomys*. Scale: A, B, C, natural size. D × 8/3.

For measurements see pp. 701–702.

Lutillus is obviously related to *muscalis*, *murinus*, and some of the Queensland species.

ILLUSTRATIONS.—Skull, Figs. 23C, 24C, 25C; tail scales, Fig. 22E.

Melomys muscalis (Thomas)

Uromys muscalis THOMAS, 1913, Ann. Mag. Nat. Hist., (8) XII, p. 217.

MATERIAL.—From R. Oriomo, 13 ♂s (A. M. 104552, 53, 55, 58, 59, 61, 63, 64, 65, 66, 67, 68, 69) and 4 ♀s (A. M. 104554, 56, 57, 60). Also 18 extra skulls.

This excellent series from near the type locality of *muscalis* gives (see measurements, pp. 700–701) a clear idea of the species which Thomas de-

scribed from the Lower Fly River. The very short molar series of the type (4.7 mm.) would seem to be slightly atypical.

The tail of *muscalis* is essentially similar in structure to that of *lutillus*, each scale being accompanied by three very short hairs of only half a scale length. Probably the two forms should be treated as subspecies, but this involves the question of the status of Australian forms which, for the present, must be left unsettled. There are ample dimensional differences to warrant their subspecific distinction.

Melomys lorentzii Group (One-haired Tail Scales)

Melomys lorentzii Jentink

Melomys lorentzii JENTINK, 1909, 'Nova Guinea,' IX, p. 8.

A single adult male, A. M. 101957, from the Weyland Range, Dutch New Guinea, 1200 meters, collected by F. Shaw Mayer. This individual (field no. 124) acquired by Archbold, was identified without comment by Dollman. Its measurements are tabulated on p. 703.

Jentink's type from 900 meters was a female. Our specimen, though agreeing in a general way with it, is smaller. The long nasals, diastema, palatal foramina, and hind feet sufficiently indicate the relationship of this animal to *lanosus* and *mollis*. In the skull of our *lorentzii* the temporal ridges are sharp and a slight tendency appears for development of postorbital processes, as mentioned by Thomas for *platyops*.

Melomys mollis Thomas

Melomys mollis THOMAS, 1913, Ann. Mag. Nat. Hist., (8) XII, pp. 210-211.

MATERIAL.—The series of 9 specimens collected by Archbold at two camps (western and eastern) on Mt. Tafa, southwest of Mt. Albert Edward, between 2000 and 2400 meters.

MEASUREMENTS.—The complete set of dimensions for this series has been drawn up (pp. 703–704) in an effort to establish the range of individual and sexual variation and has been compared with Thomas' published measurements of the type ("adult male") of *mollis* from the south slope of the Charles Louis Mountains at 1700 meters.

In view of the very close agreement of the specimens of our series with the type description they must be treated as identical with *mollis*. The rounded cranium, lack of greatly sharpened temporal ridges, slightly smaller size, and decidedly laxer hair distinguish *mollis* from *lorentzii*.

ILLUSTRATIONS.—Skull, Figs. 23A, 24A, 25A; tail scales, Fig. 22C.

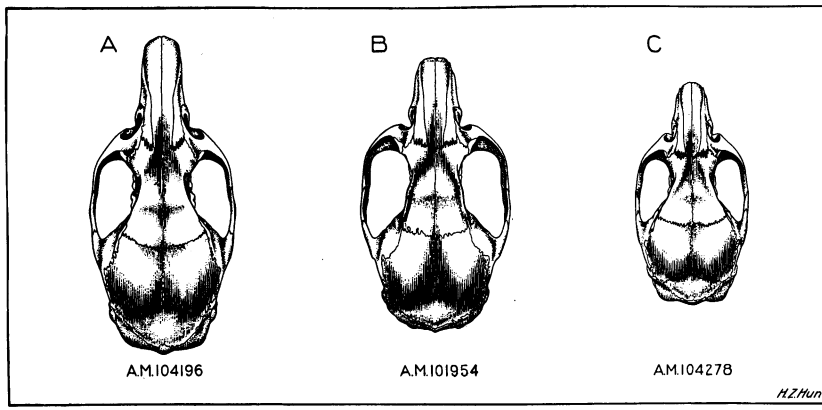


Fig. 24. Dorsal view of skulls of *Melomys mollis*, *Melomys mayeri*, *Melomy slutillus*. Natural size.

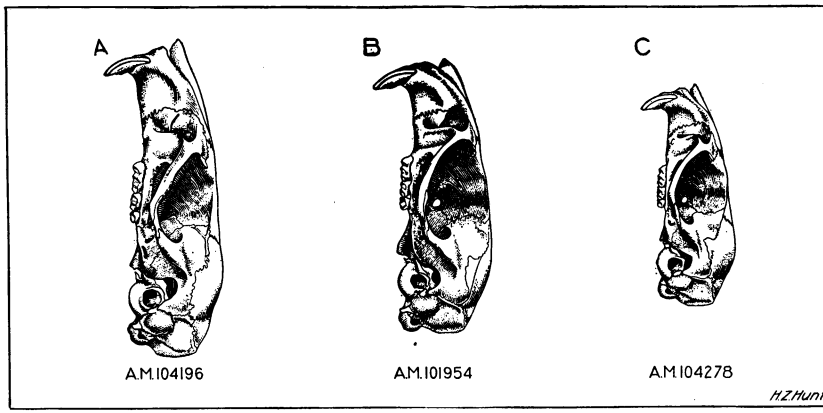


Fig. 25. Lateral view of skulls of *Melomys mollis*, *Melomys mayeri*, *Melomys lutillus*. Note the unusual depth of the skull of *M. mayeri*. Natural size.

Melomys rubex Group

Melomys tafa Tate and Archbold

Melomys tafa TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 1.

A considerable series of topotypes, as indicated in the original notice, was taken by Archbold and Rand on Mt. Tafa, Central Division, Papua, at altitudes between 2200 and 2600 meters. A single additional specimen was trapped at Murray Pass Camp, Mt. Albert Edward, 2700 meters.

The long pelage indicates the mountain habitat of the species. The dark brownish-gray color and small size set it off from other described mountain species of *Melomys*. These mice are scarcely distinguishable in the field from *Stenomys niobe* which was common on Mt. Tafa and almost equally plentiful at Murray Pass. The mammary formula of *tafa* has not been ascertained.

MEASUREMENTS.—Table, pp. 705–706.

ILLUSTRATIONS.—Tail scales, Fig. 22D.

Melomys shawi Tate and Archbold

Melomys shawi TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 2.

A reddish-mahogany-colored species of the same size as *tafa*. Collected by Shaw Mayer from the Weyland Mountains, and sent to Dollman, British Museum, by whom it was first identified as *platyops*. Reasons for distinguishing it are set out in the description of the species.

DIMENSIONS.—Table, p. 706.

Melomys rubex Thomas (?)

Melomys rubex THOMAS, 1922, 'Nova Guinea,' XIII, p. 730.

MATERIAL.—A. M. 79767, adult ♂, collected at Sevia, Cromwell Range, Huon Peninsula, 1400 meters, by R. H. Beck, Whitney South Sea Expedition, March 21, 1929.

In spite of the great distance from the type locality of *rubex* (Doormanpad, near the upper Mamberano River, at 1410 meters) at which our animal was found, it seems to agree closely with Thomas's description. The general grayish-rufous overwash of the gray-based ventral pelage and the lack of dorso-ventral transitional color line, combined with concordance in cranial characters indicate that our specimen should be referred to that species. Like *tafa* and *shawi* our animal has the 1 hair per scale arrangement of the tail. Discrepancies appear, however, in the lack of any whitish throat patch in our specimen and in the nasal length being 12.5 instead of 13.5.

Reference of this specimen to *rubex* is provisional. It may well represent a local race.

MEASUREMENTS.—See p. 706.

The following two species seem not to be closely related to any other group or to each other.

Melomys platyops (Thomas)

Uromys platyops THOMAS, 1906, Ann. Mag. Nat. Hist., (7) XVII, p. 327.

MATERIAL.—One adult ♂, 2 juvenal ♀s, from Mafulu, on the Auga River, a tributary of the St. Joseph River, 1250 meters; also 1 juvenal ♂ from Rona, Loloki River. Mafulu lies in the lower foothills some 15 miles northwest of the type locality of *platyops* (head of the Aroa River).

The measurements of our adult tally very closely with the type measurements (pp. 696, 706) but its color seems a little brighter than that described by Thomas. The juvenal animals, as is so often the case, are very much darker than the adult, their dorsal color ranging from clove brown to bone brown.

ILLUSTRATIONS.—Tail scales, Fig. 22B.

Melomys gracilis (Thomas)

Uromys gracilis THOMAS, 1906, Ann. Mag. Nat. Hist., (7) XVII, p. 328.

MATERIAL.—Mt. Tafa, 1 ad. ♂, 1 juvenal ♂; Mafulu, 1 unsexed juvenal.

The type locality, Owgarra, on the Angabunga (= St. Joseph) River is within a few miles of our localities, for the St. Joseph drains the western slopes of Tafa. Measurements of type shown on p. 697.

As was the case with *platyops*, the adult collected by Archbold matches Thomas's type very closely. The "head and body" length is less than that of the type, but all other characters are virtually identical.

The juvenal specimens are many shades darker than the adult and almost without a trace of fulvous. Their color is nearest to bone brown or clove brown.

MEASUREMENTS.—See p. 706.

ILLUSTRATIONS.—Teeth, Fig. 23D; tail scales, Fig. 22A.

Melomys latipes Group

Melomys latipes Tate and Archbold

Melomys latipes TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 3.

This species, of moderate size, with broad, heavy hind feet and tail wholly fuscous beneath as well as above, can be distinguished very readily.

MEASUREMENTS.—Table p. 705.

A skin without skull (A. M. 104549, ♀) from Wuroi, Oriomo River, Western Division, Papua, is referred here. Though slightly larger, it agrees perfectly with the type in structural and color characters. Two other females without skulls have smaller feet and more fulvous upperparts and may be referable to *calidior*.

These rats are apparently savanna-inhabiting forms, perhaps living among scattered clumps of trees and bushes. From the form of their feet they appear to be arboreal.

UROMYS PETERS

Uromys PETERS, 1867, Monatsber. K. Akad. Wiss. Berlin, pp. 342–345.

GENOTYPE.—By monotypy, *Mus macropus* Gray = *Hapalotis caudimaculatus*[1] Krefft.

The *Uromys* studied include a good series of true *validus* together with three adults from Kabuna, 25 miles west of the Aroa River; one from Matsika, St. Joseph's River; a few specimens of *caudimaculatus* from North Queensland (Raven collection); three much larger *Uromys*, respectively, one from the highlands of Mt. Tafa, south of Mt. Albert Edward, and one from Sevia, Cromwell Range, Huon Peninsula; one *neobrittanicus* from New Britain. Rather marked divergence of the mountain-inhabiting forms from the lowland forms can be observed, and most of the lowland named forms seem to be conspecific—i.e., *prolixus*, *ductor*, and *scaphax* (and, not improbably also, *aruensis*, *siebersi*, and *waigeuensis*) seem to be races of the same full species as *validus*. The published measurements of the types have been combined with those of our own material in the table (pp. 707–712) with results which substantiate this view. The two giant forms of *Uromys*, *rothschildi* and *anak*, together with *neobrittanicus* from New Britain, on account of their extremely heavy dentition, peculiarly formed bullae, short palatal foramina, and the fact that their tail scales are wider than long (in *validus* they are longer than wide) seem to constitute a well-marked group. Whether *rothschildi* and *anak* should be regarded as of higher rank than subspecies is questionable but there can be no doubt of the specific distinctness of *neobrittanicus*. The Australian forms of *caudimaculatus* seem to be allied with the *validus* division respecting size of skull, palatal foramina, and general skull form; but their widened molars and rather flattened bullae may betray a linkage with the *anak* group. Furthermore, representing as they do the southernmost extension of

[1] Iredale and Troughton have just shown (1934, Austral. Mus. Mem., VI, p. 85) that *Mus macropus* Gray, 1866, Proc. Zool. Soc. London, p. 221, is a homonym of *Mus macropus* Hodgson, 1845, Ann. Mag. Nat. Hist., (1) XV, p. 266.

Uromys, they may come nearest of all species to being "relicts" and so in a sense may be ancestral both to the *validus* group and to the *anak* group.

No material representing *nero* from the southern side of the Nassau Range is available. Although its measurements, taken from an old female, suggest that it should be placed with *anak* and *rothschildi*, the particolored tail and proportionally large palatal foramina agree more with the *validus* group. *Hapalotis papuanus* Ramsay, if it was a *Uromys* (and it fits no other genus), must be assigned to the *validus* group. The measurements of the individual teeth, which Ramsay gave in inches, when transposed to the metric system, agree within a few tenths of a millimeter with those of the *validus* group, and are nearly 20% less than those of *anak* and *rothschildi*. *Uromys papuanus* Meyer, from the southern end of Geelvink Bay, is a nomen nudum. *Multiplicatus* of Jentink from Lake Sentani, based upon a juvenal animal, is also referred now, on the basis of the measurement "$m^1 + m^2 - 9.5$" to the *validus* group. $M^1 + m^2$ in the *anak* group is INVARIABLY greater than 10 mm. *Barbatus* of Milne-Edwards from the Aroa River is probably equal to *ductor* from the same river basin, if one may judge from the scanty measurements of the dried skin offered by the author and from the length of the molar series published by Thomas.[1]

From measurements published by Thomas[2] of the skulls of his *ductor* and *prolixus*, there is no indication that the latter is "much longer than in *ductor*." In fact, apart from the body measurements (and *prolixus* was an alcoholic specimen), the two appear closely similar.

Of the three Australian forms, *caudimaculatus* and *sherrini* appear very closely allied, but *exilis*, if its dimensions are not aberrant and misleading, differs more widely.

This discussion can be concluded by grouping the species of *Uromys* in key form:

1.—Giant species of New Guinea mountains above 1000 meters, and New Britain, with relatively short palatal foramina and flattened broad bullae, etc. ..... *anak* group.
(*anak*, *rothschildi*, and *neobrittanicus*)
Smaller species of the hills and lowlands of New Guinea and surrounding islands and Australia below 1000 meters ..... 2.
2.—Queensland forms. Teeth relatively heavy, molars broader (width of m^1 = 3.4) ..... *caudimaculatus* group.
(*caudimaculatus*, *sherrini*, and *exilis*)

[1] 1907, Ann. Mag. Nat. Hist., (7) XX, p. 73.
[2] 1913, Ann. Mag. Nat. Hist., (8) XII, p. 213.

New Guinea forms. Teeth relatively slight, molars narrow (width of m^1 = 3.1 or less)..... *validus* group.
(all other described forms)

Uromys validus Group

Uromys validus Peters and Doria

(Synonymy under subspecies)

This term is employed from lack of conclusive evidence that the earlier named *aruensis* is a member of the group. If such is the case the assemblage should be termed the *aruensis* group.

In the foregoing pages reasons for bringing together the lowland *Uromys* in this way have been given. Although the American Museum's series from the Central Division of Papua is inadequate to allow final conclusions to be drawn, it seems impossible to separate the few Kabuna and Matsika specimens from true *validus*. Consequently *barbatus*, *ductor*, and *prolixus* will perhaps ultimately be sunk as synonyms of *papuanus* Ramsay and *papuanus* in its turn will stand at best as a race of *validus* (or perhaps even of *aruensis*). The race in northern New Guinea, if distinct, will be called *multiplicatus* and that of southwest Dutch New Guinea will be named *scaphax*. It is, however, unsafe, without first examining the types, to employ either *papuanus* Ramsay or *barbatus* Milne-Edwards, and the next available name, *ductor* Thomas, will be used for southeast Papuan material.

Uromys validus validus Peters and Doria

Uromys validus Peters and Doria, 1880–1881, Ann. Mus. Civ. Genova, (1) XVI, p. 704.

Material.—From Dogwa, Oriomo River, 6 adult ♂s, 4 adult ♀s, 5 juvenal ♂s, 2 juvenal ♀s. From Wuroi, 6 miles from Dogwa, 1 adult ♂, 2 sub-adult ♀s. This material is practically topotypical, the Oriomo River being located less than a score of miles from the Katau River where d'Albertis collected the type specimen. The whole of the country is low-lying with occasional low hills.

With such an admirable series of topotypes of a historically important species (only *caudimaculatus* and *aruensis* precede it chronologically), it will be valuable to analyze the species as fully as possible. The table of measurements (pp. 709–711) based on adults only, offers a very satisfactory picture of the average range of variability as well as the relatively slight size-differences due to sex appearing within the species.

The type description agrees with the present series fully, except on

the following points: feet "yellow" must be modified to grayish buff; the "brownish base" is not always distinct, though in many specimens the metatarsal area is definitely darker. The particolored condition of the tail is usual, but in two specimens the flesh color is reduced to a few blotches and in one (A. M. 104503) it is almost eliminated.

In spite of the authors' remarks about tooth wear, it seems that the type of *validus*, of which Thomas[1] gave the length of the molar series, must have been a young animal, 200 mm. for length of head and body, 200 mm. for tail length, and 52 mm. for length of hind foot being far below the dimensions of our adults. On the other hand a juvenal specimen with all molars erupted and showing a little wear is at hand in which these dimensions are approximated. Most of our young animals of that size lack m^3, however.

Young animals tend to be more neutrally colored than the adults. In two very young animals (A. M. 104577–78) with m^1 only erupted, the black hairs are as yet almost undeveloped, the general dorsal color being a dull brown becoming slightly brighter on shoulders and head.

ILLUSTRATION.—Teeth, Fig. 26D.

Uromys validus ductor Thomas

Hapalotis papuanus RAMSAY, 1884, Proc. Linn. Soc. N. S. W., VIII, p. 18.
? *Uromys barbatus* MILNE-EDWARDS, 1900, Bull. Mus. Paris, VI, p. 167.
Uromys ductor THOMAS, 1913, Ann. Mag. Nat. Hist., (8) XII, p. 213.
Uromys prolixus THOMAS, 1913, Ann. Mag. Nat. Hist., (8) XII, p. 213.

MATERIAL.—From Kabuna (on upper Kabuna River), 25 miles west of Aroa River, 2 ad. ♂s, 1 ad. ♀, 1 sub-ad. ♂; from Matsika, St. Joseph's River, 1 ad. ♂ (A. M. 104156).

Compared with the series of *validus validus*, the Central Papuan animals present only slight pelage differences. Dorsally there is a slight intensification of the rufous coloring. Ventrally the hair is thicker and softer and a clearer white. Moreover, the flesh color of the skin does not show through the ventral fur.

The reddish gray dorsal color in *ductor* extends well down the thighs and arms, tending to extend to their inner surface, whereas in *v. validus* the whole inner surface of the limbs is thickly clothed with ventral hair.

In the skulls there appears to be no difference of any significance. Measurements are shown on p. 711.

[1] 1907, Ann. Mag. Nat. Hist., (7) XX, p. 73.

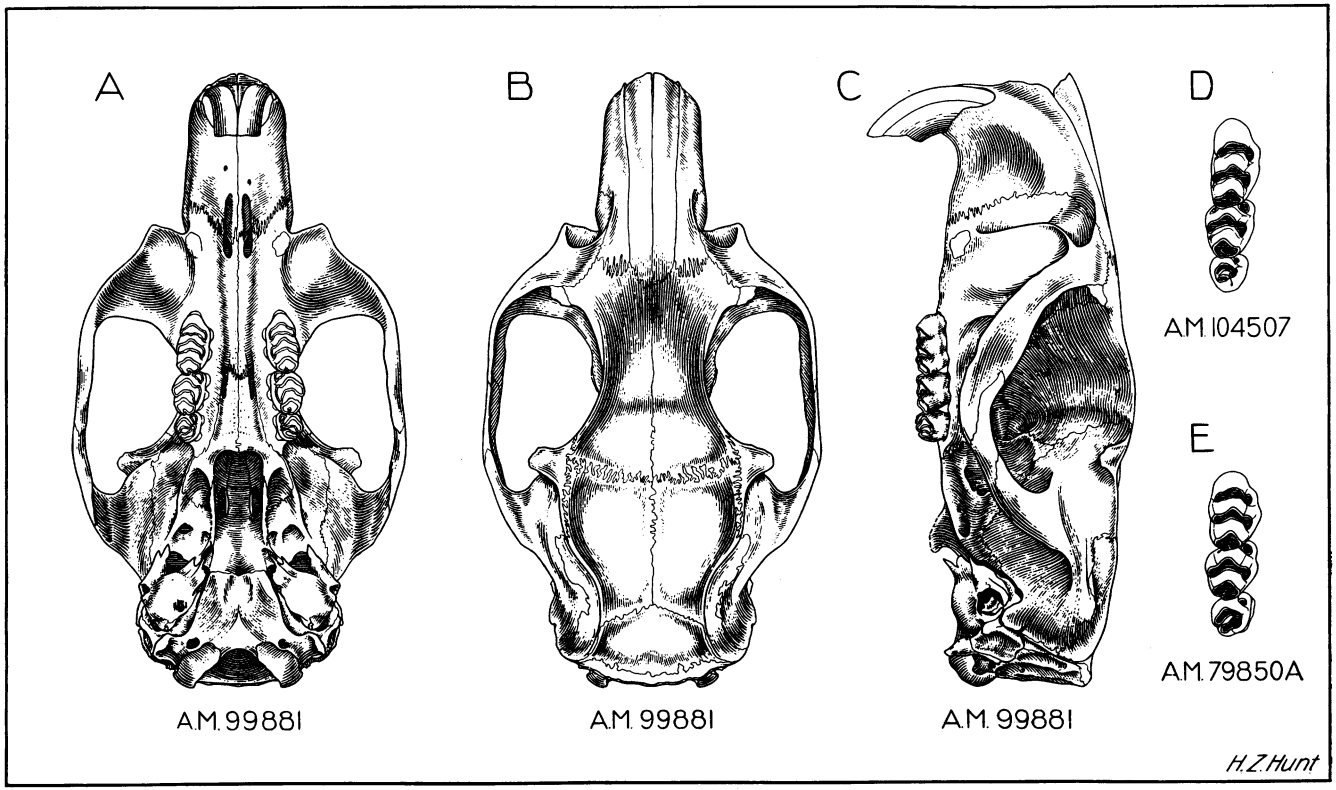


Fig. 26. Ventral, dorsal, and lateral views of *Uromys neobrittanicus*. Crown views of right upper molars of *Uromys validus validus* and *Uromys* (*Solomys*) *salamonis*.

The extraordinary temporal processes are well depicted.

Reduction of m^3 in *Uromys validus* has advanced farther than in *U.* (*Solomys*) *salamonis*. Scale: A, B, C × 6/5; D, E × 2.

Uromys anak Group

The forms comprising this group may be distinguished from each other by differences in the dimensions of their skulls, as indicated in the tabulation of measurements (pp. 709, 712).

Anak, from the southern side of the Owen Stanley Range, is the representative in Papua, *rothschildi* in the Huon Peninsula. Stein[1] has recorded *anak* from the Gebroeders Range. The Archbold collections include one adult female of *rothschildi* and two of *anak*. One specimen referred to *anak* (full species) was taken on Mt. Tafa, southwest of Mt. Albert Edward, at 2400 meters; the other from Sevia, Cromwell Range, Huon Peninsula, 1700 meters; a third, just received from Stein, is from the Weyland Mts., Dutch New Guinea. The second, judging from the condition of the molars, is slightly the older. The skins of the first two, in regard to color and texture of pelage, ears, feet, and tail, are virtually identical. Their skulls differ slightly in size (that with greater molar abrasion being larger). That size difference is, however, principally limited to the muzzle, the nasals measuring, respectively, 23.5 and 28.7, and to the maxillary root of the zygoma, the distance from the anterior edge of the zygomatic plate to the orbital edge of the zygomatic process of the maxilla being, respectively, 6.6 and 9.4. Ventrally corresponding differences indicating elongation of the facial part of the skull appear: the palatilar lengths are 35.0 and 37.7; the palatal foramina 6.8 and 5.6; the diastemata 21.2 and 22.6. The posterior parts of the crania, however, are sub-equal, thus: posterior margin of palate to center of foramen magnum, 22.9 and 23.5; fronto-parietal suture to occipito-interparietal suture, 20.3 and 21.2. Regarding the form assumed by the temporal ridges, palate, meso-pterygoid fossa, bulla, etc., the two skulls may be considered alike. The molar crowns are 12.7 and 13.3; the lengths of m^1 (crown), 5.9 and 6.3, and their widths 3.4 and 3.8.

Shortness of the palatal foramina in relation to the palatilar length (♀ *anak*, 19%, ♀ *rothschildi*, 15–18%) constitutes one of the important differences between the *anak* group and the *validus* group (20–24%). It is precisely because the corresponding measurements given for *nero* by Thomas result in a percentage of 26% (= that of *caudimaculatus* and *sherrini*) that hesitation is felt in including *nero* in the *anak* group.

Although the foregoing discussion may aid in deciding the relationship of *anak* and *rothschildi*, the point can be settled conclusively only when a much larger series becomes available. For the present they

[1] Stein, 1933, Zeits. f. Säugetierk., VIII, Heft 1/2, p. 125.

should be considered subspecies only. As will be seen, however, *neobrittanicus*, the new form of giant *Uromys* from New Britain constitutes a thoroughly distinct species.

Uromys anak Thomas

(Synonymy under subspecies)

Uromys anak anak Thomas

Uromys anak Thomas, 1907, Ann. Mag. Nat. Hist., (7) XX, p. 72.

Material.—From Mt. Tafa, southwest of Mt. Albert Edward, 2400 meters, 1 adult ♀ (A. M. 104155); from Weyland Mts., Dutch New Guinea, 1500–2000 meters (Stein), 1 adult ♀.

The type of *anak* was an old male caught by Monckton in the headwaters of the Brown River, "not less than 4000 feet." Thus the Mt. Tafa specimen was taken some 60 miles to the northwest of the type locality. It agrees closely with the type description. Stein's[1] animal from some 700 miles to the west agrees very closely with our Mt. Tafa animal. It is a black-tailed mountain species and not to be confused for a moment with *nero*[2] from the upper Utakwa River. The measurements are included with those of our Mt. Tafa specimen (p. 712).

Uromys anak rothschildi Thomas

Uromys rothschildi Thomas, 1912, Novit. Zool., XIX, p. 91.

Material.—From Sevia, Cromwell Mountains, Huon Peninsula, 1700 meters, 1 adult ♀ (A. M. 79782) collected by R. H. Beck, Whitney South Sea Expedition.

The type, an adult female, was caught in the Rawlinson Mts., a range a few miles only from the Cromwell Range and connected with it. Our specimen in consequence may be considered virtually a topotype. Moreover, its description and dimensions tally so closely with the typical ones that there can be no doubt as to its identity.

Measurements.—See p. 712.

Uromys neobrittanicus Tate and Archbold

Uromys neobrittanicus Tate and Archbold, 1935, Amer. Mus. Novit. No. 803, p. 4.

This species, founded upon a single adult skull, is so divergent in the structure of the temporal region that, as suggested in the earlier notice, it may require subgeneric recognition. It is one of several animals

[1] 1933, Zeits. f. Säugetierk., VIII, p. 125.

[2] *Nero* has a wider skull, much longer palatal foramina, white underparts, and blotches on tail.

(*Solomys, Cyromys*) occurring in the New Britain and Solomon Islands region which have diverged in various ways from the *Uromys* stem.

Neobrittanicus is reputed by its collector, W. F. Coultas[1] (who had it from his native collectors) to be arboreal.

MEASUREMENTS.—See p. 709.

ILLUSTRATIONS.—Skull, Figs. 26A, B, C.

CYROMYS THOMAS AND SOLOMYS THOMAS

Two genera of the Solomon Islands related to *Uromys* may be briefly considered, namely *Cyromys* and *Solomys*. The collection of the American Museum contains five specimens of *Solomys* collected by the Whitney South Sea Expedition.

One can hardly escape the conviction that both of these genera are little more than slightly specialized offshoots of *Uromys*. The dorsal views of the skulls of *Cyromys imperator* and *C. rex* shown by Thomas[2] support this view. Not improbably *Solomys* also, whose type *sapientis* was described originally under *Uromys*,[3] is at best worth only subgeneric separation. By checking the lengths and widths of Thomas's figures of the skulls of *rex* and *imperator* it is found that those drawings are approximately natural size. *Cyromys* and *Solomys* may be synonymized eventually.

Apparently *Cyromys* has a proportionally shorter toothrow than *Solomys*. $\frac{\text{Molar series}}{\text{Palatal length}}$ = in *rex*, 33.7%; in *imperator*, 33.1%; in *salamonis*, 37% (?); in *sapientis* (type) 39.6% (?); A. M. 79850, 38.3%. Again, $\frac{\text{molar series}}{\text{total length of skull}}$ = *rex*, 18.5% (?); *imperator*, 18.0%; *salamonis*, 20.6%; *sapientis* (type), 21%; A. M. 79850, 20.1%. In the *validus* group of *Uromys* the latter of these proportions comes between 16.8 and 18%; while for the *anak* group it is: *anak*, 18.9%; *rothschildi*, 18.5%; and *neobrittanicus*, 20.6%.

Mus salamonis Ramsay, according to the original description and the plate showing the hind foot and skull, may be considered with reasonable certainty identical to *Solomys sapientis* Thomas. Ramsay's figure showing the basal aspect of the skull (Pl. v, fig. 3) is approximately natural size, since the length is shown as 50.9 ("length 1.95" in the text when transposed into mm. = 49.5). His "greatest breadth 0.7" is an obvious error, the zygomatic breadth on the figure being 29.5 mm. or

[1] Note.—W. F. Coultas, not W. J. Eyerdam, was collector of this species.
[2] 1888, Proc. Zool. Soc. London, Pl. XXII, figs. 2 and 4.
[3] Thomas, 1902, Ann. Mag. Nat. Hist., (7) IX, p. 446.

1.16 inches. A further convincing fact is the notched posterior palatal margin to be seen in Fig. 7 of Ramsay's plate. In the table (pp. 712–713) Ramsay's measurements of *salamonis* have been compared with those of Thomas's *sapientis* and those of American Museum material with results which are convincing, even though his specimen appears to have been sub-adult. The measurements of the types of *Cyromys rex* and *imperator* are also shown.

Uromys (Solomys) salamonis (Ramsay)

Mus salamonis RAMSAY, 1883, Proc. Linn. Soc. N. S. W., VII, pp. 43–44.
Uromys sapientis THOMAS, 1902, Ann. Mag. Nat. Hist., (7) IX, p. 446.
Solomys sapientis THOMAS, 1922, Ann. Mag. Nat. Hist., (9) IX, p. 261.

MATERIAL.—From Bougainville Island, 1 ad. ♂, 2 ad. ♀s, 1 juvenal ♂; from Choiseul Island, 1 juvenal ♂.

This interesting branch of the *Uromys* stem is distinguished so far as its pelage is concerned by the more wiry and less woolly character of its hairs than those of all of our *Uromys* except *U. v. validus*. The animal tends to be smaller and to have the hind foot proportionately shorter than in *Uromys*. Its color is distinctive, namely grayish brown caused by a mixture of longer blackish guard hairs and shorter and more numerous under hairs colored between clay-color and snuff brown, the general color becoming paler on the sides due to reduction of the guard hairs. Both dorsal and lateral hairs have gray bases. On the ventral surface the short hair covering is near drab, but somewhat yellower, with the gray bases almost suppressed. It is several shades darker than that of *U. validus*, however. The tail is fuscous, without yellow or white markings.

The skull is virtually that of *Uromys*, the most noteworthy divergence appearing in the V-shaped extension of the meso-pterygoid fossa into the posterior margin of the narrowed palate, shortening of the rostrum (a *Cyromys* character, too), and the form of the zygomatic plate, pointed out by Thomas. The teeth seem to agree in every way with those of *Uromys*.

MEASUREMENTS.—See p. 712.

ILLUSTRATIONS.—Teeth, Fig. 26E.

The above constitutes the last of the "*Uromys* genera," those succeeding being for the present unplaced in relation to other Murinae.

ANISOMYS THOMAS

Anisomys THOMAS, 1903, Proc. Zool. Soc. London, II, p. 199.

In spite of the *Uromys*-like exterior, the relatively complex lamina-

tion of the teeth in which the crescentic arrangement of the lophs to be seen in *Rattus* can no longer be traced, the specialized lower incisors, the extremely shortened palatal openings and, on the tail, the presence of three well-developed hairs per scale, indicate the widely different character of *Anisomys* from *Uromys*. The tail scales, however, tend towards the hexagonal form, demonstrating that in that respect *Anisomys* has diverged from the *Rattus* type of tail. The mammary formula 1–2 = 6 (Thomas) too shows that this genus has not progressed so far in mammary reduction, for so far as is known no member of the *Uromys* section has more than 0–2 = 4 mammae. The molars of *Anisomys* in regard to function are not dissimilar to those of *Hyomys* (below), but the basic plan of their enamel loops differs considerably, *Anisomys* possessing more lamellae. The incisors of the two genera have nothing in common. The pronounced extension of the articular process beyond the angular process is noteworthy, although something of the same nature appears in *Uromys*. Probably both *Anisomys* and *Hyomys* must be regarded as "living fossils," which have come down independently from *Rattus*-like ancestral stocks.

Anisomys imitator Thomas

Anisomys imitator Thomas, 1903, Proc. Zool. Soc. London, II, p. 200.

Material.—Sevia, Cromwell Range, Huon Peninsula, 1400 meters, 1 ad. ♂, collected by R. H. Beck, Whitney South Sea Exped., March 18, 1929; Weyland Mts., 1 y. ad. ♀, collected by Stein, Sept. 22, 1931.

The difference in the rostral portions of the skulls as illustrated by the lengths of the nasals and palate (see table, p. 713) is the only point of significance, but may represent a difference of age and sex.

HYOMYS THOMAS

Hyomys Thomas, 1903, Proc. Zool. Soc. London, II, p. 198.

The close similarity of *Hyomys* to *Mallomys*, both as to appearance and size is pointed out subsequently (pp. 633–634), as well as the fact that the two genera are only remotely related. Like the previous genus *Anisomys*, *Hyomys* seems to be a relict form without living relatives (unless they occur among some of the Philippine genera), which originated far down the murid tree.

In the dentition of *Hyomys* taken as a whole, there appears marked broadening and some hypsodontism with the laminae strongly flattened, but with the crescentic formation of *Rattus* only slightly apparent. There is a general tendency for all three tubercles to be evenly developed

on each loph. Thus, in m^1 three lophs, each with three distinct tubercles, are noted. In m^2 lophs 2 and 3 have their full complement of tubercles, loph 1 possessing only the usual interior one (which, however, does function with the posterior loph of m^1 as in *Rattus*). In m^3 lophs 2 and 3 have each three tubercles. In addition to the above the third loph of each tooth is provided with an accessory tubercle derived from the outer, posterior side of its median tubercle. This structure in m^3 appears to correspond with the outer accessory posterior tubercle to be seen in *Lenomys* (p. 613).

This genus, which thus far has not been found outside New Guinea, comprises three named forms as follows:

Name	Type Locality
Hyomys meeki meeki Thomas	Avera, Aroa River, British New Guinea
Hyomys meeki dammermani Stein	Kunupiberg, Weyland Gebirge, Dutch New Guinea
Hyomys strobilurus Rümmler	Sattelberg, Mandated Territory, New Guinea

Rümmler[1] has recently made an analysis of the specimens of *Hyomys* in the collections of the British and Berlin Museums as well as the two American Museum specimens mentioned below, which were loaned to him by Mr. Archbold. His new form *strobilurus* was based upon a skin without skull.

For convenience, the following key based upon Rümmler's observations has been constructed:

1.—Tail scales longer than wide ..... *strobilurus.*
Tail scales wider than long (*meeki*) ..... 2.
2.—Hair at base of ears whitish ..... *meeki meeki.*
Hair at base of ears gray ..... *meeki dammermani.*

Hyomys meeki meeki Thomas

Hyomys meeki Thomas, 1903, Proc. Zool. Soc. London, II, p. 198.

Material.—Sevia, Cromwell Mts., German New Guinea, about 1700 meters, 79780 (March 16, 1929), 79781 (March 25, 1929).

As stated above, Rümmler has put on record all the information concerning *Hyomys* known to him at the time of writing. By way of minor correction of Rümmler's table (*loc. cit.*, p. 99) it may be noted that examination of the skin shows A. M. 79781 to be a male.

Illustrations.—Skull, Fig. 27C, teeth, Fig. 27D.

[1] 1933, Zeits. f. Säugetierk., VIII, pp. 96–99.

Hyomys meeki dammermani Stein

Hyomys meeki dammermani STEIN, 1933, Zeits. f. Säugetierk., VIII, p. 95.

MATERIAL.—One of Stein's topotypes, A. M. 103274 (= Stein 554), ad. ♀.

Of the four specimens cited by Stein, the type and ours alone are topotypical. The two from the Saruwaged, which are now at hand for reexamination, were apparently referred by Rümmler in the succeeding

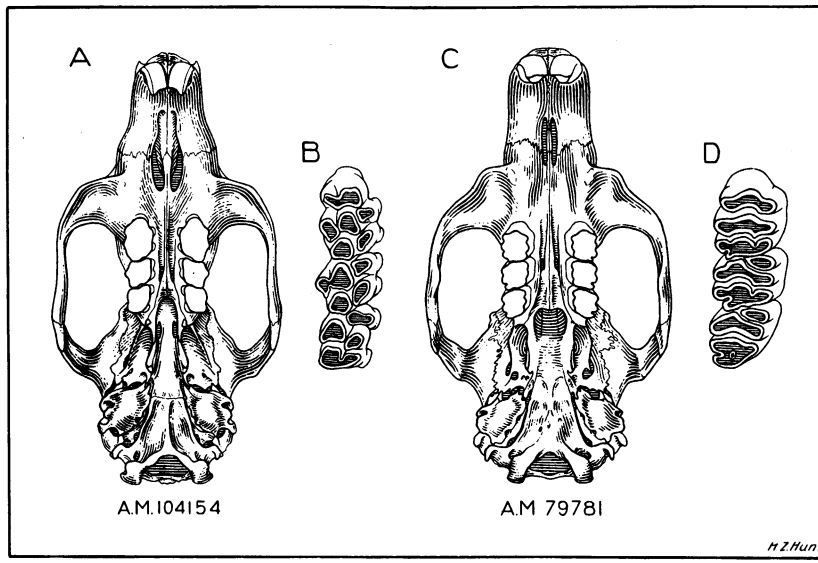


Fig. 27. Ventral views of skulls and crown views of right upper molars of *Mallomys rothschildi* and *Hyomys meeki*.

The two genera, externally so similar, are exhibited on the same plate in order to show their marked cranial and dental divergence. *Mallomys* is held to be phlaeomyine, *Hyomys* ancient murine. Scale: A, C × 3/4; B, D × 3/2.

article (*loc. cit.*, pp. 96–99) to *meeki meeki*. Both show perfectly clearly the white ear-spots of true *meeki*.

The skull of *dammermani* (topotype) compared with the two skulls of *meeki* (from Saruwaged) shows certain distinctive features, notably the increased combined width of the palatal foramina 3.5 mm. (2.9 and 2.5 in *meeki*); wider posterior nares and median pterygoid fossa, 7.8 (5.9 and 6.7 in *meeki*); smaller toothrow (crowns), 13.5 (14.5 and 15.5 in *meeki*).

The illustrations cited by Stein (p. 95) "plate XIV, figs. 1–4" are those of *Macruromys* and not of *Hyomys m. dammermani.*

MEASUREMENTS.—Full measurements of the type appear in Rümmler's table (*loc. cit.*, p. 99); of the topotype in our table (p. 714).

Hyomys strobilurus Rümmler

Hyomys strobilurus RÜMMLER, 1933, Zeits. f. Säugetierk., VIII, Heft 1/2, pp. 96–99.

In the U. S. National Museum, Washington, a specimen, No. 199521 from Ogeramnung, Bulung River, Huon Peninsula, 1800–2000 meters, only a few miles from Sattelberg, type locality of *strobilurus*, constitutes from the character of its tail scales a second example of *strobilurus.* Moreover with this specimen there is a skull, the dimensions of which are given beyond (p. 713). The skin is flat, the animal adult, but its sex indeterminable. It was collected by Förster who also obtained Rümmler's type.

The skull of this specimen is rather smaller than that of our adult *H. meeki*, particularly regarding palatal length and zygomatic breadth, but the length of its upper molar series is greater.

BANDICOTA GRAY

Bandicota GRAY, 1873, Ann. Mag. Nat. Hist., (4) XII, p. 418.

When Thomas[1] divided the original *Nesokia* into *Nesokia* Gray, 1842 (restricted), *Gunomys* Thomas [n.g.], and *Bandicota* Gray, 1873, he indicated as type of the last *gigantea* [Hardwick, 1804], i.e., the *bandicota* of Bechstein, 1800. The name *indica*, of which *setifer* Horsfield (1824) is currently considered a race,[2] dates from Bechstein's translation of Pennant, 1800.[3] It was formerly[4] considered a synonym of *bandicota*, the genotype. If *indica* is synonymous with *bandicota* then the latter, having page precedence in Bechstein's work, should be employed as the specific name. In addition to those comparisons drawn by Thomas (*loc. cit.*), Kloss[5] has further compared *Bandicota* with *Gunomys* in an article on "Bandicoot rats."

Bandicota has been reported erroneously from the Philippine Islands, Borneo, and Celebes. Its range appears to extend into eastern India and through Indo-China northward to Yunnan. The genus is an offshoot from the murid stock, probably remote from *Rattus.* The heavy teeth

[1] 1907, Ann. Mag. Nat. Hist., (7) XX, pp. 202–203.
[2] Sody, 1930, Zool. Meded., XIII, pp. 134–136; de Raadt, 1933, *idem*, XVI, p. 32.
[3] Bechstein, 1800, Pennant, Ueber Vierfüss. Thiere, II, p. 714.
[4] Trouessart, 1898, Cat. Mamm. viv. foss., p. 493.
[5] 1921, Treubia, II, p. 117.

with laminae appressed anteroposteriorly have something of the appearance of those of *Hyomys* of New Guinea. Unlike *Rattus*, too, the outer parts of the third laminae of m^1 and m^2 do not combine with the inner portions of the first laminae of m^2 and m^3 to form functional units. Although present in Java, *Bandicota* is essentially a western genus and has not been compared fully for the present paper.

Bandicota indica setifera (Horsfield)

Mus setifer Horsfield, 1894, Zool. Researches in Java, No. 8, Pl. xxiv.

Material.—Eighteen specimens of various sizes and ages, all taken at Cheribon, northern coast of Java.

This species has become so well known that little appears among the dried material before us on which to comment.

The range of *setifera* extends all over the lowlands of Java (Sody, *loc. cit.*, 1930) and Sumatra (Robinson and Kloss, 1923). Its occurrence on the Nicobar Islands (Frauenfeld, 1867) should be verified.

Illustrations.—Skull, Figs. 19A, 20A.

PHLAEOMYINAE

Muridae with Complexly Folded Molars

These rats which are believed to represent one or more very ancient lines and have been briefly discussed earlier (page 505) have become so strongly diversified that all living forms within our area are definitely specialized in various ways: most are confined to mountainous areas, and several groups have become arboreal or at least scansorial independently and by quite distinct adaptations. Also there appears, as in other murid groups which extend into the area east of Wallace's line, a physiological shift in the direction of giantism. The degree of diversification of the complex-toothed rats is readily appreciated by reading over the following headings:

1.—Relatively unspecialized (except the teeth of *Lenomys*), though large rats in which neither tail nor foot is prehensile, though digits 1 and 5 show elongation. Skull somewhat shortened. Mammae apparently 0–2 = 4. *Lenomys* of Celebes. The *Pogonomys-Chiruromys* series may have been derived from a small-sized ancestor of this genus of rats, with mammae 1–2 = 6.

2.—Medium to small-sized arboreal rats, the tip of the tail prehensile, the hind foot shortened but the great toe not opposable, claws not enlarged, skull shortened and somewhat squirrel-formed. Mammae 1–2 = 6. *Pogonomys*, *Chiruromys*.

3.—Small arboreal rats with non-prehensile tail, but highly prehensile hind foot, the great toe being opposable and thumb-like and its claw modified into a nail. Mammae 0–2 = 4. *Chiropodomys* (and *Insulaemus*).

4.—Large-sized rat-like animals with unshortened skulls, and long-clawed but comparatively unmodified feet, exemplified by *Mallomys* of the New Guinea region, and *Phlaeomys* of the Philippine Islands, and possibly *Crateromys* of Luzon with its heavily-furred, squirrel-like tail.

Eropeplus seems at first sight (p. 511 and below) to represent the starting point leading from *Rattus* to *Lenomys* (Fig. 28B, C) but in *Lenomys* the molars have become decidedly more complicated. In m^1 of *Lenomys* a new structure, representing a posterior tubercle accessory to the external tubercle of loph 2, has been developed. In m^2 a similar tubercle has appeared in the same relative position, and in addition a tubercle representing the external element of loph 1. In m^3 also a tubercle has

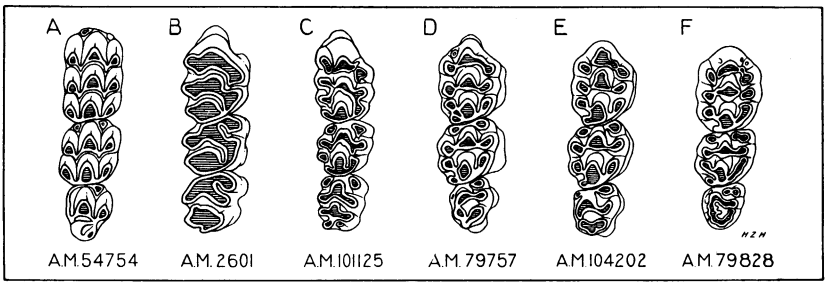


Fig. 28. Crown view of right upper molars of *Hapalomys longicaudatus, Eropeplus canus, Lenomys meyeri lamp, Pogonomys sylvestris, Pogonomys lepidus, Pogonomys (Chiruromys) forbesi satisfactus.*

In the enamel patterns shown above, that of *Eropeplus* (B) is most like *Rattus*. *Lenomys* (C) is a considerably more complex tooth, and a yet higher degree of complexity is reached by the species of *Pogonomys* (C, D, E). The extraordinarily regular pattern of *Hapalomys* (A) is unlikely to indicate primitiveness in view of specializations otherwise present in the animal. Scale: A × 7/2; B × 5/2; C × 2; D × 5; E × 5; F × 4.

grown up in loph 1 corresponding to that just mentioned for m^2; and further, the m^3 of *Lenomys* possesses two small tubercles posterior to loph 3.

The derivation of *Pogonomys* (Figs. 28D, E, F, 29C, D, E) from a small *Lenomys*-like ancestor is tentatively suggested. The new tubercles posterior to the outer tubercles of m^1 and m^2 have not developed in *Pogonomys*. Instead, some proliferation of the external tubercle of the third loph in m^1 and m^2 can be observed. Further, there appears a tendency for additional small tubercles to grow between and in front of the tubercles of loph 1 of m^1. In m^3 the external tubercles of the lophs (noted in *Lenomys*) are weakly or not at all developed, and no tubercles

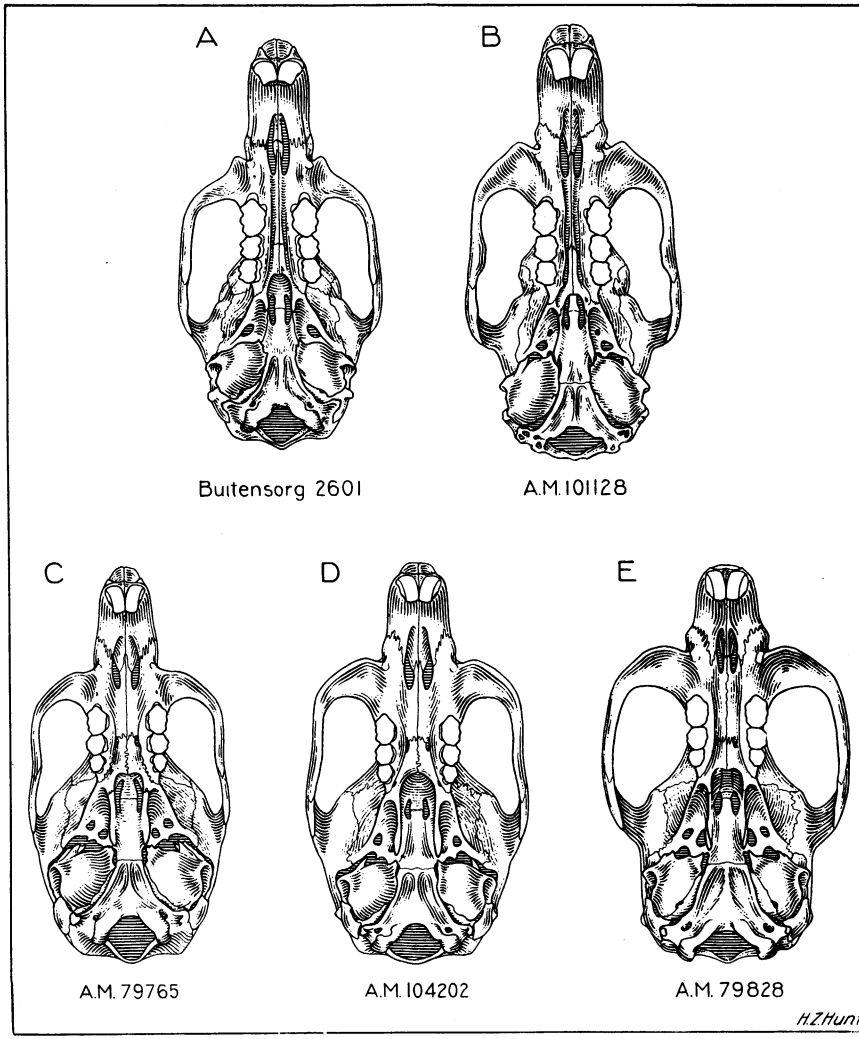


Fig. 29. Ventral views of skulls of *Eropeplus canus*, *Lenomys meyeri lampo*, *Pogonomys sylvestris*, *Pogonomys lepidus*, *Pogonomys* (*Chiruromys*) *forbesi satisfactus*.

The marked narrowing of the palates of both *Eropeplus* and *Lenomys* as well as the general facies of their skulls give the impression that they are closely related. The back of the palate, however, is on a different level in each. The difference in the molar pattern has been pointed out (Fig. 28B, C).

Successive widening of the skulls of *Pogonomys* from muroid form (*sylvestris*, C) to sciuroid form (*forbesi*, E). In all *Pogonomys* the braincase is proportionally large and full, especially posteriorly. Scale: A × 9/8; B × 1; C × 7/4; D × 7/4; E × 3/2.

appear posterior to loph 3. Additional modifications required to derive *Pogonomys* from a small *Lenomys*-like ancestor would include among others further shortening of skull and foot, secondary widening of the intermolar part of the palate, and development of prehensile function with modification of the skin of the inferior surface of the tip of the tail.

LENOMYS THOMAS

Mus JENTINK, 1879, Notes Leyden Mus., I, p. 12.
Lenomys THOMAS, 1898, Trans. Zool. Soc. London, XIV, p. 409.

This genus, which Thomas based upon characters of the feet and molar teeth, is one of the less specialized of the convolute-toothed rats. The hallux is not particularly short (at least in South Celebes forms) as Thomas averred, but attains 14 per cent of the metatarsal length and almost 50 per cent of that of the internal digits.

Three species of rats have been referred to *Lenomys:*

NAME	TYPE LOCALITY
Mus meyeri Jentink	Menado, North Celebes
Mus callitrichus Jentink	Menado, North Celebes
Lenomys longicaudatus Miller	Gimpoe, Middle Celebes

The characteristic narrow palate of *Lenomys* combined with rather large bullae and complex teeth to be noted in "callitrichus" in Jentink's[1] rather crude figure would confirm Miller's opinion[2] were the figure positively drawn from the type of *callitrichus.* However, it was copied not from the type from North Celebes but from a skull of an undoubted *Lenomys* from Paré-Paré, S. Celebes, and the drawing appears identical with the skulls of our series collected at Lampobatang, South Celebes. Meyer[3] believed *callitrichus* and *chrysocomus* (a *Rattus*) to be synonymous. He also pointed out (*loc. cit.*) that Jentink had himself made this comparison of *callitrichus* and *chrysocomus* skulls for him and now questioned Jentink's earlier identification of the Paré-Paré skull with "*callitrichus*" (meaning *chrysocomus*).

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 (shown compared with the *Rattus chrysocomus* group, p. 553) it must be assumed that *callitrichus* Jentink was truly a *Lenomys* and not a member of the *chry-*

[1] 1890, Weber's 'Zool. Ergebniss,' I, Pl. x, figs. 4–6.
[2] 1921, Proc. Biol. Soc. Wash., XXXIV, p. 96.
[3] 1899, Abh. Mus. Dresden, VII, No. 7, p. 24.

socomus group of *Rattus*. The point can be cleared up readily if the type is in existence and identifiable. (See p. 553).

Beyond (pp. 714–716), the measurements of *Lenomys*, derived from type descriptions and from new material, are compared. Summarizing from that comparison the several undoubted[1] forms of *Lenomys* may be arranged as follows:

1.—Palatal foramina short (6.8 to 7.1).....2.
Palatal foramina long (8.6 to 9.9).....*meyeri lampo*.
2.—Nasals widened anteriorly (7.1), tail longer than body.....*longicaudatus*.
Nasals not widened anteriorly (6.0), tail shorter than body.....*meyeri meyeri*.

Lenomys meyeri lampo Tate and Archbold

Lenomys meyeri lampo TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 5.

This race of *Lenomys* has been recorded hitherto only from Mt. Lampobatang, S. Celebes, at altitudes about 2200 meters. It seems probable that the skull figured by Jentink[2] which came from Paré-Paré should also be referred to *lampo*.

ILLUSTRATIONS.—Skull, Fig. 29B, teeth, Fig. 28C.

POGONOMYS COMPARED WITH CHIRUROMYS AND MELOMYS

The rats of this section of the Muridae are characterized by their relatively complicated broad teeth, widely flaring zygomata with quite short rostrum, backwardly produced frontal processes of the premaxillae, and prehensile tails. The genus was summarized by Jentink (1907).[3]

The present subgenera seem to represent the end branches of a phylogenetic series of rats, perhaps originating in common with *Lenomys*, of which *Pogonomys* is a sub-terminal branch and the more highly differentiated *Chiruromys* the terminal twig.

There is to be seen, especially in dried specimens of this group of rats, a remarkable external likeness to the genus *Melomys*. However, fundamental differences between *Pogonomys* and *Melomys* are to be observed in the pattern of the molar teeth (complexly foliate in the former but consisting of a simple transverse laminae in the latter, Figs. 23D, 28D, E, F); and in the tail (longer than head and body, and prehensile in *Pogonomys* but shorter (usually) than head and body and non-prehensile in *Melomys*). Besides the above, in the hind foot of *Melomys* the metacarpal portion is relatively long and the median digits relatively short,

[1] If *callitrichus* is definitely established it is possible that *meyeri meyeri* will prove to be a synonym of it. But different lengths of the molar toothrows, 10 mm. in *callitrichus*, 13 mm. in *meyeri* make the matter doubtful.
[2] Weber's 'Zool. Ergebniss,' I, Pl. x, figs. 4–6.
[3] Jentink, 1907, 'Nova Guinea,' V, p. 365.

while in *Pogonomys* the foot as a whole is shortened, the metacarpal part being particularly shortened but the digits relatively long. The tail in *Melomys*, besides being commonly (but not always) shorter than the body (in *Pogonomys* it is longer) has a *Uromys*-like arrangement of squarish scales sub-tended either by three hairs or one (see also pp. 589–599), while the scales of *Pogonomys* are more pointed behind, tend to become keeled, and have always three hairs.

Pogonomys and *Chiruromys*, although sharing many characters and without question closely inter-related, diverge from one another on a sufficient number of structural points (illustrated in Figs. 29C, D, E) to warrant separation of subgeneric rank.

POGONOMYS MILNE-EDWARDS

Pogonomys MILNE-EDWARDS, 1877, C. R. Acad. Sci., Paris, LXXXV, p. 1081.
Chiruromys THOMAS, 1888, Proc. Zool. Soc. London, p. 237.

Due to the complete lack of generic description in Milne-Edwards' brief account of *Pogonomys macrourus* and to the fact that Thomas's generic description of *Chiruromys*, though full, fails to include certain characteristics of the less specialized *Pogonomys*, the genus *Pogonomys* has been re-defined below. Incidentally, Thomas compared his *Chiruromys* not with *Pogonomys* but with "*Mus.*"

GENERIC DESCRIPTION.—Complex-toothed Muridae with widely to moderately expanded zygomatic arches, narrow interorbital region, short to very short nasals, and rounded braincase. Palate wide, with short toothrows and short palatal foramina. Auditory bullae very small. Zygomatic plate narrow and not thrown forward. Teeth short and broad. Fur soft, as in *Melomys*. Hind feet rather short, the metatarsal quite short, the toes long in comparison with those of *Rattus*. Tail longer than the body, the lower surface of its tip hairless with the skin modified for tactile purposes and for prehension.

GENOTYPE.—*Macrourus* Milne-Edwards, the genotype of *Pogonomys*[1] is one of the smaller species, colored "gray fawn" above and "whitish" beneath. The genotype of *Chiruromys* is *C. forbesi* Thomas.

It is not possible to determine from "whitish" whether *macrourus* had pure white belly hairs or white hairs with gray bases. The only dimensions given are body length, 120, tail length 140, which measure-

[1] From correspondence with Dr. P. Rode, of the Muséum National d'Histoire Naturelle, Paris, it has been learned that the type of *macrourus* is not in good condition, and the skull cannot be found. Dr. Rode quoted the following from the wooden base on which it is mounted:
1877—1473—No. 1104—N'elle Guinée
Arfak. M. Laglaize
Pogonomys macrourus A. M. Edwards

ments definitely place the animal (if adult) among the smaller species of *Pogonomys*. Thomas[1] wrote that *macrourus* came from Arfak in Dutch New Guinea; Jentink[2] stated that the type specimen was collected at Amberbaki, N. W. Dutch New Guinea (west of Arfak Mts., 133° east of Greenwich). There is as yet no authentic record of *sylvestris* outside the Huon region, hence *macrourus* was more probably a member of the present *lepidus* group, which is recorded at least as near Arfak as the Gebroeders Mts.

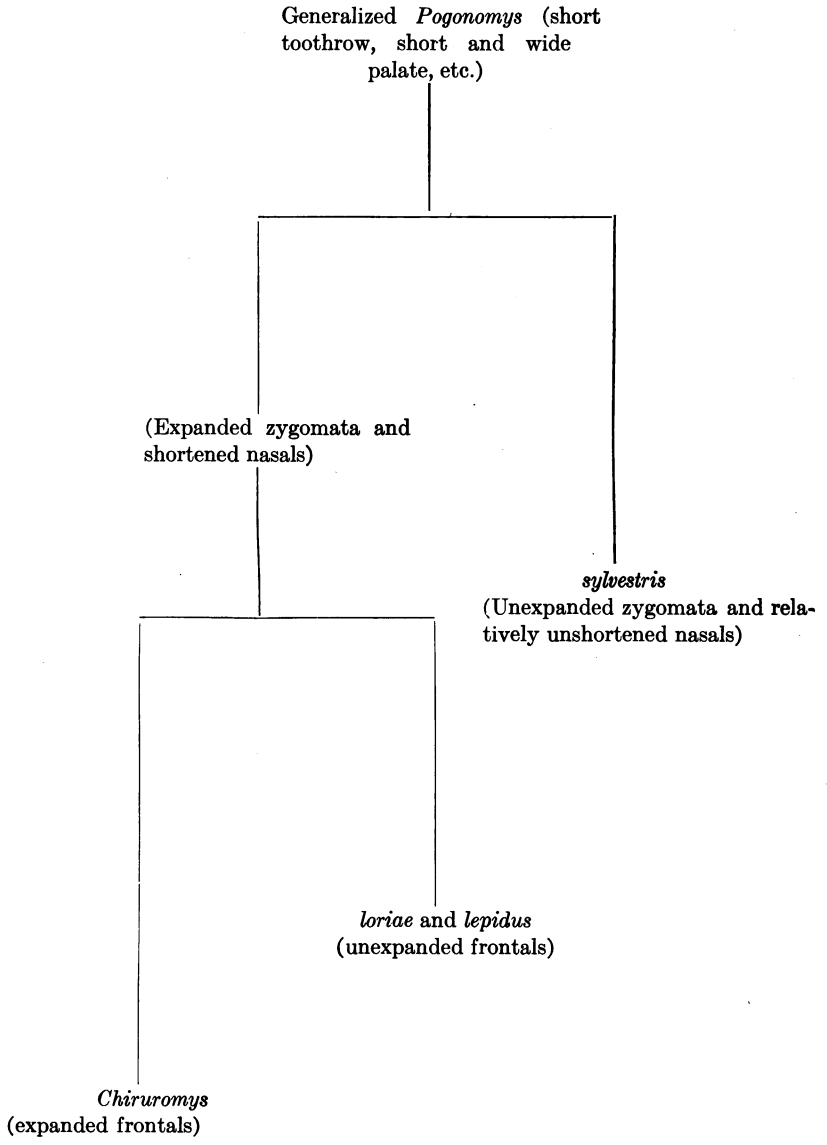
Chiruromys includes rather large rats with body length around 156 and tail 220. Between the *lepidus* group of *Pogonomys* and *Chiruromys* is a series of species of intermediate dimensions, which are currently placed in *Pogonomys*.

Since little has been published as yet to indicate the relationships of the species of *Pogonomys* to each other, it has seemed desirable to try to bring out specific characters more fully and to attempt to group the species on anatomical grounds. An analysis has been made in a succeeding table (p. 627) of the relationships of the dimensions of the molar teeth to each other, to the length of the toothrow as a whole, and to the zygomatic width. Incidentally, the similarity of the dimensions of individual teeth, coupled with the fact that the animals were from the same collecting camp, has enabled satisfactory correlation of half-grown and even quite juvenal specimens with their appropriate adults, and thus has demonstrated the distinctness in coloration between young and mature animals of the same race. Study of the molar teeth shows that the collection contains representatives of four well-marked species groups: *Pogonomys* (*Chiruromys*) in which the proportions of m^1 are 1.8/2.4 and 1.9/2.5, or 75% and 76%; *Pogonomys loriae* with m^1 proportionately narrower and longer 2.1/3.0 and 2.1/2.8 or about 70%; *Pogonomys lepidus*, a cinnamon-colored form with gray-brown young in which the first and second molars are sub-equal in width, and the proportions of the first molar from 64% to 86%. The fourth species, *P. sylvestris* (our specimens are practically topotypes), has the first molar much as *Chiruromys* of Goodenough Island, i.e., relatively short and broad $\left(\frac{\text{width}}{\text{length}}\right.$ = 76%). That *sylvestris* is far removed from *Chiruromys* is shown by its long, narrow skull 29.0/15.8 or 184% as compared with the short, broad skull, 37.4/22.3 or 168% of the *Chiruromys*.

In these same species the length of molar series expressed as % of

[1] 1920, Ann. Mag. Nat. Hist., (9) VI, p. 534.
[2] 1906, Notes Leyden Mus., XVIII, p. 187.

zygomatic width varies in the *forbesi* group (= *Chiruromys*) from 36 to 40%; in the *lepidus* group from 33 to 38%; and in the *loriae* group from 27 to 30%. In the only usable skull of *sylvestris*, that ratio worked out at 30%.



The accompanying tree summarizes our views on the probable affinities of the animals under discussion. *Sylvestris*, with relatively little broadened muroid skull-form (Fig. 29C) is considered the most primitive species; *forbesi*, with relatively sciuroid form of skull (Fig. 29E) appears the most specialized. *Lepidus* and *loriae* are intermediate, possessing widely flaring zygomata but relatively little specialization of the process of the frontal adjoining the lachrymal.

Pogonomys sylvestris Thomas

Pogonomys sylvestris Thomas, 1920, Ann. Mag. Nat. Hist., (9) VI, p. 534.

Material.—New Guinea, Sevia, Cromwell Mts., German New Guinea, (A. M. 79768) ad. ♂ (A. M. 79765) ad. ?, probably ♀; ad. ♂ (A. M. 79768), without a skull.

These animals agree very closely with Thomas's description particularly in the "more normal murine proportions" of their skulls. From Thomas's note (*loc. cit.*, p. 535) one might suspect that *macrourus* was closely allied to *sylvestris*. That animal came from Arfak, however, while Sevia, locality of our animals and one thousand miles farther east, is quite near the type locality (Rawlinson Mts.) of *sylvestris*.

True *sylvestris* is apparently recorded thus far only from the mountains of the Huon Peninsula. Of the specimens referred by Dollman[1] to *sylvestris* numbers 84 and 169 (Shaw Mayer) are now before us (A. M. 101962 and 101963). The former is not a *Pogonomys* at all, but a *Melomys*, as shown by its simple, transversely-ridged teeth and its tail and foot characters; the latter, which has white-based belly-hairs and wide zygomata, is referable not to *Pogonomys sylvestris* but to the *lepidus* branch of the genus.

Measurements.—See p. 716 (general), p. 627 (teeth).

Illustrations.—Skull, Fig. 29C, teeth, Fig. 28D.

Pogonomys lepidus Group

The collection contains 21 specimens of this general type of *Pogonomys*, characterized by having the ventral fur white or creamy white to the roots, the dorsal color being fairly bright cinnamon or rufous in adults and grayish in young animals. The young have been correlated with adults on the basis of locality combined with detailed measurements of the molar teeth (see table p. 627).

Our material is derived from three widely separated areas:

[1] Rothschild and Dollman, 1933, Proc. Zool. Soc. London, p. 214.

1.—Huon Peninsula, German New Guinea: Sevia, Cromwell Mountains, A. M. 79763, 79764 (2 ad. ♂s), 79751 (1 juv. ♂); 79766 (1 ad. ♀). Zakaheim, 1300 m., near Sevia, Cromwell Mts., 79772 (1 ad. ♂).

2.—Central District, British New Guinea: Matsika, St. Joseph's River, A. M. 104201, 104202 (ad. ♂s), 104172, 104173, 104175, 104179, 104181 (juv. ♂s), 104205, 104206, (ad. ♀s).

U. S. N. M. 120916, 120918, 120919, 120920 from "British New Guinea" (on the basis of its larger teeth and wider anterior palatal foramina, it is likely that No. 120917 may be a member of the *mollipilosus* division of *Pogonomys*, its fur having become brownish through fading or degreasing.)

3.—Dutch New Guinea: Mt. Derimpa, Gebroeders Gebirge (Weyland Range), A. M. 101963 (ad. ♀), 101961 (juv. ♀).

The type localities of the three named forms[1] of rufous *Pogonomys* are: for *lepidus*, Haveri, 9°25′ South, 147°35′ East, behind the Astrolabe Range; for *vates*, Madeu, upper St. Joseph's River; and for *lamia*, Ighibirei, on the upper Kemp Welch River, all of them in the Central District, British New Guinea. Also two specimens of *lamia* are recorded from Haveri. Ighibirei and Haveri are less than 30 miles apart. Comparing descriptions and measurements of the type material for the above three species, the following is noted:

Lepidus, "deep rufous . . ."; *vates*, "greyish ochraceous buff or rufous . . ."; *lamia*, "dull fawn grizzled with silvery." Underparts of all three are white to the bases of the hairs. The ears of *vates* were supposed to differ slightly from those of *lepidus* as was the tail also (read original descriptions). In the crania the only points in the type descriptions which lend themselves for comparison are the zygomata, "abruptly expanded" in *lamia* and "not so remarkably expanded" in *vates;* and the very narrow palatal foramina of *vates* (compared with *lamia*), and the decidedly wider ones of *lepidus*. In published measurements (all by Thomas) the hind foot is given as 21 to 21.5 (*lepidus*), 25 (*vates*), and 24 to 25 (*lamia*). From the fact that other dimensions such as "head and body," "basilar length," "palatilar length," etc., are so nearly in agreement in the three forms, the foot measurement given by Thomas for *lepidus* is considered open to question.

The chief differences appear in the form of the palatal foramina and in the length of the hind feet, in both of which characters *vates* and *lamia* are more alike than either is to *lepidus*. Probably the three are at best only local races of one species. The individuals of our series from Matsika, near the type locality of *vates*, agree exactly with none of the three. They possess short wide foramina (4.2 × 2.2) and the hind foot measurements in adults vary from 21 to 23 mm. They are here referred to

[1] Prior to publication of Amer. Mus. Novit. No. 803, 1935.

Pogonomys lepidus lepidus. In addition to the foregoing two races have been described recently,[1] *P. l. huon* from Huon Peninsula and *P. l. derimapa* from Dutch New Guinea.

Pogonomys lepidus lepidus Thomas

Pogonomys lepidus THOMAS, 1897, Ann. Mus. Civ. Genova, (2) XVIII, pp. 614–615.

MATERIAL.—Nine specimens from Matsika, Central District of Papua (see p. 621).

In the above series of *lepidus* it is easy to note the changes in pelage from a grayish brown near clove brown or seal brown of Ridgeway in juvenals to near cinnamon brown or russet in adults. The adult pelage develops first on the head and face and extends backwards along the body.

The date of collecting (Matsika was occupied from November 21 to 24) coupled with the apparently non-breeding condition of the two adult females and the large proportion of juvenal specimens, indicates that the breeding season of *P. lepidus* is some months earlier in the year. The drier period at Matsika occurs from May to September, therefore these rats apparently cease to breed in the latter half of the dry period.

MEASUREMENTS.—See table, pp. 716–717.

Illustrations show clearly the characteristics of the skull (Fig. 29D) and the teeth (Fig. 28E) of *P. lepidus lepidus.*

Pogonomys lepidus huon Tate and Archbold

Pogonomys lepidus huon TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 6.

MATERIAL.—Five specimens from Huon Peninsula (see p. 621).

P. l. huon from the mountains of the Huon Peninsula is from a geographical viewpoint considerably removed from the Central Province. Yet in spite of the distance involved, no markedly important differences between it and the Matsika animals can be found. The hind feet appear a little larger (23–25 mm.) the molar toothrow slightly longer (over 5.0 mm.). Dr. Rümmler of Berlin, to whom Mr. Archbold loaned the specimens for a time, considered them to be *lepidus.* If *vates* and *lamia* are treated as races of *lepidus,* then on the basis of their geographical isolation, shorter palatal foramina, and longer molar series, the Huon Peninsula animals must be held also to represent a distinct race.

[1] 1935, Amer. Mus. Novit. No. 803.

Pogonomys lepidus derimapa Tate and Archbold

Pogonomys lepidus derimapa Tate and Archbold, 1935, Amer. Mus. Novit. No. 803, p. 6.

Material.—Two specimens from Weyland Mts. (see p. 621).

Derimapa carries the shortening of the palatal foramina to an extreme. The pelage, moreover, is darker and of a less vivid cinnamon color than occurs in either *huon* or *lepidus*. *Derimapa* is the western representative of the *P. lepidus* group.

Since this race was proposed yet another specimen (A. M. 103272 = Stein 379), an adult male collected by Stein at Weyland Mts., has come to hand. The characters of that specimen agree closely with those of the rather younger type. Important measurements of the specimen are: head and body, 105 mm.; tail, 175; hind foot, 25; palatal length, 15.7; palatal foramina, 3.8 × 2.3; length bulla, 4.2; upper molar alveoli, 5.4; upper molar crowns, 5.1; crown of m^1, 2.4 × 1.7.

Pogonomys lepidus vates Thomas

Pogonomys vates Thomas, 1908, Ann. Mag. Nat. Hist., (8) II, pp. 495–496.

Material.—Four specimens from "British New Guinea" (see p. 621).

These examples in the U. S. National Museum can be separated readily from the Archbold series and from the two new races described above by their slit-like, much narrowed anterior palatal foramina, referred to expressly by Thomas. It is to be regretted that the exact locality from which they came is not known. But notwithstanding this, their measurments have been listed beyond (pp. 717–718). The individual measurements of their molar teeth (see p. 627) are in close accord with those of *lepidus*.

Pogonomys loriae Group

This group contains the larger, gray forms of *Pogonomys* typified by *loriae*. It is sharply set off from the still larger *Chiruromys* group by characters already mentioned (pp. 616–618). Three forms: *loriae*, *mollipilosus*, and *dryas* are tentatively compared from their type descriptions:

Dorsal colors are described as "dull slaty gray" (*loriae*); "fuscous brown" (*mollipilosus*); and "dull buffy brown" (*dryas*). The ventral color of each is pure white (yellowish white in *mollipilosus*). No other skin characters can be compared from the descriptions. No cranial characters have been published for *mollipilosus*, though Thomas com-

pared the skull of *dryas* in the type description with the type skull of *mollipilosus*. Because of this lack of measurements, no comparison can be made between *dryas* and *loriae*. Comparing what dimensions are available, the following facts appear: head and body, 148 to 149 mm. (*loriae* ♂ and ♀); 100 mm. (*mollipilosus* ♂); and 114 mm. (*dryas* ♀). Tail, 214 and 213 mm. (*loriae*); 165 mm. (*mollipilosus*); and 184 mm. (*dryas*). Hind foot, 26 and 26.7 mm. (*loriae*); 26 mm. (*mollipilosus*); and 23.5 (*dryas*). Ear in each case 15 mm. The skull measurements of *loriae* (♂ only) are consistently much greater than those given for *dryas* (♀).

It is unfortunate that no cranial measurements of the type of *mollipilosus* have been published. However, Thomas[1] wrote that the skull of the type, which he had borrowed, was essentially similar to that of a British Museum animal from Moroka (close to the type locality of *loriae*). It will be seen that although the color scheme of these rats (gray above and pure white beneath) is essentially alike, considerable size differences appear. In each the tail is shown as about half as long again as the body. The type localities of *loriae* and *dryas* are so near together that either they must represent full species, a larger and a smaller, or else *dryas* (♀) is merely an unusually small example of *loriae*. That this possibility is not precluded is shown by the similarity of important measurements such as the length of the molar series (6.8 in *loriae* ♀, 6.3 in *dryas* ♀). The slight observable difference is well within the possible range of individual variation. From the proportionately large size of the hind foot of *mollipilosus* (26 mm.) it is probable that the type was a young animal. This view is supported by the fact that the authors of *mollipilosus* showed doubt themselves by styling it "apparently adult." If such should prove to be the case, *loriae* would turn out to be either a synonym or a subspecies of *mollipilosus*. However, until some one can compare the two types, they should be considered distinct.

The type localities of the three forms compared above are: *loriae*, Haveri, behind the Austrolabe Range; *mollipilosus*, Katau, 10 miles west of the Oriomo River, opposite Daru, southern New Guinea; and *dryas*, Dinawa, Owen Stanley Range. The type localities of *loriae* and *dryas* are thus within some twenty miles of each other, while that of *mollipilosus* lies about 150 miles away from either.

Material available for examination comes from the Central Division of Papua and from Gebroeders Gebirge, Dutch New Guinea:

[1] 1897, Ann. Mus. Civ. Genova, (2) XVIII, p. 613.

Central Division: Matsika, St. Joseph's River. 104178, 104184 (ad. ♂s), 104177 (ad. ♀), 104180, 104183 (juv. ♂s)
Dutch New Guinea: Gebroeders Gebirge, Mt. Derimapa (ad. ♀)

The general dimensions of our specimens, both the Matsika animals and that from Dutch New Guinea conform to those of true *loriae*. In the length of head and body our adult animals vary from 143 to 152 mm., those of the co-types of *loriae* being 148 and 149 mm., respectively, while the same measurement in *mollipilosus* and *dryas* is given as 100 and 114 mm., but as pointed out above, the type of *mollipilosus* was not improbably a juvenal animal conspecific with *loriae*.

Only a very slight color difference can be discovered in support of possible difference between the Gebroeders animal of Dutch New Guinea and the series collected by Archbold at Matsika, the former being of a rather paler and more brownish gray than the latter. Because such a slight difference, unsupported by morphological features, could indicate mere individual variation, the animal from Dutch New Guinea should not be distinguished taxonomically.

Pogonomys loriae Thomas

Pogonomys loriae Thomas, 1897, Ann. Mus. Civ. Genova, (2) XVIII, p. 613.

Material.—Listed above.

Our series of four adults and two young is adequate to show fully the difference between juvenal and adult pelage. The fur of younger animals is definitely a clearer gray with less brownish overwash than in the adults. In the old animals this brownish shade appears especially on the sides.

Measurements.—See pp. 718–719.

Pogonomys (*Chiruromys*) *forbesi* Group

It has been intimated (pp. 617–618) that *Chiruromys* represents a group of *Pogonomys* of subgeneric rank, and certain divergent characters in the two divisions have been pointed out.

Further important differences between *Pogonomys* and *Chiruromys* appear in the frontal, nasal, and lachrymal regions. The excessive shortening of the nasals is demonstrated by dividing the occipito-nasal length by the distance from occiput to anterior margin of zygomatic plate which for *Chiruromys pulcher* = 36/28.8 or 125% (*P. loriae* 135%, *P. vates* 131% and *P. sylvestris* 134%). It is also shown by the fact that contrary to the condition present in true *Pogonomys* the premaxillae of *Chiruromys* may be seen to project anteriorly beyond the nasals when the skull is

viewed from the side or from above. The extraordinary widening of the frontals at the lachrymal area in *pulcher* is especially noteworthy. Further characters are the shorter, broader toothrow in proportion to the zygomatic breadth (table, p. 627) or palatilar length; the frontal processes of the premaxillae extended far behind the nasals; the raised ridge along the frontal and lachrymal where they border upon the orbit.

Prior to 1935, four forms referable to this subgenus of *Pogonomys* have been described from the New Guinea region, three of them subspecies of *forbesi*, all from the New Guinea mainland, and the fourth, *pulcher*, from Fergusson Island (Moratau), D'Entrecasteaux group.

Forbesi has been divided by Thomas into three subspecies: *f. forbesi*, *f. vulturnus*, and *f. mambatus* with type localities, respectively, Sogere (500 meters) S. E. New Guinea; Bara-bara, Milne Bay, S. E. New Guinea; and Kokoda, Mambaré River (300 meters) N. E. New Guinea.

The present series, which was collected by the Whitney South Sea Expedition, and comes from Goodenough Island (Dauila), adjoining Fergusson, includes representatives of *forbesi* and *pulcher*, namely, *forbesi satisfactus* and *pulcher major*.[1] It consists of four specimens in alcohol which furnish ample evidence to the effect that Thomas[2] erred when he wrote of the prehensile tail of *Chiruromys* "curling upwards." He held that the prehensile skin was situated on the dorsal surface. In our specimens it is ventral in position.

If the four earlier known forms of *Chiruromys* are compared, the following facts become apparent: dorsal color "rufous gray," later called by Thomas (1920) "cinnamon" (*forbesi*); grayer [than *forbesi*], approaching "light drab" (*vulturnus*); color as in *forbesi* (*mambatus*); soft rufous fawn, becoming deep ferruginous on rump (*pulcher*). Whitish patches between ears and eyes "prominent" (*forbesi*); "at a maximum" (*vulturnus*); "practically absent" (*mambatus*); absent (*pulcher*). Under surface "buff" (*forbesi*); not given (*vulturnus*); not given (*mambatus*); "bright reddish" (*pulcher*). Thomas described the anterior edge of the zygomatic plate as visible from above in *forbesi* and *vulturnus* and invisible in *mambatus*. *Pulcher* is said to have less right-angled anterior zygomatic roots, a more arched upper profile, palate ending more anteriorly in relation to m^3 than has *forbesi*, broader and more crenulate molar teeth.

On account of their much larger hind feet and at the same time proportionately small skulls, none of our specimens has been identifiable

[1] Described by Tate and Archbold, 1935, Amer. Mus. Novit. No. 803, pp. 8–9.
[2] 1888, Proc. Zool. Soc. London, p. 237, Fig. 2D, p. 239.

Species	A.M. No.	Locality	Sex	Upper Molar Series	Ext. Width M^1M^1	Width M^1	Width M^2	Width M^3	Length M^1	Length M^2	Length M^3	Zygomatic br. / Length M^1–M^3
sylvestris	79765	Sevia	♂	4.8	6.3	1.6	1.5	1.1	2.1	1.5	1.2	33
"	79757	"	♀	5.0	6.0	1.6	1.5	1.1	2.1	1.5	1.1	..
lepidus vates	U. S. N. M. 120916		ad.	5.0	...	1.7	1.6	1.2	2.1	1.6	1.4	..
" "	U. S. N. M. 120918		y.	5.0	...	1.5	1.5	1.1	2.1	1.5	1.3	..
" "	U. S. N. M. 120919		ad. ♀	5.1	...	1.6	1.6	1.2	2.2	1.6	1.3	37
" "	U. S. N. M. 120920		ad.	5.1	...	1.7	1.6	1.2	2.3	1.7	1.4	38
lepidus lepidus	104201	Matsika	♂	5.1	6.8	1.6	1.6	1.3	2.4	1.5	1.2	..
" "	104202	"	♂	5.0	6.4	1.6	1.6	1.2	2.2	1.4	1.1	34
" "	104205	"	♀	4.9	6.6	1.6	1.5	1.2	2.1	1.3	1.2	35
" "	104206	"	♀	4.7	6.6	1.6	1.5	1.1	2.2	1.4	1.2	37
" "	104204	"	♂	5.0	6.6	1.6	1.6	1.2	2.5	1.5	1.2	..
" "	104203	"	old ♂	5.0	6.8	1.7	1.6	1.2	2.3	1.6	1.2	35
" "	104175	"	y. ♂	...	6.4	1.6	1.5	1.2	2.2	1.5	1.2	..
" "	104173	"	y. ♂	4.9	6.2	1.6	1.6	1.2	2.2	1.4	1.2	..
" "	104179	"	y. ♂	4.9	6.1	1.5	1.5	1.2	2.1	1.4	1.2	..
" "	104172	"	juv. ♂	5.0	...	1.6	1.6	not erupted	2.2	1.5	not erupted	..
" "	104181	"	juv. ♂	...	...	1.6	1.6	not erupted	2.1	1.4	not erupted	..
lepidus huon	79763	Sevia	♂	5.2	6.7	1.9	1.7	1.3	2.2	1.7	1.4	..
" "	79772	Zakaheim	♂	5.3	7.0	1.7	1.6	1.2	2.3	1.7	1.3	..
" "	79751	Sevia	y. ♂	5.5	6.6	1.8	1.7	1.3	2.4	1.6	1.3	34
lepidus derimapa	101963	Gebroeders	♀	5.1	6.6	1.7	1.6	1.2	2.3	1.4	1.2	33
" "	101961	"	y. ♀	5.4	6.5	1.8	1.7	1.3	2.4	1.6	1.2	..
loriae	104184	Matsika	♂	6.7	7.7	2.1	2.0	1.4	3.0	2.3	1.8	30
"	104183	"	juv. ♂	...	...	2.1	2.1	not erupted	3.1	2.2	not erupted	..
"	104180	"	juv. ♂	...	7.3	2.2	2.2	not erupted	3.3	2.2	not erupted	..
"	104177	"	♀	7.0	7.7	2.2	2.2	1.7	3.2	2.2	1.9	29
"	101960	Gebroeders	♀	6.2	7.8	2.1	2.0	1.5	2.8	2.2	1.7	32.6
forbesi	79828	Goodenough Isl.	♂	6.1	6.9	1.8	1.7	1.2	2.4	1.9	1.4	36
satisfactus	79827	" "	♂	5.6	7.3	1.9	1.8	1.3	2.5	1.7	1.5	39
"	79826	" "	juv. ♂	...	6.5	1.9	1.8	not erupted	2.5	1.8	not erupted	..
pulcher major	79831	" "	ad. ♀	5.8	7.3	2.0	1.8	1.4	2.6	1.8	1.4	38

with any mainland animal. In all three subspecies of *forbesi* the hind foot measurement (s.u.) is given as 30 mm.; that of *pulcher* from Fergusson Island is 33.7 mm. The measurements of our three animals are, respectively, 36, 37, 37, including the claws. But although the allowance for the claws does not exceed 3.5 mm., only one of these specimens, *major*, a female, can be referred to the large-footed *pulcher*. This animal, as shown beyond, differs also from the remainder of our material in fur color and in characters of the scales of the tail. It is referred to *pulcher* specifically but is distinguished subspecifically as a second island race. Others of the collection comprising two adults and one juvenal animal seem more closely related to *forbesi*, and have been named *P. forbesi satisfactus*.

Pogonomys forbesi satisfactus Tate and Archbold

Pogonomys forbesi satisfactus TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 7.

As shown in the original description and in the foregoing discussion, this form represents *forbesi* on Goodenough Island. It comes closest, morphologically, to *mambatus* of the Mambaré River region, eastern Papua.

ILLUSTRATIONS.—Skull, Fig. 29E; teeth, Fig. 28F.

Pogonomys pulcher major Tate and Archbold

Pogonomys pulcher major TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 8.

Several characters were pointed out in the preliminary notice by which *major* differed from *forbesi satisfactus*, namely: the areola of white hairs around each axillary mamma; the coarseness and partial coalescence[1] of the scales of the tail; the distinct keels developed on said scales. It is assumed that such strongly marked characters were present in the original *pulcher*, but no mention of them occurs in the original description. Distinctions between *pulcher* and *major* rest primarily therefore upon differences of tail-length, and hind foot length.

"Short-tailed *Pogonomys*" of Jentink

Four names, *sexplicatus*, *lorentzii*, *leucogaster*, and *multiplicatus* were proposed by Jentink for species of *Melomys* which he placed in "*Pogonomys*." Two of these, *lorentzii* and *multiplicatus* were shown by Thomas[2] (1914, 1916) to belong to *Uromys* [later transferred to *Mel-*

[1] The coalescence may have no significance.
[2] 1914, Trans. Zool. Soc. London, XX, p. 320; 1916, Ann. Mag. Nat. Hist., (8) XII, pp. 209–210.

omys]. Such conclusions are apparently correct, since comparison of measurements published by Jentink shows skull proportions for these animals which disagree with those of recognized crania of *Pogonomys* but agree in the case of *Melomys*. For example $\frac{\text{toothrow}}{\text{diastema}} = 79\%$ (*sexplicatus*), 65% (*leucogaster*), 77% (*lorentzii*), and 73% in an undoubted *Melomys*. In *P. forbesi*, on the contrary, it is 49%. The same can be traced in other proportions. The only species of *Pogonomys* which even approaches *Melomys* in the proportions of the skull is *sylvestris*. In *sexplicatus* Jentink mentions the "single short hair" of each tail scale, a *Melomys* character.

CHIROPODOMYS PETERS

Chiropodomys PETERS, 1868, Monatsber. K. Akad. Wiss. Berlin, p. 448.

TYPE.—*C. penicillatus* Peters, currently held to be synonymous with *Mus gliroides* Blyth, 1855, Journ. As. Soc. Bengal, XXIV, p. 721. Type locality of *penicillatus* unknown ("wahrscheinlich aber in Afrika"); of *gliroides* Cheeropoonjee, Burma.

In contrast to the widely different form of its hind foot, with opposable first digit and of its non-prehensile tail, the dentition of *Chiropodomys* presents a general similarity to that of *Pogonomys*. The skulls too of the genera show a general likeness which, however, may be entirely due to convergence. In view of the uncertainty commonly prevailing as to murid relationships, it seems best to place *Chiropodomys* in its present systematic position.

The distribution of this genus as known at present is from Burma and Siam through Sumatra and Java to Borneo.[1] Following is the list of described species of *Chiropodomys* with their type localities:

gliroides Blyth	Cheeropoonjee (Sclater, 1891), Burma
syn. *peguensis* Blyth	Schwe Gyen, Sitang R., Tenasserim
niadis Miller	Lafau, Nias Island, Sumatra
anna Thomas and Wroughton	Tjilatjap, Java
legatus Thomas	Mt. Kina Balu, North Borneo
pictor Thomas	Mt. Kina Balu, North Borneo
pusillus Thomas	Mt. Kina Balu, North Borneo

The proportions of these species, based upon the type descriptions, are compared in the table (pp. 720–722). No facts of significance other than differences in size are revealed by a study of that table. The presence of three apparently distinct species on Mt. Kina Balu, Borneo, is to be noted. No evaluation of the real status of these species can be attempted at the present time because of lack of material.

[1] See remarks upon *Insulaemus*, p. 632.

The type of *C. niadis* Miller has been examined and has been found a slightly smaller, more fulvous form than *anna*. The mammae (0–2 = 4) are strongly developed. Its collector noted the presence of "three embryos the size of small peas."

Below, the type of *fulvus* Allen[1] from Yunnan has been compared with our series of *anna*. *Fulvus* differs so widely from the more typical species of *Chiropodomys* that probably it should be excluded from that genus. It seems rather to be a member of the genera of small mice allied to *Mus* or *Leggada*.

Chiropodomys anna AND "*Chiropodomys*" *fulvus* COMPARED

	Chiropodomys anna	*fulvus* Allen
D_1 of hind foot	Greatly shortened; the claw modified into a flattened nail	Not greatly shortened; the claw still pointed
Mammae	0–2 = 4	2–2 = 8
Palatal foramina / Diastema	$\frac{3.1}{7.2}$ = 43%	$\frac{4.1}{5.3}$ = 78%
Width med. pter. fossa / Width apart m^1m^1	$\frac{1.8}{3.0}$ = 60%	$\frac{1.1}{2.3}$ = 48%
Combined frontoparietal sutures	Forming an arch	Forming a backward-pointing V
Interorbital region	Strongly beaded supra-orbital ridges which commence to separate at level of fronto-nasal sutures and, at the level of transverse groove marking the junction of the olfactory lobes with the hemispheres, are already 6 mm. apart	Rounded supra-orbital ridges (with depression between them referred to by Allen) which at level of junction of olfactory lobes and cerebral hemispheres are only 4 mm. apart

Yet other divergent characters (including the teeth) not now enumerated, may be seen. Although the form of the palate strongly suggests *Mus*, the anterior zygomatic plate of *fulvus* is widely different.

Chiropodomys gliroides anna Thomas and Wroughton

Chiropodomys anna THOMAS AND WROUGHTON, 1909, Abstr. No. 68, Proc. Zool. Soc. London.

Chiropodomys anna THOMAS AND WROUGHTON, 1909, Proc. Zool. Soc. London, I, p. 390.

[1] 1927, Amer. Mus. Novitates No. 270, p. 11.

TYPE LOCALITY.—Tjilatjap, 109° east of Greenwich, south coast of Java. Sea level.

MATERIAL.—A series of eleven specimens taken at Cheribon, within a few minutes of the same meridian as the type locality, but on the north coast, collected in the crowns of cocoanut palms growing on low plains by J. J. Menden. The series comprises 4 adult ♂s (A. M. 101902,

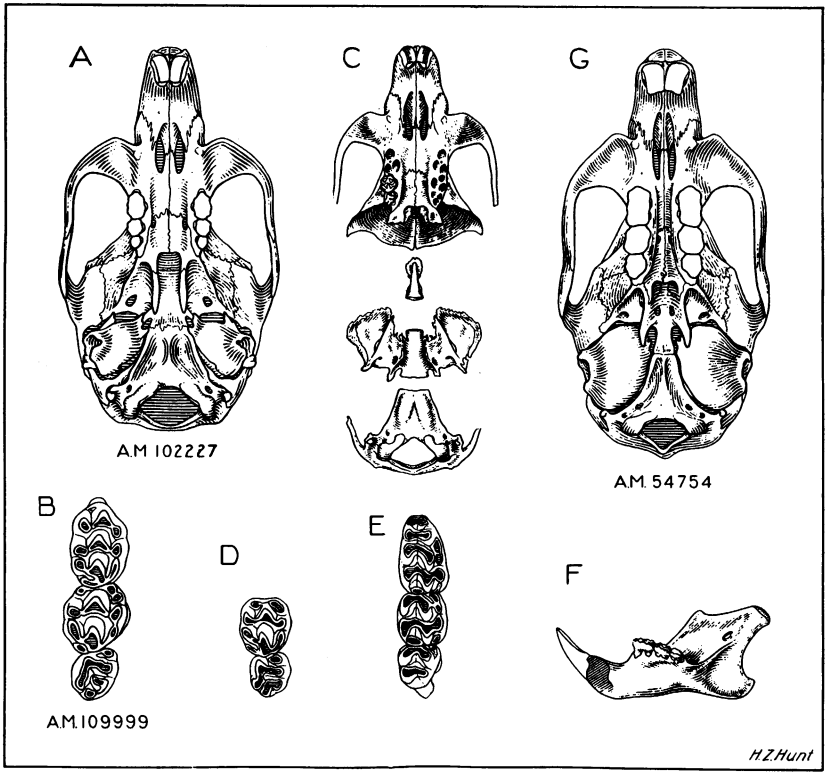


Fig. 30. Ventral view of skull and crown view of right upper molars of *Chiropodomys gliroides anna;* ventral view of skull, inner side of mandible, right upper m^2 and m^3, right lower molars of *Insulaemus calamianensis;* ventral view of skull of *Hapalomys longicaudatus.*

The close relationship of *Insulaemus* to *Chiropodomys* is comprehended by comparing C with A, and D with B. The fragmentary condition of the skull of the type of *Insulaemus* made it advisable to place complete drawings of the parts on record. The coronoid process of *Insulaemus* (F) is slightly more reduced than is that of *Chiropodomys anna.*

Note the enlarged bullae of *Hapalomys* (G). Scale: A × 2; B × 7; C × 3/2; D × 5; E × 5; F × 3/2; G × 3/2.

102000–001, 102), 2 juv. ♂s (101535, 101999), 3 adult ♀s (101901, 101904, 102119), and 1 juv. ♀ (101903).

In this collection no point of divergence from the authors' description of the Javan form can be noted. Of the three adult females, two were taken in February and the other in September. One of the two caught in February appears to be in post-breeding condition (the nipples enlarged and the hair about them more or less worn), and the September animal may also have been lactating. The three juvenal specimens bear on their labels the dates September, February, and March. In all three young the last molar has been completely erupted.

The range of dimensions of our series, given in the table pp. 721–722, is very slight and conforms quite closely to the measurements of the type of *anna* from the south coast of Java.

ILLUSTRATIONS.—Skull, Fig. 30A, teeth, Fig. 30B.

INSULAEMUS

Insulaemus calamianensis Taylor

Insulaemus calamianensis TAYLOR, 1934, 'Philippine Land Mammals,' p. 469.

Dr. Taylor has kindly loaned the unique specimen of this animal from the Calamianes Islands, Philippine Islands, for purposes of examination. The specimen (type), a female in alcohol, from which the skull has been extracted and cleaned, is in poor condition, the tip of the tail being broken off and the skull more or less fragmentary.

A careful drawing of the skull has been prepared from which *Insulaemus* is seen to be very closely related to *Chiropodomys*, if not congeneric. The opposable hind toe and mammary formula 0–2 = 4 is in agreement with the evidence of the molar pattern and skull-form to this effect. The species *calamianensis*, however, is probably valid, even though *Insulaemus* may have to be placed in synonymy.

ILLUSTRATIONS.—Skull, Figs. 30C, F; teeth, Figs. 30D, E.

MALLOMYS THOMAS

Mus JENTINK, 1892, Weber's 'Zool. Ergebniss,' III, p. 78.
Mallomys THOMAS, 1898, Novit. Zool., V, p. 1.
Dendrosminthus DE VIS, 1907, Ann. Queensland Mus., No. 7, p. 10.

This mountain-inhabiting genus of giant rats seems on account of the trefoil pattern (modified) of its molars to be referable to the Phlaeomyine subfamily of Muridae. It has diverged structurally, however, from almost all other genera in a number of ways, among which are the extremely massive rostrum and incisors combined with very long anterior palatal foramina, the form of the posterior margin of the palate in

relation to the median pterygoid fossa, the greatly reduced bullae, and the very broad zygomatic plate.

Instances of convergent development in the cases of *Uromys* and *Anisomys*, and *Pogonomys* and *Melomys* have previously been pointed out. A third instance now occurs in the case of *Mallomys* and *Hyomys* (p. 608), another giant rat which externally is remarkably like *Mallomys*.

Mallomys and *Hyomys* share the following characters: very large size (head and body 350–400 mm.); pelage dark blackish gray overlaid with long silvery (or black in some *Mallomys*) guard hairs; vibrissae very long, reaching to the shoulder; feet large and strong, with stout, curved claws; tail coarsely scaled, particolored. Few characters in the gross external structure serve to distinguish the two, the forms of the tail scales and the color of the ear conch, blackish in *Mallomys*, in *Hyomys* unpigmented (though this character may not be valid). As pointed out by Thomas[1] and by Rümmler[2] the form of the scales of the tail are quite different in the two genera. Also there seems to be a marked difference in the size and form of the external proximal pad of the

	Mallomys	*Hyomys*
Upper incisors	Very wide; more than three times width of combined anterior palatal foramina	Moderately wide; between one and one-and-a-half times width of combined anterior palatal foramina
Molars	With rounded trefoil-like loops on the transverse lophs; the posterior lophs of m^1 and m^2 lacking internal and external tubercles, also m^3 lacking external tubercles	Trefoil pattern eliminated, lophs of teeth strongly laminated
Palate	Anterior foramina 39% of palatilar length	Anterior foramina 20% of palatilar length
Frontals	Anterior portion adjoining nasals inflated	Anterior portion adjoining nasals not inflated
Zygomatic arch	Less heavily developed; maxilla not meeting squamosal	More heavily developed, particularly the jugal bone; maxilla making contact with squamosal
Mandible	Angular process not enlarged or deepened	Angular process greatly deepened

[1] 1912, Novit. Zool., XIX, p. 92.
[2] 1933, Zeits. f. Säugetierk., VII, p. 97.

pes, which in *Hyomys* appears much smaller and rounder than in *Mallomys* (in our two specimens of the former the feet are considerably mutilated).

When the skulls (Fig. 27A, B) of these two genera are compared, many important differences become apparent, which may be best shown in the accompanying table.

Mallomys and *Hyomys* have pursued quite independent courses in the development of their molars. *Mallomys* (Fig. 27B) can be derived from a somewhat *Lenomys*-like origin (Fig. 28C) by reducing the third lophs of m^1 and m^2 to a single large median tubercle, which represents a change towards simplification, i.e., a reversal of direction from that taken by *Lenomys* and *Pogonomys*. In m^3, *Mallomys* shows no evidence of any broadening of the lophs to carry external tubercles, such as may be seen in *Lenomys*, nor are posterior tubercles developed. *Hyomys* (Fig. 27D) has antero-posteriorly compressed laminae, in general not unlike those of *Bandicota* (Fig. 19A).

GENOTYPE OF *Mallomys*.—*Mallomys rothschildi* Thomas[1]

The following is a list of described forms of *Mallomys* with their type localities:

rothschildi Thomas	Mts. Murray and Scratchley, Wharton Range
(syn. *aroaensis* de Vis)[2]	Head of Aroa River
hercules Thomas	Rawlinson Mts.
argentata Rothschild and Dollman	Gebroeders Gebirge (= Weyland Mts.)
weylandi Rothschild and Dollman	Gebroeders Gebirge (= Weyland Mts.)
armandvillei (Jentink)	Flores

At present there are available for study two adult males from Mt. Tafa, Central Division of Papua, an adult female co-type of *argentata* (Mayer 148), and an adult male from the Weyland Mts. (Stein 561) which apparently represents *weylandi*. An individual in Washington representing *hercules* coming from the Huon Mountain region (U. S. N. M. 200889) has also been examined.

The guard hairs of *weylandi* were described as black; they are so colored in our Weyland Mountain specimen. In Thomas's description of *rothschildi* they were described as "black with whitish bases." In the other races of New Guinea, *hercules* and *argentata*, they are said to be white.

The chief differences in descriptions of the skulls of *Mallomys* species

[1] Note.—The type of *Dendrosminthus* is *aroaensis*, which = *Mallomys rothschildi*.

[2] See Longman, 1916, Mem. Queensland Mus., V, p. 44. Not improbably *Mus goliath* Milne-Edwards, 1900, Bull. Mus. Paris, VI, p. 165, will prove to be a *Mallomys*. It too came from the headwaters of the Aroa River.

appear between *rothschildi* and *hercules*. The latter was separated from the former on the basis of its greater size, greatly broadened muzzle, and nasals, considerably inflated anterior supraorbital region, and the absence of a small notch in the back of m^1 and m^2.

The specimen in Washington, referred to above, sex unknown, possesses the widened muzzle and nasals (see table p. 723) so stressed by Thomas, and lacks the notch in the posterior ridge of the molars. But it has the interorbital region narrower, the toothrow shorter, and is generally smaller than the type of *hercules*.

In all four of our specimens there appears a tendency for the anterior part of the frontals to be inflated and in the two males from Mt. Tafa the base of the muzzle is considerably widened, so that those characters in *hercules* are not to be considered distinctive.

Argentata was compared by its describer with *hercules*. When the skins alone are considered the co-type of *argentata* is not to be distinguished from our two specimens from Mt. Tafa. The skull, however, differs slightly by the distinct S-shape taken by the maxillo-premaxillary suture as seen from the side; in the projection of the frontal processes of the premaxillaries as far backwards as the nasals; in the greater development of postorbital processes, the width across which in the co-type exceeds 20 mm.; and in the wider posterior nares and median pterygoid fossa, 4.5 mm. (in our Tafa specimens, 3.8 and 4.0, respectively).

The points by which the skull of the type of *weylandi* (♀) was distinguished from that of *hercules* (♂) may indicate only differences of sex. It was not compared with *rothschildi*.

The taxonomic value of the color of the guard hairs has yet to be demonstrated in the case of *Mallomys*. In view of the presence of our two males, which have white guard hairs, close to the type locality of *rothschildi* (Wharton Range) and the general agreement of their skulls with the description of that of *rothschildi*, it seems that not too much weight should be given color as evidence. Furthermore, none of the four New Guinea forms is deserving of full specific rank.

Mus armandvillei Jentink of Flores appears from its short muzzle, palatal openings and molar series to be a thoroughly distinct species. Its complex molar crowns, though differing somewhat in pattern from those of *Mallomys*, indicate its general relationship to that genus.

Mallomys rothschildi rothschildi Thomas

Mallomys rothschildi Thomas, 1900, Novit. Zool., V, p. 2.
Dendrosminthus aroaensis de Vis, 1907, Ann. Queensland Mus., No. 7, pp. 10–11.

MATERIAL.—Two adult ♂s, Mt. Tafa, southwest of Mt. Albert Edward, Papua. 2070 meters.

Both specimens were brought into Archbold's camp by natives.

MEASUREMENTS.—See p. 722.

ILLUSTRATIONS.—Skull, Fig. 27A; teeth, Fig. 27B.

Mallomys rothschildi argentata Rothschild and Dollman

Mallomys argentata ROTHSCHILD AND DOLLMAN, 1933, Proc. Zool. Soc. London, p. 212.

MATERIAL.—A co-type, adult ♀, Shaw Mayer 148 (now A. M. 101-949).

MEASUREMENTS.—See p. 723.

Mallomys rothschildi weylandi Rothschild and Dollman

Mallomys weylandi ROTHSCHILD AND DOLLMAN, 1933, Proc. Zool. Soc. London, p. 212.

MATERIAL.—1 ad. ♂ from Weyland Mts., Dutch New Guinea, 1500–2000 meters.

This specimen, among others, was the basis of Stein's[1] remarks upon the habits of *Mallomys*.

MEASUREMENTS.—See p. 725.

HYDROMYINAE

MURIDAE WITH BASINED MOLARS

The Australasian water-rats (Stock 3, p. 505) represent an evolutionary line which has diverged sharply from its supposed *Rattus*-like ancestry. To a greater or less degree the changes observable seem to be related to the abandonment by some genera of a terrestrial for an aquatic environment. Certain important characters which have been modified have already been pointed out. Those modifications pertaining to skin, body form, feet, and tail are direct responses to life in the water; those relating to the palate, dentition and internal anatomy indicate what was perhaps a still older adaptation to change in the character of the animals' food.

The genera which have been referred to the Hydromyinae are *Chrotomys* (molars 3/3, Philippines); *Celaenomys* (molars 2/2, Philippines); *Crunomys* (molars 3/3, Philippines); *Leptomys* (molars 3/3, New Guinea); *Xeromys* (molars 3/3, Australia); *Parahydromys* (= *Limnomys* Thomas = *Drosomys* Thomas) (molars 2/2, New Guinea); true *Hydromys* (molars 2/2, New Guinea and Australia); *Crossomys*

[1] 1933, Zeits. f. Säugetierk, VIII, p. 124.

(molars 2/2, New Guinea); and finally *Pseudohydromys* (molars 2/2, New Guinea).

When discussing *Xeromys*, Thomas[1] regarded it as a land-inhabiting genus ancestral to *Hydromys*, and true *Hydromys* as an offshoot which had become aquatic. The basined tooth form had been acquired previously in his opinion.

In another paper[2] which dealt with Philippine mammals, he placed a new genus *Chrotomys* between *Hydromys* and *Xeromys* and referred a species, *silaceus* doubtfully to the Australian *Xeromys*, but subsequently[3] in his fuller treatment of the same collections he proposed *Celaenomys*, allied to *Chrotomys*, to accommodate *silaceus*.

Among the Loria collection from New Guinea, Thomas found and described[4] yet another Hydromyinae genus *Leptomys*. Half a score of years afterwards[5] he distinguished a new species *asper*, also from New Guinea, from true *Hydromys* under the generic term *Limnomys*. Finding *Limnomys* preoccupied by *Limnomys* Mearns[6] he proposed[7] instead *Drosomys*, but his action had been forestalled by Poche[8] who had set up the term *Parahydromys*. Later[9] came the highly aquatic *Crossomys* also from New Guinea, and quite recently *Pseudohydromys* Rümmler.[10]

Of the nine genera, *Xeromys*, *Leptomys*, *Chrotomys*, *Crunomys*, *Celaenomys*, and *Pseudohydromys* are terrestrial, and the remainder aquatic, *Parahydromys* much less so than *Hydromys* and *Crossomys*. It should be noted that Thomas referred *Crunomys* to the Hydromyinae with some doubt on account of the greatly worn molars from which he could gain only unsatisfactory data and on account of his ignorance of the mammary formula.[11]

As the matter appears at present, it seems not improbable that a primary reorganization of the molar teeth, perhaps correlated with a gradual change in habitat to moist places and river banks, where food was predominantly composed of small arthropods and mollusca took place. The teeth thus became crushing organs instead of grinding organs. In addition to the change in character of the molars, modifications in other structures appeared. Truncation of the nasal bones is

[1] 1889, Proc. Zool. Soc. London, pp. 247–250.
[2] Thomas, 1895, Ann. Mag. Nat. Hist., (6) XVI, p. 161.
[3] Thomas, 1898, Trans. Zool. Soc. London, XIV, pp. 390–393.
[4] Thomas, 1897, Ann. Mus. Civ. Genova, (2) XVIII, pp. 610–611.
[5] Thomas, 1906, Ann. Mag. Nat. Hist., (7) XVII, pp. 325–326.
[6] 1905, Proc. U. S. Nat. Mus., XXVIII, p. 451.
[7] Thomas, 1906, Proc. Biol. Soc. Wash., XIX, p. 199.
[8] 1906, Zool. Anzeiger, XXX, p. 326.
[9] Thomas, 1907, Ann. Mag. Nat. Hist., (7) XX, pp. 70–72.
[10] 1934, Zeits. f. Säugetierk., IX, p. 47
[11] Rümmler, 1934, Zeits. f. Säugetierk., IX, pp. 47–48, holds that *Crunomys* should be placed in the Murinae rather than in the Hydromyinae.

seemingly present in all of the aquatic genera, but it occurs also in *Xeromys*, *Celaeonomys*, and *Chrotomys*. It is also observable in the highly aquatic but unrelated Neotropical Ichthyomyine genera. In *Crunomys* and *Leptomys*, however, it has not taken place. It should therefore not be regarded as a response to aquatic conditions solely. Its relation to the rhinarium and other soft parts is unknown. Flattening of the skull is apparently developed in relation to penetration of a rather resistant medium—water, rotting vegetation, or soil. It may be seen well developed in the present aquatic genera, in the aquatic Ichthyomyine rodents, also in burrowing murids and cricetids such as *Rhynchomys*, and in some Insectivora (moles). All of these animals may be assumed to use the head and neck muscles to assist the limbs in driving the animal through the surrounding medium.

The unusual form of the zygomatic plate in all genera except *Xeromys*, (which was one of the characters stressed by Thomas in his discussions of *Xeromys* and of *Crunomys*), the enlarged infraorbital opening, lack of a zygomatic notch, and the development of a tubercle-like process for the accommodation of the origin of the superficial head of the masseter muscle, may all have occurred in response to peculiarities in sensory and muscular apparatus for detecting and manipulating crustacean and molluscan food. A further example of convergence can be seen in the development of an identical structure in the South American *Ichthyomys*. The masseteric tubercle seems to represent an aquatic adaptation, for though present in *Parahydromys* and *Hydromys*, it cannot be observed in illustrations of the skulls of any Philippine genus or of *Xeromys*. In *Leptomys* it is weakly developed. As regards the auditory apparatus, the outer conch is little or not at all reduced in *Leptomys*, *Celaenomys*, and *Crunomys*. In *Chrotomys* and *Xeromys*, *Hydromys* and *Parahydromys*, some diminution in size may be noted. Reduction is carried to its extreme in the case of *Crossomys*. In the same way the audital bullae of the more terrestrial forms, though rather small in proportion to those of *Rattus*, fail to reach the extreme reduction in size of those of the aquatic genera.

Touching again upon the dentition of this subfamily, the likelihood of very early development of the basined-molar form must be conceded. Such a tooth form (Figs. 31, 32) could well have reached a high stage of completion merely in response to new types of food and long before changes in the direction of an aquatic life were initiated. The tendency towards loss of the third molars, coupled with a corresponding enlargement of the first molars, may be assumed to have been acquired before

aquatic specializations developed, since it appears in the terrestrial *Celaenomys* and in *Pseudohydromys*. Also worthy of notice as possibly of subfamily value are the "multiple roots" found in *Hydromys chrysogaster* by Wood-Jones.[1]

The external characters of the Hydromyinae—pelage, ears, eyes, feet, and tail, like those of the skull and teeth, betray successive changes from land-inhabiting rats to aquatic rats. The strongly differentiated genera with their scattered distribution must belong to an ancient stock, which no doubt once had a wider area of distribution, probably originating on the mainland of southern Asia.

Before discussing the genera of Hydromyinae represented in the Archbold collections, it may be of interest to list the points of similarity between the *Hydromys*-like rats of Australasia with the unrelated *Ichthyomys*-like rats of South America. *Ichthyomys* agrees with *Hydromys* in possessing the following characters[2]:

HYDROMYS AND ICHTHYOMYS COMPARED

1.—General form of the skull, flattened dorsal surface with depressed fore brain region.

2.—Extreme constriction of the interorbital region.

3.—Nearly identical form of zygomatic plate of the maxillary, coupled with the presence of highly developed tubercles at the anterior and inferior margin of the zygomatic plate, for attachment of the pars superficialis of the masseter (Fig. 32, a^1, a^2).

4.—Great anterior abbreviation of the nasals.

5.—General similarity of the molars in developing basin-like depressions of the crowns.

The following differences between the two genera appear:

HYDROMYS	ICHTHYOMYS
1.—Anterior palatal foramina very short.	1.—Anterior palatal foramina very long.
2.—Paroccipital processes very long and slender.	2.—Paroccipital processes short.
3.—Auditory meatus semi-tubular.	3.—Meatus not tubular.
4.—Palate projecting little behind molars.	4.—Palate projecting much behind molars.

LEPTOMYS THOMAS

Leptomys THOMAS, 1897, Ann. Mus. Civ. Genova, XVIII, p. 610.

Most of the characters of the genus have been pointed out already by Thomas and Rümmler. Attention is here drawn to the feet, the elon-

[1] 1922, Proc. Zool. Soc. London, pp. 587–598.

[2] Attention was first drawn to this matter by Thomas, 1898, Trans. Zool. Soc. London, XIV, p. 393.

gate metatarsal portion and short digits of which suggest that the animals have leaping habits.

The skull of *Leptomys* is in some respects similar to that of *Xeromys* of Queensland, as illustrated by Thomas, major distinctions between them consisting in the reduction of the molars in *Xeromys* to 2/2, as well as its short nasals. The foot in *Xeromys* is a normal, terrestrial organ.

Leptomys ernstmayri Rümmler

Leptomys ernstmayri Rümmler, 1932, Das Aquarium, VI, p. 135, August.

Material.—A. M. 104199, 101200 (both adult ♂s) from Mafulu, Central Division, Papua, 1250 meters.

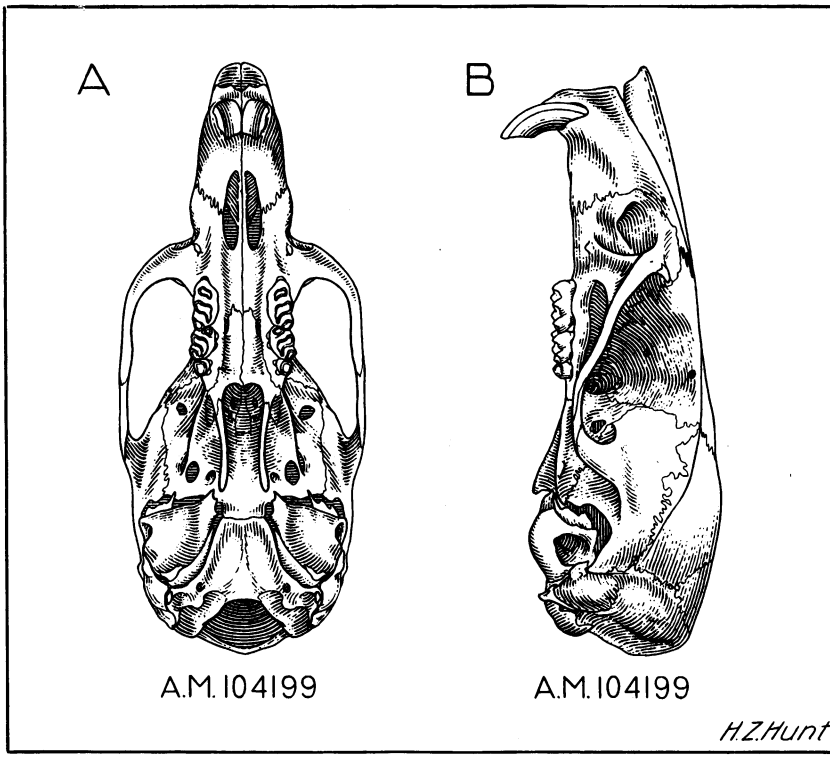


Fig. 31. Ventral and lateral views of skull of *Leptomys ernstmayri*.

Structures to be noted are the hydromyine molars with persistence of m^3; narrowed zygomatic arches but widened mastoid region; and excavated anterior margin of the zygomatic plate. Scale × 2/3.

This material has been compared carefully with the original descriptions of *elegans* and of *ernstmayri*. Its reference to the latter is due to the possession of a depressed frontal region, short rostrum, quite short incisive foramina, rather rounded and comparatively unflattened bullae (see photograph by Rümmler), sharply different form of zygomatic plate, etc.

In pelage our specimens agree more closely with *elegans* than with *ernstmayri*, i.e., with "under surface from chin to anus creamy white" (Thomas). They do not resemble "stomach gray-brown, each hair with a gray base, followed closely with a light brown band, gradually changing into an almost imperceptible white tip." (Rümmler.)

The distribution of this species appears to be wide: Rümmler records it from the Saruwaged Mts., Huon Peninsula (type), upper Aroa River, Papua, and Arfak Mts. in western Dutch New Guinea. Our material, it will be noted, comes from near the Aroa River.

The type locality of *elegans* is uncertain but Rümmler lists a second specimen from the Austrolabe Range, near Port Moresby, Central Division, Papua. It is to be noted that Rümmler's illustration is not that of the type skull of *elegans*.

MEASUREMENTS.—See pp. 724–725.

ILLUSTRATIONS.—Skull, Fig. 31A, B.

PARAHYDROMYS POCHE

Limnomys THOMAS, 1906, Ann. Mag. Nat. Hist., (7) XVII, p. 325 (a homonym).
Parahydromys POCHE, 1906, Zool. Anzeiger, XXX, p. 326.
Drosomys THOMAS, 1906, Proc. Biol. Soc. Wash., XIX, p. 199.

TYPE.—*Limnomys asper* Thomas.

In addition to the generic characters so fully set forth in the description of *Limnomys* by Thomas, there appears upon the labels of the two specimens in the Archbold collection the notations by Shaw Mayer "upper lip three times as large as in dried skin" and "top lip greatly bulged out." This enlargement of the lips is probably a character of generic importance and may well be correlated anatomically with the peculiar shortening of the skull in *Parahydromys*. The thickening of the lips may be due to increase in tissue of an adipose or glandular nature and may be further connected with the highly developed vibrissal armament and with the detection of food.

Parahydromys asper (Thomas)

Limnomys asper THOMAS, 1906, Ann. Mag. Nat. Hist., (7) XVII, p. 326.

TYPE LOCALITY.—"Mt. Gayata, Richardson Range, British New Guinea." (Part of Owen Stanley Range.) About 1000 meters.

MATERIAL.—A. M. 101950 and 101951 (field nos. 172 and 220, respectively) both adult females, collected by F. Shaw Mayer at Gebroeders, Weyland Range, Dutch New Guinea, 1800 meters. The first, judged by the slight degree of dental wear, is a relatively young animal. The second has lost the right m^2 and the empty alveoli are partly filled in by bone. Its remaining molars are greatly worn. In addition a male and female also from Weyland Range collected by R. Stein.

These animals, though taken from nearly 1000 miles west of the type locality, tally closely with Thomas's description of the skin. Cranial measurements are given (page 724) for comparison with those of the male which the describer had before him. The visible divergence is apparently due solely to age and sex. The mammary formula is 0–2 = 4.

Jentink recorded[1] and figured the skull of a specimen (sex not stated) from high in the Hellwig Mountains, South Dutch New Guinea, collected by Lorentz.

Recently Rothschild and Dollman[2] recorded one male and three females from the Gebroeders Range, two of which are now in the Archbold collection. Stein[3] denies that *Parahydromys* is an aquatic form at all. He states that it occurs in rocky places in the forest high on the mountains and is independent either of still or running water.

HYDROMYS E. GEOFFROY

Hydromys E. GEOFFROY, 1805, Ann. Mus. Paris, VI, pp. 81–90, 180.

As erected by Geoffroy, *Hydromys* was a composite genus comprising the coypu rat of South America and two species of true *Hydromys*, *chrysogaster* and *leucogaster*. However, because Kerr's[4] term *Myocaster* was already established for the coypu, *Hydromys* remained based upon *chrysogaster* and *leucogaster*, and since *leucogaster* was at best merely a form of *chrysogaster*, the latter became genotype by monotypy.

Chrysogaster is a peripheral species of *Hydromys* in regard to geographical position, and since the genus must in all probability have reached Australia and New Guinea from the north, it may well be atypical for the genus considered as a whole. However, if Matthews'[5] thesis holds for the present case then *chrysogaster* being geographically peripheral may be expected to show primitive characters, while those of northern Australia and New Guinea ought to present more progressive

[1] Jentink, 'Nova Guinea,' IX, p. 6, Pl. 1, fig. 7–9.
[2] 1933, Proc. Zool. Soc. London, p. 213.
[3] 1933, Zeits. f. Säugetierk., VIII, Heft 1/2, p. 123.
[4] 1792, 'Animal Kingdom,' p. 225.
[5] 1915, 'Climate and Evolution.'

or more recently acquired characters. The discovery of the northern species has done little, however, to modify the original generic concept. The species of the New Guinea region are definitely smaller animals than most of those of Australia and, according to Thomas,[1] *H. longmani* from north Queensland is said to be somewhat less specialized for aquatic life than the others are.

The species and subspecies of *Hydromys* recorded prior to 1935, together with their approximate ranges, are as follows:

nauticus Thomas	Aru Islands
beccarii Peters	Kei Island
esox esox Thomas	Southern New Guinea
esox illuteus Thomas	Idenburg R., N. Dutch New Guinea
longmani Thomas	North Queensland
chrysogaster reginae Thomas and Dollman	North Queensland
melicertes Thomas	Melville Island
chrysogaster fulvolatus Gould	Central Australia
chrysogaster caurinus Thomas	Northwest Australia
chrysogaster fuliginosus Gould	Southwest Australia
chrysogaster chrysogaster E. Geoffroy	Southeast Australia and Tasmania

To the above is added a record of a *Hydromys* from Waigeu Island, one from Goodenough Island, D'Entrecasteaux Islands, and a third, *neobrittanicus*, from New Britain, Solomon Islands.

In a subsequent table (pp. 725–726) the measurements of the recognized species and subspecies of *Hydromys* are compared. Although many dimensions are lacking which it is desirable should be filled in, enough can be seen to show that the *Hydromys* of New Guinea and its off-shore islands to the west comprise relatively small forms. The scanty measurements available suggest that all of these have fairly narrow molars and wide palates. To this group may be added *melicertes* of Melville Island and *longmani* of North Queensland, as well as our specimen A. M. 79829 from the D'Entrecasteaux Islands. The *chrysogaster* group of Australia generally includes, as a rule, animals of larger size in which the width of palate between the first molars, proportionately to the width of m^1, is much greater than in the New Guinea group. The reverse of this condition holds in the case of *neobrittanicus*. In it the molars are much widened in proportion to the width of the palate.

The animal from Waigeu Island (F. M. 31847) represents the most westerly record of *Hydromys* in the New Guinea area. This interesting

[1] 1923, Ann. Mag. Nat. Hist., (9) XI, p. 171.

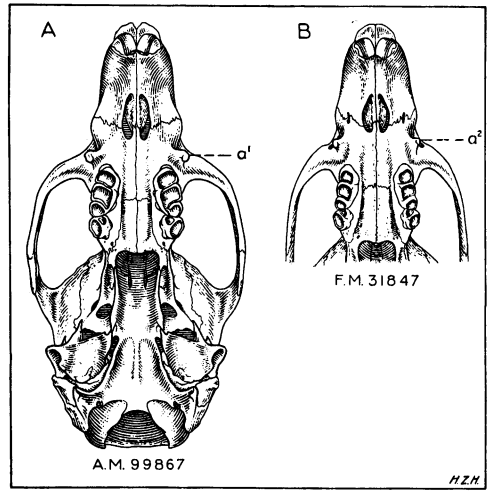


Fig. 32. Ventral views of skulls of *Hydromys esox* and *Hydromys neobrittanicus*.

Note large size of the first molars in *H. neobrittanicus* compared with normal size of same teeth in *H. esox*. The masseteric tubercles a^1, a^2 are easily observable (see p. 639). Scale: approximately 7/4.

specimen, whose molars are the narrowest of any recorded in our table, agrees essentially in color with descriptions of *nauticus* and *beccarii* and can scarcely be differentiated from that of *esox*. It is worth noting that both of our specimens and the type of *nauticus* were taken at night on the sea-beach.

In view of the likelihood that the water rats bearing the names *beccarii*, *nauticus*, and *esox* will prove to be conspecific, the Waigeu Island specimen is here identified provisionally as *Hydromys beccarii* Peters and Doria. The individual in alcohol (skull cleaned) from Goodenough Island (A. M. 79829, ad. ♂) is referred to *esox* and with probability to the subspecies *e. esox*.

MEASUREMENTS.—See p. 726.

ILLUSTRATIONS.—Anterior part of skull, Fig. 32B.

Hydromys neobrittanicus Tate and Archbold

Hydromys neobrittanicus TATE AND ARCHBOLD, 1935, Amer. Mus. Novit. No. 803, p. 8.

This *Hydromys* from New Britain, interesting because of its melanic color scheme and unusual breadth of the molar teeth, has been described fully in the original notice.

MEASUREMENTS.—See p. 726.

ILLUSTRATIONS.—Skull, Fig. 32A.

TABLES OF MEASUREMENTS

(For explanatory footnotes to these tables, see page 727.)

	A.M.14725 ad. ♂ *diezadrinus* Florida, U. S. A.	Type *diardii* ex Jent. West Java	*diardii* A.M.102005 y. ad. ♂ Cheribon, Java	*diardii* A.M.102111 y. ad. ♂ Cheribon, Java	*diardii* A.M.101845 y. ad. ♀ Cheribon, Java	Type *neglectus* ex Jent. S. E. Borneo
Skin:						
head and body	169	218[2]	152	193	155	225
tail	222	178[2]	170	195	192	
hind foot (s.u.)	34[1]	34	34[1]	37[1]	35[1]	37
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	44.5		41.2	43.5	40.5	
basal length						
basilar length						
zygomatic breadth	21.0		19.3	19.4	19.0	
inter-orbital breadth	6.1		6.5	7.0	5.6	
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	16.2		14.6	15.9	14.0	
nasals, greatest breadth						
zygomatic plate						
diastema	11.8	12.0	11.4	12.0	10.5	12.0
height muzzle behind inc.						
palatilar length	20.5		19.5	20.7	20.0	
palatal length						
ant. palatal foramina	8.3		7.8	8.2	7.5	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	8.0		6.5	7.0	7.0	
length mandible						
Teeth:						
crowns m^{1-3}	6.4	6.5	6.2	6.6	6.5	7.0
alveoli m^{1-3}	7.3		6.3	7.0	6.8	
crowns m^{1-2}						
m^1, length × breadth	2.9×1.8		2.8×1.8	3.0×1.8	3.0×1.8	
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

[1] For explanatory footnotes to this and following tables, see page 727.

	Type *korinchi* ad. ♀ ex Kloss West Sumatra	Type *argentiventer* ad. ♂ ex Kloss West Sumatra	Type *roquei* ad. ♂ ex Sody, 1930 Middle Java	*jalorensis* (= *roquei*)		
				A.M.101523 ad. ♀ Cheribon, Java	A.M.101548 ad. ♀ Cheribon, Java	A.M.101547 ad. ♀ Cheribon, Java
Skin:						
head and body	166	184	190	152	154	152
tail	224	173	215	182	175	198
hind foot (s.u.)	34	32	35	30[1]	31[1]	31.5[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length			40			
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	41.0	41.0	45.5	42.0	40.0	40.5
basal length						
basilar length						
zygomatic breadth	19.0	19.8		19.6	19.6	19.0
inter-orbital breadth			7.5	6.5	6.1	5.9
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	15.3	14.7	17.5	14.5	14.1	14.5
nasals, greatest breadth	4.9	4.2	5.0			
zygomatic plate						
diastema	10.9	11.0	13.0	11.3	10.4	10.2
height muzzle behind inc.						
palatilar length				19.5	19.2	18.9
palatal length			25.5			
ant. palatal foramina	8.2	8.5		7.6	7.1	6.7
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla				7.0	7.3	7.1
length mandible						
Teeth:						
crowns m^{1-3}			7.5	6.9	6.7	6.6
alveoli m^{1-3}	7.9	7.9		7.1	6.9	6.8
crowns m^{1-2}						
m^1, length × breadth				3.2×2.0	3.0×2.0	2.9×1.9
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.102587 ad. ♀ Type *palembang* Palembang, Sumatra	A.M.102579 ad. ♂ *palembang* Palembang, Sumatra	A.M.102576 y. ad. ♀ *palembang* Palembang, Sumatra	Type *maerens* old ad. ♀ ex Miller Nias	Type *rhionis* ad. ex Miller Rhio	A.M.101546 y. ad. ♂ *brevicaudatus* Cheribon, Java
Skin:						
head and body	173	174	162	178	187	154
tail	203	195	177	168	187	
hind foot (s.u.)	35[1]	35[1]	32[1]	33	35	32[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length				39.8		
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	40.0	40.7	38.8		44.0	37.3
basal length						
basilar length						
zygomatic breadth	19.7	18.6	18.0	20.2	20.0	17.8
inter-orbital breadth	6.0	6.1	6.1	6.8		5.4
interparietals						
breadth braincase				16.0	16.0	
mastoid breadth						
nasals, length	14.0	14.4	13.5			12.8
nasals, greatest breadth						
zygomatic plate						
diastema	11.1	10.8	10.9		13.0	9.3
height muzzle behind inc.						
palatilar length	19.8		18.8			17.4
palatal length						
ant. palatal foramina	7.0	7.0	6.7			7.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	7.1	7.1	6.7			7.1
length mandible						
Teeth:						
crowns m^{1-3}	7.1	6.8	6.1	6.6	6.7	6.6
alveoli m^{1-3}	7.3	7.0	6.6			6.8
crowns m^{1-2}						
m^1, length × breadth	3.2×2.0	3.1×2.0	3.1×1.9			3.5×2.1
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101544 y. ad. ♂ *brevicaudatus* Cheribon, Java	A.M.101522 ad. ♀ *brevicaudatus* Cheribon, Java	Type *septicus* ex Sody Banda Neira	Type *samati* ad. ♂ Bali	Type *santalum* ad. ♂ Soemba	A.M.101708 ad. ♂ Cheribon, Java
Skin:						
head and body	160	158	166	181	190	255[3]
tail	152	164	193	172	189	196
hind foot (s.u.)	33[1]	33[1]	37	33	40	42
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						48.2
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	38.1	37.5	41.2	39.8	45	49.8
basal length						
basilar length						42.0
zygomatic breadth	18.4	18.7	20.1	18.3	21.0	24.1
inter-orbital breadth	5.3	5.5	6.2	6.3	6.5	7.0
interparietals						
breadth braincase				15.3	17.0	
mastoid breadth						
nasals, length	13.0	13.3	15.7	14.6	17.0	18.3
nasals, greatest breadth				4.3	5.0	
zygomatic plate						
diastema	10.4	10.0	11.3	11.0	13.0	14.0
height muzzle behind inc.						
palatilar length	18.5	17.6				24.0
palatal length				21.3		27.1
ant. palatal foramina	7.5	7.2	7.9	7.7	9.7	8.2
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.8	6.7				8.3
length mandible						
Teeth:						
crowns m^{1-3}	7.0	6.7	7.3	6.6	7.8	7.1
alveoli m^{1-3}	7.3	7.1				7.5
crowns m^{1-2}						
m^1, length × breadth	3.4×2.1	3.1×2.1				3.4×2.0
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101776 ad. ♀ Koeningan, Java	Type *turbidus* y. ad. ♀ ex Miller Borneo	Type *dammermanni* ad. ♀ ex Thomas N. Celebes	Type *praestans* = *major* ex Hoffmann N. Celebes	Type *pesticulus* ad. ♀ ex Thomas N. Celebes	A.M.101275 ad. ♀ *pesticulus* N. Celebes
Skin:						
head and body	232[3]	189	206		151	168
tail	209	233	252		148	184
hind foot (s.u.)	44	37.5	43		30	34[1]
hind foot (c.u.)				54?		
ear						
Skull:						
total length						
condylo-basal length	46.1					
condylo-incisive length			48.0		36.0	
condylo-basilar length						
occipito-nasal length	47.3	40.7	50.0	42.8	37.5	42.5
basal length						
basilar length	40.5					
zygomatic breadth	24.3	19.6	25.0		18.0	19.8
inter-orbital breadth	7.0	6.8	7.3			6.0
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	17.0	15.8	19.7		13.0	16.0
nasals, greatest breadth						
zygomatic plate			6.0			
diastema	13.3	11.4				11.6
height muzzle behind inc.						
palatilar length	23.1		24.0[4]		18.5	20.0
palatal length	26.0					
ant. palatal foramina	8.2		9.1	9.1	7.4	8.2
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	8.0					6.5
length mandible						
Teeth:						
crowns m^{1-3}	7.4		8.0	7.6	6.5	6.7
alveoli m^{1-3}	8.0	6.8				7.2
crowns m^{1-2}						
m^1, length × breadth	3.5×2.2					3.0×2.0
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101278 y. ad. ♀ *pesticulus* N. Celebes	A.M.101024 ad. ♀ Type *talotis* S. E. Celebes	Type *doriae* ad. ♀ = *beccarii* ex Jentink, 1906 Sorong, New Guinea	Cotype *gestri* ♂ ex Thomas Kapa Kapa, New Guinea	Cotype *gestri* ♀ ex Thomas Kapa Kapa, New Guinea	Type *vanheurni* ad. ♀ ex Sody Manokwari, New Guinea	F.M.31842 y. ad. ♂ *vanheurni* Manokwari, New Guinea
Skin:							
head and body	150	152	180	158	144	140	148
tail	183	215	200	111	115	125	162
hind foot (s.u.)	34[1]	40	38	28	28	31	31.5
hind foot (c.u.)							33.0
ear							
Skull:							
total length						35.0	38.0
condylo-basal length						30.5	35.6
condylo-incisive length							
condylo-basilar length							
occipito-nasal length	39.5	46.5					
basal length							
basilar length					30		30.3
zygomatic breadth	18.2	21.6			18	17	18.1
inter-orbital breadth		6.1			5	6	5.7
interparietals							5×9.6
breadth braincase						15.5	15.2
mastoid breadth							
nasals, length	13.5	16.8				13	13.0
nasals, greatest breadth		4.5				4	3.8
zygomatic plate							4.1
diastema		13.0				9	10.2
height muzzle behind inc.							
palatilar length	18.5				17.7		18.0
palatal length						18.0	
ant. palatal foramina	7.6	8.8				6.5	7.4
breadth meso.-pter. fossa							
width inside $m^1 - m^1$							
length bulla	6.4	8.3					
length mandible							
Teeth:							
crowns m^{1-3}	6.6	7.2			6.6	6.7	6.4
alveoli m^{1-3}		7.6					6.5
crowns m^{1-2}							
m^1, length × breadth	3.2×2.0	3.2×2.1					
m^2, length × breadth							
m^3, length × breadth							
crowns, m_{1-3}							

	F.M.33053 ad. ♀ Sandakan, N. Borneo	A.M.102154 ad. ♀ West Bali	A.M.102154 ad. ♂ West Bali	*ravani* (type) ad. ♂ North Celebes	*eurous* (type) ad. ♂ North Celebes	A.M.101049 ad. ♂ Lalolis, S. E. Celebes
Skin:						
head and body	117			123	110	122
tail	126			150	135	120
hind foot (s.u.)	23	25	25.5			24.5
hind foot (c.u.)				27	24	
ear						
Skull:						
total length						
condylo-basal length	28.5			29.0	28.3	
condylo-incisive length	28.1	30.3	30.8			28.1
condylo-basilar length						
occipito-nasal length		33.6	34.1			
basal length		28.5				
basilar length	24.1	26.0				24.2
zygomatic breadth	14.4	16.0	15.6	14.4	13.9	14.3
inter-orbital breadth	4.8	4.6	4.9	4.9	4.6	4.8
interparietals	4.1×9	4.3×8.1	4.0×8.8			4.7×9.5
breadth braincase	13.1	13.2	13.5	13.2	13.2	13.4
mastoid breadth						
nasals, length		11.7				10.5
nasals, greatest breadth						
zygomatic plate	2.9	3.5	3.4			
diastema	7.5	8.6				8.0
height muzzle behind inc.						
palatilar length	14.0	15.0				14.0
palatal length		17.4		16.5	15.2	
ant. palatal foramina	5.3× —	6.3×2.1	6.3× —			5.2× —
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.5	6.2	6.0			5.8
length mandible						
Teeth:						
crowns m^{1-3}	5.3	5.4	5.4	5.6	5.3	5.0
alveoli m^{1-3}	5.5	5.8	6.1			5.2
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101048 ad. ♂ Lalolis, S. E. Celebes	A.M.101046 ad. ♀ Lalolis, S. E. Celebes	A.M.100987 ad. ♂ s. Lampobatang, Celebes, 1100 m.	A.M.100991 ad. ♀ s. Lampobatang, Celebes, 1100 m.	A.M.100986 ad. ♀ s. Lampobatang, Celebes, 1100 m.	A.M.101190 ad. ♂ s. Lampobatang, Celebes, 2500 m.
Skin:						
head and body	123	108	112	103	105	113
tail	121	122	121	121	120	113
hind foot (s.u.)	24.0	23.0	24.0	23.0	23.5	24.0
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length	29.2	28.5			26.7	25.8
condylo-basilar length						
occipito-nasal length						
basal length	32.0		30.4		29.2	29.2
basilar length	24.9		24.0		22.6	22.0
zygomatic breadth	15.3	15.5	14.2			13.5
inter-orbital breadth	4.8	5.0	4.5	4.6	4.5	4.4
interparietals	4.7×10		3.5×8.2		3.6×8.5	4.0×8.2
breadth braincase	14.0	13.7	12.8	12.2	12.4	12.5
mastoid breadth						
nasals, length	11.5	10.3	10.0	10.0	10.0	9.2
nasals, greatest breadth						
zygomatic plate					2.7	2.7
diastema	7.9	8.6	7.7	7.3	7.0	7.2
height muzzle behind inc.						
palatilar length	14.3	13.9	13.4	13.1	12.9	13.0
palatal length						
ant. palatal foramina	5.6× —	5.7× —	5.5× —	5.5× —	5.6× —	5.3× —
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.9	5.5	5.8	5.6	5.8	5.3
length mandible						
Teeth:						
crowns m^{1-3}	5.1	4.8	4.9	4.9	5.0	4.6
alveoli m^{1-3}	5.4	5.1	5.2	5.2	5.2	4.8
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	aemuli (type) ad. ♂ Saleyer, S. of Celebes	*wichmanni* (type) ad. ♂ Flores	*manoquarius* (type) ad. ♂ Sea level, west New Guinea	*lassacquerei* (type) ad. ♀ West New Guinea, 1800 m.	F.M.31832 old ad. ♂ Sepik R., New Guinea	F.M.31836 y. ad. ♂ Sepik R., New Guinea
Skin:						
head and body	134	125	114	107	147	122
tail	172	100	110	121	143	132
hind foot (s.u.)	30	23	24	25.5	26.5	26.0
hind foot (c.u.)						
ear						
Skull:						
total length			31.7	32.9	34.7	31.0
condylo-basal length						
condylo-incisive length					32.0	
condylo-basilar length						
occipito-nasal length		30.0				
basal length	30.2					
basilar length	28				28.0	
zygomatic breadth	16.5	14.0	15.1	15.8	16.3	14.2
inter-orbital breadth	5.6		5.0	5.3	5.3	
interparietals	5.3×10					
breadth braincase			13.2	13.8	13.4	
mastoid breadth						
nasals, length	12.8	11.0	11.2	12.0	12.8	11.0
nasals, greatest breadth	3.9					
zygomatic plate	3.5				3.3	
diastema	9.7	7.0	8.0	8.3	8.8	
height muzzle behind inc.						
palatilar length					15.5	
palatal length			16.7	17.2		
ant. palatal foramina	6.5×2.7		5.7	5.9	6.0	5.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla					6.0	
length mandible						
Teeth:						
crowns m^{1-3}	5.7	5.0	5.0	5.7	5.2	5.3
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	F.M.31829 y. ad. ♀ Sepik R., New Guinea	F.M.31828 y. ad. ♀ Sepik R., New Guinea	A.M.79753 y. ad. ♂ Cromwell Mts.	A.M.104220 ad. ♂ *manoquarius* Central Division Papua	A.M.104375 y. ad. ♂ *manoquarius* Central Division, Papua	A.M.104241 y. ad. ♂ *manoquarius* Central Division, Papua, 1250 m.
Skin:						
head and body	137	133	108[5]	145		133
tail	135	131	116[5]	152		131
hind foot (s.u.)	25.5	25.5	23[5]	26.5		26.0
hind foot (c.u.)						
ear						
Skull:						
total length	31.5	32.7	30.6	33.5	30.3	28.4
condylo-basal length						
condylo-incisive length	29.4	30.1	27.5	30.1	27.4	
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length	25.5	25.7	24.0	26.3	23.6	
zygomatic breadth	15.3	15.4	14.0	15.3	14.4	
inter-orbital breadth	4.9	4.8	4.6	5.4	5.1	
interparietals		4.8×8.6	4.2×8.5	4.9×9.9	4.3×8.9	
breadth braincase	13.0	13.0	12.8	12.9	12.6	
mastoid breadth						
nasals, length	11.0	11.2	10.7	12.4	10.8	
nasals, greatest breadth						
zygomatic plate	3.0	3.2	3.0	3.1	3.0	
diastema	8.0	8.3	7.5	8.2	7.7	7.4
height muzzle behind inc.						
palatilar length	14.1	14.4	13.0	14.5	13.7	
palatal length						
ant. palatal foramina	5.5	5.5	5.3	6.0	5.5	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.6	5.9	5.7	5.9	5.7	
length mandible						
Teeth:						
crowns m^{1-3}	5.1	5.2	5.4	5.1	4.7	4.9
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104250 y. ad. ♂ *manoquarius* Central Division, Papua, 1250 m.	A.M.104237 y. ad. ♀ *manoquarius* Central Division, Papua	*browni* (co-type) ♂ Duke of York Island	*browni* (co-type)[6] ♀ Duke of York Island	*echimyoides* (type) Duke of York Island	A.M.79818 ad. ♂ Bougainville Isl.
Skin:						
head and body	136	127	142	130	140	127[7]
tail	129	123	124	114	117	165[7]
hind foot (s.u.)	26.5	24.0	25.4	24.1	25.4	25.0
hind foot (c.u.)						
ear						
Skull:						
total length	30.7	29.9				34.3
condylo-basal length						
condylo-incisive length						31.5
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						27.5
zygomatic breadth	14.4	14.2				16.0
inter-orbital breadth						5.5
interparietals						5.3×8.9
breadth braincase						13.5
mastoid breadth						
nasals, length	10.6	10.0				12.2
nasals, greatest breadth						
zygomatic plate						
diastema	7.5	7.7				8.7
height muzzle behind inc.						
palatilar length						15.3
palatal length						
ant. palatal foramina						5.8
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.9	5.5				6.0
length mandible						
Teeth:						
crowns m^{1-3}	5.2	4.9				5.5
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus concolor Group (Continued)			*Rattus mülleri* Group		
	A.M.79816 ad. ♂ Bougainville Island	A.M.79819 ad. ♀ Bougainville Island	A.M.79817 y. ad. ♀ Bougainville Island	A.M.102548 ad. ♂ Palembang, S. Sumatra	A.M.102549 ad. ♀ Palembang, S. Sumatra	A.M.102848 ad. ♂ Kalianda, S. Sumatra
Skin:						
head and body	141[7]	139[7]	114[7]	225	221	230
tail	141[7]	139[7]	139[7]	280	248	278
hind foot (s.u.)	26.0	26.5	24.5	46	44	46
hind foot (c.u.)						
ear						
Skull:						
total length	34.3	33.3	31.5			
condylo-basal length				49.3	49.3	50.0
condylo-incisive length	31.2	30.4	28.4			
condylo-basilar length						
occipito-nasal length				52.4	52.3	54.1
basal length						
basilar length	27.4	26.5	24.2	42.3	42.2	42.4
zygomatic breadth	16.0	15.4	15.2	25.7	25.7	25.2
inter-orbital breadth	5.4	5.2	5.4	7.6	7.4	7.9
interparietals	5.1×9.9	4.2×8.8				
breadth braincase	13.7	13.1	13.5			
mastoid breadth						
nasals, length	12.0	12.0	10.5	20.1	19.5	21.3
nasals, greatest breadth						
zygomatic plate		3.2	2.9			
diastema	8.9	9.5	7.8	14.1	14.5	14.3
height muzzle behind inc.						
palatilar length	15.6	15.1	13.7	24.2	24.6	24.0
palatal length				28.8	28.2	28.3
ant. palatal foramina	5.9	5.8	5.5	8.4	8.5	9.0
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.9	5.9	5.4	6.5	6.4	6.3
length mandible						
Teeth:						
crowns m^{1-3}	5.4	5.3	5.3	9.7	8.7	9.4
alveoli m^{1-3}				10.1	9.0	10.0
crowns m^{1-2}						
m^1, length × breadth				4.5×2.8	4.2×2.6	4.5×2.7
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus mülleri Group (Continued)			*Rattus ringens* Group		
	A.M.102849 y. ad. ♀ Kalianda, S. Sumatra	A.M.102846 ad. ♀ Kalianda, S. Sumatra	A.M.102847 ad. ♀ Kalianda, S. Sumatra	*ringens* (type) Fly River	A.M.104526 ad. ♂ (skin only) *ringens* Oriomo River	A.M.104529 ad. ♂ (skin only) *ringens* Oriomo River
Skin:						
head and body	209	223	213	190	184	180
tail	240	258	250	160	168	161
hind foot (s.u.)	42	44	43	38	37[1]	34.5[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	46.3	49.0	48.9			
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	49.1	51.7	51.0			
basal length						
basilar length	39.7	42.0	42.0			
zygomatic breadth	23.7	25.6	25.0			
inter-orbital breadth	7.3	7.7	7.5			
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	19.0	19.3	18.2			
nasals, greatest breadth						
zygomatic plate						
diastema	12.3	14.0	14.5			
height muzzle behind inc.						
palatilar length	23.0	23.6	24.5			
palatal length	26.3	28.0	27.9			
ant. palatal foramina	7.9	8.5	7.9			
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.3	6.7	6.2			
length mandible						
Teeth:						
crowns m^{1-3}	8.8	9.0	8.8			
alveoli m^{1-3}	9.4	9.5	9.2			
crowns m^{1-2}						
m^1, length × breadth	4.3×2.7	4.4×2.6	4.3×2.6			
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104518 ad. ♀ *ringens* (skin only) Oriomo River	A.M.104620 *ringens* (skull only) Oriomo River	A.M.104626 *ringens* (skull only) Oriomo River	A.M.104627 *ringens* (skull only) Oriomo River	A.M.104612 *ringens* (skull only) Oriomo River	A.M.104625 *ringens* (skull only) Oriomo River
Skin:						
head and body	182					
tail	144					
hind foot (s.u.)	35[1]					
hind foot (c.u.)						
ear						
Skull:						
total length		42.6	42.4	43.4	44.0	
condylo-basal length						
condylo-incisive length		40.4	39.9	40.5	41.0	42.0
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth		20.2	20.5	20.3	20.1	23.4
inter-orbital breadth		5.9	6.5	5.9	6.5	
interparietals		4.7×10.4	4.7×10	4.4×9.5	5.2×11.2	5.6×10
breadth braincase		15.8	16.2	16.0	16.0	16.2
mastoid breadth						
nasals, length		16.1	15.1	15.9	16.1	
nasals, greatest breadth		4.8	4.8	4.7	5.1	5.0
zygomatic plate		4.5	4.3	3.7	4.2	4.4
diastema		12.0	11.8	12.4	12.3	11.6
height muzzle behind inc.						
palatilar length		20.3	20.1	20.5	21.0	21.2
palatal length						
ant. palatal foramina		8.1×3.4	7.6×3.0	7.5×3.4	8.1×3.5	7.7×3.2
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla		6.5	6.2	6.6	6.6	6.7
length mandible						
Teeth:						
crowns m^{1-3}		7.1	6.8	7.2	7.4	7.3
alveoli m^{1-3}		7.6	7.3	7.6	7.7	7.8
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104613 *ringens* (skull only) Oriomo River	*mordax* (type) Papua	A.M.104214 ad. ♂ *mordax*	A.M.104211 ad. ♂ *mordax*	A.M.104213 ad. ♀ *mordax*	A.M.104223 ad. ♀ *mordax*
Skin:						
head and body		190	206	200		173
tail		136	159			142
hind foot (s.u.)		32	35	34	33.8	34.0[1]
hind foot (c.u.)						
ear						
Skull:						
total length	43.1	8				
condylo-basal length						
condylo-incisive length	40.1		43.8	42.7	40.9	40.4
condylo-basilar length						
occipito-nasal length			45.4	45.4		42.8
basal length			41.4	40.7	38.4	38.3
basilar length			38.0	37.3	35.0	35.0
zygomatic breadth	20.7	22	23	22.6	22.0	21.6
inter-orbital breadth	6.4	6.0	6.1	7.2	6.9	6.3
interparietals	6.1×11.6					
breadth braincase	16.7		16.1	17.1	16.7	16.7
mastoid breadth						
nasals, length	15.9	16.0	17.3	17.4		16.3
nasals, greatest breadth	4.6	5.1	5.4	5.6	5.7	5.5
zygomatic plate	4.2		4.9	4.5	4.6	4.3
diastema	11.6	10.5	12.0	12.4	11.2	11.3
height muzzle behind inc.						
palatilar length	20.6	19.8	22.6	22.5	20.7	20.7
palatal length						
ant. palatal foramina	7.1×3.5	7.6×3	8.5	9.1	8.2	7.8
breadtb meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.3		6.9	6.9	7.0	6.6
length mandible						
Teeth:						
crowns m^{1-3}	7.4	7.2	7.7	7.4	7.6	7.4
alveoli m^{1-3}	7.8		8.6	7.9	8.3	7.9
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	manuselae (type) Ceram	*ratticolor* (type) Noord River	*bandiculus* (type) Mamberano River	*coenorum* (type) Mamberano River	*tramitius* (type) ad. ♀ New N. Dutch Guinea	*praetor* (type) ad. ♀ Guadalcanar
Skin:						
head and body	160	160	252	207	175	168
tail	165	135	220	230	170	118
hind foot (s.u.)	37	37	49	44	35.5	35.5
hind foot (c.u.)						
ear						
Skull:						
total length	42		54	47	41.5	
condylo-basal length			52.6			37.5
condylo-incisive length	39			44.3	38	
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length*						
zygomatic breadth	20		27.5	22.7	20	22
inter-orbital breadth	6.3[9]		7[10]	6.5[9]	6.2	
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	16.6		20	16.6		
nasals, greatest breadth						
zygomatic plate			6.3	5		
diastema						
height muzzle behind inc.						
palatilar length	19.6		27.6	22		
palatal length						
ant. palatal foramina	7.9		10.6×4.8	8.8	7.4	7.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						("small")
length mandible						
Teeth:						
crowns m^{1-3}	7.0		9.1	8.3	7.0	6.6
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	praetor (paratype) ad. ♂ Guadalcanar	A.M.104229 old ♂ *praetor* Central Div., Papua	A.M.104230 ad. ♂ *praetor* Central Div., Papua	A.M.104233 ad. ♂ *praetor* Central Div., Papua	A.M.104228 ad. ♀ *praetor* Central Div., Papua	A.M.104232 ad. ♀ *praetor* Central Div., Papua
Skin:						
head and body	188	179	165	177	159	171
tail	134	133	141	137	132	137
hind foot (s.u.)	35.5	32[1]	33.5[1]	34.5	32[1]	32
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length		39.3	38.1	39.1		38.3
condylo-basilar length						
occipito-nasal length		41.1	40.7	42.1	39.5	41.4
basal length		36.9	36.1	37.0		36.4
basilar length		34.2	33.1	34.1		33.7
zygomatic breadth		21.0	21.0	21.2		21.1
inter-orbital breadth		6.3	6.0	6.3	6.1	6.3
interparietals						
breadth braincase		16.6	16.2	16.4	16.4	16.6
mastoid breadth						
nasals, length		15.7	15.0	16.7	14.5	16.0
nasals, greatest breadth		5.0	5	4.6	4.7	5.0
zygomatic plate		4.4	4.0	4.2	4.2	4.1
diastema		11.2	10.9	10.9	10.2	11.2
height muzzle behind inc.						
palatilar length		20.3	19.2	20.1	19.0	20.2
palatal length						
ant. palatal foramina		8.5	8.0	8.1	7.8	8.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla		6.4	6.6	6.3	6.1	6.4
length mandible						
Teeth:						
crowns m^{1-3}		7.1	6.9	7.5	6.9	7.0
alveoli m^{1-3}		7.8	7.3	8.1	7.3	7.5
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus ringens Group (Continued)			*Rattus hoffmanni* Group				
	A.M.79761 ad. ♂ *praetor* Huon Region, Mand. Terr., New Guinea	A.M.104537 ad. ♂ *praetor* Western Div., Papua	*feliceus* (type) ad. ♀ Ceram	*hoffmanni* (type) ad. ♀ (= *celebensis*) N. Celebes	A.M.101258 ad. ♀ Roeroekan, N. Celebes	*subditivus* (type) ad. ♀	*linduensis* (type) ad. ♀	*mollicomus* (type) ad. ♂
Skin:								
head and body	165[7]		210	200[12]	200	195	170	187
tail	152[7]		172	175[12]	166	165	170	195
hind foot (s.u.)	32[1]	32.5[1]	45	38	37[1]	45	37	40
hind foot (c.u.)								
ear								
Skull:								
total length			51[11]	[13]				
condylo-basal length						44.9	38.9	42.0
condylo-incisive length	37.0	35.8	48					
condylo-basilar length								
occipito-nasal length	41.0				47.2			
basal length	35.4							
basilar length	32.1							
zygomatic breadth	19.0	29.1	24.0		23	20.9	20.5	21.7
inter-orbital breadth	6.1	6.0	7.2		7.0	7.4	5.8	6.0
interparietals								
breadth braincase	16.2		19.5					
mastoid breadth								
nasals, length	14.5	13.5	20.5		18.3			
nasals, greatest breadth		3.9			5.5			
zygomatic plate	3.9			5.8				
diastema	10.7	10.1			13.5			
height muzzle behind inc.								
palatilar length	19.1		25.5		23.8			
palatal length		18.6			26.8	26	21.9	23.9
ant. palatal foramina	7.2	6.7	9.5	8.4	8.9			
breadth meso.-pter. fossa								
width inside $m^1 - m^1$								
length bulla	5.9	6.0		7.3	7.4			
length mandible								
Teeth:								
crowns m^{1-3}	7.1	6.9	8.5	8.6	7.7	7.0	7.4	8.0
alveoli m^{1-3}	7.4	7.3			8.0			
crowns m^{1-2}								
m^1, length × breadth	3.5×2.1			–×2.4	3.7×2.4			
m^2, length × breadth								
m^3, length × breadth								
crowns, m_{1-3}								

	palelae (type) ad. ♀	A.M.101289 old ♀ Bantimoerang, S. W. Celebes	A.M.101062 ad. ♂ *mengkoka* (type) S. E. Celebes	A.M.101238 ad. ♂ *mengkoka* S. E. Celebes	A.M.101067 ad. ♂ *mengkoka* S. E. Celebes	A.M.101134 ad. ♀ (type) *mollicomulus* S. Celebes
Skin:						
head and body	178	180	186	173	175	153
tail	220	180	138	168	132	146
hind foot (s.u.)	36	36[1]	37[1]	37[1]	36[1]	32[1]
hind foot (c.u.)						
ear						
Skull:						
total length			[15]			
condylo-basal length	40.6					
condylo-incisive length						
condylo-basilar length						
occipito-nasal length			44	43	44	
basal length						
basilar length						
zygomatic breadth	19.2	22	22.3	21.1	21	19
inter-orbital breadth		6.1	6.2		6.6	5.5
interparietals						
breadth braincase						
mastoid breadth						
nasals, length		16.6	17.0		16.6	14.8
nasals, greatest breadth						
zygomatic plate			5.9	4.9		4.4
diastema		12	11.3	11.6	11.6	10.9
height muzzle behind inc.						
palatilar length		20.7	21.5	20.8	21	18.5
palatal length	23.9		25.0	23.4		21.2
ant. palatal foramina		8.2	8.0	7.9	8.6	7.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla		7.5	7.3	7.2	7.2	6.3
length mandible						
Teeth:						
crowns m^{1-3}	6.2	6.9	8.0	7.5	7.5	6.6
alveoli m^{1-3}		7.5	8.4	8.0	7.9	6.7
crowns m^{1-2}						
m^1, length × breadth		3.4×2.1	3.8×2.4	3.6×2.2	3.7×2.3	2.9×2.1
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus hoffmanni Group (Continued)		*Rattus tunneyi* Group			
	A.M.101191 ad. ♂ *mollicomulus* S. Celebes	Buitensorg 2599 ad. ♂ *mollicomulus* S. Celebes	A.M.104210 ad. ♂ (type) *brachyrhinus* Central Div., Papua	A.M.104224 ad. ♂ *brachyrhinus* Central Div., Papua	A.M.104218 ad. ♂ *brachyrhinus* Central Div., Papua	A.M.104012 ad. ♂ *brachyrhinus* Central Div., Papua
Skin:						
head and body	157	152	187	196	198	182
tail	155	174	141	152	141	135
hind foot (s.u.)	33[1]	35[1]	31[1]	32	32[1]	32[1]
hind foot (c.u.)						
ear						
Skull:	[14]					
total length						40.0
condylo-basal length						
condylo-incisive length			38.1	39.6	39.0	38.3
condylo-basilar length						
occipito-nasal length		39.5	39.3	41	40.5	
basal length			36.0	37.4	37.2	
basilar length			33.7	35.0	34.7	33.4
zygomatic breadth		19.6	20.0	21	20.5	20.3
inter-orbital breadth	5.4	6.0	4.9	5.2	4.9	5.6
interparietals						4×8.7
breadth braincase			14.9	15.7	15.1	15.8
mastoid breadth						
nasals, length		14.9	14.2	14.2	14.5	14.2
nasals, greatest breadth			4.7	5	4.7	4.8
zygomatic plate		4.5	4.1	4.8	4.1	4.7
diastema		10.0	10.9	12.0	11.0	10.1
height muzzle behind inc.						
palatilar length		18.4	18.4	19.9	19.5	18.6
palatal length		21.2				
ant. palatal foramina		7.2	7.9	8.2	8.9	8.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.3	6.7	8.2	8.8	7.9	7.6
length mandible						
Teeth:						
crowns m^{1-3}		7.1	6.8	7.1	6.9	7.2
alveoli m^{1-3}		7.4	7.3	7.5	7.4	8.0
crowns m^{1-2}						
m^1, length × breadth		3.5×2.2				
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104008 ad. ♂ *brachyrhinus* Central Div., Papua	A.M.104015 y. ad. ♂ *brachyrhinus* Central Div., Papua	A.M.104009 y. ad. ♀ *brachyrhinus* Central Div., Papua	A.M.104013 y. ad. ♀ *brachyrhinus* Central Div., Papua	A.M.101515 ad. ♂ *brachyrhinus* Western Div., Papua	A.M.104524 ad. ♂ *brachyrhinus* Western Div., Papua
Skin:						
head and body	175	160	150	151	192	176
tail	142	135	128	126	142	135
hind foot (s.u.)	32.5[1]	32[1]	29.0	30	32[1]	29[1]
hind foot (c.u.)						
ear						
Skull:						
total length	38.6	38.1	36.9	35.0		
condylo-basal length						
condylo-incisive length	37.2	37.0	35.8	33.2	40.6	
condylo-basilar length						
occipito-nasal length					41.0	
basal length						
basilar length	32.1	32.1	30.8	29.0		
zygomatic breadth	20.1	20.4	19.3	17.9	20.3	
inter-orbital breadth	5.4	5.3	5.3	5.1	5.6	
interparietals	4.4×8.1	4.7×9.0	3.8×8.9		4.5×8.7	
breadth braincase	16.2	16.0	15.5		15.8	
mastoid breadth						
nasals, length	13.5	13.4	13.0	12.0	14.8	
nasals, greatest breadth	4.3	4.9	4.3		5	
zygomatic plate	4.7	4.5	4.4	4.0	4.5	
diastema	10.0	9.6	9.9		11.5	
height muzzle behind inc.						
palatilar length	18.1	18.0	17.5		19.8	
palatal length						
ant. palatal foramina	8.1	8.0	7.4		8.4	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	7.4	7.4	7.1	6.6	8.6	
length mandible						
Teeth:						
crowns m^{1-3}	7.5	7.4	7.2	7.3	7.4	
alveoli m^{1-3}	8.0	8.0	7.7		8.3	
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104530 ad. ♂ *brachyrhinus* Western Div., Papua	A.M.104517 ad. ♀ *brachyrhinus* Western Div., Papua	A.M.104527 ad. ♀ *brachyrhinus* Western Div., Papua	A.M.104535 ad. ♀ *brachyrhinus* Western Div., Papua	A.M.104623 *brachyrhinus* Western Div., Papua	A.M.104624 *brachyrhinus* Western Div., Papua
Skin:						
head and body	167	165	161	173		
tail	136	128	113	130		
hind foot (s.u.)	28[1]	30[1]	28[1]	30[1]		
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length					41.1	41.2
condylo-basilar length						
occipito-nasal length					42.3	42.0
basal length						
basilar length						
zygomatic breadth					21.0	21.3
inter-orbital breadth					5.5	5.7
interparietals					4.6×9.1	4.2×9.0
breadth braincase					15.7	15.6
mastoid breadth						
nasals, length					16.2	15.1
nasals, greatest breadth					5.3	5.1
zygomatic plate						5.2
diastema					12.0	11.5
height muzzle behind inc.						
palatilar length					21.0	20.0
palatal length						
ant. palatal foramina					8.9	9.0
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla					7.8	8.4
length mandible						
Teeth:						
crowns m^{1-3}					7.2	7.3
alveoli m^{1-3}					8.4	8.3
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus tunneyi Group (Continued)			*Rattus chrysocomus* Group		
	A.M.104614 *brachyrhinus* Western Div., Papua	A.M.104617 *brachyrhinus* Western Div., Papua	*tunneyi* (type)	*chrysocomus* (type) N. Celebes	*Lenomys callitrichus* (type)[16] N. Celebes	*fratrorum* (type) ad. ♂ N. Celebes
Skin:						
head and body			150	175	240	193
tail			105	125	210	157
hind foot (s.u.)			30	32	46	38.8
hind foot (c.u.)						
ear						
Skull:						
total length			36			
condylo-basal length						
condylo-incisive length	38.1	39.0				
condylo-basilar length						
occipito-nasal length	39.2	39.8				
basal length						37.5
basilar length			31			34.3
zygomatic breadth	20.0	20.6	20.3			21.2
inter-orbital breadth	5.4	6.1	5.2			6.4
interparietals	4.0×9.4	4.2×8.5				
breadth braincase	15.3	15.4				
mastoid breadth						
nasals, length	14.5	14.7	12.3			19.4
nasals, greatest breadth	5.1	5.3				4.6
zygomatic plate	4.6	4.7				
diastema	11.2	11.1	10		13	12
height muzzle behind inc.						
palatilar length	19.1	19.6	17			19.2
palatal length						
ant. palatal foramina	8.1	8.4	7.4			7.4×3.2
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	8.2	8.0	9.5	6.8		
length mandible						
Teeth:						
crowns m^{1-3}	7.1	7.0	7.3	6.6	10	7.6
alveoli m^{1-3}	7.5	7.6				
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	nigellus (type) ♂ y. ad. Middle Celebes	*penitus* (type) ♂ y. ad. Middle Celebes	A.M.101237 ad. ♂ *penitus* Mengkoka Mts., Celebes	A.M.101209 ad. ♂ *penitus* Mengkoka Mts., Celebes	A.M.101227 ad. ♀ *penitus* Mengkoka Mts., Celebes	*rallus* (type) ad. ♀ Middle Celebes
Skin:						
head and body	160	172	173	170	165	145
tail	131	190	166		173	130
hind foot (s.u.)	34	41	38.0[1]	38.0[1]	37.0[1]	32
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	35.8	40.2				35.8
condylo-incisive length			38.9	40.4	38.5	
condylo-basilar length						
occipito-nasal length			42.6	44.5	42.5	
basal length						
basilar length						
zygomatic breadth	17.5	18.9	19.6	19.5	19.0	18.3
inter-orbital breadth	6.3	6.8	7.0	6.8	6.2	6.3
interparietals						
breadth braincase			15.8	15.3	15.2	
mastoid breadth						
nasals, length		18.1	16.8	18.2	17.4	
nasals, greatest breadth		5.8				
zygomatic plate						
diastema			11.1	13.0	11.3	
height muzzle behind inc.						
palatilar length			19.0	20.6		
palatal length		22.5	22.0			
ant. palatal foramina			7.7	8.5	8.1	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla			7.1	6.9	6.8	
length mandible						
Teeth:						
crowns m^{1-3}			7.5	7.3	7.7	
alveoli m^{1-3}	6.5	7.8	7.7	7.5	8.0	6.3
crowns m^{1-2}						
m^1, length × breadth			— ×2.4	— ×2.3	— ×2.5	
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	adspersus (type) ad. ♂ Middle Celebes	A.M.101006 ad. ♂ (type) *heinrichi* S. Celebes	A.M.100996 ad. ♂ *heinrichi* S. Celebes	A.M.101009 ad. ♀ *heinrichi* S. Celebes	*sericatus* (type) Middle Celebes	Buitensorg 2604 y. ad. ♂ *sericatus* Middle Celebes	Buitensorg 2614 ad. ♀ *sericatus* Middle Celebes
Skin:							
head and body	163	162	148	152	175	154	173
tail	147	136	140	134	170	143	161
hind foot (s.u.)	38	35[1]	36[1]	33[1]	40	37[1]	38.5[1]
hind foot (c.u.)							
ear							
Skull:							
total length							
condylo-basal length	38.8				41.4		
condylo-incisive length		37.4	36.1	36.0		36.3	39.5
condylo-basilar length							
occipito-nasal length	41.4	40.0	39.1	38.5		39.4	42.3
basal length	36.5						
basilar length							
zygomatic breadth	19.8	19.9	19.3	19.3	19.5	18.1	21.5
inter-orbital breadth	6.7	6.3	6.5	6.2	6.9	6.5	7.1
interparietals							
breadth braincase	16.0	16.4	15.0	15.2		15.8	16.3
mastoid breadth							
nasals, length	17.4	15.5	15.8	15.2	18.7	15.4	16.3
nasals, greatest breadth					5.3		
zygomatic plate							
diastema	11.5	10.5	10.6	11.0		11.0	12.1
height muzzle behind inc.							
palatilar length	18.6	18.3	17.6	18.0		18.7	20.0
palatal length	21.2	21.2	20.0	20.2	23.7	21.1	22.8
ant. palatal foramina	7.4	7.6	7.4	6.7		8.0	8.7
breadth meso.-pter. fossa							
width inside $m^1 - m^1$							
length bulla	6.3	6.4	6.5	6.7		6.3	6.8
length mandible							
Teeth:							
crowns m^{1-3}	7.5	7.3	7.2	6.9		8.0	7.7
alveoli m^{1-3}	7.7	7.5	7.4	7.2	8.1		8.1
crowns m^{1-2}							
m^1, length × breadth		—×2.3				—×2.4	—×2.5
m^2, length × breadth							
m^3, length × breadth							
crowns, m_{1-3}							

	Buitensorg 2609 ad. ♀ *sericatus* Middle Celebes	A.M.101058 ad. ♂ *inferior*	A.M.101059 ad. ♂ *inferior* (type)	A.M.101055 (type) *talolis* S. E. Celebes	A.M.101051 *talolis* S. E. Celebes	A.M.101052 *talolis*	*andrewsi* (paratype) Buton Isl., Celebes
Skin:							
head and body	168	170	177	157	150	147	150
tail	171	172	170	138	145	123	110
hind foot (s.u.)	37.0[1]	39.0[1]	40.5[1]	34.0[1]	32.5[1]	32.0[1]	35
hind foot (c.u.)							
ear							
Skull:							
total length							
condylo-basal length							36.0
condylo-incisive length	40.0	39.0	41.5	36.0		34.2	
condylo-basilar length							
occipito-nasal length	43.7	41.6	45.3	39.6		37.3	
basal length							33.3
basilar length							30.8
zygomatic breadth	20.0	19.8	20.5	19.0		18.0	19.0
inter-orbital breadth	6.7	6.7	6.6	6.5	6.6	6.4	6.6
interparietals							
breadth braincase	15.9	16.2	16.8	16.0		15.1	
mastoid breadth							
nasals, length	16.4	17.4	18.8	15.4	15.0	13.9	15.6
nasals, greatest breadth							4.8
zygomatic plate							
diastema	12.1	10.9	12.2	10.9	10.5	10.2	9.9
height muzzle behind inc.							
palatilar length	19.6	18.8	20.8	17.7		16.6	16.9
palatal length	22.4	21.5	23.6	20.4		19.7	20.0
ant. palatal foramina	8.1	7.9	9.3	6.8		6.7	7.1
breadth meso.-pter. fossa							
width inside $m^1 - m^1$							
length bulla	6.6	6.8	6.9	7.0	6.6	6.1	7.0
length mandible							
Teeth:							
crowns m^{1-3}	7.3	7.5	7.8	6.2	6.3	6.1	7.2
alveoli m^{1-3}	7.6	7.9	8.3	9.5	6.5	6.3	7.4
crowns m^{1-2}							
m^1, length × breadth	–×2.3	–×2.4	–×2.5	–×2.0	–×2.1	–×1.9	3.9×2.2
m^2, length × breadth							
m^3, length × breadth							
crowns, m_{1-3}							

	A.M.101249 ad. ♂ *xanthurus* N. Celebes	A.M.101250 y. ad. ♂ *xanthurus* N. Celebes	A.M.101251 y. ad. ♂ *xanthurus* N. Celebes	A.M.101256 ad. ♀ *xanthurus* N. Celebes	*marmosurus* (type) ad. ♂ N. Celebes	A.M.101257 y. ad. ♂ *marmosurus* N. Celebes
Skin:						
head and body	260	240	242	235	230	194
tail	330	312	293	307	260	263
hind foot (s.u.)	47[1]	46[1]	45[1]	45[1]	36	38.5[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						40.5
condylo-incisive length					42.7	
condylo-basilar length						
occipito-nasal length	55.5		49		45	
basal length						
basilar length	45.7		41.7	43.0		35.0
zygomatic breadth	26	24.1	24.0	24.2	22	20.1
inter-orbital breadth	7.3	6.4	5.6	5.9	6.0	6.0
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	20	18.2	17.9	18.3	17	14.0
nasals, greatest breadth	6.3	5.8	5.8		5.5	
zygomatic plate	4.0	4.4	4.8	4.5	4.2	3.4
diastema	16.2	15.3	14.6	14.4		11.4
height muzzle behind inc.						
palatilar length	25.9	23.4	23.4	22.9	21	19.5
palatal length	28.7	26.6	26.6	27.0		21.6
ant. palatal foramina	10.4	9.3	9.4	9.1	9.2	8.0
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	9.1	9.0	9.0	9.0		7.5
length mandible						
Teeth:						
crowns m^{1-3}		7.9	7.9	8.0	7.2	6.9
alveoli m^{1-3}	8.6	8.2	8.3	8.5		7.1
crowns m^{1-2}						
m^1, length × breadth			—×2.5			— ×2.2
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101255 y. ad. ♂ *marmosurus* N. Celebes	A.M.101254 y. ad. ♀ *marmosurus* N. Celebes	*dominator* (type) ad. ♂ N. Celebes	A.M.101120 old ♀ *dominator* S. E. Celebes	A.M.101116 ad. ♀ *dominator* S. E. Celebes	A.M.101077 ad. ♀ *dominator* S. E. Celebes
Skin:						
head and body	173	193	226	245	242	245
tail	243	248	256	311	300	233
hind foot (s.u.)	37[1]	36[1]	50	52[1]	51[1]	50[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	40.0		51.7	55.4	57.4	54.9
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	43		56	59.0	61.2	59.0
basal length						
basilar length	34.6			45	44.9	
zygomatic breadth	20.0	20.5±	26.8	28.0	28.1	27.9
inter-orbital breadth	6.0	6.5	6.5	8.5	7.6	8.1
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	14.3		22.3	27.1	23.0	22.0
nasals, greatest breadth			5.6	5.7	6.4	
zygomatic plate	3.5		7.3	8.3	7.9	7.8
diastema	11.4			15.6	16.9	15.1
height muzzle behind inc.						
palatilar length	18.4		26.5	27.8	29.4	26.7
palatal length	21.8			32.9	34.5	
ant. palatal foramina	7.8		8.2×3.2	6.6×2.4	7.6×3.2	6.9
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	7.0	7.5		7.3	7.4	7.2
length mandible						
Teeth:						
crowns m^{1-3}	6.8	6.4	9	9.7	9.9	9.6
alveoli m^{1-3}	6.8	6.8		10.3	10.3	9.9
crowns m^{1-2}						
m^1, length × breadth	— ×2.2	— ×2.1		— ×3.1		
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101172 ad. ♂ *dominator* Middle Celebes	A.M.101173 ad. ♂ *dominator* Middle Celebes	Buitensorg 2600 ad. ♀ *dominator* Middle Celebes	A.M.101252 ad. ♀ *dominator* N. Celebes	*camurus* (type) ad. ♂ Middle Celebes	U.S.N.M.219557 y. ad. ♂ *camurus* Middle Celebes
Skin:						
head and body	246	233	208	232	235	220
tail	267	272	312	268	257	302
hind foot (s.u.)	48[1]	47[1]	47.5[1]	49.5[1]	51	49[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	51	50.2		55 ±	55.3	
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	55.6	54.5		59 ±	59.1	56.3
basal length						
basilar length	44.3		43.4	47		42.7
zygomatic breadth	26.1	25.6	26.5	28	27.2	25.3
inter-orbital breadth	7.7	7.7	7.0	7.3	7.7	6.9
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	21.3	21.0	22.3	22.3		22.3
nasals, greatest breadth	5.7		5.7	5.9		6.2
zygomatic plate	6.6	6.0	6.8	8.1		7.0
diastema	15.0	14.5	14.4	15.9		14.1
height muzzle behind inc.						
palatilar length	25.6	24.7	24.8	27.0		25.0
palatal length	29.6		29.6			
ant. palatal foramina	8.0×2.9	7.9	6.4	7.9×3.2		7.7
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.6	7.0	7.5	7.2	"smaller"	7.1
length mandible						
Teeth:						
crowns m^{1-3}	9.0	8.9	9.2	10.2		9.0
alveoli m^{1-3}	9.6	9.4	9.7	11.0	10.2	9.9
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	bontanus (type) ad. ♂ "Mt. Bonthian," S. Celebes	A.M.101178 ad. ♂ *bontanus* S. Lampobatang, Celebes	A.M.101179 y. ad. ♂ *bontanus* S. Lampobatang, Celebes	A.M.101184 y. ad. ♂ *bontanus* S. Lampobatang, Celebes	A.M.101186 y. ad. ♂ *bontanus* S. Lampobatang, Celebes	A.M.101183 ad. ♀ *bontanus* S. Lampobatang, Celebes
Skin:						
head and body	187	228	207	200	236	216
tail	235	232	268	278	302	243
hind foot (s.u.)	43	45[1]	44[1]	46[1]	45[1]	44[1]
hind foot (c.u.)						
ear						
Skull:						
total length	[17]				[20]	
condylo-basal length	[18]					
condylo-incisive length						
condylo-basilar length						
occipito-nasal length		50	46.2	48.4		46.0
basal length						
basilar length		40.5			40.1	36.5
zygomatic breadth		24.5	23.8	24.0	23.5	22.3
inter-orbital breadth	6.2	5.7			5.9	5.9
interparietals						
breadth braincase						
mastoid breadth						
nasals, length		18			17.4	16.9
nasals, greatest breadth						
zygomatic plate	5.0	5.0	5.1	4.8	4.9	4.9
diastema		14.0	13.5	12.0	13.6	12.4
height muzzle behind inc.						
palatilar length		22.7			22.5	20.4
palatal length		26.3[19]			26.0	
ant. palatal foramina		10.0	10.0	9.2	10.3	8.9
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla		9.0	8.0	8.3	8.3	8.0
length mandible						
Teeth:						
crowns m^{1-3}	8.4	8.6	8.9	8.8	8.8	8.9
alveoli m^{1-3}		9.0	9.4		9.0	9.2
crowns m^{1-2}						
m^1, length × breadth		— ×3.0	— ×3.0	— ×2.8	— ×2.8	— ×2.7
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	taerae (type) ad. ♂ N. Celebes	A.M.101244 ad. ♀ *taerae* N. Celebes	*facetus* (type) ad. ♂ Middle Celebes	*tondanus* (type) sex ? N. Celebes	*hamatus* (type) ad. ♂ Middle Celebes	U.S.N.M.218685 y. ad. ♀ (*hamatus*) Middle Celebes
Skin:						
head and body	221	209	135	193	183	185
tail	217	215	175	257	185	193
hind foot (s.u.)	42.5	44[1]	33	41	42	40
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	45	47		38.8	41.3	41.0
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	51.3	50.5	32.5	44.1	46.1	44.4
basal length						
basilar length		40.1				35
zygomatic breadth	24.5	23.5	16.4	20.9	22.6	22.5
inter-orbital breadth	7.1	6.9	5.3	6.9	6.5	6.4
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	22.3	19.8		16.3	18.4	16.9
nasals, greatest breadth	5.5			7	5	
zygomatic plate		5.3				5.0
diastema	13.9	13.4		12.1		11.0
height muzzle behind inc.						
palatilar length		23.2				21.0
palatal length	27.5	27		22.7	25.0	24.8
ant. palatal foramina	9.2	9.0		8		8.0
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	9.4	6.1		much "smaller"		6.0
length mandible						
Teeth:						
crowns m^{1-3}		8.9		7.3		8.8
alveoli m^{1-3}		9.6	6.8		8.8	9.2
crowns m^{1-2}						
m^1, length × breadth		— ×2.5			4.6× —	4.8×2.5
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101111 (type) ad. ♀ *arcuatus* S. E. Celebes	A.M.101113 ad. ♀ *arcuatus* S. E. Celebes	A.M.101114 y. ad. ♂ *arcuatus* S. E. Celebes	A.M.101112 y. ad. ♂ *arcuatus* S. E. Celebes	A.M.101119 (type) ad. ♀ *salocco* S. E. Celebes	A.M.101121 ad. ♀ *salocco* S. E. Celebes
Skin:						
head and body	203	202	212	200	211	203
tail	245	235	203	226	265	258
hind foot (s.u.)	43.5[1]	45[1]	41.5[1]	45[1]	39[1]	39[1]
hind foot (c.u.)						
ear						
Skull:						
total length			[21]			[22]
condylo-basal length	45.8	47	46.1		45.6	44.2
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	50.0	51.7	50.4	50.6	46	46.5
basal length						
basilar length	38.8	41	39.5		39.4	37.8
zygomatic breadth	21.7	23	22	21.2	23.5	22.5
inter-orbital breadth	6.7	7.0	6.6	7.0	6.2	6.0
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	20.7	21.0	20.1		16.7	16.6
nasals, greatest breadth						
zygomatic plate	5.7	6.7	5.8	5.5	4.3	4.0
diastema	12.5	13.0	13.0	13.5	13.2	12.6
height muzzle behind inc.						
palatilar length	21.9	22.3	22.3		22.0	20.8
palatal length	25.6	26.7	25.9		24.9	24.0
ant. palatal foramina	7.8	7.5	7.0	7.6	9.0	8.8
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	7.0	7.4	7.3	7.1	9.5	9.0
length mandible						
Teeth:						
crowns m^{1-3}	9.3	9.7	9.0	8.8	7.7	7.7
alveoli m^{1-3}		10.1	10.0		8.3	7.9
crowns m^{1-2}						
m^1, length × breadth	— ×2.6	— ×2.7	— ×2.5	— ×2.4	— ×2.5	— ×2.5
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus xanthurus Group (Continued)		*Rattus huang-fulvescens* Group			
	A.M.101108 (type) ad. ♂ *microbullatus* S. E. Celebes	A.M.101109 ad. ♀ *microbullatus* S. E. Celebes	*mengurus* (type) ad. ♂	A.M.102667 ad. ♂ *hylomyoides* S. Sumatra	A.M.102666 ad. ♂ *hylomyoides* S. Sumatra	A.M.102668 y. ad. ♀ *hylomyoides* S. Sumatra
Skin:						
head and body	203	203	134	130	130	108
tail	223	267	182	152	162	155
hind foot (s.u.)	42	46	25	25.5[1]	25.5[1]	25.5[1]
hind foot (c.u.)						
ear						
Skull:						
total length	[23]					
condylo-basal length	47.7	48.0	30.6			
condylo-incisive length				29.8	30.2	27.8
condylo-basilar length				27.8		25.9
occipito-nasal length	50.4	50.1		32.7	33.5	31.0
basal length						
basilar length	40.4	41.2				
zygomatic breadth	25.2	34.5	15.0	15.6	15.3	14.2
inter-orbital breadth	6.7	6.9	5.6	5.7	5.1	5.2
interparietals						
breadth braincase			13.4	13.6	13.8	13.3
mastoid breadth						
nasals, length	19.8	19.7	12.2	11.3	12.1	10.4
nasals, greatest breadth				4.5	3.7	
zygomatic plate	5.3	5.4				
diastema	14	14.2		8.8	8.4	7.8
height muzzle behind inc.						
palatilar length	23.3	23.7		14.2	14.2	13.0
palatal length	27	27		16.6	16.5	15.2
ant. palatal foramina	7.0	7.2		5.0	4.7	4.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.6	6.6		4.2	4.3	4.3
length mandible						
Teeth:						
crowns m^{1-3}	9.0	9.0		5.1	5.4	5.4
alveoli m^{1-3}	9.2	9.2	5.8	5.2	5.7	
crowns m^{1-2}						
m^1, length × breadth	— ×2.9	— ×2.8		— ×1.4	— ×1.5	— ×1.4
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus cremoriventer Group			*Rattus whiteheadi* Group		
	beccarii (type) N. Celebes	*thysanurus* (type) ad. ♀ N. Celebes	A.M.101261 ad. ♀ *beccarii* N. Celebes	*whiteheadi* (type) ad. ♀ N. Borneo	*whiteheadi* (alc.) ♂ N. Borneo	*perlutus* (type) old ♀
Skin:						
head and body	150	123	127		102	130
tail	168	186	155		110	120
hind foot (s.u.)	25	25	25	27	27	29.7
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length			30.3			
condylo-incisive length			29.9			
condylo-basilar length		28	27.8			
occipito-nasal length		33.0			33.6	35
basal length						
basilar length					25.4	28.2
zygomatic breadth		16.5	15.5		16	15.5
inter-orbital breadth		5.1	5.3		6.1	5.7
interparietals						
breadth braincase		15	13.7			
mastoid breadth						
nasals, length		12	11.5		11.4	11.7
nasals, greatest breadth		3.5	3.6			
zygomatic plate						
diastema	9.0	9.5	9.2		8.9	9.0
height muzzle behind inc.						
palatilar length			14		13.6	14.0
palatal length		16	16.2			
ant. palatal foramina		6	5.3		4.8	4.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla			4.7			
length mandible						
Teeth:						
crowns m^{1-3}	5.0	4.7	5.0		5.1	5.8
alveoli m^{1-3}			5.2			
crowns m^{1-2}						
m^1, length × breadth			— ×1.5			
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus whiteheadi Group (Continued)					*Rattus rajah* Group
	A.M.102653 ad. ♂ *whiteheadi* S. Sumatra	A.M.102660 ad. ♂ *whiteheadi* S. Sumatra	A.M.102659 ad. ♀ *whiteheadi* S. Sumatra	A.M.101281 (type) y. ad. ♀ *aspinatus* N. Celebes	A.M.101282 y. ad. ♂ *aspinatus* N. Celebes	*musschenbroekii* (type) N. Celebes
Skin:						
head and body	111	108	110	98	103	175
tail	99	94	94	93	97	124
hind foot (s.u.)	27[1]	26[1]	24.5[1]	26.5[1]	27.5[1]	31
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length	29.3	29.0	26.8			
condylo-basilar length						
occipito-nasal length	33.6		30.0			
basal length	27.9	27.1				
basilar length	25.0	24.3				
zygomatic breadth	15		13.5	14±	13.5	
inter-orbital breadth	5.8	5.8	5.7	5.5	6.0	
interparietals				3.9×8.4		
breadth braincase	13.3	13.1	13.0			
mastoid breadth						
nasals, length	11.3		10.0	9.1		
nasals, greatest breadth						
zygomatic plate				2.1	2.6	
diastema	7.9	8.2	7.3	6.5	6.9	8.5
height muzzle behind inc.						
palatilar length	12.9	12.9	12.1	11.4	11.8	
palatal length	15.7	15.4	14.4	13.7	14.1	
ant. palatal foramina	4.8	4.5	4.5	3.7×2.0	4.0×2.3	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	4.2	4.0	4.0	3.9	4.2	
length mandible						
Teeth:						
crowns m^{1-3}	5.6	5.3	5.2	6.0	6.0	6.0
alveoli m^{1-3}	5.8	5.4	5.4			
crowns m^{1-2}						
m^1, length × breadth				3.1×1.9	3.2×1.9	
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101286 ad. ♂ *musschenbroekii* N. Celebes	A. M. 101284 ad. ♀ *musschenbroekii* N. Celebes	A.M.101096 y. ad. ♂ *musschenbroekii* S. E. Celebes	A.M.101192 ad. ♂ *musschenbroekii* S. Celebes	*tetricus* (type) ad. ♂ Middle Celebes	*hellwaldii* (type) Celebes
Skin:						
head and body	135	141	137	132	160	235
tail	137	127	137	122	145	160
hind foot (s.u.)	32[1]	32[1]	31[1]	32[1]	34	41
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length					35	
condylo-incisive length	33.0					
condylo-basilar length						
occipito-nasal length	37.0	37.0	35.8	35.2		
basal length	30.5					
basilar length	27.5					
zygomatic breadth		17.2	17.0	16.2	16.7	
inter-orbital breadth	6.3	6.3	6.0		5.9	
interparietals						
breadth braincase	16.2	14.8			15.1	
mastoid breadth						
nasals, length	12.8	12.6	12.4	12.1		
nasals, greatest breadth	3.2					
zygomatic plate						
diastema	9.0	9.1	8.5	8.1		11.0
height muzzle behind inc.						
palatilar length	14.2	14.3	13.7	14.0		
palatal length	17.0	17.2				
ant. palatal foramina	5.3	5.3	5.2	4.8		
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	4.4	4.7	4.3	4.7		
length mandible	19.2	19.3	19.3		20.8	
Teeth:						
crowns m^{1-3}	5.7	6.0	6.0	6.1		7.0
alveoli m^{1-3}	6.0	6.2	6.2	6.4	6.1	
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101028 ad. ♂ S. E. Celebes, 50–500 m.	A.M.101030 ad. ♂ S. E. Celebes, 50–500 m.	A.M.101032 ad. ♀ S. E. Celebes, 50–500 m.	A.M.101029 ad. ♀ S. E. Celebes, 50–500 m.	A.M.101099 ad. ♂ S. E. Celebes, 1500 m.	A.M.101023 ad. ♀ S. Celebes, 1100 m.
Skin:						
head and body	214	211	138[24]	215	163	170
tail	224		210	213	135	182
hind foot (s.u.)	47[1]	45.5[1]	44.0	46.5[1]	37[1]	39.5[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	43.8	44.0	43.0	44.0		40.1
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	48.8	50.0	47.5	49.0	41.0	44.8
basal length	40.6	41.0	40.0	40.5		37.4
basilar length	37.3	37.4	36.7	37.3		34.0
zygomatic breadth	21.5	21.5	21.2		18.8	20.0
inter-orbital breadth	7.6	7.8	7.3	7.3	6.6	7.1
interparietals						
breadth braincase	18.2	18.5	18.0	17.8		16.8
mastoid breadth	16.0	16.0	16.7	15.8	14.0	14.8
nasals, length	19.2	21.2	18.8	19.2	14.2	18.4
nasals, greatest breadth	5.3	5.3	4.7	5.0		
zygomatic plate						
diastema	12.7	12.8	12.0	12.8	9.3	11.5
height muzzle behind inc.						
palatilar length	19.0	19.2	18.7	19.2	15.1	17.5
palatal length	22.2	22.4	21.8	22.3	17.8	20.8
ant. palatal foramina	6.7	7.0	6.8	7.1	6.0	6.7
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.5	5.6	5.5	5.9	5.7	5.5
length mandible	25.4		25.8	26.5	21.7	23.6
Teeth:						
crowns m^{1-3}	6.8	7.0	6.7	6.9	5.8	6.7
alveoli m^{1-3}	7.0	7.1	7.0	7.1	6.0	6.8
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	localis (type) ad. ♂	*cereus* (type) ad. ♂	*lingensis* (type) ad. ♂ Linga Isl., 1000 feet	A.M.102563 ad. ♂ S. Sumatra	A.M.102573 ad. ♂ S. Sumatra	A.M.102561 ad. ♀ S. Sumatra
Skin:						
head and body	174	200	216	188	188	182
tail	186	181	171	198	183	180
hind foot (s.u.)	43	46	40.4	38.5[1]	38.5[1]	37.0[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	41.2	43.2				
condylo-incisive length				40.6	38.9	38.6
condylo-basilar length						
occipito-nasal length			47.5	46.3	43.5	44.0
basal length			40.4			
basilar length			37.5			
zygomatic breadth	19.6	20.6	20.0	19.0	18.8	
inter-orbital breadth	7.2	6.8	6.8	7.1	6.5	6.5
interparietals						
breadth braincase			17.0	16.0	16.5	16.2
mastoid breadth	16.5	17.0				
nasals, length			19.0	17.0	16.4	16.9
nasals, greatest breadth						
zygomatic plate						
diastema			13.4	12.4	12.6	12.5
height muzzle behind inc.						
palatilar length				18.1	18.0	17.3
palatal length			21.8	21.9	21.5	21.1
ant. palatal foramina			7	6.5	7.0	6.1
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla				5.0	4.5	5.1
length mandible	23.5	25.2				
Teeth:						
crowns m^{1-3}				6.2	5.8	5.7
alveoli m^{1-3}	7.0	7.3	8.0	6.6	6.3	5.9
crowns m^{1-2}						
m^1, length × breadth			—×2.2			
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus rajah Group (Continued)		*Rattus sabanus* Group			
	A.M.102571 ad. ♀ S. Sumatra	*catellifer* (type)	*sabanus* (type) ad. ♂	A.M.102818 ad. ♂ S. Sumatra	A.M.102850 ad. ♂ S. Sumatra	A.M.102851 ad. ♂ S. Sumatra
Skin:						
head and body	186	202	280	226	235	243
tail	184	146	340	340	382	368
hind foot (s.u.)	38.0[1]	40	43.5	42[1]	42[1]	42[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length	39.5					
condylo-basilar length						
occipito-nasal length	43.9				53.9	53.8
basal length		39				
basilar length		37				
zygomatic breadth	20.0	20			25.8	25.1
inter-orbital breadth	6.6	6.6	7.7		9.1	9.1
interparietals						
breadth braincase	16.3					
mastoid breadth						
nasals, length	17.0	17	21.0		20.8	20.4
nasals, greatest breadth			6.0			
zygomatic plate			4.7			
diastema	12.9	13	13.6		14.2	14.3
height muzzle behind inc.						
palatilar length	18.5				24.1	24.4
palatal length	21.5		26.5		28.3	29.1
ant. palatal foramina	6.6	7	7.9		7.4	8.3
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	4.7				5.7	5.6
length mandible						
Teeth:						
crowns m^{1-3}	6.1		9.4		9.0	9.0
alveoli m^{1-3}	6.3	7			9.9	9.7
crowns m^{1-2}						
m^1, length × breadth					4.3×2.7	4.7×2.6
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus sabanus Group (Continued)			*Rattus*		
	A.M.102852 y. ad. ♂ S. Sumatra	*vociferans* U.S.N.M.86742 y. ad. ♂	*edwardsi* ad. ♀ A.M.87475 Laos (Indo China)	*bartelsi* (type) Java, 6000 ft.	A.M.102413 old ♂ *bartelsi* Tjerimai, Java	A.M.102417 ad. ♂ *bartelsi* Tjerimai, Java
Skin:						
head and body	214	222	223	145	178	166
tail	341	355	395	119+	170	165
hind foot (s.u.)	42[1]			33	35[1]	34[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length					37.6	36.4
condylo-incisive length					35.9	35.0
condylo-basilar length					34.0	33.4
occipito-nasal length	53.0	54.2	57.8		39.9	39.1
basal length						
basilar length						
zygomatic breadth	23.7	23.6	24.7		16.5	16.6
inter-orbital breadth	8.1	8.4	8.7		6.3	6.3
interparietals						
breadth braincase					14.5	14.6
mastoid breadth						
nasals, length	20.6	20.5	22.0		13.9	14.9
nasals, greatest breadth						
zygomatic plate						
diastema	12.9	14.2	15.0	8.5	11.4	11.1
height muzzle behind inc.						
palatilar length	22.7	23.8	25.0		16.3	16.0
palatal length	27.7	28.0	29.7		19.9	19.3
ant. palatal foramina	7.9	7.8	8.0		6.5×2.9	6.6×2.9
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.4	5.8	5.4		5.2	5.1
length mandible						
Teeth:						
crowns m^{1-3}	9.0	9.7	9.7	5.5	5.7	5.3
alveoli m^{1-3}	9.7	10.3	10.2		5.8	5.6
crowns m^{1-2}						
m^1, length × breadth	4.6×2.7	4.7×2.8	4.6×2.6		— ×1.7	— ×1.7
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.102418 ad. ♀ *bartelsi* Tjerimai, Java	A.M.102420 old ♀ *bartelsi* Tjerimai, Java	*tjibuniensis* (type) ad. ♂ Java	*lepturus* (type)	A.M.102398 ad. ♂ Tjerimai, Java	A.M.102647 ad. ♂ Tjerimai, Java
Skin:						
head and body	135	152	159[25]	135	170	165
tail	152	156	147[25]	178	227	221
hind foot (s.u.)	33[1]	32[1]	33	26	30[1]	31.5[1]
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length	34.8	35.0	32.8		35.2	33.1
condylo-incisive length	33.5	35.0			34.6	32.7
condylo-basilar length	31.5	31.8			32.1	30.2
occipito-nasal length	37.4	37.8	38.9		39.1	37.1
basal length						
basilar length						
zygomatic breadth	16.4	16.3	17.1		17.6	17.3
inter-orbital breadth	6.2	6.1	6.6		5.3	5.1
interparietals						
breadth braincase	14.3	14.4	15.2		15.2	15.1
mastoid breadth						
nasals, length	12.8	14.2	14.5		14.0	12.9
nasals, greatest breadth			3.9		4.5	4.6
zygomatic plate						
diastema	10.5	10.4	11.1	8	9.5	8.7
height muzzle behind inc.						
palatilar length	15.3	15.4			16.8	15.6
palatal length	18.5	18.8	17.9		19.8	18.6
ant. palatal foramina	6.5×2.9	6.3×2.9	5.9		6.7	6.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.1	5.0			4.7	5.0
length mandible						
Teeth:						
crowns m^{1-3}	5.4	5.3	5.3	6	7.0	7.0
alveoli m^{1-3}	5.6				7.3	7.3
crowns m^{1-2}						
m^1, length × breadth	— ×1.7	— ×1.6				
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Rattus (Continued)					*Bunomys*
	A.M.102399 ad. ♀ Tjerimai, Java	A.M.102405 old ♀ Tjerimai, Java	*besuki* (type) ad. ♀	*fredericki* (type) ad. ♂	*maculipectus* (type) ad. ♀	*caelestis* (type) ad. ♀ Celebes
Skin:						
head and body	124	143	143	152	148	148
tail	206	205	192	225	208	148
hind foot (s.u.)	29[1]	30[1]	28	30	30	34
hind foot (c.u.)						[26]
ear						
Skull:						
total length						
condylo-basal length	32.3			33	33.1	
condylo-incisive length	31.7					
condylo-basilar length	29.6					
occipito-nasal length			36.5±	38.5	38.7	
basal length						36.2
basilar length						33.7
zygomatic breadth	17.0	18.1	17.5	17.5	17.9	19.4
inter-orbital breadth	5.3	5.7	6	6	5.8	6.9
interparietals						3.5×9
breadth braincase	15.4	15.6		16		
mastoid breadth						
nasals, length		13.9	12±	13.5	14.2	15.7
nasals, greatest breadth			4	4	4.3	3.7
zygomatic plate						
diastema	8.6	9.8	9.0	10.0	10.0	
height muzzle behind inc.						
palatilar length	15.4	16.7				19.6
palatal length	18.0	19.9	18.5	20.0	19.8	
ant. palatal foramina	6.1	6.7			7.2	6.7×2.1
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	5.0	4.8				
length mandible						
Teeth:						
crowns m^{1-3}	7.0	7.1	6.3	7.2	7.2	6.6
alveoli m^{1-3}	7.1	7.2				
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101156 ad. ♂ *caelestis* S. Celebes, 2500 m.	A.M.101141 ad. ♂ *caelestis* S. Celebes, 2500 m.	A.M.101143 ad. ♂ *caelestis* S. Celebes, 2500 m.	A.M.101145 ad. ♀ *caelestis* S. Celebes, 2500 m.	A.M.101158 ad. ♀ *caelestis* S. Celebes, 2500 m.	A.M.101153 ad. ♀ *caelestis* S. Celebes, 2500 m.
Skin:						
head and body	153	178	172	154	157	158
tail	147	153	171	156	152	158
hind foot (s.u.)	36[1]	36[1]	36[1]	34.5[1]	34.0[1]	34.5[1]
hind foot (c.u.)	[27]	[28]	[29]	[30]	[31]	[32]
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length		41.3	41.1	40.8	39.5	39.6
basal length	38.0	37.5		37.0	35.0	35.1
basilar length	35.0	34.4		34.0	32.2	32.1
zygomatic breadth	19.3	19.4	20.1	19.2	18.9	18.7
inter-orbital breadth	6.8	6.8	6.9	6.4	6.7	6.8
interparietals	3.2×8	3.5×9.5	3.4×8.7	3.2×7.4	3.4×10	4.0×10.1
breadth braincase						
mastoid breadth						
nasals, length	17.4	17.2	16.5	16.7	15.6	15.9
nasals, greatest breadth	4.0	3.9	3.5	4	3.8	4
zygomatic plate						
diastema						
height muzzle behind inc.						
palatilar length	20.0	19.4	19.4		18.2	18.2
palatal length						
ant. palatal foramina	7.0×2.1	7.4×2.4	7.5×2.2	7.5×2.1	6.9×2	6.4×2.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.8	6.6	6.3		6.1	6.1
length mandible						
Teeth:						
crowns m^{1-3}	6.4	6.2	6.7	6.1	6.2	6.0
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth	— ×2.0	— ×1.9	— ×2.0	— ×1.8	— ×1.9	— ×2.0
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Bunomys (Continued)					*Stenomys*
	A.M.101236 (type) *koka* S. E. Celebes	A.M.101217 ad. ♂ *koka*	A.M.101226 ad. ♂ *koka*	A.M.101220 ad. ♀ *koka*	A.M.101211 ad. ♀ *koka*	*arrogans* (type) ad. ♀ Noord River, D. N. Guinea
Skin:						
head and body	135	144	143	138	135	120
tail	148	144	143	134	150	125
hind foot (s.u.)	33.5[1]	34[1]	33.5[1]	31.5[1]	32.5[1]	25.5
hind foot (c.u.)	33	34	35	36	37	
ear						
Skull:						
total length						34
condylo-basal length						
condylo-incisive length						30.6
condylo-basilar length						
occipito-nasal length	38.7	39.4	39.4	37.3	37.5	
basal length	33.4	34.0	35.0	32.0	32.8	
basilar length	30.5	31.1	32.1	29.5	30.0	
zygomatic breadth	18.1	17.7	18.0	17.9	17.6	17
inter-orbital breadth	6.6	6.7	6.5	6.9	6.5	6.6
interparietals	5.1×9.9	4.9×11.1	4.0×9.5	4.8×9.6	4.8×9.5	
breadth braincase						15.5
mastoid breadth						
nasals, length	15.3	14.5	16.1	14.5	14.2	12.5
nasals, greatest breadth	3.9	3.5	3.6	3.5	3.3	
zygomatic plate						
diastema						
height muzzle behind inc.						
palatilar length	17.5	17.2	18.4	19.4	16.9	14.4
palatal length						
ant. palatal foramina	6.3×2.4	6.8×2.2	6.8×2.4	6.6×2.5	7.0×2.3	5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	6.8	6.7	6.1	6.5	6.7	
length mandible						
Teeth:						
crowns m^{1-3}	6.1	6.7	6.1	5.9	5.9	6.0
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth	— ×2.0	— ×2.2	— ×1.8	— ×1.9	— ×2.0	
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	klossi (type) ad. ♂ Utakwa R., Dutch New Guinea	*niobe* (type) ad. y. Angabunga R., Papua	A.M.104324 ad. ♂ *niobe* Mt. Tafa, Papua	A.M.104344, ad. ♂ *niobe* Mt. Tafa, Papua	A.M.104306 ad. ♂ *niobe* Mt. Tafa, Papua	A.M.104316 y. ad. ♀ *niobe* Mt. Tafa, Papua
Skin:						
head and body	123	126	132	137	134	132
tail	130	134		133	134	146
hind foot (s.u.)	27	27	25	26.5	26.8	26.1
hind foot (c.u.)						
ear						
Skull:						
total length	34.3	32.5				
condylo-basal length						
condylo-incisive length	31		30.0	29.8	29.8	27.0
condylo-basilar length						
occipito-nasal length				32.9	33.2	30.6
basal length		25.3	28.3	28.4	28.4	26.1
basilar length			26.1	26.3	25.9	23.4
zygomatic breadth	15.8	14.8	15.0	14.8	15.2	13.5
inter-orbital breadth	6.0	5.7	5.9	5.9	5.7	5.6
interparietals			4.6×9.7	4.1×9.4	4.3×9.0	
breadth braincase	14.6	14	14.0	13.8		13.2
mastoid breadth						
nasals, length	12.6	12		11.6	12.0	11.2
nasals, greatest breadth		3.6		3.3	3.5	
zygomatic plate			2.0	2.4	2.2	2.1
diastema		8.3	8.7	8.6	8.3	
height muzzle behind inc.		5.2	5.5	5.1	5.4	
palatilar length	15.0		15.0	15.1	14.9	
palatal length						
ant. palatal foramina	5.2	4.9×2.3	5.2	5.7	5.1	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	5.6	5.4	5.4	5.3	5.7	5.5
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

Stenomys (Continued)

	A.M.104307 y. ad. ♀ *niobe* Mt. Tafa, Papua	A.M.104305 ad. ♀ *niobe* Mt. Tafa, Papua	*rufulus* (type) ad. ♀ Saruwaged, Mand. Terr. New Guinea	*verecundus* (type) old ♀ Aroa R., Papua	A.M.104277 old ♂ *verecundus* Angabunga R., Papua	A.M.104234 old ♂ *verecundus* Angabunga R., Papua
Skin:						
head and body	123	126	122	150?	128	
tail	125	131	106?	168	158	
hind foot (s.u.)	25.2	25.1	27	34	32.0[1]	35.0[1]
hind foot (c.u.)						
ear						
Skull:						
total length			33.5	40.5		
condylo-basal length						
condylo-incisive length		29.6	30.0		33.0	37.1
condylo-basilar length						
occipito-nasal length	31.6	32.6			37.0	41.0
basal length		28.1			31.6	35.0
basilar length		25.4		32	29.2	32.0
zygomatic breadth	15.1	15.3		18	16.8	18.2
inter-orbital breadth	5.6	5.9	5.8	6	5.8	6.5
interparietals	4.5×9.3	4.6×9.4			4.4×9.0	4.2×11.0
breadth braincase	14.2	14.1	14.2	16	14.6	15.2
mastoid breadth						
nasals, length	11.3	12.5	12.6	15.2	13.5	15.4
nasals, greatest breadth				4.8	3.9	4.5
zygomatic plate	2.1	2.1		3.4	2.9	3.2
diastema	7.6	8.4		11	9.6	11.1
height muzzle behind inc.	5.2	5.4			6.5	7.6
palatilar length	14.1	14.5	14.8	18.6	16.6	18.7
palatal length						
ant. palatal foramina	4.8	5.0	4.9	7.1×3	6.3	7.3
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	5.3	5.4	5.7	6.7	6.1	6.5
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Stenomys (Continued)			*Echiothrix*		
	A.M.103270 y. ad. ♀ *verecundus* Weyland Mts.	A.M.103269 y. ad. ♀ *verecundus* Weyland Mts.	*ceramicus* (type) ad. ♂ Ceram	*leucura* (type)	A.M.101245 y. ad. ♂ Celebes	A.M.101243 ad. ♀ Celebes
Skin:						
head and body	147	135	135	235	230[38]	216[38]
tail	152	142	140	215	240[38]	233[38]
hind foot (s.u.)	32	33	30	48	50[38]	49[38]
hind foot (c.u.)						
ear				30	33[38]	32[38]
Skull:						
total length	36.1	35.7	38			
condylo-basal length					55.1	
condylo-incisive length	32.7	32.3	34.8		54.2	
condylo-basilar length						
occipito-nasal length	36.1	35.7			57.8	55.4
basal length	31.0	29.5				
basilar length						
zygomatic breadth	16.3		16.6		25.3?	24.8
inter-orbital breadth	6.3	6.1	5.7		7.1	7.6
interparietals						
breadth braincase	15.0	14.7	15.0		19.7	19.8
mastoid breadth						
nasals, length	13.4	12.8	15		24.2[39]	24.0[40]
nasals, greatest breadth	3.6		4.2		4.2	4.4
zygomatic plate	3.2	3.0				
diastema	9.5	9.0			20.5	19.6
height muzzle behind inc.						
palatilar length	16.2		19.7		29.2	28.5
palatal length					31.5	31.0
ant. palatal foramina	6.3	6.1	6		10.0	9.3
breadth meso.-pter. fossa						
width inside $m^1 - m^1$					5.3	5.2
length bulla						
length mandible					32.9	31.2
Teeth:						
crowns m^{1-3}	6.4	6.4	6.2			
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth	3.1×2.0	3.1×2.0				
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}					7.4	

	Echiothrix (Continued)					*Macruromys*
	A.M.101246 ad. ♀ Celebes	A.M.101247 y. ad. ♀ Celebes	A.M.101248 juv. ♀	*brevicula* (type) ad. ♂	*centrosa* (type) ad. ♂	*elegans* ad. ♀ Stein–385
Skin:						
head and body	220[38]	225[38]	198[38]	198	265	158
tail	220[38]	225[38]	212[38]	240	215	207
hind foot (s.u.)	50[38]	50[38]	44[38,43]	48	53	35
hind foot (c.u.)						37
ear	33	33	31	28.1	29.4	
Skull:						
total length						38
condylo-basal length	54.5	51.4		48.7	52.0	
condylo-incisive length	53.4	50.6				
condylo-basilar length						
occipito-nasal length	57.1	54.6				
basal length						32.4
basilar length						
zygomatic breadth	24.3	24.4		23.7	23.6	17.9
inter-orbital breadth	7.1	7.7	6.9	6.9	7.7	6.0
interparietals						4.5×8.5
breadth braincase	19.4	19.8		19.0	19.6	16.2
mastoid breadth						14.2
nasals, length	24.3[41]	23.0[42]	22.5[44]	[45]	[46]	14.3
nasals, greatest breadth	4.2	4.3	4.1			4.1
zygomatic plate						1.8
diastema	20.8	19.0	17.9			10.0
height muzzle behind inc.						
palatilar length	29.1	27.2				15.3
palatal length	32.0	29.8		27.8	29.5	18.3
ant. palatal foramina	9.8	10.0	10.0			4.6
breadth meso.-pter. fossa						
width inside $m^1 - m^1$	5.5					
length bulla						4.0
length mandible	31.0	30.1	26.9	28.2	30.8	
Teeth:						
crowns m^{1-3}	6.9		6.9	6.5	6.4	4.8
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						2.3×1.2
m^2, length × breadth						1.6×1.1
m^3, length × breadth						1.1×1.0
crowns, m_{1-3}	6.8	6.6	6.8	6.5	6.7	

	caurinus (type descrip.) old ♀ Talaud Isl.	*talaudium* (type descrip.) ad. ♀ Talaud Isl.	*obiensis* (type descrip.) ad. ♀ Obi	*aerosus* (type descrip.) ad. ♀ Ceram	*fulgens* (type descrip.) old ♂ Ceram	*fraterculus* (type descrip.) ad. ♂ Ceram
Skin:						
head and body	176	145	142	150	150	115
tail	130	190	154	138	200	155
hind foot (s.u.)	30	31	28	31	34	26
hind foot (c.u.)						
ear						
Skull:						
total length	39	39.5		38	40	33
condylo-basal length						
condylo-incisive length	37.2	37.8		35	37.5	31
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth	30.2[47]	21		19.0	22.7	14
inter-orbital breadth	6.7	6.2	5.6	5.7	7	
interparietals						
breadth braincase				15.8	16.5	
mastoid breadth						
nasals, length		13.0	11.3	14.3	13	
nasals, greatest breadth						
zygomatic plate						
diastema			9.2			
height muzzle behind inc.						
palatilar length	17.8	18.4	16	16.5	17.2	14.6
palatal length						
ant. palatal foramina	5.4×2.6	6.3	6.1	6.5	5.7	6.3
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	8.0	7.3	6.4	7.8	7.1	6.6
alveoli m^{1-3}					(7.6)	
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	bruijnii (type descrip.) Salawatti	*naso* (type descrip.) ad. ♀ New S. Dutch Guinea	*calidior* (type descrip.) old ♂ New S. Dutch Guinea	*sexplicatus* (type descrip.) ad. ♀ New N. Dutch Guinea	*leucogaster* (type descrip.) ad. ♀ New S. Dutch Guinea	*stalkeri* (type descrip.) ♀ N. W. Papua
Skin:						
head and body	190	188	153	150	175	135
tail	202	132	156	135	shorter	137
hind foot (s.u.)	33	36	30	26	35	27
hind foot (c.u.)						
ear						
Skull:						
total length		45.5	33.8	34.0		33.4
condylo-basal length						
condylo-incisive length		41.3	33.4			
condylo-basilar length						
occipito-nasal length						
basal length					37	
basilar length						27
zygomatic breadth		20.2	17.7		22	17
inter-orbital breadth		7.0	6.2	5.5		5.8
interparietals						
breadth braincase		16.5				14.5
mastoid breadth						
nasals, length		17.0×5	11		14	10×3.7
nasals, greatest breadth						
zygomatic plate						
diastema		12.7		9.5	11.5	9.2
height muzzle behind inc.						
palatilar length		21.0	16.2			15
palatal length						
ant. palatal foramina		7×3.2	4.8			4.9×2
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}		8.6	6.5	7.5	7	6.0
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	arcium (type descrip.) ad. ♀ Louisiades	*rufescens* (type descrip.) ♀ Duke of York	*musavora* (type descrip.) Duke of York	*platyops* (type descrip.) ad. ♂ Central Div., Papua	*levipes* (type descrip.) ♂ co-type Central Div., Papua	*levipes* (type descrip.) ♂ co-type Central Div., Papua
Skin:						
head and body	138	127	170	144	147	152
tail	127	109	96.5	116	131	141
hind foot (s.u.)	28	26.5		30	36	37
hind foot (c.u.)			30.5			
ear						
Skull:						
total length	40		35.6	37.0		
condylo-basal length						
condylo-incisive length	38.1					
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length				29.4	31.5	
zygomatic breadth	21			18.5	19.7	
inter-orbital breadth	6.8		6.1	6.0	6.1	
interparietals						
breadth braincase				14.7		
mastoid breadth						
nasals, length				12.7		
nasals, greatest breadth						
zygomatic plate						
diastema				10.0	11.1	
height muzzle behind inc.						
palatilar length	18.1			17.0	18.2	
palatal length						
ant. palatal foramina	6.2		5.1	5.0	5.6×2.3	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	7.1		7.4	7.0	7.7	
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	gracilis (type descrip.) ad. ♀ Central Div., Papua	*banfieldi* (type descrip.) N. Queensland	*cervinipes* S. Queensland	*c. eboreus* (type descrip.) ad. ♂ Queensland	*c. pallidus* (type descrip.) ad. ♂ Queensland	*rubicola* (type descrip.) ad. ♂ Torres Straits
Skin:						
head and body	140	140		135	136	
tail	175	152		145	144	180
hind foot (s.u.)	27	28		28.5	28	30
hind foot (c.u.)						
ear						
Skull:						
total length	33.8	37		33.7	34	[45]
condylo-basal length						
condylo-incisive length				32.0	31.4	
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length	27.5					
zygomatic breadth	17.2					19.5
inter-orbital breadth	5				5.3	6.0
interparietals						
breadth braincase	14				14.2	14.3
mastoid breadth						
nasals, length	11	11		11.5	11.3	13.0
nasals, greatest breadth						
zygomatic plate						
diastema	9.5					
height muzzle behind inc.	6.4					
palatilar length	14.8				15.2	
palatal length						
ant. palatal foramina	4.4×2				6.2	6.0
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	6.2				6.5	6.8
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

Melomys (Continued)

	littoralis (type descrip.) ad. ♀ Queensland	*insulae* (type descrip.) ad. ♂ Queensland	*murinus* (type descrip.) ad. ♀ Torres Straits	*muscalis* (type descrip.) old ♂ Fly River, Papua	*australis* (type descrip.) ad. ♀ Queensland	*lorentzii* (type descrip.) ad. ♀ Dutch New Guinea
Skin:						
head and body	90	128	97	95	109	185
tail	112	112	109	105	109	122
hind foot (s.u.)	26	25.5	24	22	22	36
hind foot (c.u.)	27.8					
ear						
Skull:						
total length	30.2	30.2	30.0	29.0	28.6	
condylo-basal length						
condylo-incisive length	28.0	27.8	27.0	26.6	26.5	
condylo-basilar length						
occipito-nasal length						
basal length						37
basilar length						
zygomatic breadth	15	15.4	15.0	14.5		21.5
inter-orbital breadth	4.7		4.7	4.1	4.1	
interparietals						
breadth braincase					13	
mastoid breadth						
nasals, length	10.5	10.7	10.0	10.2	10	15
nasals, greatest breadth						
zygomatic plate						
diastema						11.0
height muzzle behind inc.						
palatilar length	13.5	13.4	12.7	12.4		
palatal length						
ant. palatal foramina	4.8	5.0	4.9	4	5.0	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	6.1	5.9	5.2	4.7	5.0	8.5
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	mollis (type descrip.) ad. ♂ Dutch New Guinea	*lanosus* (type descrip.) old ♀ Dutch New Guinea	*rattoides* (type descrip.) ad. ♂ N. Dutch New Guinea	*rubex* (type descrip.) ad. ♂ Dutch New Guinea	*monektoni* (type descrip.) ♂ N. E. Papua	*lutillus* (type descrip.) Central Div., Papua
Skin:						
head and body	161	175	210	132	160	112
tail	140	143	160	130	127	114
hind foot (s.u.)	34	36.5	41	29	30.5	24
hind foot (c.u.)						
ear						
Skull:						
total length	39.5	42	48.5	34.2	38.5	29[49]
condylo-basal length						
condylo-incisive length	36.2	38	42.5	31		27
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth	18.5	19	22.0	17	18.2	15.2
inter-orbital breadth	7.1	7.6	7.4	5.8	6.1	4.3
interparietals						
breadth braincase	15.7	17.3	18.3	14		
mastoid breadth						
nasals, length	13.8	15.5	17.2	13.5	12.8	10.3
nasals, greatest breadth						
zygomatic plate		3.6				
diastema					10.1	
height muzzle behind inc.						
palatilar length	18.5	18.2	20.0	15.5	16.5	12.7
palatal length						
ant. palatal foramina	5.9	6.2	6.0	5.0	5×2.6	5.1
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	8.0	7.8	8.2	6.4	7.0	5.3
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	melicus (type descrip.) ad. ♀ Melville Isl.	*mayeri* (type descrip.) ad. ♂ Dutch New Guinea	A.M.79755 ad. ♂ *sevia* (type) Sevia	A.M.104563 ad. ♂ *muscalis* W. Div., Papua	A.M.104568 ad. ♂ *muscalis* W. Div., Papua	A.M.104558 y. ad. ♂ *muscalis* W. Div., Papua
Skin:						
head and body	122	152	124	109	112	103
tail	149	201	140	123	115	109
hind foot (s.u.)	29	31	25[1]	23.5[1]	22.5[1]	23[1]
hind foot (c.u.)						
ear						
Skull:						
total length	32.7	37				
condylo-basal length						
condylo-incisive length	30.5		29.0	26.0	25.7	24.6
condylo-basilar length						
occipito-nasal length			31.5	27.5	27.6	27.1
basal length			26.6			
basilar length			24.3			
zygomatic breadth	17.3	19	15.3	13.6	14.1	
inter-orbital breadth	4.9	6	5.2	4.4	4.5	4.3
interparietals						
breadth braincase		15.1	13.4	11.9	12.2	11.3
mastoid breadth						
nasals, length	11.1	12.5	10.0	9.3	9.2	9.3
nasals, greatest breadth			3.2			
zygomatic plate			3.3	2.7	3.1	2.9
diastema			7.6	7.5	7.3	6.9
height muzzle behind inc.			5.5			
palatilar length	14.2	16.5	13.0	12.4	11.8	12.1
palatal length			15.0			
ant. palatal foramina	5.3		5.1	4.2	4.3	4.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	5.8	7	5.7	5.0	5.0	5.0
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

Melomys (Continued)

	A.M.104562 old ♂ *muscalis* W. Div., Papua	A.M.104560 ad. ♀ *muscalis* W. Div., Papua	A.M.104557 ad. ♀ *muscalis* W. Div., Papua	A.M.104278 ad. ♂ *lutillus* Central Div., Papua	A.M.104163 ad. ♂ *lutillus* Central Div., Papua	A.M.104166 ad. ♂ *lutillus* Central Div., Papua
Skin:						
head and body	115[50]	112	97	118	114	116
tail	98[50]	103	103	117	119	117
hind foot (s.u.)	23[1]	22[1]	22	24.8	25.0	24.5
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length		24.9	23.4	26.8		26.4
condylo-basilar length						
occipito-nasal length	28.6	27.5	25.7	29.0		28.8
basal length						
basilar length						
zygomatic breadth	15.4	14.0	13.6	14.9		14.7
inter-orbital breadth	4.3	4.3	4.6	4.4	4.5	4.7
interparietals						
breadth braincase	12.5	12.4	12.0	12.5		12.7
mastoid breadth						
nasals, length	9.6	9.8	8.7	10.0	9.9	9.6
nasals, greatest breadth						
zygomatic plate	2.9	2.8	3.0	3.4	3.4	3.3
diastema	6.9	7.6	6.4	7.5	7.5	7.1
height muzzle behind inc.						
palatilar length	12.0	11.9	11.5	12.4	13.0	12.5
palatal length						
ant. palatal foramina	4.1	4.5	4.3	4.5	4.7	4.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	5.1	4.8	5.1	5.4	5.5	5.4
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104279 ad. ♀ *lutillus* Central Div., Papua	A.M.104003 ad. ♂ *lutillus* Central Div., Papua	A.M.104002 ad. ♂ *lutillus* Central Div., Papua	A.M.104185 old ♀ near *stalkeri*	A.M.103273 ad. ♂ *stalkeri* or *calidior* ? Weyland Mts.	A.M.103271 juv. ♂ *stalkeri* or *calidior* ? Weyland Mts.
Skin:						
head and body	103	127	120	142	133	116
tail	103	128	121	119	107	106
hind foot (s.u.)	24.0	25.0	24.5	24.8+	26	27
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length	27.4	28.1			29.7	
condylo-basilar length						
occipito-nasal length	29.5	30.6			32.6	
basal length						
basilar length						
zygomatic breadth	15.3	15.4			16.8	
inter-orbital breadth	4.5	4.6		5.9	5.7	
interparietals						
breadth braincase	12.8	13.0			13.5	
mastoid breadth						
nasals, length	9.8	10.5		11.9	11.5	
nasals, greatest breadth				4.0		
zygomatic plate	3.4	4.0		4.2	3.4	
diastema	7.6	7.9		9.7	9.3	
height muzzle behind inc.				6.5		
palatilar length	12.6	13.0		14.9	14.9	
palatal length						
ant. palatal foramina	5.0	4.7		4.7	4.3	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla					4.0	
length mandible						
Teeth:						
crowns m^{1-3}	5.6	5.7	5.6	6.0	6.0	6.3
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth					3.1×1.9	3.3×1.9
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.103257 ad. ♀ *stalkeri* or *calidior*? Weyland Mts.	A.M.103263, ad. ♂ near *aerosus* Weyland Mts. (Stein 462) Dutch New Guinea	A.M.101957 ad. ♂ *lorentzi*	A.M.104196 ad. ♂ *mollis*	A.M.104194 ad. ♂ *mollis*	A.M.104144 ad. ♂ *mollis*
Skin:						
head and body	122	155	177	163	169	156
tail	107	112	142	156	143	151
hind foot (s.u.)	26	32	35	34.9	34.1	35.8
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length	28.9	35.0		37.9	37.1	37.4
condylo-basilar length						
occipito-nasal length	32.0	38.0	42.1	41.6	41.0	41.1
basal length			36.4	35.2	34.1	34.8
basilar length		30.2		32.0	31.2	31.5
zygomatic breadth	16.3		18.6	19.0	19.2	18.9
inter-orbital breadth	5.7	7.0	6.7	6.2	6.7	6.3
interparietals		4.9×9.7				
breadth braincase	13.9			14.6	14.8	14.6
mastoid breadth						
nasals, length	10.6	11.4	14.6	15.8	14.8	15.4
nasals, greatest breadth			4.8	4.8	4.8	4.8
zygomatic plate	3.5	4.2		4.1	4.3	4.3
diastema	8.6	11.0	12.0	11.8	11.2	11.1
height muzzle behind inc.				7.6	7.4	7.7
palatilar length	14.2	17.4	18.9	18.5	18.3	18.4
palatal length				21.5	21.3	21.4
ant. palatal foramina	4.3	6.5	6.1	6.1	6.5	6.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla	4.1	4.9				
length mandible						
Teeth:						
crowns m^{1-3}	6.3	7.3	7.8	7.8	7.9	7.9
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth	3.3×1.9	3.6×2.3				
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104188 ad. ♂ *mollis*	A.M.104189 ad. ♂ *mollis*	A.M.104190 ad. ♀ *mollis*	A.M.104186 ad. ♀ *mollis*	A.M.104193 ad. ♀ *mollis*	A.M.104191 ad. ♀ *mollis*
Skin:						
head and body	157	158	163	152	154	159
tail	156	160	153	150	141	156
hind foot (s.u.)	34.4	35.4	34.4	32.5	34.4	34.2
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length				33.9	34.8	
condylo-basilar length						
occipito-nasal length				37.0	38.4	
basal length				31.2	32.2	
basilar length				28.5	29.2	
zygomatic breadth	18.4			18.2	18.0	
inter-orbital breadth	6.6		6.7	6.4	6.4	6.6
interparietals						
breadth braincase				14.1	14.3	
mastoid breadth						
nasals, length	14.2	14.3	15.3	13.7	13.1	13.8
nasals, greatest breadth		4.7	4.5	4.6	4.6	4.9
zygomatic plate	3.7	3.9	3.8	3.8	4.0	3.9
diastema	11.0	10.5	11.3	10.0	9.8	10.6
height muzzle behind inc.	7.3	7.3	6.9	6.8	7.1	7.2
palatilar length	18.2	17.9	18.5	16.6	16.9	17.5
palatal length	20.4	20.2	20.6	19.1	19.5	20.2
ant. palatal foramina	6.2	5.8	6.8	5.4	5.8	6.0
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	8.0	8.2	7.8	7.6	7.7	7.8
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104273 y. ad. ♂ *latipes* (type)	A.M.104341 (type) ad. ♀ *tafa* Mt. Tafa, 2400 m.	A.M.104350 ad. ♂ *tafa* Mt. Tafa	A.M.104319 ad. ♂ *tafa* Mt. Tafa	A.M.104321 y. ad. ♂ *tafa* Mt. Tafa	A.M.104351 ad. ♀ *tafa* Mt. Tafa
Skin:						
head and body	142	128	133	135	122	132
tail	147	143	136	138	131	138
hind foot (s.u.)	31	30.3	30.5	31.0	28.0[1]	29.1
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length	32.1	31.5		30.9	30.1	30.8
condylo-basilar length						
occipito-nasal length		34.7	34.8	33.7	32.8	33.9
basal length	30.5	29.2		28.6	28.1	28.6
basilar length	27.4	27.0		26.0	25.7	26.2
zygomatic breadth	17.5	17.1	17.2	16.5	17.0	16.7
inter-orbital breadth	5.6					
interparietals						
breadth braincase	14.5	13.4	13.3	13.4	13.4	13.3
mastoid breadth						
nasals, length		12.0	11.7	11.5	11.0	11.8
nasals, greatest breadth		4.1				
zygomatic plate	4.0	3.8	4.0	3.9	3.7	3.9
diastema	9.1	9.7	10.0	9.6	9.2	9.4
height muzzle behind inc.	7.0	6.4	6.5	6.5	6.4	6.0
palatilar length	15.6	16.1	15.7	15.5	15.3	15.7
palatal length	17.7	18.1	17.7	17.8	17.5	17.9
ant. palatal foramina	4.9+	4.7	4.8	4.5	4.0	4.8
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	7.1	6.7	6.4	6.5	6.4	6.5
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104195 ad. ♀ *tafa* Mt. Tafa	A.M.104297 y. ad. ♀ *tafa* Murray Pass, Papua, 2860 m.	A.M.101959 (type) ad. ♂ *shawi*	A.M.79767 ad. ♂ (? *rubex*)	A.M.104198 ad. ♂ (*platyops*)	A.M.104187 ad. ♂ (*gracilis*)
Skin:						
head and body	132	126	110	140	147	125
tail	140	131	109	113	125	180
hind foot (s.u.)	29.2	29.4	27	30	29.3	27.8
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length	31.1	30.2	30.0	31.5	33.1	31.4
condylo-basilar length						
occipito-nasal length	34.8	33.3	32.9	35.1		33.7
basal length	28.8	28.1	27.5	29.6	31.2	29.0
basilar length	27.0	25.7	25.5	27.0	28.9	26.6
zygomatic breadth	17.1	17.0	16.4	17.0	17.1	17.1
inter-orbital breadth			5.7	5.6	6.1	5.4
interparietals						
breadth braincase	13.4	13.4	13.4	13.3	13.0	13.0
mastoid breadth						
nasals, length	12.0	11.7	11.5	12.3		10.8
nasals, greatest breadth	3.8		3.5	4.1	4.3	3.7
zygomatic plate	3.8	3.9	3.7	3.8	4.6	3.7
diastema	9.9	9.3	9.0	9.7	10.4	9.1
height muzzle behind inc.	6.5	6.2	5.7	6.2	7.0	6.7
palatilar length	15.9	15.1	15.0	15.7	16.6	15.2
palatal length	17.9	17.4	17.0	18.4	19.0	17.3
ant. palatal foramina	4.0	4.3	4.4	4.9	4.8	4.2
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	6.5	6.6	6.4	6.5	6.8	6.4
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	aruensis (type descrip.) Aru Island	*vaigeuensis* (type descrip.) ad. ♂ Waigeu	*siebersi* (type descrip.) ad. ♂	*scaphax* (type descrip.) ad. ♀	*multiplicatus* juv. Dutch New Guinea	*validus* (type descrip.) W. Division, Papua
Skin:						
head and body			280	277		200
tail			234	235		200
hind foot (s.u.)			50	52		52
hind foot (c.u.)						
ear			26	26		28
Skull:						
total length	59.3	60	63	62.5		
condylo-basal length						
condylo-incisive length			58	57.4		
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth	29.6	35.0		32.2		
inter-orbital breadth		10.9	10.3	11.8		
interparietals						
breadth braincase		20.6				
mastoid breadth						
nasals, length		24.3×8.4	22.5	21.5×6.4		
nasals, greatest breadth						
zygomatic plate						
diastema		11.5				
height muzzle behind inc.						
palatilar length		36.5		31.2		
palatal length						
ant. palatal foramina		7.8	7.0	6.6		
breadth meso.-pter. fossa		6.0		5		
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}		12.5	12.0	10.5		11.3
alveoli m^{1-3}						
crowns m^{1-2}					9.5	
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	papuanus Ramsay Papua	*prolixus* (type descrip.) ad. ♂ (alc.)	*ductor* (type descrip.) ad. ♂	*barbatus* (type descrip.)	*caudimaculatus* from Frechkop	*sherrini* (type descrip.) ad. ♀
Skin:						
head and body		265	325	270	280	286
tail		272	280	210	335	344
hind foot (s.u.)	58.4	64	55	60	65.0	'56
hind foot (c.u.)						
ear		25	26			31
Skull:						
total length		66.6	65		64.3	
condylo-basal length						
condylo-incisive length	69.8	62	61.5		62.6	64
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth		32.2	32		32.7	33.7
inter-orbital breadth		10.0	9.4		10.2	10.0
interparietals						
breadth braincase			21.5		21.0	
mastoid breadth		21				
nasals, length		24.2×8.2	24.2×7.4		23.9×6.7	23
nasals, greatest breadth						
zygomatic plate						
diastema					20.2	
height muzzle behind inc.						
palatilar length		33.5	32.6		32.8	33.5
palatal length						
ant. palatal foramina		7.3×3.3	7.3		8.5×3.8	8.4
breadth meso.-pter. fossa		5.0	5.2		4.8	
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	12.4	12.2	11.2	11.0	11.9	11.2
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	exilis (type descrip.) ad. ♀ (alc.)	*nero* (type descrip.) old ♀	*anak* (type descrip.) old ♂	*rothschildi* (type descrip.) ad. ♀	*neobrittanicus* old ♂	A.M.104500 ad. ♂ *validus* Western Div., Papua
Skin:						
head and body	276	279	310	350		278
tail	314	232	400	355		289
hind foot (s.u.)	60	56	69	68		57.6
hind foot (c.u.)						
ear	30	30	24	23		
Skull:						
total length		68.3			67.6	65.2
condylo-basal length						
condylo-incisive length	68.5	63.7			66.0	61.8
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth	36.3	36.5		34	36.8	34.4
inter-orbital breadth	11.6	11	10.3	10.5	11.2	11.2
interparietals						
breadth braincase		22			22.2	21.8
mastoid breadth						
nasals, length	26.4	25×8.5	27×8.6	28×7.4	24×6.7	22.6
nasals, greatest breadth						7.4
zygomatic plate						
diastema			23.5		20.4	20.0
height muzzle behind inc.						
palatilar length	36.5	31.2	38.5	37.6	34.8	32.2
palatal length						
ant. palatal foramina	8.5	8.2	7.3	6.5×3.4	7.0	7.0
breadth meso.-pter. fossa		6.5			5.2	4.6
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	12.0	12.2	14.2	12.8	13.9	11.1
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.104501 ad. ♂ *validus* Western Div., Papua	A.M.104505 ad. ♂ *validus* Western Div., Papua	A.M.104503 ad. ♂ *validus* Western Div., Papua	A.M.104509 ad. ♂ *validus* Western Div., Papua	A.M.104506 ad. ♀ *validus* Western Div., Papua	A.M.104508 ad. ♀ *validus* Western Div., Papua
Skin:						
head and body	270		284	288	269	280
tail	295		279	288	298	267
hind foot (s.u.)	57.9	56.8	55.2	57.6	53.5	54.7
hind foot (c.u.)						
ear						
Skull:						
total length	66.9		67.4	66.3	65.7	61.2
condylo-basal length						
condylo-incisive length	64.0		63.8	63.5	63.0	58.2
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth	33.0	33.3	32.7	33.9	34.3	32.4
inter-orbital breadth	10.5	11.2	12.4	11.0	11.1	10.6
interparietals						
breadth braincase	20.0	20.9	19.6	20.8	20.1	20.3
mastoid breadth						
nasals, length	23.6	23.0	23.0	22.6	24.0	21.5
nasals, greatest breadth	7.4	7.5	7.3	7.4	6.9	6.9
zygomatic plate						
diastema	20.9	20.4	20.6	19.9	20.5	19.2
height muzzle behind inc.						
palatilar length	34.5	33.0	35.0	34.0	34.5	31.5
palatal length						
ant. palatal foramina	7.2	6.7	7.6	6.7	7.1	7.2
breadth meso.-pter. fossa	4.6	4.9	5.0	4.8	5.0	4.2
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	11.2	11.2	11.7	11.9	12.0	10.0
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

Uromys (Continued)

	A.M.104502 ad. ♀ *validus* Western Div., Papua	A.M.104504 ad. ♀ *validus* Western Div., Papua	A.M.104156 ad. ♂ *ductor* Central Div., Papua	A.M.104158 ad. ♂ *ductor* Central Div., Papua	A.M.104157 ad. ♀ *ductor* Central Div., Papua	A.M.66037 *caudimaculatus* ad. ♀
Skin:						
head and body	271	270	283	285	250	
tail	296	257	302	300	275	
hind foot (s.u.)	57.8	53.9	59	58	56	
hind foot (c.u.)						
ear						
Skull:						
total length		65.6	63.9	64.7	60.3	64.3
condylo-basal length						
condylo-incisive length		63.4	60.9	61.6	53.0	62.6
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth	33.5	34.6	30.8	31.1	49.1	32.7
inter-orbital breadth	10.6	11.7	9.4	10.8	10.3	10.2
interparietals						
breadth braincase	20.2	21.0	20.5	20.6	19.7	21.0
mastoid breadth						
nasals, length	22.9	27.3	22.7	23.5	21.4	23.9×6.7
nasals, greatest breadth	6.9	7.4				
zygomatic plate						
diastema	19.7	20.2	19.0	19.7	18.0	20.2
height muzzle behind inc.						
palatilar length	31.9	34.3	33.3	32.8	30.5	32.8
palatal length						
ant. palatal foramina	7.1	6.9	6.8	7.1	7.0	8.5×3.8
breadth meso.-pter. fossa	5.2	5.2	5.0	5.6	4.8	4.8
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	11.3	11.6	11.2	11.9	11.0	11.9
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Uromys (Continued)			*Solomys* and *Cyromys*		
	A.M.104155 *anak* ad. ♀ Mt. Tafa	A.M.79782 ad. ♀ *rothschildi* Huon Region	A.M.103258 ad. ♀ *rothschildi* Weyland Mts.	*S. salamonis* (type) "ad. ♂"	*S. sapientis* (type) ♀	A.M.79850 ♀ (*salamonis*)
Skin:						
head and body	335	355	305	223	250	245
tail	373	355	321	216	250	250
hind foot (s.u.)	66	69	66	44.4	51	52
hind foot (c.u.)	73	76				
ear	21					
Skull:						
total length	67.3	71.3	63.5	49.5	52.5[52]	53.7
condylo-basal length						
condylo-incisive length	66.9	70.8	64.2			
condylo-basilar length						
occipito-nasal length						
basal length						51
basilar length					44	45.3
zygomatic breadth	35.3	36.0	32.7	25.4[51]	28.7	30
inter-orbital breadth	9.5	11.3	9.9		8.3	8.2
interparietals					15.0×7.5	12.8
breadth braincase	22.6	22.0	21.7			
mastoid breadth						
nasals, length	23.5×7.8	28.7×7.9	23.0×6.5		18.0	18.6
nasals, greatest breadth					6.3	
zygomatic plate						
diastema	21.2	22.6	20.5	±15.5[51]	15	14.1
height muzzle behind inc.						
palatilar length	35.0	37.7	34.6	24.7[51]	24.0[53]	24.3
palatal length				27.8[51]		28.2
ant. palatal foramina	6.8	5.6×3.1	6.3	5.1×2.8		6.2×3.0
breadth meso.-pter. fossa	6.4	6.1	5.5			
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	12.7	13.3	12.2	10.2	11.0	10.8
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth				5.1×2.5		5.2×3.2
m^2, length × breadth				3.8× —		3.9× —
m^3, length × breadth				2.5× —		2.5× —
crowns, m_{1-3}						

	Solomys and *Cyromys* (Continued)		*Anisomys*			*Hyomys*
	C. rex (type)	*C. imperator* (type) ♀	A.M.79779ad. ♂ *Anisomys imitator* Sevia, Cromwell Range Mand. Terr. New Guinea	A.M.103265 ad. ♀ *Anisomys imitator* Weyland Mts. Dutch New Guinea	Type *imitator* ♂ Aroa River, Papua	U.S.N.M.199521 *Hyomys stribiturus*
Skin:						
head and body	290	340	279	244	300	330 ±
tail	296	258	305	314	320	
hind foot (s.u.)	55	66	66	61	60	55
hind foot (c.u.)						
ear						
Skull:						
total length	60.0[51]	66.7[51]				
condylo-basal length						
condylo-incisive length			61.4	55.1		
condylo-basilar length						
occipito-nasal length			67.5	60.6		72.8
basal length	54	60				66.4
basilar length						
zygomatic breadth	33	35	34.6	29.9	35.0	38.5
inter-orbital breadth	9	11.1	11.6	10.4	11.3	8.9
interparietals	13.2	12.5	9.0×14.8	7.1×14.5	8.3×14.5	
breadth braincase			22.3	22.9		
mastoid breadth			22.8	21.5		
nasals, length	20	24	27.3	18.4	27.0	30.3
nasals, greatest breadth			7.5	7.0	8.6	12.0
zygomatic plate			9.5	8.4	9.2	
diastema			19.8	17.7	20	
height muzzle behind inc.			14.6	13.1		
palatilar length			32.3	29.1	33.0	37.5
palatal length	33.0	36.3				41.8
ant. palatal foramina			3.8	3.9	3.7×3.1	7.8×3.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla			6.0	6.0		
length mandible						
Teeth:						
crowns m^{1-3}	11.1	12.0	10.2	9.7	10.2	16.0
alveoli m^{1-3}						15.8
crowns m^{1-2}						
m^1, length × breadth			4.4×2.9	4.3×2.7	— ×3.1	
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Hyomys (Continued)	*Lenomys*				
	A.M.103274 ad. ♀ *H. m. dammermani*	*meyeri* (type descrip.) (Jent. 1879) Menado, Celebes	*meyeri* (Jent. 1887) From figure of type, adult	*meyeri* (Hoffmann, 1887), adult Minahassa	*longicaudatus* (type descrip.) ad. ♀ Middle Celebes	*longicaudatus* (re-measured)
Skin:						
head and body	302	290		250	235	260
tail	299	270		240	280	260
hind foot (s.u.)	57	46			45	45
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	63.2					55.4
basal length	59.4					
basilar length						
zygomatic breadth	35.0					
inter-orbital breadth	8.5					
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	25.0					
nasals, greatest breadth	11.0		6.0			7.1
zygomatic plate						
diastema		13.5	14.2			13.8
height muzzle behind inc.						
palatilar length	31.5		27.2			25.6
palatal length	46.0		30.1		29.5	29.0
ant. palatal foramina	8.0×3.5		7.1			6.8
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	14.2		11.4			10.9
alveoli m^{1-3}	14.0	13.0	12.5	12.4	11.5	11.5
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	A.M.101128 *lampo* (type) ad. ♀ S. Celebes	A.M.101125 ad. ♂ S. Celebes	A.M.101124 ad. ♂ S. Celebes	A.M.101129 ad. ♀ S. Celebes	A.M.101127 ad. ♀ S. Celebes	A.M.101126 ad. ♀ S. Celebes
Skin:						
head and body	275	271	266	275	245	262
tail	276	234	277	285	273	252
hind foot (s.u.)	47	47	45	47	46	46
hind foot (c.u.)						
ear						
Skull:						
total length		52.0				
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length						
basal length						
basilar length						
zygomatic breadth	28.3				27.0	27.2
inter-orbital breadth	7.3	7.4			6.9	7.7
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	20.5				18.5	17.5
nasals, greatest breadth	5.9				5.4	6.3
zygomatic plate						
diastema	15.8	14.5			13.7	13.5
height muzzle behind inc.						
palatilar length	27.7	28.0			26.5	26.0
palatal length						
ant. palatal foramina	8.8	8.7			8.7	8.6
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}		12.0				
alveoli m^{1-3}	11.6	12.9			12.0	12.3
crowns m^{1-2}						
m^1, length × breadth						
m^2 length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Lenomys (Continued)	*Pogonomys*				
		sylvestris			*lepidus lepidus*	
	"*callitrichus*" from Jentink Paré-paré	A.M.79757 ad. ♂ Huon Mts.	A.M.79768 ad. ♂ Huon Mts.	A.M.79765 ad. ♂ Huon Mts.	A.M.104201 ad. ♂ Papua	A.M.104202 ad. ♂ Papua
Skin:						
head and body					126	117
tail					168	175
hind foot (s.u.)		23	23	22	22	22
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	54.0					30.0
basal length		27.7		29.0		26.2
basilar length						
zygomatic breadth				15.8		16.8
inter-orbital breadth		4.5	4.3	4.3	4.7	4.4
interparietals						
breadth braincase						
mastoid breadth						
nasals, length						
nasals, greatest breadth	5.8					
zygomatic plate						
diastema	13.2					
height muzzle behind inc.						
palatilar length	25.9	12.0		12.0	13.1	12.5
palatal length	28.1					
ant. palatal foramina	9.9	3.6		3.5	4.2	
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible		17.2	17.2	17.1	19.9	18.1
Teeth:						
crowns m^{1-3}	10.3	5.6	5.0	4.8	5.1	5.0
alveoli m^{1-3}	11.4					
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	lepidus lepidus				*lepidus vates*	
	A.M.104203 ad. ♂ Papua	A.M.104204 ad. ♂ Papua	A.M.104205 ad. ♀ Papua	A.M.104206 ad. ♀ Papua	U.S.N.M.120916 ad. No locality	U.S.N.M.120918 y. No locality
Skin:						
head and body	115	115	123	120		
tail	170	172	181	172		
hind foot (s.u.)	22	22	22	22		
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	29.9		30.5	30.7		
basal length			26.6	26.7		
basilar length						
zygomatic breadth	17.5		17.8	17.4		
inter-orbital breadth	4.9	4.7	4.4	4.5	5.0	4.8
interparietals						
breadth braincase						
mastoid breadth						
nasals, length						
nasals, greatest breadth						
zygomatic plate						
diastema						
height muzzle behind inc.						
palatilar length	13.3	12.4	13.3	13.1		12.6
palatal length						
ant. palatal foramina	4.3	3.7	4.2	4.3	4.1	3.4
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible	18.5	17.6	18.5	18.6		
Teeth:						
crowns m^{1-3}	4.9	5.0	4.9	4.7	5.0	5.0
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	lepidus vates		*lepidus huon*			
	U.S.N.M.120919 ad. ♀ No locality	U.S.N.M.120920 ad. No locality	A.M.79772 ad. ♂ Huon Region	A.M.79763 ad. ♀ Huon Region	A.M.101963 ad. ♀ *lepidus derimapa* Dutch New Guinea	A.M.104184 ad. ♂ *loriae* Papua
Skin:						
head and body					112	159
tail					174	236
hind foot (s.u.)			24	23	23	28
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length			31.5	29.6	30.9	35.4
basal length			28.4	26.7	27.3	32.0
basilar length						
zygomatic breadth	18.8	19.6	18.0		16.9	19.9
inter-orbital breadth	4.9	5.0	4.5	4.2	4.5	4.5
interparietals						
breadth braincase						
mastoid breadth						
nasals, length						
nasals, greatest breadth						
zygomatic plate						
diastema						
height muzzle behind inc.						
palatilar length	13.8	13.5	13.5	13.0	13.4	17.6
palatal length						
ant. palatal foramina	4.2	3.9	4.3	3.9	3.4	4.2
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible			19.7	18.1	19.1	23.1
Teeth:						
crowns m^{1-3}	5.1	5.1	5.3	5.1	5.1	6.7
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	loriae			*forbesi satisfactus*		
	A.M.104178 ad. ♂ Papua	A.M.104177 ad. ♀ Papua	A.M.101960 ad. ♀ Dutch New Guinea	A.M.79827 ad. ♂	A.M.79828 ad. ♂	A.M.79831 ad. ♀ *pulcher major*
Skin:						
head and body	146	147	143			
tail	218	206	203		225	245
hind foot (s.u.)	28	27	27	36	37	37
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length	36.1	34.2	34.5	36.7	35.0	37.4
basal length	33.0	31.5	31.6	32.4	31.3	33.7
basilar length						
zygomatic breadth	20.0	20.1	20.2	21.7	21.7	22.3
inter-orbital breadth	5.0	4.7	5.1	5.6	6.1	5.9
interparietals						
breadth braincase						
mastoid breadth						
nasals, length						
nasals, greatest breadth						
zygomatic plate						
diastema						
height muzzle behind inc.						
palatilar length	17.0	17.0	16.6	15.3	15.0	15.9
palatal length						
ant. palatal foramina	4.3	3.9	3.9	3.2	3.5	3.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible	23.1	21.8	21.8	22.4	22.7	23.7
Teeth:						
crowns m^{1-3}	7.2	7.0	6.2	5.6	5.9	6.1
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	penicillatus (type descrip.) juv.	*peguensis* (type descrip.) ♀ Tenasserim	*peguensis* (type descrip.) ♂ Tenasserim	*peguensis* (*from* Thomas under *anna*)	*niadis* (measured from type) ♀ Sumatra	*anna* ♀ Java
Skin:						
head and body	117	79			81	87
tail	95	98	114		102	112
hind foot (s.u.)	19	19			19 [18]	18
hind foot (c.u.)						
ear	13				14.6×10	16
Skull:						
total length				26	24	24
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length						
basal length				20.5	20.4	
basilar length						18.5
zygomatic breadth				15	14	14
inter-orbital breadth					4.8	
interparietals						
breadth braincase						
mastoid breadth						
nasals, length						
nasals, greatest breadth						
zygomatic plate						
diastema						
height muzzle behind inc.						
palatilar length						
palatal length						
ant. palatal foramina						
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}				4		3.8
alveoli m^{1-3}					3.6	
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

Chiropodomys (Continued)

	legatus ♂ N. Borneo	*pictor* ♂ N. Borneo	*pusillus* N. Borneo	*anna*			
				A.M.102228 ad. ♂ Java	A.M.102227 ad. ♂ Java	A.M.102001 ad. ♂ Java	A.M.102000 ad. ♂ Java
Skin:							
head and body	133	120	76	88	91	85	88
tail	152	120	81	132	118	125	134
hind foot (s.u.)	24.5	20.5	15.8	19	20	20	21
hind foot (c.u.)							
ear	16	16	11.5				
Skull:							
total length					25.0		25.3
condylo-basal length							
condylo-incisive length							
condylo-basilar length							
occipito-nasal length							
basal length					21.3	21.2	21.5
basilar length							
zygomatic breadth	17.2	16.5		14.4	14.5	14.7	14.5
inter-orbital breadth	5.5	5.3	4.2	4.7	4.5	4.5	4.6
interparietals							
breadth braincase							
mastoid breadth							
nasals, length							
nasals, greatest breadth							
zygomatic plate							
diastema							
height muzzle behind inc.							
palatilar length	15			10.0	10.5	10.4	10.5
palatal length		12.8					
ant. palatal foramina							
breadth meso.-pter. fossa							
width inside $m^1 - m^1$							
length bulla							
length mandible				14.5	15.0	15.2	15.4
Teeth:							
crowns m^{1-3}	4.7	4		3.4	3.4	3.6	3.7
alveoli m^{1-3}							
crowns m^{1-2}							
m^1, length × breadth							
m^2, length × breadth							
m^3, length × breadth							
crowns, m_{1-3}							

	Chiropodomys (Continued)			*Mallomys*		
	anna				*rothschildi*	
	A.M.102119 ad. ♀ Java	A.M.101901 ad. ♀ Java	A.M.101904 ad. ♀ Java	*rothschildi* type ad. ♂	A.M.104153 ad. ♂ Mt. Tafa	A.M.104154 ad. ♂ Mt. Tafa
Skin:						
head and body	85	84	86	400	395	400
tail	123	98	118	380	405	385
hind foot (s.u.)	20	19.5	20	65	70	71.5
hind foot (c.u.)						
ear						
Skull:						
total length	24.4					
condylo-basal length						
condylo-incisive length						
condylo-basilar length						
occipito-nasal length					78.2	75.5
basal length	21.1				73.0	69.3
basilar length						
zygomatic breadth	14.5	13.8	15.1	36	41.2	
inter-orbital breadth	4.2	4.4	4.5	10	12.8	10.7
interparietals						
breadth braincase						
mastoid breadth						
nasals, length				27	31.5	31.0
nasals, greatest breadth				9	9.6	10.0
zygomatic plate						
diastema				21.5	22.8	21.9
height muzzle behind inc.						
palatilar length	10.3	10.3	10.4			
palatal length						
ant. palatal foramina				14×5.3	16.2×5.9	13.5×5.3
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible	15.1		14.9			
Teeth:						
crowns m^{1-3}		3.3	3.5	16.3	17.2	17.1
alveoli m^{1-3}						
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	hercules type ad. ♂	U.S.N.M.200889 *hercules* Huon Region	*argentata* co-type ad. ♀ A.M.101949 (= Mayer 148)	*weylandi* type ad. ♀	A.M.103261 ad. ♀ *weylandi*	*armandvillei* type ad. ♂ Flores
Skin:						
head and body	470	300 ±	370	370	379	420
tail	400	300 ±	400	400	391	350
hind foot (s.u.)	68	60				
hind foot (c.u.)			72	71	71	86
ear						
Skull:						
total length				78		66
condylo-basal length						
condylo-incisive length	75.2					
condylo-basilar length						
occipito-nasal length	77.0	72.6	71		71.9	
basal length						
basilar length						
zygomatic breadth	41	37.6	38.5	39	37	
inter-orbital breadth	11.7	9.7	11.0	11.0	10.4	
interparietals						
breadth braincase						
mastoid breadth						
nasals, length	29.5	29.3	27.5	29.0	26.1	24.0
nasals, greatest breadth	13	11.4	9.0		8.5	
zygomatic plate						
diastema	22.2	20.7	20.8		21.0	17.0
height muzzle behind inc.						
palatilar length						
palatal length						
ant. palatal foramina	16.2×7.0	14.5×5.9	13.6×5.0		14.5×5.1	10.0
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	18.0	16.7	17.0	17.0	16.3	15.0
alveoli m^{1-3}		17.6				
crowns m^{1-2}						
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Parahydromys					*Leptomys*
	asper (type) ad. ♂ Mt. Gayata, Papua	A.M.103256 y. ad. ♂ Weyland Mts.	A.M.103255 ad. ♀ Weyland Mts.	A.M.101951 old ♀ Gebroeders Mts.	A.M.101950 y. ♀ Gebroeders Mts.	*ernstmayri* ad. ♂ Central Div., Papua
Skin:						
head and body						152
tail						154
hind foot (s.u.)						40
hind foot (c.u.)						
ear						
Skull:						
total length						
condylo-basal length						
condylo-incisive length						35.0
condylo-basilar length						
occipito-nasal length						38.0
basal length						
basilar length	40.2	36.6	38.0	36.7	36.2	
zygomatic breadth	26.5	25.4	26.9	26.4	25.3	16.2
inter-orbital breadth	8.3	7.9	8.7	9.2	8.5	6.2
interparietals						
breadth braincase	21.5	20.8	22.1	21.7	20.7	14.6
mastoid breadth						
nasals, length	15.5		12.8	13.3	12.5	14.4
nasals, greatest breadth	6.1		5.4	6.0	5.2	4.2
zygomatic plate						2.0
diastema	12.5	11.2	11.6	11.5	10.8	9.2
height muzzle behind inc.						
palatilar length	23.0		22.1	21.2	20.6	16.0
palatal length						
ant. palatal foramina	4.4×2.7	4.3×2.3	4.3×2.5	4.0×2.3	3.7×2.1	5.1
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						
length bulla						
length mandible	34.0[54]	30.5[54]	32.0[54]	31.7[54]	30.4[54]	
Teeth:						
crowns m^{1-3}						6.3
alveoli m^{1-3}						
crowns m^{1-2}		9.4	9.6	9.0	9.0	
m^1, length × breadth	9.6[55]	6.4	6.8	6.1	6.2	
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	Leptomys (Continued)	*Hydromys*				
	ernstmayri ad. ♂ Central Div., Papua	*nauticus* (type descrip.) old ♀	*beccarii* (type descrip.)	*esox* (type descrip.) ad. ♂	*illuteus* (type descrip.) ad. ♂	A.M.99867 ad. ♀ *neobritannicus* (type)
Skin:						
head and body	145	265	255	295	260	288
tail	160	215	230	225	215	289
hind foot (s.u.)	40	50	55	50	50.5	
hind foot (c.u.)						63
ear		22	18	15	17	25
Skull:						
total length		55				56.3
condylo-basal length						
condylo-incisive length	34.2	52.5			47	54.7
condylo-basilar length					48.5	
occipito-nasal length	37.7					
basal length				46 (c)		51.7
basilar length						46.4
zygomatic breadth	15.9	27		24.7	23.7	28.4
inter-orbital breadth	6.0	6.8		6.7	7.0	6.7
interparietals						
breadth braincase	15.0	20		18.8	19	21.0
mastoid breadth						
nasals, length	13.3	17×6.6		15.5×5.4		17.5×5.6
nasals, greatest breadth	4.1					
zygomatic plate	2.0					
diastema	9.3			14.2		14.5
height muzzle behind inc.		[56]		8.5		11.0[57]
palatilar length	16.1	25		23.7	22.5	26.1
palatal length						31.2
ant. palatal foramina	4.6	6.1×3.7		5.3× —	5.5×3.6	6.0×3.7
breadth meso.-pter. fossa						
width inside $m^1 - m^1$						3.7
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	6.1					
alveoli m^{1-3}						
crowns m^{1-2}		8.1		8.1	8.2	9.4
m^1, length × breadth		— ×2.8		5.9× —		6.7×3.6
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

	longmani (type descrip.) ad. ♂	*chrysogaster reginae* (type descrip.) ad. ♂	*melicertes* (type descrip.) y. ad. ♀	*chrysogaster caurinus* (type descrip.) ad. ♀	A.M.79829 *esox* ad. ♂	F.M.31847 *beccarii* ad. ♀
Skin:						
head and body	270	336	232	284		226
tail	247	320	206	272	220	249
hind foot (s.u.)	58	66	54	61		55.5
hind foot (c.u.)					55	59
ear	20	19	20	20		
Skull:						
total length	52					
condylo-basal length						51.0
condylo-incisive length	49					48.9
condylo-basilar length				59		
occipito-nasal length						
basal length		54.7				46.9
basilar length		52.2				42.0
zygomatic breadth	27.0	31.7	25.0	30.0	23.3	23.3
inter-orbital breadth			6.8		6.6	6.8
interparietals						
breadth braincase	20.5		19.0		18.9	19.2
mastoid breadth						
nasals, length	17.5	20.5	16.8×5.5		15.2×4.8	16.0
nasals, greatest breadth						5.4
zygomatic plate						
diastema				16.5	13.0	13.5
height muzzle behind inc.		[58]			9.1[59]	8.8
palatilar length	23.5	28.5	23.5	27.3	22.5	23.5
palatal length					27.1	28.3
ant. palatal foramina	5.8	6.7	5.8	6.2	5.0×3.2	4.7×3.5
breadth meso.-pter. fossa						
width inside $m^1 - m^1$					4.1	4.3
length bulla						
length mandible						
Teeth:						
crowns m^{1-3}	7.8	9.0	8.2	8.8	7.9	8.2
alveoli m^{1-3}						
crowns m^{1-2}			— ×2.9		5.6×2.8	5.8×2.6
m^1, length × breadth						
m^2, length × breadth						
m^3, length × breadth						
crowns, m_{1-3}						

Footnotes for Tables of Measurements

[1] Remeasured.
[2] See corrected measurements by de Raadt (1918), 160, 178; ♀ mammae 2–3 = 10.
[3] Giant rats of Java with mammae 3–3 = 12.
[4] Post-foraminal palate = 10.0.
[5] Roughly measured in the field.
[6] Thomas's lectotype, B.M.77.7.18.26.
[7] Transposed from rough field measurements originally in inches.
[8] Tip of nasals to front of interparietals, 36.5.
[9] Breadth temporal ridges, 15.7.
[10] Breadth temporal ridges, 16.2.
[11] Total length, old ♂, 54.7.
[12] Measured on stuffed specimen.
[13] Back of interparietals to tip of nasals, 44.
[14] Skull in fragments.
[15] Back of interparietals to tip of nasals, 43.5.
[16] Included merely for comparison with *chrysocomus*.
[17] Back of nasals to occiput, 30.0.
[18] Condyle to front of molars, 28.
[19] "Post foraminal palate," 8.2, of *bontanus*, 7.9.
[20] Back of nasals to occiput, 30.0.
[21] Back of nasals to occiput, 30.0.
[22] Back of nasals to occiput, 30.1.
[23] Back of nasals to occiput, 31.0.
[24] Note that discrepancies exist in body measurements as taken by the collector (Heinrich).
[25] Erroneous, as explained by Sody, Natuurk v. Nederl.-Indie, XCIV, p. 177, 1934.
[26] Longest fore claw, 4.9; longest hind claw, 4.6.
[27] Longest fore claw, 4.8; longest hind claw, 4.3.
[28] Longest fore claw, 4.9; longest hind claw, 4.7.
[29] Longest fore claw, 4.1; longest hind claw, 4.4.
[30] Longest fore claw, 5.0; longest hind claw, 4.5.
[31] Longest fore claw, 4.4; longest hind claw, 4.2.
[32] Longest fore claw, 4.6; longest hind claw, 4.3.
[33] Longest fore claw, 3.8; longest hind claw, 3.5.
[34] Longest fore claw, 3.8; longest hind claw, 3.7.
[35] Longest fore claw, 3.8; longest hind claw, 3.5.
[36] Longest fore claw, 3.8; longest hind claw, 3.6.
[37] Longest fore claw, 3.0; longest hind claw, 3.0.
[38] Field measurements.
[39] "Orbit to end nasals," 27.0.
[40] "Orbit to end nasals," 25.8.
[41] "Orbit to end nasals," 26.9.
[42] "Orbit to end nasals," 25.0.
[43] Error. Reaches at least 49.
[44] "Orbit to end nasals," 24.2.
[45] "Orbit to end nasals," 23.1.
[46] "Orbit to end nasals," 25.2.

[47] Error ?
[48] Nasals to back of interparietals, 36.5.
[49] Nasals to back of interparietals, 25.7.
[50] Dubious.
[51] Measured on natural size drawing.
[52] "Upper length" (Thomas).
[53] "Palate length" (Thomas).
[54] Length mandible to tip incisor.
[55] Error. 9.6 may have been length $m^1 + m^2$.
[56] Muzzle breadth at premaxillae-maxillae suture, 10.8.
[57] Muzzle breadth at premaxillae-maxillae suture, 10.1.
[58] Muzzle breadth at premaxillae-maxillae suture, 8.3.
[59] Muzzle breadth at premaxillae-maxillae suture, 9.5.