

**ON THE SUBSPECIES OF RHIZOMYS  
SUMATRENSIS (RAFFLES) WITH SOME NOTES  
ON RELATED SPECIES**

by

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*With 4 textfigures*

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The present paper, chiefly dealing with *Rhizomys sumatrensis* (Raffl.), is based on the examination of a series of specimens in the collections of the Rijksmuseum van Natuurlijke Historie, Leiden; Zoölogisch Museum, Amsterdam; British Museum (Natural History), London; Muséum d'Histoire Naturelle, Genève; Naturhistorisches Museum, Bern and the Collection of Mr. H. J. V. Sody, Amsterdam.

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For some unknown reason Raffles (1822, p. 258) gave the name *Mus sumatrensis* to a rodent, which was known from Malacca, but which at the time had not yet been recorded from Sumatra<sup>1</sup>). Temminck (1832, p. 7, pl. 1), who thought the name inappropriate, redescribed the species as

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<sup>1</sup>) In the older literature the species has been mentioned from Sumatra by several authors, e.g., Lesson (1827, p. 265), Schlegel (1837, p. 235), M'Clelland (1842: fide Cantor 1846, p. 255), Murray (1866, p. 383), W. H. Flower & Garson (1884, p. 612), but they were probably misled by the name *sumatrensis*. The first positive evidence of the species occurring in Sumatra was given by Jentink (1887, p. 224). The species has also been said to occur in Borneo (Mohnicke 1883, p. 429; Tjeenk Willink 1905, pp. 264, 329; Van Balen 1914, p. 265), but these records have never been confirmed. Murray (1866, map 83) includes Java in the range of the Spalacidae, but he does not mention them from that island in the faunistical list on p. 383; perhaps this author was misled by the name *Spalax javanus*, given to a bamboo-rat by Cuvier (1829, p. 211).

*Nyctocleptes dékan*. Previously, however, Gray (1831a, p. 95; 1831b, p. 235) had established a new genus *Rhizomys*, in which he placed *Rhizomys sinensis* Gray and *Rhizomys sumatrensis* (Raffl.). Since that time several other species have been described, and these were placed in the genus *Rhizomys*, until Thomas (1915a, p. 57) arrived at the conclusion that these species must be grouped into three distinct genera, for which he used the names: *Nyctocleptes* Temm. (type: *N. sumatrensis* (Raffl.)), *Rhizomys* Gray (type, according to Thomas: *Rhizomys sinensis* Gray<sup>1)</sup>) and *Cannomys* Thos. (type: *C. badius* (Hodgs.)). These genera were separated on a number of differences, which, however, I consider to be of specific value only, as was done also by Winge (1924, p. 121). Osgood (1932, p. 325), when referring to the characters of *Nyctocleptes*, remarks: "Its distinction from *Rhizomys* rests mainly on characters of the plantar pads and mammae the significance of which may be a matter of opinion", thus showing that he does not attach great importance to these differences. As said I believe the differences to be of specific value only, and I therefore consider *Nyctocleptes* Temm. and *Cannomys* Thos. to be synonyms of *Rhizomys* Gray. In all probability future researches will show that the numerous species of *Rhizomys* (incl. *Nyctocleptes* and *Cannomys*), as they are recognized by Thomas (1915 a; 1915 b; 1916 a) and other authors, will prove to be subspecies of a relatively small number of species, which are distinguished chiefly by the characters used by Thomas to separate the genera. Chasen & Kloss (1930, p. 75) mention *Cannomys minor* (Gray) as a subspecies of *C. badius* (Hodgs.). Judging by the specimens examined by me<sup>2)</sup> *castaneus* (Blyth) is also a subspecies of *badius*. According to Osgood (1932, p. 324) *Rhizomys senex* Thos., *Rh. latouchei* Thos. and *Rh. pannosus* Thos. must be considered as subspecies of *Rh. pruinus* Blyth and this author (Osgood, l.c., p. 325) also mentions that *Nyctocleptes sumatrensis* (Raffl.), *N. cinereus* (M'Clell.) and *N. insularis* Thos. are so closely related that the genus *Nyctocleptes* is practically monotypical. Indeed, Thomas (1892, p. 943) mentioned *cinereus* (under the synonymous name *Rhizomys sumatrensis erythrogegens* And.) as a subspecies of *sumatrensis*, but in 1915 he gave it specific rank again. Robinson & Kloss (1919, p. 316) reduced *insularis* to a subspecies of *sumatrensis*. The views expressed by Osgood (1932, p. 325) and Robinson & Kloss (1919, p. 316), at least as far as they

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1) cf. p. 139.

2) Jentink (1887, p. 224:b) mentions the skull of a stuffed specimen of *Rhizomys badius*. This is probably an error as the only stuffed specimen in our collection (Jentink, 1888, p. 92, specimen: a) has the skull in the skin.

refer to the bamboo-rats formerly placed in the genus *Nyctocleptes*, are doubtlessly right. Of *Rhizomys sumatrensis* (Raffl.) four subspecies may be recognized: 1. *Rh. sumatrensis sumatrensis* (Raffl.); 2. *Rh. sumatrensis insularis* (Thos.); 3. *Rh. sumatrensis padangensis* nov. subsp.; 4. *Rh. sumatrensis cinereus* (M'Clell.).

The description of these subspecies may be preceded by a discussion of the question as to which species must be considered the type of the genus *Rhizomys* Gray, and by some notes on the anatomy of *Rh. sumatrensis* (Raffl.), *Rh. pruinus pruinus* Blyth and *Rh. badius castaneus* Blyth.

The original description of the genus *Rhizomys* (Gray 1831a, p. 95) is preceded by the following paragraph: "The third genus described was founded on a *glirine* quadruped nearly allied to the Bamboo-Rat (*Mus Sumatrensis* Raffl.?) with which Mr. Gray associated it under the following characters." As, besides *Rh. sumatrensis* (Raffl.), Gray included only one other species, i.e., *Rhizomys sinensis* Gray, in the genus *Rhizomys*, it is clear that the latter was the "glirine quadruped" meant. Thomas (1915a, p. 56, note) is of the opinion that in the paragraph preceding the description, Gray fixed the type of the genus *Rhizomys*. I do not feel sure, however, that this is a fixation of a type-species by original designation in the strict sense of the International Rules of Zoological Nomenclature<sup>1</sup>), and, therefore, not Gray, but Thomas (1915a, p. 56) may have to be regarded as the author who made *Rhizomys sinensis* the type of the genus. Should this point of view be accepted the fixation of the type-species by Thomas (1915a, p. 57) is antedated by that by Gervais (1846, p. 701), who mentions *Mus sumatrensis* Raffl. as the type of the genus *Rhizomys* Gray. For the present this is not important, as I place both species in the same genus, but should the division into three genera (as proposed by Thomas 1915a, p. 56) be retained, the genus *Rhizomys* (sensu Thomas 1915a, p. 57) would be without a name. This question has been discussed here with the hope, that the International Commission for Zoological Nomenclature will give an opinion stating, whether mention being made by an author that a genus is founded on a certain species (even if this species is not mentioned by name, as was done by Gray) constitutes the fixation of a type-species (by original designation). Personally I am greatly in favour of the view expressed by Thomas (1915a, p. 56) that *Rhizomys sinensis* is the type of the genus *Rhizomys* Gray.

The synonymy of the genus is the following:

1) It must be borne in mind that those authors in the first half of the 19th century, who mentioned types for the genera described by them, in reality did not fix a type as meant in the Rules, but just gave it as an example (cf. Schlegel, *Isis*, vol. 20, 1827, p. 292, who mentioned two types for a single genus of snakes ("N. G. *Dendrophis* Boie, Col. pictus Gm. und ahaetulla Linn. als Typen"))).

**Rhizomys** Gray

*Mus*, Raffles, Trans. Linn. Soc. Lond., vol. 13, 1822, p. 258; Lesson, Manuel Mamm., 1827, p. 265 (part.).

*Lemmus* (part.), Fischer, Synops. Mamm., 1829, p. 289.

*Spalax*, Cuvier, Règne Animal, 2nd ed., 1829, vol. 1, p. 211; Lesson, Hist. Nat. gén. part. Mammif. Oiseaux, vol. 5, 1836, p. 464.

*Rhizomys* Gray, Proc. Comm. Sci. Corresp. Zool. Soc. Lond., pt. 1, 1831, p. 95; Gray, Philos. Mag., n.s., vol. 10, 1831, p. 235; Gray, List Spec. Mamm. Brit. Mus., 1843, p. XXVI; Schinz, Synops. Mamm., vol. 2, 1845, p. 123; Cantor, J. As. Soc. Beng., vol. 15, 1846, p. 255; Gervais, Dict. univers. Hist. Nat., vol. 8, 1846, p. 701 (type: *Mus sumatrensis* Raffl.); Gervais, Hist. Nat. Mammif., vol. 1, 1854, p. 379; Chenu, Encycl. Hist. Nat. (Rong. Pachyd.), no date, p. 191 (type: *Mus sumatrensis* Raffl.); Giebel, Säugethiere, 1855, p. 518; Blyth, Cat. Mamm. Mus. As. Soc., 1863, p. 122; Fitzinger, SB. Ak. Wiss. Wien, Math. Naturw. Cl., 1867, Abth. 1, pp. 459, 466, 506; Gervais, Dict. univers. Hist. Nat., 2nd ed., vol. 9, no date, p. 526 (type: *Mus sumatrensis*); Anderson, Anat. Zool. Res. Yunnan, 1879, text, p. 314; Blanford, Fauna Brit. India, Mamm., 1891, p. 438; Forsyth Major, Proc. Zool. Soc. Lond., 1897, pp. 700, 702, 709, 710, 711; Trouessart, Cat. Mamm., vol. 1, 1897, p. 568; S. S. Flower, Proc. Zool. Soc. Lond., 1900, p. 363; Palmer, Index Gen. Mamm., 1904, p. 608; Trouessart, Cat. Mamm., Suppl., 1904, p. 465; Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, pp. 56, 57 (type: *Rh. sincsis* Gray); Thomas, J. Bombay Nat. Hist. Soc., vol. 24, 1916, p. 408 footnote; Winge, Pattedyr-Slaegter, vol. 2, 1924, p. 121; Weber, Säugetiere, 2nd ed., vol. 2, 1928, p. 282; Raven, Bull. Am. Mus. Nat. Hist., vol. 68, 1935, p. 257.

*Nyctocleptes* Temminck, Bijdr. Natuurk. Wetensch., vol. 7, 1st part, 1832, pp. 1, 5, 6, 7 (type: *N. dékan* = *Mus sumatrensis* Raffl.); Temminck, Monogr. Mamm., vol. 2, 1835, pp. 40, 44; Waterhouse, Mag. Nat. Hist., n.s., vol. 3, 1839, p. 278; Gervais, Voy. Bonite, Zool., vol. 1, 1841, p. 54; Gervais, Dict. univers. Hist. Nat., vol. 8, 1846, p. 701; Chenu, Encycl. Hist. Nat. (Rong. Pachyd.), no date, p. 191; Gervais, Dict. univers. Hist. Nat., 2nd ed., vol. 9, no date, p. 526; Palmer, Index Gen. Mamm., 1904, p. 467; Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, pp. 56, 57; Thomas, J. Bombay Nat. Hist. Soc., vol. 24, 1916, p. 408 footnote; Wroughton, J. Bombay Nat. Hist. Soc., vol. 27, 1920, p. 62 and 1921, p. 533; Winge, Pattedyr-Slaegter, vol. 2, 1924, p. 121; Osgood, Field Mus. Nat. Hist., Publ. no. 312, Zool. Ser., vol. 18, no. 10, 1932, pp. 324, 325.

*Nyctocleptes*, Temminck, Monogr. Mamm., vol. 2, 1835, p. 42.

*Nyctoleptes*, Fitzinger, SB. Ak. Wiss. Wien, Math. Naturw. Cl., 1867, Abth. 1, p. 466 (under synonyms); Raven, Bull. Am. Mus. Nat. Hist., vol. 68, 1935, pp. 197, 239 (erroneously placed with the Sciuridae).

*Aspalomys*, Gervais, Voy. Bonite, Zool., vol. 1, 1841, p. 56 (part.).

*Cannomys* Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, p. 57 (type: *Rhizomys badius* Hodgs.) and p. 314; Thomas, J. Bombay Nat. Hist. Soc., vol. 24, 1916, p. 408 footnote; Wroughton, J. Bombay Nat. Hist. Soc., vol. 27, 1920, pp. 62, 63; Winge, Pattedyr-Slaegter, vol. 2, 1924, p. 121.

The sole-pads were studied in a number of specimens preserved in spirit. In fullgrown *Rhizomys sumatrensis insularis* the posterior sole-pads are conjoined (fig. 1a), though a median depression is present between the lateral and medial pad. In young specimens of the same subspecies and in one of *Rh. sumatrensis padangensis* (fig. 1b) the posterior sole-pads are free from one another, the granulation not extending across the intervening area. Ex-

amination of a series of specimens of different ages shows that in *Rh. s. insularis* the posterior sole-pads become conjoined when the specimen grows larger. In dry skins of *Rh. s. padangensis* a marked but very narrow groove is present between the posterior sole-pads, but I could not make out whether the granulation extends across the groove. For comparison I give figures of the hindfoot of *Rh. pruinosus pruinosus* (fig. 1c) and of *Rh. badius*

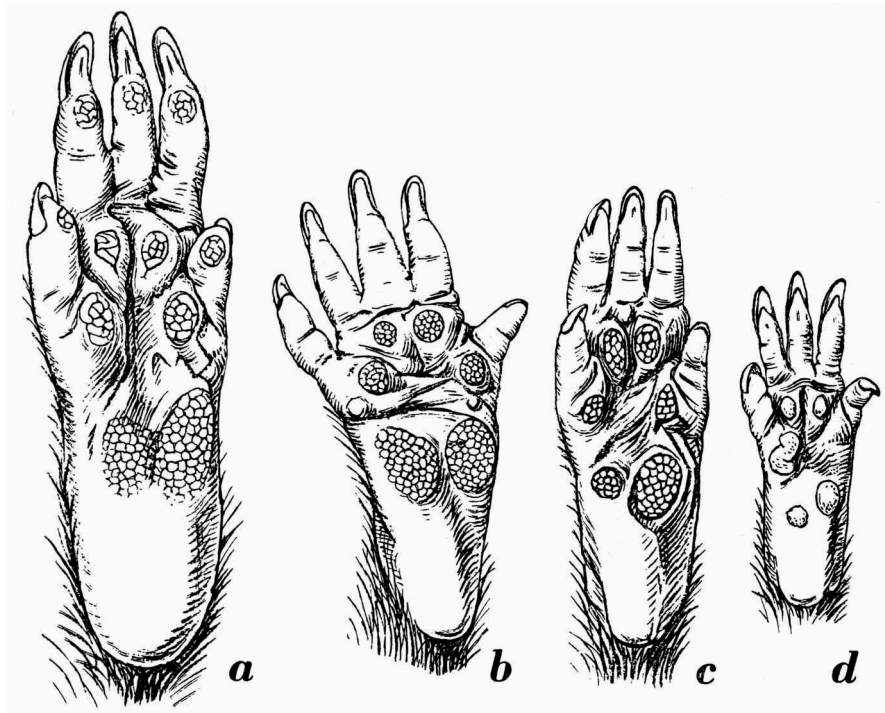


Fig. 1. Plantar surface of right foot of: a, *Rhizomys sumatrensis insularis* (Thos.), ♀ ad., Mus. Leid., reg. no. 1256; b, *Rh. s. padangensis* nov. subsp., ♂ juv., paratype, Mus. Leid., reg. 1255; c, *Rh. pr. pruinosus* Blyth, ♀ ad., Mus. Leid., reg. no. 1172; d, *Rh. badius castaneus* Blyth, ♀ ad., Mus. Leid., reg. no. 1171. All figures nat. size.

*castaneus* (fig. 1d). In the former the sole-pads are distinct and granulated; the posterior ones are free from each other, the medial one being much larger than the lateral one. In *Rh. badius castaneus* the sole-pads are distinct, but not granulated; the posterior two are free. In nearly all specimens of *Rh. s. insularis* four distal sole-pads are present, one each at the bases of the 1st, 2nd and 5th toe, and one at the base of the 3rd and 4th toe. A specimen from Deli (in the Amsterdam Museum) shows an additional granulated pad between that at the base of the 5th toe and the lateral posterior one. In full-

grown *Rh. s. insularis* granulated pads are also developed below the tips of the toes. These are very indistinct in young specimens.

The tail is covered by hairs in its basal parts; on the remaining part only a few scattered hairs are present, especially on the lower surface. In a very young specimen the whole tail is rather densely haired. The arrangement of the hairs on the back and on the tail has been studied by De Meijere (1893, pp. 16, 85, table; 1894, pp. 323, 379, 419).

In all females of *Rhizomys sumatrensis* (Raffl.) and its subspecies the number of the mammae is  $2 + 3 = 10$ . In *Rhizomys pruinosus* this number generally is  $1 + 3 = 8$ , but as mentioned by Thomas (1915a, p. 59) in his description of *Rh. latouchei* (which must be considered as a subspecies of *pruinosus*) there is in addition a minute anterior pectoral pair, which is considered by him to be not functional. In *Rhizomys pruinosus* the number of the mammae is, therefore, variable and it seems to be a character of doubtful value to separate genera of bamboo-rats.

The tongue of *Rhizomys badius* has been studied by Sonntag (1924, p. 731, fig. 33L), who (1924, p. 731, 739; 1925, p. 714, 715) mentions the presence of three circumvallate papillae arranged in a triangle a characteristic of the Spalacidae. Tongues of *Rh. sumatrensis insularis* (Thos.), *Rh. pr. pruinosus* and *Rh. badius castaneus* were examined by me, but I found only two circumvallate papillae. The latter number is also mentioned as characteristic for the Spalacidae by Weber (1928, p. 257). In *Rhizomys badius* Sonntag (1924, p. 731, fig. 33L) describes a well developed intermolar eminence, but the eminence is only faintly developed in the specimen of *Rh. badius castaneus* examined by me. In *Rh. sumatrensis insularis* and *Rh. pr. pruinosus* the eminence is well developed. There are relatively few fungiform papillae distributed in obliquely transverse rows on the anterior part of the dorsum of the tongue; but they are numerous on the tip of the tongue and on the anterior part of the lower surface. The conical papillae are small and numerous. The papillae on the anterior part of the intermolar eminence are somewhat larger than the others. The dorsum of the tongue shows a well developed median furrow anteriorly. Some transverse grooves are present, but these are caused by the palatal rugae. The papilla incisiva (fig. 3a, p.i.) is large and roundish with a small pore on each side. It is followed by the palatal rugae, of which the anterior four are strongly developed, each with a slight median depression. The posterior five rugae are placed between the molars, and are distinctly interrupted in the median line; they are much lower than the anterior rugae, their size decreasing from in front backwards. The mouth is divided into two parts by flaps of skin which are bent inwards and which separate the anterior part in which the incisors are placed from

the posterior part containing the molars. This structure is also found in other fossorial rodents (Vinogradov 1926, p. 277, pl. 18 figs. 2, 4; pl. 19 figs. 1, 2, 3), and seems to be connected with the habit of using the incisors for burrowing.

The stomach of *Rh. sumatrensis insularis* is divided into a left and a right part by a fringe which encircles it just to the right of the oesophagus. The part of the stomach to the left of the fringe is covered by horny layers, no gland-fields being discernable; the part to the right of the fringe is covered by mucous tissue, but the state of preservation does not allow recognition of the different fields of glands. The stomach of *Rh. pruinus* and that of *Rh. badius* has been described by Anderson (1879, pp. 317, 318, figs. 11, 12). The liver shows a very large lobus centralis which is divided into a larger lobus centralis dexter and a smaller lobus centralis sinister; the lobus lateralis sinister is large, the lobus lateralis dexter, however, is very small, and does reach posteriorly only half as far as the lobus centralis. The gallbladder is very small and lies imbedded in the lobus centralis dexter. Several small ducts emerge from the central lobes of the liver and after fusion into a single duct join the ductus cysticus at some distance from the gallbladder. The ductus choledochus is joined by other ducts which originate from the lateral lobes.

Of *Rhizomys sumatrensis insularis* I examined the lungs of two specimens, a halfgrown female and an adult male; of *Rh. s. padangensis* the lungs of a young male were available, while for comparison I studied the lungs of a female of *Rh. pr. pruinus* and of a female of *Rh. badius castaneus*. The lungs of the three species examined by me (fig. 2) agree in their general characters. The left lung is divided into lobes: lobus anterior, lobus medius, lobus posterior and lobus impar; moreover a very small lobe is present on the posterior surface of the lobus posterior with its apex pointing forwards (figs. 2b, e, g). The relative size of these lobes is variable, even within the species. In the halfgrown female of *Rh. s. insularis* (figs. 2a) the anterior and posterior lobe meet, and the lobus medius is excluded from the inner border of the lung; it reaches farther laterally than the anterior and posterior lobe. The lobus impar is rather small (fig. 2b). The adult male had been preserved in spirit already a long time and the lungs obviously have shrunk, but it is clearly seen that the anterior and posterior lobe are separated by a small trapezoid one, which also excludes the median lobe from the internal border of the lung (fig. 2c). In this specimen the lobus impar is strongly developed. The young male of *Rh. s. padangensis* has all three lobes (anterior, medius and posterior) well developed; the lobus medius separating the anterior and posterior lobe for the greater part; in this spec-

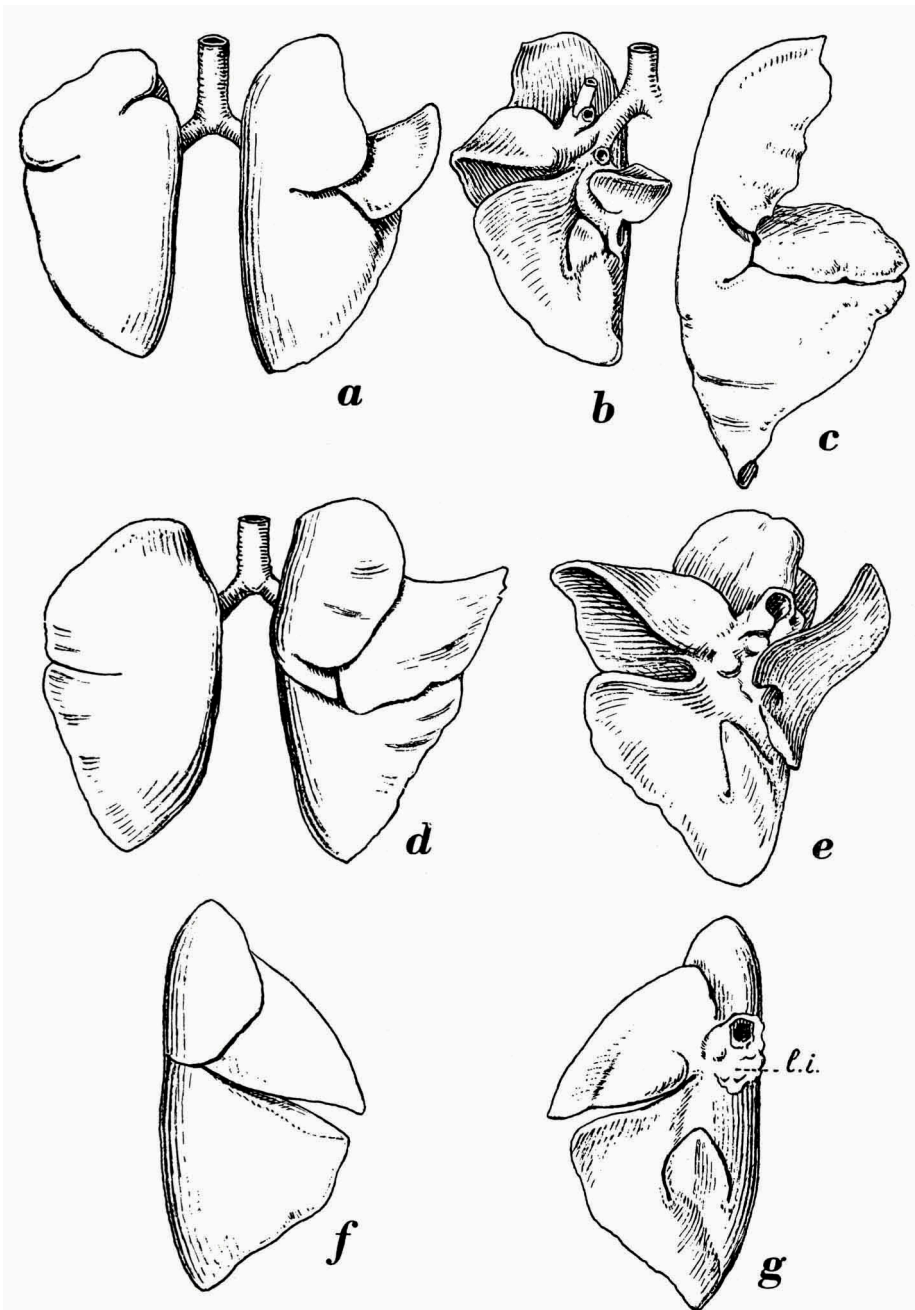


Fig. 2. a, *Rhizomys sumatrensis insularis* (Thos.), ♀ hgr., Deli, Mus. Amst., lungs ventral view; b, id., left lung of same specimen, dorsal view; c, id., ♂ ad., Deli, Mus. Amst., left lung ventral view; d, *Rh. pr. pruinosus* Blyth, ♀ ad., Mus. Leid., reg. no. 1172, lungs, ventral view; e, id., left lung of same specimen, dorsal view; f, *Rh. badius castaneus* Blyth, ♀ ad., Mus. Leid., reg. no. 1171, left lung, ventral view; g, id., left lung of same specimen, dorsal view, l.i. base of lobus impar  
Figs. a—e, nat. size; figs. f, g, × 2.



imen the lobus impar is very large. In *Rh. pr. pruinus* (fig. 2d) a small lobe is present between lobus anterior and lobus posterior separating the lobus medius from the internal border of the lung; the lobus impar is very large (fig. 2e). The left lung of *Rh. badius castaneus* (fig. 2f, g) has a large lobus medius. The lungs of this specimen being rather badly preserved, the lobus impar was lost during the preparation, when the lungs were removed from the thorax. The right lung is undivided in *Rh. badius castaneus*, but in the halfgrown female of *Rh. s. insularis* (fig. 2a) it has a distinct incisure at its lateral border and a superficial one on the antero-mesial border; thus the lung is incompletely divided into an anterior and a posterior lobe. A lateral incisure is also found in the right lung of *Rh. pr. pruinus* (fig. 2d).

Weber (1928, p. 269) mentions as one of the characters of the Spalacidae that the anterior two upper molars ( $M^1$  and  $M^2$ ) are equal in size. This does not hold good when the asiatic bamboo-rats are taken into consideration. Forsyth Major (1897, p. 709, pl. 40 fig. 3a) mentions that in *Rh. badius*  $M^1$  is larger than  $M^2$  and  $M^3$ ; this is also the case in the skull of *Rh. badius castaneus* examined by me. In *Rh. pruinus*  $M^1$  is larger than  $M^2$  in young specimens (Forsyth Major, 1897, p. 709, pl. 40 fig. 4a), but in very old dentitions it becomes smaller than  $M^2$  (Forsyth Major, l.c.); in *Rh. sinensis* (Forsyth Major, l.c., pl. 40 fig. 7a)  $M^2$  is larger than  $M^1$  (cf. also Thomas, 1915a, pp. 57, 58).

Vertebral columns were examined of three specimens of *Rhizomys sumatrensis insularis*, two of *Rh. s. padangensis*, one of *Rh. badius*, one of *Rh. badius castaneus* and one of *Rh. pr. pruinus*. The number of vertebrae is:

	cervical	dorsal	lumbar	sacral
<i>Rh. s. insularis</i>	7	15	5	4
<i>Rh. s. padangensis</i>	7	15	5	4
<i>Rh. pr. pruinus</i>	7	14	6	4
<i>Rh. badius castaneus</i>	7	14	5	4

Of the sacral vertebrae the posterior two might be named pseudosacral. In *Rh. sumatrensis* the last of the 15 pairs of ribs is very small, which may account for their being lost in some skeletons. The number of dorsal and lumbar vertebrae given for *Rh. pruinus* differs from that given by Flower (1885, p. 85; 1888, p. 80), who mentions 15 dorsal and 5 lumbar vertebrae for this species. As the skeleton studied by me was taken from a spirit specimen, I am certain that no ribs were lost, so that the number of ribs (and of dorsal vertebrae) seems to be variable. Jentink (1897, p. 215) mentions 13 dorsal and 6 lumbar vertebrae for *Rh. badius*. In the mounted skeleton examined by Jentink (cat. ost.: a) I count 18 dorsal + lumbar

vertebrae, the anterior twelve of which bear ribs; it is not impossible that one or two pairs of ribs were lost in preparation, and that the number of dorsal vertebrae in this specimen is 13 or 14. The skeleton of *Rh. badius*

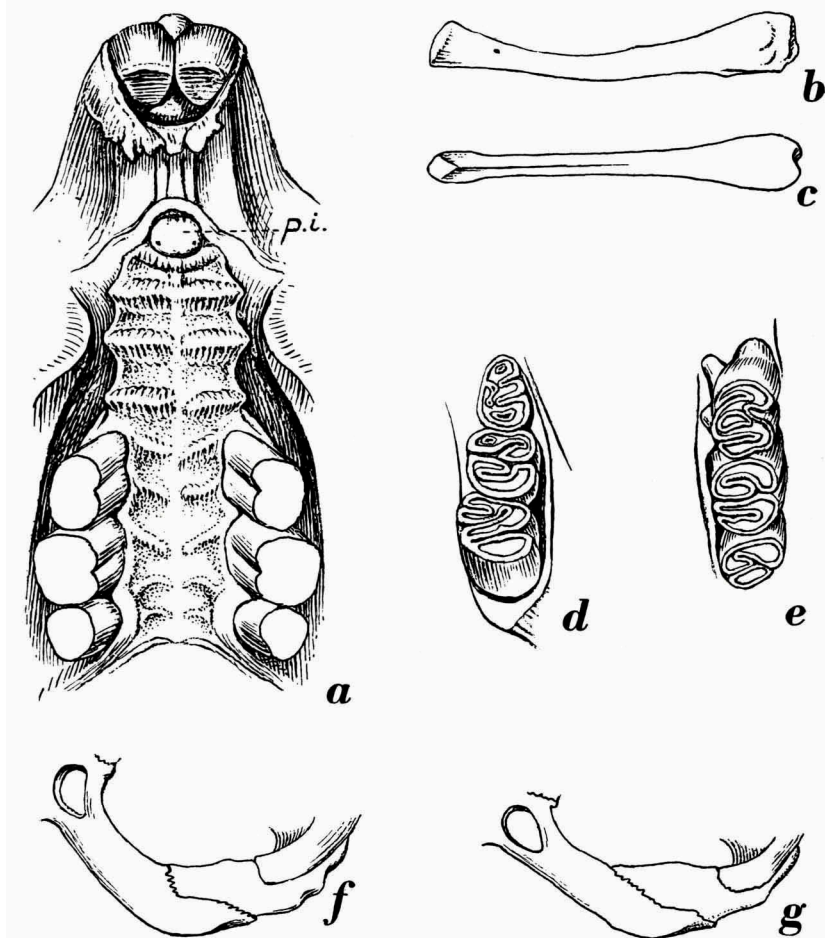


Fig. 3. a, palate of *Rhizomys sumatrensis insularis* Thos., ♀ ad., Mus. Leid., reg. no. 1256, p.i.: papilla incisiva; b, *Rhizomys sumatrensis insularis* (Thos.), ad. ♂, Deli, Sumatra, leg. Dr L. P. le Cosquino de Bussy, Mus. Amst., baculum side view; c, id., upper view; d, *Rhizomys sumatrensis padangensis* nov. subspec., ♀, type, Koto Gadang (Singgalang), leg. Dr E. Jacobson (coll. no. E. J. 382), Mus. Leid., reg. no. 1013, lower molars; e, id., upper molars; f, left jugal arch of *Rhizomys s. sumatrensis* (Raffl.), ♀, B. M., reg. no. 3. 2. 5. 18; g, left jugal arch of *Rh. s. insularis* (Thos.), ♂, paratype, B. M., reg. no. 89. 11. 8. 1. Fig. a, × 2; figs b, c, × 4; figs d, e, × 1½; figs f, g, nat. size.

*castaneus* examined by me, which I took from a spirit specimen, shows 14 pairs of ribs.

The baculum (fig. 3 b, c) was examined in an adult male of *Rh. sumatrensis insularis*. It is a small, slightly curved bone, compressed distally; the upper border is slightly angular distally, rounded proximally. The proximal extremity is slightly hollowed out, with shallow depressions at the sides.

In *Rhizomys sumatrensis* and its subspecies the zygomatic arch shows some variations in the size and shape of the different elements composing it (figs. 3 f, g). The processus zygomaticus of the maxillary and that of the squamosal may be rather high, and at the same time the two may approach each other, thus narrowing the part of the jugal between them. The jugal becomes divided into a more or less rectangular antero-superior part connected by a narrow intermediate part to the elongated postero-inferior part (fig. 3 f). In other specimens this rectangular antero-superior part is not distinctly marked as the suture between the processus zygomaticus of the maxillary and the jugal slopes gradually downwards and backwards (fig. 3 g). Though these evidently are individual variations, as I found both types in specimens of *Rh. s. cinereus* from one locality, the first type (shown in fig. 3 f) is very frequent in *Rh. s. sumatrensis*, the second type (fig. 3 g) in *Rh. s. insularis*, thus being to some extent a character in which the latter two races differ from each other. Variable is also the shape of the mastoid as seen on the occipital plane (figs. 4 d—g). This is also a character subject to individual variations, but it is interesting that two races which are so very closely related as *Rh. s. sumatrensis* and *Rh. s. insularis* are more or less characterized by the different shape of the mastoid. In *Rh. s. sumatrensis* the mastoid when viewed from behind (figs. 4 d, e) is rather broad in relation to its height, generally having a bifurcate process at its medio-superior angle; in *Rh. s. insularis* (fig. 4f) the mastoid is rather narrow in relation to its height, and the medio-superior process is weakly, if at all, developed. Specimens of the other races show intermediate conditions.

There is no distinctly marked fossa glenoidea for the reception of the condyle of the lower jaw; its position is marked only by a smooth surface on the lower side of the squamosal. When the lower jaw is placed so that the condyle touches this surface of the squamosal the upper and lower molars are not in supposition, but the upper first molar is above the lower second molar. To bring the corresponding molars opposite each other the lower jaw must be moved backwards till the condyle fits into a false "glenoid cavity" formed by the posterior border of the squamosal and the hollowed out anterior border of the bulla. This condition has been noticed by Vinogradov (1926, pp. 278—281, pl. 20) in several other fossorial rodents. It is especially well marked in *Spalax* Gueld. (Vinogradov, l.c., p. 279 fig. 1) where a false

glenoid fossa is formed by the laminar process of the squamosal and the tympanic bulla. When the condyle fits into the false glenoid fossa the incisors do not meet. Vinogradov concludes that in *Spalax* the lower jaw takes a different position when acting as a gnawing or as a masticatory apparatus. In the former case the condyle is placed in the true glenoid fossa (which is distinctly marked in *Spalax*), when used for mastication it is placed in the false glenoid fossa. It will be necessary to examine living specimens to check the conclusions of Vinogradov which are based on a study of the skull only. When the crowns of upper and lower molars are rubbed against each other during mastication, this probably will be done chiefly by moving the lower jaw forwards and backwards in the true and false glenoid fossa, for when fixed in the false glenoid fossa the movements of the jaw are very limited. Transverse movements of the jaw are probably very limited, especially when the jaw is placed in the false glenoid fossa; in *Rhizomys* transverse movements may be possible to some extent when the jaw is placed in the glenoid "fossa" which has no marked lateral borders. In *Spalax*, however, the glenoid fossa has a longitudinally oblong shape with strongly marked lateral borders, limiting the movements of the lower jaw to those in an antero-posterior direction. It has been noted in literature that these fossorial rodents use the incisors in burrowing, and I do think it possible that the development of the false glenoid fossa may be connected with this habit, the lower jaw being placed in a fixed position when the incisors are used for digging. The incisors of *Rhizomys sumatrensis* show many variations; in some specimens the lower ones extend hardly beyond the alveoli, the upper ones having grown down to meet them.

Fullgrown specimens of the four subspecies may be recognized as follows:

- I. Adult specimens with distinct rufous cheeks
  - a. Back blackish brown, especially on the middle; sides of head red-ochrous. Size large. Northern part of Malay Peninsula to Upper Burma, Siam, Tonkin, Laos, Annam . . . . . *Rh. s. cinereus*
  - b. Back greyish, darkest on the middle and posteriorly; sides of body with a distinct rufous tinge; sides of head rufous, but much lighter than in the foregoing subspecies. Padang Highlands . . . . . *Rh. s. padangensis*
- II. Adult specimens without distinct rufous cheeks (small patches of a rufous colour are sometimes present round the eye or ear)
  - a. Head with a dark median band enclosing a whitish spot. Southern part of the Malay Peninsula . . . . . *Rh. s. sumatrensis*
  - b. Head generally uniformly greyish, an indistinct, darker band rarely present; no light spot; body silvery grey to yellowish. Eastern Sumatra . . . . . *Rh. s. insularis*

**Rhizomys sumatrensis sumatrensis** (Raffl.) (figs. 3f, 4d—e).

*Mus sumatrensis* Raffles<sup>1</sup>), Trans. Linn. Soc. Lond., vol. 13, 1822, p. 258; Lesson, Manuel Mammologie, 1827, p. 265; Gervais, Dict. univers. Hist. Nat. (d'Oribigny), vol. 8, 1846, p. 701 (article: Nyctocleptes); Gervais, Dict. univers. Hist. Nat. (d'Oribigny), 2nd ed., vol. 9, 1868 (?), p. 526 (article: Nyctocleptes).

*L(emmus)? Sumatrensis*, Fischer, Synops. Mamm., 1829, p. 291 (in the group Hypudaei s. Arvicolae).

*Rhizomys sumatrensis*, Gray, Proc. Comm. Sci. Corresp. Zool. Soc. Lond., pt. 1, 1831, p. 95; Gray, Philos. Mag., n.s., vol. 10, 1831, p. 235; Gray, List spec. Mamm. Brit. Mus., 1843, p. 150; Cantor, J. As. Soc. Beng., vol. 15, 1846, p. 255 (part.); Gervais, Hist. Nat. Mammif., vol. 1, 1854, p. 379, fig. on p. 380 (bad); Giebel, Säugethiere, 1855, p. 518 (part.); Gray, Cat. Bones Mamm. Brit. Mus., 1862, p. 224; Murray, Geogr. Distr. Mamm., 1866, p. 357 (part.), p. 384; Fitzinger, SB. Ak. Wiss. Wien, Math. Naturw. Cl., 1867, Abth. 1, p. 506; Anderson, Proc. As. Soc. Beng., 1877, p. 149; Anderson, Anat. Zool. Res. Yunnan, 1879, text, p. 322 (part.), atlas, p. III (part.); W. H. Flower & Garson, Cat. Spec. Osteol. Dent. Roy. Coll. Surgeons, 1884, pp. XXV, 612; Blanford, Fauna Brit. India, Mamm., 1891, p. 439 (part.); Sclater, Cat. Mamm. Ind. Mus., pt. 2, 1891, pp. XIV, 95; Jentink, Notes Leyden Mus., vol. 18, 1897, p. 213 (part.); S. S. Flower, Proc. Zool. Soc. Lond., 1900, p. 363 (part.); Trouessart, Cat. Mamm., Suppl., 1904, p. 465 (part.); Ménégau, Mammifères, no date, p. 133.

*Aspalomys sumatrensis*, Gervais, Voy. Bonite, Zool., vol. 1, 1841, p. 56.

*Arvicola? sumatrensis*, Fitzinger, SB. Ak. Wiss. Wien, Math. Naturw. Cl., 1867, Abth. 1, p. 506 (among synonyms).

*Nyctocleptes sumatrensis*, Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, pp. 57, 58; Osgood, Field Mus. Nat. Hist., Publ. no. 312, Zool. Ser., vol. 18, no. 10, 1932, p. 325.

*Mus sumatranus*, Blainville, Voy. Bonite, Zool., vol. 1, 1841, p. XVII.

*Spalax javanus* Cuvier, Règne Animal, 2nd ed., vol. 1, 1829, p. 211; Lesson, Hist. Nat. gén. part. Mammif. Oiseaux, vol. 5, 1836, p. 464.

*Spalax javanicus*, Anderson, Anat. Zool. Res. Yunnan, text, 1879, p. 322 (among synonyms of *Rhizomys sumatrensis*).

*Nyctocleptes dékan* Temminck, Bijdr. Natuurk. Wet., vol. 7, 1st pt., 1832, p. 7, pl.

*Nyctocleptes Dékan*, Temminck, Mon. Mamm., vol. 2, 1835, p. 44 (part.), pl. 33; Waterhouse, Mag. Nat. Hist., n.s., vol. 3, 1839, p. 277 (part.); Gervais, Voyage Bonite, Zool., vol. 1, 1841, p. 54, pls. 10, 11 figs. 1—3; Chenu, Encycl. Hist. Nat., Rongeurs et Pachydermes, no date, p. 191.

*Rhizomys Decan*, Wagner in: Schreber, Säugethiere, suppl. vol. 3, 1843, pp. X, 366; Schinz, Synopsis Mammalium, vol. 2, 1845, p. 123.

*Rhizomys dekan*, Schlegel, Dierentuin, Zoogd., 1872, p. 80; Jentink, Cat. ost. Mammif., Mus. Hist. Nat. Pays-Bas, vol. 9, 1887, p. 224 (part.); Jentink, Cat. syst. Mammif., Mus. Hist. Nat. Pays-Bas, vol. 12, 1888, p. 91.

## Specimens examined:

- 1 ♀, Malacca, leg. Eydoux, Mus. Leiden, cat. syst.: b, stuffed skin; cat. ost.: a, skull.  
Cotype of *Nyctocleptes dékan* Temm.  
1 ex., Malacca, leg. Diard, Mus. Leiden, cat. syst.: a, stuffed skin, cat. ost.: b, skull.  
Cotype of *Nyctocleptes dékan* Temm.

1) Thomas (1915a, p. 58) mentions Hardwicke as the author of *Mus sumatrensis*, but I have not been able to find any evidence to this effect.

- 1 ex., Malacca, don. A. Charlton, B.M., reg. no. 46.5.4.39, skin and 46.6.15.15 (old no. 601c), skull.  
 1 ♂, Malacca, leg. Cantor, B.M., not registered, skin and skull.  
 2 ex., hgr., Malacca, B.M., reg. no. 46.4.10.13—14 (old nos. 601a, 601b), skulls (skins were given away as duplicates).  
 1 ♂, 1 juv., 1 neonatus, Malacca, B.M., reg. no. 60.5.4.74, 80, 75, skins with the skull inside.  
 1 ♀, Perak Jungles, leg. Ferguson, B.M., reg. no. 97.8.10.2, mounted skin and skull.  
 1 ♀, Gedong Batang, Padang, Perak, B.M., reg. no. 3.2.5.18, skin and skull.  
 1 ♂, Taiping, Perak, B.M., reg. no. 2.5.2.3, skin and skull.  
 1 ♀, Province Wellesley, ex Coll. Cantor, don. Ind. Mus., B. M., reg. no. 79.11.21.387, skin with skull inside.  
 1 ♀, Malay Peninsula, leg. Harvey, B.M., reg. no. 86.8.18.1, skin and skull.  
 1 ♀, Selangor, don. H. F. Bellamy, B.M., reg. no. 89.5.14.3, skin and skull.

Terra typica of *Mus sumatrensis* Raffl.: Malacca; of *Nyctocleptes dékan*: Malacca; of *Spalax javanus* Cuv.: "Iles de la Sonde".

General colour greyish, darkest on the posterior part of the back; a dark median band on the head and anterior part of the back, enclosing a whitish spot on the head. In young specimens the head is distinctly rufous as in *Rhizomys sumatrensis cinereus*, the white spot on the head is, however, distinctly marked, while it is absent in *cinereus*. Only one young specimen (from Selangor) could not be distinguished from *cinereus* as the white spot on the head was absent; it is doubtfully included in *Rh. s. sumatrensis* as it falls well within the range of that subspecies. On p. 147 the shape of the mastoid and the jugal have been noted which are more or less characteristic for this subspecies as opposed to *Rh. s. insularis*.

The measurements of the skulls which I examined are given in table I. Of only one specimen measurements (in mm) taken in the flesh were available, as all the other specimens were from very old collections:

	head + body	tail	hindfoot	ear
B.M., 3.2.5.18 ♀	323	127	55	19

Distribution: Southern part of the Malay Peninsula, northward to the Province Wellesley.

### ***Rhizomys sumatrensis insularis* (Thos.) (figs. 1a; 2a—c; 3a—c, g; 4f)**

*Rhizomys dekan*, Jentink, Cat. ost. Mammif., Mus. Hist. Nat. Pays-Bas, vol. 9, 1887, p. 224 (part.); Jentink, Notes Leyden Mus., vol. 11, 1889, p. 19, p. 28 (part.); Hagen, Tijdschr. Kon. Ned. Aardr. Gen., ser. 2, vol. 7 (1st part.), 1891, p. 125; Tjeenk Willink, Natuurk. Tijdschr. Ned. Ind., vol. 65, 1905, pp. 264, 329.

*Rhizomys sumatrensis*, De Meijere, Over de Haren der Zoogd., 1893, pp. 16, 85, table; De Meijere, Morphol. Jahrb., vol. 21, 1894, pp. 323, 379, 419; Jentink, Notes Leyden Mus., vol. 18, 1897, p. 214 (part.), p. 215; Trouessart, Cat. Mamm., vol. 1, 1897, p. 568 (part.), and vol. 2, 1899, p. 1334 (part.); Trouessart, Cat. Mamm., Suppl., 1904,

p. 465 (part.); Schneider, Zool. Jahrb. Syst., vol. 23, 1905, pp. 112, 146, pl. 3; Van Balen, Dierenwereld, vol. 1, 1914, p. 265, fig.; Weber, Säugetiere, vol. 2, 1928, p. 282 (part.); Raven, Bull. Am. Mus. Nat. Hist., vol. 68, 1935, p. 257 (part.).

*Rhizomys sumatranus*, De Beaufort, Zoogeographie, 1926, p. 59 (part.).

*Nyctocleptes insularis* Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, pp. 57, 58; Robinson & Kloss, J. Fed. Mal. St. Mus., vol. 8, pt. 2, 1918, p. 77 and 1923, p. 319 (part.) (as a race of *N. sumatrensis*); Osgood, Field Mus. Nat. Hist., Publ. no. 312, Zool. Ser., vol. 18, no. 10, 1932, p. 325.

*Nyctocleptes sumatrensis insularis*, Robinson & Kloss, J. Fed. Mal. St. Mus., vol. 7, pt. 5, 1919, p. 316 (part.).

*Nyctocleptes insularis*, Raven, Bull. Am. Mus. Nat. Hist., vol. 68, 1935, p. 239 (erroneously placed with the Sciuridae).

#### Specimens examined:

- 1 ♀, type, Padang Brahrang, Deli, Sumatra, don. T. C. Barclay, B.M., reg. no. 99.8.21.5, skin and skull.
- 1 ♂, paratype, Helvetia Estate, Deli, Sumatra, leg. Iversin, exch. Christiania Museum, B.M., reg. no. 90.1.20.4, skin and skull.
- 1 ♂, 1 ♀, paratypes, Deli, Sumatra, leg. Dr Moesch (exch.), B. M., reg. nos. 89.11.8.1—2, skins in spirit, skulls.
- 1 ♀, Sumatra, purchased of Rowland Ward, B.M., reg. no. 24.12.17.6, in spirit.
- 1 ex., Sumatra, purchased of Rowland Ward, B.M., reg. no. 24.12.17.5, stuffed skin.
- 1 ex., Tandjong Morawa, Deli, Sumatra, leg. Dr B. Hagen, Mus. Leiden, cat. ost.: c, skull.
- 1 ♀, Medan, Deli, leg. Mr Goedhart, from the Zoological Garden at the Hague, rec. 9. X. 1895, Mus. Leid., cat. syst.: c, stuffed skin; cat. ost.: e, skeleton.
- 1 ♀, Deli, Sumatra, leg. Dr Moesch, Mus. Leid., reg. no. 1256, skin in spirit, skeleton.
- 1 ex., Sumatra, leg. Dr Moesch, purchased from Frank, 1892, Mus. Leid., cat. ost.: d, skeleton.
- 1 ♀ hgr., 1 ♀ juv., Deli, Sumatra, leg. L. P. le Cosquino de Bussy, rec. 10. VI. 1916, Mus. Leid., reg. no. 647, skins and skulls.
- 1 ♀ hgr., Serbodjadi, Deli, Sumatra, leg. L. P. le Cosquino de Bussy, 29. VII, 1915, Mus. Amst., skin with the skull inside.
- 1 ex., Deli, Sumatra, from Zoological Garden, Amsterdam (26.III.1934), Mus. Amst., no. E7.I, skull.
- 1 ♀, Deli, Sumatra, leg. L. P. le Cosquino de Bussy, Mus. Amst., no. E7.II, skin and skull.
- 8 juvs., Deli Sumatra, leg. L. P. le Cosquino de Bussy, Mus. Amst., in spirit.
- 1 ♂, Medan, Deli, Sumatra, leg. L. P. le Cosquino de Bussy, skin in spirit, skull.
- 1 ♂, 1 ♀ hgr., Medan, Deli, Sumatra, Zoological Garden, Amsterdam (2.XII.1921), Mus. Amst., in spirit, skull, baculum.
- 1 ♀, Sumatra (Deli?), leg. Dr Moesch, 1892, Mus. Amst. (property of Prof. Dr M. Weber), in spirit.
- 1 ♀, Bahsoemba (Bahsoemboe?) near Tebbingtinggi, Deli, Sumatra, leg. W. Morton, Mus. Hist. Nat. Genève, reg. no. 813/82, skin and skull.
- 2 ♂, 2 ♀, Tobacco estate near Medan, Deli, Sumatra, leg. J. C. van der Meer Mohr, in collection of Mr H. J. V. Sody, Amsterdam, skins and skulls.
- 1 ♂, Deli, Sumatra, Nat. Hist. Mus. Bern, reg. no. 905, stuffed skin.

Terra typica: Padang Brahrang, Deli, Sumatra.

This subspecies is very closely related to *Rh. s. sumatrensis* from Malacca. Thomas (1915a, p. 58) separated *Nyctocleptes insularis* from the Malacca

form on the strength of the lesser size and the lesser development of the crests on the skull. These characters do not hold good, however, when a larger series is examined. Skulls of fullgrown specimens from Deli are just as large as of specimens from Malacca, and in the largest skull examined by me the crests are strongly developed. The type and paratypes described by Thomas have the three molars erupted; these have been used, but not to such an extent as would indicate fullgrown, old specimens. The type, a female, was examined by me in the British Museum. On the right side the throat showed a distinctly rufous patch. It proved, however, that this was not the natural colour, as it could be removed with a wet cloth; it was also clearly visible that the red substance was adherent to the tips of the hairs, instead of the hairs having red bases and white tips. In young specimens, of which I examined a number preserved in spirit, the head has a distinct rufous colour, and the back is dark grey to blackish. In not yet fullgrown adult specimens the cheeks, between the eye and the ear, may have a faint rufous tinge. This rufous tinge is best marked in three specimens from Deli in the

Table I. *Rhizomys sumatrensis sumatrensis* (Raffl.), skullmeasurements, in mm

	sex	condylobasal length	condylo-incisive length	zygomatic breadth	breadth across frontals anteriorly	intertemporal breadth	height of skull from alveolus of M3	height of occiput from basion	height of occiput from foramen magnum	breadth of occiput	median length of nasals	breadth of combined nasals	length of upper molar series	length of lower molar series	length of foramen incisivum
Mus. Leid.: a	♀	—	—	62.8	28.5	14.1	32.6	—	—	—	32.1	13.9	15.4	16.6	7.3
B.M.: 46. 6. 15. 15	?	—	—	61.6	25.3	12.6	—	—	—	—	26.7	12.2	13.0	15.9	8.4
B.M.: 2. 5. 2. 3	♂	80.3	81.8	60.7	27.0	12.1	32.1	28.3	19.1	33.0	26.0	12.2	15.1	16.8	10.0
B.M.: 97. 8. 10. 2	♀	78.9	78.9	59.9	23.9	12.1	33.2	28.7	19.5	34.6	24.6+	—	13.7	14.6	8.5
B.M.: 3. 2. 15. 18	♀	75.9	76.9	57.8	24.4	12.6	29.5	26.1	17.3	35.0	28.4	13.0	12.3	—	7.4
Mus. Leid.: b	♀	71.5	72.2	56.5	23.0	13.1	27.3	26.0	15.0	34.9	25.6	11.6	13.4	16.1	6.5
B.M.: 601 <sup>a</sup>	?	—	—	49.2	20.2	11.8	22.8	—	—	—	21.9	10.2	13.0	15.6	8.0
B.M.: 601 <sup>b</sup>	?	—	—	40.1	16.6	10.8	20.3	—	—	—	18.5	7.5	—	—	4.6
B.M. ex coll. Cantor	♂	—	—	66.0	29.3	13.9	± 33	—	—	—	31.6	15.4	15.2	15.9	9.4
B.M.: 86. 8. 18. 1	♀	—	—	59.2	26.2	12.3	29.7	—	—	—	26.5	11.9	12.9	14.1	7.8
B.M.: 89. 5. 14. 3	♀	—	—	—	—	—	—	—	—	—	25.1	11.7	13.0	± 13.3	8.0



collection of Mr H. J. V. Sody, but even in these it is very faint if compared to the rufous colour in specimens of *Rh. s. padangensis*; in these specimens the dark band on the head is also present. The general colour of adult specimens is silvery grey, sometimes more or less yellowish. The skullmeasurements are given in table II. Of none of the specimens I examined measurements taken in the flesh, were available. Schneider (1905, p. 112) gives as the maximal length of head and body for the specimens collected by him 45 cm, tail 11 cm. There is, therefore, no reason to believe that this race is smaller than the typical form from the Malay Peninsula. Mr Sody gave me the measurements of the four specimens in his collection, which were taken from the skins preserved in formaline; the length of head and body of the largest of these specimens (a male) was about 27 cm.

Table II. *Rhizomys sumatrensis insularis* (Thos.), skullmeasurements, in mm

	sex	condylobasal length	condylo-incisive length	zygomatic breadth	breadth across frontals anteriorly	intertemporal breadth	height of skull from alveolus of M <sup>3</sup>	height of occiput from basion	height of occiput from foramen magnum	breadth of occiput	median length of nasals	breadth of combined nasals	length of upper molar series	length of lower molar series	length of foramen incisivum
Deli, Mus. Amst.	♂	86.1	89.4	64.5	26.2	14.3	35.2	28.8	18.4	40.0	30.1	15.0	14.5	16.0	8.1
" " "	♂	80.0	81.9	58.5	23.9	12.6	30.2	26.5	16.9	36.8	28.4	13.5	14.3	16.1	6.7
Mus. Leid.: c	?	79.0	81.0	57.1	22.2	12.6	28.3	25.2	16.0	± 35.0	25.7	12.0	13.8	14.8	9.0
" " : e	♀	78.0	79.8	59.4	23.6	13.0	29.9	25.4	15.5	36.2	29.3	11.9	14.4	14.4	8.3
Mus. Amst.: E 7. II	♀	76.9	—	57.8	22.8	13.0	29.4	26.0	16.0	36.1	27.1	11.9	14.1	15.4	7.3
Mus. Genève: 813/82	♀	76.3	76.9	56.1	22.1	11.9	29.1	25.7	15.8	36.4	26.6	11.2	13.6	15.1	7.4
B.M.: 90. 1. 20. 4	♂	75.7	77.0	55.6	20.9	12.0	27.7	24.5	14.1	33.2	27.1	10.7	14.5	15.9	8.2
Mus. Leid.: 647	♀	74.5	75.4	56.0	23.2	13.7	27.2	25.1	16.6	34.0	26.4	11.2	14.1	16.4	6.8
B.M.: 89. 11. 8. 1, Paratype	♂	73.8	75.2	55.4	23.0	11.6	27.3	24.8	15.1	33.4	24.5	11.1	13.6	15.5	6.9
Collection Sody	♀	72.7	73.9	55.9	22.4	14.3	29.5	24.9	15.8	33.4	26.0	11.8	14.9	15.5	—
" "	♂	70.9	72.3	52.8	21.6	12.8	26.6	23.5	15.7	± 31.2	23.5	10.6	14.4	14.5	—
B.M.: 99. 8. 21. 5, Type	♀	70.6	72.0	51.9	23.5	12.6	27.0	24.6	14.6	33.4	23.0	11.0	13.5	15.3	6.4
B.M.: 89. 11. 8. 2, Paratype	♀	70.2	71.9	53.5	19.2	11.6	26.6	25.0	16.0	32.3	23.5	9.5	13.5	15.0	7.7
Mus. Amst.: E 7. I	?	70.2	71.0	53.9	21.2	12.3	25.1	22.7	14.0	32.5	24.7	11.7	14.0	14.0	6.9
Mus. Leid.: d	?	69.2	70.7	54.0	20.9	13.5	21.6	23.7	13.9	32.7	21.9	10.3	13.8	14.9	8.0
Collection Sody	♀	69.2	70.0	50.9	19.3	12.1	26.5	22.8	15.0	30.7	22.3	9.8	13.8	14.1	5.7
Mus. Leid.: 1256	♀	66.4	67.4	50.1	18.8	12.2	25.1	21.9	12.8	31.1	21.2	9.4	14.7	14.8	6.7
Collection Sody	♂	65.0	66.2	50.2	19.0	12.0	24.7	± 21.3	—	28.0	21.3	9.7	13.6	14.0	6.2

The only difference found between skins of this subspecies and those of *Rh. s. sumatrensis* is that in fullgrown specimens of *insularis* the dark band and the white spot on the head are absent. This was also noted by Schneider (1905, p. 112) for the fullgrown specimens examined by him. As described on p. 147 some slight differences were found in the shape of the jugal and of the mastoid, which to some extent may serve to distinguish *Rh. s. sumatrensis* and *Rh. s. insularis*.

Distribution: North-eastern Sumatra.

***Rhizomys sumatrensis padangensis* nov. subsp. (figs. 1b; 3d—e; 4a—c, g).**

*Rhizomys sumatrensis*, Jentink, Notes Leyden Mus., vol. 18, 1897, p. 214 (part.); Trouessart, Cat. Mamm., vol. 1, 1897, p. 568 (part.); Trouessart, Cat. Mamm., Suppl., 1904, p. 465 (part.); Van Balen, Dierenwereld, vol. 1, 1914, p. 265 (part.); Weber, Säugetiere, vol. 2, 1928, p. 282 (part.); Raven, Bull. Am. Mus. Nat. Hist., vol. 68, 1935, p. 257 (part.).

*Rhizomys sumatranus*, De Beaufort, Zoogeographie, 1926, p. 59 (part.).

*Nyctocleptes insularis*, Robinson & Kloss, J. Fed. Mal. St. Mus., vol. 8, pt. 2, 1918, p. 77 (part.) and 1923, p. 319 (part.; as a race of *N. sumatrensis*).

*Nyctocleptes sumatrensis insularis*, Robinson & Kloss, J. Fed. Mal. St. Mus., vol. 7, pt. 5, 1919, p. 316 (part.).

Specimens examined:

- 1 ♀, type, Koto Gadang (Singgalang), Padang Highlands, W. Sumatra, 10. IX. 1917, leg. Dr E. Jacobson, collector's number E. J. 382, Mus. Leid., reg. no. 1013, skin and skull.
- 2 ♀ ♀, paratypes, Koto Gadang (Singgalang), Padang Highlands, W. Sumatra, 9. XI. 1917 (coll. no. E. J. 391) and 22. XI. 1917 (coll. no. E. J. 392), leg. Dr E. Jacobson, Mus. Leid., reg. no. 1013, skins and skulls.
- 1 ♂, 1 juv., paratypes, Fort de Kock, Padang Highlands, W. Sumatra, V. 1914, leg. Dr E. Jacobson, Mus. Leid., reg. no. 872, skins and skulls.
- 1 ♂ juv., paratype, Loeboek Basong between the Lake of Manindjoe and Priaman, W. Sumatra, leg. Prof. A. A. W. Hubrecht, Mus. Leid., reg. no. 1255, skin in spirit, skeleton.

Terra typica: Koto Gadang (Singgalang), W. Sumatra.

This subspecies differs from *Rh. s. sumatrensis* and *Rh. s. insularis* in the very pronounced rufous colour of the head and body. This colour is best developed on the head, much fainter on the sides of the body; it is somewhat tempered by the red hairs having white tips. Posteriorly the back is dark greyish, sprinkled with lighter greyish, as white hairs are present between the darker ones, and the dark hairs have white tips. The rufous colour is not so pronounced as in *Rh. s. cinereus*, which has a distinct dark band on the head,

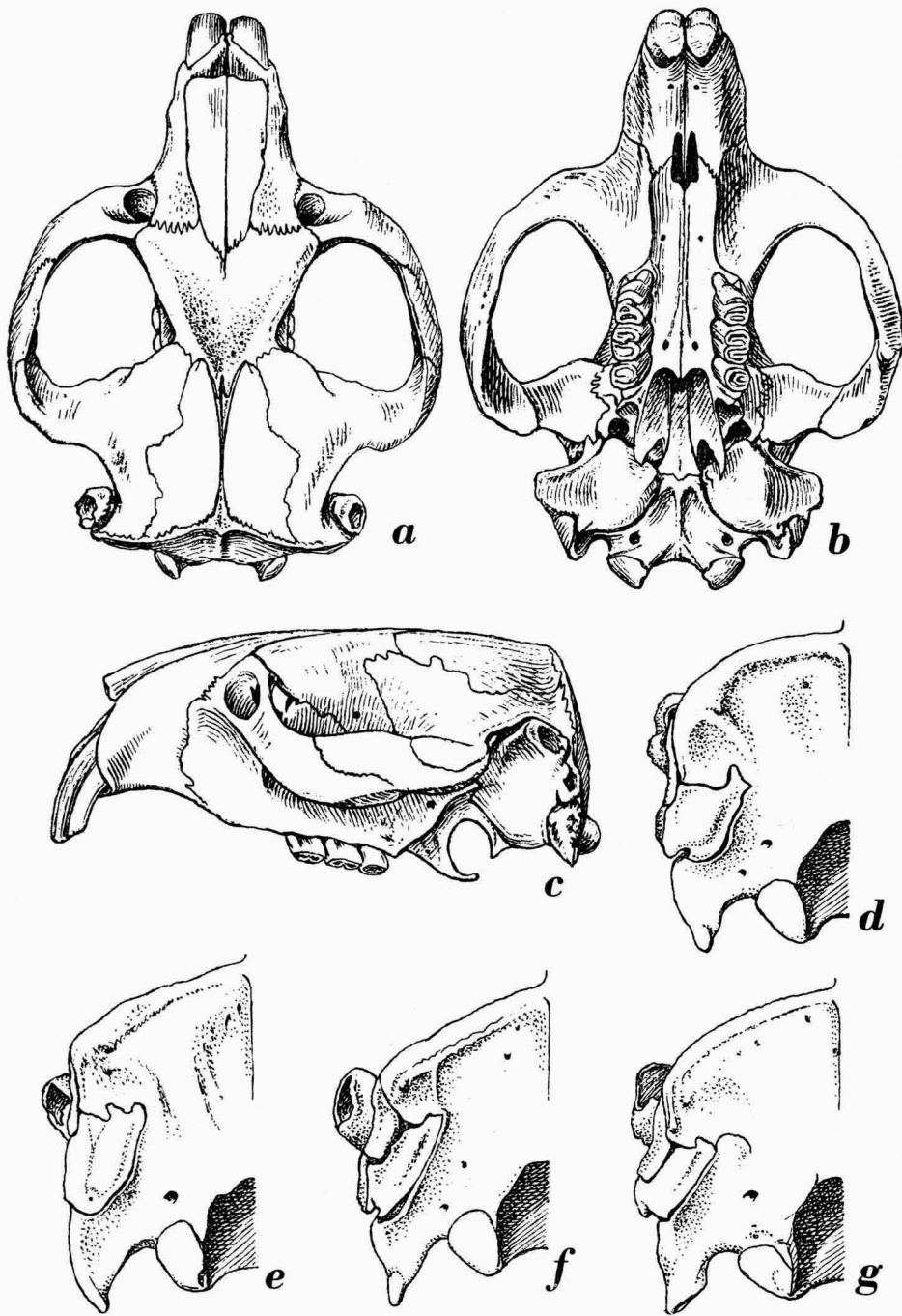


Fig. 4. a, *Rhizomys sumatrensis padangensis* nov. subspec., ♀, type, Koto Gadang (Singgalang), leg. Dr E. Jacobson (coll. no. E. J. 382), Mus. Leid., reg. no. 1013, skull, norma verticalis; b, id., norma basilaris (for details of the enamel structure of the molars see fig. 3e); c, id., norma lateralis; d, left half of occiput of *Rhizomys s. sumatrensis* (Raffl.), ♀, B. M., reg. no. 3.2.5.18; e, id. of *Rhizomys s. sumatrensis* (Raffl.), ♂, B. M. reg. no. 2.5.2.3; f, id. of *Rh. s. insularis* (Thos.), ♂, paratype, B. M., reg. no. 89.11.8.1; g, id. of *Rh. s. padangensis* nov. subspec., ♀, paratype, Koto Gadang (Singgalang), leg. Dr E. Jacobson (coll. no. E. J. 391), Mus. Leid., reg. no. 1013. Figs. a—c, nat. size; d—g,  $\times 1\frac{1}{2}$ .

the latter being indistinct in *padangensis*. No white spot on the head. The skullmeasurements are given in table III, while the measurements taken from the specimens in the flesh are given in table IV. In the latter table I have included the measurements of a male described by Robinson & Kloss (1919, p. 316); the maximum length of head and body of the females examined by these authors is 398 mm. It must be noted that none of the types are wholly fullgrown, though some of them are adult, the molars also showing distinct traces of use.

Distribution: Padang Highlands, W. Sumatra.

Table III. *Rhizomys sumatrensis padangensis* nov. subspec., skullmeasurements, in mm

	sex	condylobasal length	condylo-incisive length	zygomatic breadth	breadth across frontals anteriorly	intertemporal breadth	height of skull from alveolus of M <sup>3</sup>	height of occiput from basion	height of occiput from foramen magnum	breadth of occiput	median length of nasals	breadth of combined nasals	length of upper molar series	length of lower molar series	length of foramen incisivum
E. J. 392, Paratype	♀	76.9	78.0	57.3	23.5	12.2	30.5	27.3	16.9	35.7	24.5	11.0	14.0	16.2	7.1
E. J. 391, Paratype	♀	75.9	77.5	± 57.8	25.0	13.0	30.7	27.3	17.0	± 36	25.7	10.8	13.9	15.9	7.4
E. J. 382, Type	♀	74.7	76.5	59.0	24.4	12.8	30.6	27.2	17.4	35.0	24.6	10.6	13.8	15.1	7.4
Fort de Kock, Parat.	♂	71.9	73.3	57.9	23.4	13.7	27.9	26.0	16.9	33.7	23.0	11.6	12.4	15.6	6.0

Table IV. Measurements of *Rhizomys sumatrensis padangensis* nov. subspec., in mm

		head + body	tail	hindfoot	ear
type, E. J. 382	♀	338	181	63	37
paratype, E. J. 391		368	140	62	19
" E. J. 392	♀	351	169	62	20
(Robinson & Kloss	♂	335	145	61	17

***Rhizomys sumatrensis cinereus* M'Clelland**

*Rhizomys cinereus* M'Clelland, Calcutta Journ. Nat. Hist., vol. 2, 1842, pp. 456, 458,

pl. XIV; Milne-Edwards, Rech. Hist. Nat. Mammif., vol. 1, 1872, p. 295; Ryley, J. Bombay Nat. Hist. Soc., vol. 22, 1914, pp. 714, 724, 725; Wroughton, J. Bombay Nat. Hist. Soc., vol. 23, 1915, p. 716.

*N(yctocleptes) cinereus*, Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, 1915, p. 57; Wroughton, J. Bombay Nat. Hist. Soc., vol. 27, 1920, p. 63, and 1921, p. 533.

(*Nyctocleptes cinereus*, Wroughton, J. Bombay Nat. Hist. Soc., vol. 27, 1920, p. 62. *Nyctocleptes sumatrensis cinereus*, Osgood, Field Mus. Nat. Hist., Publ. no. 312, Zool. Ser., vol. 18, no. 10, 1932, p. 324.

*R(hizomys) cinerea*, Anderson, Proc. As. Soc. Beng., 1877, p. 149.

*R(hizomys) cinerus*, Anderson, Proc. As. Soc. Beng., 1877, p. 150.

*Rhizomys Decan*, Schinz, Synops. Mamm., vol. 2, 1845, p. 123 (part.).

*Rhizomys Dekan*, Milne-Edwards, Rech. Hist. Nat. Mammif., vol. 1, 1872, pp. 295.

*Rhizomys dekan*, Jentink, Notes Leyden Mus., vol. 11, 1889, p. 28 (part.).

*Rhizomys sumatrensis*, Cantor, J. As. Soc. Beng., vol. 15, 1846, p. 255 (part.); Gray, Cat. Bones Mamm. Brit. Mus., 1862, p. 224 (part.); Murray, Geogr. Distr. Mamm., 1866, p. 357 (part.), p. 385; Anderson, Anat. Zool. Res. Yunnan, 1879, text, p. 322 (part.), atlas, p. III (part.); Blanford, Fauna Brit. India, Mamm., 1891, p. 439 (part.), fig. 143; Bonhote, Proc. Zool. Soc. Lond., 1900, p. 881; S. S. Flower, Proc. Zool. Lond., 1900, p. 363 (part.); Robinson & Kloss, J. Fed. Mal. St. Mus., vol. 5, 1925, p. 34.

*Rh(hizomys) sumatrensis*, Blyth, Cat. Mamm. Mus. As. Soc., 1863, p. 122 (part.).

*R(hizomys) sumatrensis*, Lydekker, Wild Life of the World, vol. 2, no date, p. 180.

*Rhizomys erythrogenys* Anderson, Proc. As. Soc. Beng., 1877, p. 150; Anderson, Anat. Zool. Res. Yunnan, 1879, text, p. 324, atlas, p. III, pl. XIII A; Anderson, J. Linn. Soc. Lond., Zool., vol. 21, 1889, p. 341; Sterndale, Nat. Hist. Mamm. India & Ceylon, 1884, p. 354; Sclater, Cat. Mamm. Ind. Mus., pt. 2, 1891, pp. XIV, 96.

*Rhizomys sumatrensis erythrogenys*, Thomas, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 10 (= vol. 30), 1892, p. 943; Trouessart, Cat. Mamm., vol. 1, 1897, p. 569.

*Rhizomys erythrogenis*, Fea, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 17 (= vol. 37), 1897, p. 412 (as a race of *R. sumatrensis*).

*Rhizomys sumatrensis erythrogenis*, Fea, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 17 (= vol. 37), 1897, p. 426.

#### Specimens examined:

- 2 ♂ ♂, Pyaunggaung, Northern Shan States, Burma, 2794 ft., 9. and 10. V. 1913, leg. G. C. Shortridge, don. Bombay Nat. Hist. Soc., B. M., reg. no. 14. 7. 8. 52—53, skins and skulls.
- 1 ♀, Pyaunggaung, Northern Shan States, Burma, 2794 ft., leg. G. C. Shortridge, don. Bombay Nat. Hist. Soc., B. M., reg. no. 14. 7. 8. 54, mounted skin and skull.
- 1 ♂, Mamsam Falls, Nam Yao River, Northern Shan States, Burma, 2000 ft., 7. VIII. 1913, leg. G. C. Shortridge, don. Bombay Nat. Hist. Soc., B. M., reg. no. 13. 11. 18. 3, skin and skull.
- 1 ♀, Se'en, Hsipaw State, Northern Shan States, Burma, 1411 ft., 24. V. 1913, leg. G. C. Shortridge, don. Bombay Nat. Hist. Soc., B. M., reg. no. 14. 7. 8. 55, skin and skull.
- 1 ♀, Loikaw, military post, borders of Karennee, 3000 ft., don. E. W. Oates, B. M., reg. no. 93. 7. 1. 2, in spirit.
- 1 ♂, Metéleo, Carin Bia Pó (Karennee), 1000 ft., 7. VIII. 1888, leg. L. Fea, Mus. Leid., cat. syst.: a, skin and skull.
- 1 ♂ hgr., Ataran, 50 miles S. of Moulmein, Lower Burma, 15. V. 1913, leg. J. P. Cook, don. Bombay Nat. Hist. Soc., B. M., reg. no. 14. 7. 8. 56, skin and skull.
- 2 ♂ ♂, 2 ♀ ♀, Mewong River, 40 miles E. of Um Pang, Siam, 11, 12 and 13. II. 1924, leg. W. P. Lowe, don. A. S. Vernay, B. M., reg. no. 24. 9. 2. 62—63 (♂ ♂), 65—66 (♀ ♀), skins and skulls.

- 1 ♂, 2 ♀ ♀, Mewong River, 40 miles E. of Um Pang, Siam, 12 and 14. II 1924, leg. W. P. Lowe, don. A. S. Vernay, B. M., reg. nos. 24.9.2.64 (♂) and 67—68 (♀ ♀), skins.
- 1 ♀, ♂ ♀ juvs., Mee Taw Forest, Raheng, Siam, 2500 ft., 18. XII. 1913, don. C. S. Barton, B. M., reg. nos. 14.6.18.22 (♀) 24 (♀ juv.) and 25 (♂ juv.), skins and skull of ad. ♀, skullfragments of juvs.; these specimens were dug out of a burrow with two other young.
- 1 ♀, Mee Taw Forest, Raheng, Siam, 1000 ft., 21. IV. 1913, don. C. S. Barton, B. M., reg. no. 14.6.18.21, skin and skull.
- 1 ♀ juv., Mee Taw Forest, Raheng, Siam, 800 ft., 12. XII. 1913, don. C. S. Barton, B. M., reg. no. 14.6.18.23, skin and lower jaw.
- 1 ex., 80 miles N. of Bangkok, alt. 80 m, Siam, don. K. G. Gairdner, B. M., reg. no. 14.8.22.28, skin and skull.
- 1 juv., Lopburi, about 60 miles N. of Bangkok, Siam, don. K. G. Gairdner, B. M., reg. 14.8.22.29, skin and incomplete skull.
- 1 ♂, 1 ♀, Hoi-Xuan, Annam, 15. II. 1930, leg. Delacour and Lowe, B. M., reg. nos. 33.4.1.487—488, skins and skulls.
- 2 ♂ ♂, Banlaw, Gt. Tenasserim River, 22 and 23. IV. 1914, leg. G. C. Shortridge, don. Bombay Nat. Hist. Soc., B. M., reg. no. 14.12.8.221, skin, fragment of skull and lower jaw; no. 14.12.8.222, skin and skull.
- 2 ♂ ♂, 1 ♀, Thaget, Little Tenasserim River, 20 and 26. III. 1914 and 4. IV. 1914, leg. G. C. Shortridge, don. Bombay Nat. Hist. Soc., B. M., reg. no. 14.12.8.218 (♂), skin, fragment of skull and lower jaw; nos. 14.12.8.219 (♂) — 220 (♀), skins and skulls.
- 1 ♂, 2 ♀ ♀, Tenasserim Town, 6, 13 and 18. III. 1914, leg. G. C. Shortridge, don. Bombay Nat. Hist. Soc., B. M., reg. no. 14.12.8.215 (♂), skin and skull; nos. 14.12.8.216—217 (♀ ♀), skins and fragments of skulls.
- 1 ♂, 1 ♀, Telom River, Pahang, 400ft., 29. II and 5. III. 1932, leg. Capt. F. A. B. Holloway, don. A. S. Vernay, B. M., reg. no. 34.7.18.113b (♂), skull; no. 34.7.18.113a (♀), skin.
- 1 ♀, K. Jalor, 3. XI. 1901, don. H. C. Robinson and N. Annandale, B. M., reg. no. 3.2.6.72, skin and skull.
- 1 ex., Mergui, don. Prof. Oldham, B. M., reg. no. 56.5.6.26 (old no. 601d), skull.

Terra typica of *Rhizomys cinereus*: Tenasserim; of *Rh. erythrogegensys*: Salween Hill Tracts (paratype from Tenasserim).

This subspecies is easily recognized by the strongly pronounced red colour of the head, and the wedge-shaped, median, black band, which runs over the middle of the head (starting between the eyes) on to the back. The back is brownish to blackish brown, the sides of the body are brownish. A rather large series was examined, of which the skullmeasurements are given in table V. The bodymeasurements, together with the weights of some specimens are given in table VI. Some very young specimens were examined; these are alike to those of *Rh. s. sumatrensis*, except for the absence of the white spot on the head. This difference may not hold good if larger series are examined, as I examined a halfgrown specimen from Selangor, which I hesitatingly refer to *Rh. s. sumatrensis*, but which agrees with *Rh. s. cinereus* in lacking the white spot on the head.

Distribution: This subspecies ranges from the Northern part of the Malay Peninsula (Jalor, Tenasserim, Mergui) to Upper Burma (Northern Shan States), and to Siam, Laos, Tonkin and Annam.

Table V. *Rhizomys sumatrensis cinereus* M'Clell., skullmeasurements, in mm

	sex	condylobasal length	condylo-incisive length	zygomatic breadth	breadth across frontals anteriorly	intertemporal breadth	height of skull from alveolus of M <sub>3</sub>	height of occiput from basion	height of occiput from foramen magnum	breadth of occiput	median length of nasals	breadth of combined nasals	length of upper molar series	length of lower molar series	length of foramen incisivum
B.M., 14. 7. 8. 52	♂	—	—	70.0	30.5	15.1	37.2	30.4	22.7	39.9	32.4	12.8	15.5	17.3	10.1
B.M., 14. 7. 8. 53	♂	91.1	93.7	67.7	30.1	14.1	38.6	30.6	20.6	42.9	31.4	13.3	14.9	17.4	8.1
B.M., 14. 12. 8. 222	♂	78	78	58.2	26.3	14.3	33.2	27.7	18.1	35.2	25.3	11.3	15.5	16.8	9.6
B.M., 14. 7. 8. 55	♀	88.2	89.2	65.1	28.1	13.9	36.7	30.4	20.0	41.9	29.4	14.3	16.7	16.8	9.9
B.M., 601 <sup>d</sup>	?	85.8	88.4	63.8	29.3	14.1	—	28.1	16.8	36.6	28.9	13.1	—	15.1	9.3
B.M., 14. 7. 8. 54	♀	82.8	84.6	63.5	28.4	15.1	35.0	30.0	19.5	37.0	28.4	13.2	14.3	16.0	7.9
B.M., 14. 12. 8. 219	♂	80.5	81.2	—	25.5	12.0	31.6	29.1	19.6	36.0	27.1	10.8	12.8	15.7	9.7
B.M., 14. 12. 8. 220	♀	79.9	81.5	61.1	24.5	12.4	31.9	29.6	19.9	36.4	25.9	11.9	14.0	15.3	8.6
B.M., 14. 6. 18. 22	♀	—	—	57.6	24.1	12.8	28.4	—	—	—	25.4	10.9	14.6	15.7	9.0
Mus. Leid.: a	♂	79.7	81.4	56.9	19.9	13.1	30.3	24.8	16.9	35.4	24.4	10.7	14.2	16.5	8.8
B.M., 14. 6. 18. 21	♀	74.2	75.3	—	22.2	12.6	29.1	25.3	15.9	32.1	23.9	10.0	14.8	16.5	7.4
B.M., 14. 8. 22. 28	?	74.2	76.2	—	24.0	12.8	30.6	27.0	16.6	35.3	25.6	12.0	12.8	—	8.2
B.M., 24. 9. 2. 65	♀	71.1	73.0	54.9	23.2	13.2	28.7	24.9	14.9	33.8	22.2	9.9	14.2	16.2	7.3
B.M., 13. 11. 18. 3	♂	—	—	±54.1	22.4	12.0	27.1	—	—	—	25.7	10.9	14.1	15.2	7.6
B.M., 24. 9. 2. 62	♂	69.7	70.7	52.9	20.4	11.3	26.4	23.2	14.4	32.2	21.4	9.0	14.3	15.6	8.1
B.M., 14. 7. 8. 56	juv. ♂	64.8	65.7	±50.2	19.8	12.3	26.5	23.7	14.5	29.6	22.3	9.7	13.4	15.7	8.0
B.M., 3. 2. 6. 72	♀	65.1	65.3	49.1	20.0	13.6	25.2	22.8	15.1	30.3	21.8	9.9	13.3	15.5	6.0
B.M., 14. 12. 8. 215	♂	—	—	46.4	18.2	12.8	—	—	—	—	18.2	8.4	—	—	6.5
B.M., 24. 9. 2. 63	juv. ♂	—	—	43.5	18.8	12.9	—	—	—	—	17.5	8.8	—	—	5.1
B.M., 24. 9. 2. 66	juv. ♀	—	—	41.0	16.1	12.7	—	—	—	—	17.4	7.7	—	—	5.6
B.M., 14. 8. 22. 29	?	—	—	39.3	15.5	10.9	—	—	—	—	16.1	7.3	—	—	5.6
B.M., 33. 4. 1. 487	♂	78.7	79.6	57.8	24.3	13.6	35.7	28.0	17.9	31.7	24.6	12.4	13.7	—	9.3
B.M., 33. 4. 1. 488	♀	84.0	84.4	59.8	25.3	13.4	36.8	28.5	17.8	35.1	26.7	13	14.3	—	8.7

Table VI. Measurements of *Rhizomys sumatrensis cinereus* M'Clell., in mm; Weights in grams (1 lb = 453 grams)

	sex	head + body	tail	hindfoot	hindfoot s. u.	ear	weight
B.M., 14. 7. 8. 52	♂	480	175	—	77	36	4210
B.M., 14. 7. 8. 53	♂	435	182	—	73	24.5	3171
B.M., 13. 11. 18. 3	♂	370	140	—	61	22	
B.M., 14. 7. 8. 55	♀	430	186	—	70	25	3624
B.M., 14. 7. 8. 56	♂	304.8	120.6	—	53.3	20.3	
B.M., 33. 4. 1. 487	♂	370	131	62	—	24	
B.M., 33. 4. 1. 488	♀	380	163	66	—	21 <sup>1</sup> / <sub>2</sub>	
B.M., 14. 12. 8. 222	♂	390	154	—	68	21.5	2379
B.M., 14. 12. 8. 221	♂	265	102	—	47	19.5	
B.M., 14. 12. 8. 220	♀	390	200	—	67	20.5	2379
B.M., 14. 12. 8. 218	♂	245	115	—	46	18	
B.M., 14. 12. 8. 219	♂	415	186	—	65	20	
B.M., 14. 12. 8. 215	♂	295	119	—	51	19	
B.M., 14. 12. 8. 216	♀	370	170	—	64	21.5	2039
B.M., 14. 12. 8. 217	♀	455	172	—	66	23	2955
B.M., 34. 7. 18. 113a	♀	340	130	49	—	16	
B.M., 24. 9. 2. 65	♀	330	138	61	—	22	
B.M., 24. 9. 2. 67	♀	129	38	25	—	10	
B.M., 24. 9. 2. 68	♀	123	37	25	—	10	
B.M., 24. 9. 2. 66	♀	240	92	45	—	17	
B.M., 24. 9. 2. 64	♂	221	90	45	—	17	453
B.M., 24. 9. 2. 63	♂	245	92	47	—	16	453
B.M., 24. 9. 2. 62	♂	—	—	—	—	—	906
B.M., 14. 6. 18. 21	♀	381	140	61	—	22	
B.M., 14. 6. 18. 22	♀	369	135	56	—	21	
B.M., 14. 6. 18. 24	♀	135	42	24	—	10	
B.M., 14. 6. 18. 25	♂	126	44	24	—	9	
B.M., 14. 6. 18. 23	♀	180	60	33	—	13	
B.M., 3. 2. 6. 72	♀	322	127	53	—	20	

Mr. R. W. Hayman kindly copied the original description for me. This appears under the heading "On Collections", which also appears in other parts of the journal, and though not signed, it is undoubtedly the work of the editor, John M'Clelland, as Dr Hinton points out to me. In addition at the foot of p. 458 a reference is given to pl. XIV, in which the specific name is followed by the initials "J. M.", also indicating that M'Clelland is the author of *Rhizomys cinereus*.



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