CONTRIBUTIONS TO THE FAUNA OF MANIPUR STATE, ASSAM.

PART III.—MAMMALS, WITH SPECIAL REFERENCE TO THE FAMILY MURIDAE (ORDER RODENTIA).

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(Plates I—IX)

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I.—Introduction.

General.

As mentioned in Part I of this series (General Introduction, Roonwal, 1949*a*), the collection reported upon here was made mainly by the writer and his associates of the General Headquarters (India) Field Typhus Research Team during the period June-December 1945, mostly from central Manipur; a few specimens were also collected in the Kabaw Valley (W. Burma) south up to Kalewa on the R. Chindwin. In addition, a few mammals collected by a Zoological Survey of India Party from the Naga Hills and Manipur during February-March 1936 have also been incorporated in the report.

A detailed account of the ecology and bionomics of these mammals will be found in Roonwal's (1949*c*) monograph while the same paper as well as another (Roonwal, 1948) contain a preliminary account of their systematics, including a description of 3 new subspecies of rats and mice (Rodentia: Muridae). In the present paper, which must be read in conjunction the two others mentioned above, the systematic aspect is amplified, especially with regard to the Muridae; fuller descriptions of the 3 new subspecies are provided, and illustrations are provided of the skulls of several species and subspecies of Muridae which have never before been either fully or satisfactorily figured.

A total of nearly 500 specimens were collected and examined. Of these, the Common Manipur White-bellied Rat, *Rattus rattus bullocki* Roonwal, constituted the majority—about 359 specimens. This study includes 35 species and subspecies, thus: Insectivora 5, Chiroptera 1, Carnivora 6, Primates 2, Rodentia 20 and Ungulata 1.

Measurements.

The following body- and skull-measurements were generally taken; in all cases, they were 'straight-line' measurements between two points, and not along the curvatures of the body- or skull-parts.

BODY-MEASUREMENTS.

The following 'lengths' were measured on freshly-killed animals, with the body-parts fully relaxed and pressed against a flat surface; no stretching was allowed:—(i) *Head-and-body* (H. & B.): From the tip of the nose to the ventral root of the tail just above the anus. (ii) *Tail* (Tl.): From the ventral root of the tail to the tip of the tail vertebrae, excluding the hair. (iii) *Hind-foot* (H.F.): From the outer, most prominent surface of the heel to the tip of the longest toe, excluding the claw or nail. (iv) *Ear* (E.): From the most prominent surface of the tragus to the farthest edge of the pinna.

SKULL-MEASUREMENTS.

The measurements were taken under a large table-lens magnifying about $2\frac{1}{2}$ times, and by means of a vernier callipre with a dial graduation reading up to 0·1 mm. The following 'lengths' were generally measured, especially in the Muridae (Rodentia):—

(i) *Greatest length (or occipitopremaxillar length).*—From the hindmost point of the occipital surface in the middle line to the most forward point of the premaxilla.

(ii) *Codylobasal length.*—From the hindmost point of the occipital condyle of one side to the most forward point of the premaxilla of that side. (This is slightly different from the " condylobasal " of Ellerman 1947*c*, p. 250, who measures it from " the occiput to the front of the incisors ".)

(iii) *Occipitonasal length.*—From the hindmost point of the occipital surface in the middle line to the most forward tip of the nasals.

(iv) *Greatest zygomatic width.*—Greatest width across the outer surfaces of the two cheek bones (zygomatic arches), measured at right angles to the long axis of the skull.

(v) *Least interorbital width.*—Least width, between the orbits, of the frontal bone as viewed from above. (This is the " frontals width " of Ellerman, 1947*c*, p. 250.)

(vi) *Cranial width.*—Greatest width of the cranium or brain-case just above the squamosal roots of the zygomatic arches.

(vii) *Occipital breadth.*—Breadth of the occipital region just above the external auditory meatus and in front of the mastoid processes of the periotic.

(viii) *Median depth of occiput.*—Vertical median height of the occiput, from the highest surface of the occipital crest in the middle line to the lowest surface of the foramen magnum in the middle line. (This is different from the " occiput " of Ellerman, 1947*c*, p. 250.)

(ix) *Postmolar length.*—From the hindmost point of the occipital condyle of one side to the hindmost point of the base of the last molar or m_3 of that side where it emerges from the maxilla.

(x) *Auditory length.*—From the hindmost point of the occipital condyle to the most forward surface of the tympanic bulla of that side.

(xi) *Length of tympanic bulla.*—Maximum length of the bulla proper, from a point immediately next to the paroccipital process to the opposite point on the inflated bulla, excluding the spinous processes and the mastoid portion when swollen.

(xii) *Length of nasals.*—Maximum length of nasals along the antero-posterior axis.

(xiii) *Greatest combined width of nasals.*—Measured at right angles to the antero-posterior axis of the nasals.

(xiv) *Palatal length.*—From the hindmost edge of the palate in the middle line, excluding the palatal spine when present, to the most forward point of the premaxilla on the ventro-lateral side where it meets the *back* or *posterior* edge of the first incisor or i_1. (Ellerman, 1947*c*, p. 250, however, measures it, for rodents, " from the front of the incisors to the back of the palate, ignoring the spinous process if it is present ", thus obtaining larger values.)

(xv) *Length of diastema.*—From a point on the ventro-lateral side of the premaxilla where it meets the back or posterior edge of the first incisor or i_1 to the most forward point of the base of the first (most anterior) tooth present in the premolar-molar series of that side where it emerges from the maxilla.

(xvi) *Length of anterior palatine foramina.*—The maximum length long the antero-posterior axis.

(xvii) *Greatest combined width of anterior palatine foramina.*—Maximum width of the two foramina, at right angles to the antero-posterior axis.

(xviii) *Length of upper molars.*—Maximum total length of all the upper molars (excluding the premolars) on the crowns.

(xix) *Mandibular length.*—From the hindmost point of the mandibular condyle to the most forward point of the mandible on the ventro-lateral side where it meets the posterior edge of the first incisor or i_1.

Mammalogy of Manipur State.

The larger mammals, especially the game animals, of Manipur are more or less well known, and accounts of them will be found in Allen (1905, pp. 9-10), Higgins (1933*a-c*, 1934*a-b*), and elsewhere. The medium-sized and smaller mammals, particularly such inconspicuous ones as the Insectivora (moles, shrews, etc.), and the Muridae (rats and mice), are, however, imperfectly known. In addition to a number of individual records scattered in the literature, mention must be made of the small but interesting collection that A.O. Hume made in Manipur in the last quarter of the 19th century and which was reported upon by Thomas (1886). Annandale (1921, p. 538) casually mentioned that otters are plentiful in Manipur but did not name the species.

While the surrounding districts of Assam and Burma were fairly worked out by the various surveys conducted by the Bombay Natural History Society in the early part of this century, Manipur has remained comparatively unknown. In recent years, owing to the War, considerable collections have been made in Manipur, especially of the Insectivora and Rodentia. Ellerman (1947*a-d*) records from Manipur a number of Rodents, specially rats, including the rare species *Hadromys humei* (Th.) and *Diomys crumpi* Th. A recent account of the systematics, ecology and bionomics of some of the Manipur mammals will be found in the accounts by Roonwal (1949*a-c*), and the present account should be read in conjunction with these papers.

Acknowledgments.

The excellent drawings of skulls which illustrate this paper were made, under the writer's supervision, by the Zoological Survey of India's staff artists, Mr. Subodh Chandra Mondal and Mr. Akhoy Kumar Mondal. A few doubtful rats (Muridae) were referred to Sir John R. Ellerman of the Mammal Department, British Museum (Natural History), London, and his opinions are referred to in appropriate places.

Addendum.

Whilst this paper was in page-proof, J R. Ellerman's *The Families and Genera of Living Rodents*, vol. III, part 1, 4+210 pp., London, March 1949 came into my hands. It contains interesting observations, among others, on *Rattus niviventer niviventer*, *R. n. mentosus* and the genus *Hadromys*. As far as I can judge, no major change in my conclusions is called for.

II.—SYSTEMATIC ACCOUNT.

Order 1.—INSECTIVORA.

Family (i) TUPAIIDAE (Tree-shrews).

1. **Tupaia belangeri** (Wagner) (?subspecies).

(The ?Burmese Tree-Shrew.)

1841. *Cladobates belangeri* Wagner, *Schreber's Säugethiere,* Supplement bd. II, p. 42. (Type-locality : Siriam, Pegu District, Burma.)

1949. *Tupaia belangeri* (?subsp.), Roonwal, *Trans. nation. Inst. Sci. India* III, p. 72.

Material.—5 adults—2 from Manipur (Assam) and 3 from the Kabaw Valley (Upper Chindwin District, W Burma) collected during August to November 1945, as follows :—

Manipur : 1 adult ♂ (Z.S.I. Registered No. 11,135) at milestone 34, south-east of Imphal on Tamu Road, *ca.* 4,000 ft., on 14 November ; 1 adult ♂ (No. 11,136) at milestone 117, about 16 miles north of Imphal on Dimapur Road, *ca.* 3,500 ft., on 27 November.

Kabaw Valley : 1 unsexed adult (no Registered No. ; Collection No. CT22/10-8-45) at Moreh near Manipur -Burma frontier, *ca.* 580 ft., on 10 August ; 2 adult ♂♂ (Nos. 11,133 and 11,134) on Tamu-Kalewa Road, *ca.* 400 ft., on 28 August and 2 September.

Size, etc.—4 adult ♂♂ gave the following measurements, in mm. :— Head-and-body 165-182 ; tail ' over 145 ' -178 ; hind-foot 40-43 ; ear 15-19 (Text-fig. 1).

Systematic note.—The specimens are too variable to be satisfactorily assigned to any of the subspecies known from eastern India and Burma, but are allied to *siccata* Th., *assamensis* Wr. and *versurae* Th. With regard to the 4 specimens now available, the following may be stated :—

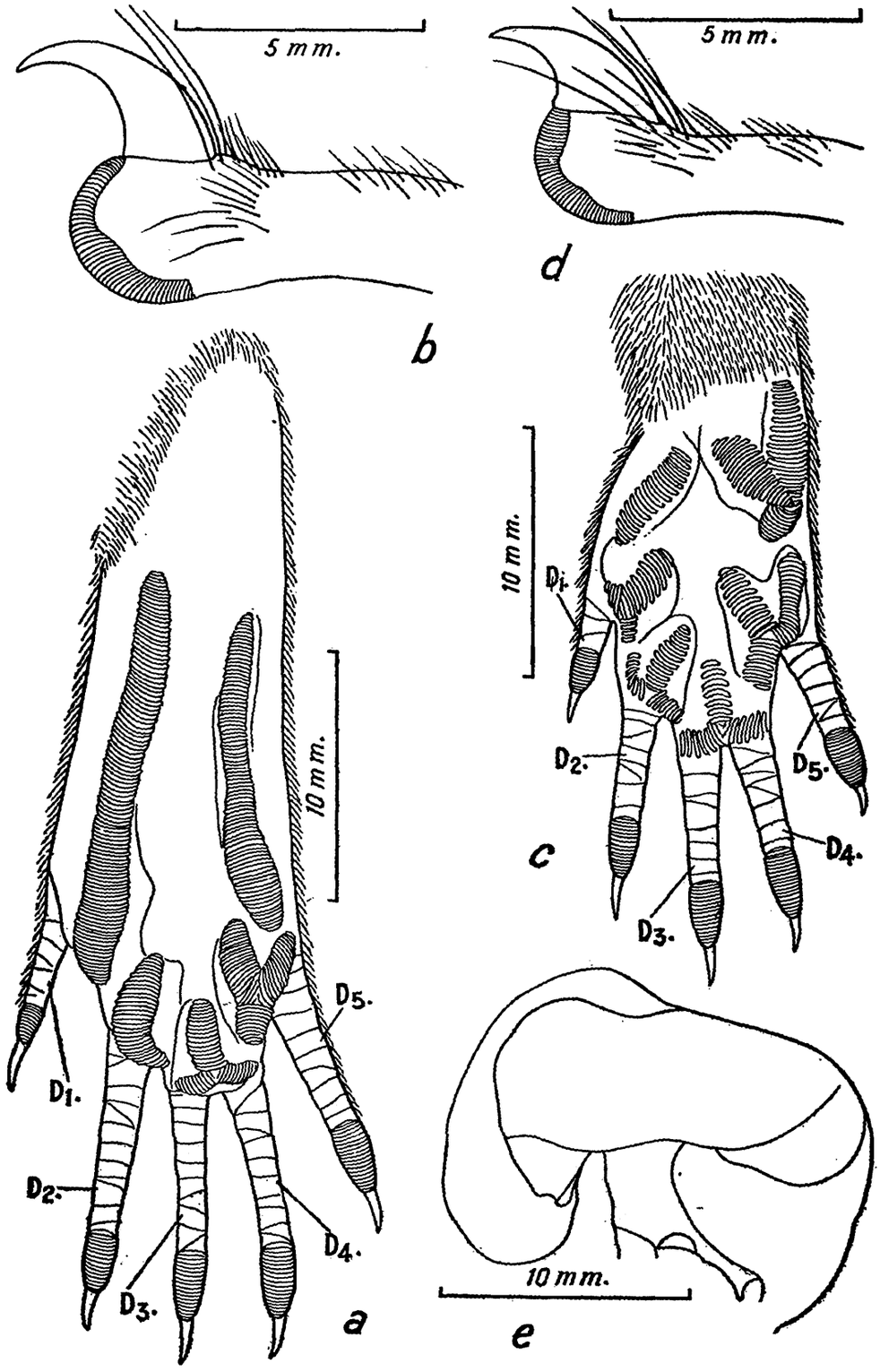
No. 11,133, August 28, Kabaw Valley : Dorsum, including tail, grizzly dark olivaceous, and uniform throughout ; hairs on lower back 8-15 mm. long ; faint remains of buff shoulder stripes, about 8 mm. long, present on either side. Venter dull pale buffy.

No. 11,134, September 2, Kabaw Valley : The white venter would place it near *siccata* Th., but the shoulder stripes are ill-developed and are buffy as in *versurae* Th.

No. 11,135, November 14, Manipur : Dorsum, including tail, grizzly dark olivaceous, and uniform throughout ; hairs on back 14-20 mm. long. Faint remains of buff shoulder stripes, about 10 mm. long, present on either side. Venter dull pale buffy.

No. 11,136, November 27, Manipur : Similar to No. 11,135, but differs in following respects : No shoulder stripes visible ; venter bright buffy, nearly ochraceous on chest ; iguinal hairs slaty-based.

The last two specimens are close to *assamensis* Wr. and *versurae* Th.



TEXT-FIG. 1.—*Tupaia belangeri* (Wagn.) (?subspecies).

Adult ♂, Z. S. I. Reg. No. 11,133, Tamu-Kalewa Road, Kabaw Valley, W. Burma *ca.* 400—500 ft., 28 August 1945.

(*a*) Lower view of right hind-foot, to show the pads. × 3. (*b*) Middle toe (D_3) of right hind-foot, in side view. × 6. (*c*) Lower view of right hand, to show the pads. × 3. (*d*) Middle finger (D_3) of right hand, in side view. × 6. (*e*) Left ear. × 3.

D_1—D_5, first to fifth digits.

Family (ii) Talpidae (Moles).

2. **Talpa micrura** Hodgson.

(The Short-tailed Mole.)

1840. *Talpa micrura* Hodgson, *J. Asiat. Soc. Bengal* X, p. 910 (Type-locality : Darjeeling, N. Bengal.)

1949. *Talpa micrura*, Roonwal, *Trans. nation. Inst. Sci. India.* III, p. 73.

Material.—1 specimen collected in late June 1945 in the " Kanglatongbi area " about 16 miles north of Imphal, Manipur, *ca.* 3,500 ft. Not preserved.

Distribution.—Himalayas from Nepal, *via* Sikkim, N. Bengal (Darjeeling) to Assam and Upper Burma (Myitkyina). The present would appear to be the first record from Manipur.

Family (iii) Soricidae (Shrews).

3. **Suncus caeruleus fulvocinereus** (Anderson).

(The Grey Assam Shrew.)

1877. *Crocidura* (*Pachyura*) *fulvocinereus* Anderson, *J. Asiat. Soc. Bengal* XLVI, p. 263. (Type-locality : Gauhaty, Assam.) Types in Zoological Survey of India, examined.

1881. *Crocidura* (*Pachyura*) *caeruleus*, var. *fulvocinerea*, Anderson, *Catal. Mamm. Indian Mus. Calcutta*, Pt. 1, p. 178.

1888. *Crocidura caerulea* (in part), Blanford, *Fauna Brit. India, Mamm.*, Pt. 1, p. 236.

1929. *Suncus caeruleus fulvocinereus*, Lindsay, *J. Bombay nat. Hist. Soc.* XXXII (2), p. 330.

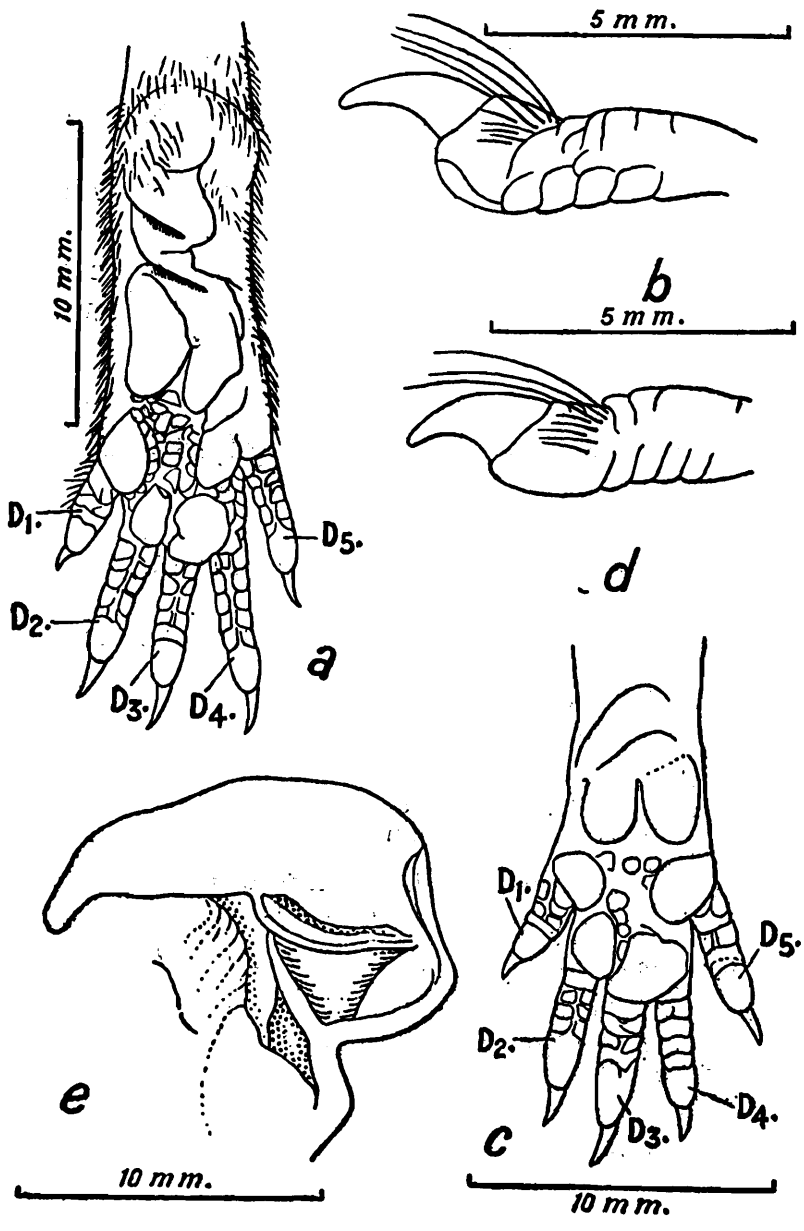
1949. *Suncus caeruleus fulvocinereus*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 74.

Material.—26 specimens were collected during June-December 1945, as follows :—(i) 25 (12 ♂♂, 11 ♀♀, 2 unsexed), collected 6-23 miles north of Imphal on Dimapur Road, Manipur, *ca.* 3,000-3,500 ft., June to end-December. Of these, 16 (Z.S.I. Registered Nos. 11,138-11,140 and 11,142-11,154) were preserved. (ii) 1 (No. 11,141) collected on road between Tamu and Kalewa, Kabaw Valley, W Burma, *ca.* 500 ft., during last week of August.

Size, etc.—16 adults (10 ♂♂, 5 ♀♀, 1 unsexed) gave the following measurements, in mm. :—Head-and-body 120-149 ; tail 65-84 ; hind foot 17-20 ; ear 9-13. (*See* Text-fig. 2.)

The mammary formula is : Th. 0+abd. 3 = 6.

Habitat.—This shrew prefers moist places such as evergreen jungle ; it is found less often in the drier areas, *e.g.*, oak scrub. Not infrequently, it occurs in human habitations, *e.g.*, army camps. For further details about its ecology, breeding, etc., *see* Roonwal (1949*c*).



TEXT-FIG. 2.—*Suncus caeruleus fulvocinereus* (And.).

Adult ♀, from Imphal Valley, Manipur, Assam, *ca.* 3,500 ft., September 1945.

(*a*) Lower view of right hind-foot, to show the pads. ×3. (*b*) Middle finger (D_3) of right hind-foot, in side view. × 6. (*c*) Lower view of right hand, to show the pads. × 3. (*d*) Middle finger (D_3) of right hand, in side view. × 6. (*e*) Left ear. × 3.

D_1—D_5, first to fifth digits.

Skull.—No other differences, except the following, are noticeable between the skulls of the two species of shrews mentioned in the present account :—

S. c. fulvocinereus : Skull larger. Development of supraoccipital crest irregular usually ill developed, though in a few specimens well developed.

S. griffithi : Skullsmaller. Supraoccipital crest prominent in all skulls.

Colour notes, etc.—The fur on the dorsum is brownish grey, on the venter paler and more greyish. Several skins have irregular tiny patches of whitish hair both above and below. The tail is coloured like the body and is swollen at the base.

The smaller specimens, some of which at least might be juveniles, are difficult to distinguish from *S. griffithi*, but, as already reported (Roonwal, 1949*c*), the following characters have helped to distinguish them from the latter :—

S. c. fulvocinereus : Paler above and below and distinctly more greyish ; venter grey with little or no brown ; tail swollen at base.

S. griffithi : Darker all over ; rich rusty brown above ; below similar but paler, with little or no grey ; tail not swollen at base.

Distribution.—Assam, including Manipur ; Kabaw Valley (Upper Chindwin District, W. Burma). Up to at least 3,500 feet altitude. The present would appear to be the first record from Manipur and the Kabaw Valley.

4. **Suncus griffithi** (Horsfield).

(The Brown Assam Shrew.)

1851. *Sorex griffithi* Horsfield, *Catal. Mamm. Mus. E. India Coy. London*, p. 134. (Type-locality : Afghanistan, *errore*=Khasi Hills, Assam, *vide* Blyth, 1863, *infra.*)

1863. *Sorex griffithi*, Blyth, *Catal. Mamm. Mus. Asiat. Soc. Bengal*, p. 83.

1877. *Crocidura* (*Pachyura*) *blythii* Anderson, *J. Asiat. Soc. Bengal* XLVI, p. 264. (Type-locality : Assam.)

1881. *Crocidura murina* (Linn.) (in part), Anderson, *Catal. Mamm. Indian Mus. Calcutta*, Pt. 1, p. 180.

1888. *Crocidura murina* (Linn.) (in part), Blanford, *Fauna Brit. India, Mamm.*, Pt. 1, p. 233.

1929. *Suncus griffithi*, Lindsay, *J. Bombay nat. Hist. Soc.* XXXIII (2), p. 333.

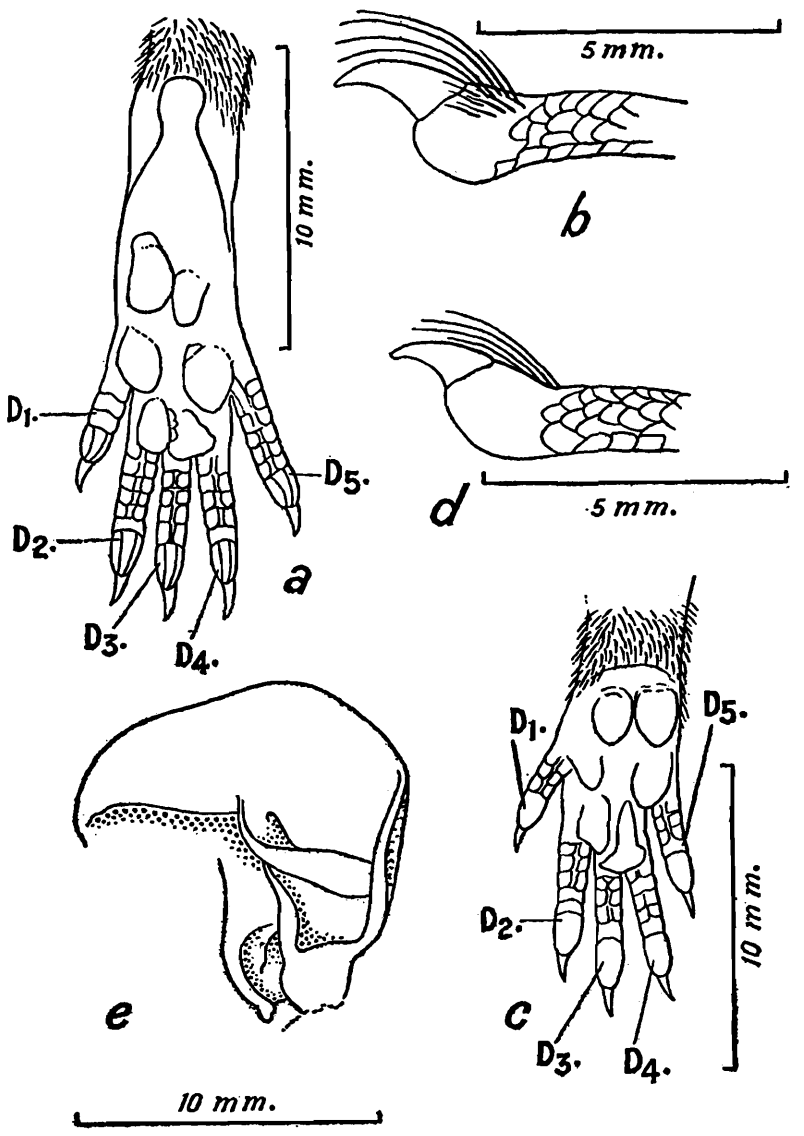
1949. *Suncus griffithi*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 76.

Material.—15 specimens were collected during July to December 1945 from Manipur (Assam) and the Kabaw Valley (W Burma), as follows :—

Manipur : 3♂♂, 8 ♀♀, 3 unsexed, collected 6-17 miles north of Imphal on Dimapur Road, *ca.* 3,500 ft., during July-December. Of these, 8 (Z.S.I. Registered Nos. 11,155-11,158 and 11,160-11,163) were preserved.

Kabaw Valley : 1 adult ♀ (Z.S.I. Registered No. 11,159), collected on road between Tamu and Kalewa, *ca.* 500 ft., in last week of August.

Size, etc.—13 adults (3 ♂♂, 9 ♀♀, 1 unsexed), gave the following measurements, in mm. :—Head-and-body 100-141 ; tail 53-72 ; hind-foot 16-19 ; ear 9-13. (*See* Text-fig. 3.)



TEXT-FIG. 3.—*Suncus griffithi* (Horsf.).

Adult, ♀ from Imphal Valley, Manipur, Assam, *ca.* 3,500 ft., October 1945.

(*a*) Lower view of right hind-foot, to show the pads. × 3. (*b*) Middle finger (D_3) of right hind-foot, in side view. × 6. (*c*) Lower view of right hand, to show the pads. × 3. (*d*) Middle finger (D_3) of right hand, in side view. × 6. (*e*) Left ear. × 3.

D_1—D_5, first to fifth digits.

The colour, skull, etc. have been discussed above under *S. caeruleus fulvocinereus*.

The mammary formula is : Th. 0 + abd. 3 = 6.

Habitat.—Like *S. caeruleus furvocinereus*, *S. griffithi* prefers moist places such as evergreen jungles ; it is semi-arboreal. For further details of its ecology and bionomics, *see* Roonwal, 1949*c*.

Distribution.—Assam, including Manipur ; Western Burma, *e.g.*, Kabaw Valley (Upper Chindwin District) and Arakan. Up to at least 3,500 feet altitude. The present would appear to be the first record from Manipur and the Kabaw Valley.

5. **Suncus** sp.

Material.—1 unsexed adult(?) (Z.S.I. Registered No. 11,326), collected by Major S. L. Kalra on 26 August 1945, on road between Tamu and Kalewa, Kabaw Valley, Western Burma, *ca.* 500 ft.

This specimen could not be satisfactorily identified. It resembles *Suncus caeruleus fulvocinereus* in body-size, etc., but is much paler, especially on the venter which is silvery hoary. The skull also differs in having the median fronto-parietal crest and the lateral occipital crests well developed, the later being wing-like. In *S. c. fulvocinereus* both these crests are generally absent, and, when present, they are but poorly developed.

Order 2. CHIROPTERA.

Family (i) PTEROPODIDAE (Flying-foxes or Fruit-bats).

6. **Pteropus giganteus leucocephalus** Hodgson.

(The Himalayan Fruit-Bat or Flying-Fox.)

1835. *Pteropus leucocephalus* Hodgson, *J. Asiat. Soc. Bengal* IV, p. 700. (Type-locality : Central region of Nepal.)

1839. *Pteropus assamensis* McClelland, *Proc. zool. Soc. London*, p. 148. (Type-locality : Assam.)

1886. *Pteropus medius*, Thomas, *Proc. zool. Soc. London*, p. 59. (One ♂ Kotschim-kooleh, Manipur, 7 April, 1881.)

1891. *Pteropus medius*, Temm. (in part), Blanford, *Fauna Brit. India. Mamm.*, Pt. 2, p. 257. And of several older authors.

1912. *Pteropus giganteus leucocephalus*, K. Andersen, *Catal. Chiroptera Brit. Mus.* (2nd ed.) I, *Megachiroptera*, p. 333.

1949. *Pteropus giganteus leucocephalus*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 77.

Material.—11 specimens (7 ♂♂, 4 ♀♀, Z.S.I. Registered Nos. 11,164-11,174) were collected from Imphal Town, Manipur, *ca.* 2,600 ft., during September to November 1945. Of these 8 (5 ♂♂, 3 ♀♀) were adults, the remainder being either juveniles or subadults.

Size, etc.—8 adults (5 ♂♂, 3 ♀♀) gave the following measurements, in mm. :—Head-and-body 219=270 ; hind-foot 117=132 ; ear 36=42 ; wing expanse 1,003=1,210.

The fur in adults is long, as shown by the following measurements (in mm.) on 4 ♂♂ and 3 ♀♀ : On mantle : ♂ 12=20, ♀ 14=16 ; on back : ♂ 11=19, ♀ 10=16 ; on abdomen : ♂ 10=17, ♀ 12=13.

Habitat.—This bat occurs in hundreds on the tall trees in the vicinity of Imphal Town, hanging on the trees during the day and leaving them and flying to nearby forests (?) at dusk.

Distribution.—Sub-himalayan region from Kulu Valley (E. Punjab) in the west, to Nepal and Assam, including Manipur. The only previous record from Manipur is of a single male from Kotschim-kooleh (Eastern Manipur), recorded by Thomas (1886, p. 59) and K. Andersen (1912, p. 335).

Order 3. CARNIVORA.

Family (i) FELIDAE (Cats).

7. **Prionailurus bengalensis bengalensis** (Kerr).

(Pennant's Leopard Cat.)

1792. *Felis bengalensis* Kerr, *Anim. Kingd.*, p. 151. (Type-locality: Southern Bengal.)

1888. *Felis bengalensis*, Blanford, *Fauna Brit. India, Mamm.*, Pt. 1, p. 78.

1918. *Felis bengalensis*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (1), p. 43.

1939. *Prionailurus bengalensis bengalensis*, Pocock, *Fauna Brit. India, Mamm.* (2nd ed.) I, p. 268.

1949. *Prionailurus bengalensis bengalensis*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 79.

Material.—1 adult ♂ (Z.S.I. Registered No. 11,175), collected on 28 November 1945 near Kanglatongbi village, about 11 miles north of Imphal on Dimapur Road, Manipur, *ca.* 3,500 ft.

Size (in mm.).—Head-and-body 465 ; tail 250 ; hind-foot 106 ; ear 46.

Habitat.—This specimen, which was the only one found, was shot at night in oak scrub. This cat is evidently less common than the Jungle Cat, *Felis chaus*.

Distribution.—Southern India, Bengal, southern Assam (including Manipur) ; and Burma to Indo-China.

8. **Felis chaus** Güldenstädt (?subspecies).

(The Jungle Cat.)

1776. *Felis chaus* Güldenstädt, *Nov. Com. Acad. Petrop.* XX, p. 483 and pls.

1949. *Felis chaus*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 79.

Material.—6 adults (2 ♂♂, 4 ♀♀) (Z.S.I. Registered Nos. 11,176—11,181), were collected from 10 November to 4 December 1945 from the Imphal Valley and immediate vicinity (up of 18 miles north of Imphal on Dimapur Road and 10 miles south-east of Imphal on Palel-Tamu Road), *ca.* 2,600=3,500 ft.

Size, colour, etc.—5 adults measured as follows, in mm :—

	H. & B.	Tl.	H.F.	E.
1♂ :	655	215	147	73
4♀♀:	506-615	232-245	110-140	64-75

An adult ♂ (No. 11,118) stood 42 mm. (*ca.* 17 in.) at the shoulders, and 390 mm. (*ca.* 15½ in.) at the hindquarters. An adult ♀ (No. 11,178) stood 363 mm. (*ca.* 14½ in.) at the shoulders. Males would appear to be slightly larger than females.

The mammary formula is : Th. 2+abd. 2 = 8.

Habitat.—This cat is very common in the Imphal Valley, roaming about at night in open country, *e.g.*, oak scrub, patches of tall grass, etc. (*See* also Roonwal, 1949*c*.)

Distribution.—It is widely distributed in Asia and North Africa. Several subspecies are recognized, but it has not been possible to satisfactorily place the Manipur specimens subspecifically.

9. Domestic Cat.

In addition to the Jungle Cat, *Felis chaus* Güld., mentioned above, 10 specimens (7 ♂♂, 3 ♀♀) of what appears to be the Domestic Cat were collected in the Imphal Valley, *ca.* 2,600=3,500 ft., during November and December 1945. All of them were shot at night in open country.

Size, etc.—7 adults measured as follows, in mm. :—

	H. & B.	Tl.	H.F.	E.
5 ♂♂:	455-540	220-280	107-125	55-60
2 ♀♀:	400-450	194-230	98-102	54-56

Systematic note.—The majority of these specimens are of the '*Felis chaus* type ' Some are close to the wild *chaus*, others close to the tabby or domestic cat common near houses all over India, and still others intermediate. All of them must be regarded as derived from the wild *Felis chaus* either by hybridisation with tabby cats, or by a process of domestication. It is noteworthy that in all cases the skulls are much broader in the zygomatic region than in the wild *Felis chaus*.

Family (ii) VIVERRIDAE (Civets).

10. Viverricula indica (Geoffroy) (?subspecies).

(The Small Indian Civet.)

1788. *Viverra malaccensis*, Gmelin, *Syst. Nat.* I, p. 92. *Nomen confusum.*

1803. *Civetta indica*, Geoffroy, *Cat. Mamm.*, p. 113. (Type-locality : Maha Oya, Eastern Province, Ceylon.)

1888. *Viverricula malaccensis*, Blanford, *Fauna Brit. India, Mamm.*, Pt. 1, p. 100. And of most older authors.

1933. *Viverricula indica*, Pocock, *J. Bombay nat. Hist. Soc.* XXXVI, p. 629.

1939. *Viverricula indica*, Pocock, *Fauna Brit. India, Mamm.*, (2nd ed.) I, p. 363.

1949. *Viverricula indica*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 81.

Material.—1 adult ♀ (Z.S.I. Registered No. 11,182) was collected on 4 December 1945 at milestone 18, south-east of Imphal on Imphal-Palel-Tamu Road, Manipur, Assam, *ca.* 3,000 ft.

Size (in mm.).—Head-and-body 483 ; tail 315 ; hind-foot 84 ; ear 36. The ♀ stood 204 mm. (*ca.* 8 in.) at the shoulders and 230 mm. (*ca.* 9 in.) at the hind-quarters.

Colour, etc.—Iris dark chocolate-grey. Nose and rhinarium dirty pale horny. Tongue pale fleshy. Mouth pinkish white. Claws pale fleshy, smoky horny at tips. Pads of hands and feet smoky pink.

The ♀ had a pair of prominent swollen scent glands situated 10 mm. below the vagina and the same distance above the anus ; each swelling was 10 mm. broad and 17 mm. high ; the median slit-like vertical opening of the gland was about 16 mm. long.

Habitat.—The specimen collected was shot at night on the road in open country in the vicinity of rice fields where it was evidently feeding. (*See* also Roonwal, 1949*c*.)

Distribution.—Whole of India, Burma and Ceylon; also extends farther east into Malaya Peninsula, Siam and Indo-China.

It is a very variable species, and several subspecies, which are difficult to distinguish, have been recognized. Two subspecies, *V i. baptistae* Pocock and *V i. thai* Kloss, are found in Assam.

Family (iii) (HERPESTIDAE) (Mungooses).

11. **Herpestes urva** (Hodgson).

(The Crab-eating Mungoose.)

1836. *Gulo urva*, Hodgson, *J. Asiat. Soc. Bengal* V, p. 238. (Type-locality; Nepal.)

1888. *Herpestes urva*, Blandford, *Fauna Brit. India, Mamm.*, Pt. 1, p. 129.

1918. *Mungos urva*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (1), p. 58.

1941. *Herpestes urva*, Pocock, *Fauna Brit. India, Mamm.* (2nd ed.) II, p. 51. (Gives full synonymy, etc.)

1949. *Herpestes urva*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 82.

Material.—1 adult ♀ (Z.S.I. Registered No. 11,183) was collected on 1 December 1945 from the hill-forest near Modbung village, about 16 miles north of Imphal, off Dimapur Road, Manipur, Assam, *ca.* 3,500 ft. (Purchased.)

Size (in mm.), *colour, etc.*—Head-and-body 400; tail 258; hind-foot 90; ear 25. Height at shoulders 215 mm. (*ca.* 8½ in.). Horizontal length of eye 13 mm. Iris brownish. Lips, tongue and tooth-gums fleshy. Rhinarium dirty pink. Hands and feet: Soles smoky with fleshy tinge; claws smoky-fleshy at base, pale horny at tips. For habitat, etc., *see* Roonwal (1949*c*.)

Distribution.—*Indian*: Nepal, Sikkim, Bhutan, Bengal Duars and Assam (including Manipur, present record). *Extra-Indian*: Burma, S. China, Formosa, Hainan Is., Malaya Peninsula, Siam and Indo-China.

Family (iv) CANIDAE (Jackals, etc.).

12. **Canis aureus indicus** Hodgson.

(The Himalayan Jackal.)

1833. *Canis aureus indicus*, Hodgson, *Asiat. Res.* XVIII, p. 237. (Type-locality: Nepal.)

1888. *Canis aureus* Linn. (in part), Blanford, *Fauna Brit. India, Mamm.* Pt. 1, p. 140.

1919. *Canis indicus indicus*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (2), p. 339.

1941. *Canis aureus indicus*, Pocock, *Fauna Brit. India, Mamm.* (2nd ed.) II p. 100.

1949. *Canis aureus indicus*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 82.

Material.—3 specimens, *e.g.*, 1 unsexed adult (Z.S.I. Registered No. 11,184) August 1945, and 2 adult ♀♀ (Nos. 11,185 and 11,186) 14 November and 4 December 1945, were collected in Imphal Valley both north and south-east of Imphal, Manipur, Assam, *ca.* 2,600-3,000 ft.

Size.—2 adult ♀♀ gave the following measurements, in mm. :— Head-and-body 675-720; tail 175-188; hind-foot 142-150; ear 73-74. Height at shoulders (No. 11,186), 483 mm. (*ca.* 19 in.).

Colour (in No. 11,186).—Iris golden brown; pupil grey; rhinarium of nose black; tongue fleshy pink. Hands and feet: Claws horny black; pads dirty grey.

Habitat.—The jackals are common in open country, *e.g.*, oak scrub, riverine scrub, riverine meadow and cultivated fields, throughout the Imphal Valley, usually roaming about at night in small packs of about 4 or 5, rarely singly. During the day they ascend the wooded hills whence they could be heard howling, several together. They were about equally common throughout the period of observation (July-December). (*See* also Roonwal, 1949*c*.)

Distribution.—N.E. India from Nepal eastward, *e.g.*, Nepal, Sikkim, Bengal, Assam; extending into Burma and S.W Siam. Up to 12,000 ft. in some parts.

Order 4. PRIMATES.

Family (i) CERCOPITHECIDAE (Macque monkeys, etc.).

13. **Macaca mulatta mulatta** (Zimmermann).

(The Indian Rhesus Macaque.)

1770. *Cercopithecus mulatta*, Zimmermann, *Geogr. Gesch. Mensch.* II, p. 195. (Type-locality: India.)

1939. *Macaca mulatta mulatta*, Pocock, *Fauna Brit. India, Mamm.*, (2nd ed.) I, p. 45.

Material, etc.—1 adult ♀ was purchased locally in October 1945, but no wild examples were seen. It measured as follows (in mm.) :— Head-and-body 460; tail 225; hind-foot 140; ear 35.

Remarks.—This ♀, which was kept in captivity, menstruated on 3rd November. The menstruatal flow lasted 3 days during which the blood discharge was moderate; there was no particular swelling or reddenning of the hind-quarters during this period.

14. **Macaca assamensis assamensis** McClelland.

(The Assamese Macaque.)

1839. *Macaca assamensis*, McClelland in Horsfield, *Proc. zool. Soc. London*, p. 148. (Type-locality: Assam.)

1879. *Macaca assamensis*, Anderson, *Anat. & Zool. Res. Two Exped. W. Yunnan*, p. 64. Re-description of the type.

1888. *Macacus assamensis*, McCl. (in part), Blanford, *Fauna Brit. India, Mamm.*, Pt. 1, p. 15.

1921. *Macaca assamensis*, Hinton and Wroughton, *J. Bombay nat. Hist. Soc.* XXVII (4), p. 669.

1932. *Macaca assemensis coolidgei* Osgood, *Field Mus. nat. Hist. Chicago (Zool.* XVIII, p. 209. (Type-locality: Hoi Xuen, Annam.)

1939. *Macaca assamensis assamensis*, Pocock, *Fauna Brit. India, Mamm.*, (2nd ed.) I, p. 53.

1941. *Macaca assamensis assamensis*, Pocock, *Fauna Brit. India, Mamm.*, (2nd ed.) II, Appendix, p. 470.

1949. *Macaca assamensis assamensis*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 83.

Material.—1 subadult ♂ (Z.S.I. No. 11,187) collected in the Imphal Valley, off milestone 129, about 4 miles north of Imphal on Dimapur Road, Manipur, Assam, *ca.* 3,000 ft. One subadult ♀, purchased at Myitkina, Burma, also examined alive.

Size.—1 subadult ♂ (Imphal) measured as follows, in mm. :—Head-and-body 410; tail 201; hind-foot 137; ear 38.

Habitat.—The above ♂ was shot from a large school (several schools?) of well over a hundred individuals inhabiting the edge of a clearing (named Lulworth Cove by the Army) in evergreen jungle at the base of a hill. Such schools frequently visited the camp kitchens, especially in the evenings—their appearance was as sudden as their disappearance into the thick wood when alarmed.

Distribution.—*India*: Assam, *e.g.*, Mishmi and Naga Hills; Manipur (present record); Bengal (?); Upper Burma. *S. E. Asia*: Tong-King and Annam. At about 2,000-6,000 ft. altitude. The only other well-established subspecies, *M. a pelops* Hodgs., inhabits the sub-Himalayan region west of the typical subspecies, *e.g.*, from Bhutan, through Sikkim and Nepal, to Mussoori (U.P.) in the west; this too occurs at about 2,000-6,000 ft. altitude.

Systematic note.—Some interesting points of difference, as noted in living specimens, between *Maccaa mulatta* (Manipur specimen) and *M. assamensis* (Manipur and Burmese specimens) may be mentioned here, particularly since the remarks in Pocock (1939; 1941) were based on preserved skins only.

The colour of subadult ♂ and ♀ of *M. assamensis* was as follows :—Dorsum rich olivaceous brown with pale grey wash; hind-parts deep rusty. Face pale fleshy (as in *M. mulatta*), but with many (4 to 5) deep, diagonal wrinkles; in *M. mulatta* these wrinkles are entirely wanting in the relaxed face, while only 3 or 4 faint ones are seen under emotional tension. Cheek whiskers dark smoky, much darker and more extensively distributed than in *M. mulatta*. Arms outside like dorsum but with less olivaceous and more grey, much darker than in *M. mulatta*; hands like arms; palms dark fleshy; nails dark horny as in *M. mulatta*. Outer sides of legs as dorsum but more rufous, the rufous decreasing towards the extremity; feet dirty grey; soles and claws as in hand. Inner sides of arms and legs and whole of venter paler than dorsum, and as in *M. mulatta*. Callosities near hind-quarters dirty pinkish

horny as in *M. mulatta*, but with no bare area around them. Hind-quarters coloured like rest of body, not red as in *M. mulatta*. Tail like dorsum, darker above than below. Fur on body slightly " felted " or " matted " ; no trace of felting in *M. mulatta*.

The direction of the hair on the head is interesting. Pocock (1939, pp. 52–53) wrote :

" The growth-direction of the head, not recorded in the living animal, is very variable in made-up skins, but typically, at all events, there is a short median parting just behind the brow-ridges, whence the hair diverges to right and left and sweeps round the sides of the crown above the ears, the rest of the hair on the crown being directed backwards. But in some skins the crown exhibits a distinct whorl, whence the hair radiates in all directions forming a kind of ' cap ' with well-defined anterior edge much resembling that of *M. nemestrina* and *M. silenus*. "

Again, Pocock (1941, p. 470) wrote that in the several preserved skins that he examined from Burma, some had the parting of hair and the whorl, and the others did not. In the two live examples examined by me, the hair-direction, contrary to what Pocock stated, was of the " brushed back" type, exactly as in *M. mulatta*, and there was not even a suggestion of either a whorl or a partition ; nor was there any cap-formation.

Order 5. RODENTIA.

Family (i) SCIURIDAE (Squirrels, etc.).

15. **Hylopetes alboniger** (Hodgson).

(The Parti-coloured Flying-Squirrel.)

1836. *Sciuropterus alboniger*, Hodgson, *J. Asiat. Soc. Bengal* V, p. 231. (Type-locality : Nepal.)

1891. *Sciuropterus alboniger*, Blanford, *Fauna Brit. India, Mamm.*, Pt. 2, p. 367.

1919. *Pteromys* (*Hylopetes*) *alboniger*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (2), p. 359.

1940. *Hylopetes alboniger*, Ellerman, *Fam. & Genera Living Rodents* I, p. 300.

1947. *Hylopetes alboniger*, Ellerman, *J. Mammal.* XXVIII (3), p. 257.

1949. *Hylopetes alboniger*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 84.

Material.—1 juvenile ♂ (Z.S.I. Registered No. 11,118) was collected on 10 December 1945 in hill-forest near Modbung, *ca.* 16 miles north of Imphal, off Dimapur Road, *ca.* 4,000 ft. (Purchased.)

Size (in mm.).—Head-and-body 196 ; tail 178 ; hind-foot 43 ; ear 32.

Distribution.—Himalayas from Nepal eastwards, including Bengal Duars (Darjeeling) and Bhutan Duars ; also southern Assam (Naga Hills, Silhet, Manipur) ; Sikkim ; W. Burma (Chin Hills and Upper Chindwin District). At about 3,000–5,000 feet altitude.

16. **Callosciurus erythraeus erythrogaster** Blyth.

(The Manipur Squirrel.)

1842. *Sciurus erythrogaster* Blyth, *J. Asiat. Soc. Bengal* XI, p. 970. (Type-locality: Manipur, Assam.)
1891. *Sciurus erythraeus* Pall. (in part), Blanford, *Fauna Brit. India, Mamm.*, Pt. 2, p. 377, No. 245.
1916. *Callosciurus erythraeus nagarum*, Thomas and Wroughton, *J. Bombay nat. Hist. Soc.* XXIV (2), p. 228. (Type-locality: Sadiya, Assam.)
1918. *Callosciurus erythraeus erythrogaster*, Robinson and Kloss, *Rec. Indian Mus.* XV, p. 197.
1919. *Callosciurus erythraeus erythrogaster*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (2), p. 369.
1940. *Callosciurus erythraeus erythrogaster*, Ellerman, *Fam. & Genera Living Rodents* I, p. 358.
1947. *Callosciurus erythraeus erythrogaster*, Ellerman, *J. Mammal.* XXVIII (3), p. 270.
1949. *Callosciurus erythraeus ?erythrogaster*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 84.

Material.—2 specimens (1 adult ♀, Coll. No. R4/24.9.45; and 1 unsexed, Coll. No. R5/2-10-45) were obtained on 24 September and 2 October 1945, off milestone 117, about 16 miles north of Imphal on Dimapur Road, Manipur, Assam, *ca.* 3,500 ft.

Size.—1 adult ♀ measured as follows, in mm.:—Head-and-body 236; tail 204; hind-foot 53; ear 23.

Habitat.—This squirrel was rare in the "Kanglatongbi Area" near Imphal, only 2 or 3 specimens having been obtained. No. R4/24-9-45 was obtained in evergreen jungle, and No. R5/2-10-45 in riverine scrub. (Also *see* Roonwal, 1949*c*.)

Distribution.—Assam, including Manipur; W. Burma.

17. **Dremomys lokriah macmillani** Thomas and Wroughton.

(Macmillan's Squirrel.)

1916. *Dremomys macmillani* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.* XXIV (2), p. 238. (Type-locality: Tatkon, on west bank of R. Chindwin near Kindat, Upper Chindwin District, Burma.)
1916. *Dremomys macmillani*, Wroughton, *J. Bombay nat. Hist. Soc.* XXIV (2), p. 306.
1916. *Dremomys macmillani*, Thomas, *J. Bombay nat. Hist. Soc.* XXIV (3), p. 418.
1916. *Dremomys macmillani*, Wroughton, *J. Bombay nat. Hist. Soc.* XXIV (4), p. 771.
1918. *Dremomys macmillani*, Robinson and Kloss, *Rec. Indian Mus.* XV, p. 236.
1919. *Dremomys macmillani*, Wroughton, *J. Bombay nat. Hist. Soc.*, XXVI (2), p. 364.
1923. *Dremomys macmillani*, Mills, *J. Bombay nat. Hist. Soc.*, XXIX (1), p. 227.
1940. *Dremomys lokriah macmillani*, Ellerman, *Fam. & Genera Living Rodents* I, p. 381.
1947. *Dremomys lokriah macmillani*, Ellerman, *J. Mammal.* XXVIII (3), p. 264.
1949. *Dremomys lokriah macmillani*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 85.

Material.—12 specimens (8 ♂♂, 3 ♀♀, 1 unsexed) were examined from 25 September to 18 December 1945, 15—16 miles north of Imphal on Dimapur Road, Manipur, Assam, *ca.* 3,500 ft. Of these, 11 (Z.S.I. Registered Nos. 11,189—11,199) were preserved.

Size, etc.—8 adults measured as follows, in mm. :—

	H. & B.	Tl.	H.F.	Ear
5♂♂:	160-210	110-160	44-47	19-21
3♀♀:	180-194	133-153	42-45	19-22

In 3 adult examples the horizontal length of the eye was about 9 mm. In 2 ♀♀, collected on 25 September and 30 November, the mammary formula was : Th. 1 + abd. 2 = 6.

Habitat.—This squirrel is common in the "Kanglatongbi area" north of Imphal. It occurs both in evergreen jungle and oak scrub, perhaps frequenting the latter association somewhat more than the former. A specimen was also trapped in riverine scrub. It is arboreal and diurnal. (Also *see* Roonwal, 1949*c*.)

Distribution.—E. Assam (Garo, Jaintia and Naga Hills, and Manipur) and W. Burma (Kabaw Valley in Upper Chindwin District, and Chin Hills). Up to about 5,000 ft. altitude.

Family (ii) MURIDAE (Rats, etc.).

18. **Bandicota bengalensis bengalensis** (Gray and Hardwicke).

(The Indian Mole-Rat.).

1833. *Arvicola bengalensis*, Gray & Hardwicke, *Illustr. Indian Zool.* II, pl. 21. (Type-locality : Bengal.)

1941. *Bandicota bengalensis bengalensis*, Ellerman, *Fam. & Genera Living Rodents* II, p. 278.

1947. *Bandicota bengalensis bengalensis*, Ellerman, *J. Mammal.* XXVIII, p. 367.

1949. *Bandicota bengalensis bengalensis*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 86.

Material.—10 specimens were obtained as follows :—9 from an area 16—22 miles north of Imphal on Dimapur Road, *ca.* 3,500 ft., during late July to early December 1945 ; and 1 from Moreh near Tamu on Manipur-Burma frontier, Upper Chindwin District, W Burma, *ca.* 500 ft., on 10 August 1945. Of these, 9 were preserved, *e.g.*, Z.S.I. Registered Nos. 11,200—11,208.

This is a very variable form in so far at least as body-size is concerned. 6 adults (4 ♂♂, 2 ♀♀) gave the following lengths (in mm.) : Head-and-body 183-204 (mean 194) ; tail 150-197 (mean 163) ; hind-foot 34-39 (mean 36·7) ; ear 22-23 (mean 22·3). The tail was 76-87%, once 108%, (mean 84%) of head-and-body ; and the hind-foot 17·3—20·5% (mean 18·7 %).

The skull is equally variable in size (Table 1*a*). It is strong and well-built and very like that of *Rattus rattus*, but larger. The mandibular knob at the basal tip of the lower incisors is only moderately developed, as is also the case in *Rattus rattus bullocki* ; it is much less developed than in the delicate skull of *Rattus manipulus* described below.

Habitat.—The mole-rat was trapped both in evergreen jungle and in oak scrub.

Distribution.—Central and Eastern India, up to W. Burma.

19. **Bandicota bengalensis ?varius** (Thomas).

(The Malay Mole-Rat.)

1907. *Gunomys varius* Thomas, *Ann. Mag. nat. Hist.* (7) XX, p. 204. (Type-locality: Georgetown, Penang, Malay.)

1947. *Bandicota bengalensis varius*, Ellerman, *J. Mammal.* XXVIII, p. 366.

1949. *Bandicota bengalensis ?varius*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 87.

Material.—1 adult ♂ (Coll. No. 597) collected on 30 August 1945 at Kalewa on R. Chindwin, W. Burma, *ca.* 360 ft. Head-and-body 224 mm.; tail 186 mm.; hind-foot 41 mm.; ear 23 mm. The specimen was not preserved; it was quite similar in coloration to *Bandicota bengalensis, bengalensis* but owing to its large size I regard it as *varius*.

20. **Rattus rattus bullocki** Roonwal.

(The Common Manipur White-bellied Rat.)

(Pl. I, Fig. 1; and Pl. II.)

1948. *Rattus rattus bullocki* Roonwal, *Proc. nation. Inst. Sci. India* XIV, p. 385. (Type-locality: 16 miles N. of Imphal on Dimapur Road, Manipur, Assam, *ca.* 3,500 ft.)

1949. *Rattus rattus bullocki*, Roonwal, *Trans. nation. Inst. Sci. India* III (2), p. 87.

A brief, preliminary description was given in Roonwal (1948, p. 385), and a fuller one is now provided.

Material.—(i) About 359 specimens were obtained during end-June to end-December 1945 from the following areas in Manipur and the adjoining parts of W. Burma, but mostly in the former area:—(*a*) 307 from "Kanglatongbi Area" up to about 22 miles north of Imphal on Dimapur Road, *ca.* 2,600—4,000 ft., (*b*) 7 from the "Palel Area" about 34—37 miles south-east of Imphal on Tamu Road, *ca.* 4,000 ft. (*c*) 37 from the "Tamu and Moreh Areas" on the Manipur frontier, W. Burma, *ca.* 580 ft.; (*d*) Kabaw Valley, Upper Chindwin District, W. Burma, especially along road from Tamu to Kalewa on R. Chindwin, *ca.* 360—580 ft. Of these, 92 were preserved either as stuffed skins or in spirit, *e.g.*, Z.S.I. Registered Nos. 11,098 and 11,209—11,300. (ii) 1 unsexed, adult (Z.S.I. Registered No. 11,347) was obtained by the Zoological Survey of India Party from Nanglea Atrow, 63 miles west of Imphal on Silchar Road, W Manipur, *ca.* 3,250 ft.

Diagnosis.

Colour.—Dorsum: Dark grey to ochraceous tawny with the grey tinge grizzled with black owing to long black hairs; with steel-blue sheen in certain lights. Ground colour more grey than tawny, especially in mid-dorsal line where a wide, diffuse black stripe is sometimes formed on lower back and rump. Fur slaty-based, with a subterminal band (2 mm. long) ochraceous tawny, and a narrower terminal tip black. With numerous soft, flattened bristles, all longer than under-fur, with basal half white and terminal half black; the longer bristles with the basal two-thirds or more whitish. Whiskers almost all black; occasionally

a few (2 or 3) of the lower whiskers being either wholely or terminally white. *Venter :* Ranging from : (i) pure white and ivory white (cream), with all hairs white to the bases, to : (ii) white, with a few hoary patches (owing to hairs having slaty bases and white tips), especially on chest, and forming a mid-ventral pectoral streak ; in addition, sometimes having irregular ochraceous to buff and yellow patches and streaks (with hair slaty-based, with ochraceous buff or yellowish tips) ; or (iii) silvery hoary with or without buff patches or streaks ; or (iv) grey or buffy grey ; this last coloration being similar to the one found in domesticated examples (*R. rattus rufescens*) ; only two such specimens found in a total of nearly 359 examined. A pure white venter tends usually to be sharply demarcated from the dorsum at the sides. *Tail :* Dark brown, unicolorous above and below ; hairs stiff, short and dark brown with paler tips ; in 2 specimens, with the extreme tip (5—20 mm. long) white all round. In length averaging subequal to head-and-body. *Hands and feet* (Pl. II, Figs. 7-10): White above, sometimes with dusky patches on the metacarpel areas ; claws pale pink ; tufts of vibrissae above claws silvery white. *Ears* (Pl. II, Fig. 11) : Dusky grey outside ; paler, with pink tinge inside, darker towards edges.

Size, etc.—111 adults (about half males, half females) gave the following lengths (in mm.) of the body-parts :—Head-and-body 148—197 (mean 172) ; tail 130—216 (mean 172) ; hind-foot 28—36 (mean 32) ; ear 15—26 (mean 21). Considered as percentages of head-and-body, these lengths are : Tail 72—127% (mean 100·4 %) ; hind-foot 12—22% (mean 18%) ; ear 10—15% (mean 13%). In the 7 specimens from Tamu and Moreh in the Kabaw Valley, the tail averages slightly larger (107% of hand-and-body length).

The eyes are large, measuring about 7·25×5·0 mm. in horizontal and vertical lengths respectively, or about 4·26 %×2·94% of the head-and-body length. The mammary formula is mostly th. 3 + abd. 3=12 (35 examples) ; and occasionally with 11 teats (2 examples), one of the thorocic teats of one side being absent ; and 2+ 3 = 10 (3 examples). Breeding examples were found in August-November. Further details of the ecology of this rat, *e.g.*, habitat preferences, food, etc., will be found in Roonwal (1949*c*).

Skull (Table 1*b* ; and Pl. II, Figs. 1—6).—The skull is typical of the wild forms of the *Rattus rattus* group. Twenty-six adult skulls (13♂♂, 13♀♀) gave the following measurements (in mm.) : Greatest length 36·2—42·0 (mean 38·7) ; condylobasal length 35·4—41·3 (mean 38·1) ; occipitonasal length 37·0—43·5 (mean 40·3) ; greatest zygomatic width 18·9—21·0 (mean 19·9) ; least interorbital width 5·3—6·6 (mean 5·95) ; cranial width 15·3—16·7 (mean 15·9) ; occipital width 13·4—15·1 (mean 14·5) ; median depth of occiput 8·7—10·4 (mean 9·4) ; post-molar length 15·6—18·7 (mean 17·1) ; auditory length 9·3—11·2 (mean 10·1) ; length of tympanic bulla 6·6—7·7, once 8·5 (mean 7·2) ; length of nasals 12·2—16·7 (mean 15·2) ; greatest combined width of nasals 3·6—4·9 (mean 4·2) ; palatal length 16·6—20·5 (mean 18·5) ; length of diastema 8·9—12·7 (mean 10·4) ; length of anterior palatine foramina 6·2—8·0 (mean 7·2) ; greatest combined width of anterior palatine foramina 2·0—2·8, once 3·4 (mean 2·4) ; length of upper molar

crowns 6·2—7·5 (mean 6·9); mandibular length 20·2—24·0 (mean 22·1). The tympanic bulla is 17·0—18·7%, once 15·5% and 19·7% (mean 17·9%) of the occipitonasal length. The upper incisors are bent backwards (opisthodont).

Types.—Deposited in the Zoological Survey of India Collections. *Holotype* (Pl. I, Fig. 1; and Pl. II, Figs. 1-6): Z.S.I. Registered No. 11,228. Original Collector's No. FL1/4·8-45. Adult ♀; stuffed skin, with separate skull. Collected on 4th August 1945 by Major M. L. Roonwal in evergreen jungle near milestone 117, about 16 miles north of Imphal on Dimapur Road, Manipur, *ca.* 3,500 ft. Head-and-body 166 mm.; tail 167 mm.; hind-foot 33 mm.; ear 21 mm. Mammae 3 + 3 = 12. Dorsum ochraceous tawny with grey tinge, especially at the sides. Venter white, with a mid-ventral pectoral streak of grey tinged with buff. Skull measurements (in mm.): Greatest length 40·5; condylobasal length 38·1; occipitonasal length 41·3; greatest zygomatic width 21·0; least interorbital width 6·1; cranial width 16·5; occipital width 15·1; median depth of occiput 9·8; post-molar length 17·4; auditory length 10·4; length of tympanic bulla 7·4; length of nasals 15·6; combined width of nasals 4·7; length of diastema 12·7; length of anterior palatine foramina 7·5; greatest combined width of anterior palatine foramina 2·3; length of upper molars 6·8; mandibular length 23·1. Upper incisors opisthodont. Tympanic bulla 17·9% of occipitonasal length.

Paratypes: All stuffed skins of adults, with separate skulls; collected from the type-locality. Z.S.I. Registered Nos. 11,230 (♂), 11,253 (♀) 11,274 (♂), 11,286 (♂), 11,291 (♀).

Habitat.—*See* Roonwal, 1949*c*, pp. 87-99.

Distribution.—Known mostly from central Manipur, *e.g.*, the Imphal Valley and the surrounding hills up to about 22 miles north of Imphal along Dimapur Road and about 37 miles south-east of Imphal along Tamu Road. One specimen examined from Nanglea Atrow (W. Manipur). Upto *ca.* 4,000 ft. altitude. Specimens from Tamu, Moreh and Kalewa (Kabaw Valley, W. Burma) differing only slighty, having rather longer tails (107% of head and-body), and may be intermediate between *bullocki* Roon. and *khyensis* Hint.

Comparisons.—*R. r. bullocki* is closely allied to the following five subspecies: *khyensis* Hint., *tatkonensis* Hint., *tikos* Hint., *tistae*[1] Hint. and *brunneusculus* Hodgs. (syn. *sikkimensis* Hint.); of these it is closest, both geographically and otherwise, to the first two. It, can however, be separated by the key given below. The head-and-body in *bullocki* is the longest, and the tail proportionately the shortest, being, on the average, subsequal ((100·4%) to head-and-body. Ellerman (1947*d*, p. 380) assigns specimens from the Manipur Valley (Bishenpur and Lake Loktak, *i.e.*, within about 40 miles of the area where *R. r. bullocki* were obtained) to two subspecies, *brunneusculus* Hodgs. (syn. *sikkimensis* Hint.) and *tistae* Hint., but I think that they may prove to be *bullocki*.

[1]Ellerman (1947*d*, p. 380) puts *tistae* among the dark-bellied forms, whereas Hinton (1918) in his original description and key stated that it is primarily white-bellied, only about a third of the specimens having a dark venter.

***Key** to some subspecies of* Rattus rattus *from Eastern India and Burma.*
(Average measurements are given.)

1. (4.) Size larger; head-and-body length over 160 mm.
2. (3.) Tail length short, being 100% of head-and-body; not infrequently shorter than head-and-body. Hind-foot length 18% of head-and-body. Tympanic bullae moderately large (length 7·2 mm., or 17·9% of occipitonasal length). Mammae mostly 3+3=12; rarely less. Dorsal colour dark grey to ochraceous tawny with pronounced grey tinge. Venter white or ivory cream, often with streaks or patches of grey, yellow or buff.

   1. *R. r. bullocki* Roon.

3. (2). Tail longer, 110-120% of head-and-body. Hind-foot 19-20% of head-and body. Bullae larger (length averaging 7·5-8·4 mm., or 18·5-20% of occipitonasal length.) Mammae mostly 3+3=12. Dorsal colour bright or dull rusty red with some grey. Venter white or cream, sometimes with slaty streaks. 2. *R. r. khyensis* Hint. 3. *R. r. tatkonensis* Hint.
4. (1.) Size smaller; head-and-body length below 160 mm. (5.)
5. (6.) Tail shorter, 108% of head-and-body. Hind-foot 21% of head-and-body. Mammae tend to reduction in many specimens, 10-12 in number. Dorsal colour dull umber brown, with darker hairs; venter as in *khyensis.*

   4. *R. r. tikos* Hint.

6. (5.) Tail longer 123-131% of head-and-body. Hind-foot 21-22·5% of head-and-body. Dorsal colour dark olive-brown. Venter white or cream, in some individuals of *tistae* suffused with slaty or buff either wholely or in patches or streaks. Mammae tend to be fewer in *tistae* (2+8=10); the normal 12 in *brunneusculus.*

   5. *R. r. tistae* Hint.

   6. *R. r. brunneusculus* Hodgs. (syn. *sikkimensis* Hint.)

21. Rattus rattus ?khyensis Hinton.

1919. *Rattus rattus khyensis* Hinton, *J. Bombay nat. Hist. Soc.* XXVI (2), p. 398. (Type-locality: 25 miles W. of Kindat, Chin Hills, W. Burma, 600 ft.)

1941. *Rattus rattus khyensis,* Ellerman, *Fam. & Gen. Living Rodents* II, p. 176.

1947. *Rattus rattus khyensis,* Ellerman, *J. Mammal.* XXVIII, p. 380.

Material.—3 specimens (1 ad. ♂, 1 ad. ♀, 1 unsexed subad.?, *e.g.,* Z.S.I. Registered Nos. 11,318—11,320), collected by Major S. L. Kalra on 28 August 1945 from Kalewa on R. Chindwin, W. Burma, *ca.* 360 ft.

Size, colour, etc.—The 2 adults measure as follows (in mm.): Head-and-body 141—162; tail 155—165 (or 101—110% of head-and-body); hind-foot 30-32. The coloration above is more dull and colder than in *R. r. bullocki* Roon. already described. The venter is pure white; the feet white above, and the tail dark brown throughout. The specimens having been obtained in the hot season, the fur in the adults is coarse and mixed with spines. The mammary formula in No. 11318 is: Th. 2 + abd. 3 = 10.

Skull.—The skull measurements are given in Table 1*c.* The length of the tympanic bullae is 6·7—7·9 mm. or 18—19·2% of the occipitonasal length.

Distribution.—Western portion of Upper Burma, and Central Burma (Ellerman, 1947*d*).

TABLE

Skull-measurements, in mm., of some Muridae (Rodentia) of the genera
Figures within brackets are percentages of the occipitonasal length.
of adults.

Abbreviations.—(*i*) *State of wear of molars* : H, *half worn out* ; M,
incisor ' index ' : Opi., *opisthodont (bent backward)* ; Ort., *orthodont*

Registered Number (Z.S.I.)	Collection Number	Locality	Sex	Age. (State of wear of molars.)	Upper incisor "index"	Greatest length 1	Condylobasal length 2

(*a*)—*Bandicota bengalensis*

11,200	FL1/25-7-45	Nr. Imphal	♂	S	*Opi.*	42·5	42·0
11,201	FL6/25-7-45	Nr. Imphal	♂	H	,,	45·3	44·5
11,203	FL6/26-7-45	Nr. Imphal	♂	S	,,	42·8	42·5
11,205	R6/9-10-45	Nr. Imphal	♂	S	,,	—	—
11,206	R5/27-10-45	Nr. Imphal	♂	H	,,	41·1	40·0
11,207	R1/12-11-45	Nr. Imphal	♂	S	,,	40·7	40·2
11,202	FL4/26-7-45	Nr. Imphal	♀	M	,,	42·4	41·8
		Number of samples				6	6
		Range				40·7-45·3	40·0-44·5
		Mean				**42·5**	**41·8**

(*b*)—*Rattus rattus bullocki* Roonwal. (13 ♂♂, 13 ♀♀. All from " Kangla
dont in all.).

Number of samples		25	24
Range		36·2-42·0	35·4-41·3
Mean		**38·7**	**38·1**

(*c*)—*Rattus rattus*

11,320	K3/28-8-45	Kalewa, W. Burma.	♂	S	*Opi.*	40·4	40·0
11,318	K1/28-8-45	Kalewa, W. Burma.	♀	N	,,	36·2	35·2
11,319	K2/28-8-45	Kalewa, W. Burma.	(?)	N	,,	36·6	35·3

1(*a-l*).

Bandicota, Rattus *and* Hadromys *from Assam and W Burma. All measurements, except when otherwise stated* (e.g., '*subadults*'), *are*

much worn out ; N, *not worn out* ; S, *slightly worn out.* (*ii*) *Upper* (*straight or vertical*) ; Pro., *proodont* (*bent forward*).

Occipitonasal length	Greatest zygomatic width	Least interorbital width	Cranial width	Occipital breadth	Med. depth of occiput	Post-molar length	Auditory length
3	4	5	6	7	8	9	10

bengalensis (Gr. & Hardw.).

44·6	20·1	6·1	16·6	15·0	10·1	19·3	10·8
45·8	21·5	6·3	16·8	15·4	10·7	20·4	11·1
44·4	20·0	6·2	16·6	14·9	10·5	19·7	10·6
—	—	—	17·4	15·7	10·5	—	10·8
42·2	—	6·5	16·5	14·5	10·0	18·5	10·2
42·0	—	6·2	16·8	14·6	9·8	18·0	9·9
44·2	21·3	6·5	17·1	15·0	10·5	19·4	10·5
6	4	6	7	7	7	6	7
42·0-45·8	20·0-21·5	6·1-6·5	16·5-17·4	14·5-15·7	9·8-10·7	18·0-20·4	9·9-11·1
43·9	**20·7**	**6·3**	**16·8**	**15**	**10·3**	**19·2**	**10·6**

tongbi area " near Imphal, Central Manipur. Upper incisors opistho-

22	4	26	24	19	21	26	24
37·0-43·5	18·9-21·0	5·3-6·6	15·3-16·7	13·4-15·1	8·7-10·4	15·6-18·7	9·3-11·2
40·3	**19·9**	**5·95**	**15·9**	**14·5**	**9·4**	**17·1**	**10·1**

?khyensis Hinton.

41·2	19·4	5·9	16·5	14·6	9·2	18·1	10·9
37·2	—	5·3	16·1	14·2	8·9	15·6	9·5
37·4	17·2	5·8	15·6	13·8	9·1	15·5	9·6

TABLE 1(*a-l*)—

Registered Number (Z.S.I.)	Collection Number	Locality	Sex	Age, (State of wear of molars.)	Upper incisor "index"	Length of tympanic bulla	Length of nasals
						11	12

(*a*)—*Bandicota bengalensis*

11,200	FL1/25-7-45	Nr. Imphal	♂	S	*Opi.*	6·6	17·8
11,201	FL6/25-7-45	Nr. Imphal	♂	H	,,	7·0	18·0
11,203	FL6/26-7-45	Nr. Imphal	♂	S	,,	6·4	18·2
11,205	R6/9-10-45	Nr. Imphal	♂	S	,,	7·4	19·5
11,206	R5/27-10-45	Nr. Imphal	♂	H	,,	7·4	15·8
11,207	R1/12-11-45	Nr. Imphal	♂	S	,,	6·7	16·4
11,202	FL4/26-7-45	Nr. Imphal	♀	M	,,	6·8	17·7
		Number of samples				7	7
		Range .			.	6·4-7·4	15·8-19·5
		Mean				**6·9**	**17·6**

(*b*)—*Rattus rattus bullocki* Roonwal (*contd.*). (13 ♂♂, 13♀♀. All from opisthodont in all.)

Number of samples	25	22
Range .	6·6-7·7 (once 8·5)	12·2-16·7
Mean	**7·2**	**15·2**

(*c*)—*Ruttus rattus*

11,320	K3/28-8-45	Kalewa, W. Burma.	♂	S	*Opi.*	7·9	15·3
11,318	K1/28-8-45	Kalewa, W. Burma.	♀	N	,,	6·7	13·9
11,319	K2/28-8-45	Kalewa, W. Burma.	(?)	N	,,	6·9	13·6

continued.

Gr. comb. width of nasals	Palatal length	Length of diastema	Length of ant. palatine foramina	Gr. comb. width of ant. palatine foramina	Length of upper molar crowns	Mandibular length
13	14	15	16	17	18	19

bengalensis (Gr. & Hardw.) (*contd.*).

5·0	—	11·8	8·2	2·6	6·2	24·2
5·0	22·0	12·8	8·5	2·8	7·2	25·0
5·0	20·7	12·0	8·0	2·6	6·8	23·9
5·3	—	11·7	8·0	3·1	7·0	25·1
4·4	19·6	11·0	7·7	2·6	6·9	22·9
4·7	20·5	10·7	8·0	2·7	7·0	22·8
4·9	20·8	12·1	7·9	2·7	6·6	24·0
7	5	7	7	7	7	7
4·4-5·3	19·6-22·0	10·7-12·8	7·7-8·5	2·6-3·1	6·2-7·2	22·8-25·1
4·99	**20·6**	**11·7**	**8**	**2·7**	**6·8**	**24**

" Kanglatongbi area " near Imphal, Central Manipur. Upper incisors

25	19	25	26	26	25	24
3·6-4·9	16·6-20·5	8·9-12·7	6·2-8·0	2·0-2·8 (once 3·4)	6·2-7·5	20·2-24·0
4·2	**18·5**	**10·4**	**7·2**	**2·4**	**6·86**	**22·06**

?khyensis Hinton (*contd.*).

4·5	19·6	10·2	7·8	2·1	7·3	22·2
4·5	—	9·2	6·6	2·2	6·8	20·7
4·0	16·3	9·0	6·4	2·0	7·1	20

TABLE 1(*a-l*)—

Registered Number (Z.S.I.)	Collection Number	Locality	Sex	Age. (State of wear of molars.)	Upper incisor "index"	Length of tympanic bulla	Length of nasals.
						1	2

(*d*)—*Rattus rattus* (? subspecies). Grey-bellied. Probably close to

11,316	FL11/25-7-45	C. Manipur	(?)	S	*Opi.*	39·2	38·7
11,317	FL19/25-7-45	C. Manipur	♀	S	,,	34·8	34·1
11,321	602/2-9-45	E. Manipur, nr. Tamu.	♂	S	,,	37·2	36·1

(*e*)—*Rattus nitidus*

11,340	—	W. Manipur	♂	S	*Opi.*	35·9	35·0
11,322	R3/8-12-45	Nr. Imphal (C. Manipur)	♂ (subad.?)	S	*Opi.*	—	—

(*f*)—*Rattus manipulus*

11,307	R1/19-10-45	C. Manipur	♂ subad.	N	*Pro.*	—	—
11,309	R1/3-11-45	C. Manipur	,,	N	,,	34·7	34·3
11,312	R1/7-12-45	C. Manipur	,,	N	,,	34·1	33·7
11,303	R1/25-8-45	C. Manipur	♀	M	,,	38·5	38·1
11,304	R1/11-9-45	C. Manipur	♂	M	,,	40·0	40·0
11,311	R1/3-12-45	C. Manipur	♂	N	,,	37·1	36·5
Adults only	Number of samples					3	3
	Range					37·1-40·0	36·5-40·0
	Mean					38·5	38·2

continued.

Occipitonasal length	Greatest zygomatic width	Least interobital width	Cranial width	Occipital breadth	Med. depth of occiput	Post-molar length	Auditory length
3	4	5	6	7	8	9	10

R. r. bullocki Roonwal and *R. r. khyensis* Hinton.

40·0	18·7	5·7	16·3 (40·8%)	14·8 (37%)	9·6 (24%)	17·6 (44%)	9·7
35·8	—	5·6	16·0 (44·7%)	14·4 (40·2%)	9·0 (25·1%)	15·8 (44·1%)	9·3
38·6	—	5·9	16·8 (43·5%)	14·5 (37·6%)	9·0 (23·3%)	15·8 (40·9%)	9·4

obsoletus Hinton.

37·2	—	5·5	15·9	14·5 (39%)	8·7	15·2 (40·1%)	8·9
—	—	—	—	14·2	8·9	—	9·0

manipulus (Thomas). Upper incisors slightly proodont.

—	—	6·6	14·9	14·2	10·2	14·7	8·8
35·6	—	6·7	15·7	14·5	10·5	15·3	9·0
—	—	6·3	14·9	13·9	10·0	15·2	9·1
—	—	6·9	15·8	—	11·2	17·2	9·4
41·3	21·1	6·7	15·7	14·4	11·0	18·0	10·1
38·0	19·6	6·5	15·7	14·1	10·1	16·4	9·0
2	2	3	3	2	3	3	3
38·0-41·3	19·6-21·1	6·5-6·9	15·7-15·8	14·1-14·4	10·1-11·2	16·4-18·0	9·0-10·1
99·7	**20·4**	**6·7**	**15·7**	**14·3**	**10·8**	**17·2**	**9·5**

TABLE 1(*a-l*)—

Registered Number (Z. S. I.)	Collection Number	Locality	Sex	Age. (State of wear of molars.)	Upper incisor "index"	Length of tympanic bulla	Length of nasals
						11	12

(*d*)—*Rattus rattus* (? subspecies) (*contd.*). Grey-bellied. Probably

11,316	FL11/25-7-45	C. Manipur	(?)	S	*Opi.*	6·6 (16·5%)	15·3 (38·3%)
11,317	FL19/25-7-45	C. Manipur	♀	S	,,	6·5 (18·2%)	13·3 (37·2%)
11,321	602/2-9-45	E. Manipur, nr. Tamu.	♂	S	,,	6·4 (16·7%)	15·7 (40·7%)

(*e*)—*Rattus nitidus*

11,340	—	W. Manipur	♂	S	*Opi.*	6·2 (16·7%)	15·0 (40·3%)
11,322	R3/8-12-45	Nr. Imphal (C. Manipur).	♂ (subad.?)	S	*Opi.*	6·5	13·7

(*f*)—*Rattus manipulus*

11,307	R1/19-10-45	C. Manipur	♂ subad.	N	*Pro.*	5·7	—
11,309	R1/3-11-45	C. Manipur	,,	N	,,	6·0	13·8
11,312	R1/7-12-45	C. Manipur	,,	N	,,	5·8	—
11,303	R1/25-8-45	C. Manipur	♀	M	,,	6·2	—
11,304	R1/11-9-45	C. Manipur	♂	M	,,	6·0	17·8
11,311	R1/3-12-45	C. Manipur	♂	N	,,	6·0	15·5
Adults only	Number of samples					3	2
	Range					6·0-6·2	15·5-17·8
	Mean					6·1	16·7

continued.

Gr. comb. width of nasals	Palatal length	Length of diastema	Length of ant. palatine foramina	Gr. comb. width of ant. palatine foramina	Length of upper molar crowns	Mandibular length
13	14	15	16	17	18	19

close to *R. r. bullocki* Roonwal and *R. r. khyensis* Hinton.

4·6 (11·5%)	19·1 (47·8%)	11·1 (27·8%)	7·8 (19·5%)	3·0	6·6 (16·5%)	21·6
4·2 (11·7%)	17·4 (48·6%)	9·7 (27·2%)	6·7 (18·7%)	2·4	6·4 (17·9%)	19·6
4·5 (11·7%)	—	10·2 (26·4%)	6·6 (17·3%)	2·4	6·7 (17·4%)	20·4

obsoletus Hinton (*contd.*).

4·4 (11·8%)	17·6 (47·3%)	9·6 (25·8%)	6·2 (16·7%)	2·2	6·6 (17·7%)	20·7
4·0	—	9·1	6·7	—	6·5	—

manipulus (Thomas) (*contd.*). Upper incisors slightly proodont.

—	17·1	10·7	6·5	2·2	5·7	21·2
3·6	—	11·0	6·2	2·2	6·1	21·0
	17·5	11·6	6·5	2·2	5·9	21·1
—	18·8	13·0	7·5	2·5	5·4	—
4·6	19·9	14·1	7·9	2·5	5·7	23·6
4·0	18·5	12·1	8·0	2·0	5·9	22·7
2	3	3	3	3	3	2
4·0-4·6	18·5-19·9	12·1-14·1	7·5-8·0	2·0-2·5	5·4-5·9	22·7-23·6
4·3	**18·7**	**13·1**	**7·8**	**2·3**	**5·7**	**23·2**

TABLE 1(*a-l*)—

Registered Number (Z.S.I.)	Collection Number	Locality	Sex	Age. (State of wear of molars.)	Upper incisor "index"	Greatest length	Condylobasal length
						1	2

(*g*)—*Rattus manipulus kekrimus* Roonwal. From Kekrima, Naga Hills

11,342	1	Naga Hills	♂	S	*Pro.*	36·2	35·6
11,341 (Holotype)	2	Naga Hills	♂	M	,,	39·8	38·7
11,343	3	Naga Hills	♂	S	,,	36·6	36·0
11,344	4	Naga Hills	♀	H	,,	37·5	37·1
		Number of samples				4	4
		Range				36·2-39·8	35·6-38·7
		Mean				**37·5**	**36·9**

(*h*)—*Rattus bowersii*

10,078 (Holotype)	—	Kakhyan Hills (S. Yunnan).	♀	H	*Orth.*	52·2	50·5

(*i*)—*Rattus bowersii*

11,345	—	W. Manipur	♂	M	*Orth.*	48·2	47·2
11,346	—	W. Manipur	♂	H	,,	47·1	46·8

(*j*)—*Rattus niviventer*

11,130	R2/11-9-45	C. Manipur	♂	—	*Opi.*	36·2	35·5

continued.

Occipitonasal length	Greatest zygomatic width	Least interobital width	Cranial width	Occipital breadth	Med. depth of occiput	Post-molar length	Auditory length
3	4	5	6	7	8	9	10

Assam. Upper incisors slightly proodont.

—	19·4	6·4	14·8	13·1	9·8	15·5	9·0
40·2	—	6·4	15·2	—	10·5	17·1	—
—	—	6·4	15·6	14·1	10·2	15·0	8·6
37·9	—	6·6	—	—	10·5	16·4	—
2	1	4	3	2	4	4	2
37·9-40·2	19·4	6·4-6·6	14·8-15·6	13·1-14·1	9·8-10·5	15·0-17·1	8·6-9·0
39·1	**19·4**	**6·5**	**15·2**	**13·6**	**10·3**	**16·5**	**8·8**

bowersii (Anderson).

53·5	—	8·0	21·1	19·6	13·3	21·5 (40·2%)	12·5

mackenziei (Thomas).

50·2	—	7·5	18·8	16·6	12·8	20·3 (40·4%)	11·1
48·8	24·4	7·5	19·5	17·0	13·0	20·2 (41·4%)	11·0

niviventer Hodgson.

37·5	16·1 (42·9%)	6·1	14·5 (38·7%)	12·2	8·0 (21·3%)	15·6	8·4

TABLE 1(*a-l*)—

Registered Number (Z.S.I.)	Collection Number	Locality	Sex	Age. (State of wear of molars.)	Upper incisor "index"	Length of tympanic bulla	Length of nasals.
						11	12

(*g*)—*Rattus manipulus kekrimus* Roonwal (*contd.*). From Kekrima,

11,342	1	Naga Hills	♂	S	*Pro.*	5·8	—
11,341 (Holotype).	2	Naga Hills	♂	M	,,	—	—
11,343	3	Naga Hills	♂	S	,,	5·8	—
11,344	4	Naga Hills	♀	H	,,	—	15·4
		Number of samples				2	1
		Range				5·8	15·4
		Mean				**5·8**	**15·4**

(*h*)—*Rattus bowersii*

10,078 (Holotype).	—	Kakhyan Hills (S., Yunnan).	♀	H	*Orth.*	8·3 (15·5%)	20·6 (38·5%)

(*i*)—*Rattus bowersii*

11,345	—	W. Manipur	♂	M	*Orth.*	6·6 (13·1%)	20·5 (40·8%)
11,346	—	W. Manipur	♂	H	,,	6·5 (13·3%)	19·7 (40·4%)

(*j*)—*Rattus niviventer*

11 130	R2/11-9-45	C. Manipur	♂	—	*Opi.*	5·2 (13·9%)	13·8 (36·8%)

continued.

Gr. comb. width of nasals	Palatal length	Length of diastema	Length of ant. palatine foramina	Gr. comb. width of ant. palatine foramina	Length of upper molar crowns	Mandibular length
13	14	15	16	17	18	19

Naga Hills, Assam. Upper incisors slightly proodont.

—	18·3	12·0	6·7	1·7	6·3	—
—	19·8	13·7	7·4	2·3	6·0	23·8
—	19·2	12·4	7·1	1·8	6·4	22·0
4·0	18·8	12·2	7·0	2·2	6·4	—
1	4	4	4	4	4	2
4·0	18·3-19·8	12·0-13·7	6·7-7·4	1·7-2·3	6·0-6·4	22·0-23·8
4·0	**19**	**12·6**	**7·1**	**2·0**	**6·3**	**22·9**

bowersii (Anderson) (*contd.*).

5·2 (9·7%)	25·1 (46·9%)	16·6 (31%)	9·0 (16·8%)	—	8·2 (15·3%)	31·1

mackenziei (Thomas) (*contd.*).

5·0 (10%)	23·8 (47·4%)	15·6 (31·1%)	9·4 (18·7%)	2·7	7·9 (15·7%)	28·2
5·5 (11·3%)	23·1 (47·9%)	14·6 (29·9%)	9·2 (18·9%)	3·0	8·4 (17·2%)	28·6

niviventer (Hodgson) (*contd.*).

4·0 (10·7%)	16·6 (44·3%)	10·0	6·5 (17·3%)	2·5	5·6	18·2

TABLE 1(*a-l*)—

Registered Number (Z.S.I.)	Collection Number	Locality	Sex	Age. (State of wear of molars.)	Upper incisor "index"	Greatest length	Condylobasal length
						1	2

(*k*)—*Rattus*

11,126	FL3/25-7-45	C. Manipur	♂	M	*Opi.*	36·5	35·5
11,131	R1/25-12-45	C. Manipur	♂	H	,,	38·3	37·1
11,127	FL4/25-7-45	C. Manipur	♀	H	,,	36·0	35·0
11,128	FL1/3-8-45	C. Manipur	♀	M	,,	35·1	33·6
11,129	R6/29-10-45	C. Manipur	♀	M	,,	35·7	34·6
		No. of samples				5	5
		Range				35·1-38·3	33·6-37·1
		Mean				**36·3**	**35·2**

(*l*)—*Hadromys*

11,116	R1/14-11-45	C. Manipur	♂	H	*Opi.*	31·8	31·0
11,117	R3/18-12-45	C. Manipur	♂	S	,,	29·5	28·4
11,132	FL4/27-7-45	C. Manipur	♂	H	,,	31·9	30·5
11,112	K1/17-9-45	C. Manipur	♀	S	,,	29·7	28·6
		No. of samples				4	4
		Range				29·5-31·9	28·4-31·0
		Mean				**30·7**	**29·6**

continued.

Occipitonasal length	Greatest zygomatic width	Least interobital width	Cranial width	Occipital breadth	Med. depth of occiput	Post-molar length	Auditory length
3	4	5	6	7	8	9	10

mentosus Thomas.

37·3	—	6·0	14·7	12·4	8·7	15·8	8·1
39·7	—	6·2	15·7	12·7	8·8	16·5	7·6
37·0	16·5	5·8	14·6	12·3	8·7	15·6	7·9
37·3	17·0	6·0	15·2	13·0	8·6	15·0	8·0
36·5	—	6·4	—	12·7	8·5	15·5	8·6
5	2	5	4	5	5	5	5
36·5-39·7	16·5-17·0	5·8-6·4	14·6-15·7	12·3-13·0	8·5-8·8	15·0-16·5	7·6-8·6
37·6	**16·8** (44·7%)	**6·1**	**15·1** (40·2%)	**12·6** (12·2%)	**8·7** (23·1%)	**15·7**	**8·04**

humei (Thomas).

32·3	—	5·2	12·7	—	7·8	13·8	—
—	—	4·6	12·6	—	6·8	12·6	7·0
32·3	15·9	4·7	13·0	12·4	8·4	13·3	7·7
30·8	14·9	4·6	12·4	11·2	7·4	12·6	7·2
3	2	4	4	2	4	4	3
30·8-32·3	14·9-15·9	4·6-5·2	12·4-13·0	11·2-12·4	6·8-8·4	12·6-13·8	7·0-7·7
31·8	**15·4**	**4·8**	**12·7**	**11·8**	**7·5**	**13·1**	**7·3**

TABLE 1(*a-l*)—

Registered Number (Z. S. I.)	Collection Number	Locality.	Sex	Age. (State of wear of molars.)	Upper incisor "index"	Length of tympanic bulla	Length of nasals
						11	12

(*k*)—*Rattus*

11,126	FL3/25-7-45	C. Manipur	♂	M	*Opi.*	4·7	14·5
11,131	R1/25-12-45	C. Manipur	♂	H	,,	4·9	15·5
11,127	FL4/25-7-45	C. Manipur	♀	H	,,	4·5	14·5
11,128	FL1/3-8-45	C. Manipur	♀	M	,,	4·7	14·6
11,129	R6/29-10-45	C. Manipur	♀	M	,,	4·7	14·5
		No. of samples				5	5
		Range				4·5-4·9	14·5-15·5
		Mean				**4·7** (12·5%)	**14·7** (39·1%)

(*l*)—*Hadromys*

11,116	R1/14-11-45	C. Manipur	♂	H	*Opi.*	—	10·0
11,117	R3/18-12-45	C. Manipur	♂	S	,,	4·8	—
11,132	FL4/27-7-45	C. Manipur	♂	H	,,	5·1	11·5
11,112	K1/17-9-45	C. Manipur	♀	S	,,	4·8	10·3
		No. of samples				3	3
		Range				4·8-5·1	10·0-11·5
		Mean				**4·9**	**10·6**

continued.

Gr. comb. width of nasals	Palatal length	Length of diastema	Length of ant. palatine foramina	Gr. comb. width of ant. palatine foramina	Length of upper molar crowns	Mandibular length
13	14	15	16	17	18	19

mentosus Thomas (*contd.*).

4·5	15·4	9·1	5·5	2·5	5·5	18·7
4·4	16·7	9·4	5·8	2·7	6·4	19·0
4·2	15·2	9·0	—	2·5	5·7	19·6
4·0	15·0	9·6	6·5	2·5	5·6	19·0
4·5	15·6	9·5	5·7	2·5	5·7	19·0
5	5	5	4	5	5	5
4·0-4·5	15·0-16·7	9·0-9·6	5·5-6·5	2·5-2·7	5·5-6·4	18·7-19·6
4·4 (11·7%)	**15·6** (40·2%)	**9·3**	**5·9** (15·7%)	**2·5**	**5·8**	**19·2**

humei (Thomas) (*contd.*).

—	—	7·9	—	—	5·4	18·5
—	13·6	7·6	5·7	1·1	5·1	16·6
3·5	13·6	8·4	5·7	1·1	5·5	18·4
3·2	13·2	7·5	5·7	1·2	5·3	16·8
2	3	4	3	3	4	4
3·2-3·5	13·2-13·6	7·5-8·4	5·7	1·1-1·2	5·1-5·4	16·8-18·5
3·4	**13·5**	**7·9**	**5·7**	**1·13**	**5·3**	**17·6**

22. **Rattus rattus** (?subspecies). (Grey-bellied.)

Material.—3 adult specimens collected by Major M. L. Roonwal as follows :—1 unsexed (Z.S.I. Registered No. 11,316) and 1♀ (No. 11,317) from milestone 111, about 22 miles N. of Imphal on Dimapur Road, *ca.* 3,500 ft., both collected on 25 July 1945 ; and 1♂ (No. 11,321) from " Mite Hill ", *ca.* 63½ miles from Imphal on Tamu Road, eastern Manipur (near India-Burma frontier), collected on 2 September 1945.

Size, colour, etc.—The 3 adults measure as follows (in mm.) :—Head-and-body 135—154 ; tail 127—140 (or 91—97% of head-and-body) ; hind-foot 30—35 (or 22—24% of head-and-body ; ear (1♂) 20. The coloration is rather similar to *R. r. ?khyensis* described above, except that the venter is grey in all the three specimens ; the fur too is softer.

Skull.—The skull measurements are given in Table 1*d*. The tympanic bullae are rather smaller (length 6·4—6·6, mean 6·5 mm.) than in *R. r. bullocki* and *R. r. ?khyensis*, but otherwise the skull appear to resemble these forms.

Comparisons.—These examples are difficult to place. Sir John Ellerman, to whom they were referred, regards them as *R. r. tistae* Hint., evidently because of the grey venter, and indeed, he has recorded (Ellerman 1947*d*, pp. 380—381) '*tistae*' from almost all over Assam (including Manipur) and Sikkim (this last being the type-locality). As already stated above under *Rattus rattus bullocki* (p. 22, foot-note), Hinton's (1918) original *tistae* from Pashok (Sikkim, 3,500 ft.) are primarily white-bellied. The present examples, though grey-bellied, are closer to the subspecies *khyensis* and *bullocki* than to *tistae*. I am rather inclined to the view that, at any rate in the white-bellied forms of the eastern Himalayas, Assam and W. Burma, fully grey-bellied forms arise independently in the various subspecies, and may be regarded more as 'mutants' than as discrete subspecies.

23. **Rattus nitidus obsoletus** Hinton.

1919. *Rattus nitidus obsoletus* Hinton, *J. Bombay nat. Hist. Soc.* XXVI (2), p. 415. (Type-locality : 50 miles west of Kindat, Chin Hills District, Upper Burma, 5,000 feet.)

1919. *Rattus nitidus obsoletus*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (3), pp. 792, 795.

1941. *Rattus nitidus obsoletus*, Ellerman, *Fam. & Gen. Living Rodents* II, p. 180.

1947. *Rattus nitidus obsoletus*, Ellerman, *J. Mammal.* XXVIII, p. 378.

Material.—2 specimens from Manipur, collected as follows :—1 adult ♂ (Z.S.I. Registered No. 11,340), collected by Zoological Survey of India Party on 11 February 1936 at Regailous Camp, *ca.* 3,250 ft., about 63 miles west of Imphal on Silchar Road ; and 1 adult or subadult ♂ (No. 11,322), collected by Major M. L. Roonwal on 8 December 1945, about 16 miles north of Imphal on Dimapur Road, *ca.* 3,500 ft.

Size, colour, etc.—Measurements (in mm.) :—Head-and-body 155, 150 ; tail 140, 138 (or 97 and 92% of head-and-body) ; hind-foot 34, 35 ; ear 25. Dorsum mummy brown ; venter rusty brown mixed with dark grey. Hands whitish on anterior half, the remainder dark brown ; feet dark brown. Tail brown all over. For skull measurements, *see* Table 1*e*.

Distribution.—Assam, in the western hills and central portion (Imphal Valley) of Manipur, upto *ca.* 3,500 ft. ; and the Chin Hills in Western Burma. The present is the first record from Assam.

This is a poorly known form, and the only previous records are the 5 adults of the type-series from the Chin Hills. It is possible that it is merely a dark-bellied mutant of *R. n. nitidus*, in much the same way as happens in *Rattus rattus tistiae* Hint. and other white-bellied subspecies of *Rattus rattus*, as mentioned above.

24. **Rattus** sp.

Material.—1 adult ♂ (Z.S.I. Registered No. 11,313) collected by " Scrub Typhus Research Team, Imphal ", in June 1945, near milestone 127, about 6 miles north of Imphal on Dimapur Road, *ca.* 2,600 ft., Manipur.

This example shows a remarkable superficial resemblance to *Rattus nitidus obsoletus* Hint. in colour, size, body-proportions and the nature of the fur. But the presence of a 20 mm. long white tip to the tail throws this identification in considerable doubt. (The short white tip of the tail is very unusual in the *rattus* and *nitidus* groups of the genus *Rattus*, and it may belong to one of the other groups in the genus ; but as there is no skull, it is difficult to be certain.)

25. **Rattus manipulus manipulus** (Thomas).

(The Manipur Rat.)

(Pl. III)

1886. *Mus berdmorei* Bly., Thomas, *Proc. zool. Soc. London*, 1886, p. 62. (Kopum Thall, Manipur. Wrong identification, *vide* Thomas 1916, *infra*.)

1891. *Mus berdmorei* (in part), Blanford, *Fauna Brit. India, Mamm.*, pt. 2, p. 410.

1916. *Epimys berdmorei*, Wroughton, *J. Bombay nat. Hist. Soc.*, XXIV (2), p. 308. (W. Burma : *e.g.*, Yuyu River, Hkamti, Upper Chindwin District ; and Chin Hills. Wrong identification.)

1916. *Epimys manipulus* Thomas, *J. Bombay nat. Hist. Soc.* XXIV (3), p. 413. (Type-locality : Khampat, 20 miles W. of Kindat, Kabaw Valley, Upper Chindwin District, W. Burma, 600 ft.).

1916. *Rattus manipulus* , Wroughton, *J. Bombay nat. Hist. Soc.*, XXIV (4), p. 772. (Kabaw Valley and Chin Hills, W. Burma.)

1919. *Rattus manipulus*, Wroughton, *J. Bombay nat. Hist. Soc.*, XXVI (3), p. 797. (Manipur, Assam ; Kabaw Valley and Chin Hills, Burma.)

1941. *Rattus manipulus*, Ellerman, *Fam. & Genera Living Rodents* II, p. 204.

1947. *Rattus (Berylmys) manipulus*, Ellerman, *Proc. zool. Soc. London* CXVII, p. 268.

1947. *Rattus (Berylmys) manipulus manipulus* (in part), Ellerman, *J. Mammal.* XXVIII(4), p. 373. (Bishenpur and Hopum Thal in Manipur; Naga Hills; Kabaw Valley.)

1948. *Rattus manipulus manipulus*, Roonwal, *Proc. nation. Inst. Sci. India*, XIV, p. 386.

1949. *Rattus manipulus manipulus*, Roonwal, *Trans. nation. Inst. Sci. India*, III, (2), p. 100. (Central Manipur.)

Material.—21 specimens were collected and examined, from 26 June to 29 December 1945, in Manipur, as follows: 20 from an area about 6—22 miles north of Imphal on Dimapur Road, *ca.*, 3,500—3,800 ft.; and 1 about 34 miles south-east of Imphal on Tamu Road, *ca.*, 4,000 ft. Of these, 13 (Z.S.I. Registered Nos. 11,110 and 11,301—11,312) were preserved—some dry, others in spirit.

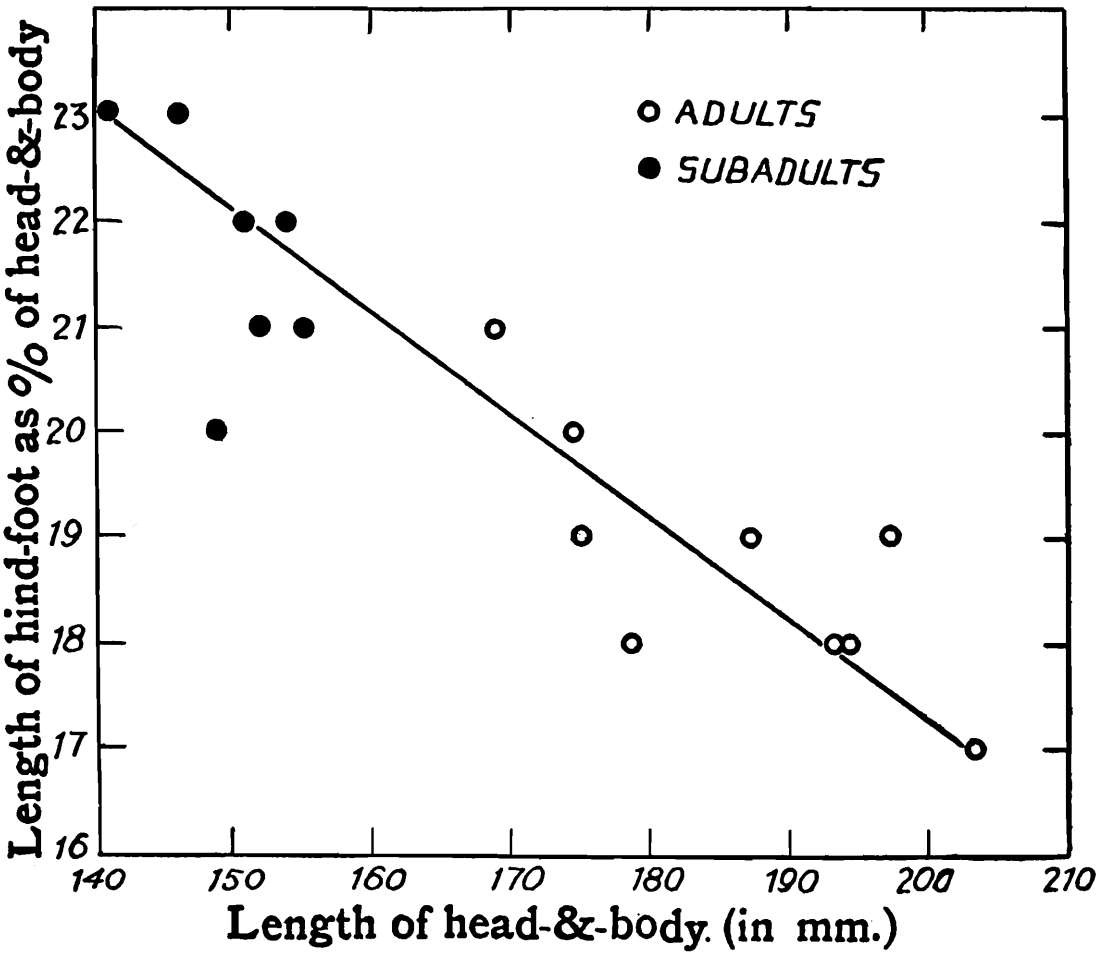
Size, colour, etc.—The variation in the size of the body-parts is given below in Table 2.

TABLE 2.

Size-range, etc. of body-parts in adults of Rattus manipulus.

Range and Mean	Length in mm.				Length as % of H.-&-B.	
	Head-and-body	Tail	Hind-foot	Ear	Tail	Hind-foot
	1. *Rattus manipulus manipulus* (Th.). (From central Manipur. 6 ♂♂, 6 ♀♀, 1 unsexed.)					
Range:	149-203	139-183	30-37	21-24	81-115%	17-22%
Mean:	175·6	162·8	33·8	22·4	92·7%	19·3%
	2. *Rattus manipulus kekrimus* Roonwal (*vide infra*). (From Kekrima, Naga Hills. 3 ♂♂, 1 ♀.)					
Range:	139-177	150-172	34-39		95-124%	20-28%
Mean:	154·8	160·8	36·5		104·8%	23·8%

The hind-foot is much longer, in proportion to the head-and- body length, in juveniles than in adults; among the latter the proportionate length of the hind-foot steadily decreases with the increasing head-and-body length (Text-fig. 4). The same applies, though to a less marked degree, to the tail-length (Text-fig. 5).

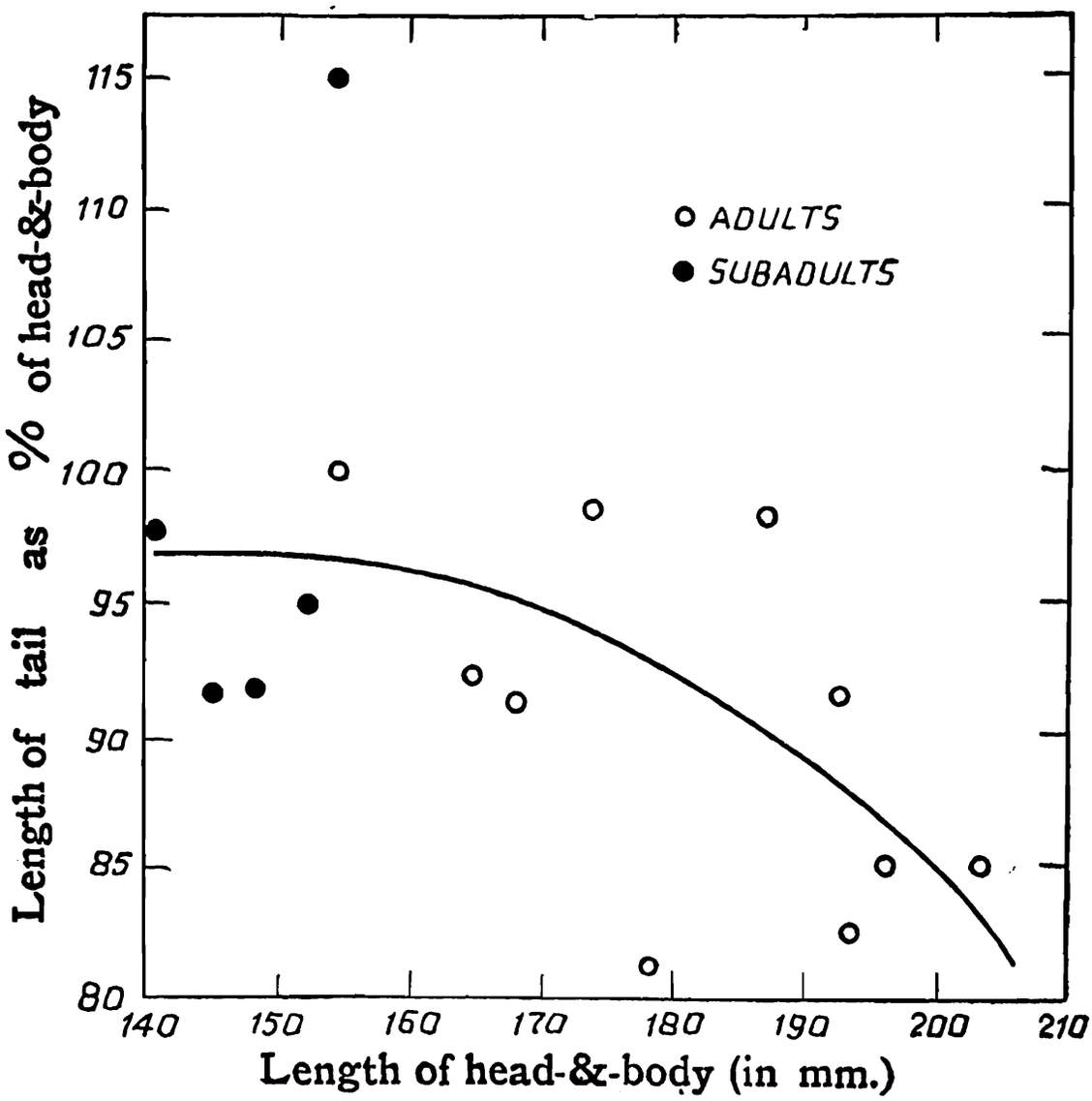


TEXT FIG. 4.—*Rattus manipulus manipulus* (Th.).

Graph showing correlation between the length of hind-foot (as percentage of head and-body length) and the length of head-and-body. The former decreases with the increase of the latter. (The regression line has been drawn by visual inspection only.)

The brief note on colour originally given by Thomas (1916, p. 413) needs supplementing. This may be done as follows, my observations being based on several living and freshly killed specimens :—Head and body : Dorsum : Grissly grey, darker middorsally, almost giving the appearance of a diffuse dark middorsal stripe in some. Individual hairs grey, with a broad subterminal white band and narrow, black tip ; bristles, which are stiffer and more numerous in the hotter months (as is seen in Coll. No. JH/26-6-45 collected on 26 June) than in winter (November, December), black, with basal half whitish. Length (in mm.) of hairs and bristles : in summer (June), hair 5, bristles 10—12 ; in winter, hair 10—12, bristles 16—17. Ventrum : Pure white, sharply demarcated from dorsum ; hairs white to the bases. Tip of nose pink ; above this grey suffused with brown. Upper lip at the tip greyish brown, the remainder pink ; lower lip greyish pink. Whiskers black with white tips. Ears (Pl. III, Fig. 11) pinkish smoky on outside ; on inside, dirty pink at base, shading to greyish pink at the edges. Tail : Distal half whitish pink with small stiff hairs entirely white ; proximal half dark brown above with black hair, and whitish pink below with hairs mostly white to the bases but some hairs, especially the lateral ones, dark-brown at the base and white terminally. The distal pale

part of tail not always sharply demarcated from the proximal dark part ; its proportionate length varying considerably, being in 11 specimens (7 ♂♂, 3 ♀♀, 1 unsexed) 29—57% of the total tail-length. Thomas (1916, p. 413) gave this as : " Tail with its terminal two-fifths to a half white all round. " Hands and feet (Pl. III, Figs. 7—10) : Hands pinkish white all round with white hairs, the two carpal pads sometimes with a grey spot on each. Feet pinkish white all round, except the proximal part of the soles and some of the pads which are dark grey. Claws on hands and feet dirty pink at base, smoky at tips. Penis pale pink. Area around anus smoky pink.



TEXT FIG. 5.—*Rattus manipulus manipulus* (Th.).

Graph showing correlation between the length of tail (as percentage of head-and-body length) and the length of head-and-body. The former tends to gradually decrease with the increase of the latter. (The regression line has been drawn by visual inspection only.)

The eyes are very small, the mean horizontal and vertical lengths being about 5·3 and 4·5 mm. respectively, or about 3·43% and 2·9% of the head-and-body length. This contrasts with the large eyes of *Rattus rattus bullocki* Roonwal where the correspondig measurements are about 7·3×5·0 mm., or 4·3%×2·94% (*vide* Roonwal, 1949*c*).

The mammary formula is : Th. 3+ abd. 2=10.

Skull (Tables 1*f* and 3 ; and Pl. III, Figs. 1—6).—The skull is of delicate build and is practically devoid of frontal ridges and other such prominences in contrast to the skull in the *Rattus rattus* group. The incisors are slightly proodont. The mandibular knob marking the inner concealed tip of the lower incisors is, however, exceptionally developed in adults—much more so than in *Rattus rattus bullocki* or any of the other rats dealt with here.

Habitat.—This rat is common in oak scrub which is its favourite habitat ; it also occurs in evergreen rain jungle, riverine meadow and oak parkland, but was never obtained in or near human habitations. Its food consists of both vegetable (grasses, etc.) and animal matter, *viz.*, insects and earthworms. In commonly eating earthworms, whenever available, this rat appears to be unique. Further details of its ecology, etc., will be found in Roonwal (1949*c*).

Distribution.—The Khasia Hills (?) and central Manipur in Assam, to the adjoining tracts of W Burma, *e.g.*, Upper Chindwin District (Kabaw Valley and " Yuyu [= Uyu] River, Hkamti "), and the Chin Hills District. Up to about 4,000 feet altitude.

The Khasia Hills are included on Blanford's record (1891, p. 411), as this northern specimen is likely to be *R. manipulus* rather than *R. berdmorei.*

The Naga Hills specimens belong to a separate subspecies, *vide infra.*

26. **Rattus manipulus kekrimus** Roonwal.

(The Naga Hills Race of Manipur Rat.)

1948. *Rattus manipulus kekrimus* Roonwal, *Proc. nation. Inst. Sci. India* XIV, p. 386.

A brief, preliminary diagnosis was given in Roonwal (1948, p. 386), and a fuller description is now provided.

Material.—4 adults (3♂♂, 1 ♀), Z. S. I. Registered Nos. 11,341-11,344, collected on 23 January 1936, by a Zoological Survey of India Party at Kekrima (=Chekrimi), *ca.*, 5,390 ft., about 10 miles (air distance) south-east of Kohima, Naga Hills District, Assam.

Diagnosis.

Similar to *Rattus manipulus manipulus* (Th.), but differing in the following respects : Colour of dorsum paler, with less grey and more brown. Tail longer, being on an average about 105%, as against 93%, of the head-and-body length. Differences in skull characters are given below, while the body-measurements will be found in Table 2 above.

Skull (Tables 1*g* and 3).—Differs from that of *R. m. manipuls* as follows : Skull smaller, mean condylobasal length 36·9 mm. *versus* 38·2 mm. Other characters, considered here as percentages of condylobasal length, differing thus : Post-molar length shorter (43·4% *vs.* 45%). Palatal length greater (51·7% *vs.* 50%). Anterior palatine foramina much smaller (length 19·1% *vs.* 20·5% ; greatest combined width 5·4% *vs.* 6·3%). Length of upper molar crowns much greater (17·1% *vs.* 14·9%).

TABLE 3.

Some skull-characters of Rattus manipulus.

Character	*Rattus m. manipulus* (Th.) (6 specimens: 2 ad. ♂♂, 3 subad. ♂♂, 1 ad. ♀)				*Rattus m. kekrimus* Roon. (4 specimens: 3 ad. ♂♂, 1 ad. ♀)			
	Size (mm.) (Adults only)		% of condylobasal length		Size (mm.) (Adults only)		% of condylobasal length	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
1. Post-molar length	16·4—18·0	17·2	44·6—45·1%	45%	15·0—17·1	16	41·7—44·2%	43·4%
2. Palatal length	18·5—19·9	18·7	49·3—50·8% (Adults only)	50%	18·3—19·8	19	50·7—53·3%	51·7%
3. Anterior palatine foramina								
(*a*) Length	7·5—8·0	7·8	19·7—21·9% (Adults only)	20·5%	6·7—7·4	7·05	18·8—19·7%	19·1%
(*b*) Greatest combined width	2·0—2·5	2·3	5·5—6·7%	6·3%	1·7—2·3	2·0	4·8—5·9%	5·4%
4. Length of upper molar crowns	5·4—5·9	5·7	14·2—16·2% (Adults only)	14·9%	6·0—6·4	6·3	15·5—17·8%	17·1%

The most striking difference between the *adults* of the two subspecies would appear to be in the length of the upper molar crowns, both as regards absolute size and as a percentage of the condylobasal length. Although the *kekrimus* skull is smaller, the absolute length of the upper molar crowns is 6·0—6·4 mm. (mean 6·3 mm., or about 11% larger than in *R. m. manipulus*) whereas in the typical *manipulus*, which has a larger skull, the figure is 5·4—5·9 mm. (mean 5·7 mm.). The same applies, though to a lesser extent, to the palatal length. As seen in *R. m. manipulus*, subadults, however, have longer upper molars than adults in proportion to skull-size (condylobasal length).

Types.—Deposited in the Zoological Survey of India Collections. All are stuffed skins with separate skulls. *Holotype* : Z. S. I. Registered No. 11,341. Original Collector's No. 2. Adult ♂, collected on 23rd January 1936 at Kekrima, *ca.*, 5,390 ft., Naga Hills, Assam, by a Zoological Survey of India Party. Body-measurements (in mm.) : H.-and-B. 139 ; Tl. 172 ; H. F. 39. *Paratypes* : Z. S. I. Registered Nos. 11,342 (ad. ♂), 11,343 (ad. ♂), and 11,344 (ad. ♀), all from Kekrima.

Distribution.—Known only from the type-locality. The 2 specimens from " Naga Hills " mentioned by Ellerman (1947*d*, p. 374) may also belong here.

Key to subspecies of Rattus manipulus.

Skull larger (mean condylobasal length 38·2 mm.). Palatal length smaller (50% of condylobasal length). Length of upper molar crowns much shorter (14·9% of condylobasal length). Tail shorter (93% of head-and-body length)....*R. m. manipulus* (Th.).

Skull smaller (mean condylobasal length 36·9 mm.). Palatal length greater (51·7% of condylobasal length). Length of upper molar crowns much greater (17·1% of condylobasal length). Tail longer (105% of head-and-body length). .*R. m. kekrimus* Roon.

27 **Rattus bowersii**[1] **mackenziei** (Thomas).

(Mackenzie's Rat.)
(Pl. V.)

1916. *Epimys mackenziei mackenziei* Thomas, *J. Bombay nat. Hist. Soc.* XXIV (3), p. 411. (Type-locality : Haingyan, 50 miles W. of Kindat, Chin Hills District, W. Burma, 5,000 ft.)

1919. *Rattus mackenziei*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (3), p. 797.

1921. *Rattus wellesi* Thomas, *J. Bombay nat. Hist. Soc* XXVIII (1), p. 26. (Type-locality : Mawphlang, 5,550 ft. Khasi Hills, Assam.) Ellerman synonymises it with *mackenziei* Th.

1941. *Rattus mackenziei mackenziei*, Ellerman, *Fam & Gen. Living Rodents* II, p. 204.

1947. *Rattus bowersi mackenziei*, Ellerman, *Proc. zool. Soc. London*, CXVII, p. 264.

1947. *Rattus bowersi mackenziei*, Ellerman, *J. Mammal.* XXVIII, p. 374.

Material.—2 adult ♂♂ (Z. S. I. Registered Nos. 11,345 and 11,346) collected by Zoological Survey of India Party on 9 February 1936 at Luanglong Khulen, *ca.* 3,250 ft., about 63 miles west of Imphal on Silchar Road, Manipur, Assam.

[1] The original spelling (Anderson, 1878, p. 304) is *bowersii*, not *bowersi* of some subsequent authors.

Size, colour, etc.—The two males measure (in mm.) as follows:—Head-and-body 205, 205; tail 245, 237; and hind-foot 48, 50. These lengths in terms of the percentages of the head-and-body are: Tail 119·5%, 115·6%; hind-foot 23·4%, 24·4%.

The colour-pattern is very similar to that of *Rattus manipulus*, with this difference that the dorsum is more brown and with less of the iron-grey, and is rather less sharply separated from the white venter. In the tail the distal one-third to one-half is whitish all round. There are 6 plantar pads.

Skull (Pl. V).—The skull-measurements are given in Table 1*i*. For comparison, the measurements of the type-skull of *Rattus bowersii bowersii* (Anderson 1878) (Pl. IV), which is present in the Zoological Survey of India Collections (Reg. No. 10,078; the type-skin is in spirit), are given (Table 1*h*). The two *R. b. mackenziei* skulls from Manipur differ from the type *bowersii* skull from Yunnan in the following respects: Skull smaller in length; but the following characters are proportionately (as percentages of occipitonasal length) larger, *viz.*, nasals (40·4-40·8% *vs.* 38·5%), and length of anterior palatine foramina (*ca.* 19% *vs.* 17%). The tympanic bullae are considerably smaller (size 6·5-6·6 mm., *vs.* 8·3 mm. or 13·1-13·3%, *vs.* 15·5%. This last feature constitutes a striking difference. The upper incisors are short, stout and almost vertically set (orthodont). I have no material of *R. b. wellesi* Th. and *R. b. feae* Th. for comparison, but Ellerman (1947*a*, *c*) tends to synonymise them with *mackenziei*.

Distribution.—Ellerman (1947*d*) gives the following range of *R. b. mackenziei* Th. (including *wellesi* Th., but not *feae* Th.): Eastern Assam, *e.g.*, Khasi and Naga Hills, central and eastern Manipur and W. Burma. To this we may add the western hills (Luanglong Khulen) of Manipur on the basis of the present record.

Ellerman records *R. b. bowersii* also from Machi in Manipur.

28. **Rattus niviventer**[1] **niviventer** Hodgson.

(Hodgson's White-bellied Rat.)

(Pl. VI.)

1836. *Mus* (*Rattus*) *niviventer* Hodgson, *J. Asiat. Soc. Bengal* V, p. 234. (Type-locality: Central region of Nepal.)

1891. *Mus niveiventer*, Blanford, *Fauna Brit. India, Mamm.*, pt. 2, p. 412.

1941. *Rattus niveiventer*, Ellerman, *Fam. and Gen. Living Rodents*, II, p. 192.

1947. *Rattus niviventer*, Ellerman, *Proc. zool. Soc. London*, CXVII, p. 264.

1947. *Rattus niviventer niviventer*, Ellerman, *J. Mammal.* XXVIII, p. 377.

Material.—1 adult ♂ (Z. S. I. Registered No. 11,130) collected on 11 September 1945 off milestone 34, south-east of Imphal on Tamu Road, *ca.* 4,000 ft. Trapped in grassy area in oak parkland.

[1] The original spelling (Hodgson 1836, p. 234) is *niviventer*, not *niveiventer* of some subsequent authors.

Size, colour, etc.—Head-and-body 150 mm. ; tail (slightly damaged) 165 mm. (or 110% of head-and-body) ; hind-foot 29 mm. ; ear 21 mm.

The following notes on colour, etc. are based on a freshly killed specimen :—Dorsum slaty brown ; individual hairs slaty-based with pale brownish tips ; no bright rusty tinge as in *R. mentosus*. Fur mixed with numerous flattened spines which are thinner than in *R. mentosus* ; spines whitish, transluscent and with black tips. Ventrum white, sharply demarcated from dorsum ; hairs white to the bases ; no dark midventral stripe. Tail dark brown above, whitish below. Hands and feet above : Distal half pale pink with faint grey tinge ; proximal half more or less like dorsum of body. Both palmar and plantar pads and lobes on the finger tips are well developed but appreciably less so than in *R. mentosus*, suggesting less arboreal and more ground habits.

Skull (Table 1*j* ; and Pl. VI).—The skull is very similar to that of *Rattus mentosus*, but is *narrower* and also differs in the following respects, the dimensions being given as percentages of the occipitonasal length :—The following parts are shorter : Zygomatic width (43% *vs.* 45%) ; cranial width (39% *vs.* 40%) ; median depth of occiput (21% *vs.* 23%) ; nasal length (37% *vs.* 39%) ; nasal width (11% *vs.* 12%). The following parts are longer : Palatal length (44% *vs.* 40%) ; length of anterior palatine foramina (17% *vs.* 16%) ; length of tympanic bullae (14% *vs.* 12-13%), and, as a consequence, the auditory length too.

Although the present specimen almostly certainly belongs to the typical subspecies in Ellerman's (1947*d*, p. 337) arrangement, the skull is much larger—occipitonasal length 37·5 mm. as against a maximum of 33·5 mm. allowed by Ellerman.

Distribution.—Himalayan region, from Simla Hills (Punjab) in the west, through Kumaon and Nepal to Manipur (E. Assam) and Kachin area (N. Burma) in the east. From about 4,000 ft. upwards. The present is the first record from Manipur. Ellerman (1947*d*, p. 377) recognizes 4 Indian subspecies, namely, *niviventer* Hodgs., *lepcha* Wr., *bukit* Bonh. and *mentosus* Th. In the present account I have considered *mentosus* Th. as a separate species (*vide infra*) purely for convenience.

29. **Rattus mentosus** Thomas.

(The Chin Hills Rat.)

(Pl. VII.)

1916. *Epimys jerdoni* Bly., Wroughton, *J. Bombay nat. Hist. Soc.* XXIV (2), p. 307. (Hakamti and Chin Hills, Upper Burma. Wrong identification *vide* Wroughton 1916, *infra*.)

1916. *Rattus mentosus* Thomas, *J. Bombay nat. Hist. Soc.* XXIV (4), p. 643. (Type-locality : " Hakmpti " [=Singkaling Hakamti = Zingkaling Hakamti], Upper Chindwin District, W. Burma, 500 ft.)

1916. *Rattus mentosus*, Wroughton, *J. Bombay nat. Hist. Soc.* XXIV (4), p. 772.

1923. *Rattus mentosus*, Mills, *J. Bombay nat. Hist. Soc.* XXIX (1), p. 227. (Mokokchung, Naga Hills, 5,000 ft.)

1941. *Rattus mentosus*, Ellerman, *Fam. & Gen. Living Rodents* II, p. 194.

1943. *Rattus mentosus*, Carter, *Bull. Amer. Mus. nat. Hist.* LXXXII, p. 113· (Dalu and Lonklin, Upper Burma.)

1947. *Rattus niviventer mentosus*, Ellerman, *Proc. zool. Soc. London* CXVII, p. 264.

1947. *Rattus niviventer mentosus*, Ellerman, *J. Mammal.* XXVIII, p. 377.

1949. *Rattus mentosus*, Roonwal, *Trans. nation. Inst. Sci. India* III (2), p. 103.

Material.—6 adults (2♂♂, 4♀♀) were obtained in late July, August, October and late December 1945, from an area 6—18 miles north of Imphal along Dimapur Road, Manipur, *ca.* 2,600—3,500 ft. Of these, 5 (*e.g.*, Z. S. I. Registered Nos. 11,126—11,129 and 11,131) were preserved.

Size, colour, etc.—5 adults (2♂♂, 3♀♀) gave the following measurements (in mm.): Head-and-body 138—156 (mean 147·6); tail 174—195 (mean 187·8); hind-foot 28—31 (mean 29·3); ear 18—21 (mean 19·5). The tail in 4 examples was 114·5—138·4% (mean 129·4%) of head-and-body.

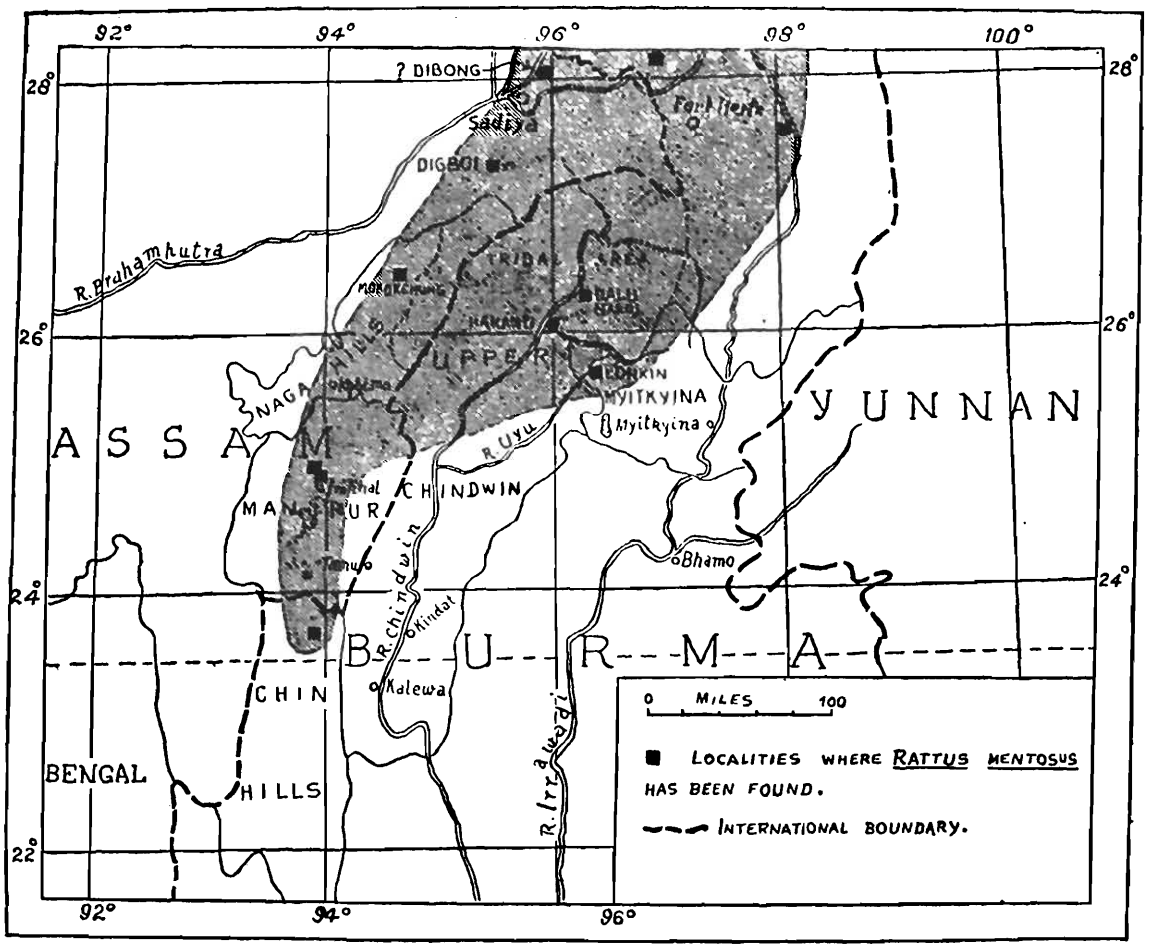
The following notes on colour are based on freshly killed specimens :— Dorsum rusty red mixed with black in summer ; tending to be ochraceous buff and colder in tint in winter owing to the fur-hairs having their terminal halves so coloured. Venter pure white with hairs white to the bases ; sharply demar ated at the sides from dorsum. Tail dark dirty brown abov , pale ben ath. Length of hair and spines 9—10 mm. and 14—15 mm. respectively in July—October ; about 12 mm. and 18 mm. respectively in December. July and October specimens tending to be very spiny, but August and December ones distinctly less so and possessing much softer fur. Hands and feet (Pl. VII, Figs. 7—10): Upper surface brownish grey up to centre of metacarpels and metatarsals, being rather dark in the central areas ; distal portions whitish. Hind-foot with bunches of long, silvery white hairs springing dorsally at base of claws and overhanging the latter. Similar hairs present on hands, but are shorter and less profuse. Pollex very reduced, without claw or nail ; all other digits with claws. Pads heavy ; plantar pads 6 ; palmar pads 5. Tips of digits heavily lobular, specially in hind-feet, suggesting adaptation to arboreal habit.

Mammae (in 2 ♀♀) : Th. 2+ abd. 2=8.

Skull (Pl. VII, Figs. 1—6 and Table 1*k*).—The skull, as studied in 5 adults (2 ♂♂, 3♀♀) is moderately large (occipitonasal length 36·5—39·7 mm mean 37·6 mm.) and rather well built. The frontal and parietal ridges are well developed ; the bullae are comparatively small, being 4·5—4·9 mm. (mean 4·7 mm.) long, or 12·2—12·9% (mean 12·5%) of occipitonasal length. The upper incisors are short and strongly built as in *Rattus rattus bullocki* Roon., and have the front surface orange ; they are bent backwards (opisthodont). The lower incisors are long, delicate and with sharp edges. The mandibular knob at the base of the incisors is moderately well developed—rather more so than in *Bandicota bengalensis* and *Rattus r. bullocki*, and distinctly less than in *Rattus manipulus*,

Habitat.—*R. mentosus* occurs as a rule in the vicinity of streams in evergreen jungle ; an evidently exceptional individual was found in tall dry grass on a hill-slope about 20 miles away from the nearest jungle. (Also *see* Roonwal, 1949*c*, pp. 103-105.)

Distribution (Text-fig. 6).—E. Assam, *e.g*, Manipur, Naga Hills, Sadiya Frontier Tract, and the Mishmi Hills ; and Upper Burma, *e.g.*, Upper Chindwin, Chin Hills and Myitkina Districts, including the Adung and Nam Nat Valleys (Wroughton, 1916 ; Carter, 1943 ; Ellerman, 1947, all *op. cit.*). Upto about 5,000 feet altitude. The present is evidently the first record from Manipur.



TEXT-FIG 6.—Map of Assam and Burma, showing the range of distribution (shaded portion) of *Rattus mentosus* Th. Also add : " Mode Forest (Mansi) " and "Nam Nat Valley ", both in Upper Burma.

30. **Hadromys humei** (Thomas).

(The Manipur Bush Mouse.)

(Pl. VIII.)

1886 (January). *Mus humei*, Thomas, *Ann. Mag. nat. Hist.* (5) XVII, p. 84. (Type-locality : Moirang, Manipur, Assam.) Preliminary diagnosis.

1886 (January 19th). *Mus humei*, Thomas, *Proc. zool. Soc. London*, p. 63, pl. V. Fuller diagnosis.

1891. *Mus humei*, Blanford, *Fauna Brit. India, Mamm.*, pt. 2, p. 421.

1891. *Mus humei*, Sclater, *Catal. Mamm. Indian Mus. Calcutta*, pt. 2, p. 70.

1911. *Hadromys humei*, Thomas, *J. Bombay nat. Hist. Soc.* XX (4), p. 999.

1920. *Hadromys humei*, Wroughton, *J. Bombay nat. Hist. Soc.* XXVI (4), p. 964.

1926. *Hadromys humei*, Hinton and Lindsay, *J. Bombay nat. Hist. Soc.* XXXI (2), p. 22. (One ♀, Angarakhata, N. Kamrup, Assam, 300 ft.)

1941. *Hadromys humei*, Ellerman, *Fam. and Genera Living Rodents* II, p. 127.

1947. *Hadromys humei*, Ellerman, *Ann. Mag. nat. Hist.* (11) XIII, p. 204. (" Bishampur, Manipur. ")

1947. *Hadromys humei humei*, Ellerman, *J. Mammal.* XXVIII, p. 370.

1949. *Hadromys humei*, Roonwal, *Trans. nation. Inst. Sci. India.* III, p. 105.

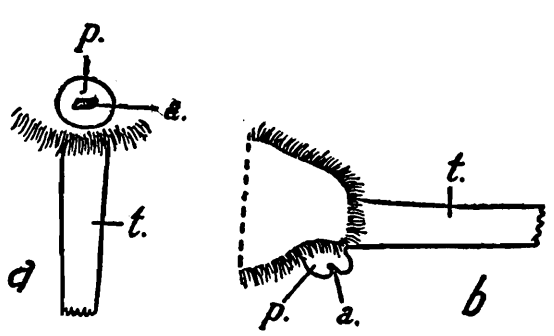
Material.—7 adults were obtained during end-July to mid-December 1945 from central Manipur—2♂♂ off milestone 117, *i.e.*, about 16 miles north of Imphal on Dimapur Road, *ca.* 3,500 ft.; and 5 (4♂♂, 1♀), off milestones 34, on Imphal-Tamu Road, *ca*, 4,000 ft. Of these, 6 were preserved, *e.g.*, Z. S. I. Registered Nos. 11,112—11,117 and 11,132.

Size, colour, etc.—6 adult males gave the following lengths (in mm.): Head-and-body 92—140 (mean 123·5); tail 121—135 (mean 128·4); hind-foot 24—27 (mean 25·5); ear 15—19 (mean 17·3). Considered as percentages of the head-and-body length, these measurements are: Tail 96—118%, once 136% (mean 108%); hind-foot 18—26% (mean 21·1%).

The colour agrees closely with the original description of Thomas (1886). The following additional notes are based on either living or freshly killed specimens: Dorsum dark salt-and-pepper coloured, with rusty red tinge especially on the rump. Venter dirty white, tinged with buff here and there but especially so at the sides of the lower throat and on the thighs. Hands and feet (Pl. VIII, Figs. 8-11) buff coloured; unusually hairy above. Palm dirty pink, with 5 pads; soles of feet dark pinkish smoky, with 6 pads. Tail dark horny black above, dirty pale pinkish below. Ears (Pl. VIII, Fig. 12) pinkish smoky; very hairy, even inner sides having numerous short brown and chestnut hair in the upper half of pinna.

The mammary formula in one ♀ was: Th. 2+abd. 2=8.

The eyes are small, the horizontal and vertical lengths being about 4·5×2·8 mm., or 3·4%×2·1% of head-and-body length. The anus lies on a prominent papilla, about 4 mm. high, at the base of the tail (Text-figs. 7*a*, *b*).



TEXT-FIG 7.—*Hadromys humei* (Th.).

Base of tail to show the anal papilla in adult ♂ from Imphal Valley, Manipur, Assam, *ca.* 3,500 ft., 18 December 1945.

(*a*) Ventral view. (*b*) Side view.
a; anus; *p.*, anal papilla; *t.*, tail.

Skull (Pl. VIII, Figs. 1-7 ; and Table 1*l*).—The skull agrees with thr accounts of Thomas (1886) and Ellerman (1947*a*, *d*). The uppee incisors are strong, well built and bent backwards (opisthodont). Some of the measurements (in mm.) are as follows : Occipitonasal length 30·8—32·3 (mean 31·8) ; palatal length 13·2—13·6 (mean 13·5), or 42—43% of occipitonasal length ; length of anterior palatine foramina 5·7, or 17·6—18·5% of occipitonasal length ; length of tympanic bullae 4·5—5·1 (mean 4·9), or about 15·7% of occipitonasal length, or 16·8% of condylobasal length.

Habitat.—Hadromys humei is commonly found in oak parkland ; an odd specimen was trapped in oak scrub. (Also *see* Roonwal, 1949 *c*.)

Distribution.—Northern and eastern Assam, upto about 4,000 ft.

This rare and interesting rat appears to have a very restricted distribution. After the first few examples obtained on 23 March 1881 (Thomas 1886) from Moirang in Manipur, the only other specimen obtained until recent years was a ♀ from Angarakhata (N. Kamrup, Assam, 300 ft.) reported by Hinton and Lindsay (1926, *op. cit.*). Ellerman (1947*a*, *d*) reports on a recent collection from " Bishampur " [=Bishenpur], Manipur ; while the present series was obtained in 1945 from central Manipur.

Leggada nagarum Thomas.

The following are the available references on *L. nagarum* Th. :—

1921. *Leggada nagarum* O. Thomas, *J. Bombay nat. Hist. Soc.* XXVII, p. 597. (Type-locality : Golaghat, 300 ft., Sibsagar District, Assam.)

1926. *Leggada nagarum*, Hinton and Lindsay, *J. Bombay nat. Hist. Soc.* XXXI, p. 399.

1931. *Leggada nagarum*, Fry, *J. Bombay nat. Hist. Soc.* XXXIV, p. 918.

1941. *Mus nagarum*, Ellerman, *Fam. & Genera Living Rodents* II, p. 250.

1947. *Mus cervicolor nagarum*, Ellerman, *J. Mammal.* XXVIII, p. 384.

31. **Leggada nagarum imphalensis** Roonwal.

(The Manipur Jungle Mouse.)

(Pl. I, Fig. 2 ; and Pl. IX.)

1948. *Leggada nagarum imphalensis*, Roonwal, *Proc. nation. Inst. Sci India* XIV, p. 386. Type-locality : About 16 miles N. of Imphal on Dimapur Road, Manipur, Assam, *ca.* 3,500 ft.

1949. *Leggada nagarum imphalensis*, Roonwal, *Trans. nation. Inst. Sci. Indi* III (2), p. 107.

A brief, preliminary description was given in Roonwal (1948, p.38)6, and a fuller one is now provided.

Material.—5 adults (4♀♀, 1 unsexed) were collected by Major M. L. Roonwal from Central Manipur (Assam) and W Burma as follows :— (i) 4♀♀ (Z. S. I. Registered Nos. 11,119, 11,120, 11,122, 11,123), 16-17 miles north of Imphal on Dimapur Road, *ca.* 3,500 ft., 26 July to 5 October 1945. (ii) 1 unsexed (No. 11,121), from Kalewa on R. Chindwin, Kabaw Valley, W. Burma, *ca.* 360 ft., July 1945.

Diagnosis.

Colour.—Dorsum : Grizzled dark mummy brown, becoming paler and more tawny at the sides, especially so in the anterior half. Hair : slaty-based for about ⅔rd the length, then rufous and finally black at the tip ; the longer hairs entirely black-tipped, without any rufous. Rump hairs : Under-fur 5—7 mm. long ; long hairs 7—9 mm. long. *Venter* : Silvery grey ; fur slaty-based with white tips, on th oat and chin white to the bases. Ears dark brown. *Tail* : Covered with numerous hort (about 0·5—1 mm. long) fine stiff hairs. Tail hairs above dark brown with pale rufous tips ; below white, except about a centimetre at the tip where they are as on the upper side. Scale rings 20—26 to the centimetre, being more numerous towards the two ends and less numerous in the middle. *Hands and feet* : Dull pinkish white with pale grey-brown tinge.

The Kalewa specimen is much paler than the others all over and has the hands and feet silvery white. In three specimens of *L. n. nagarum* examined (*vide* Table 4*b*), the colour of the dorsum is much warmer and has less grey than is the case in *imphalensis* ; the venter shows no difference.

Size, etc.—5 adults gave the following measurements, in mm. :— Length of head-and-body 85—91 (mean 87·8) ; tail 56—64 (mean 60) ; hind-foot 15—17 ; ear 12—13. The tail is 63—72% (mean 68·4%) of head-and-body.

In typical *nagarum*, whose measurements are given below, the head and body is distinctly shorter, and the tail longer both actually and proportionately :—

	H.-&-B.	Tail	Tail as % of H.-&-B.
(*a*) Type-specimen for Golaghat, Upper Assam (Thomas, 1921).	76 mm.	77 mm.	101%
(*b*) Average of several specimens (Fry, 1931).	75·5 mm.	62 mm.	82%
(*c*) Three specimens (1♂, 2♀♀) from Jaintia Hills and Cheerapunji, Assam, in collection of Bombay Nat. Hist. Soc.	72-81 mm.	63-70 mm.	82-90%

The mammary formula in 2♀♀ of *L. n. imphalensis* is : Th. 3+abd. 2=10.

Skull (Pl. IX and Table 4).—Similar to that of *L. n. nagarum.* but differs in the following points : (i) Anterior margin of zy omatic plate straight instead of conex. Margin convex in three examples of *L. n. nagarum* (in coll. of Bombay Nat. Hist. Soc.) examined, but in one No. M4304) only slightly so. (ii) Upper incisors slightly proodont rather than orthodont, with front surface orange coloured. Lower incisors very pale orange infront. (iii) skull slightly larger (mean greatest length 21·4 mm. *vs.* 21 mm.). (iv) Nasals much longer, 8·4—9·1 mm. (mean 8·7) *vs.* 7·6—8·2 mm. (mean 7·8). *Measurements* (in mm.) : greatest length 20·6—22·3 (mean 21·4) ; condylobasal length 19·7—21·8 (mean 20·6) ; greatest zygomatic width 10·0—10·6 (mean 10·3) ; length of nasals 8·4—9·1 (mean 8·7) ; length of muzzle 4·5—5·0 (mean 4·9) ; breadth across front basal edges of upper molars 3·4—3·7 (mean 3·5) ; total length of upper molars on crowns 3·5—3·8 (mean 3·7) ; cranial width 9·6—10·2 (mean 9·9) ; length of anterior palatine foramina 4·8—5·6 (mean 5·2).

Types.—Deposited in the Zoological Survey of India Collections. *Holotype* (Pl. I, Fig. 2 ; and Pl. IX) : Z. S. I. Registered No. 11,120. Original Collector's No. FL2/26-7-45. Adult ♀ (stuffed skin and separate skull), from 16 miles north of Imphal on Dimapur Road, about 3,500 feet altitude, Manipur, E. Assam. Collected on 26 July 1 45 by Major M. L. Roonwal. Body-measurements, in mm., a e as follows : Head-and-body 86 ; tail 59 (or 68·6% of head-and-body) ; hind-foot 15 ; ear 13. The skull-parts (Pl. IX) measure as follows (in mm.), the figures within brackets being the percentages in terms of the occipitonasal length : Greatest length 20·6 ; condylobasal length 19·7 ; occipitonasal length 21·4 ; greatest zygomatic width 10·0 ; least interorbital width 3·7 ; cranial width 9·6 ; occipital width 8·8 ; median dep'h of occiput *ca.* 5·5 ; post-molar length 9·6 ; auditory length 5·7 ; length of tympanic bulla 3·8 (18·1%) ; length of nasals 8·4 (39·3%) ; greatest combined width of nasals 2·7 ; length of muzzle 4·5 (21%) ; length of diastema 6·2 (29%) ; length of anterior palatine foramina 5·0 ; greatest combined breadth of anterior palatine foramina 1·7 ; total length of upper molar crowns 3·6 ; breadth across front ba al edges of upper molars 3·5. The upper incisors are slightly proodont and are oran e-coloured on the whole of the front surface.

Paratypes.—All stuffed skins of adult ♀♀, with separate skulls ; collected from the type-locality. Z. S. I. Registered Nos. 11,119, 11,222 and 11,123.

Distribut'o n.—Central Manipur, Assam, *ca.* 3,500 ft. ; also Kalewa in Kabaw Valley, W Burma, 360 ft. This is east of the range of *L. n. nagarum* which covers practically the whole of eastern Assam, including the Sibsagar and Kamrup Districts and the Jaintia, Khashi and Mishmi Hills (*vide* Thomas, 1921 ; Hinton and Lindsay, 1926 ; Fry, 1931).

Habitat.—Trapped near streams in riverine scrub and riverine meadow with no tall trees (tree canopy entirely open), short to medium grass (shrub canopy half to fully open), and with ground canopy half-covered ; soil moist to water-logged. (Also *see* Roonwal, 1949*c*, p. 107.)

TABLE 4(*a-t*).

Skull-measurements (in mm.), etc. of Leggada nagarum *adults.*

egistered Number (Z.S.I. or B.N.H.S.)	Collector's Number.	Sex.	Age. (State of wear of molars).	Date of collection.	Locality.	Greatest length.	Condylo-basal length.	Greatest zygo-matic width.	Length of nasals.	Length of muzzle*.	Breadth across front basal edges of upper molars.	Length of upper molars on crowns.	Cranial width.	Length of anterior palatine foramina.	Upper incisors.
(*a*) *Leggada nagarum imphalensis* Roonwal. (In coll. of Zool. Surv. India ; collected in 1945 by Major M. L. Roonwal.)															
11,121	..	..	Not worn out.	July	Kalewa	..	..	10·2	8·4	4·8	3·4	3·8	..	5·2	Slightly proodont
11,119	FL1/26-7-45	♀	Much worn out	26 July	Near Imphal.	22·3	21·8	..	9·1	5·5	3·7	3·8	10·2	5·6	Ditto.
11,120 Holotype)	FL2/26-7-45	♀	Not worn out.	26 July	Ditto.	20·6	19·7	10·0	8·4	4·5	3·5	3·6	9·6	5·0	Ditto.
11,122	R11/5-10-45	♀	Half worn out	5 Oct.	Ditto.	21·0	20·2	10·6	..	4·7	3·4	3·6	10·0	4·8	Ditto.
11,122	R2/8-10-45	♀	Half worn out	8 Oct.	Ditto.	21·6	20·7	..	8·7	5·0	3·4	3·5	9·6	..	Ditto.
					Mean :	**21·4**	**20·6**	**10·3**	**8·7**	**4·9**	**3·5**	**3·7**	**9·9**	**5·2**	..
(*b*) *Leggada nagarum nagarum* Th. (3 in coll. of Bombay Nat. Hist. Soc. ; collected in 1920 by H. W. Wells.)															
M4,302	885	♂	Half worn out	5 Aug.	Shang-pung, Jaintia Hills, Assam, 4,000 ft.	21·0	20·7	10·5	8·2	..	..	..	..	..	Ortho-dont. (Front orange at base only.)
M4,303	928	♀	Partly worn out	10 Aug.	Ditto.	20·6	20·0	..	7·7	..	..	..	..	..	Ditto. (Front surface orange.)
M4,304	489	♀	Not worn out	21 Apr.	Cheera-punji, Assam.	..	..	..	7·6	..	3·5	3·6	..	..	..
Type (Measu-rements of O. Thomas, 1921.)	260	♂	..	12 Feb.	Golaghat, Assam.	21·5	20·6	10·3	8·0	..	..	4·0	10·3	4·9	..
					Mean :	**21**	**20·4**	**10·4**	**7·9**	..	..	**9·8**	..	..	..

* Length of muzzle is the distance from front margin of premaxilla to lower corner of zygomatic plate.

Comparisons.—The following differences would separate the two subspecies of *Leggada nagarum* :—

L. n. nagarum Thomas.	*L. n. imphalensis* Roonwal.
1. *Size.*—Head-and-body shorter (72-81, mean about 75·5 mm.). Tail much longer both absolutely (62-77, mean 62 mm.) and proportionately (82-101%, mean about 89·7% of H.-&-B.).	1. *Size.*—Head-and-body longer (85-91, mean 87·8 mm.). Tail much shorter both absolutely (56-64, mean 60 mm.) and proportionately (63-72%, mean 68·4% of H.-&-B.).
2. *Colour.*—Dorsum warmer, with less grey.	2. *Colour.*—Dorsum colder and darker, with more grey.
3. *Skull.*—Smaller (greatest length about 20·6-21·5, mean 21 mm.). Nasals much shorter (7·6-8·2, mean 7·9 mm.). Anterior margin of zygomatic plate markedly or slightly convex, not straight. Upper incisors orthodont.	3. *Skull.*—Larger (greatest length 20·6-22·3, mean 21·4 mm.). Nasals much longer (8·4-9·1, mean 8·7 mm.). Anterior margin of zygomatic plate straight. Upper incisors proodont.

L. n. imphalensis would also appear to be close to *Mus cervicolor nitidulus* Bly. (as understood by Ellerman, 1947*d*, p. 384). But specimens of ' *Mus nitidulus* ' Bly., as listed by Sclater (1891, p. 76 ; wrongly spelt as *nitulidus*), and now present in the Zoological Survey of India Collections, are markedly different. The tail length is usually above 100% of head-and-body ; and in the two skulls examined, the anterior margin of the zygomatic plate is slightly convex, while the upper incisors are orthodont. On the whole, it would appear that *Leggada nagarum imphalensis* might be entitled to specific rank, but for the present I prefer to retain it as a subspecies of *L. nagarum.*

32. **Mus musculus ?musculus** Linnaeus.

1758. *Mus musculus*, Linnaeus, *Syst. Nat.* (10th ed.) I, p. 62. (Type-locality : Upsala, Sweden.)

1941. *Mus musculus musculus*, Ellerman, *Fam. & Gen. Living Rodents* II, p. 243.

1949. *Mus musculus musculus*, Roonwal, *Trans. nation. Inst. Sci. India.* III, p. 107.

Material.—1 adult ♀ (Z.S.I. Registered No. 11,124), obtained on 22 October 1945 in oak scrub, about 16 miles north of Imphal on Dimapur Road, Manipur, Assam, *ca.* 3,500 ft.

Size, colour, etc.—Head-and-body 71 mm. ; tail 78 mm. ; hind-foot 16 mm. ; ear 11 mm. The colour of the dorsum is similar to *M. m. homoourus*, but more grey ; the ventrum is pure grey. The skull measures thus (in mm.) : Greatest length 19·2 ; condylobasal length 18·5 ; greatest zygomatic width 10·6 ; length of nasals 7·6 ; length of muzzle 4·6 ; breadth across front basal edges of upper molars 3·5 ; length of upper molars on crowns 3·5 ; cranial width 9·6 ; length of anterior palatine foramina 4·5.

33. **Mus musculus homoourus** Hodgson.

1845. *Mus dubius* Hodgson, *Ann. Mag. nat. Hist.* XV, p. 268, line 34. (Type-locality : Central Nepal, Himalayas.) Preoccupied by *M. dubius* Fischer, *Syn. Mamm.*, 1829, p. 326, a S. American species.

1845. *Mus homoourus* Hodgson, *Ann. Mag. nat. Hist.* XV, p. 268, line 38. (Type-locality : Central Nepal, Himalayas.)

1941. *Mus musculus homourus* Ellerman, *Fam. & Genera Living Rodents* II, p. 245.

1947. *Mus musculus homoourus*, Ellerman, *J. Mammal.* XXVIII, p. 386.

1949. *Mus musculus homoourus*, Roonwal, *Trans. nation. Inst. Sci India* III, p. 108.

Material.—1 adult ♂ (Z.S.I. Registered No. 11,125), obtained on 24 September 1945 in a hut in army camp about 16 miles north of Imphal on Dim pur Road, Manipur, Assam, *ca.* 3,500 ft.

Size, colour, etc.—Head-and-body 80 mm. ; tail 71 mm. ; hind-foot 14 mm. ; ear 11 mm. The dorsum is dark, grizled and tinged with fawn, especially infront of the ears, at the base of the tail, and at the sides ; the fur is slaty-based, tipped with fawn or brown. The venter is similar to dorsum but more grey. The skull measures thus (in mm.) : Greatest length 20·4 ; condylobasal length 19·8 ; greatest zygomatic width 10·7 ; length of nasals 7·6 ; length of muzzle 3·8 ; breadth across front basal edges of upper molars 3·5 ; length of upper molars on crowns 3·5 ; cranial width 9·6 ; length of anterior palatine foramina 4·9.

Family (iii) Hystricidae (Porcupines).

34. **Hystrix hodgsonii subcristatus** Swinhoe.

(The Crestless South Chinese Porcupine.)

1870. *Hystrix subcristata* Swinhoe, *Proc. zool. Soc. London*, p. 638. (Type-locality : " Swatow (province Kwangtung) and at Foochow (province Fokien) ", S. China.)

1940. *Hystrix subcristatus subcristatus* (also *H. klossi klossi* Th. and *H. k. millsi* Th.), Ellerman, *Fam. & Gen. Living Rodents* I, p. 218.

1947. *Hystrix hodgsoni subcristatus*, Ellerman, *J. Mammal.* XXVIII, p. 251.

1949. *Hystrix* (*Acanthion*) *hodgsonii*, Roonwal, *Trans. nation. Inst. Sci. India* III, p. 108.

Material.—One subadult ♀ (Z.S.I. Registered No. 11,349) collected on 29 November 1945 (shot at night while crossing the road) near milestone 115, about 18 miles north of Imphal on Dimapur Road, Manipur, *ca.* 3,500 ft.

Size, colour, etc.—Head-and-body 555 mm. ; tail 120 mm. ; hind-foot 85 mm. ; ear 37 mm. The main quills have a comparatively narrow, dark band and a much longer terminal white area ; the thinner, long hair-like quills are wholely white. The skull is with the upper and lower M_3 just erupting. It measures as follows (in mm.) : Greatest length 121 ; condylobasal length 117 ; occipitonasal length 119 ; greatest zygomatic width 64·3 ; least interorbital width 49·3 ; post-molar length 49·7 ; length of nasals 66·2 ; combined width of nasals 37·3 ; length of frontal in middle line 30 ; palatal length 55 ; length of diastema 32 ; length of tympanic bulla 17·2 ; mandibular length 75·5.

Distribution.—Naga Hills (Assam), S. Burma and S. China (Ellerman, 947c). Manipur, E. Assam (present record).

Order 6. UNGULATA.

Family (i) CERVIDAE (Deer, etc.).

35. **Muntiacus muntjak** (Zimmermann) (?subspecies).

(The Rib-faced or Barking Deer.)

1780. *Cervus muntjak* Zimmermann, *Geog. Gesch.* II, p. 131. (Type-locality :?)

1891. *Cervulus muntjak*, Blanford, *Fauna Brit. India, Mamm.*, pt. 2, p. 532.

1920. *Muntiacus* (?spp.), Wroughton, *J. Bombay nat. Hist. Soc.* XXVII (2) pp. 302-303.

Material.—None was procured inspite of many attempts, but several were heard barking. During the period of observation (from July to December, 1945) at the " Kanglatongbi " Field Thphus Station, near Imphal, I heard them barking at night and in the early morning from November onward ; they were very common in December, having evidently come down from the higher hills to the camp site in oak scrub at *ca.* 3,600 ft. altitude. The bark was a short, hoarse one, repeated several times.

III.—SUMMARY.

1. The paper comprises a systematic report, with special reference to the family Muridae (order Rodentia), upon a collection of mammals made in June to December 1945, by the writer and his associates, principally in central Manipur (Imphal Valley and the neighbouring foothills), and, to a lesser extent, in eastern Manipur (Imphal-Palel-Tamu Road) and in the Kabaw Valley, western Burma, right up to Kalewa on R. Chindwin. A small collection, made in February-March 1936 by a Zoological Survey of India Party in central and western (along Imphal-Silchar Road) Manipur and in the immediately adjoining portions of the Naga Hills, is also included.

2. INSECTIVORA : The following species are dealt with :—Tupaiidae : *Tupaia belangeri* (Wagn.) (?subsp.). Talpidae : *Talpa micrura* Hodgs. Soricidae : *Suncus caeruleus fulvocinereus* (And.) ; *S. griffithi* (Horsf.) ; and *Suncus* sp.

3. CHIROPTERA : Pteropodidae : *Pteropous giganteus leucocephalus* Hodgs. is recorded from Manipur.

4. CARNIVORA : The following species are dealt with : Felidae : *Prionailurus bengalensis bengalensis* (Kerr) ; *Felis chaus* (Güld.) (?subsp.) and Domestic Cat (*Felis chaus* type). Viverridae : *Viverricula indica* (Geoff.) (?subsp.). Herpestidae : *Herpestes urva* Hodgs. Canidae : *Canis aureus indicus* Hodgs.

5. PRIMATES : The following monkeys were recorded : Cercopithecidae : *Macaca mulatta mulatta* (Zimm.) and *M. assamensis assamensis* McCl. Some observations on live specimens of the latter species are mentioned regarding the body-coloration and the hair-direction on the head ; certain differences between the two above-mentioned species are also discussed. It was also noted that in a ♀ of *M. mulatta* the menstrual flow lasted 3 days (from 3-5 November, 1945), and that during this period the blood discharge was moderate and there was no particular swelling or reddening of the hind-quarters.

6. RODENTIA : Non-Muridae : The following species were recorded : Sciuride : *Hylopetes alboniger* (Hodgs.) ; *Callosciurus erythraeus erythrogaster* Bly. ; and *Dremomys lokriah macmillani* Th. & Wr. Hystricidae : *Hytrix hodgsonii subcristatus* Swin.

7. RODENTIA (*contd.*) : Muridae: The following species were recorded : *Bandicota bengalensis* (Gr. & Hardw.) ; *B. bengalensis ?varius* (Th.) ; *Rattus rattus bullocki** Roon. ; *R. r. ?khyensis* Hint. ; *R. rattus* (?subsp.) ; *Rattus* sp. ; *R. manipulus manipulus** (Th.) ; *R. m. kekrimus* Roon. ; *R. bowersii mackenziei** (Th.) ; *R. niviventer niveventer** Hodgs. ; *R. mentosus** Th. ; *Hadromys humei** (Th.) ; *Legadda nagarum imphalensis** Roon. ; *Mus musculus ?musculus* Linn. ; and *M. musculus homoourus* Hodgs. Detailed skull-measurements are provided in most of the above cases. Skull-drawings are given for the majority of cases (marked with an asterisk*), either because no drawings were hitherto available in the literature or, if available, they were not suitable for systematic comparisons. In addition, skull-drawings of *Rattus bowersii bowersii** (And.) are provided for comparison with that of *R. b. mackenziei* (Th.). Fuller diagnoses are given of the following three forms whose brief preliminarily diagnoses had appeared earlier (Roonwal, 1948) : *Rattus rattus bullocki*, *R. manipulus kekrimus* and *Leggada nagarum imphalensis*. In *R. manipulus manipulus* the hind-foot is much longer, in proportion to the head-and-body length, in juveniles than in adults ; among the latter, the proportionate length of the hind-foot steadily decreases with the increasing head-and-body length; and the same applies to the tail length.

8. UNGULATA : Cervidae : *Muntiacus muntjak* (Zimm.) (?subsp.) was commonly heard barking in central Manipur, but no specimens were procured.

9. The following are new distributional records from either Manipur or W. Burma (*vide* also Roonwal, 1948 ; 1949 *a-c*) : INSECTIVORA : *Talpa micrura* Hodgs. Imphal Valley, central Manipur, *ca.* 3,500 ft. ; hitherto recorded in E. Himalayas only from higher altitudes. *Suncus caeruleus fulvocinereus* (And.) and *Suncus griffithi* (Horsf.), Imphal Valley, central Manipur, *ca.* 3,000-3,500 ft. and the Kabaw Valley, W. Burma, *ca.* 500 ft. CARNIVORA : *Herpestes urva* (Hodgs.), Manipur. PRIMATES : *Macaca assamensis assamensis* McCl., Manipur. RODENTIA : *Rattus nitidus obsoletus* Hint., Manipur. *Rattus bowersii mackenziei* (Th.), western hills of Manipur. *Rattus niviventer niviventer* Hodgs., S.-E. Manipur, *ca.* 4,000 ft. *Rattus mentosus* Th., central Manipur, *ca.* 2,600-3,500 ft. *Leggada nagarum* Th., central Manipur (3,500 ft.) and the Kabaw Valley, W. Burma (360 ft.)—this form is *L. n. imphalensis* Roonwal (1948). Hystricidae : *Hytrix hodgsonii subcristatus* Swin., central Manipur.

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