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THE FAUNA OF INDIA

including

PAKISTAN, BURMA and CEYLON

Edited by

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Director, Zoological Survey of India

MAMMALIA

(Second Edition)

Vol. 3

RODENTIA (in two parts)

by

J. R. ELLERMAN

With 54 Text-figures and a Coloured Map

WITH AN APPENDIX BY

M. L. ROONWAL AND B. BISWAS

Part 1

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EDITOR'S PREFACE

The present is the fourth volume in the newly named series, *Fauna of India*, published under the patronage of the Government of India (and formerly called 'Fauna of British India' which was published under the Secretary of State for India in England). The first three volumes bearing the new name were those on: (i) Butterflies, Vol. 2, by G. Talbot (1947); (ii) Coleoptera: Lamellicornia, Vol. 4, Lucanidae and Passalidae, by G. J. Arrow (1950); and (iii) Annelida: Polychaeta, by P. Fauvel (1953). Of these, the last mentioned was the first one to be printed in India, and, according to the decision of the Government of India, all newly assigned future volumes will be edited and printed in India.

The present volume on the Rodentia forms Volume 3 in the second edition of the volumes on *Mammalia*, the first two volumes being by R. Pocock as follows: Volume 1 (1939) on Primates and Carnivora (in part), families Felidae and Viverridae; and Volume 2 (1941) on Carnivora (continued), suborders Aeluroidea (part) and Arctoidea.

In the first edition of the *Mammalia* volume by W. T. Blanford (1888-1891: Part 2 containing Rodentia, published 1891), the section on Rodentia (including Rodentia proper, i.e. the Simplicidentata and the modern order Lagomorpha which includes the Duplicidentate rodents comprising the families Leporidae and Ochotonidae) occupied 104 pages (pp. 356-459) and included 106 species and 15 varieties, thus: 93 species and 15 varieties of the Simplicidentata and 13 species of the Duplicidentata (Lagomorpha).

During the period of over a half-century which has elapsed since the publication of Blanford's volume, there has been considerable addition to our knowledge of the mammalian fauna of India, in particular the Simplicidentate Rodentia, as a result of surveys carried out by the Mammal Survey, ca. 1911-1929 (largely financed by the Government of India), the Zoological Survey of India, and several other bodies. As a result, a huge body of material was accumulated, and several new species of Indian rodents were described. In the present volume about 46 genera, 128 species and 260 subspecies of the order Rodentia *sens. str.* (that is, excluding the Lagomorpha) are listed as occurring in the Indian region. To these numbers we may add about 8 species and 25 subspecies whose status is not clear.

We were fortunate in securing the co-operation of Sir John Ellerman for writing this volume. He is acknowledged as the world's leading authority on the living rodents, and I am sure that the present volume will serve as an authoritative guide to the rodents of India.

The manuscript of the present volume was ready several years ago and contained material published up to about 1946 only. For a variety of reasons, it came late into our hands. It was, therefore, considered desirable to bring it up to date as far as possible. For this purpose, and with the author's consent, I have added here an Appendix (by M. L. Roonwal and B. Biswas) to include 10 new species and subspecies which have been described since the original manuscript of the present volume was completed. It is hoped that the addition of the Appendix will enhance the usefulness of the volume.

CALCUTTA,
25th July, 1958

M. L. ROONWAL,
Director,
Zoological Survey of India

AUTHOR'S PREFACE

The present volume on the ' Order Rodentia ' in the *Fauna of India* series is based upon the very extensive collections in the British Museum. In order to arrive at the conclusions here offered, it was necessary to study all rodents available from the whole of Asia, Europe, North Africa and Australia, and detailed notes were taken on 13,000 specimens or more, including measurements of all unbroken skulls available in the London collection. When one is dealing with such very large numbers of specimens, it soon becomes clear that supposed differences between subspecies (and indeed sometimes between closely allied species) must become average rather than absolute. I have, however, retained all named subspecies in India where there seemed the least excuse for so doing ; probably several forms retained in the present work will ultimately disappear into synonymy. In addition to the magnificent material assembled by the work of the Bombay Natural History Society's Mammal Survey of India, I was fortunate in having a valuable collection made by the late Mr. W J C. Frost from Sind, Assam and Manipur. The majority of the text-figures are reproduced by courtesy of the British Museum (Natural History), London, and were drawn by the late Mr. A. J. E. Terzi. The index has been prepared by Miss J. M. Ingles. This work was completed for publication in 1946.

ABBREVIATIONS

LANGUAGES :

<i>Baluch.</i>	= Baluchi	<i>H.</i>	= Hindi
<i>Beng.</i>	= Bengali	<i>Mahr.</i>	= Marathi
<i>Burm.</i>	= Burmese	<i>Mal.</i>	= Malayalam
<i>Bhot.</i>	= Bhotia	<i>Nepal.</i>	= Nepali
<i>Can.</i>	= Canarese	<i>Tam.</i>	= Tamil
<i>Cing.</i>	= Cingalese or Sinhalese	<i>Tel.</i>	= Telugu
<i>Gond.</i>	= Gond		

OTHERS :

F. = Female
M. = Male

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ORDER RODENTIA

INTRODUCTION

The Order Rodentia contains a very large number of placental mammals in which the mouth is adapted for gnawing, as a result of which the first upper and lower incisor teeth are enormously enlarged, at the cost of all the other front teeth (the second and third incisors and the canines) which are absent. The large incisors are rootless and there is always a considerable diastema or space between the incisors and the cheekteeth. Correlated with this modification towards gnawing the jaw muscles have become extremely powerful, and they modify the skull in various ways, and are the best characters to use for the classification of the Order into families. In many but not all of the families, the masseter muscle passes through the infraorbital foramen which is then enlarged to a greater or lesser degree. Rodents are primarily vegetarian in diet, and the cheekteeth are as a rule adapted for dealing with vegetable food, although some rodents may exist on a mixed diet. Generally the digits of the feet bear claws. It is normal for the pollex (thumb) to be vestigial or absent, and a rodent with a functional pollex is a rarity. The toes of the hindfeet vary between five and three in number. There is considerable variation in the Order towards various forms of life; some rodents are quite specialized towards arboreal life, some towards aquatic life, many towards underground life, etc. But many are rather generalized small terrestrial forms like rats and mice. Often within the Order the tail is naked and scaly, which is a character only found in more generalized Orders of mammals. The brain is said to be not of a high type. In the skull, the zygoma and auditory bullae are always present, and the orbit is never ringed by bone. Except for squirrels, normally the postorbital processes are absent.

The Order is by far the largest Order of existing mammals. Simpson (1945) in his recent classification of the Mammalia states (p. 197) that 'Living rodents are believed to be as abundant individually and in variety as all other mammals put together' and 'more than half of living mammals are Rodents'. There are close on three hundred living genera, and in 1940-41 I published a list of named varieties which then comprised more than six thousand four hundred named forms. (If the Order was revised, many of these would disappear into synonymy; and many more have, of course, been named since

1941.) This Order is the only Order of placental mammals (other than bats which can fly and such things as seals, etc., which swim) which has reached Australasia (otherwise than by human introduction); the distribution of the Rodentia is world-wide.

The origin of the Order is not well known. Simpson (1945) divides the placental mammals into four great cohorts, one of which comprises the Rodentia (with their supposed allies the Lagomorpha).

In Blanford's work (1891) on the mammals of India, and in very many subsequent works, the Rodentia as then understood was divided into two suborders, the Duplicidentata (containing the hares, rabbits and pikas) and the Simplicidentata (= Rodentia as here understood). Gidley (1912) proposed to give ordinal rank to the Duplicidentata, under the name Lagomorpha, and he has been widely followed in this classification. Simpson (1945) states that both Lagomorpha and restricted Rodentia are known from the Palaeocene, and that even at that time the two Orders were distinct, and, so far as I am aware, no intermediate fossil forms between the two groups have yet been discovered. There is even doubt as to whether the two groups are sufficiently closely related for them to be put into the same 'Superorder'.

The Order Lagomorpha is not dealt with in the present work, but as Pocock (1939) did not include it in his key to Orders in the first volume of the new edition of the *Fauna of British India* series on Mammalia a few notes on the Lagomorpha, my knowledge of which is not extensive, are included.

In the Lagomorpha, apparently the infraorbital foramen is not reached by the masseter muscles, and it is not modified by them. The palate is usually extremely short from before backwards, and is reduced to a mere bridge between the molars, and the palatal foramen is typically very large. The fibula is said to articulate with the calcaneum. There are two upper incisors in each jaw, but the second one is small, placed immediately behind the front one, and not functionally important. There are five lower cheekteeth. All these characters are in contrast to those normally present in the Rodentia. Miller (1912), in his catalogue of mammals of western Europe, also states that in Lagomorpha (then called by him suborder Duplicidentata, although later he recognized the Lagomorpha as a distinct order) the 'distance between mandibular toothrows [is] much less than that between maxillary toothrows, only one pair of rows capable of opposition at the same time, the motion of the jaws in mastication

consequently lateral'; and in Rodentia; the 'distance between mandibular and maxillary toothrows approximately equal, both pairs of rows capable of opposition at the same time, the primary motion of the jaws in mastication longitudinal or oblique' The angular portion of the lower jaw in the Lagomorpha is straighter and more upstanding and less distorted in shape than is the case in the Rodentia. The two Orders may be roughly keyed as follows:—

Infraorbital foramen not reached by masseter muscles, and not enlarged nor modified thereby. Ascending ramus of mandible straight. Palate usually much shortened, and palatal foramina much enlarged. A second, vestigial upper incisor present. Five lower cheekteeth ..

LAGOMORPHA

Infraorbital foramen reached by masseter muscles, usually enlarged or otherwise modified thereby. Ascending ramus of mandible more curved or distorted. Palate well developed, palatal foramina usually more moderate. Normally only one upper incisor each side. At most four permanent lower cheekteeth

RODENTIA

The Order Rodentia was defined by Miller and Gidley (1918) as follows:—

'Terrestrial and fossorial, occasionally arboreal or semi-aquatic placental mammals with both brain and placentation generalized in type; feet unguiculate; elbow joint always permitting free rotary motion of forearm; fibula never articulating with calcaneum; masseter muscle highly specialized, divided into three or more distinct portions, having slightly different functions; caecum without spiral fold; dental formula not known to exceed i. 1/1, c. 0/0, p. 2/1, m. 3/3 = 22 permanent teeth; incisors scalpiform growing from persistent pulp, the enamel of upper tooth not extending to posterior surface; distance between mandibular and maxillary toothrows approximately equal, both pairs of rows capable of partial or complete opposition at the same time, the primary motion of the lower jaw in mastication longitudinal or oblique.'

In the detailed classification of Rodentia, no two authors are in exact agreement. Seven major classifications of the Order have been offered since 1896, and although they present a general similarity towards one another, and are not irreconcilable, all of them differ in detail from each other. These classifications are fully discussed in Ellerman (1940, 1941 and 1949).

The classification here used is that of Ellerman (1940). According to this classification, eight families of rodents occur in Asia, and six of them reach India. The two extralimital families which fail to reach India are the Castoridae (beavers) and Spalacidae (European mole-rats). Blanford (1891) recognized five families in India, *viz.*, the Sciuridae (squirrels, marmots, flying squirrels), Dipodidae (jerboas), Muridae (rats and mice, hamsters, voles and gerbils, also *Platacanthomys*), Spalacidae (in which he included the bamboo-rats, *Rhizomys* and allies), and Hystricidae (porcupines). It will be noted that he placed *Platacanthomys* in the Muridae, but Winge (1887), Thomas (1897), and most subsequent authors place this genus in the family Muscardinidae (dormice); some authors prefer to regard it as type of a special family, the Platacanthomyidae, which classification seems unnecessary. It will also be noted that Blanford placed *Rhizomys* in the Spalacidae, but it becomes increasingly clear that *Rhizomys* has little to do with *Spalax*, as these two genera seem merely both to be offshoots of some probably Cricetine group of Muridae which have become specialized for underground life but which are not closely related to each other but rather differ widely, and most authors today recognize two separate families, Spalacidae and Rhizomyidae, although they are not all agreed as to the limits of either family. It is suggested that the correct classification seems to be to restrict the Rhizomyidae to *Rhizomys* (with its ally *Cannomys*), and to restrict the Spalacidae to its typical genus. *Spalax* and *Rhizomys* seem really at opposite ends of two extremes of specialization towards underground life. Since Blanford's day, a true dormouse (Muscardinidae) has been found to occur in Indian territory, and another dipodide, *Sicista*, the Palaearctic birchmouse, has been found in Kashmir, which brings another distinct subfamily of Dipodidae (or family of some authors) into the Indian list.

It used to be the custom to divide the Rodentia into three tribes or suborders, the Sciuromorpha (squirrel-like rodents), Myomorpha (mouse-like rodents) and Hystricomorpha (porcupine-like rodents). This was done by Blanford, Thomas and others, and more recently by Simpson. It may be easily shown, however, that there are three or four families, mainly from Africa, which are neither Sciuromorpha, Myomorpha nor Hystricomorpha if these groups are to be definable. Simpson has made no attempt to define his three 'suborders', and he leaves some of the families *incertae sedis* in each of his suborders.

Another division was proposed by Tullberg (1899) in his monograph of the Rodentia; this author divided the Rodentia into two major divisions, the Hystricognathi ('porcupine-jawed' rodents) (with a Hystricomorph series for the majority of the group, in which the infraorbital foramen is open for muscle transmission, and a Bathyergomorph series for the aberrant African family Bathyergidae which has the infraorbital foramen not or scarcely open for muscle transmission, and further disagrees with the more normal Hystricomorphs in having the fibula fused with the tibia), and the Sciurognathi ('squirrel-jawed' rodents), with a Myomorph series for the rats, mice and allied groups which have the infraorbital foramen open for muscle transmission, and a Sciuiromorph series for the families in which the infraorbital foramen does not transmit muscle. Miller and Gidley (1918) divided the Order into five superfamilies, based upon various details of the arrangement of the jaw muscles, but their classification has usually been rejected as unnatural. It seems to me that it is not possible to divide the Order into natural suborders.

*Key to families and subfamilies of living RODENTIA
which occur in Indian territory*

- 1 (2) Lower jaw specialized by distortion outwards of the angular process by a specialized limb of masseter lateralis superficialis. The infraorbital foramen is much enlarged for muscle transmission, the zygomatic plate is narrow and completely below it. Fibula unreduced, not fused with tibia. Premolars unreduced in size, cheekteeth 4/4, their pattern flatcrowned, with inner and outer re-entrant folds. Skull broad, normally with unconstricted frontals. The fur modified into spines or quills or a mixture of both, the tail entering into the general spiny modification, bearing either a cluster of hollow rattling quills, or a brush of modified bristles at its end. Five hindtoes . . .
- 2 (1) Lower jaw with angular portion not distorted outwards as above described, the angular process either pulled inwards or without special peculiarity (occasionally perforated). (In India, no extreme modification of fur into spines.)

Fam.: HYSTRICIDAE

- 3 (4) Infraorbital foramen not or scarcely open for muscle transmission. Zygomatic plate broadened, more specialized, tilted upwards to a greater or lesser degree, not completely below the infraorbital foramen. Five hindtoes. Skull with postorbital processes. Cheekteeth $5/4$ or $4/4$, the pattern normally a series of transverse ridges and corner cusps in the upper jaw, the lower cheekteeth usually basin-shaped, with a cusp at each corner. Fibula not fused with the tibia. Externally modified for arboreal or terrestrial life, sometimes with flying membrane attached to the sides. Tail always completely haired
- Fam.: SCIURIDAE
- 4 (3) Infraorbital foramen clearly open for muscle transmission. Skull without postorbital processes. Not combining the characters of the last family. Fibula reduced, fully fused with the tibia. . . .
- 5 (8) The zygomatic plate is narrow and completely below the strongly enlarged infraorbital foramen. Jugal bone usually long; mandible with angular portion sometimes perforated; cheekteeth rooted, either cuspidate (in which case the cusps of the upper molars are arranged in two longitudinal rows or flat-crowned, with inner and outer re-entrant folds, their number $4/3$ or $3/3$)
- Fam.: DIPODIDAE (6)
- 6 (7) The three central metatarsal bones not fused to form a cannonbone. Animal not modified for bipedal saltatorial life. Zygoma simple, not in two portions, the jugal slanting gradually up towards the lachrymal. Five functional hindtoes. Frontals constricted . . .
- Subfam.: SICISTINAE
- 7 (6) The three central metatarsals fused to form a cannonbone. Animal modified for bipedal saltatorial life. The zygoma in two sharply contrasted portions, a horizontal and a vertical. Three functional hindtoes (but five in all in the Indian genus). Frontals scarcely constricted
- Subfam.: DIPODINAE
- 8 (5) The zygomatic plate is broadened and tilted upwards to a greater or lesser degree; the infraorbital fora-

men normally not so strongly enlarged. Usually frontals somewhat narrowed. (Never modified for bipedal saltatorial life in Asian genera.)

9

- 9 (12) The pattern of the cheekteeth has many transverse crossridges extending across the crowns; in primitive forms the teeth are more or less basinshaped, with cusps at corners, reminiscent of those of the Sciuridae; in specialized forms the cheekteeth become flatcrowned. Angular portion of lower jaw sometimes perforated. Cheekteeth 4/4 or 3/3. Caecum usually, not always, absent. Jugal usually relatively long. Tail usually fully haired or bushy. Palate proportionately short
- [(10)
Fam.: MUSCARDINIDAE
- 10 (11) Cheekteeth 4/4, cuspidate. Bullae large, well inflated. Palate less imperfectly ossified. Frontals relatively narrow
- [NINAE
Subfam.: MUSCARDI-
- 11 (10) Cheekteeth 3/3, flatcrowned, with the depressions (between the ridges) becoming isolated on crown surface with wear. Bullae small, reduced. Palate rather poorly ossified. Frontals relatively broad
- [MYINAE
Subfam.: PLATACANTHO-
- 12 (9) The pattern of the cheekteeth is various, but never as described above for the Muscardinidae, and the number of the cheekteeth does not normally exceed 3/3. Angular portion of the mandible not perforated. Jugal mostly shortened and reduced. The tail is most often naked, and very rarely bushy.
- (13)
- 13 (14) Infraorbital foramen reduced, its lower border nearly straight. Zygomatic plate tilted very strongly upwards, the masseter muscle extending its line of attachment on to the inside of the infraorbital foramen. Cheekteeth flatcrowned, with re-entrant inner and outer folds which ultimately isolate as islands on crown surface. Cranially specialized for underground life; mandible with lower incisor root forming a prominent knob below or near the condylar process
- Fam.: RHIZOMYIDAE
- 14 (13) Infraorbital foramen as a rule less reduced, its lower border usually V-shaped. Masseter muscle not, so

- far as known, extending its line of attachment on to inside of infra-orbital foramen
- 15 (16) Cheekteeth frequently evergrowing, complex-prismatic in pattern. Skull considerably specialized, either for underground life or, more normally, by a general shifting forwards of the ridges for jawmuscle attachment; the ridges fuse, when they do so, in the interorbital region of the skull rather than (as in other rodents) on the parietals. Squamosal crests developed. Infraorbital foramen small. Tail normally hairy and relatively short.
- 16 (15) Cheekteeth of different pattern, rooted (with one extralimital exception (the Gerbilline genus *Rhombomys*)). Skull without the peculiarities described above.. .. (17)
- 17 (18) Skull specialized with tendency to inflation of the bullae, enlargement of braincase, and weakening of rostrum, zygoma and mandible, its general type suggestive of that found elsewhere in saltatorial rodents. External form more or less specialized for life in plains or deserts; some species at least are saltatorial. Tail usually hairy, long in Asiatic genera. Cheekteeth either relatively simple prismatic in type, or upper molars with two longitudinal rows of cusps. (Upper incisors usually grooved.)
- 18 (17) Skull without the specializations described above 19
- 19 (20) Upper cheekteeth with the laminae separated by fairly wide folds, and when cuspidate there are two well marked rows of cusps present. (In Asiatic genera, the tail is rather hairy and, with the exception of *Calomyscus*, considerably shortened.) ...
- Upper cheekteeth laminate, with the laminae pressed closely together, and when cuspidate there are three well-marked rows of cusps present. (Animal usually generalized, with long and naked tail. Occasionally the hallux lacks a claw and becomes fully opposable.)
- Fam.: MURIDAE (15)
- Subfam.: MICROTINAE
- Subfam.: GERBILLINAE
- Subfam.: CRICETINAE
- Subfam.: MURINAE

American authors prefer to split the Muridae into two families Muridae and Cricetidae (the latter containing Gerbillinae and Microtinae). In favour of this classification, see Simpson (1945, p. 206), and against it Hinton (1926, p. 122). Having examined every skull in the British Museum for the Rodentia, I agree with Hinton that there is 'evidence to prove that all Muridae (and indeed all Simplicidentata rodents) have descended from ancestors with brachyodont multi-tuberculate molars, in which the tubercles both in upper and lower molars were triserially arranged', and I therefore follow that author who regarded Cricetinae, Microtinae and Gerbillinae as belonging to the family Muridae. There are in Africa certain genera which seem dentally somewhat intermediate between Cricetinae and Microtinae; indeed if any splitting within the family Muridae is done, it should be the Microtinae and Gerbillinae which should be given family rank rather than the Cricetinae.

Some authors prefer to divide the Hystricidae into two subfamilies Hystricinae and Atherurinae, and the Sciuridae into two subfamilies Sciurinae and Pteromyinae, but these divisions are in my opinion unnecessary as I have fully discussed elsewhere. Blanford (1891), while keeping the flying squirrels ('Pteromyinae') in his Sciurinae, regarded the marmots as a subfamily 'Arctomyinae' (which would now be called Marmotinae), but this division was long ago abandoned.

GEOGRAPHICAL DISTRIBUTION

The territory now under consideration might be divided into three large areas, each of which has a characteristic fauna. The first area, Nepal, Assam and Burma, has by far the largest number of species of rodents (approximately 79 out of the 115 species recognized in this work), and has its affinities with southern China, Indo-China, and the Malay region. About 55 of the species do not occur in any other part of India (some 20 of which are known from Burma alone), while a few Peninsular or Palaearctic species have their easternmost distributional limit in Nepal. Two peculiar genera of Murinae, *Diomys* and *Hadromys*, seem practically confined to Manipur. The second great area comprises Kashmir, Baluchistan, the Punjab and parts of Sind, and its fauna is primarily Palaearctic. In this area about 41 (out of 115) species occur. Of these 17 are not known from any other part of India, and the sole Indian representatives of the family Dipodidae and the subfamily Cricetinae are in this region. The woolly flying squirrel, *Eupetaurus*, is found in no other part of the

world than Kashmir, and a Microtine genus, *Hyperacrius*, is likewise entirely confined to the present region. The third great area is the Peninsula of India and Ceylon, with a relatively poor rodent fauna (approximately 35 out of 115 species only); for some reason the Ganges River, and for more obvious reasons the semi-deserts of the north-west of the area seem to have prevented infiltration of many species into the region. Fifteen species are, within Indian territory, only found in this region (three of them, Murines, are confined to Ceylon). The interesting Malabar spiny dormouse, *Platacanthomys*, is peculiar to southern India. Of the 35 species found in the Peninsula, five do not range south of Kathiawar, and seem to be mainly Palaearctic in range. The Murine genus *Golunda* is only known from Indian territory, but it has a wide range (practically throughout although not recorded from Kashmir and not eastwards of NW Assam). The Sciurine genus *Funambulus* which is confined to the west of the Bay of Bengal has recently been recorded from southern Persia but is otherwise Indian in distribution.

CRANIAL MEASUREMENTS

The cranial measurements for the various species have been taken as follows:—

OCCIPITONASAL: from the anterior tip of the nasal to the back of the occiput (approximately to top of foramen magnum in the rare cases when the occiput slants backwards behind lambdoid region, as in extremely fossorial rodents).

PALATE: from the front of the incisors to the back of the palate, ignoring the spinous process when it is present behind the palate.

DIASTEMA: from a point immediately behind the incisor to a point immediately in front of the front cheektooth.

PALATAL FORAMINA: from a point immediately in front of the foramina to a point immediately behind it.

BULLAE: from a point immediately next to the paroccipital process to the nearest point opposite of the inflated part of the bulla, but not including the mastoid portion should it be swollen (as occurs in some genera of Gerbillinae or Dipodidae).

TOOTHROW: crown length of upper toothrow

FRONTALS: least interorbital width.

ORBIT (used in Sciuridae but not elsewhere): from the lachrymal to a point on the posterior zygomatic root just after the latter has left the squamosal,

OCCIPUT (used in fossorial rodents like Rhizomyidae): from top of foramen magnum to top of the lambdoid ridge.

CONDYLOBASAL: from the occiput to the front of the incisor.

NASALS: length of nasals.

All measurements, both cranial and external, are in millimetres.

SYSTEMATIC ACCOUNT

Family I. SCIURIDAE

Squirrels and Marmots

Distribution : World-wide except southern South America, Australasia and Madagascar.

Typically medium sized, but occasionally very small or large rodents in which the infraorbital foramen is not open for muscle transmission, but the zygomatic plate is broadened or tilted upwards to a greater or lesser extent and the masseter lateralis muscle rises up over it to the superior border of the rostrum; angular portion of mandible never distorted outwards, but often with signs of inflection. Jugal bone rather long. Skull always with clear postorbital processes. In general the skull is broad, with broad little-constricted frontal bones, and with the bullae not much enlarged nor reduced, and the palatal foramina very small and situated far in front of the toothrows. Dental formula I. 1/1, C. 0/0, P. 2 or 1/1, M. 3/3 = 20 or 22. The cheekteeth are rooted and primitively complex in pattern, the lower molars usually basinshaped; the upper series have as a general rule one long main inner cusp and as many as four outer cusps, with at least two transverse ridges present in most of the teeth. The extra premolar when present is as a rule very small, though rarely it may be quite large and functional. Externally, the tail is always fully haired and usually bushy; there are five hindtoes; the feet are not very highly specialized towards arboreal life although the majority of the genera are arboreal; a flying membrane may be present attached to sides of body. Fibula free, not fused with the tibia.

This family is one of the most successful of rodent families, being in number of genera and species and races second only to the enormous family Muridae. It also has the widest

distribution of any family of rodents except the Muridae. Among Indian rodents it may at once be distinguished by being the only family in which the infraorbital foramen does not transmit muscle.

Authors are not in entire agreement about the number of genera to be retained in this family, but about thirty valid genera are known from some part of Asia, and eleven of these reach Indian territory. It is convenient to divide the family into two groups based on the presence or absence of flying membrane. Many authors regard these two groups as sub-families, some even as families. There is no proof, however, that the presence of a flying membrane of necessity makes all genera with the character specially allied to each other; it may have been developed independently several times. This family is very much more numerous as regards genera in the tropics, particularly in Asia. Thus, only half a dozen genera range as far north as Siberian territory (Turkestan included); whereas in the Malay Peninsula and larger Malay Islands to Borneo and Celebes there are no less than eighteen genera present. In Blanford's day there were only five genera recognized in Indian territory; about double this number may be admitted today, on a conservative basis. The more important genera which occur on the mainland of Asia but do not reach India are as follows:—

Non-flying squirrels: *Sciurus*, typical tree-squirrels (whole of Europe)—Siberia east to Japan and in Mongolia, Persia and Asia Minor. *Tamias*, chipmunks—Siberia and China south to Szechuan, Japan. *Citellus*, sousliks—Siberia, northern China, Persia, Asia Minor. *Spermophilopsis*, a terrestrial genus from Russian Turkestan and Afghanistan. *Sciurotamias*—China, from Szechuan to Chihli. *Lariscus* and *Rhinosciurus*—Malay States and thence south-eastwards through the larger islands. Flying squirrels: *Pteromys*, northern flying squirrels—Russia, Siberia, Japan and north China. *Trogopterus*—China from Chihli to Yunnan and the Indian border in the Chumbi Valley. And four Malay Islands genera which just reach the mainland in the Malay States, *Petaurillus*, *Iomys*, *Pteromyscus* and *Aeromys*. A few other Asiatic genera are confined to the larger Malay Islands. The eleven genera which do occur in India will be dealt with in detail below.

Special works of reference on squirrels include:

- 1893. Forsyth Major, *Proc. zool. Soc., Lond.*, 179. On some Miocene squirrels, with remarks on the dentition and classification of the Sciuridae.
- 1908. Thomas, *J. Bombay nat. Hist. Soc.*, 18, 244. On the generic position of the groups of squirrels typified by

- Sciurus berdmorei* and *pernyi* respectively. (Rearrangement of genera from the Indo-Malayan region, not including flying squirrels.)
1908. Thomas, *Ann. Mag. nat. Hist.*, **1**, 1. The genera and subgenera of the *Sciuropterus* group. (Rearrangement of genera of the smaller flying squirrels.)
1912. Miller, *Catalogue of Mammals of Western Europe*, 897. Sciuridae and 'Petauristidae'. European genera.
1915. Thomas, *Ann. Mag. nat. Hist.*, **15**, 383. The penis-bone or baculum as a guide to classification of certain squirrels.
1918. Robinson and Kloss, *Rec. Indian Mus.*, **15**, 4, 171-250. Nominal list of oriental Sciuridae.
1922. Pocock, *Proc. zool. Soc., Lond.*, 1171. On the external characters of the beaver and some squirrels.
1923. Pocock, *Proc. zool. Soc., Lond.*, 209. Classification of Sciuridae based on the baculum.
1940. Ellerman, *Families and Genera of Living Rodents*, **1**, 259. Review of history of classification of genera.

Blanford (1891) recognized five genera of Sciuridae—*Eupetaurus*, *Pteromys*, *Sciuropterus*, *Sciurus*, and '*Arctomys*'. '*Arctomys*' is now called *Marmota* because that name is the first name for the marmots. This and *Eupetaurus* of Blanford are unchanged in scope. *Pteromys* of Blanford is now called *Petaurista*, which is an earlier name. '*Sciuropterus*' of Blanford has since been divided by Thomas into two genera, one of which, *Belomys* (for *pearsoni*), is entirely distinct from all others, and requires no great comparison with any of them on account of its peculiar dental characters; the rest were referred to *Sciuropterus* by Thomas, and divided into about three subgenera (in Indian territory). '*Sciuropterus*' is now called *Pteromys*. I have endeavoured to show (Ellerman, 1940) that this name should be restricted to the northern Palaearctic flying squirrels which are just as distinct generically from other Pteromyine genera as are those groups given full generic rank by Thomas. Therefore, the other subgenera of Thomas should be given generic rank. *Hylopetes* is the first name, and contains the species *alboniger*, *lepidus* and *spadiceus*. The species *fimbriatus* has received another generic name *Eoglaucomys*, which I formerly adopted, but subsequent work suggests that there is no need to retain that as a full genus distinct from *Hylopetes*. The remaining species in Blanford, *fuscocapillus*, belongs to the genus *Petinomys* which I think it reasonable to retain on account of its peculiar bullae. It must be noted, however, that Simpson (1945) in his classification of the family and the list he gives has merged *Petinomys* with *Hylopetes* but retains *Eoglaucomys*. It is further complicated by the fact that *Hylopetes* which contains the generalized species of smaller flying squirrel from the Indo-Malayan region is very closely allied to the North

American genus *Glaucomys*, which antedates it. Of the non-flying squirrels, the genus *Sciurus* is now restricted to the Palaearctic, Nearctic, and Neotropical regions. Seven genera of Thomas are represented in Blanford's genus *Sciurus*. Two of these, '*Tomeutes*' and *Tamiops* I have merged with *Callosciurus*, which now contains the least specialized typical tree-squirrels of the Indo-Malayan region, because I believe them to be not generically separable. Indeed, *Callosciurus* is only distinguishable from *Sciurus* on the structure of its baculum, and this bone is not known yet for all the species. Chasen (1940) ignores *Callosciurus*, and there is something to be said for that idea, although it probably represents a natural group. 'Baculum' classifiers separate it widely from true *Sciurus*. Four other genera of tree-squirrels which occur in India are more definable: *Fumambulus*, for the western Indian striped palm-squirrels, species *palmarum*, *tristriatus*, *sublineatus* and *layardi* of Blanford; *Ratufa*, for the giant squirrels, *bicolor*, *indica* and *macroura*; *Dremomys*, for *rufigenis* and *lokriah* (and *pernyi* which is now known to occur in India; but *Dremomys* comes very close to *Callosciurus* and its retention is perhaps rather a matter of convenience than actual necessity); and, more distinct than those above, *Menetes*, for *berdmorei*, with peculiar dental characters. These five genera are now universally recognized, and it is reasonable to retain them.

Key to the Indian genera

1	(10) Flying membrane present, attached to sides of the body	2
2	(3) 'Cheekteeth strongly hypsodont'; 'Inner borders of upper molars proximally subangulate, their upper surfaces flat.' Fur exceptionally thick and heavy; sole heavily haired; a large species, hindfoot about 85 mm. (I have not been able to examine a skull of this genus.)	<i>Eupetaurus</i>
3	(2) Cheekteeth not strongly hypsodont, the inner borders of the upper molars more rounded, their surface normally not flat. As a rule the fur is less thick and heavy, and the sole is not heavily haired. Except in certain forms of <i>Petaurista</i> , the hindfoot is below 85 mm.	4
4	(7) The lower molars are complex and excessively wrinkled, and lack the large central depression, which is	

characteristic of nearly all normal Sciuridae, in its place there are numerous small depressions on crown surface which are partially or completely isolated, the general effect very complex. The normal Sciurine pattern of the lower molars is masked. The upper molars are to a greater or lesser extent wrinkled as well

5

- 5 (6) The occipitonasal length in adult skull is normally not less than 60 mm. The width of the frontals is more than one-fifth of the occipitonasal length as a general rule, and the length of the upper toothrow is normally over one-fifth of the occipitonasal length and is very generally over 13 mm. (12.7 mm. and more). The third upper molar has normally two transverse ridges between the anterior and posterior margins of the tooth, or elements corresponding to two main ridges (the second main ridge has not become obliterated)

Petaurista

- 6 (5) The occipitonasal length is about 42 mm. The width of the frontals is less than one-fifth of the occipitonasal length. The length of the upper toothrow is roughly 10 mm. or less. (Upper and lower molars are excessively complexly wrinkled.)

Belomys

- 7 (4) The lower molars are less excessively wrinkled, and the large central depression which is characteristic of most normal Sciuridae is present and clear in each tooth. The upper molars have as a rule less tendency to wrinkling or complexity than in *Petaurista*; much less than in *Belomys*. The occipitonasal length very rarely reaches 60 mm. (only in about four specimens out of about a hundred examined; all these are *Hylomys fimbriatus*; in this species the toothrow does not exceed 12.3 mm. in length and is usually less than one-fifth of the occipitonasal length). The upper toothrow not over 12.3 mm. in the remaining genera. M. 3 has one main transverse ridge between the anterior and posterior margins of the tooth

8

- 8 (9) Bullae much flattened, scarcely rising above general level of base of the skull *Petinomys*
- 9 (8) Bullae not specially flattened, and not abnormal *Hylopetes*
- 10 (1) No flying membrane 11
- 11 (12) Occipitonasal length (in Europe and Asia) not less than 83.5 mm. and may exceed 100 mm. The braincase flattened, and a heavy sagittal crest present. The orbit (measured from the lachrymal to the posterior zygomatic root just after this has left the squamosal) is long, clearly over one-third of the occipitonasal length. P. 3 is large and functional. The external form is terrestrial, the middle finger is the longest, the tail is short, rather less than half the length of head and body. The appearance heavy, not squirrel-like. *Marmota*
- 12 (11) Occipitonasal length not exceeding 81 mm. Braincase usually less flattened, and sagittal crest most often absent, but when present light and weak; orbit as a rule less than a third of occipitonasal length (or rarely approximates this percentage in some forms of *Ratufa*); P. 4 usually reduced, or absent; external form arboreal; fourth finger of hand tends to be dominant; tail less shortened, exceeds half the head and body length; general form squirrel-like. 13
- 13 (14) Large squirrels, occipitonasal length exceeding 60 mm.; frontals very wide, their least width sometimes as much as 40% of the occipitonasal length; palate (measured from front of incisors to back of palate) very short; only four upper cheekteeth. *Ratufa*
- 14 (13) Smaller, occipitonasal length not reaching 60 mm.; characters as indicated for the last genus not combined; five upper cheekteeth. 15
- 15 (16) Pattern of cheekteeth abnormal, becoming flatcrowned, with isolated folds present in adult; upper molars become more or less horse-shoe-shaped; lower molars tend to become transversely ridged, the central pitlike depression characteristic of normal genera reduced and appearing as a pitlike central

- re-entrant fold; rostrum elongated, nasal length exceeds least inter-orbital width; coronoid process of mandible reduced; back striped *Menetes*
- 16 (15) Pattern of cheekteeth without extreme peculiarity 17
- 17 (18) Coronoid process of mandible low and reduced; baculum simpler in structure ('lacking an accessory blade', Pocock); back striped; most often there is a tendency towards narrowing of frontal bones (except in *F. layardi*, a little known species in which, so far as is ascertainable in the poor material available, the length of the nasals exceeds 11 mm.) . . . *Funambulus*
- 18 (17) Coronoid process of mandible not reduced; baculum more complex, 'with an accessory blade present' (Pocock, Thomas). Back generally not striped, except in subgenus *Tamiops* of *Callosciurus*, which contains species in which the nasals do not reach 11 mm. in length, and in which the frontals are relatively wider than in normal species of *Funambulus* (all species except *F. layardi*) . . . 19
- 19 (20) Skull narrow, length of nasals usually exceeds interorbital breadth, which is usually less than 30% of occipitonasal length; rostrum somewhat elongated; orbit normally less than 30% of occipitonasal length, and in Indian specimens less than 16 mm. in length *Dremomys*
- 20 (19) Skull wide, interorbital breadth usually exceeds nasal length and is rarely as low as 30% of occipitonasal length (in Indian forms, the sole exception among numerous races to the last statement seems to be *C. pygerythrus owensi*, which has the length of the orbit at least 16 mm.) *Callosciurus*

Genus 1. *Belomys* Thomas

1908. *Belomys* Thomas, *Ann. Mag. nat. Hist.*, 1, 2.

Type-species.—*Sciuropterus pearsoni* Gray.

Range.—SIKKIM, N. BENGAL, ASSAM, BURMA, Indo-China, Formosa, and according to Allen (1938) probably Yunnan and Kwantung.

This genus contains a single species of flying squirrel which is remarkable for its unusually wrinkled and complex cheek-teeth, a structure which may represent a primitive character or may be an abnormal specialization towards some kind of diet; but cheekteeth as complex as in this genus are not known elsewhere in the Order Rodentia except for a few closely allied genera as *Trogopterus*, *Pteromyscus* and perhaps *Petaurista* in part. As in all flying squirrels there are five upper cheekteeth, and the orbit is long, clearly over one-third of occipitonasal length, as is very general in Eurasian flying squirrel genera (the sole exception as far as I know to this character is the genus *Petaurillus*).

This genus is best distinguished from *Trogopterus*, a closely allied genus from China which antedates it, by its shorter teeth; in *Belomys* they are not, apparently, over 10.1 mm. at highest, and are considerably less than one-quarter of the occipitonasal length, whereas in *Trogopterus* they are apparently not under 14 mm., and over one-quarter of the occipitonasal length. *Belomys* has narrower frontals apparently than any species of *Petaurista*, to which its molars bear some resemblance, and is considerably smaller in size. From *Pteromyscus*, another complex-toothed genus from Malaya, Sumatra and Borneo, it differs by its much smaller bullae (well under one-quarter of occipitonasal length in *Belomys*, over one-quarter in *Pteromyscus*). Other genera of flying squirrels have much simpler molars than *Belomys*. There is only one valid species of *Belomys*.

External characters.—As in the species below.

Cranial and dental characters.—As in the species below.

1. *Belomys pearsonii* (Gray)

The Hairy-footed Flying Squirrel

1842. *Sciuropterus pearsonii* Gray, *Ann. Mag. nat. Hist.*, **10**, 263.

1847. *Sciuropterus villosus* Blyth, *J. Asiat. Soc. Bengal*, **16**, 866.

Type-locality.—Darjeeling.

Distribution.—As in the genus *Belomys*.

It is probable that there are two races in India. These will be discussed below.

External characters.—Fur rather soft; tail long, but not so long as head and body apparently, flat and broad, bushy throughout. A tuft of longish hairs at base of each earconch. Whiskers prominent. Belly well furred. Hand with four functional digits, the claws sharp, the relative lengths of the

fingers being 4 longest, then 3, then 5, then 2. Foot with five toes, fourth slightly the longest, the others nearly equal to it except the hallux which only reaches up to about half the length of the second toe; claws sharp and prominent. The outer side of the sole is hairy, and there is one conspicuous pad at the base of the hallux, which is joined to the four at the base of the digits (not separated from them by the hair of the outer side of the sole). The flying membrane stretches from the wrist to the knee each side, or to slightly below the knee. The flying membrane of flying squirrels is supported by a cartilaginous outgrowth from the wrist.

I have no note on the mammary formula, but there are at least six traceable in a skin seen.

Colour.—Above dark brown to reddish brown, grizzled, with white tipped hairs profusely present. Parachute evidently darker than sides, mostly black. Feet as a rule paler, dark greyish. Tail brown through most of its length, tending to be near greyish white basally in some specimens, particularly below. Belly white throughout in two skins available for *trichotis*, this extending to the chest and throat; other specimens appear greyish white to grey below, but the throat often white.

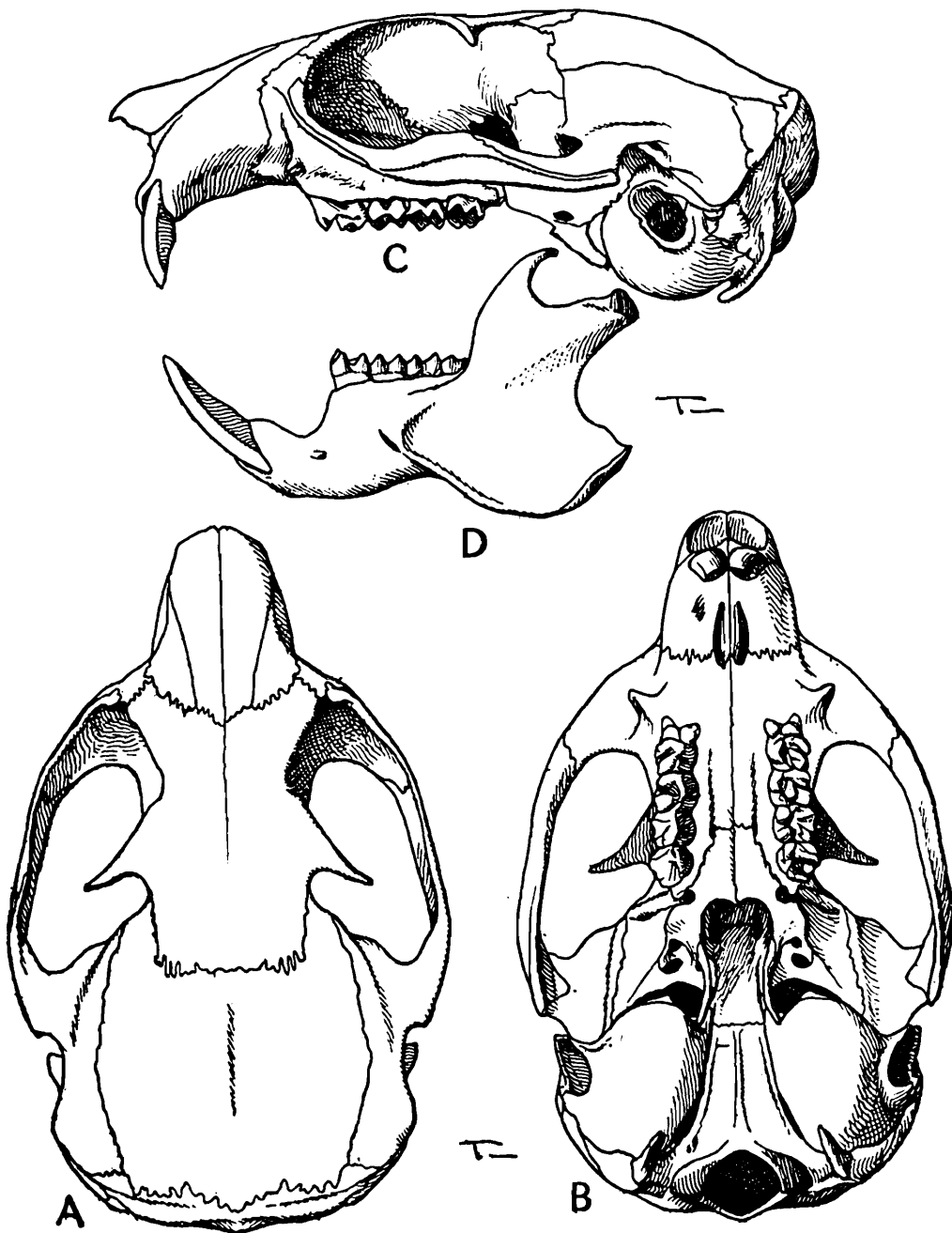
External measurements.—Of the specimens of the species examined by me, the only one that had been measured in flesh came from Yin, Chindwin. H. and B. 180; Tail 161; Hindfoot 36.5; Ear 22.5 mm.

Unmeasured skins seen from 40 miles west of Kalewa, Chindwin, and the type of *trichotis*, which came from Machi, Manipur. Unmeasured skins for the typical race seen from Sikkim and Darjeeling (including the type). One specimen was 'taken in hole in teak tree, in teak and bamboo forest'

Cranial characters.—The skull is medium in size; the occipitonasal length in the one unbroken specimen which I have seen is 42.3 mm. in length. Nasals wider in front than behind. Postorbital process quite well developed though less exaggerated than in larger species. Frontals moderately constricted in front of the postorbital process. Suture of frontals and parietals nearly straight, situated considerably behind the postorbital process. Parietals not specially ridged. Occiput low. Bullae moderately large, over one-fifth of occipitonasal length. Palate long, over a half of occipitonasal length, and broad; extending to slightly behind the toothrows; pterygoid fossae extremely shallow. Palatal foramina situated far in front of the toothrows, and short. Zygomatic plate very low for a member of this family but tilted upwards to a certain extent, its outer border ridged.

The orbit, measured from lachrymal to a point near the posterior zygomatic root, is as in almost all flying squirrels (and all Indian ones) long, clearly over one-third of the occipitonasal length. Mandible with well developed coronoid process, the angular portion shows signs of inflection, its lower border well ridged.

A skull from Tonkin measures: occipitonasal length 42.3 mm., palate 21.7 mm., toothrow 8.5 mm., nasals 12.7 mm., frontals 8.4 mm., orbit 15.9 mm., and bullae about 9.1 mm.



TEXT-FIG. 1. *Belomys pearsoni trichotis* Thomas ♂. A, B, C, dorsal, ventral and lateral views of the skull; D, lower jaw of the same. ($\times 2$). (After Ellerman, 1940, p. 278.)

Dental characters.—Upper incisors yellow, of medium width, and plain. Upper toothrow about a fifth of the occipitonasal length, the pattern of the molars excessively distorted by wrinkling. P. 3 very small, situated on the inner side of the front portion of P. 4, not visible when the toothrow is viewed from the outside. Teeth not varying greatly in size except for the small front premolar; a tendency present perhaps of P. 4 to be slightly dominant. Instead of the inner border of the upper molars being more or less evenly rounded (one long cusp), there are traces of at least two well marked inner cusps on each molar; the small functionless premolar more or less takes the place of the front inner cusp of the molars on the second, large premolar which therefore has only one inner cusp. Outer side of upper molars with two main outer cusps, and a small cusp situated in between them; M. 3, as often in squirrels, with only one large outer cusp (situated anteriorly); in the middle of the teeth may be traced a third (central) row of low cusps or projections in moderately worn specimens; the cusps high, and surrounded by numerous deep depressions; a specimen with worn teeth has the cusps lower than usual, and at least six isolated islands (formerly depressions) of varying sizes more or less isolated on each tooth; (M. 3 slightly simpler, with five isolated depressions); the general effect is always excessively complex. Lower molars; fundamentally there is a cusp at the corner of each tooth, the anterointernal one the highest for each tooth; and there is a small mid-outer cusp between the two main ones on the outer side; the cusps high, and the depressions between them deep; there are numerous small cusp spaces or pits in the middle of the lower molars, which in the specimen with worn teeth are all isolated in the middle of the teeth, so that the large central depression characteristic of normal Sciurine lower molars is practically obliterated. There is a tendency for the teeth to decrease slightly in size from M. 3 forwards.

Cranial measurements.—All Indian specimens available for *Belomys pearsoni* are broken, or not fully measurable. Specimens examined from Sikkim and Naga Hills, Assam, and (for *trichotis*) from Yin, and the type which came from Machi, Manipur.

Dimensions of the species *Belomys pearsoni*, as indicated by *British Museum material*: the occipitonasal is about 42.3 mm. The toothrow varies between 8.5 and 10.1 mm. The head and body between 180 and 196 mm. The tail between 151 and 168 mm. The hindfoot 31–39 mm.

The material for this genus is very scanty, and it is not at all well known. But it does seem to me possible that there are two valid races in India. The second name in the genus appears to be *villosus* Blyth, 1847, which is probably a synonym of *pearsoni*. I have not seen material to prove this one way or the other; but Anthony (1941) states that 'there is nothing in Blyth's description of *villosus* that will not fit *pearsoni*'. The Formosan race, *kaleensis*, 1862, appears to me to come very close to the typical race, and I do not know how it can be separated from that; but *B. p. trichotis* Thomas, 1908, can be separated from the typical on the basis of its smaller tooththrow. Osgood's race, *blandus*, 1932, from Tonkin, is most like *trichotis* in dental size. But, as I have said above, the material is very scanty, and with a large series perhaps even this distinction could not be maintained.

*Provisional key to the races of Belomys
pearsoni from India*

1	(2)	The upper tooththrow 9.6 and more, most often about 10 mm.	<i>B. p. pearsoni</i>
2	(1)	The upper tooththrow not exceeding 9 mm., usually less	<i>B. p. trichotis</i>

(i) *Belomys pearsoni pearsoni* (Gray)

1842. *Sciuropterus pearsonii* Gray, *Ann. Mag. nat. Hist.*, **10**, 263.

1847. *Sciuropterus villosus* Blyth, *J. Asiat. Soc. Bengal*, **16**, 866.
(Upper Assam.)

Type-locality.—Darjeeling, N. Bengal.

Range.—Specimens examined from SIKKIM; N. BENGAL, Darjeeling. ASSAM, Naga Hills.

Upper tooththrow about 9.6–10 mm. Underside not wholly white, particularly the chest region.

(ii) *Belomys pearsoni trichotis* Thomas

Text-fig. 1

1908. *Belomys trichotis* Thomas, *Ann. Mag. nat. Hist.*, **1**, 7.

Type-locality.—Machi, Manipur.

Range.—Specimens examined from MANIPUR, Machi; BURMA, Yin, Lower Chindwin; 40 miles west of Kalewa, Chindwin; TONKIN.

Upper tooththrow about 8.8–9 mm. Underside, including the chest, white.

Genus 2. *Petaurista* Link

1795. *Petaurista* Link, *Beytr. Naturgesch.*, 1(2), 78.

Type-species.—*Sciurus petaurista* ('Linnaeus') = *Sciurus petaurista* Gmelin = *Sciurus petaurista* Pallas.

Range.—CEYLON, PENINSULAR INDIA, PUNJAB, KASHMIR, NEPAL, ASSAM, BURMA; southern and eastern China, northwards to Japan and Manchuria, and to Kansu; Formosa, Indo-China, Siam, Malay States, Sumatra, Java, and Borneo, and adjacent small islands in the Malay region.

This genus contains the larger flying squirrels with wrinkled and complex molars, and is one of the most abundant and widely distributed of flying squirrel genera. It is distributed almost throughout Indian territory with the exception of the western Palaearctic portion (west of the Indus) and it seems rare or absent in Rajputana and adjacent states.

Now that Allen (1940) has separated the Chihli giant flying squirrel *melanopterus* as a distinct genus *Aeretes*, it may be safely said that species of *Petaurista* do not differ cranially or dentally from each other apart sometimes from slight size differences, and the definition of species within the genus is largely a matter of convenience, or of defining species where two or more forms occur in the same places, or the same general neighbourhood. Undoubtedly there have in the past been far too many species retained in this genus. It will be most convenient, before dealing with the species and races, to deal with the cranial and dental characters of the genus.

Cranial characters.—The skull is large; I have only seen one specimen out of well over a hundred which had the occipitonasal length less than 60 mm. The nasals are, as usual in squirrels, slightly wider in front than behind. The frontals are wide, more than one-fifth of the occipitonasal length normally, but most narrowed in front of the post-orbital process which is very prominent and well spread out from the skull, the frontals between the postorbital processes tending to be depressed. Frontals most often nearly straight where they meet the parietals posteriorly, but there is individual variation in this character. The parietals are ridged, if somewhat faintly, but the ridges remain widely apart in the adult. The ridges run forward from the top of the occiput to the back of the postorbital process. Occiput low. Paroccipital process quite prominent, closely applied to the bullae. Palate broad; it may be over half or less than half the occipitonasal length. Palatal foramina situated far in front of the toothrows, short and reduced. Of the numerous forms I have examined, the foramina are least reduced in the

Formosan form *P alborufus lena* Thomas, and they are slightly prominent in the one skull examined for the form *yunanensis*, which occurs in India. Mesopterygoid space wide; outside it the pterygoid fossae are very shallow. The bullae are well inflated though as a rule are less than one-fifth of the occipitonasal length. The toothrows are large in this genus, and always average over one-fifth of the occipitonasal length for each race. As is usual in flying squirrels, the orbit measurement (from lachrymal to posterior zygomatic root just after this leaves the squamosal) is always over one-third of the occipitonasal length. The mandible is not peculiar in formation; its coronoid is quite strong, and the angular portion is inflected to a degree. Zygomatic plate low.

Dental characters.—Upper incisors are red, usually, rather narrow, and plain, or at least not conspicuously grooved, though traces of incisor-grooving may occur in this genus, as individually in very many other genera of rodents. The molars are not of normal Sciurine pattern, and decidedly approach the abnormal condition found in *Belomys* in some ways, although they are not as extreme as in that genus. Front upper premolar very small and reduced; the remaining four teeth about equal in size. There is a tendency in this genus for the molars to become flatcrowned and lose their cuspidate character. Inner side of upper main teeth more or less rounded, but generally with a short but noticeable re-entrant fold in the posterointernal portion. There are in P 4, M. 1 and M. 2, the usual four main ridges extending outwards from the large inner cusp portion and surrounding three main depressions and in young teeth traces of numerous small extra complexities; the pattern ultimately wears down and the folds isolate as islands on crown surface. In this genus M. 3 is more complex than in most genera in that almost always there is a second clear ridge on that part of the tooth which in almost all allies is flat and simplified; this is the third ridge of the normal Sciurine tooth (the first being the anterior border of the tooth, the second being the one normally retained in M. 3 in squirrels, and the fourth being the posterior margin of the tooth). This is a very rare character in this family, and is of some importance. Its presence seems quite constant in a large series of skulls examined. It is a character which this genus shares with *Pteromys*, the Northern Palaearctic flying squirrels. This third main ridge is, however, in M. 3 smaller than the second main ridge, and tends sometimes to slant backwards to the middle of the back of the tooth, and then the fold between it and the main ridge in front of it becomes wider than is

usual. Occasionally in small Chinese races of the species *P. elegans*, such as *clarkei* and *marica*, are individuals which have M. 3 more as in *Hylopetes* or flying squirrels with more normal dentition, but these are very much the exception rather than the rule. The lower molars tend to decrease slightly in size from M. 3 forwards, and are highly abnormal. As in *Belomys*, their surface is excessively wrinkled and besides the four cusps at each corner are two small extra outer cusps as a rule, and numerous isolated small depressions running down the centre of the tooth so that the lower molars are not basinshaped but rather have a central row of small ridges isolating about four small central depressions; these depressions are isolated between two other suggested rows of depressions caused by the folds between the small and large inner and outer cusps, the general effect being complex in the extreme, and individually variable, but reminiscent of the pattern of *Belomys*.

*A note on the species of Petaurista, with particular
reference to the forms occurring in India*

The earliest name in this genus is *Petaurista petaurista* of Pallas, 1766, from Java, which is also the type. Chasen (1940) has shown that in the regions covered in his work, namely Malay States, Sumatra, Java, Borneo and adjacent small islands, there are two species of *Petaurista* occurring side by side throughout, which differ chiefly in size, *P. petaurista*, the larger species, and *P. elegans* Müller, 1839, the smaller one. If one takes a broad view of species one might quite safely say that these two species (or a larger and a smaller species) occur together throughout the whole of the south-eastern range of the genus, that is to say from Borneo westwards to as far north as Nepal in Indian territory and Szechuan in Chinese territory. This is the range of a group of races which I believe should bear the name *Petaurista elegans*.

Blanford (1891) recognized six species of *Petaurista* in India, which he characterized roughly as follows:—

Lower surface white or grey, *Petaurista philippensis*, 1839, which he called 'oral' (1842), and including *cineraceus*, 1847, from 'All the larger forests of the Indian Peninsula south of the Ganges, also Ceylon, and throughout Burma to Tenasserim and the Mergui Archipelago'.

Lower surface rufous; no white spots on the back.

Head above coloured like the back.

A short clearly defined black tip to tail.

Back paler in colour than parachute, *Petaurista albiventer*, 1834, which he called '*inornatus*', 1844. From 'The Western Himalayas, from 6,000 to 10,000 ft., extending west to Murree, common in Kashmir and about Simla, found in Kumaon and in Nepal (Katmandu)'.

Back deeper in colour than parachute, *Petaurista magnificus*, 1836 (with '*nobilis*', 1842, and '*chrysotrix*', 1844), from 'The Himalayas from Nepal eastwards and the ranges south of the Assam valley, at elevations from 6,000 to 9,000 ft.'

Tail-tip not black, or long and ill-defined, *Petaurista yunnanensis*, 1875 (from 'Hills south of the Assam valley, extending eastward to Yunnan'), (whether Blanford's name was based on true *yunnanensis* or not is not at the moment clear to me. Our Indian specimens of this form are from Mishmi and North Burma. Wroughton described Blanford's *yunnanensis* as *candidulus*, but Blanford's description does not seem entirely to fit *candidulus* as I understand that form, and we have several specimens available). Head much greyer than the back. *Petaurista caniceps*, 1842. From 'Nepal and Sikkim, ranging west as far as Landour at a lower elevation than *P. magnificus*, about 4,000-6,000 ft.' (with '*senex*', 1843).

Lower surface rufous; white spots on the back, *Petaurista punctatus*, from Karennee, Burma.

The Indian representative of this form is now called *marica*.

Both *punctatus* (*marica*) and *caniceps* I believe to be representative forms of the small species, *Petaurista elegans*. I have few specimens for *P. caniceps*, and this is one of those forms which is on the border-line in size between small *P. petaurista* type and largest *P. elegans*, making the two species difficult to define.

Cranial characters do not help very much in this genus, at least as far as measurements are concerned, and I have measurements for every unbroken skull for all races of the genus available in the British Museum. Certainly when measurements for all specimens of all races are noted, all Wroughton's keys for this genus at once collapse as quite valueless.

As this is the case, I have regarded most of the larger forms as races of the first name, *P. petaurista*. It seems unnecessary to divide this genus in India into several nominal species based on colour characters which intergrade to a certain extent.

It is certainly true that *Petaurista petaurista* as understood and listed by Chasen (1940), i.e. Malaya to Borneo, differs from Indian forms hitherto given specific or group rank like *albiventer* and *philippensis* by the fact that they are mostly unicolorous, without the grizzling on the back which is always present in *albiventer* and *philippensis*. I doubt whether this alone need be regarded as a specific character, and certainly

measurements of Malayasian *P. petaurista* are overlapped by the *albiventer* and *philippensis* sections of races throughout.

I would regard *P. magnificus* as a valid species because, so far as I have had occasion to examine it, it is very distinct in colour characters from all other forms and chiefly because there is a distinct possibility that it might occur in Nepal with *albiventer*. I have seen an authentic specimen of *albiventer* from Nepal, and according to Blanford, these two forms occur at the same elevation. The whole of our Nepal and Sikkim collection for *Petaurista* is not in good order and is rather scanty, *magnificus*, *albiventer* and *caniceps* included, and very many of the skins are very old, and with very little data on them. I do not know to what extent, if any at all, these two forms occur together, but taking into account the general distinctness of *magnificus* in outward appearance, it seems reasonable to leave that form as a distinct species confined (so far as our material shows) to Nepal and Sikkim, pending further collecting.

It is necessary to state that there is a very distinct species in Szechuan and Yunnan in China, with a representative in Formosa, namely *P. alborufus* Milne-Edwards, 1870. This is perhaps the most beautiful of all flying squirrels, and differs from the other species in its highly specialized deep red and white colour pattern, with the head white. I had always thought of it as being confined to China, but I suspect that it might be wise to refer the Assamese-Burmese race *candidulus* to it. This is a somewhat strikingly coloured large form, and it has the white head and forehead of *alborufus*, but is much less specialized than that in other colour characters. Nevertheless it is more like *P. alborufus* than other Indian forms of *Petaurista*, and it occurs in the same general region as *albiventer* in the Naga Hills. It also occurs in Tenasserim, where there is another form of what I propose to call *petaurista*, and although I do not know that *candidulus* definitely occurs with either of these, the possibility that it might do so cannot be ignored, but by regarding it as a generalized form of *alborufus*, to which in a way it is annectent, that difficulty is overcome. It may be mentioned that four out of the five valid species as here recognized, namely *petaurista*, *leucogenys*, *elegans* and *alborufus*, all occur in Yunnan; three of them together in the Likiang Range.

Key to the forms of Petaurista inhabiting India

- 1 (10) Relatively small species; the fully adult skull rarely reaches 65 mm. in occipitonasal length. (This

	species occurs with <i>Petaurista petaurista</i> throughout its range.)	<i>Petaurista elegans</i>	2
2	(3) Copious white spots are present on the forepart of the back ..	<i>P. e. marica</i>	
3	(2) No large white spots on the back		4
4	(5) The occipitonasal length of the type (and only known) skull is less than 61 mm.	<i>P. e. sibylla</i>	
5	(4) The occipitonasal length is normally more than 61 mm. (one exception in ten skulls).		6
6	(9) Smaller animals, the occipitonasal length is 64.1 mm. and less. The back is usually less brown ..		7
7	(8) Length of the nasals over 19.3 mm.	<i>P. e. gorkhali</i>	
8	(7) Length of the nasals 19.3 mm. and usually less ..	<i>P. e. clarkei</i>	
9	(6) Larger animals, the occipitonasal length roughly 64.7 mm. or more. Back usually browner ..	<i>P. e. caniceps</i>	
10	(1) Relatively large species. In Indian races, the fully adult skull is more than 65 mm.		11
11	(12) The head, including the forehead, white, strongly contrasted with the back. General colour red and white ..	[<i>P. a. candidulus</i> (with 'taylori') <i>Petaurista alborufus</i>	
12	(11) The head never white strongly contrasted with the back. (The cheeks can be white but, except in rare individual variations, never the forehead.).		13
13	(14) A large dark saddle patch on the back present or suggested; the middle of the neck and back always markedly darker than the sides and shoulders and generally than the parachute ..	[(with 'nobilis') <i>Petaurista magnificus</i>	
14	(13) No dark saddle patch, and the middle of the neck and back not markedly darker than and contrasted with the sides, shoulders or parachute ..	<i>Petaurista petaurista</i>	15
15	(26) The underparts white, or grey, or dull, never with any rufous tinge		16
16	(19) The tail mostly black, and with long black terminal portion ..		17
17	(18) The frontals proportionately wider, their combined width most often over 18 mm.	<i>P. p. lanka</i>	
18	(17) The frontals proportionately narrower, their combined width less than 18 mm., most often less than 17 mm.	['oral', 'cinderella') <i>P. p. philippensis</i> (with	
19	(16) The tail mostly grey, or only with a short black terminal portion		20

- 20 (21) The adult skull is about 74·8 mm. and more. The tail length is in material available over 500 mm. *P. p. cineraceus*
- 21 (20) The adult skull is less than 71 mm. The tail length in material available does not reach 500 mm. . . . 22
- 22 (23) The dorsal surface suffused with rufous *P. p. primrosei*
- 23 (22) The dorsal surface not as above; drab.
- 24 (25) Occipitonasal less than 67 mm. in length *P. p. mergulus*
- 25 (24) Occipitonasal more than 70 mm. in length *P. p. reguli*
- 26 (15) Underparts red or white, but always with a rufous tinge or some reddish or rufous markings on some part 27
- 27 (28) Occipitonasal length not less than 77 mm. (in the one Indian skull, it is over 81 mm.). *P. p. lylei* ('venningi')
- 28 (27) Occipitonasal length in material available not exceeding 76·3 mm. 29
- 29 (30) Occipitonasal length about 76 mm. The back is mostly deep, dark red *P. p. yunnanensis*
- 30 (29) Occipitonasal length not exceeding 73·1 mm. The red of the back when present is lighter, less deep and dark *P. p. albiventer* (with 'inornatus', 'birrelli' and 'fulvinus')

2. *Petaurista elegans* (Müller)

1839. *Pteromys elegans* Müller, in Temminck, *Verh. Nat. Ges. Ned. Overz. Bezitt. Zool.* (Zoogd. 1839), 35, 56 and 107, 112, pl. xvi, figs. 1-3.

Type-locality.—Island of Nusa Kumbangan, south of Java.

Distribution of the species (as here understood).—Borneo, Sumatra, Java, Malay Peninsula, Indo-China, Yunnan, Szechuan, BURMA, SIKKIM and NEPAL. Also the Natunas (*P. e. nitidula* Thomas, 1900, which is currently regarded as a form of *P. petaurista*, but apparently erroneously so).

A small species, variable in size, but always smaller than the local race of *Petaurista petaurista* occurring in the same neighbourhood with any race of the present species.

External characters.—Blanford states that this genus has the bony cartilage supporting the outer side of the wrist relatively longer than in the small flying squirrels, and that there is an interfemoral membrane and that the tail is bushy

but not distichous. Generally speaking this is probably so in *Petaurista*, but I would doubt whether it is a constant distinction between the genera. Some of the small races of the present species probably make an approach to the smaller genera; and sometimes in the Japanese species, *P. leucogenys*, the tail is thicker and more heavily haired than is usual in *Petaurista*. Tail long, usually longer than head and body as far as seen in skins available, and rather narrow, bushy throughout. Fur thick. Four fingers present, the fourth longest, the claws curved and prominent. Five toes, the hallux shortest, the others nearly equal in length, but the fifth not so long as the fourth. Sole mostly naked except the portion below the fifth toe which is hairy; four pads under the digits, one main pad behind the small one at base of hallux, and a small supplementary pad under the one at the base of D. 5, most often present or traceable.

Colour.—True *P. elegans* from Java differs from the Indian races in having the back darker grey, the rump and flying membranes contrasted dark reddish brown, the belly deeper red, and perhaps the tail blacker, but only one skin has been examined.

Petaurista elegans caniceps.—Nearly uniform brownish above, the head considerably greyer than the back. Underfur dark; grizzling apparent owing to many of the hairs being light at tips. Parachute slightly darker than the back, or tends to be so. Feet brown; cheeks grey; tail rather nondescript brownish, tending to be edged with black. Throat pale. Belly whitish to reddish, but with some rufous tinge present. One skin from Nepal is much darker brown in colour than two skins from Sikkim. This form is not at all well known.

Petaurista elegans clarkei.—A greyish species, the dorsal surface being mixed greyish and buffy; feet and sides of the parachute very pale light brown, and there are patches of this colour behind the ears. Head darker grey than back. Tail about the same colour as the back; black terminally. Cheeks grey, throat white. Belly whitish, sometimes mixed with yellowish on the chest, the sides of the ventral surface light reddish yellow.

Petaurista elegans gorkhali.—Is fairly similar, the back slightly more yellowish, less greyish; the belly tending to be more washed with ochraceous, and less whitish. Both these forms tend to have the genital regions area pale grey. On three skins is noted, 'weight 2 lb.'

Petaurista elegans marica.—Was described by Thomas as with the back 'tawny olive', and it has red flying membranes and a blackish head; over the head and forepart of the back are numerous strongly contrasted white spots which vary very much in development, and are more or less tufts of hair; they are most numerous on the head in two specimens, not so in a third. Feet the same colour as the flying membrane but the toes tend to become black at least in part; tail light brown. Belly yellowish or buffy, the midventral line tinged very pale reddish. This form is easily recognized by its white spots. Thomas says it differs from *P. e. punctatus* 'by its more yellowish general colour, its blackish head, and bright rufous tail and feet' Cheeks the same colour as the belly. Tail can be slightly black terminally.

External measurements of Petaurista elegans in India

	Head and body	Tail	Hind- foot	Ear
<i>Petaurista elegans caniceps</i>				
F. Sikkim	?	?	63	42
Nepal, type	?	?	67	42
M. Type of 'senex', Nepal	?	?	65	39
<i>Petaurista elegans gorkhali</i>				
Apoon Sottidanda, Gorkha, Nepal .	330	345	63	44
Barpak, Gorkha, Nepal	315	360	62	46
Barpak, Nepal	330	370	63	42
M. Apoon Sottidanda, Nepal, Type	340	350	62	42
<i>Petaurista elegans marica</i>				
M. Yunnan	350	375	59	45
M. Yunnan	373	347	60	45

Both these specimens are extralimital. An authentic but unmeasured skin examined from Namhsan 40 miles East of Mogok, North Shan States, Upper Burma.

Our skins for *P. e. clarkei* are all from Yunnan, and vary as follows: head and body 296–368 mm. Tail 365–403 mm. Foot 59–68 mm. Ear 46–50 mm.

According to Thomas, the type of *P. e. sibylla* measured head and body 341 mm., tail 341, foot 62 and ear 39 mm.

Cranial and dental characters.—Cranial and dental characters have been described above, under the genus *Petaurista*.

Cranial measurements of Indian forms of Petaurista elegans

	Occipitonasal	Palate	Toothrow	Nasals	Frontals	Orbit

Petaurista elegans caniceps

53.8.16.9 Nepal	64.7	32.3	14.2	19.5	13.7	22.7

The type skull, from Nepal, is broken. The type of 'senex', currently associated with this form, has the skull too large for the present species.

558a. Type of 'senex' Nepal	66.1	32.2	13.8	20.8	13.8	24.2

Petaurista elegans gorkhali

M. 1937.6.14.2 Barpak, Gorkha, Nepal	61.6	31.3	13.5	19.8	12.4	22.8
F. 1937.6.14.3 Barpak, Gorkha	63.5	31.9	14.6	19.6	12.7	23.1

The type, from Apoon Sottidanda, Gorkha, male, has the occipitonasal about 63.4 mm., the nasals 19.5 mm., the frontals less abnormally narrowed than those above, about 13.4 mm. Toothrow 14 mm.

I have seen no Indian skulls for *P. e. marica*, but I have seen skins for it from Burma. The occipitonasal length in Yunnan skulls is about 61–62.5 mm., the toothrow 12.7–13.2 mm., the frontals 14.7–15.2 mm. and the orbit about 22–22.7 mm.

I have seen no Indian specimens for *P. e. clarkei*, which has, however, been recorded from Upper Burma by Anthony. This form is very like *gorkhali*, which it antedates, differing merely in having the nasals slightly shorter. I have five skulls for *clarkei*, from Yunnan; their occipitonasal varies between 58.8 and 64.1 mm., but only once under 63 mm., the toothrow 13.2–14.6 mm. The nasals 17.8–19.3 mm., the frontals 13.2–15.2 mm. and the orbit 21–22.8 mm.

Petaurista elegans sybilla

	Occipitonasal	Palate	Toothrow	Nasals	Frontals	Orbit
F. 16.3.26.14. Type	60.4	30.3	14.1	17.1	14.1	22.7

Fifty miles west of Kindat, Chin Hills, Burma.

Dimensions of the species Petaurista elegans, as indicated in British Museum material, are as follows: The occipitonasal length varies between 58.8 and 66.1 mm. if 'senex' really belongs here, otherwise not over 64.7 mm. The toothrow

between 12·7 and 14·6 mm. The head and body varies between 296 and 373 mm., the tail between 345 and 403 mm., and the hindfoot between 59 and 68 mm.

Petaurista elegans caniceps is the first name for a race from India. I have seen only one skin, and no skulls, for the typical, Javan, race. It is entirely distinct in colour from any Indian race known to me. The next name in the species was *punctatus* Gray, 1846, from Malacca, which Chasen makes a race of *elegans*. This very likely occurs in India under the name *marica*, but *punctatus* is very little known, and most authors have adopted *marica* as a valid race. The peculiarity about these two races are the vivid white spots on the large part of the back, which distinguishes them well from their allies. The other races available to me, except the little known Natunas form, will all be discussed below, as they all inhabit India.

(i) *Petaurista elegans caniceps* (Gray)

The Grey-headed Flying Squirrel

1842. *Sciuropterus caniceps* Gray, *Ann. Mag. nat. Hist.*, 10, 262.

1844. *Sciuropterus senex* Hodgson, *J. Asiat. Soc. Beng.*, 13, 68.
(Nepal.)

Type-locality.—The type skull and skin in the British Museum are labelled Nepal.

Range.—Specimens examined from SIKKIM, no exact locality, and NEPAL, no exact locality. (At altitudes 4,000–6,000 ft., Blanford.)

Largest of the races of *P. elegans*, apparently, with the occipitonasal length about 64·7–66 mm. Colours rather drab, the back browner than in *clarkei*, the head greyer to a certain extent than the back. Hindfoot 63–67 mm. Frontals about 20–21% of occipitonasal length. So far as I can tell with inadequate material, constantly smaller than those forms of *P. petaurista* with which it is likely to occur, and smaller than *magnificus*.

(ii) *Petaurista elegans clarkei* Thomas

1922. *Petaurista clarkei* Thomas, *Ann. Mag. nat. Hist.*, 10, 396.

Type-locality.—Mekong Valley, Yunnan, 9–10,000 ft.

Specimens examined from YUNNAN, Mekong Valley, 28° N. Recorded from Upper Burma by Anthony.

Smaller than the last, occipitonasal length about 58·8–64·1 mm. in material examined. Colour differing from

caniceps in having the back less brown, more greyish. Hindfoot 59–68 mm. but usually about 60 mm. (65 in the type). Frontals varying between 21 and 23% of the occipitonasal length; 13.2 mm. at lowest in material examined.

(iii) ***Petaurista elegans gorkhali* (Lindsay)**

1929. *Sciuropterus gorkhali* Lindsay, *J. Bombay nat. Hist. Soc.*, 33, 3, 566.

Type-locality.—Apoon Sottidanda, Gorkha, Nepal, 12,000 ft. 84.50° E., 28° N.

Specimens seen from NEPAL: Apoon Sottidanda and Barpak, Gorkha, 12,000 ft.

Essentially like *clarkei* of which it is very likely a synonym, but the nasals apparently constantly longer. In *gorkhali* they are 19.3–19.8 mm. in our material, whereas in *clarkei* they are 18.7–19.3 mm. Occipitonasal length 61.8–63.5 mm. Hindfoot 62–64 mm. Frontals about 20–21% of occipitonasal length; unusually narrowed in the two duplicate skulls examined, but not so in the type.

It is a little difficult to see why Mrs. Lindsay in describing this form referred it to '*Sciuropterus*'. Although she quotes many similarities towards the smaller flying squirrels in her description and quotes several resemblances of this small *Petaurista* towards '*Sciuropterus*', her figures and averages on page 569 show close similarity in '*S.* *gorkhali* and *Petaurista clarkei*'; cranially *gorkhali* is shown merely as averaging a little narrower in the frontals and zygomatic breadth, and longer in the nasals. Individual skulls from *clarkei* overlap *gorkhali* in the frontal measurements. The incisive index is a little shorter in *gorkhali*. The generic character of *Petaurista* when all flying squirrels are compared really lies primarily in the lower molars in which *gorkhali* is a true *Petaurista*.

(iv) ***Petaurista elegans sybilla* Thomas**

1916. *Petaurista sybilla* Thomas, *J. Bombay nat. Hist. Soc.*, 24, 3, 424.

Type-locality.—50 miles west of Kindat, Chin Hills, Burma.

Apparently known only by the type specimen. The occipitonasal length of the type skull is 60.4 mm. The frontals about 23% of the occipitonasal length. Hindfoot 62 mm. (Thomas).

When I examined the type skins at Tring, I did not find this specimen. It may be distinguished from other Indian skulls of *P. elegans* by its unusually small size, though I have

seen one specimen of *clarkei* which is even smaller. Altitude 5,000 ft., so not a high level form as are *clarkei* and *gorkhali*. 'Coloration nearly similar to that of *marica*, but practically without white spots, a single one only present on the right hip of the type. Dorsal area grizzled ochraceous tawny, more olivaceous anteriorly, deeper tawny posteriorly. Parachute brilliant rufous. Undersurface bright ochraceous buff, edged with the brilliant rich rufous of the parachute; a black spot on the chin. Head rather more tawny than back, not blacker as in *marica*, a narrow blackish edge along the upper side of the orbits continued forward towards the muzzle; a spot at base of whiskers blackish. Postauricular patch large, prominent, brilliant ochraceous rufous. Hands and feet rich tawny rufous; a few brown hairs at the base of the claw of the hallux. Tail tawny rufous, the basal fourth of the hairs slaty; tip of tail with a few black hairs' (Thomas).

(v) *Petaurista elegans marica* Thomas

The Spotted Flying Squirrel

1912. *Petaurista marica* Thomas, *Ann. Mag. nat. Hist.*, 9, 687.

Type-locality.—Yunnan, probably near Mongtze.

Range.—Specimens examined from YUNNAN: No locality BURMA: Namhsan, 40 miles East of Mogok, North Shan States—it also occurs in Tonkin and Laos.

Occipitonasal length about 61–62.5 mm. Hindfoot 59–63 mm. Frontals rather wide, averaging about 24% of occipitonasal length in our small series. At once distinguishable from other Indian races by the large white spots on the back. According to Thomas, it may be distinguished from *P. e. punctatus* Gray, 1846, from Malacca, by its more yellowish general colour, its blackish head, and its bright rufous tail and feet. Our material for *punctatus* is very inadequate, but I suspect the present form might well be a synonym of it. The hindfoot in one skin for *punctatus*, the type, is 67 mm.

3. *Petaurista alborufus* (Milne-Edwards)

The Red and White Flying Squirrel

1870. *Pteromys alborufus* Milne-Edwards, *C.R. Acad. Sci. Paris*, 70, 342.

Type-locality.—From the neighbourhood of Moupin, Szechuan, China.

Distribution of the species (as here understood).—Szechuan, Hupeh, Yunnan, Formosa, ASSAM, parts of BURMA, TENASSERIM, Siam.

Distinguished from other *Petaurista* species by its highly specialized red and white colour pattern. The Indian race is much less specialized in this character than the Chinese races, but as it has the white forehead which is present in *P. alborufus*, and is, in general, intermediate between *alborufus* and some of the northern *petaurista* races of India, and as it occurs in the same general neighbourhood as *P. petaurista albiventer*, I am tentatively making it a race of *P. alborufus*. The Formosan race of *alborufus*, *P. a. lena* Thomas, 1907, antedates the Indian race; but it is a much smaller animal, and has the fully developed specialized contrasted red and white colour pattern of typical *alborufus*, which the Indian form lacks.

This species is always larger than *Petaurista elegans*, as judged by size of the skull.

Only one race, *P. e. candidulus* Wroughton, occurs in the Indian area and is characterized as follows:—

(i) *Petaurista alborufus candidulus* Wroughton

1911. *Petaurista candidulus* Wroughton, *J. Bombay nat. Hist. Soc.*, 20 (4), 1014, 1022.

1914 *Petaurista taylori* Thomas, *J. Bombay nat. Hist. Soc.*, 23 (2), 205. (Bankason, southern Tenasserim.)

Type-locality.—Kindat, West Burma.

P. a. 'taylori' is a little known form, and the material available is in bad condition, but I would doubt whether it will prove to be really distinguishable from *candidulus*, at least on material examined. The type has the back less grizzled than the type of *candidulus*. A reddish and white flying squirrel with the colours much less contrasted than they are in the Chinese races.

Range.—Specimens examined from MANIPUR, Bishampur. ASSAM: Okotso in Naga Hills; Naga Hills, 5,000 ft. Dilkoosha, Cachar. BURMA: Kindat; 6 miles west of Kindat; Kin; Tatkon; Lagan Reserve on Lower Chindwin. Mogaung ('*taylori*'). Near Bankason, Tenasserim (type of '*taylori*').

External characters.—Large and striking flying squirrels, with the tail longer than the head and body, and the hind-foot large, mostly over 80 mm. Differing from *alborufus* and *lena* of China and Formosa by having the back profusely grizzled, whereas skins of the two last-named forms have

almost no grizzling on the back. The white of the head, too, seems more contrasted and pure and noticeable than in the present race. Fur thick; four fingers and five toes, these well clawed, the proportions of the digits as usual, and as described above for *P. elegans*, the sole mostly naked except the side of the foot which is below the fifth toe, which is hairy; apparently six plantar pads, the sixth one being under the pad at the base of D. 5, and very small.

The belly colour varies individually, specimens with differently coloured bellies being found in the same locality (e.g., Kin).

Colour.—Above reddish profusely grizzled with white throughout, the parachutes deep red. Numerous white tipped hairs scattered profusely throughout the back. Forehead strikingly contrasted white, a point not brought out in the original description. 'Individual hairs of back basally mouse grey—then reddish—and remainder reddish white with a very short black tip.' Tail drab yellowish or greyish, with a strong and well marked black tip, at end. Feet vary from mainly reddish to black. Cheeks greyish; throat white usually; belly and chest whitish tinged with rufous. In some skins it is almost wholly white, in some almost wholly rufous.

External measurements.—As in Table 1, below.

TABLE 1.—*External measurements of*
Petaurista alborufus candidulus

	Head and body	Tail	Hind- foot	Ear
M. Kin, Chindwin	465	615	85	47½
Kin	460	610	85	48½
M. 6 miles west of Kindat	477	574	89	49
F. 6 miles west of Kindat	451	588	90	49
M. Frost Coll. 474				
Bishampur, Manipur	420	500	80	50
M. Frost Coll. 277				
Naga Hills, 5,000 ft.	420	575	85	40
M. Frost Coll. 326				
Naga Hills	480	525	75	45
M. Frost Coll. 346				
Naga Hills	440	575	80	50
M. Frost Coll. 476				
Naga Hills	450	580	90	46
M. Frost Coll. 345				
Naga Hills	520	635	90	55
M. Kindat (type).	405	610	100	52

Cranial and dental characters.—As above, under the genus. Skull large, at extreme development one of the largest of Indian *Petaurista*.

Cranial measurements.—As in Table 2, below.

TABLE 2.—*Cranial measurements of*
Petaurista alborufus candidulus

	Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
M. 15.5.5.40 Tatkon, West Burma	76.6	39.2	16.1	23.3	18.0	27.4
M. 16.3.26.12 Kindat, West Burma	75.1	37.8	17.5	22.3	17.3	26.5
F. 16.3.26.13 Kindat	74.9	37.7	?	22.6	16.2	26.3
Frost Coll. 277. M. Naga Hills, 5,000 ft.	75.2	39.1	16.6	23.4	16.3	26.7
Frost Coll. 326. M. Naga Hills	77.8	38.2	17.3	23.3	17.8	27.8
Frost Coll. 345. M. Naga Hills	75.1	38.6	17.4	23.8	19.0	27.1
Frost Coll. 346. M. <i>Circa</i> Naga Hills	77.0	40.2	17.4	24.3	20.1	26.2
Frost Coll. 474 M. Bishampur, Manipur	73.6	36.7	17.3	23.5	16.6	27.0
Frost Coll. 476. M. Naga Hills	75.8	39.1	17.6	22.8	17.7	27.8

Dimensions of the species *Petaurista alborufus* *as indicated by British Museum material*: The occipitonasal varies between 68.3 and 82 mm. (but only one skull from China which is 82 mm. in measurement, and not under 73.6 mm. except in the Formosan race); the toothrow between 14.8 and 18.6 mm. The head and body length varies between 420 and 520 mm. in the Indian race, the tail between 500 and 635 mm. (the above based entirely on *candidulus*; I have seen no fully measured skins from China). The hindfoot varies between 74 and 100 mm. (including all races).

This flying squirrel may be distinguished easily from other Indian *Petaurista* by its white head, contrasted with the back, or at least its white forehead. The cheeks may be white in some other skins, as sometimes *albiventer* for instance, but it seems that *candidulus* can always easily be distinguished when all specimens available from India for the genus are taken out and compared.

Specimens collected six miles West of Kindat; 'Shot by moonlight, feeding on pyngado seeds' Same locality: 'Shot at dusk in a pyngado tree, eating seeds'.

4. *Petaurista magnificus* (Hodgson)

Hodgson's Flying Squirrel

1836. *Sciuropterus magnificus* Hodgson, *J. Asiat. Soc. Beng.*, 5, 231.
 1842. *Sciuropterus nobilis* Gray, *Ann. Mag. nat. Hist.*, 10, 263. (Darjeeling.)
 1844. *Sciuropterus chrysorix* Hodgson, *J. Asiat. Soc. Beng.*, 13, 67.

Vernacular names (Blanford).—*H.*—Suraj-bhagat. *Lepcha*—Biyom.

Type-locality.—Nepal.

Distribution of species.—NEPAL and SIKKIM.

Range.—Specimens examined from SIKKIM: Sedonchen; Darjeeling (type of '*nobilis*'); NEPAL: Satthar Hill, Gorkha; Naivacot.

This *Petaurista* is fairly clearly distinct from all others in India and elsewhere by its colour pattern, which according to Blanford apparently changes seasonally. Wroughton used the name *nobilis* for it, believing *magnificus* of Hodgson to be a synonym of *albiventer* Gray 1834, but Robinson and Kloss (1918) revert to Blanford's nomenclature. 'In this small series all gradations from a form with a clearly defined median stripe on the back to one with no stripe at all are present. In view of Hodgson's specimen above which has the upper surface ungrizzled I have used his name for the species rather than the later one *P. nobilis* Gray which has been adopted by Wroughton—who has transferred *P. magnificus* as a synonym to the larger grizzled form to which he has applied the name *P. albiventer* Gray.'

I regard it as a distinct species, as discussed above, because I think it possible that it may occur with *P. albiventer* in Nepal, although that form appears rather local there, and this species perhaps takes its place. It is a high level form, according to Blanford (at elevations from 6,000 to 9,000 ft.), the same as *albiventer* approximately (from 6,000 to 10,000 ft.).

In most of our specimens a large dark saddle patch is present or suggested on the back. The middle of the neck and the back always appear to be strikingly darker than the sides and the parachute. This is not the case with most specimens of other races examined. The size is medium in this species; larger than in *P. elegans*, smaller than in *P. alborufus candidulus*, the same size as many Indian races of *P. petaurista*.

External characters.—According to Blanford, occurring in two-colour phases. He writes: 'Colour above varying, probably with the time of year. In *P. nobilis* or *chrysotrix*, which I suppose to be the summer garb, the body, neck and head above are deep maroon, generally with a more or less well marked yellow median line, commencing with a broad spot on the forehead. Sides of the neck and inner border of parachute, where it joins the body, yellowish buff, remainder of parachute rufous, often chestnut. In the other phase, probably winter fur (*P. magnificus*) there is no median dorsal line, the body and the head are chestnut above, more or less grizzled by some of the longer hairs being whitish near the tip, but the body above is always darker than the parachute. The dorsal hairs are dark ashy at the base. The feet are chestnut or black; the tail rufous with a well-defined black tip, the lower parts pale rufous.'

External measurements.—

		Head and body	Tail	Hind- foot	Ear
	Satthar Hill, Gorkha	420	470	78	42
F.	Satthar Hill, Gorkha	415	480	76	42
	Sedonchen, Sikkim	390	460	73	45

Also seen from Naivacot, Nepal. Altitudes 6,500 and 7,000 ft., in various skins.

Cranial and dental characters.—As above, under the genus *Petaurista*.

TABLE 3.—*Cranial measurements of Petaurista magnificus*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
F	15.9.1.99 Sedonchen, Sikkim	69.4	35.5	16.3	20.6	13.8	26.0
F	23.11.5.26 Satthar Hill, Nepal	72.9	36.4	15.6	21.5	15.1	27.2
	43.1.12.42 Nepal	71.5	35.6	16.4	22.8	16.0	24.6
	58.6.24.82 Nepal	69.2	34.6	15.1	19.3	15.2	25.2
	58.5.4.400 No loc.	70.2	35.2	16.5	21.6	16.4	23.8
	557g Nepal	72.2	34.7	?	21.4	17.7	25.8
	23.11.5.25 Satthar Hill, Gorkha, Nepal	72.5	36.5	15.5	23.3	16.4	26.5

Dimensions of the species *Petaurista magnificus*.—The occipitonasal length varies between 69.2 and 72.9 mm. Tooth-row 15.1–16.5 mm. The head and body length varies between 390 and 420 mm. in three measured skins, the tail 460–480 mm., and the hindfoot 73–78 mm.

Certainly '*nobilis*' is a very striking animal, very different in colour from most or all other *Petaurista* races I have examined, but this colour pattern is lost apparently seasonally as noted above, and typical *magnificus* is not so striking, though as far as I have seen it always has the sides noticeably lighter than the back. The tail appears to be longer than the head and body, and is narrow; the feet and digits and pads appear to be essentially as I have described above for *candidulus*. At least six mammae are traceable in a dried skin. Two skins from Satthar Hill, Gorkha, Nepal, are noted as with weight 2½ lb. and weight 4 lb. respectively. The colour is as noted above. We have half-a-dozen skins in the '*nobilis*' phase, one of which was taken in November, the others have no date on them. Two of them lack the yellow mid-dorsal stripe, the others have it present. The tail is light brown, with a fairly well-defined black tip as a rule.

Our true *magnificus* phase skins, four in number, are as described by Blanford above. In all skins examined the sides, and particularly the shoulders, are very much yellower and paler than the middle of the back; this character will it seems always clearly identify this form from other races and species in India and probably elsewhere as well. There is certain variation in colour in individuals. Two of the *magnificus* phase skins were collected in January, but one from Naivacot was taken in August.

5. *Petaurista petaurista* (Pallas)

The Common Giant Flying Squirrel

1766. *Sciurus petaurista* Pallas, *Misc. Zool.*, 54.

Type-locality.—Western Java.

Distribution of the species (as here understood).—Borneo, Sumatra, Java, Malay Peninsula, Siam, Indo-China, Formosa, Fukien, Yunnan, Szechuan, BURMA, ASSAM, NEPAL, PUNJAB, KASHMIR, PENINSULA OF INDIA and CEYLON.

My reasons for referring a very large number of races from India and elsewhere to this, the first name in the genus, have been given above (*supra*, p. 25). These are large flying

squirrels, without the colour peculiarities of *P. alborufus* and *P. magnificus*, and always larger than any race of *P. elegans* where it occurs with a race of the present species.

There are two or three groups of subspecies in *P. petaurista* as here understood. The second name in the species is an Indian one, *P. albiventer*, and if it is desired to retain the Indian races as a species, then the name *Petaurista albiventer* should be used.

External characters.—The typical race from Java, and its allies from Borneo, Sumatra, and Malaya, also *P. p. grandis* from Formosa and apparently one or two Chinese races, which are not in the British Museum, differ from all those to be dealt with here by their nearly uniform coloration, and their lack of evident grizzling in the fur. This character is not, I think, so important as has been thought, and is more valid for a character for a group of races than for a species, because the cranial characters of the group under discussion do not differ in any way from the *albiventer* branch of Indian races and immediate allies.

In India there seem to be two groups of races: the *philippensis* type, which includes *lanka* (Ceylon), *philippensis* (west of the Bay of Bengal), *cineraceus* (Burma) and *mergulus* and its allies (Islands of the Mergui Archipelago), in which the lower surface is white, more rarely grey or dull, but without rufous tinge; and the *albiventer* section, which includes *albiventer* and its various synonyms, *yunanensis* (the colour of which is slightly different apparently from its immediate allies) and *lylei*; the range of this section is from Kashmir to Burma, and the underparts are white or red but always with a rufous tinge or some rufous markings.

These races have been keyed above (*supra*, p. 28), so far as they are distinguishable, and will be discussed in more detail in the following pages.

External measurements.—As in Table 4, below.

TABLE 4.—*External measurements of the Indian races of Petaurista petaurista*

	Head and body	Tail	Hind- foot	Ear	
<i>Petaurista petaurista albiventer</i>					
F. Naini Tal, Kumaon	415	448	74	43	6 mammae
M. Naini Tal	380	?	74	44	

Other skins, hindfoot 76–78 mm., from Nepal and Naga Hills, Assam.

TABLE 4.—*External measurements of the Indian races of Petaurista petaurista (contd.)*

The following were identified as '*inornatus*'.

	Head and body	Tail	Hind- foot	Ear
M. Kashmir	356	356	?	?
F. Kashmir	356	356	?	?
Kashmir	330	356	?	?
M. Sardalla, Kashmir	310	310	65	43
F. Pahlgam, Kashmir	352	333	64?	41
M. Pahlgam	356	351	68	42
F. Baragali, Murree Hills	283	385	66	41
M. Murree	375	460	75	?
M. Rahla, Lahul	436	445	70	45
M. Rahla, Lahul	440	?	70	45
M. Kothi, Kulu, Lahul	327	415	70	46
Doonglagali, N.W. Frontier	406	419	72	44½
F. Hazara district (type of ' <i>birrelli</i> ')	420	445	65	46

Petaurista petaurista yunanensis

M. Tiki, Mishmi	440	525	80	42
M. Adung Valley, N. Burma	440	480	67	48

Other skins from Salween-Irrawaddy Divide, Chaglon, Mishmi, Mogaung, Upper Burma, and Dreyi, Mishmi.

Petaurista petaurista philippensis

M. Srimangala, Coorg	450	530	79	40
M. Kutta, Coorg	445	450	79	44
M. Halery, Coorg	455	455	81	44
F. Virajpet, Coorg	450	510	82	42
M. Jog, Gersoppa Falls, Kanara	430	505	76	47
M. Jog, Gersoppa Falls	440	495	80	43
M. Jog, Gersoppa Falls	410	493	77	46
M. Rookery, Kil Kota- giri, Nilgiri Hills	405	485	72	43
M. Tigershola, Palni Hills	450	510	74	44
Near Kodaikanal (Young)	370	440	72	42

A type, South Mahratta country, has the hindfoot 84 mm. Other skins, hindfoot varying between 69 and 86 mm., seen from Trivandrum, Travancore, Nilgiris, and Shevaroy Hills.

The following were identified as '*oral*'.

M. Luia, Chaibassa, Orissa	375	430	70	40
F. Luia, Chaibassa	350	409	70	42
M. Pili, Sipna, Berar	372	438	72	46

TABLE 4.—*External measurements of the Indian races of Petaurista petaurista (concl'd.)*

The following were identified as 'cinderella'

		Head and body	Tail	Hind- foot	Ear
	Waghai Dangs	424	?	70	40
F.	Pempri Dangs (type)	440	485	75	?

Petaurista petaurista lanka

M.	Mousekande, Ceylon	426	471	75	48
	Mousekande	360	501	71	50
F.	Mousekande	439	549	79	43
M.	Mousekande	432	463	73	46
	Mousekande	451	522	78	47
F.	Kumbukkan, Uva	418	510	77	45½

Another skin (hindfoot 86 mm.) from Kandy.

Petaurista petaurista cineraceus

M.	20 miles NW. of Toungoo, Burma	489	607	83	47
M.	30 miles NW. of Toungoo	446	565	89	42
M.	30 miles NW. of Toungoo	445	560	85	44
M.	40 miles NW. of Toungoo	430	538	85	44

Other skins from 70 miles north of Pegu, Hankaryit, Tenasserim, and Wimpong, Thaton, Tenasserim (35 miles north of Moulmein).

Note unusually long tail in these skins.

Petaurista petaurista mergulus

F.	Ross Island	410	405	68	37
	Tavoy Island	385	460	66	36
M.	Ross Island (type)	410	400	70	31

Petaurista petaurista reguli

F.	King Island	440	450	72	40
F.	Malcolm Island	410	405	65	37

Petaurista petaurista primrosei

F.	Sullivan Island	425	478	72	38

The following notes have been taken from skins:—

Naini Tal, Kumaon. 'Weight 3 lb.'

Baragali. 'Caught on hillside. *Niula*.'

Kashmir. 'Fir woods; lives in hollow trees devoid of branches, easily obtained by tapping trees, when it emerges.'

No. 6.12.3.5 (see also skull measurement): 'A small but adult specimen. These flying squirrels vary greatly in size, according to locality'

Murree, 'Weight 2.5 lb.' Sardalla, 'Weight 3 lb.'

Kothi, Kulu Valley, 'Weight 2.75 lb.'

Doonglagali, 'Shot in tree near roadside. Weight $3\frac{3}{4}$ lb.'

Mammæ 6 (one skin).

Blanford thought there was only one race in Kashmir, for which he used the name *inornatus*, which is, however, later than *albiventer*, and he said it ranged to Kumaon and Katmandu in Nepal. I have seen authentic skins from Nepal and the Naga Hills, Assam.

It is just possible that we are dealing with two species here, a smaller and a larger; *inornatus* might be available for the smaller one. But I do not think that this is so.

Cranial and dental characters.—As under the genus *Petaurista* (*supra*, p. 23).

TABLE 5.—Cranial measurements of the Indian races of *Petaurista petaurista*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Petaurista petaurista albiventer</i>							
F.	14.7.10.76 Naini Tal, Kumaon	72.0	36.8	16.0	22.0	16.8	26.5
M.	85.8.1.122 Simla, Punjab	71.6	34.6	15.7	21.1	16.5	25.7
The type is perhaps not adult, but has the occipitonasal length about 67 mm.							
The remainder were identified as ' <i>inornatus</i> ', which I think is most likely a synonym of <i>albiventer</i> .							
F.	6.12.3.3 Kashmir. Young	66.3	32.4	?	20.4	14.1	23.4
M.	6.12.3.4. Young Pahlgahm, Kashmir	65.1	31.9	14.7	18.8	14.8	23.7
M.	6.12.3.5 Kashmir. Apparently adult	67.3	32.6	15.5	18.7	14.0	24.0
M.	8.7.6.25 Khargeskote, Kashmir. Adult	66.1	?	13.7	19.5	14.6	24.1
	20.6.27.5 Doonglagali, NW. Frontier Province	71.1	34.8	?	22.6	15.9	25.4
M.	23.11.4.12 Murree, Punjab	70.7	36.0	?	20.3	15.2	25.6
M.	23.9.1.34 Rahla, Lahul	71.5	34.5	16.0	20.2	16.3	26.3

TABLE 5.—*Cranial measurements of the Indian races of Petaurista petaurista (contd.)*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Petaurista petaurista albiventer</i> (concl'd.)							
M.	23.9.1.34 Rahla, Lahul	69.7	35.8	15.9	20.0	16.1	26.3
M.	23.9.1.35 Rahla, Lahul	73.1	35.9	16.4	21.2	15.7	25.8
M.	25.6.10.14 Sardalla, Kashmir. Young	66.3	32.0	?	20.0	14.0	23.5
	26.8.13.1 Nasai, Kashmir	70.5	33.7	15.4	20.8	14.2	25.3
	26.10.8.56 Garwhal, Kumaon	72.5	36.1	?	23.0	16.5	26.1
F	5.11.19.3 Thandeani, Murree, Punjab. (Type of 'birrelli').	72.6	35.1	15.9	22.5	16.3	24.9
<i>Petaurista petaurista yunanensis</i>							
M.	21.12.5.44 Tiki, Mishmi	76.3	<i>circa</i> 38.5	<i>circa</i> 17.3	23.1	17.5	27.3
<i>Petaurista petaurista philippensis</i>							
M.	12.11.28.77 Gersoppa Falls, North Kanara	72.3	36.6	16.3	23.0	16.7	24.0
M.	12.11.28.78 Gersoppa Falls	71.0	36.1	15.1	23.9	16.6	25.4
M.	12.11.28.79 Gersoppa Falls	71.8	36.3	15.7	21.4	16.2	26.0
M.	13.8.22.33 Srimangala, Coorg	73.7	36.1	16.2	21.8	15.8	24.8
M.	13.8.2.34 Haleri, Coorg	73.5	38.3	16.5	22.1	—	26.2
F.	13.8.22.36 Haleri	72.2	37.9	16.0	19.1	17.7	25.6
F.	13.8.22.37 Haleri	73.5	38.5	17.4	22.7	?	25.8
M.	13.8.22.38 Haleri	70.7	36.4	16.1	20.1	15.0	24.5
F.	13.8.22.39 Kutta, Coorg	75.2	37.3	17.3	22.9	16.3	25.5
M.	19.6.2.26 Kotagiri, Nilgiris	69.9	35.4	?	21.9	?	24.1
M.	25.10.1.12 Tigershola, Madras	73.2	37.4	15.5	21.6	15.9	25.8
	94.7.1.14 Trivandrum	73.2	36.5	16.6	21.2	14.1	25.4

Two co-types have the occipitonasal length respectively 75.6 mm. and 74.9 mm., and the frontals 17.7 mm. and 16 mm. Both are from Bombay.

TABLE 5.—*Cranial measurements of the Indian races of Petaurista petaurista (concl'd.)*

	Occipito-nasal	Palate	Toothrow	Nasals	Frontals	Orbit
M. 96.11.7.4 Wanghai Dangs ('cinderella')	73.0	36.5	?	22.6	17.4	25.2
The type of 'cinderella', from Pempri Dangs, has the occipitonasal 74 mm., the frontals 16.8 mm.						
The following are identified as 'oral', but neither are adult.						
M. 12.3.8.6 Berar. Young	65.8	33.2	14.7	19.8	14.5	23.1
F. 15.4.3.69 Chaibassa. Young	66.1	32.2	14.6	18.4	13.1	23.4
<i>Petaurista petaurista lanka</i>						
F. 15.3.1.61 Uva, Ceylon	73.2	36.3	16.0	21.1	18.4	25.7
M. 31.9.11.4 Gammaduwa, Ceylon	73.0	36.5	?	?	18.2	26.4
F. 31.9.11.5 Gammaduwa, Ceylon	74.1	?	?	21.8	18.1	25.8
The type has the occipitonasal 74.1 mm., the frontals 18 mm. Another specimen has the frontals over 17 mm., but is not fully measurable.						
<i>Petaurista petaurista cineraceus</i>						
M. 27.11.18.15 North of Toungoo, Burma	74.4	38.5	17.1	23.5	15.7	26.3
85.8.1.124 Thaton, Tenasserim	Circa 78.6	40.0	17.3	25.0	18.3	28.0
M. 27.11.18.14 Toungoo. Young	70.1	36.4	17.0	20.5	15.5	25.6
<i>Petaurista petaurista mergulus</i>						
F. 23.1.6.51 Tavoy Island, Mergui	66.9	34.2	15.3	20.5	15.6	24.4
M. 22.8.21.1 Ross Island, Mergui, type	66.0	34.2	14.8	20.1	13.3	23.0
<i>Petaurista petaurista reguli</i>						
F. 23.1.6.50 King Island, Mergui, type	70.3	36.6	16.5	21.8	14.6	25.5
F. 23.1.6.54 Malcolm Island, Mergui	70.8	35.9	15.7	22.0	14.8	24.8
<i>Petaurista petaurista lylei</i> ('venningi')						
M. 14.4.3.1 Kalaw, Shan States, Burma, type	81.2	40.5	17.6	24.5	18.1	27.3
<i>Petaurista petaurista primrosei</i>						
F. 23.1.6.53 Sullivan Island, type	68.5	34.5	14.8	21.4	15.0	24.4

Dimensions of the species *Petaurista petaurista*, including all available races: The head and body varies between 283 mm. and 510 mm. The tail between 310 and 608 mm. The hind-foot between 63 and 89 mm. The occipitonasal between 64 mm. (Batu Island race) and 81.2 mm., but very rarely under 65 mm. The toothrow between 13.7 and 18.6 mm.

(i) ***Petaurista petaurista philippensis* (Elliot)**

Text-fig. 2

The Large Brown Flying Squirrel

1839. *Pteromys philippensis* Elliot, *Madras J. Litt. and Sci.*, **10**, 217.

1842. *Pteromys oral* Tickell, *Calcutta J. nat. Hist.*, **2**, 401.

1911. *Petaurista cinderella* Wroughton, *J. Bombay nat. Hist. Soc.*, **20**, 4; 1014, 1018.

Vernacular names.—Kol. Ural. Mahr. Pakya. Mal. Parachaten. Cing. Egala-dandolena. Burm. Shu-byan.

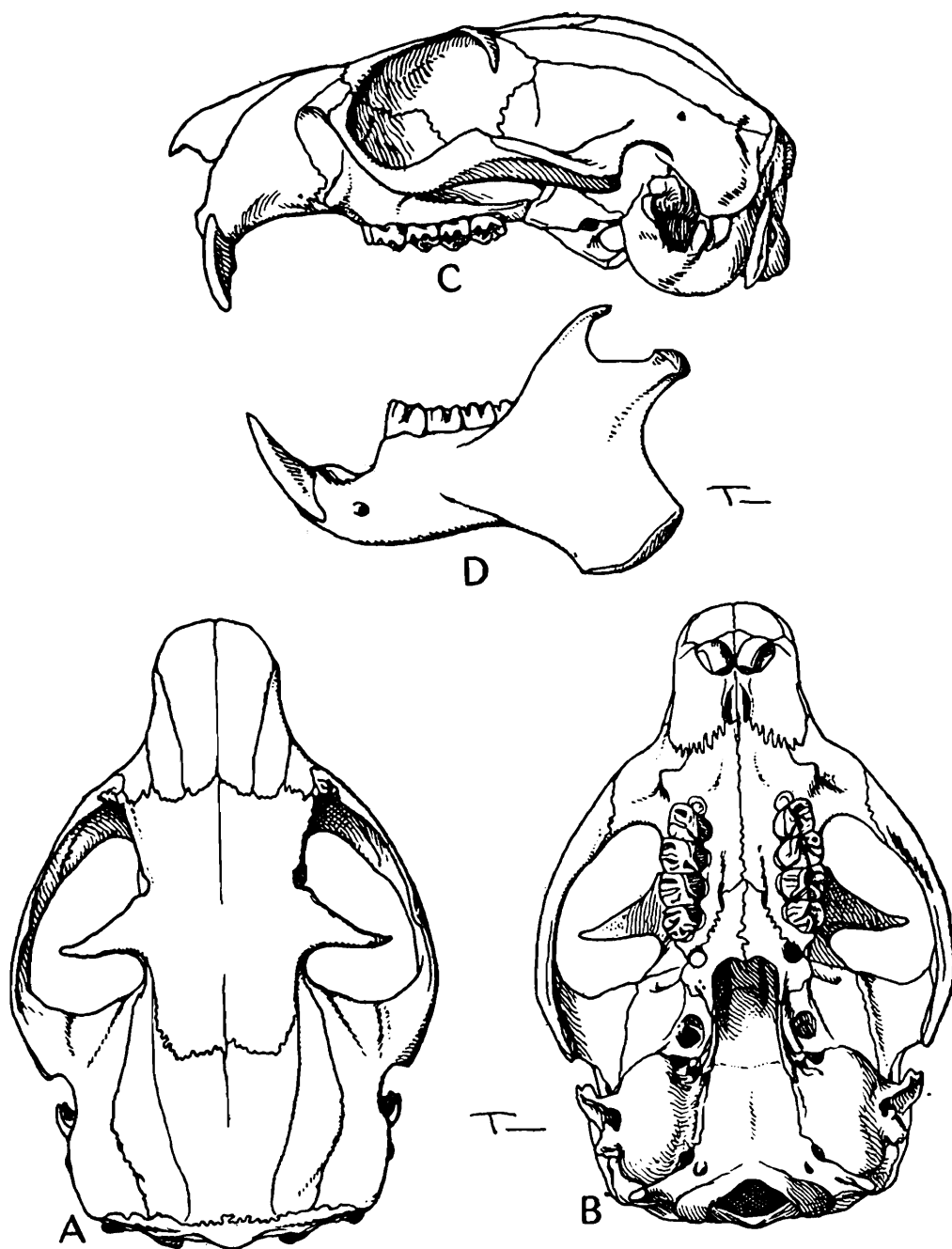
*Type-locality** of *philippensis*, South Mahratta country, of *oral*, the Singhbhum district, Orissa, of *cinderella*, the Dangs, Surat district, Bombay Presidency.

Range.—Specimens seen from COORG, Haleri, Kutta, Virajpet, Srimangala. NILGIRIS and district; Kotagiri, Kodai-kanal, Tigershola; SOUTH MAHRATTA, no exact locality; NORTH KANARA: Jog, Gersoppa Falls. COCHIN, Karapara. TRAVANCORE, Trivandrum. Pempri Dangs; Waghai Dangs. EASTERN GHATS: Shevaroy Hill. CENTRAL PROVINCE, Pili Sipna Valley, Berar. ORISSA: Chaibassa and Luia.

Wroughton also quoted as a synonym *Pteromys griseiventer* Gray (1843). The general external characters, including the tail and feet and digits, are about as described above under the foregoing species. Tail longer than head and body. Wroughton thought that '*oral*' and '*cinderella*' were separable from *philippensis* on supposed size differences, but our material for '*oral*' is not adult. The hindfoot size does not vary in the three supposed races when all skins of *philippensis* are taken into consideration, and I would very much doubt whether these forms are separable on colour characters.

In general colour, this form has as a rule a greyish effect on the back (greyish rather than reddish), the back being described by Blanford as 'grizzled brown, varying from deep

* No locality given in original description of *philippensis*, but the paper in which it is described is on the mammals of the South Mahratta country.



TEXT-FIG. 2. *Petaurista petaurista philippensis* (Elliot) ♂. A, B, C, dorsal, ventral and lateral views of the skull; D, lower jaw of the same ($\times 1$). (After Ellerman, 1940, pp. 282, 283.)

chestnut to greyish brown in one direction and to sooty black in the other, the longer hairs partly white, giving a hoary appearance.' Parachute and forelimbs usually brown, less frosted. One specimen from Gersoppa falls, Kanara, has a whitish head. Feet mostly black in the large series examined. Tail black through the greater part of its length, but sometimes greyer basally, distinctly so in one of two skins for 'cinderella' in which it is almost whitish for some

part of its length. Underparts white, grey or drab grey, never with any red or rufous apparent. Cheeks usually grey. Wroughton described the individual hairs as 'basally smoke grey—then seal brown—and lastly white, tipped black.'

(ii) ***Petaurista petaurista lanka* Wroughton**

1911. *Petaurista lanka* Wroughton, *J. Bombay nat. Hist. Soc.*, 20, 4, 1014, 1017.

Type-locality.—Ceylon.

Range.—Specimens seen from CEYLON: Gammaduwa, Kumbukkan, Kandy, Mousekande.

Described as a *Petaurista* in size and pattern quite like true *philippensis* but entirely lacking the rufous tinge so characteristic of the latter species. This is true, although doubtless individuals on the mainland would overlap the colour character. More important is the fact that there is a very general tendency for the frontals to be actually wider, and certainly proportionately wider, than in *philippensis*, as will be seen from the cranial measurements listed above.

(iii) ***Petaurista petaurista cineraceus* (Blyth)**

1847. *Pteromys petaurista* var. *cineraceus* Blyth, *J. Asiat. Soc. Bengal*, 16, 865.

Vernacular names.—Same as for *P. p. philippensis*.

Type-locality.—Arakan.

Range.—Specimens seen from TENASSERIM: Thaton, Wimpong, Hankaryit. BURMA: North of Pegu (70 miles). 20, 30 and 40 miles NW of Toungoo.

Like *P. p. philippensis*, but the tail pale, drab grey throughout almost its whole length, only black at extreme tip as a rule. The back mostly grey, but may be brown. One skin from 40 miles north of Toungoo has the head whitish. This is the Burmese representative of the *philippensis* group. Only two adult skulls are available; these are larger than is usual in *philippensis*, though the smaller one is overlapped in size by individual *philippensis*. The Tenasserim skull is larger than any *philippensis*, and one of the largest of the genus in India.

The following notes taken from some of the skins:—

P. p. lanka, 'Shot at dusk, feeding in a Banyan tree. Weight 3½ lb.' 'A very large specimen, killed in hollow tree in heavy jungle, together with one small

young one. Weight 5 lb.' *P. p. philippensis* ('cinderella'): 'Forest at Pempri, common, nocturnal.' ('oral'): Luia, Chaibassa, weight 1 lb. 13½ oz. and weight 2 lb. Virajpet, Coorg; 'weight 4 lb.' Gersoppa; 'weight 5 lb.' or 4¾ lb. or 4½ lb. Coorg; weight 5 lb. or 4¾ lb. Kil Kotagiri, Nilgiris; 'Out of hole in tree below tea factory.'

The Mergui Island races

(iv) ***Petaurista petaurista mergulus* Thomas**

1922. *Petaurista mergulus* Thomas, *J. Bombay nat. Hist. Soc.*, 28, 4, 1067.

Type-locality.—Ross Island, Mergui Archipelago.

Range.—Specimens from Ross Island, and Tavoy Island, Mergui Archipelago.

This is a small insular race, which was described as allied to *cineraceus* but very much smaller. The frosting of the back seems to me less evident than in *cineraceus*, the white tips to the hairs being less in evidence. Feet black; tail greyish brown with only the tip black, underparts drab grey. Head rather greyer than the back. Occipitonasal length of skull about 66-67 mm.

(v) ***Petaurista petaurista reguli* Thomas**

1926. *Petaurista reguli* Thomas, *J. Bombay nat. Hist. Soc.*, 31, 22.

Type-locality.—King Island, Mergui Archipelago.

Range.—Specimens from King Island, and Malcolm Island, Mergui Archipelago.

Essentially like *mergulus*, but with a larger skull, the occipitonasal length more than 70 mm. in length in our specimens, which are few. I include here the skull from Malcolm Island.

(vi) ***Petaurista petaurista primrosei* Thomas**

1926. *Petaurista primrosei* Thomas, *J. Bombay nat. Hist. Soc.*, 31, 22.

Type-locality.—Sullivan Island, Mergui Archipelago.

Essentially like *mergulus* but the 'whole dorsal surface and especially the patagium suffused with deep chestnut rufous' Only known, apparently, by the type specimen, the occipitonasal length of which is 68.5 mm.

There is, at the moment of writing, another type skin from Sullivan Island, bearing this name, and with exactly the same measurements and date as that of the type of *primrosei*, but which is so obviously a totally different animal that one is tempted to believe there has been some error in the labeling. It is much redder, and has a reddish belly and tail, and I would identify it as a specimen of *P. p. albiventer*. It is entirely different from the drab, white-bellied *mergulus-primrosei* type.

The albiventer section of races

The following races differ from *philippensis* and immediate allies in having the belly with at least some rufous or reddish markings.

(vii) ***Petaurista petaurista yunanensis* (Anderson)**

1875. *Pteromys yunanensis* Anderson, *Ann. Mag. nat. Hist.*, 16, 282.

Type-locality.—Momein, Yunnan.

Range.—Specimens seen from BURMA, Hpimaw, Salween-Irrawaddy divide; Adung Valley, 28°10' N., 97°40' E.; MISHMI: Chaglon, Dreyi and Tiki.

Back in general deep dark red, individually variable in shade, with numerous white-tipped hairs giving a frosted effect to a certain extent. Hands, feet, and the greater part of tail including the terminal portion black. Underside varying from almost wholly reddish in a specimen from Tiki, Mishmi, to almost white but with a red median line (skins from Adung Valley and Hpimaw). Throat white in the Adung Valley skin, black in the one from Tiki; cheeks usually dark. Essential external characters as described above for the other races and species. The unusually dark red dorsal coloration will distinguish this race from *albiventer* and allies. Skull apparently large.

(viii) ***Petaurista petaurista lylei* Bonhote**

1900. *Petaurista lylei* Bonhote, *Proc. zool. Soc. Lond.*, 192.

1914. *Petaurista lylei venningi* Thomas, *J. Bombay nat. Hist. Soc.*, 23 (1), 27.

Type-locality.—Doi Sritepe, Chiengmai, Siam.

Range.—One specimen, the type of '*venningi*' from Kalaw, Shan States, BURMA.

An unusually large race; skulls available vary between 77.2 and 81.2 mm. in occipitonasal length. The back is quite like *philippensis* in colour, but the belly is red or reddish almost throughout. Thomas's race *venningi* was based on one specimen, with an occipitonasal length of 81.2 mm. It was separated from *lylei* on some colour details, which do not seem to be constant. Thomas in 1914 described two other races of *Petaurista*, *annamensis* from Bali, Annam and *lylei badiatus* from Ngaitio, Tonkin. A perusal of the material in London indicates that it is very difficult to distinguish these two forms from *lylei* on the one hand and *yunanensis* on the other. These forms are distinguishable from *albiventer* by their larger skulls, but apart from that, about all that can be said is that in *yunanensis* (perhaps with *annamensis*) the occipitonasal length is so far as at present known less than 77 mm., whereas *lylei* (with both its supposed races) has this length 77.2–81.2 mm. It is probable that the supposed differences between *venningi*, *badiatus* and *lylei* are merely individual differences.

Besides these two forms with reddish belly, there remains to be considered the smaller western races, of which I think there is only one form, the first name in India for a *Petaurista*.

(ix) *Petaurista petaurista albiventer* (Gray)

The Large Red Flying Squirrel

Text-fig. 3

- 1834. *Pteromys albiventer* Gray, *Illustr. Indian Zool.*, pl. xviii.
Type skull in British Museum, labelled Nepal.
- 1844. *Pteromys inornatus* Geoffroy, in *Jacquemont's Voyage*, 4, Mamm., 62. Atlas, 2, pl. iv. (Northern India.)
- 1911. *Petaurista birrelli* Wroughton, *J. Bombay nat. Hist. Soc.*, 20, 4, 1014, 1019. (Murree, Punjab.)
- 1911. *Petaurista fulvinus* Wroughton, *J. Bombay nat. Hist. Soc.*, 20, 4, 1014, 1021. (Simla, Punjab.)

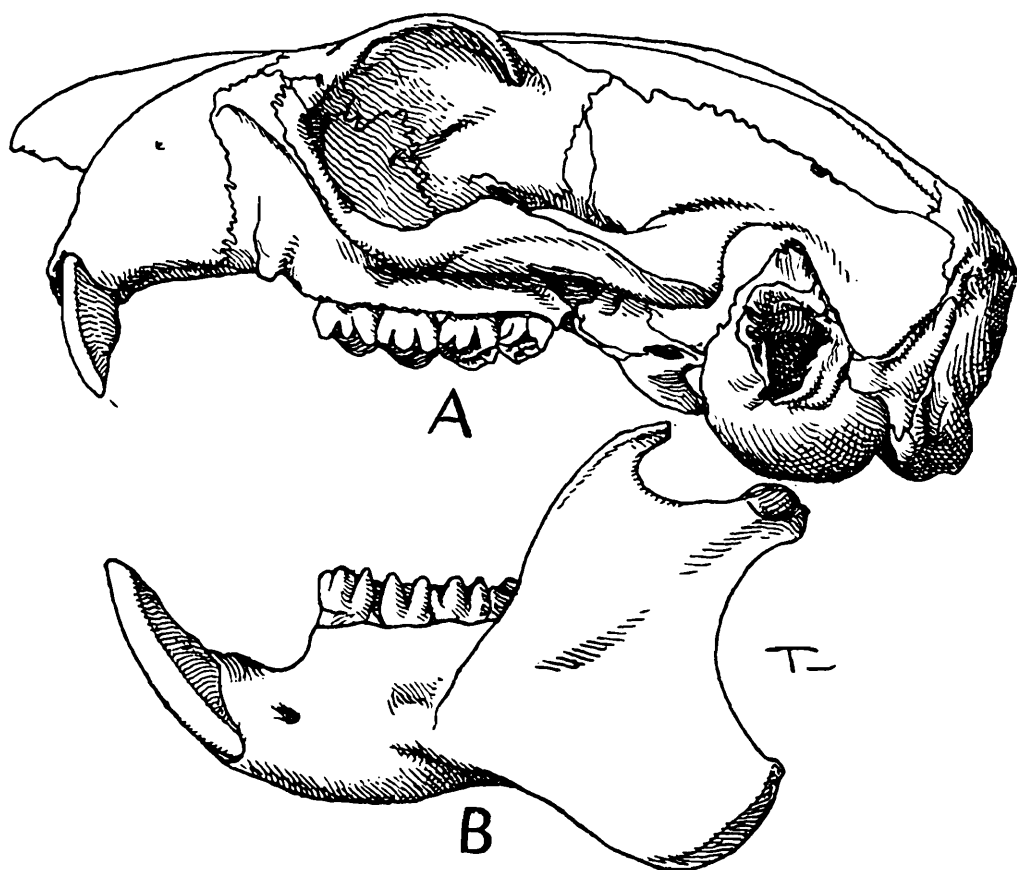
Vernacular names.—*Kashmiri*: Rusi gugar; Niula.

Range.—Specimens seen from ASSAM, Naga Hills. NEPAL, no exact locality. KUMAON, Naini Tal, Garwhal. PUNJAB, Simla; Murree; Baragali, Murree Hills; Rahla and Kothi Lahul; Thandiani, Murree (type skin of 'birrelli' Mianjani Hill, Hazara district). KASHMIR, Islamabad, Sardalla, Pahlgam, Liddar Valley, Nasai, Kargheskote. NW FRONTIER: Doongla-gali.

Smaller than in *yunanensis*, *venningi* and *lylei*, the occipitonasal length not more than 73.1 mm., usually less. *P. p.*

albiventer has very thick fur, and the essential characters including the feet and digits are as described above for the other species. Tail usually longer than head and body.

Colour above mostly reddish (rather than greyish), chestnut, sometimes the head and back paler than the parachute, and sometimes the back almost greyish and transitional to the *philippensis* type, and always with the fur grizzled and several white tipped hairs profusely present. Possibly Kashmir specimens tend to be greyer and less red than skins from further south. In two skins shoulders are strikingly paler than the back, for a short distance (Simla and Naini Tal respectively). Feet usually black, but sometimes mixed with red, and in the Naini Tal skin almost all reddish. Tail rufous or brownish rufous or greyish, usually but not always



TEXT-FIG. 3. *Petaurista petaurista albiventer* (Gray). A, lateral view of the skull; B, lower jaw of the same ($\times 1$).

with a short black tip. Belly pale rufous varying from almost wholly very light reddish in one skin to almost white but with yellow rufous tinge at the sides in others. Most often but not always the throat is white, and the cheeks tend to be white or grey. According to Wroughton's key, the 'back of ears' should be 'coloured like the head' in *albiventer* and *fulvinus*, 'black' in *birrelli* and *inornatus*. I do not find

this apparent or constant in the series examined. The colour distinctions given by Wroughton for 'birrelli' and 'fulvinus' strike me as individual variations rather than racial characteristics. Wroughton, 1911, stated that the molars are '17 mm.' in *albiventer*, in his key, as against '15-16.5 mm.' for *inornatus*, but I do not find this to be the case.

Genus 3. *Hylopetes* Thomas

1908. *Hylopetes* Thomas, *Ann. Mag. nat. Hist.*, 1, 6.

1915. *Eoglaucumys* Howell, *Proc. biol. Soc. Wash.*, 28, 109.

(*Sciuropterus fimbriatus* Gray. Valid as a subgenus.)

Type-species.—*Sciuropterus everetti* Thomas, the Natuna Island race of *H. lepidus* Horsfield.

Range.—AFGHANISTAN, KASHMIR, PUNJAB (subgenus *Eoglaucumys*). NEPAL, ASSAM, BURMA, Yunnan, Indo-China, Siam, Malaya, Sumatra, Java, Borneo and adjacent small Islands, Philippine Islands.

This genus contains the smaller flying squirrels of the Indo-Malay region which have no very special peculiarities, the molars less wrinkled and complex than in *Belomys* and *Petaurista*, and the bullae not specially flattened, compare *Petinomys*. There are half-a-dozen species belonging to this genus, one of which is confined to the Philippine Islands. All of the others occur in India. *Eoglaucumys* was referred by Thomas to the American genus *Glaucumys* in 1908 when he revised the genera of flying squirrels (*Glaucumys* and *Hylopetes* being treated as subgenera of *Pteromys* ('*Sciuropterus*')). *Hylopetes* is not very clearly distinguishable from *Glaucumys* except by various climatic modifications (*Glaucumys* is modified for a life in cold climates). Certainly *Eoglaucumys* does not differ from *Hylopetes* in characters which are of real generic value when detailed work is done on all species; its differences are merely larger size than the largest *Hylopetes*; slightly longer nasals; and rather more upstanding zygomatic plate. I prefer therefore to regard it as a subgenus only.

External and cranial characters.—As in species.

Key to the subgenera of Hylopetes

- 1 (2) Larger animal, the occipitonasal length is not under 55.2 mm. in length; the nasals, proportionately longer, are usually over 17 mm. in length; the zygomatic plate rather more upstanding and high .. . *Eoglaucumys*

- 2 (1) Smaller animals, the occipitonasal length does not exceed 52.8 mm. in length; the nasals, proportionately shorter, are less than 16 mm. in length; the zygomatic plate is low. *Hylopetes*

Subgenus *Eoglaucomys* contains only the species *H. fimbriatus*. Subgenus *Hylopetes* contains apparently four species in India. It should perhaps be added that as a genus *Hylopetes* differs from *Pteromys* (restricted to the northern Palaearctic flying squirrels) by its shorter palatal foramina (which are large and functional in *Pteromys*, a very rare character for a squirrel), its less upstanding zygomatic plate, which is unusually strong in *Pteromys* for a flying squirrel; its lack of specialization towards life in cold climates; its more normal M. 3, which in *Pteromys* is with two clear transverse ridges between the front and back of the tooth, an unusual character for a squirrel, and its general more normal, less complex dental pattern, as described by Thomas (1908).

Subgenus (*a*) **Hylopetes** Thomas

Differing from *Eoglaucomys* by the characters as indicated in the key above. There are two rather sharply distinct groups of species in this subgenus, typified by *lepidus*, the first name in the genus, which are smaller animals, occipitonasal length not exceeding 42 mm. in length, and *alboniger*, larger animals, the occipitonasal length not under *circa* 42.5 mm., and usually more than this. Of Indian species, only *H. alboniger* belongs in the larger group, although there is a species of similar size in the Philippine Islands; the remaining *Hylopetes* of eastern India, Malaya and eastwards to Borneo belong to the *lepidus* group.

Blanford used the name *sagitta* for what must now be called *lepidus* and in this he was followed by most subsequent authors, but the late Dr. G. H. H. Tate examined the type of *sagitta* and reported that it was a *Petinomys*. Consequently *lepidus* becomes the correct name for the common small species. This occurs in Tenasserim. Blanford placed *phayrei* in *sagitta*, but I am inclined to regard it as a possibly valid species. The Indian species I retain in this group are *spadiceus*, *lepidus* and *phayrei*. Chasen (1940) thinks *spadiceus* is a race of *lepidus* and that the Sumatran race *platyurus* is a distinct species, and states that there are two distinct species occurring side by side on the Malay Peninsula. I have no material for *spadiceus* from that region.

But when all our specimens of the *lepidus* group are worked through in detail, it becomes clear that *platyurus* cannot be defined as a valid species against *lepidus*, whereas *spadiceus* (though I admit the material seen is rather scanty) can, by its proportionately larger bullae. In any case *spadiceus* is an Indian (northern) species rather than a Malayan form, and it might be that Chasen's *spadiceus* from Malaya is really something else. There is no difference in size between the Sumatran form *platyurus* and other small races of *lepidus* as understood by Chasen, the Indian *belone* included. I therefore regard *platyurus* as a race of *lepidus* and *spadiceus* as the distinct species.

Key to the Indian species of subgenus Hylopetes

1	(2) Larger species, the occipitonasal length about 42.5 mm. at lowest, but usually over 45 mm. Hindfoot 36 mm. and more	<i>Hylopetes alboniger</i>	
2	(1) Smaller species, the occipitonasal length not exceeding 42 mm. in length. Hindfoot 34 mm. and less		3
3	(4) Bullae smaller, on average 20% at most of the occipitonasal length.	<i>Hylopetes lepidus</i>	
4	(3) Bullae larger, on average at least 21% of the occipitonasal length, usually more		5
5	(6) Smaller species, the occipitonasal length not over 33.5 mm. The hindfoot 27 mm. and less.	<i>Hylopetes spadiceus</i>	
6	(5) Larger species, the occipitonasal not less than 37.5 mm. The hindfoot 29 mm. and more	<i>Hylopetes phayrei</i>	

6. *Hylopetes lepidus* (Horsfield)

The Javan Lesser Flying Squirrel

1822. *Pteromys lepidus* Horsfield, *Zool. Res. Java*, No. 5 (plate and text page unnumbered). (October) From Java.

Distribution.—Borneo, Java, Sumatra, Malaya and TENASERIM.

One race of this species occurs in Indian territory. It is one of the last to be named, and there are five names which antedate it for which I have specimens. Of these, true *lepidus* (Java), *everetti* Thomas, 1895, from the Natunas, and *harrisoni* Stone, 1900, Borneo, are all larger animals, the occipitonasal length usually over 36 mm. It is not so

easy to distinguish the Tenasserim form from *platyurus* Jentink, 1890, from Sumatra, and *aurantiacus* Wagner, 1841, from Banka. These two are about the same size as the Indian race. *H. l. platyurus* has smaller bullae in the specimens seen (6.4 mm. and less, not under 6.9 mm. in measurements I have taken for *aurantiacus* and *belone*). Thomas says that *belone* can be distinguished from *aurantiacus* by having narrower nasals, and differently shaped bullae, 'less inflated vertically, but longer horizontally' There is, however, very little difference in the length as far as I can see. The type of *belone* has the tail rather darker above than the type of *aurantiacus*. On these very trivial characters *belone* must stand, unless it is to be synonymized with *aurantiacus*. This will probably ultimately be done, when really representative material is collected. At the moment the London collection contains only one specimen for *aurantiacus*, the type. *Pteromys horsfieldii* Waterhouse, which Blanford erroneously placed in the synonymy of *H. sagitta*, is the type of an entirely distinct genus *Iomys*, from the Malay region and Islands.

(i) ***Hylopetes lepidus belone* (Thomas)**

1908. *Sciuropterus (Hylopetes) belone* Thomas, *Ann. Mag. nat. Hist.*, 2, 305.

Type-locality.—Pulau Terutau, Straits of Malacca.

Range.—Specimens examined from TENASSERIM: Banlaw. TERUTAU Island.

External characters.—A smallish flying squirrel with the tail (as usual in the typical subgenus) rather shorter than the head and body, broad, flat and feather shaped. Hand as usual in the present group with four fingers; the fourth finger slightly the longest, but there is not much difference in the digits' lengths, the outer ones are the shorter. Foot with five toes, the hallux shorter than the other four. At least 6 mammae traceable in one dried skin. Colour blackish with reddish tinge above, the tail dark brown (or pale brown in one skin). A whitish or pale patch behind the ears. Below the throat is white usually, the chest whitish becoming greyer, the belly dull grey, underside of tail tending to be light brown at least in the basal portion. On the whole the back tends to have a less reddish tinge than *H. spadiceus*, but there are intermediate specimens of the last named.

External measurements.—*Hylopetes lepidus belone*

	Head and body	Tail	Hind- foot	Ear
M. Banlaw, Tenasserim	135	130	27	19
M. Banlaw	133	124	27½	19½
M. Banlaw	136	135	28½	20
F. Banlaw	139	127	28	20

Cranial characters.—Skull rather small, not reaching 40 mm. in length in any race for which I have specimens, and in the Tenasserim form not exceeding 35.5 mm. Postorbital process not very strongly developed, as is usual in small species. Frontals over one-fifth of occipitonasal in width; narrowest immediately in front of the postorbital, and sometimes notched each side just in front of the postorbital. Nasals wider in front than behind. Parietals broad, nearly straight anteriorly, unridged; interparietal well developed, occipital region of skull low. Bullae not large, and not flattened; averaging 20% at most of occipitonasal length; pterygoid fossae rather shallow and flat; palate less than half occipitonasal length measured from front of incisors; wide, and extending to about the back of the toothrows; palatal foramina small, situated far in front of palate. Zygomatic plate relatively low. Jugal long, as is usual in the family, the middle of its upper border slightly raised.

Dental characters.—Incisors narrow, plain, and reddish in colour. Upper cheekteeth five, the pattern much simpler than in *Belomys*, and about typical for normal squirrels; P. 3 very small indeed; P. 4, M. 1 and M. 2 have each one large more or less rounded inner cusp (probably the three original cusps fused together), and two main outer cusps, these both connected to the large inner cusp by a transverse ridge which extends across the tooth. The anterior and posterior border of each tooth are also noticeable as low transverse ridges, and there may be in between the two main outer ridges of the upper teeth a low subsidiary cusp. M. 3 simpler; the front main transverse ridge is present but the second main transverse ridge has become suppressed, and there is a corresponding large space behind it. Lower teeth basinshaped, with a large central depression and a cusp at each corner of the tooth, the anterointernal one the highest. M. 3 slightly dominant, and the premolar the smallest tooth. Usually there are traces of a subsidiary cusp between the two outer cusps of the lower teeth.

Cranial measurements.—*Hylopetes lepidus belone*

	Occipito- nasal	Palate	Bullae	Toothrow	Nasals	Frontals	Orbit
M. 14.12.8.117 Banlaw, Tenasserim	35.5	16.7	7.1	6.4	?	8.0	12.7
M. 14.12.8.119 Banlaw	34.6	17.0	7.0	6.6	9.3	8.1	12.3

Dimensions of the species Hylopetes lepidus as indicated by British Museum material: The occipitonasal length varies between 32.4 and 39.2 mm. in adult skulls; the toothrow between 6.4 and 7.9 mm. The head and body varies between 100 and 161 mm. The tail between 86 and 140 mm. The hindfoot between 25 and 29 mm. in our skins.

7. Hylopetes phayrei (Blyth)

Phayre's Flying Squirrel

1859. *Sciuropterus phayrei* Blyth, *J. Asiat. Soc. Beng.*, 28, 278.

Type-locality.—Rangoon, Burma.

Distribution.—BURMA, Siam, Indo-China.

Very similar to *Hylopetes lepidus*, of which perhaps it is only a race or group of races, but with proportionately larger bullae, as indicated above in the key to the species, and usually of larger size, the hindfoot at least 29 mm. and only once under 30 mm. in our skins; some specimens are not larger cranially than the large Bornean race of *Hylopetes lepidus*, which has, however, noticeably smaller bullae, these being below 8 mm. in length (8.4 mm. and more in specimens examined for *phayrei*). On this account it is reasonable it seems to treat *H. phayrei* as a distinct species, as is usually done, until more material is available.

(i) Hylopetes phayrei phayrei (Blyth)

Text-fig. 4

1859. *Sciuropterus phayrei* Blyth, *J. Asiat. Soc. Beng.*, 28, 278.

1914. *Sciuropterus phayrei probus* Thomas, *J. Bombay nat. Hist. Soc.*, 23, 1, 28. (Mt. Poppa, Burma.)

1914. *Sciuropterus phayrei laotum* Thomas, *J. Bombay nat. Hist. Soc.*, 23, 1, 28. (Laos Mountains.)

Siamese native name 'Bahng'

Type-locality.—Rangoon.

Specimens examined from.—BURMA: Pegu Yomas; Mount Poppa. MANIPUR, Haingyan (an unmeasured skin without

skull, identification not certain). SIAM: Nan, Lakhon. LAOS, no exact locality.

Thomas stated that the feet in true *phayrei* are wholly brown with the exception of a few hairs at the roots of the claws, whereas in his race '*probus*' from Mt. Poppa, the hands and feet are only brown at the base, and on the middle line, the sides and whole of the digits whiter. I have seen few true *phayrei*, but the differences between the two types is so small, and there is such individual variation as regards the amount of whiteness on the feet of '*probus*' that I am placing it in synonymy. In the same paper Thomas went on to describe another (extralimital) race '*laotum*', which was supposed to be larger than *phayrei* and *probus*, with larger hindfoot. This is also a synonym. Siamese skins available have the hindfoot varying between 29 mm. and 33 mm., compare measurements above. Weight in two skins noted as 4 oz. and 3½ oz. respectively.

External characters.—Larger than in the allied species *H. spadiceus* and *H. lepidus* (Indian race); tail shorter than head and body, broad and feather shaped as usual. Feet and digits as in the smaller allied species; soles mostly naked. Dorsally the colour is brown, and the reddish or orange tinge which is usual in *lepidus* and *spadiceus* is scarcely marked. Tail brown, sometimes slightly paler at the sides, at least basally, and faintly darker terminally. A whitish or pale patch behind the ears. Below white, sometimes yellowish tinge suggested. Cheeks white. Tail rather paler below than above. 6 mammae traceable in one skin.

External measurements of Hylopetes phayrei 'probus' = H. p. phayrei

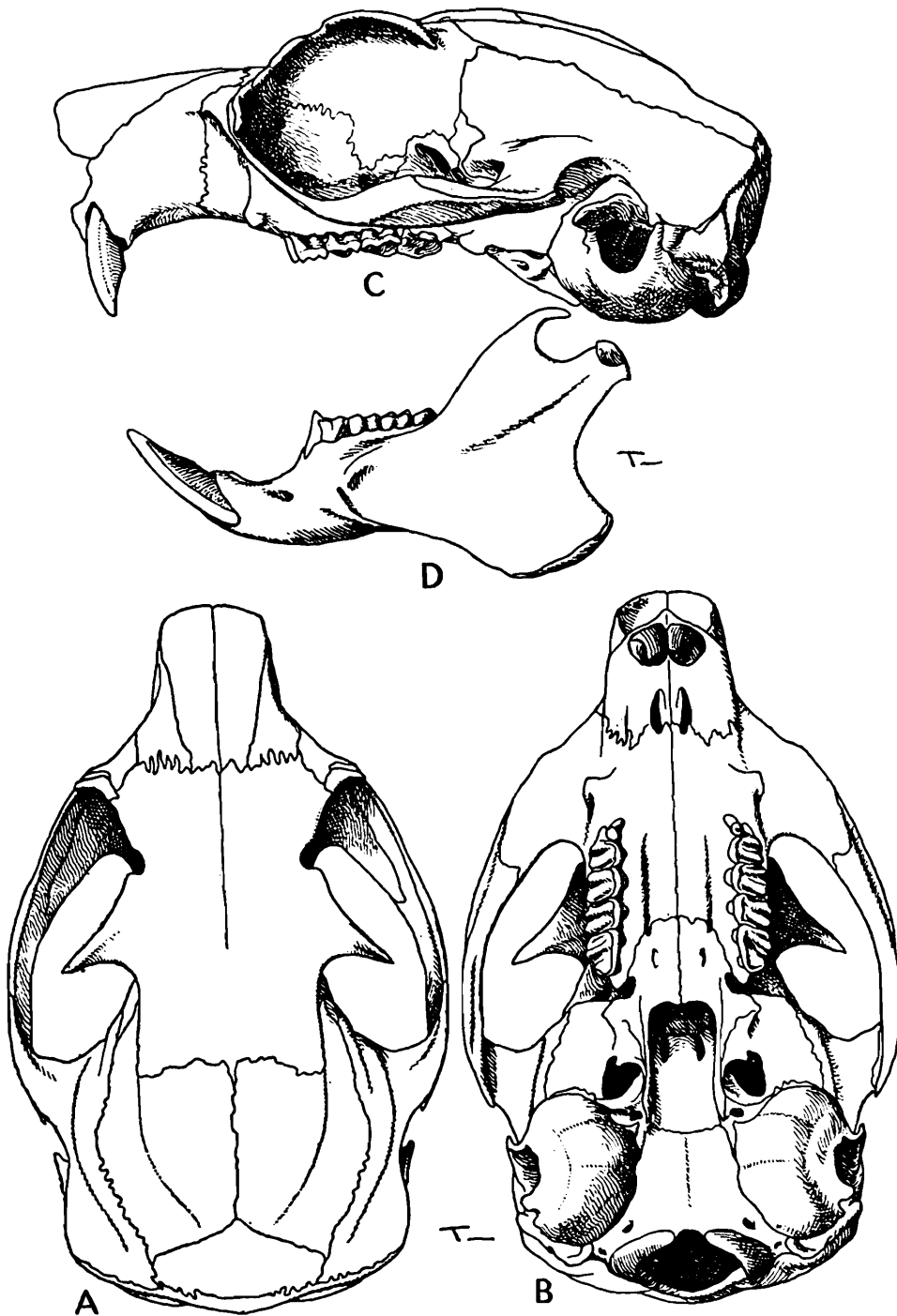
	Head and body	Tail	Hind- foot	Ear
M. Mount Poppa, Burma	160	142	32	24
F. Mt. Poppa	144	139	32	24
M. Mt. Poppa	162	147	33½	25
M. Mt. Poppa	159	148	32½	24
F. Mt. Poppa	161	142	34	24
F. Mt. Poppa	155	146	33	23½
M. Mt. Poppa	167	157	32½	25
F. Mt. Poppa	164	145	32.75	24
M. Mt. Poppa	165	153	32½	25
F. Mt. Poppa	163	151	32½	24
M. Mt. Poppa, type	148	128	30½	23

Unmeasured skins for this species seen from Pegu Yomas, and from Haingyan in East Manipur.

Cranial characters.—Not essentially different from *H. lepidus* larger races, except that the occipitonasal length may

reach 42 mm. at extreme development, and that the bullae are larger, Indian specimens having them about 22-23% of the occipitonasal length, and over 8 mm. in length. The palate may sometimes be more than half the occipitonasal length in this species.

Dental characters.—As in *H. lepidus*; young specimens showing signs of considerable complexities, but the essential Sciurine pattern not masked, and the complexities of young teeth not as extreme as in *Belomys* young or old.



TEXT-FIG. 4. *Hylopetes phayrei phayrei* (Blyth). A, B, C, dorsal, ventral and lateral views of the skull; D, lower jaw of the same ($\times 5$).

Cranial measurements.—As below. Unfortunately, several skulls from Mt. Poppa are broken, in addition to the three given here. I have no specimens for the typical form; these all represent *H. p. probus* Thomas, 1914.

Hylopetes phayrei 'probus' = *H. p. phayrei*

		Occipito- nasal	Palate	Bullae	Toothrow	Nasals	Frontals	Orbit
M. 14.7.9.94	<i>Circa</i>	37.5	19.3	8.8	7.8	—	8.7	14.7
Mt. Poppa, Burma								
M. 14.7.9.95		40.4	20.0	8.9	7.9	11.8	8.4	14.3
Mt. Poppa								
14.7.9.103	<i>Circa</i>	38.2	19.5	8.5	8.2	—	8.6	14.5
Mt. Poppa								

The type of *probus* has the occipitonasal about 39.1 mm., the bullae 8.5 mm.

Dimensions of Hylopetes phayrei as indicated by British Museum material: The occipitonasal length varies between 37.5 mm. and 42 mm. The toothrow between 7.8 and 8.4 mm. The head and body varies between 148 mm. and 209 mm., the tail between 128 and 158 mm., the hindfoot between 29 and 34 mm. but only once under 30 mm. in specimens seen.

8. *Hylopetes spadiceus* (Blyth)

The Pygmy Flying Squirrel

1847. *Sciuropterus spadiceus* Blyth, *J. Asiat. Soc. Beng.*, 16, 867.

Vernacular name (Blanford).—*Arakan* : *Kywek-shu-pyan*.

Type-locality.—*Arakan*.

Specimens seen from BURMA, Maymyo. *Arakan*. ANNAM, Djiring, Kontoum; COCHIN-CHINA, no exact locality. CAMBODIA, no exact locality. 'Mammæ 3 pairs' is noted on the Cambodia skin.

Range.—BURMA, Indo-China, and according to Chasen the Malay Peninsula.

My reasons for giving this form specific rank have been given above. It differs from all races of *H. lepidus* available (and I have examined all but two as listed by Chasen) in its proportionately larger bullae. A small species, the occipitonasal length not much more than 33 mm. and the hindfoot usually less than 27 mm.

External characters.—Essentially as in *H. lepidus*. Size small. Colour above with distinct reddish tinge in three

skins, this not so pronounced in three others including the one from Maymyo. Described by Blanford as with basal $\frac{3}{4}$ of the dorsal fur sooty black, the tips red. A more or less marked whitish or pale patch behind the ears. Membranes and limbs darker than the back. Tail dark brown, with tendency for a contrasted light brown portion to be present near the body on either side. In the Maymyo skin, the sides of the feet tend to be white, and the digits are white, the rest of the feet black. Underside white or whitish.

External measurements.—

	Head and body	Tail	Hindfoot	Ear
M. Maymyo, Burma	132	100 $\frac{1}{2}$	22	19

Three other skins from Indo-China have been examined; these vary in measurements as indicated below under dimensions for the species.

Cranial characters.—Essentially as described above for *Hylopetes lepidus* except the fact that the bullae are relatively larger, in length about 22-23% of the occipitonasal length, therefore larger than in all races of *Hylopetes lepidus* which are represented in London. Thus the length of the bullae are 7.5 mm. and more in the few skulls examined, and the occipitonasal length is 33.0 and less, whereas *H. lepidus belone*, with an actually larger skull (occipitonasal 34.6-35.5 mm.), has actually smaller bullae (7.7-1 mm.).

Dental characters.—Essentially as in *H. lepidus*.

Cranial measurements.—

	Occipito-nasal	Palate	Bullae	Toothrow	Nasals	Frontals	Orbit
M. 14.7.19.104	32.7	16.2	7.7	6.4	<i>circa</i> 8.0	7.8	11.6
Maymyo, Upper Burma							

Another specimen from Kontoum, Annam, has the occipitonasal 33.0 mm., the bullae 7.5 mm., the toothrow 6.5 mm., the frontals 7.1 mm. and orbit 11.5 mm.

A co-type, from Arakan, has the occipitonasal *circa* 33.5 mm. The bullae, unfortunately, are impossible to measure accurately as they are partly broken.

Dimensions of the species Hylopetes spadiceus, as indicated by British Museum material: The occipitonasal varies between 32.7 and *circa* 33.5 mm. The toothrow 6.3-6.5 mm. The head and body varies between 119 and 137 mm. The tail

between $100\frac{1}{2}$ and 118 mm. The hindfoot between 19 and 25 mm., or in an old skin from Cochin-China, which could be a wrong identification, 27 mm.

9. *Hylopetes alboniger* (Hodgson)

The Parti-coloured Flying Squirrel

- 1836. *Sciuropterus alboniger* Hodgson, *J. Asiat. Soc. Beng.*, 5, 231.
- 1837. *Sciuropterus turnbulli* Gray, *Proc. zool. Soc. Lond.*, 68. ('India.')
- 1837. *Pteromys leächii* Gray, *Charlesworth's Mag. nat. Hist.*, 1, 584.
- 1940. *Pteromys (Hylopetes) alboniger orinus* G. Allen, *Mamm. China and Mongolia*, 2, 723. (Likiang Range, Yunnan, China.)

Type-locality.—Nepal.

Distribution.—NEPAL, ASSAM, BURMA, Yunnan, Siam, Indo-China.

This is a much more distinct species from *H. lepidus* than are the last two dealt with. It belongs to a different group, being considerably larger in size. Thus the hindfoot is normally 38 mm. at least, most often over 40 mm., and the occipitonasal length of the skull is at least 42.5 mm. The type of the form *H. a. leonardi*, Thomas, from North Burma, which I regard as a race of *alboniger*, has the occipitonasal (difficult to measure accurately as the skull is not entirely whole) about 42.5 mm. in length or slightly more. The typical race has the occipitonasal length 45.2 mm. at lowest in our considerable series. The toothrow is less than 11 mm. in length; actually and proportionately shorter than in a species from the Philippine Islands, *H. nigripes*, Thomas, which shows considerable resemblance to this species otherwise, but has the molars about 12 mm. or more.

I am not entirely satisfied that the Yunnan form described by G. Allen in 1940 as *Hylopetes alboniger orinus* can be distinguished on the cranial characters mentioned by him, 'larger teeth and audital bullae' when all specimens are taken into consideration. Measurements above show that, at least in the bulla length, some Assam specimens are smaller than the Nepal skull. Our Yunnan skulls have the bullae varying between 9 and 9.3 mm., which measurements again are quite covered by specimens listed above from Assam. The teeth of the Yunnan skulls vary between about 10 and 10.5 mm., just as in the Assam series above, and 10.8 mm. in one specimen. Allen says the 'feet are larger by several

millimeters' in *orinus*, but our specimens have the hindfoot varying from 41–44 mm. in the Likiang series, which measurements are covered by those given above. The colour of the tail which Allen mentions as typical of *orinus* is covered by specimens from Darjeeling, Pashok, and Bhutan Duars, and is I think an individual character rather than a racial one, judging by material examined. I do not see how this race from Yunnan, therefore, is to be maintained.

External characters.—Largest of the typical subgenus in Indian territory. Except for larger size, the essential external characters seem to be much as in *H. lepidus*, including the somewhat flattened tail, and the feet and digits; soles mostly naked. Five plantar pads apparently.

Colour.—Above varying from greyish to reddish brown, but everywhere mixed with the dark underfur, and general effect drab rather than striking. Shoulders tending to have white or light patches present or suggested. Tail brown typically, mixed with black as a rule, and rather variable individually; sometimes with a long black terminal portion; and sometimes almost whitish each side at base, as in specimens from Yunnan, and from Darjeeling and Bhutan Duars, etc.; in some of the specimens from Khonshnong, the tail is almost wholly pale greyish, only a little darker in the middle and at the end. Feet wholly dark or dark with the toes contrasted white, sometimes strikingly so, varying individually in different specimens from the same locality. Lower parts giving a general grey effect owing to the hairs being mostly bluish-grey at bases, but white in part on most specimens, particularly the throat and sometimes the chest. According to Blanford, young specimens are black above, white below.

External measurements.—As in Table 6, below.

Unmeasured skins seen from Mokokchung in Naga Hills, Silhet. Machi, Manipur; also the types of *alboniger*, Nepal, and '*turnbulli*' from 'India', and the type of *leonardi*, from 28.5 lat., 97.25 long.

Four specimens from Khonshnong, (typical race), weighed respectively 7.75 oz., 8 oz., 9 oz. and 10 oz. 'Mammae 3 pairs', one skin, Denning.

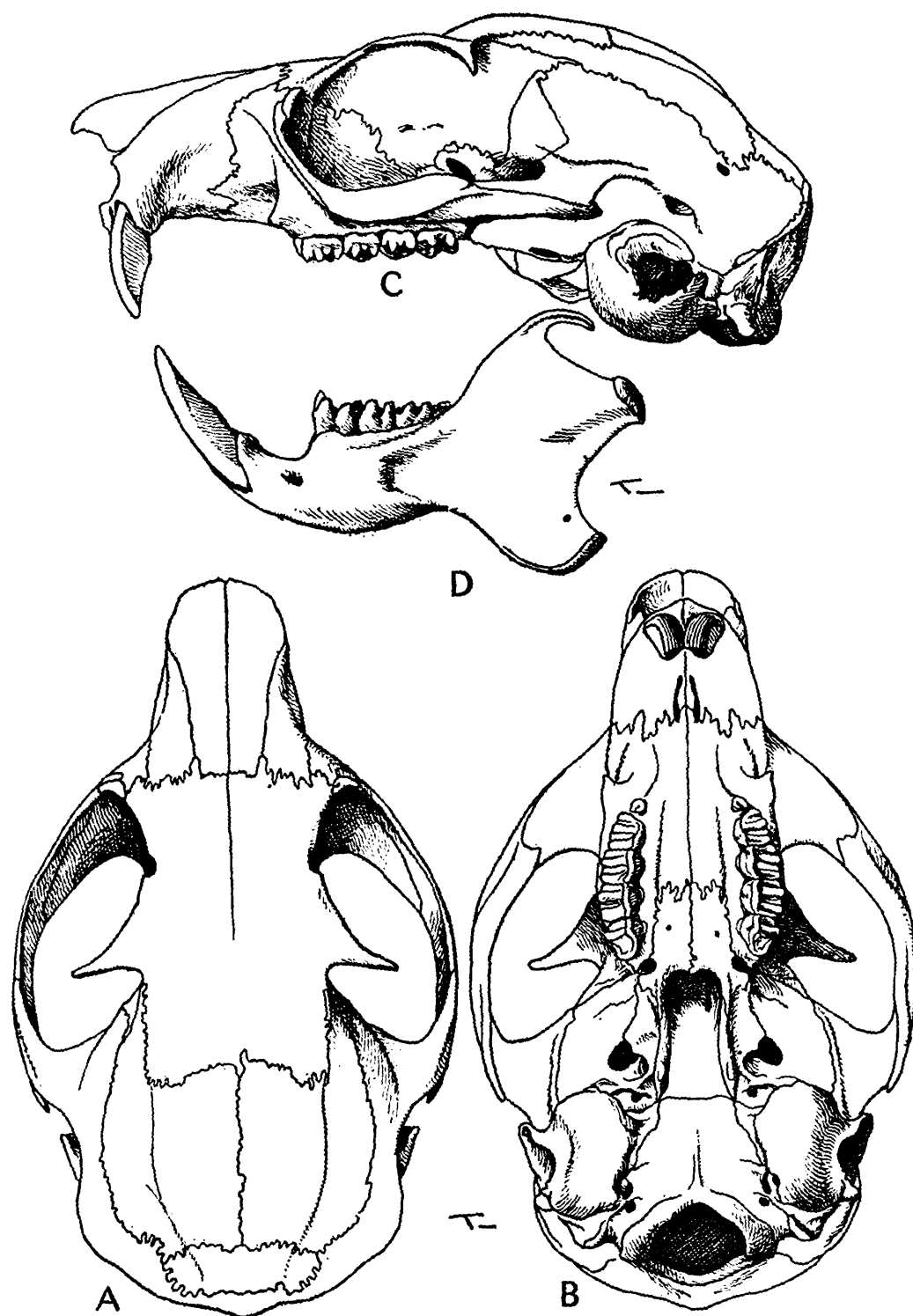
Cranial characters.—Skull of medium size, the postorbital processes well developed, notches present in the frontals each side in front of them, and the frontals somewhat depressed between them. Parietals rather shorter than frontals, not meeting the frontals in a straight line, the frontals posteriorly being usually broadly W-shaped. Interparietal well developed, and parietals lack ridges. Occiput low. Bullae not flattened, and not very large, less than one-fifth

TABLE 6.—*External measurements of Hylopetes alboniger alboniger*

	Head and body	Tail	Hind- foot	Ear	
M. Dening, Mishmi	236	227	45	36½	
F. Dening	247	222	43	34½	'Mammæ 3 pairs'
F. Khonshnong, Jaintia Hills, Assam	215	210	43	33	
F. Khonshnong	200	186	40	32	
M. Khonshnong	220	198	40	33	
F. Khonshnong	225	200	40	30	
M. Khonshnong	205	187	40	32	
M. Khonshnong	210	202	41	31	
F. Bharnabari, Bhutan Duars	190	207	42	32	
F. Pashok, Sikkim	175	179	39	31	
Ambootia, Darjeeling	214	202	40	31	
M. Sipuri, Nepal	196	184	40	35	
M. 50 miles W. of Kindat, Chin Hills, Burma	201	184	39	32	
Frost Collection—					
M. 283. Naga Hills, 5,000 ft.	225	210	40	33	
M. 249. Naga Hills	200	190	40	32	
F. 284. Naga Hills	220	175	40	33	
F. 285. Naga Hills	185	163	36	32	
F. 288. Naga Hills	210	200	40	30	
M. 289. Naga Hills	180	165	40	33	

of the occipitonasal length, therefore proportionately smaller than in *H. phayrei*, *H. spadiceus*, the Indian race of *H. lepidus*, and *Eoglaucomys*. Palate broad, and normally over half the occipitonasal in length; palatal foramina situated far in front of the toothrows, and small. Pterygoid fossae very shallow. Zygomatic plate low; jugal long and of usual Sciurine formation. Mandible with well-developed coronoid process, and the angular portion showing some signs of inflection.

Dental characters.—Upper incisors yellow or reddish, of medium width, and usually plain. Five upper cheekteeth; P. 3 very small. Upper molars of normal Sciurine pattern, essentially as described above for *Hylopetes lepidus belone*. M. 3 simple as usual, with one (anterior) main ridge only between the front and back of the tooth. P. 4 3-rooted. The molars may show signs of extra complexities such as numerous little isolated depressions which may be suggested on the crown surface, but nothing like the same extent as in *Belomys*, and the essential Sciurine pattern always traceable. Lower molars normal; rather clear small subsidiary cusps



TEXT-FIG. 5. *Hylopetes alboniger alboniger* (Hodgson). A, B, C, dorsal, ventral and lateral views of the skull; D, lower jaw of the same ($\times 2$).

each side between the main anterior and posterior cusps at each corner of each tooth.

Cranial measurements.—As in Table 7, below.

Two co-types, Nepal, measure, respectively, 46.4 mm. and 47.3 mm. in occipitonasal length, with the bullae 8–8.3 mm. and the toothrow 9.2–9.7 mm., the smaller one is not fully

TABLE 7.—*Cranial measurements of the Indian races of Hylopetes alboniger*

	Occipito- nasal	Palate	Bullae	Toothrow	Nasals	Frontals	Orbit
<i>Hylopetes alboniger alboniger</i>							
M. 16.3.26.15 .	46.9	23.7	9.1	10.2	13.1	10.4	17.0
Chin Hills, West Burma							
F. 16.3.25.59	46.0	23.3	8.0	—	13.2	10.5	16.3
Pashok, Sikkim. Rather young							
F. 16.7.29.91	48.0	24.5	8.7	10.3	14.3	10.0	17.7
Bharnabari, Bhutan Duars							
F. 20.6.6.10	47.6	24.6	8.7	—	13.2	10.4	17.2
Mokokchung, Naga Hills, Assam					<i>circa</i>		
M. 21.12.5.41	49.7	25.7	8.5	10.3	14.1	10.4	17.4
Dening, Mishmi							
F. 21.12.5.42	50.5	26.6	8.3	10.5	15.5	11.1	17.8
Dening							
M. 21.1.6.56 .	48.0	24.8	8.5	10.1	13.3	9.7	17.3
Khonshnong, Jaintia Hills, Assam							
M. 21.1.6.57 .	48.3	24.9	8.4	—	13.0	9.1	18.3
Khonshnong, Jaintia Hills, Assam							
M. 21.1.6.58	48.7	24.8	8.5	10.0	14.4	9.4	17.6
Khonshnong							
F. 21.1.6.60	50.6	25.8	9.3	10.5	14.8	11.0	18.4
Khonshnong		<i>circa</i>					
F. 21.1.6.61 ..	49.7	25.6	9.1	10.1	14.5	10.2	17.7
Khonshnong. Upper incisors slightly overgrown							
45.1.8.247	45.6	23.4	8.4	9.7	11.7	10.0	16.6
Nepal.							
Frost Collection—							
F. Unnumbered							
Naga Hills	46.8	23.8	8.4	10.6	14.0	10.4	17.3
M. Unnumbered							
Naga Hills	46.6	23.1	8.3	9.9	13.5	9.7	17.1
M. 283. Naga Hills.	50.2	24.8	8.8	10.2	14.6	10.4	17.4
F. 284. Naga Hills.	49.6	24.9	9.1	10.2	13.7	11.5	17.1
M. Unnumbered				<i>circa</i>			
Naga Hills	48.5	24.5	8.9	10.0	13.3	10.7	17.3
F. 288. Naga Hills.	49.7	24.7	9.2	10.2	14.6	10.5	17.3
						<i>circa</i>	
M. 289. Naga Hills.	45.2	23.2	8.6	—	—	9.0	16.4
Rather young							

Hylopetes alboniger leonardi

M. 20.8.8.2	<i>circa</i> 42.5	21.0	—	—	12.4	8.9	15.2

Kachin, North Burma. Occiput not complete.

adult. Broken skulls also seen from Nam Tisang, Upper Burma, Ambootia, Darjeeling, Silhet, and Manipur.

Dimension of the species Hylopetes alboniger including specimens in the British Museum from Indo-China and Yunnan: The occipitonasal varies between circa 42.5 mm. or slightly more (type of *leonardi*), and 50.6 mm. The tooth-row between 9.2 and 10.8 mm. (up to 11.3 mm. in Allen's individuals). The head and body varies between 174 and 247 mm.; the tail between 163 and 227 mm. The hindfoot between 34 and 45 mm. but only twice below 39 mm. (The tail is only 125 mm. in the type of *leonardi*, according to Thomas).

Provisional key to races of Hylopetes alboniger

1	(2) Smaller, occipitonasal roughly 42.5 mm..	<i>H. a. leonardi</i>
2	(1) Larger, occipitonasal not less than 45.2 mm..	<i>H. a. alboniger</i>

(i) **Hylopetes alboniger alboniger** (Hodgson)

Text-fig. 5

1836. *Sciuropterus alboniger* Hodgson, *J. Asiat. Soc. Beng.*, 5, 231.

Type-locality.—Nepal.

Specimens seen from NEPAL, Sipuri and no exact locality, including type, and type of '*turnbulli*', from 'India' SIKKIM: Ambootia, Darjeeling, Pashok. MANIPUR, Machi. ASSAM: Mokokchung in Naga Hills; Naga Hills, 5,000 ft., no exact locality; Khonshnong in Jaintia Hills; Silhet; MISHMI, Dening; BHUTAN DUARS, Bharnabari; BURMA: 30–50 miles west of Kindat; Kachin, 28° N., 97° E. Nam Tamai Valley. Nam Tisang, Yunnan, NW flank of Likiang Range. Annam: Kontoum, Dakto.

(ii) **Hylopetes alboniger leonardi** (Thomas)

1921. *Pteromys (Hylopetes) leonardi* Thomas, *J. Bombay nat. Hist. Soc.*, 27, 3, 501.

From Kachin Province, North Burma, 28.5° N., 97.25° E. Altitude 8,000 ft.

The type only available for examination.

This is known only by one specimen, but may be regarded as a race of *alboniger*, characterized chiefly by its smaller size. Its colour seems rather different in detail from *alboniger*, and was described by Thomas as 'general colour above blackish buffy, the hairs with long blackish slaty bases and buffy tips, under surface pinkish buffy, the chest and axillary regions

white. Edges of parachute broadly black. Face and streaks running up sides of neck clearer buffy. Hands and feet blackish, lighter along their inner edges than terminally. Tail with wool hairs buffy, its long hairs glossy blackish.'

Its dimensions were given as head and body 180 mm., tail 125 mm., hindfoot 39 mm.

Subgenus (b) **Eoglaucomys** Howell

1915. *Eoglaucomys* Howell, *Proc. biol. Soc. Washington*, 28, 109.

This subgenus contains one species which differs from *Hylopetes* in larger size, with the hindfoot over 50 mm., and the occipitonasal length over 55 mm. in length; the nasals actually and proportionately longer and the zygomatic plate higher and more upstanding. The mammae are said to be 8 in number, instead of 6, for the typical subgenus. The nasals are usually over 30% of the occipitonasal length.

In size at extreme development this species may be cranially as large as small species of *Petaurista*. It has a more normal dentition than *Petaurista*, and the toothrow is actually shorter than any specimen of *Petaurista* out of approximately 125 which I measured. It is Palaearctic in distribution whereas true *Hylopetes* is Indo-Malayan.

10. **Hylopetes fimbriatus** (Gray)

The Smaller Kashmir Flying Squirrel

1837. *Sciuropterus fimbriatus* Gray, *Ann. Mag. nat. Hist.*, 1, 584.

Type-locality.—Simla.

Distribution.—Afghanistan, KASHMIR, PUNJAB.

It is my belief that there may well be two valid races in this species, although I have only one skull for the form *H. f. baberi*. This race was described as being like *fimbriatus* but markedly larger. The skull for *baberi* is not old, and its parietal ridges are free and not approaching each other; it is larger, however, than the oldest skulls we have for true *fimbriatus*, some of which have the parietals fused into a sagittal ridge. *H. f. baberi* was described from Afghanistan, and the skull I have examined is from Hazara, NW Frontier, not very distant from the locality of *baberi*.

External characters.—A medium sized flying squirrel, with dimensions as indicated above, and the tail as often as not a little longer than the head and body. Tail rather broad and flat, and fur thick. The ear is large and prominent.

Hand with, as usual, four functional fingers, the claws quite prominent; soles mostly naked, with five well-developed pads, and a very small extra one behind the pad at base of fifth toe, the toes of normal proportions. (The side of the sole is hairy, below the fifth toe, but the large posterior plantar pad is not separated by any hair from the small pads under the toes). 8 mammae traceable in two skins.

Colour.—Back light greyish brown, more or less mixed with black. A small mid-dorsal dark line can be suggested in some specimens. Two skins from Simla, and one from Bhurban, Murree, are more reddish brown in general colour. Fur on the whole is darker basally, lighter terminally. Tail brown, with long black terminal portion (the dark terminal portion only slightly marked in the Simla skins). Hands and feet usually black. Underparts white or whitish.

External measurements.—As in Table 8, below.

TABLE 8.—*External measurements of the Indian races of*
Hylopetes fimbriatus

	Head and body	Tail	Hind- foot	Ear
<i>H. fimbriatus fimbriatus</i>				
F. Gharial, Punjab.	270	250	50	36
M. Gharial	270	260	60	43
Murree, Punjab	250	252	50	37
M. Bhurban, Murree	244	252	52	37
F. Thandiani, Punjab	234½	253½	52.2	39.5
M. Naggar, Kulu Valley, Lahul	260	230	55	40
M. Sardalla, Kashmir	290	280	62	44
Sardalla	280	310	60	45
Sardalla	260	295	65	45
<i>H. fimbriatus baberi</i>				
M. Kagan Valley	300	310	60	45
M. Kagan Valley	300	311	62	47

Other skins bearing this name from Kashmir, no exact locality, and Hazara.

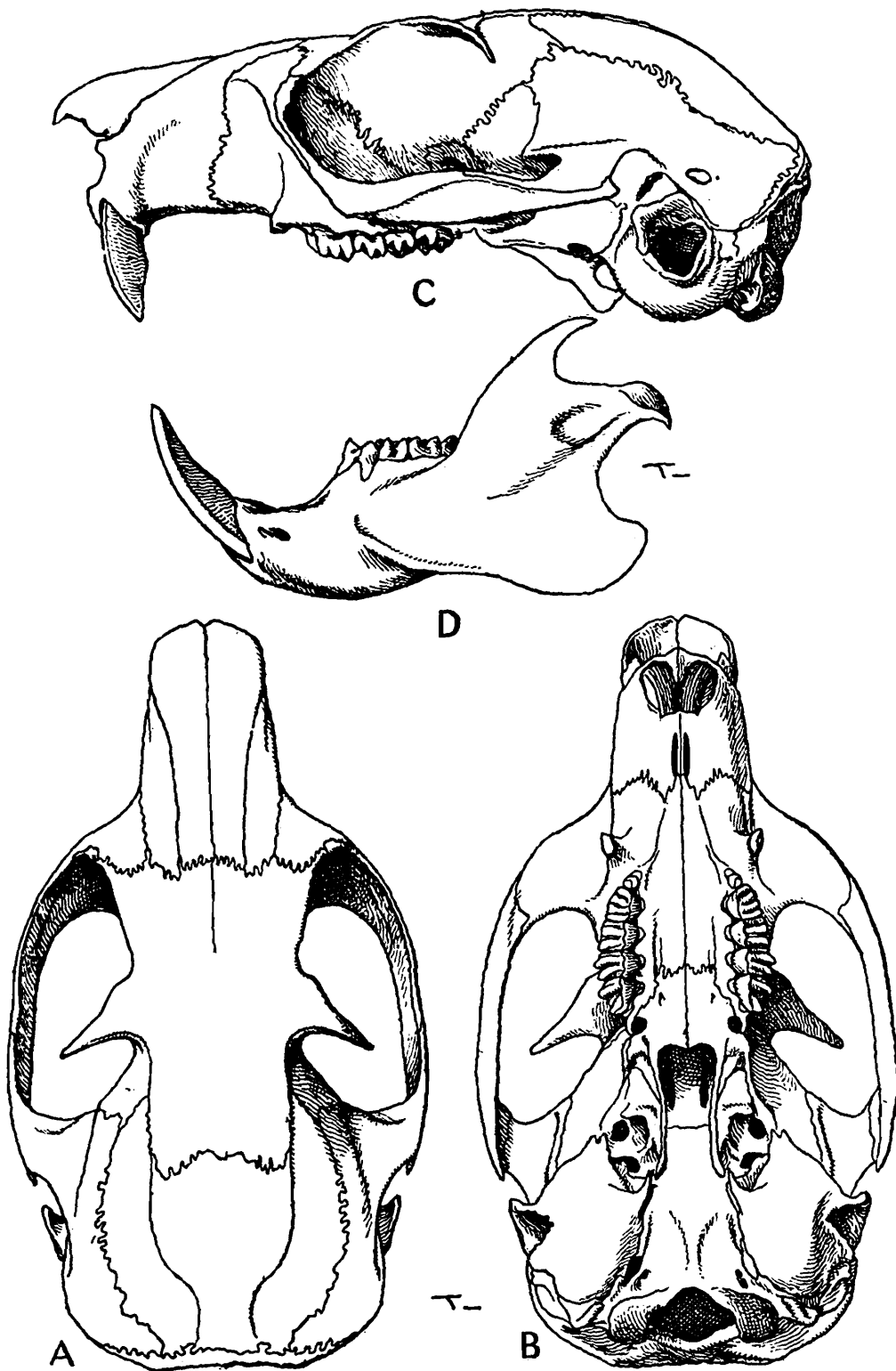
Other skins from Pongye, Chamba; Gilgit district; Hazara; Tuan, Pangi; Simla; Nasai, Kashmir. Near base of Diobani Mountain, 12,000 ft.

The following notes have been taken from the skin labels:—

From Gharial, 'Nocturnal, lives in roofs of bungalows' or 'Lives in roofs of houses, caught at dusk.'

From Sardalla, weight 2 lb., or 1½ lb., and from Bhurban, weight 13.75 oz.

From Gilgit, 'Four young ones inside it.'



TEXT-FIG. 6. *Hylopetes fimbriatus fimbriatus* (Gray). A, B, C, dorsal, ventral and lateral views of the skull; D, lower jaw of the same ($\times 3$).

From Thandiani, 'Shot in pine forest.'

From Murree, 'Lived in roof of a house; native name *Niula*.'

Cranial characters.—Largest in the genus *Hylopetes*, and at extreme development it may be as large as in small species of *Petaurista*. Postorbitals strong and well developed, the frontals somewhat depressed between them. Nasals rather long, proportionately longer than in other species of *Hylopetes*, over 30% of the occipitonasal length as a rule. The parietals are weakly ridged, and in old age the two ridges fuse for a short distance in front of the top of the occiput to form a very weak, scarcely visible sagittal ridge. Interparietal apparently reduced, not apparent in the skulls examined. Occiput low, but perhaps tending to be slightly more ridged than in the smaller species. Bullae large and well inflated, over one-fifth of the occipitonasal length in the majority, particularly inflated in one specimen from Gilgit as compared with the other skulls seen. Pterygoid fossae low; palate long, over half the occipitonasal length in the majority. Palatal foramina very short as usual. Zygomatic plate rather noticeably more upstanding and less low than in the majority of flying squirrels (*Pteromys* excepted). Jugal long and rather broad. Mandible with well-developed coronoid, and angular process showing signs of inflection.

Dental characters.—The incisors are brightish red in all skulls examined; the upper ones plain. Pattern of molars essentially normal, and as described above for *H. lepidus*. The upper molars, however, seem to be relatively simpler in detail than in forms like *H. alboniger*, etc., in that they appear to lack the small outer subsidiary cusp in M. 1 and M. 2 between the two main outer ridges. These main ridges may be seen to be formed of at least three small cusps in cutting teeth (particularly the hinder main ridges). M. 3 simplified posteriorly as usual, and P. 3 very small as usual. Lower molars basinshaped, and without peculiarity, though showing signs of numerous small cusps when cut.

Cranial measurements.—As in Table 9, below.

It may be added that the type skull of *H. fimbriatus fimbriatus* is in the British Museum, and its occipitonasal length is about 56.5 mm.

Dimensions of the species *Hylopetes fimbriatus*: The occipitonasal length varies between 55.2 and 61.7 mm. in the material examined; the upper toothrow 10.5–12.3 mm. The head and body varies between 234 and 300 mm., the tail between 230 and 311 mm. The hindfoot 50–65 mm.

TABLE 9.—*Cranial measurements of the Indian races of Hylopetes fimbriatus*

		Occipito- nasal	Palate	Bullae	Toothrow	Nasals	Frontals	Orbit
<i>H. fimbriatus fimbriatus</i>								
F.	5.11.19.4 Murree, Punjab	58.5	30.3	—	11.1	18.3	—	—
M.	7.8.1.2 Thandiani, Punjab	56.8	28.8	12.1	10.9	18.1	12.8	20.1
F.	7.8.1.3 Thandiani	55.2	28.4	11.6	11.4	17.2	12.2	19.8
M.	7.11.21.13 Gharial, Punjab	56.9	28.6	12.1	—	19.1	12.1	20.8
F.	7.11.21.14. <i>circa</i> Gharial	57.9	29.6	11.5	11.3	17.3	13.1	20.8
M.	23.9.1.36 Naggar, Kulu Valley, Lahul	55.9	29.3	12.0	11.0	17.0	11.6	20.8
M.	25.6.10.15 Sardalla, Kashmir.	60.6	30.5	—	11.7	20.0	12.8	22.0
	79.7.2.12 Kashmir	60.7	31.5	11.6	12.2	20.0	13.3	21.5
F.	81.3.1.5 Gilgit. Note large bullae	58.8	29.7	13.1	12.0	19.6	11.7	20.7
	83.1.13.3 Tuan, Pangl, NE. of Simla.	59.9	30.7	11.6	10.5	19.7	14.8	21.4
F.	85.8.1.129 Simla	56.9	28.1	11.7	10.7	17.8	12.4	20.9
F.	85.8.1.128 Simla. Parietal ridges fused	57.1	29.2	11.8	10.9	17.2	12.9	20.2
F.	83.1.13.4 Tuan, Pangl. Parietal ridges almost fused	61.3	31.8	12.5	12.3	20.2	15.0	21.9
<i>H. fimbriatus baberi</i>								
	12.11.26.10 Hazara, NW. Frontier	61.7	31.2	12.9	12.2	19.5	14.0	22.0

The two races may be provisionally keyed as follows:—

- 1 (2) Larger, occipitonasal length (in one skull available, adult but not old, with its parietal ridges separate and not approached) is 61.7 mm. *H. f. baberi*
- 2 (1) Smaller, occipitonasal length in the oldest skulls available, with parietal ridges approached or fused, not exceeding 61.4 mm. and only once reaching 61 mm... , , , , *H. f. fimbriatus*

(i) **Hylopetes fimbriatus fimbriatus** (Gray)

Text-fig. 6

1837. *Sciuropterus fimbriatus* Gray, *Ann. Mag. nat. Hist.*, **1**, 584.*Native Name*.—'Niula' (note on skin taken at Murree).*Type-locality*.—Simla.*Range*.—Specimens examined from PUNJAB: Simla; Naggar, Lahul; Murree, and Bhurban near Murree; Thandiani; Tuan, Pangi, NE. of Simla; Gharial; Pongye, Chamba; KASHMIR: Gilgit; Nasai; Sardalla.(ii) **Hylopetes fimbriatus baberi** (Blyth)1847. *Sciuropterus baberi* Blyth, *J. Asiat. Soc. Beng.*, **16**, 866.*Type-locality*.—Mountain district of Nijrow, Kohistan, Afghanistan.*Range*.—Specimens examined from KASHMIR, no exact locality; Kagan Valley; Hazara. AFGHANISTAN: Peiwar Kotal.Larger than the last; size of a small *Petaurista*; as judged by one skull available, occipitonasal at maximum for species, 61.7 mm.Genus 4. **Petinomys** Thomas1908. *Petinomys* Thomas, *Ann. Mag. nat. Hist.*, **1**, 6.*Type-species*.—*Sciuropterus lugens* Thomas, from Sipora Island, near Sumatra.*Range*.—CEYLON and SOUTH INDIA: TENASSERIM: Malay States; Sumatra, Java, Borneo, Basilan Island in the Philippines.This genus contains small to medium-sized flying squirrels with the molars not excessively wrinkled, and with the bullae peculiarly low and flattened, scarcely rising above the general level of the base of the skull. It probably comprises a series of parallel offshoots of *Hylopetes*.There are three very distinct groups of species of this genus, two of which occur in some part of India; the *setosus* group, small flying squirrels, occipitonasal length 27.5–30.6 mm. in material available; TENASSERIM to Malaya, Sumatra and Borneo; the *sagitta* group, medium-sized flying squirrels, occipitonasal length 37.4–41.5 mm., hitherto known as the *genibarbis* group but now that *sagitta* Linnaeus is known to be a *Petinomys* in all probability it will displace the name 'genibarbis'; Malaya, Sumatra, Java, Borneo; and the *fusco-capillus* group, largish flying squirrels, occipitonasal length 49.4–57.7 mm., SOUTH INDIA, CEYLON, Sumatra and Islands

to the west of it. The type is from Sipora Island, west of Sumatra, and belongs to this group, as does apparently the Philippines form.

Key to the species of Petinomys occurring in India.—

1	(2) Small species, occipitonasal length not over 30.6 mm.; hindfoot 21– 24 mm.	<i>Petinomys setosus</i>
2	(1) Large species, occipitonasal length not under 55.5 mm.; hindfoot about 52 mm.	<i>Petinomys fuscocapillus</i>

11. *Petinomys setosus* (Temminck)

Temminck's Pygmy Flying Squirrel

1845. *Pteromys (Sciuropterus) setosus* Temminck, *Fauna Japon. Mamm.*, 49. From Padang, western Sumatra.

Range.—Tenasserim, Malaya, Sumatra, Borneo.

This species contains about three races. Chasen (1940) restricts it to the typical race, and calls the Indian race *Petinomys vordermanni phipsoni* (*P. vordermanni* is the second name in the group, of Jentink, 1890, from Billiton Island, off Sumatra). I have not seen *vordermanni*, but there is so little real difference between *setosus* and *hipsoni* that I prefer to regard *hipsoni* as a race of *setosus*. Material seen indicates that *setosus* has the head and body (1 skin) 113 mm., whereas in *hipsoni* it is 120 mm. or more; the occipitonasal length in the typical race averages smaller than *hipsoni* (27.5–30.6 mm.) (but only once over 29 mm.), in *hipsoni* it is 30.4–30.6 mm. in two specimens. This race, therefore, averages slightly larger than the typical, and that is about all that can be said, except that in the scanty series seen the teeth in *hipsoni* appear a fraction longer.

(i) *Petinomys setosus phipsoni* (Thomas)

Phipson's Flying Squirrel

1916. *Pteromys (Petinomys) phipsoni* Thomas, *J. Bombay nat. Hist. Soc.*, 24, 3, 421.

Type-locality.—Tenasserim Village.

Range.—Specimens examined from Tenasserim, the type-locality, and Malay States, Bagnara, Patani.

External characters.—Small size, and the tail a little shorter than head and body. The tail is feather shaped as usual in smaller flying squirrels, and flat and broad. Four functional fingers; and five toes, all bearing sharp claws; the hallux is

a little shorter than the other four toes which are roughly equal in length.

Colour.—Decidedly pinker dorsally than in typical *setosus* skins from Sumatra and Borneo. Described by Thomas as 'general colour above blackish slaty washed with fulvous or cinnamon, which becomes deeper and richer on posterior back. Undersurface cream-buff, whiter mesially.' There is a black line between the eye and nose, and the throat is pale reddish brown. Middle line of throat white. A small tuft of black hairs beside the ears. Feet dark. Tail dull greyish brown, darker terminally, above and below.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
14.12.8.243				
Tenasserim village, type	123	116.5	24	14.5
17.1.26.1				
Banghara, Satani, Malaya	120	110.0	21	?

Cranial characters.—Skull small, the occipitonasal length not exceeding 30.6 mm. in material examined. As is usual with small species of Sciuridae, the postorbital processes are small and weak. Frontals narrowed in front of them, but not excessively so; parietals straight on their junction with the frontals, and interparietal large and prominent. Zygomatic plate very low and but little tilted upwards. Palatal foramina very small, far in front of the toothrows as usual; palate less than half occipitonasal length, broad; pterygoid fossae very shallow. Bullae large, 22–23% of occipitonasal length in the Indian race, and unusually flattened throughout, their substance as described by Thomas for this genus 'unusually thick and opaque', and quite different and distinguishable at a glance from those of *Hylopetes*.

Dental characters.—Upper incisors short, yellow, thin and plain. Molars simple (compared at least with *Belomys*) of quite normal Sciurine type, and apparently without extreme peculiarity. The duplicate specimen of *phipsoni* lacks P. 3, which is normally present in the species.

Cranial measurements.—

	Occipito- nasal	Palate	Bullae	Toothrow	Nasals	Frontals	Orbit
F. 17.1.26.1	30.6	14.3	7.5	5.7	6.8	6.5	10.7
Banghara, Patani, Malaya							<i>circa</i>
F. 14.12.8.243	30.4	14.5	7.0	5.4	7.8	—	10.6
Tenasserim, type							

Dimensions of Petinomys setosus as indicated by British Museum material, including the typical race from Borneo and Sumatra: The occipitonasal length varies between 27·5 and 30·6 mm. The toothrow between 4·6 and 5·7 mm. (5·4–5·7 mm. in *phipsoni*, 4·6–5·2 mm. in our specimens of *setosus*); the head and body between 113 and 123 mm. (in very few measured skins), the tail between 98 and 116 mm., the hindfoot between 21 and 24 mm.

12. *Petinomys fuscocapillus* (Jerdon)

The Small Travancore Flying Squirrel

1847. *Sciuropterus fuscocapillus* Jerdon in Blyth, *J. Asiat. Soc. Beng.*, 16, 867.

Distribution.—South India and Ceylon.

Very much larger than the Tenasserim *Petinomys*, as indicated by the measurements in the key. Intermediate forms (in size) are known from the Malayan region.

Wroughton (1915) revived the name *layardi* for the Ceylon race, stating 'The type of *layardi* Kelaart is in the National Collection—the type of *fuscocapillus* (is) apparently lost, and the only thing I have to represent it is a mutilated flat skin collected by Mr. Bourdillon in Travancore. Kelaart in his description of *layardi* says "beneath grey", while Blyth writes of *fuscocapillus* "underparts rufous white extending to the cheeks and under-lip, the lateral fur margining the membrane rufo fulvous" There is sufficient of Mr. Bourdillon's specimen to show that the fur of the cheeks and the adjoining side and membrane (and indeed all fur on lower side of membrane) is buffy, growing paler near the base, whereas in *layardi* and in the present specimen the hairs of the underside are dark slate grey with pale points.'

While it is perhaps premature to divide the present species into races based on the above-mentioned unsatisfactory material, there seems to me, as Wroughton pointed out, to be too much difference on the undersides of the two skins in question to permit the name *layardi* to be placed in synonymy, and there the matter will have to rest until more specimens come to hand for both races.

External characters.—A medium-sized flying squirrel with thick fur and broad, long, feather shaped tail, the tail in the one measured skin examined being longer than the head and body. Four fingers on the hand; the fourth finger longest, as is usual in tree-squirrels, the third next in length, the

fifth next, the second shortest, but the fingers not very different in length from each other. Foot with five toes, of normal proportions, the hallux shortest, sole quite naked and apparently with six plantar pads; on the sole the long pad under the hallux is much clearer than the one opposite to it. A pencil of long hairs, which are black, is present beside the ears.

Colour.—Above mostly reddish brown, the sides darker than the middle of the back, the underfur dark. Cheeks apparently lighter than shoulders. Hairs of the flying membrane apparently black. Feet pale yellowish brown. Tail with a central line of blackish hairs through most of its length, and lightish brown on either side of this. Under-surface white in the typical race, 'rufescent white, the hairs dark grey near the skin' (Blanford), grey in colour in the Ceylon form, whiter grey centrally.

Cranial characters.—The skull is large for the present group of genera, although smaller than *Petaurista*; between 55.5 and 57.7 mm. in length. Postorbital processes large, strong and prominent, the frontals depressed between them, and just in front of them there is a conspicuous notch in the sides of the frontals, which is more developed in one specimen than in another examined. Parietals faintly ridged, the ridges not approaching each other, their anterior borders nearly straight. Nasals rather broader in front than behind, occiput low. Bullae flattened, as described for the genus, but rather less so than in *P. setosus* apparently. Pterygoid fossae shallow; palate broad, but less than half the occipitonasal length. Palatal foramina perhaps a little less reduced than is usual, situated far in front of the toothrows. Zygomatic plate relatively low. Cranial measurements indicate that the toothrow is less than one-fifth of the occipitonasal length, the orbit is well over one-third of the occipitonasal length, as usual in this group of genera, and that the bullae are roughly 21%, 22% or 23% of the occipitonasal.

Dental characters.—Upper incisors yellow and plain; upper cheekteeth without striking peculiarities, the small extra front premolar present but closely applied to the inner side of the front of P. 4. Molars without peculiarity other than a slight tendency to appear slightly complex in detail rather than simple; M. 3 simple posteriorly as normal; lower molars basinshaped, and without abnormality.

Apparently we lack skulls for the Indian mainland for this species. My notes are based on Ceylonese specimens.

Provisional key to the races of Petinomys fuscocapillus

- 1 (2) Cheeks and sides of belly white. . . *P. f. fuscocapillus*
 (one skin only)
 2 (1) Cheeks and the belly grey *P. f. layardi*

(i) **Petinomys fuscocapillus fuscocapillus** (Jerdon)

1847. *Sciuropterus fuscocapillus* Jerdon in Blyth, *J. Asiat. Soc. Beng.*, 16, 867.

Type-locality.—South India.

Specimens examined: one skin, in bad condition, from TRAVANCORE.

External and Cranial measurements.—These are not given for lack of specimens.

(ii) **Petinomys fuscocapillus layardi** (Kelaart)

1850. *Sciuropterus layardi* Kelaart, *J. Ceylon Br. Asiat. Soc.*, 2, 215 (328 of 1887 reprint).

Type-locality.—Ceylon.

Specimens, including the type, examined from CEYLON: Wellawaya, and no exact locality.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
F. 15.3.1.62 Wellawaya, Uva, Ceylon	296	310	52	30

This represents the form *layardi*. We have one un-measured skin for the typical form from Travancore.

Cranial measurements.—

	Occipito- nasal	Palate	Bullae	Toothrow	Nasals	Frontals	Orbit
F. 15.3.1.62 <i>circa</i> Wellawaya, Uva, Ceylon	55.5	27.8	12.3	11.0	16.8	11.1	20.0
M. 87.3.2.1 Ceylon	57.7	27.0	12.5	10.8	18.2	13.2	20.0
1166a (type) Ceylon	57.6	28.1	13.8	11.4	16.5	12.5	20.3

Dimensions of Petinomys fuscocapillus as indicated by British Museum material.—The occipitonasal varies between 55.5 and 57.7 mm. The toothrow between 10.8 and 11.4 mm.

One skin has the head and body 296 mm., the tail 310 mm., the hindfoot 52 mm.

13. *Petinomys* ? *morrisi* (Carter)

1942. *Pteromys (Olisthomys) morrisi* Carter, *Amer. Mus. Novit.*, 1208, 2.

Type-locality.—Taro, 26·2° N., 96·11° E., Northern Burma.

I have not seen this form. The describer refers it to the genus *Pteromys* (as a new subgenus), but I have already shown that *Pteromys* should be restricted to the northern Palaearctic flying squirrels, which seem to be not very closely allied to *Hylopetes* and *Petinomys*. It was said to be nearest *Hylopetes* but to lack any sculpturing of the teeth and to possess the low spreading bullae of *Petinomys*. The latter character seems to suggest that it should be placed in the genus *Petinomys*. It was said to be nearest '*sagitta*' (probably what now must be called *lepidus*) but lacking the golden brown colouring of the fur; with smaller teeth, and the braincase less rounded. Measurements given included total length 258 mm., tail 123 mm., hindfoot 26 mm., skull 32·1 mm., upper toothrow 5·8 mm., nasals 7·9 mm., zygomatic width 19·5 mm. The upperparts are stated to be grizzled, the cheeks and underparts white, a dark slaty black ring about eye extending forward to end of nose; tail fuscous, black above and paler below, with white tip.

Genus 5. *Eupetaurus* Thomas

1888. *Eupetaurus* Thomas, *J. Asiat. Soc. Beng.*, 57, 2(3), 256.

Type-species.—*Eupetaurus cinereus* Thomas.

Distribution.—Kashmir.

This genus contains a single large species confined to Kashmir, which apparently differs considerably from other flying squirrels in the structure of the cheekteeth, which are described by Blanford as 'hypsodont, the molars having high crowns, with the grinding surface perfectly flat and not very complicated. Upper molars peculiarly shaped, the crowns almost semi-oval, with a subangular apex inside, placed at the proximal extremity of each tooth, so that the greatest breadth of the tooth is oblique' As figured by Blanford, they appear very distinct from the usual Sciurine pattern. I have never been able to examine a skull of this genus. Thomas stated the skull was distinguishable from *Petaurista*

by 'its longer, trumpet-shaped muzzle, more marked supra-orbital notches, longer anterior palatine foramina and shorter bony palate' The external characters are quite striking and the genus may be more or less distinguished by these alone, with its unusually heavy thick fur and tail, heavily haired sole, and large size, the hindfoot about 85 mm.

According to Prater (1947), this genus occurs among rocks and cliffs and would seem therefore to differ in habit from the other flying squirrels. This author states that flying squirrels 'inhabit the tropical and temperate forests from plains level to an altitude coinciding with the limits of the tree line. The single exception is the woolly flying squirrel (*Eupetaurus cinereus*) which is found, even in the treeless parts of Hunza and Gilgit, among barren rocks and cliffs'

14. *Eupetaurus cinereus* Thomas

The Woolly Flying Squirrel

1888. *Eupetaurus cinereus* Thomas, *J. Asiatic Soc. Beng.*, 57, 2(3), 258.

Type-locality.—Gilgit Valley.

Specimens examined from Astor Valley (a co-type), Chitral and Gilgit, all KASHMIR.

External characters.—A very large flying squirrel with immensely thick fur throughout the whole of the back and tail. The hindfoot is 85 mm. in one measured skin. Thomas gave the following measurements for two specimens: head and body 610 and 515 mm., tail 380 and 480 mm., hindfoot 87 and 85 mm., ear 27 and 29 mm. Belly well furred, though less so than the back. Hand with four well clawed fingers, and apparently three small pads at digit's bases, and two large pads behind these; some short hair evidently present between the front and second row of pads just mentioned. Foot with five toes, the hallux shorter than the other four; the sole densely haired nearly throughout, but at the base of the toes are four clear naked pads, and under the hallux is a fifth small but clear naked pad which shows through the surrounding hair.

Colour.—Lightish grey throughout, but the belly much lighter (almost silvery grey) than the back. Back of hands apparently black, but the feet not conspicuously different from the back. There are numerous white-tipped hairs throughout the back. I have seen only four skins for this genus, one of which is in bad condition, and a co-type.

The *external measurements*, taken from Thomas's original description, are given below.

	Head and body	Tail	Hind- foot	Ear
F. Chitral	.. ?	?	85	37

Some *cranial measurements*, from Thomas, for *Eupetaurus cinereus* were:

Basal length of skull 68 mm., nasals 28 mm., least interorbital 20 mm. Width across postorbitals 34 mm. Palate 41 mm. Diastema 16.8 mm. Palatal foramina 8.5 mm. Toothrow (upper) 19.3 mm.

Genus 6. *Callosciurus* Gray

- 1867. *Callosciurus* Gray, *Ann. Mag. nat. Hist.*, **20**, 277.
- 1867. *Baginia* Gray, *Ann. Mag. nat. Hist.*, **20**, 279. *Sciurus notatus* Boddaert, from Java.
- 1867. *Erythrosciurus* Gray, *Ann. Mag. nat. Hist.*, **20**, 285. *Sciurus ferrugineus* Cuvier.
- 1880. *Heterosciurus* Trouessart, *Le Naturaliste*, **1**, 292. *Sciurus erythraeus* Pallas.
- 1906. *Tamiops* J. Allen, *Bull. Amer. Mus. nat. Hist.*, **22**, 475. *Sciurus maclellandi* Horsfield. Valid as a subgenus.
- 1915. *Tomeutes* Thomas, *Ann. Mag. nat. Hist.*, **15**, 385. *Sciurus lokroides* Horsfield.

Type-species.—*Sciurus rafflesi* Vigors and Horsfield, a Sumatran race of *C. prevosti* Desmarest, from Malacca.

Distribution.—The Philippine Islands, Celebes, Borneo, Sumatra, Java, the Malay States, Siam, Indo-China, BURMA, ASSAM, NEPAL, Yunnan, south-eastern China, Hainan, Formosa, Szechuan, Kansu, and Chihli. (Only the subgenus *Tamiops* ranges as far north as the last two States.)

This and the remaining genera differ from those which have been dealt with above in lacking the flying membrane.

The present genus contains essentially typical tree-squirrels. It is not distinguishable cranially and dentally from the Palaearctic, Nearctic and Neotropical genus *Sciurus*. It was given generic rank by Thomas owing to the fact that the baculum is of different structure, so far as known, from that of *Sciurus*. The baculum in this group is said to be complex in structure, with an accessory blade present. As recently as 1940 Chasen in his 'Hand List of Malay Mammals' refers the whole of this group (except *Tamiops*) to the genus *Sciurus*, and ignores *Callosciurus*, and there is much to be said for this classification. However, this group is most likely a natural one, and it is certainly convenient to retain

it. In 1940 I published a list of named subspecies and species of rodents; this genus contained approximately 320 forms, and *Sciurus* contained nearly two hundred. As a general rule, the pattern of the cheekteeth tends in this genus to be a little more distinct than in *Sciurus*. The two Palearctic species of *Sciurus* are quite easily separated from all species referable to *Callosciurus*; *S. vulgaris* by its general specializations towards life in cold climates, such as tufted ear, soles hairy seasonally, etc., and also as a general rule by its rather longer palate (than all *Callosciurus* except *C. hippurus*), and *S. anomalus* by the fact that it has only four upper cheekteeth. My reasons for referring *Tamiops* to *Callosciurus* as a subgenus have already been given (Ellerman, 1940, p. 349), and need not be repeated here; on the same page my reasons for ignoring '*Tomeutes*', based solely on the structure of the baculum, are given. One or two of the extralimital species, such as *C. hippurus* of Malaya, Borneo and Sumatra, and more particularly *C. leucomus* of Celebes, and *C. rubriventer* of Celebes are very widely distinct from most of the species currently referred to *Callosciurus*. Apart from the subgenus *Tamiops*, the Indian species do not differ very much from each other, and so far as specific definitions are concerned it ultimately becomes a matter of preference where to draw the line between groups of closely allied races.

On the structure of the baculum within the present genus I quote Thomas (1915): 'All the Indian and Malayan species hitherto referred to *Sciurus*' (i.e. = the present group of species) 'have bacula totally different from that of true *Sciurus*, and themselves divisible into two types, with an essential community between the two. For in all the baculum consists of two parts, a shaft or capulus of varying length and a separate sharp blade or lamina attached to the shaft by ligament and slightly movable upon it. The lamina has a concave base, which articulates with the rounded surface of the shaft and allows a certain amount of lateral play. As already noted the compound bacula are of two types, relatively more and less specialized. The less specialized consists of a long, slender, slightly curved shaft, with a narrow blade set on the side of it, in the concavity of its general curvature. The blade is attached nearly throughout its length and its greatest breadth is only about one-fourth to one-sixth of its length, so that it projects from the shaft as quite a low cutting blade. In the more specialized type the lamina is attached to the side of the blade, recurved

backwards towards the hilt of the shaft, which it may equal or exceed in length.'

After this he revived the name *Callosciurus* for the less specialized type described above, and it may be noted that in the list he gave of species and races examined, the type of *Callosciurus* is not included. The name '*Tomeutes*' was based on the more specialized type. Forms listed by him as examined were, for *Callosciurus*, *atrodorsalis*, *caniceps*, *erythraeus*, *castaneoventris*, *notatus*, *pluto* and *sladeni*, and for '*Tomeutes*', *lokroides*, *similis* (= *lokroides*), *phayrei*, *blanfordi*, *pygerythrus*, *janetta*, *pryeri*, *philippinensis*, *melanogaster*, *tenuis*, *brookei*, *lowi* and *murinus*. The last named, *murinus*, does not belong to the genus *Callosciurus*, so that he had examined nineteen out of roughly two hundred and ninety named forms, and evidently thought proper to erect a new genus on this very poor percentage of forms examined.

Key to the subgenera of Callosciurus occurring in India

1	(2) The back is clearly or prominently striped. Small species, the occipitonasal length does not reach 38 mm.	<i>Tamiops</i>
2	(1) The back is without clear stripes (other than sometimes a mid-dorsal line). In India, the occipitonasal length of the skull is not less than 42 mm.	<i>Callosciurus</i>

(But two extralimital species, *C. tenuis* and *C. lowi*, may frequently be as small, cranially, as *Tamiops*. The lack of stripes of these two species becomes then the main distinguishing character between the two subgenera.)

Subgenus (a) **Tamiops** J. Allen

1906. *Tamiops* J. Allen, *Bull. Amer. Mus. nat. Hist.*, **22**, 475.

Differing from *Callosciurus* by its prominently striped back, and in India by its smaller size. This is a difficult group to classify as these small squirrels vary seasonally in colour. Osgood (1932) published a preliminary review of the subgenus which recognized four species; but later G. Allen (1940) thought that there were only two species which occur together in some places and differ mainly by size. I am not wholly convinced that all the named forms could not be regarded as belonging to one species, but for the time being I follow G. Allen's classification.

Key to the species of subgenus Tamioops

1	(2) Averaging smaller; the occipitonasal length of the skull very rarely reaches 34 mm.	<i>Callosciurus maclellandi</i>
2	(1) Averaging larger; the occipitonasal length of the skull is very rarely less than 34 mm.	<i>Callosciurus swinhoei</i>

Of fifty-one skulls in the British Museum for *C. maclellandi* only three reach 34 mm. in occipitonasal length. In the same collection only two specimens for *C. swinhoei* out of about thirty-six are less than the above-mentioned length.

15. *Callosciurus maclellandi* (Horsfield)

The Himalayan Striped Squirrel

1839. *Sciurus maclellandi* Horsfield, *Proc. zool. Soc. Lond.*, 152.

Type-locality.—Assam.

Distribution.—Malay States, Siam, Indo-China, BURMA, ASSAM, westwards to NEPAL, and north-eastwards to southern Yunnan.

A small striped squirrel, with the tail somewhat narrow, and the ears more or less tufted. As a rule more southern in distribution than its ally *C. swinhoei*, and averaging smaller in size.

External characters.—Small striped squirrels, with the tail either slightly longer than head and body, or often rather shorter than head and body, the tail as a rule narrow although fully haired, but less bushy than is normal in tree-squirrels. Hand with four functional fingers; D. 4 slightly dominant; foot with five toes, not peculiar in formation, the hallux shortest, D. 5 slightly shorter than the central three digits, with D. 4 slightly dominant. Mammae 6. Ear hairy, and slightly tufted.

Colour.—General ground colour of back dull greyish or dull brownish; a black mid-dorsal stripe running down the middle of the back, with a pale stripe on each side of this (well marked in *barbei*, duller in the northern, typical race); on either side of these pale stripes or bands there is another dark stripe each side, which is duller than the mid-dorsal in the typical race, and less black, but is usually black in the southern races; outside these dark stripes is another pale stripe, either buffy or whitish, and sometimes very wide and prominent. In *barbei* this pale band often has an outer dark border which appears as a further stripe each side, and this

can sometimes be suggested in the typical race. Ear tuft black with conspicuous white tip. Tail with alternating rings of reddish, white, and black, giving a mottled effect. Lower parts in the typical race greyish whitish or brownish, but in general dull in colour, always lacking the rufous or orange tinge of the southern races. In these, *barbei*, *rodolphei*, *kongensis*, etc., the chest and throat always have a reddish or orange tinge, and sometimes the whole underparts are likewise; there is much individual variation, but there is a clear distinction in the considerable material available for examination between the northern dull-bellied and the southern ochraceous-bellied types.

External measurements.—As in Table 10, below.

TABLE 10.—*External measurements of the Indian races of Callosciurus maccllellandi*

	Head and body	Tail	Hind- foot	Ear	
<i>Callosciurus maccllellandi maccllellandi</i>					
Gangtok, Sikkim	106	105	30	14	
F. Gangtok	117	94	29	13	
M. Gangtok	107	99	28	12	
M. Chuntang, Sikkim	110	102	29	14	
F. Sedonchen, Sikkim	112	99	27	14	mammae 6
F. Sedonchen	123	90	29	14	mammae 6
F. Ringin, Sikkim	102	103	28	14	
F. Dreyi, Mishmi	105	91	25	14	
M. Dreyi	111	97	27	14	
F. Dening, Mishmi	113	98	26	13	mammae 6
M. Dreyi	100	94	24	14	
F. Dening	116	108	27	15	
F. Dening	113	115	29	—	
M. Dening	113	106	27	14	
Tiki, Mishmi	109	98	27	13	
F. Sadiya, Assam	105	96	—	12	
M. Sadiya	105	95	26	12	
M. Hkamti, Burma	115	104	29	13½	
M. Hkamti	119	105	30	13½	
F. Hkamti	112½	103½	28	13.25	
M. Hkamti	110	99	26½	13	
65 miles west of Kindat	113	92	18	12	
('manipurensis')					
M. 50 miles west of Kindat	121	104	28½	13	
M. 65 miles west of Kindat	119	89	17	12	
M. 55 miles north of					
Myitkyina	112	81	25	11	
F. Tamanthe, Chindwin	115	92	28.25	13.75	
F. Tamanthe	118	94	28	13	
F. Homalin, Burma	106	100	28	14	
M. Sedonchen, Sikkim	115	96	28	13	

TABLE 10.—*External measurements of the Indian races of Callosciurus maccllelandi (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus maccllelandi maccllelandi</i> (concl.)				
Frost collections—				
F. 270. Naga Hills, 5,000 ft.	110	90	25	14
F. 278. Naga Hills	110	100	28	15
M. 291. Naga Hills	110	105	?	13
M. 292. Naga Hills	115	85	20	14
M. 293. Naga Hills	110	97	23	15
M. 294. Naga Hills	120	95	25	15
F. 295. Naga Hills	118	95	25	12
F. 296. Naga Hills	110	100	25	15
M. 297. Naga Hills	115	90	25	14
F. 298. Naga Hills	110	90	25	14
F. 299. Naga Hills	112	85	25	15
M. 300. Naga Hills	120	100	25	15
F. 301. Naga Hills	120	75	25	14
M. 307. Naga Hills	105	95	23	15
F. 308. Naga Hills	105	98	24	14
M. 309. Naga Hills	110	80	24	14
F. 367. Naga Hills	112	100	23	13
M. 372. Naga Hills	105	95	25	13
F. 373. Naga Hills	110	95	25	15

Unmeasured skins examined from Aimole, Manipur (type of '*manipurensis*'), Haingyan in Chin Hills, Ratana, Mishmi, near Krang, Burma, near Schwebo, Sadiya, Mokokchung in Naga Hills, Nepal, Bhutan, Diking in Assam, Myitkyina, Cachar Hills, Machi and Loanghol, both Manipur.

Notes from skins.—*C. m. maccllelandi*: Sikkim; Sedonchen, weight of three specimens respectively 2 oz., 2½ oz. and 2¼ oz. Two of these noted as with 6 mammae. Chuntang, weight 2 oz. Ringin, weight 1½ oz. Gangtok, two specimens weighed 1½ oz. and 2½ oz. respectively. Burma; Hkamti, two specimens weighed 1½ oz. and 2 oz. Dening, mammae 1-1-1 = 6. 55 miles north of Myitkyina; 'Shot in tree in jungle, common'.

Callosciurus maccllelandi barbei

F. Amherst district	116	96	26	14
M. Tenasserim village	115	117	28½	13
F. Tenasserim town	120	111	28	13
M. Tenasserim town	111	112	28	13
F. Tenasserim town	121	113	28	14
F. Banlaw, Tenasserim	115	111	27½	13
F. Banlaw	120	116	28½	13
M. Banlaw	118	114	28	13
F. Lampea, Tenasserim	105	116	29	14
M. Kawkereik, Tenasserim	102	122	31	16
M. Kakya, Tenasserim	110	125	30	14
Taok Plateau, Tenasserim	118	135	32	14

TABLE 10.—*External measurements of the Indian races of Callosciurus maccllellandi (concl'd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus maccllellandi barbei</i> (concl'd.)				
F. Pyaunggaung, Shan States, Burma	118	114	28½	13
Five miles east of Toungoo, Burma	115	94	24	11½
M. Near Toungoo	99	119	27	11
M. King Island, Mergui Archipelago	110	105	25	13
M. King Island	123	115	26	14
F. Kisseraing Island, Mergui Archipelago	105	105	25	13
M. Kisseraing Island	105	109	26	13

Other skins seen from Hankaryit, Tenasserim; Watau, Bhamo; Maymyo, Burma; Thoungyeh and Mywadu, both Tenasserim; near Tavoy; Bankason; 30 miles east of Mandalay, south of Moulmein, etc., and SW Siam.

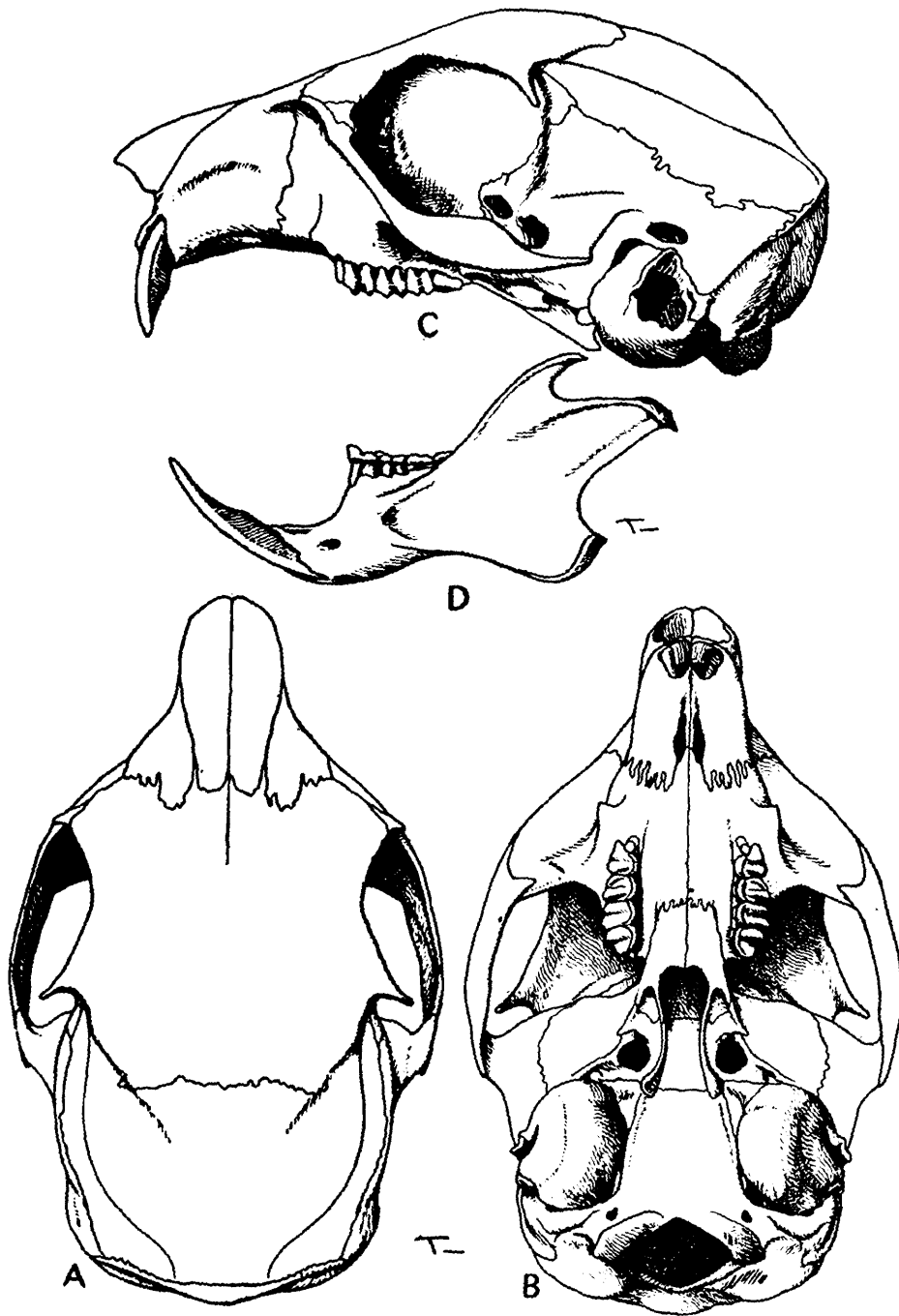
Callosciurus maccllellandi barbei ('kongensis')

35 miles SE. of Prome, Burma	115	127	30	12
35 miles SE. of Prome	115	116	30	15
35 miles SE. of Prome	116	114	28	14 6 mammae
F. Shan Mepale, Amherst	117	124	27	14
M. Shan Mepale	115	126	27	14

Notes from skins.—*C. m. barbei*: Banlaw, weight 1½ oz. Kisseraing Island, weight 2 oz. Banlaw, weight 1¾ oz. Pyaunggaung, weight 1¾ oz. 35 miles SE. of Prome, mammae 3 pairs.

Cranial characters.—The skull is small for a member of the present genus. The occipitonasal length does not reach 38 mm. in British Museum material. This fact will distinguish the present group from other *Callosciurus* of India, but the small Indo-Malayan species *C. lowi* and *C. tenuis* are often about the same size as *Tamiops*. These species very generally have the frontal width proportionately narrower than the present species and its ally *C. swinhoei*, but not in every individual. The orbit tends to be proportionately shorter in this group than in *tenuis*. The skull is somewhat bowed down anteriorly; the nasals are shorter than the least width of the frontals, but not peculiar in form. The frontals are wide, almost always over one-third of the occipitonasal length. Postorbital process directed backwards, and relatively small. Width across postorbital processes usually roughly half the occipitonasal length; this character may normally

be used for distinguishing this subgenus from *Funambulus*, perhaps excepting the rare species *F. layardi*. The suture of the frontals and parietals is some distance behind the postorbitals, and often nearly straight; parietals not or scarcely ridged, and no sagittal crest. Occiput low and weak. Bullae moderately inflated, and without special peculiarities. Pterygoid fossae quite well marked, the hamular process rather long, but not joining bullae. The palate is



TEXT-FIG. 7. *Callosciurus maccllelandi maccllelandi* (Horsfield). A, B, C, dorsal, ventral and lateral views of the skull; D, lower jaw of the same ($\times 6$).

distinctly short; on average 44% or less of the occipitonasal length. Palatal foramina very short, and far in front of the toothrows. Zygomatic plate quite well tilted up. Coronoid process of mandible recurved, and not reduced in any way, but well developed. Angular portion rather narrow, its lower border quite well ridged.

Dental characters.—Upper incisors slightly proodont, narrow, red or yellow, normally ungrooved. Five upper cheekteeth; P. 3 of medium development, considerably smaller than the other teeth. These have, as usual, each two main cross ridges between their anterior and posterior margins except M. 3, which lacks the second main cross ridge. No subsidiary cusp on outer side of the teeth between the cusps formed by the outer edge of the two main cross ridges. Lower molars decreasing in size from M. 3 forwards as usual, essentially normal and without peculiarities; as usual there is a large central depression, which is retained, in each tooth, and four main corner cusps, the anterointernal one the highest.

Cranial measurements.—As in Table 11, below.

TABLE 11.—*Cranial measurements of the Indian races of Callosciurus * maclellandi*

	Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus maclellandi maclellandi</i>					
M. 15.9.1.129 Sedonchen, Sikkim	32.6	15.2	9.6	11.7	9.7
F. 15.9.1.130 Sedonchen. Old	34.9	15.7	9.8	11.7	9.5
F. 15.9.1.131 Sedonchen	33.3	15.3	9.1	12.0	10.1
M. 15.9.1.132 Gangtok, Sikkim. Young	31.9	14.2	9.0	11.0	9.2
F. 15.9.1.133 Gangtok	33.6	15.3	10.2	12.4	9.8
M. 15.5.5.199 Tamanthe, Burma	30.3	14.0	—	10.8	9.0
M. 15.5.5.200 Hkamti, Burma	32.5	15.2	—	11.4	9.4
F. 15.5.5.204 Tamanthe, Burma	32.0	14.6 circa	8.5	11.8	9.9

* I omit the toothrow measurement on this and certain other genera of Sciuridae owing to the fact that the small P. 3 tends to drop out in adult specimens and therefore I have not found it a very satisfactory measurement,

TABLE 11.—*Cranial measurements of the Indian races of Callosciurus macclellandi (contd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus macclellandi macclellandi</i> (concl.)						
F.	15.5.5.205 Hkamti, Burma	32.5	14.8	8.8	11.8	9.8
F.	15.5.5.206 Homalin, Burma. Rather young	31.7	14.6	8.3	12.1	9.2
M.	16.3.26.41 West of Chin Hills (' <i>manipurensis</i> ')	32.7	14.5	8.3	11.2	9.8
M.	16.3.26.42 Chin Hills (' <i>manipurensis</i> ')	31.5	14.1	8.5	11.9	9.4
M.	20.6.7.28 Sadiya, North Assam	31.2	14.2	7.8	10.7	9.1
M.	20.6.6.16 Mokokchung, Naga Hills	32.7	14.8	8.7	11.5	9.1
M.	20.6.7.29 Sadiya, North Assam	32.0	14.2	7.9	12.1	9.2
F.	21.12.5.19 Dening, Mishmi	33.3	15.1	8.4	12.1	9.5
F.	21.12.5.20 Dening	31.8	14.4	8.8	11.2	9.2
M.	32.11.1.68 Kachin Hills, Burma	31.9	14.6 <i>circa</i>	9.1	11.7	9.3
F.	32.11.1.190 Nam Tisang Valley, Upper Burma	34.1	15.9	9.1 <i>circa</i>	12.0	10.2
F.	32.11.1.191 Nam Tisang Valley	33.9	—	9.7	11.9	10.0
F.	88.4.4.4 Darjeeling	33.9	15.6	9.5	12.1	10.2
M.	20.6.6.15 Mokokchung, Naga Hills (' <i>manipurensis</i> ')	31.6	14.4	8.5	11.3	9.3
Frost collections—						
F.	270. Naga Hills, 5,000 ft.	31.1	14.2	7.8	10.9	9.2
M.	292. Naga Hills	32.1	15.0	8.2	11.4	9.6
M.	293. Naga Hills	31.2	14.3	7.6	11.0	9.3
F.	298. Naga Hills	32.1	—	8.9	11.1	9.6
F.	296. Naga Hills	32.5	15.3	9.1	10.9	9.6
F.	278. Naga Hills	32.0	14.9	8.3	11.4	9.7
F.	299. Naga Hills	32.6	15.2	8.9	11.6	9.8
M.	300. Naga Hills	33.6	15.1 <i>circa</i>	8.4	12.1	9.7
F.	301. Naga Hills	31.8	15.2	8.7 <i>circa</i>	11.0	9.6
F.	367. Naga Hills	32.3	14.7	9.0	11.8	9.8
F.	373. Naga Hills	32.2	14.9 <i>circa</i>	8.6	10.8	9.3
M.	372. Naga Hills	31.1	14.4 <i>circa</i>	8.0	10.3	9.4

A co-type of '*pembertoni*' (from Bhutan) has the occipitonasal length about 32.9 mm.

TABLE 11.—*Cranial measurements of the Indian races of Callosciurus macclellandi (concl'd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus macclellandi barbei</i>						
M.	14.7.8.36	32.3	14.5	8.7	12.3	10.0
	Zammi Reserve, 100 miles south of Moulmein, Burma					
F.	14.12.8.140	31.8	13.7	8.5	11.7	9.2
	Bankason, Tenasserim					
F.	14.2.8.141	32.5	14.3 circa	9.6	12.3	9.0
	Banlaw, Tenasserim					
F.	88.2.6.13	30.8	14.0	8.6	11.4	9.4
	Near Moulmein					
M.	14.12.8.139	32.0 circa	14.3 circa	9.0	12.8	—
	Banlaw					
F.	14.12.8.145	31.6	13.8	8.1	11.8	9.0
	Tenasserim town					
F.	82.11.18.3	33.4	—	9.6	13.0	10.0
	Attara R., Tenasserim					

Callosciurus macclellandi barbei ('kongensis')

F.	22.10.30.1	31.8	14.0	8.1	12.5	—
	35 miles south-east of Prome, Burma. Rather young					

Other specimens of this race vary in occipitonasal length between 32.3 and about 34 mm. (Siam).

Dimensions of the species Callosciurus macclellandi in British Museum material.—The occipitonasal length varies between 29.7 and 34.9 mm. (but reaches 34 mm. only three times in over 50 specimens). The head and body length varies between 79 and 138 mm. Tail between 72 and 135 mm. Hindfoot 17–31 mm., but almost always over 20 mm.

Key to Indian races of Callosciurus macclellandi

- 1 (2) Mid-dorsal stripe darker than outer dark stripes. Underparts not reddish or orange in colour, or with no trace of these colours *C. m. macclellandi*
- 2 (1) Mid-dorsal stripe not darker than outer dark stripes, or scarcely so. Underparts orange or reddish in colour, or with clear traces of these colours *C. m. barbei*

(i) **Callosciurus macclellandi macclellandi**
(Horsfield)

Text-fig. 7

1839. *Sciurus macclellandi* Horsfield, *Proc. zool. Soc. Lond.*, 152.
1842. *Sciurus pembertonii* Blyth, *J. Asiat. Soc. Beng.*, 11, 887.
(Bhutan.)
1900. *Sciurus macclellandi manipurensis* Bonhote, *Ann. Mag. nat. Hist.*, 5, 51. (Aimole, Manipur.)

Type-locality.—Assam.

Range.—Specimens examined from BURMA: Hkamti, Haingyan, Kachin, near Krang (Upper Burma), Nam Tisang, Schwebo; 50–65 miles west of Kindat; Myitkyina and north of it; Homalin, Tamanthe (both on Chindwin). Nam Nat Valley. ASSAM: Mokokchung in Naga Hills; Sadiya, Diking, Cachar. MISHMI: Dreyi, Dening, Ratana and Tiki. MANIPUR: Aimole, Loanghol, and Machi. BHUTAN, no locality. NEPAL, no locality. SIKKIM: Chuntang, Gangtok, Sedonchen, Ringin, and Darjeeling district.

A race with the two outer dark stripes usually less black than the mid-dorsal, and with greyer, duller underparts than in allied more southern subspecies.

For the typical race, specimens have been examined which were collected in all months of the year except February, March and October, and for '*manipurensis*', specimens collected April, May and October. Osgood stated that this form 'stands directly between *macclellandi* and *barbei*, and seasonal variations in both seem sufficient to cover its supposed characters' Its belly colour is essentially as in *macclellandi*, of which I regard it as a synonym, as the characters given by Wroughton (1919), 'lighter, greyer, stripes distinct' compared with the typical race, which is supposed to be with 'general colour suffused with yellowish' are not apparent to me, when the two are compared.

(ii) **Callosciurus macclellandi barbei** (Blyth)*

1847. *Sciurus barbei* Blyth, *J. Asiat. Soc. Beng.*, 16, 875.
1901. *Sciurus macclellandi kongensis* Bonhote, *Proc. zool. Soc. Lond.*, 1, 55. (Raheng, Siam.)

Type-locality.—Ye, Tenasserim.

Range.—Specimens seen from TENASSERIM: Kawkereik, Lampea, Lakya, Taok Plateau, Thoungyeh, Amherst, Ye, near Tavoy, Maywadu, Bankason, Banlaw, Tenasserim town,

* Kachin name *Kinshi Shang*, noted on a skin in bad condition from Simia, Upper Burma, *macclellandi* or subsp.

Attaran R. BURMA: Near Moulmein, Hankaryit, 30 miles east of Mandalay, east, north-west and west of Toungoo, Pyaung-gaung in Shan States. Maymyo, Watau, Bhamo, 100 miles south of Moulmein. King Island, and Kisseraing Island (Mergui Archipelago). Thirty-five miles SE. of Prome, and Shan Mepale, Amherst district ('*kongensis*'). SIAM: Nan, Phre, Raheng, 28-53 miles east of Um Pang, and no exact locality.

Usually more brightly coloured than the typical race; the two outer dark stripes about as black as the mid-dorsal; underparts bright, reddish or orange or with a suggestion of this coloration present. Outer pale stripes normally very wide, thereby differing from the allied Indo-Chinese race *rodolphei*. Glover Allen says this race occurs in Yunnan.

Specimens for *barbei* were collected in January, March, April, May, October and December. There seems little seasonal change in both this and the typical race, so far as I have had occasion to examine them, in general colour.

Specimens for '*kongensis*' were collected January, February, April, May, June, July, September and November. Summer skins tend to be somewhat brighter than winter ones, but there appears to be individual variation. This race is difficult to classify. It is antedated by *barbei*, and by *C. m. rodolphei*, Milne-Edwards, 1867, from Cochin-China. We have a large series for the last. It may almost without exception be distinguished from *barbei* by the fact that the outer light stripes are narrow. *C. m. kongensis* has the broad outer pale stripes of *barbei*, and is described as being distinguishable by its 'much greyer' colour, and the outer light stripes 'much paler yellow'. This is so in some individuals, not so in others. On the whole I think '*kongensis*' will have to be regarded as a synonym of *barbei*, because although that form averages darker most often, it is by no means always so, and then specimens would be referable to either race.

(iii) **Callosciurus macclellandi collinus** (Moore)

See Appendix.

16. **Callosciurus swinhoei** (Milne-Edwards)

Swinhoe's Striped Squirrel

1874. *Sciurus macclellandi* var. *swinhoei* Milne-Edwards, *Rech. Mamm.*, 308.

Type-locality.—Moupin, Szechuan, China.

Range.—Indo-China, Southern China generally (including

Hainan) and eastwards to Fukien, Yunnan, Szechuan, Kansu and Chihli; Formosa; NORTH BURMA.

Essentially like *Callosciurus macclellandi*, but averaging larger, the occipitonasal length of the skull in material available normally more than 34 mm. in length. Occurring with *macclellandi* in some places, as for instance in Indo-China.

This species is largely extralimital. A few skins from the Adung Valley evidently represent a form of this species. They were identified as '*forresti*', a form which Glover Allen says is a synonym of the race *C. s. clarkei*. They are not, however, typical of '*forresti*', and I regard them as representing the race *C. s. maritimus*, which is the second name in the species. This race is at least on average rather smaller than the typical race, *swinhoei*, from Szechuan; the outer pale stripes generally tend to be lighter, and the tail appears to be narrow as usual, whereas in our specimens of *swinhoei* there is a tendency for the tail to be less narrow than it normally is in this subgenus. I have my doubts whether *clarkei* can be maintained as a valid race when compared with *maritimus*, which is the earlier name, and I am not entirely sure that Allen was right in making *forresti* a synonym of *clarkei*, because our *clarkei* skull has the occipitonasal length 37.7 mm. (an old specimen), whereas our largest *forresti* is only 35.5 mm. (also an old specimen), and, as Thomas pointed out, the type of *clarkei* is larger than *forresti*.

There is another race, *C. s. ? spencei*, named by Thomas, 1921, from North Burma. So far as our material is concerned there seems to be only the type, a skin without a skull, so that it is not certainly specifically identifiable, and our material is so scanty that I prefer not to commit myself on the status of this form.

External characters.—The Indian skins are essentially as in *C. macclellandi*, as described above. Tail shorter than head and body. The colour is in these skins much as in *C. m. macclellandi*. The outer pale stripe is narrow, and lighter than the inner one; in one specimen all three dark stripes are about equally black, in the other two the mid-dorsal appears darker than the outer dark stripes. Subocular stripe not continuous with outer pale stripe of back, thereby differing from *macclellandi* (normal specimens).

Typical *C. s. swinhoei* is a large race, occipitonasal length not much less than 37 mm. in our material, with the tail less narrowed apparently than is usual, and with the outer pale stripes not very much lighter than the inner ones. Glover Allen says that *C. s. maritimus* Bonhote, 1900, from Fukien, of which he makes '*monticolus*' Bonhote, 1900, from

Fukien, a synonym (and I agree with this classification), may be distinguished by having its outer pale stripe paler than the inner one, whitish to buffy, and at least on average this is so. A skin from the Namnat Valley, North Burma, without a skull, identified as '*forresti*' has the subocular line undivided and would appear to be a specimen of typical *maccllellandi* as far as one can say.

The Indian specimens, collected October and November, were both trapped 'in jungle'

External measurements.—

Callosciurus swinhoei maritimus

	Head and body	Tail	Hind- foot	Ear
M. Adung Valley, North Burma	120	95	28	15
M. Adung Valley ..	118	106	29	15

The type of *C. s. ? spencei*, unmeasured, from North Burma, 20°22' N., 97°4' E., has also been examined; a form with very thick fur, and stripes almost absent, only the mid-dorsal present.

Cranial and dental characters.—Essentially as in its ally, *C. maccllellandi*, but the skull averages larger.

Cranial measurements.—

Callosciurus swinhoei maritimus

	Occipito- nasal	Palate	Nasals	Frontals	Orbit
M. 32.11.1.69 .. Adung Valley, North Burma	35.0	16.0	—	11.5	10.3
M. 32.11.1.70 Adung Valley	34.3	15.2 circa	9.6	11.4	10.0
M. 32.11.1.71 Adung Valley	34.0	15.5	9.5	12.3	10.1

Dimensions of the species Callosciurus swinhoei in British Museum material.—The occipitonasal length 33.1–37.9 mm., but over 34 mm. except in two specimens from Indo-China which could be wrongly identified. The head and body length varies between 99 and 168 mm. but only once under 100 mm. in material seen. Tail varies between 87 and 120 mm. Hindfoot 18–37 mm. but normally over 20 mm.

In North India, the specimens seen have the subocular stripe interrupted, not continuous with the outer pale lateral stripe, thereby differing from *C. maccllellandi* in which

the two are usually continuous. This is not a constant character for specific division everywhere in this subgenus but it is a character which means something apparently, and generally in the north (*swinhoei*) this line tends to be divided whereas in the south (*macclellandi*) it is as a rule not divided.

(i) **Callosciurus swinhoei maritimus** (Bonhote)

1900. *Sciurus macclellandi maritimus* Bonhote, *Ann. Mag. nat. Hist.*, **5**, 51.

1900. *Sciurus macclellandi monticolus* Bonhote, *Ann. Mag. nat. Hist.*, **5**, 52. (Ching-feng-ling, Fukien, China.)

Type-locality.—Foochow, Fukien.

Range.—Specimens examined from UPPER BURMA: Adung Valley. Also Fukien, Kuatun, Foochow, Pucheng, Hupeh, Chungyang, Anhwei, Chinteh, and variously from Tonkin and Annam, unless these localities represent the allied form *hainanus*.

A note on 'Tamiops spencei' Thomas

1921. *Tamiops spencei* Thomas, *J. Bombay nat. Hist. Soc.*, **27**, 3, 503.

Type-locality.—North Kachin Province, North Burma; 28°22' N., 97°40' E., Altitude 10,000 ft.

This is known by very few specimens, and the British Museum collection appears only to contain the type. The skull is not known, so this form cannot be exactly identified specifically. The fur is unusually thick, and the stripes are unusually weak, only the mid-dorsal remaining on the type, and this not extremely well marked. Hindfoot of type 33 mm. It most likely represents a form of *C. swinhoei*. Osgood made it a race of '*monticolus*', and in this he has been followed by Anthony (1941), who referred specimens taken from Imau Bum and road to Chimeli Pass to this form. He states, 'These skins bear considerable resemblance to specimens from Mucheng, Yunnan, identified by Allen as *T. s. swinhoei* and compared by Osgood to *spencei*. The latter noted the resemblance of the Mucheng specimens to *spencei* as described. Our Burmese squirrels are not quite as clearly striped as the Mucheng animals.'

Thomas described *spencei* as 'size about as in *macclellandi*. Fur very long and soft, more so than in any others of the Museum series; general colour strongly suffused with dull rufous, not so olivaceous as usual. Striping very little developed, the median black stripe alone definitely developed, and even that rather short. The other stripes only faintly

distinguishable as stripes at all, subequal in breadth, the inner one greyish buffy, the next brownish rufous, followed by the broad dull buffy band which represents the usual outer light stripe; this ends behind the shoulders and does not contact with the subocular. Hairs of undersurface dark slaty with dull creamy tips' It was based on a skin taken in December.

I have examined the type. Doubtless this may be a valid form, but in the present very incomplete state of our knowledge I prefer not to include it in the keys.

Subgenus (b) **Callosciurus** Gray

1867. *Callosciurus* Gray, *Ann. Mag. nat. Hist.*, (3) 20, 277.

Type-species.—*Sciurus rafflesii* Vigors and Horsfield, 1828.

Range.—Indo-Malayan region.

Typical tree-squirrels of the Indo-Malayan region. Differing from *Tamiops* in the lack of the several stripes on the back. (One race has a dark mid-dorsal line on the back, but is very different from *Tamiops*.) Occipitonasal length in India exceeds 42 mm.

This is an enormous group, and very difficult to classify with certainty, particularly on the southern Indo-Malayan mainland, in such places as Siam, Indo-China, and in part Burma. There are some very distinct species in Celebes, and Borneo. Apart from these, the following occur on the mainland of Asia but do not reach Indian territory so far as known:—*Callosciurus hippurus*, a large species, occipitonasal length about 53–59 mm., with the palate apparently proportionately longer than in allied species, and the skull often with a sagittal crest; Malay Peninsula, Sumatra, Borneo. *Callosciurus lowi*, a small species, occipitonasal length about 31–nearly 39 mm., so roughly as in *Tamiops* in size, but the back is not striped; tail usually less than 100 mm. in length, generally white-bellied, and the incisors rather proodont; Malay States, Sumatra, Borneo. *Callosciurus tenuis*, like the last but with the belly usually not white, the incisors tending to be less proodont; the tail usually over 100 mm. in length; occipitonasal length 35½–43 mm.; Malay States, Sumatra, Borneo. *Callosciurus prevosti*, large squirrels, occipitonasal length 52 to nearly 59 mm. Frontals very wide, over 20 mm. in width, sometimes as much as 40% of the occipitonasal length. Usually with white flankstripes, red belly, and black back, but in some races the white flankstripes have disappeared; Malay States, Sumatra, Borneo.

Callosciurus notatus differing from the last in almost always having the frontals width less than 20 mm.; usually in smaller size of hindfoot; skull usually smaller (occipitonasal length varying between 43 and 54 mm.): usually with a white flankstripe (beside a black one); colour of underparts varies, but never blue-grey; Malay States, Sumatra, Java, Borneo. And *Callosciurus nigrovittatus*, like *notatus* but occurring with it almost throughout its range, and with blue-grey belly. Occipitonasal length about 39–51 mm. The characters which I have outlined for these species are never combined in Indian and northern species. Indeed the species of the Malay States and larger Malay Islands are much more easily defined than those of the mainland, and seem quite distinct always from them.

In India there are two groups of species which can be separated on skull characters. The first names for these two groups are respectively *C. pygerythrus* and *C. erythraeus*. They occur together extensively. In the *erythraeus* group there are some half dozen species, all of which seem to occur together somewhere in their various ranges, but which are quite indistinguishable cranially. I restrict *C. pygerythrus* to those races in which the frontals (least interorbital width) approximates to one-third of the occipitonasal length or less, and only exceeds it in comparatively rare individual cases, and in which the occipitonasal length is most often below 50 mm., or rarely about 50 mm. at maximum. In the *erythraeus* group the frontals width normally clearly exceeds one-third of the occipitonasal length, and most often, at least in India, the last-named length exceeds 50 mm.

Blanford (1891) gave specific rank to the following species which are now referred to *Callosciurus*:—

<i>C. ferrugineus</i>	<i>C. caniceps</i>
<i>C. erythraeus</i>	<i>C. griseimanus</i>
<i>C. quinquestriatus</i>	(Milne-Edwards, 1867)
<i>C. phayrei</i>	<i>C. lokroides</i>
<i>C. pygerythrus</i>	<i>C. atrodorsalis</i>

He quoted a single specimen of *griseimanus* from Upper Burma, but this form has not been taken again in India, despite intensive collecting, and Wroughton (1919) dropped it from the Indian list. It is here considered a subspecies of *C. flavimanus*, and is currently restricted to southern Indo-China.

Blanford's remaining species are the species of this work (though not always under the same names), except that I

regard *lokroides* as a race of *pygerythrus*, and *atrodorsalis* as a race of *erythraeus*. Members of the *C. erythraeus* group (i.e., all forms in India except *C. pygerythrus* and its races) do not differ from each other very much in cranial characters. Throughout most of the mainland of the Indo-Malay region (east of the Bay of Bengal) there appear to be two species which occur together and differ from each other mainly in the colour of the underparts. One of these two has dull underparts, and the prior name for this is *caniceps*. Broadly speaking *caniceps* seems to take the place of *C. pygerythrus* through much of its range; I do not think *pygerythrus* and *caniceps* occur together. But whereas *pygerythrus* can be distinguished cranially, as I have already pointed out, from *erythraeus* and its numerous forms and allies, *caniceps* cannot be so distinguished.

The bright bellied species presents many problems in classification. A bewildering number of forms is named, mainly based on colour details, and colour is known to change seasonally in at least some extralimital forms. In others, such as *atrodorsalis* and *griseimanus*, there is considerable and disconcerting individual variability in colour. It is possible that all the remaining forms represent one excessively variable species, but at present, having worked through the very large collection in the British Museum (which possesses nearly two hundred named forms), and although differences are often rather average than absolute, I retain three groups of races as species because of the likelihood that they occur together, and also the rarer and aberrant *C. quinquestriatus*. Here *erythraeus* is restricted to those forms with least peculiarities; the prior name for a species which might even represent it but appears to occur in the same neighbourhood in Indo-China and elsewhere, and which differs from it in having brightly coloured feet, is *C. flavimanus*, which was named in 1831 from Indo-China, and antedates the better known names *phayrei* and *sladeni*, both of which seem to be conspecific with it; and a third species, which occurs with *flavimanus* in Burma and elsewhere, I have tentatively (1951) regarded as *C. finlaysoni*; this has only one Indian representative (*ferrugineus*), and appears to be a species which is very variable in colour and some forms of which change from white to red seasonally.

It should perhaps be mentioned that the form *phayrei* was referred by Thomas to '*Tomeutes*' because of the structure of its baculum, whereas *sladeni* was retained in *Callosciurus*. I regard these two forms as conspecific. There seems no difficulty in regarding two forms with slightly different

baculum formation as well marked subspecies of one species when one considers that within *Callosciurus notatus* as listed by Chasen (1940), which is surely a natural species, these two types of baculum are said to occur in different races. Also the structure is unknown in very many named forms.

Key to the species of Callosciurus sensu stricto in India

1 (2)	The width of the frontals usually approximates to one-third of the occipitonasal length or less, and only exceeds it in comparatively rare individual cases; all races have the majority of specimens under one-third of the occipitonasal length; this length is generally less than 50 mm., or in one race averages about 50 mm.	<i>Callosciurus pygerythrus</i>	
2 (1)	The width of the frontals is with few individual exceptions clearly in excess of one-third of the occipitonasal length. In all races, the majority of specimens have the frontals as just indicated, in width. Most often in India the occipitonasal length is more than 50 mm.		3
3 (4)	Belly longitudinally banded with black and white	<i>Callosciurus quinques-</i>	[<i>triatus</i>]
4 (3)	Belly not as just described		5
5 (6)	The underparts are dull in colour; variable in the different races, but never strikingly coloured	<i>Callosciurus caniceps</i>	
6 (5)	The underparts are bright; variable in the different races, typically red, but always strikingly coloured rather than dull		7
7 (8)	In the Indian race, the body, back as well as underparts, is red, the feet dark	<i>Callosciurus finlaysoni</i>	
8 (7)	The back normally not red (for one exception which sometimes occurs in a red phase and has red feet; when in that phase see key to races below)		9
9 (10)	The hands and feet are white or red or yellow, in contrast with the limbs	<i>Callosciurus flavimanus</i>	
	The hands and feet are normally dark, not much paler than the limbs	<i>Callosciurus erythraeus</i>	

(Occasionally the form *C. erythraeus atrodorsalis* may have the feet tending to be pale. Its dark mid-dorsal stripe will then distinguish it from forms of *C. flavimanus*.)

It will be more convenient to deal with *Callosciurus pygerythrus* and its races separately, but to give a key to the named forms of the other five species together. I list the differences I have found in the various named forms, but the retention of any subspecies does not necessarily mean that it will be regarded as valid when more collections have been made and seasonal differences and individual colour differences become better understood. As I have already indicated, I have tried to define the more closely allied species bearing in mind the fact that where two forms occur together in one place, the one cannot be regarded as a geographical race of the other.

Key to the better known races of Callosciurus erythraeus, Callosciurus caniceps, Callosciurus flavimanus, Callosciurus finlaysoni and Callosciurus quinquestriatus inhabiting India

1 (2) Belly longitudinally banded black and white (typically a mid-ventral stripe, bordered by two white patches bordered by two lateral dark stripes)..... (‘<i>imarius</i>’ included in the typical race.) (Skins collected March, May, June and October of material examined.) 2 (1) Belly not longitudinally banded black and white. (If dark flankstripes are present, there is no mid-ventral line; when the mid-ventral line appears, then the belly on either side of it is red.) 3 (12) The underparts are dull: greenish grey, like the back, or sometimes brown, but dull and not strikingly coloured. If any red appears on the underparts, it appears, normally, only as flankstripes outside a conspicuous greenish or brownish or dull mid-ventral area... .. 4 (5) The skull is smaller, the occipito-nasal length of the skull only rarely reaches 51 mm. (Skins collected April, May, July, October, November.) 5 (4) The skull is larger, the occipito-nasal length of the skull is over 52 mm.... . 6 (7) Winter skins (collected November, December, January, February, March) with the back bright golden brown in colour. Summer	[<i>triatatus</i> <i>Callosciurus quinques-</i> 3 <i>Callosciurus caniceps</i> 4 <i>C. c. shanicus</i> 6

- skins (with the back not or only a little tending towards the bright gold-brown colour, collected March, in part, April, May, September and October) have no flankpatches. These summer skins have the colour of the ventral parts almost always lighter than *C. c. crumpi*, and lacking the dark red-brown tinge of that. Feet usually paler than *davisoni* and allies...
- 7 (6) Back never golden brown in colour *C. c. caniceps* 8
- 8 (9) No flankpatches on the sides. Belly with dark red-brown tinge. Nose reddish brown. ... *C. c. crumpi*
(November skins only are available.)
- 9 (8) Normally with reddish or brownish flankpatches on each side of the belly. Nose not reddish brown .
- 10 (11) Slightly smaller, occipitonasal length of skull most often less than 54 mm..... *C. c. sullivanus*
(From Malcolm Island and Sullivan Island. Material is not plentiful for these small forms. *C. c. epomophorus* (Bonhote, 1901, from Junk Seylon Island) is the first name for this group of races. The form *sullivanus*, skins of which were collected in January and March, has paler neckpatches than *epomophorus*.)
- 11 (10) Slightly larger, occipitonasal length of skull exceeds 54 mm..... ['*hastilis*' and '*tabaudius*')
C. c. davisoni (with
(There seems sufficient individual variation in *davisoni* to cover the supposed characters of the Mergui Island forms included here as synonyms, and I also include specimens identified by Thomas as *domelicus*, but perhaps these are not authentic.) (Skins collected in March, April, June, September, December (*davisoni*); March and September (*hastilis*); October (*tabaudius*); January (*domelicus*).)
- 12 (3) The underparts are bright; various in colour, typically red, but always bright rather than dull .. 13
- 13 (14) The whole animal is (in the Indian race) mainly red in colour, the back as well as the underparts. The feet, in the Indian race, are black. *Callosciurus finlaysoni*.

- Only the form *C. f. ferrugineus* occurs in India. Skins examined were collected in January, February, March, April, July, August, September, October and December.
- 14 (13) The back is usually not red or reddish; except in a colour phase of a form of *C. flavimanus* (*C. f. rubex*). This form, when in red phase, differs from *C. f. ferrugineus* in having red feet; from *C. finlaysoni cinnamomeus* of Cambodia in its larger size as judged by the skull, and from *C. finlaysoni splendens* of Siam and parts of Cambodia, which it most resembles among the races of *C. finlaysoni* which antedate it, by its smaller average skull; measurements for the three races just noted are, occipitonasal length for *cinnamomeus* 48.5 mm. and less; for *rubex*, 52.3–54 mm., and for *splendens*, 52–56.4 mm. but nearly always more than 53½ mm., whereas *rubex* is mostly under 53½ mm. Besides this, the back appears to be somewhat paler than in some specimens of *splendens*. *C. f. ferrugineus* has the skull varying between 51.3 and 56.8 mm. in our material. ... 15
- 15 (28) The hands and feet are white or red or sandy-yellow, in contrast to the limbs. [16
Callosciurus flavimanus
- 16 (19) A clear short black tail-tip is present. 1
- 17 (18) Occipitonasal length usually more than 54 mm. Clear dark flank-stripes each side.... .. *C. f. phayrei*
(Skins examined were collected January, April, May, July, November, December.)
- 18 (17) Occipitonasal length mostly below 54 mm. The dark flankstripes usually absent or obsolete. *C. f. blanfordi*
(Skins examined collected July, August, September.)
- 19 (16) No black tail-tip. 20
- 20 (21) The occipitonasal length of the skull is about 54 mm. at highest.... .. *C. f. rubex*
(A form occurring in two colour phases, as noted above; skins with either red or dark brownish back collected in June, at the same locality; and one in October.)
- 21 (20) The occipitonasal length of the skull approximates to 55 mm. or exceeds

- it, with about four exceptions in about forty skulls. 22
- 22 (25) The underside of the tail is mostly white, or with a long whitish tuft. 23
- 23 (24) Back nearly white *C. f. haringtoni* (with ['careyi'])
- (The type-locality of which is near to the localities where *haringtoni* occurs, and which is a pale form, tending to be slightly yellower or browner than *haringtoni*, but quite different to the next race.)
- (Skins seen were collected July, August.)
- 24 (23) Back much darker, grizzled dark grey. *C. f. millardi*
- (Skins collected June and July.)
- 25 (22) The underside of the tail is as a rule not white. 26
- 26 (27) Back darker, more grey. Face conspicuously reddish *C. f. sladeni*
- (and probably '*midas*' could be the same, although the colours are more bright and intense than is usual in *sladeni*. Skins seen were collected May, June, July November, and one for *midas* in November.)
- 27 (26) Back paler, more brown. Face less reddish in the majority of the specimens. ['fryanus']
- (Specimens collected July and August.) *C. f. shortridgei* (with)
- 28 (15) The feet are normally dark, or not contrasted with the limbs (not much paler than limbs). Or if, as occasionally individually in *atrodorsalis* the feet are a little paler than the limbs, then this form may be distinguished by its black mid-dorsal stripe or area, which does not occur in races of *flavimanus* dealt with above. *Callosciurus erythraeus* 29
- 29 (30) Back normally with clear mid-dorsal black patch or stripe *C. e. atrodorsalis*
- (A form which appears individually variable in colour, and is difficult to classify. Skins examined were collected in January, February, March, May, October, November, December; and from Siam in June and August; in all these months are specimens with normal red belly and normal black mid-dorsal stripe, so it would appear there is not any seasonal colour change here. Two specimens from Tavoy

- district labelled with this name would appear to represent *C. caniceps shanicus*.)
- 30 (29) Back normally without clear mid-dorsal black patch or stripe. 31
- 31 (32) Tail mostly red, or with a long red tuft (with or without a white tip) (Specimens seen were collected March, April, September, November, and for 'wellsi', July and August.) *C. e. erythraeus* ['wellsi'] (with 31
- 32 (31) Tail not red 33
- 33 (34) Tail mainly white, but with a clear black tip.. (Specimens collected February, April, June, July.) *C. e. kinneari*
- 34 (33) Tail normally not as just described 35
- 35 (36) Smaller races, the occipitonasal length of the skull is seldom more than 51 mm. (Not reaching 52 mm. in Indian material examined.) (Specimens seen collected April, July, August, September, December.) *C. e. gordonii**
- 36 (35) Larger races, the occipitonasal length of the skull is normally over 52 mm. 37
- 37 (38) The tail has a very long black terminal tuft, or is sometimes wholly black.. (Skins were collected in February, April, June; and for 'nagarum', May, June, July, August, November and December.) ['nagarum' and 'punctatissimus'] *C. e. erythrogaster* (with 37
- C. e. 'nagarum'* comes from localities very near those of *erythrogaster*. Although possibly it averages a little less dark dorsally than *erythrogaster*, I imagine the two are probably the same. It is not always possible to distinguish individuals.
- 38 (37) Tail usually not conspicuously black terminally. (Two specimens of *C. e. crotalius* are exceptions.) . 39
- 39 (40) Tail averages darker, with some clear black colouring in it, and usually edged or tipped with white hairs. (Sometimes the tip is white.) *C. e. crotalius*

* We have one skin (collected in November) for the form *C. e. rubeculus* (1903) (which probably should be called *hyperythrus* Blyth (1855), which name antedates *gordonii*); this skin is close to *gordonii* but appears to differ in having a reddish-brownish forehead but the form is so poorly represented in London that I prefer not to include it in the key.

It is very close to *C. e. castaneoven- tris*, from Hainan, one of the oldest names in the species, but its skull is a little larger than our specimen for *castaneoven- tris*. (July and August skins seen, for *crotalius*.)

- 40 (39) Tail averages paler, with very little or no black in it. [(synonym 'aquilo')
C. e. intermedius
The specimens examined were col-
lected in March, April, May, June
and December.

The form *bhutanensis* is so little known that I do not include it in the key. It is said to be like *erythraeus* but with the tail similar in colour to the back but with a black tip, and the forehead is described as rufous. Only the type is available to me, and one duplicate, an old skin.

17. *Callosciurus erythraeus* (Pallas)

Pallas's Squirrel

1779. *Sciurus erythraeus* Pallas, *Nov. Spec. Quad. Glir. Ord.*, 377.

Vernacular name.—*Manipuri*: Kherwa.

Distribution.—ASSAM, BURMA (in part; not occurring evidently in the region between the Chindwin and Irrawaddy Rivers); TENASSERIM, Malay Peninsula, Siam, Indo-China, southern China, states of Yunnan and Szechuan eastwards to Fukien and adjacent States, north at least to Chekiang; Hainan and Formosa.

Squirrels with relatively wide frontals, these bones at their least width normally clearly more than one-third of the occipitonasal length. The underparts are typically red and always bright in colour. The hands and feet are normally dark, not contrasted with the limbs. The back is not red in colour, nor it is white; the underparts are not banded with black and white. As thus defined the species contains about twenty-five or more races.

External characters.—Typical medium-sized tree-squirrels. Most often the tail tends to be a little shorter than the head and body. It is bushy throughout. Hand with four fingers; D. 4 slightly the longest; D. 3 slightly longer than the outer two. Foot with five toes; the hallux the shortest; the fifth toe clearly longer than hallux, but shorter than the central three which are subequal, with a tendency for the fourth to be slightly dominant. 4 mammae.

Colour.—*Callosciurus erythraeus erythraeus*.—Back as a rule greenish-brownish speckled, the hairs apparently black basally and then with two or three yellow alternating blackish rings. Ears as a rule reddish or brownish. Tail normally dark red through the greater part of its length, and at least with a conspicuous red tuft; sometimes coloured like the back for the basal portion, and red terminally; with or without a short white tuft at end. These white-tufted specimens were separated by Wroughton as *C. e. wellsi*, but I think it is at least as likely that they represent a 'family party' rather than a subspecies, and there is variation elsewhere in other races in this character. Face as a general rule the same colour as head, or less brown except individually than the very rare form which Bonhote separated as *C. e. bhutanensis*. (This has not got the red tail of the typical race.) Hands and feet black. Chin the same colour as upper parts; the whole of the rest of the undersurface is deep red in colour. Basal part of tail below coloured like the back in all specimens for a greater or lesser distance; the end red.

Notes from skins.—Tura; weight 1 lb., mammae 1-1 = 4; weight 11 oz., weight 14.75 oz. Duragiri; weight 15 oz., mammae 2 pairs. Khasi Hills; mammae 1-1 = 4, Jaintia Hills, ('*wellsi*'); weight respectively 14 oz., 13.75 oz. '2 embryo young' Rajapara; 15 oz., 15.25 oz., 1 lb., 14.5 oz.

Callosciurus erythraeus erythrogaster.—As here understood this is typically darker above than *erythraeus*, but the form '*nagarum*' seems to be intermediate between this and the typical race (some specimens of *nagarum* are only a little paler than some specimens of *erythrogaster*). The ears are mainly the same colour as the head, and so is the face. Tail mainly or wholly black; or in some specimens, basally coloured like the body, but with a long black tuft. Hands and feet black, or dark. Underparts as in the typical race. Usually the tail is coloured like the back basally, but black terminally always. *C. e. 'nagarum'* was based on the slightly paler type which Bonhote, 1901, thought was the summer dress of *erythrogaster*. Thomas and Wroughton later separated these specimens as '*nagarum*', and thought there were two races. Both types occur in Manipur, in material examined, and they inhabit the same general localities to such a degree, and come so close to each other individually, that I would doubt whether there really are two races. *C. e. 'punctatissimus'* has currently been retained by previous authors. The skull is not known. It is a very dark, ? melanistic type, with the annulations on hairs of back narrow. Whether it represents an abnormality, or merely the darkest

phase of *erythrogaster*, or a distinct race which appears never to have been collected subsequently since it was described by Gray in 1867 I am not in a position to say. I am inclined not to regard it as a valid distinct subspecies.

Notes from skin.—Chin Hills; mammae 2 pairs, abdominal. ('*nagarum*'). Syndai, Jaintia Hills; weight 15.5 oz., mammae 1-1 = 4; weight 14 oz., weight 13 oz. A specimen from Cachar weighed 13 oz. ('*nagarum*').

Callosciurus erythraeus crotalius.—This is an average rather than an absolute race. Above, including the dark feet, it is like the typical race except that the ears are less brown, and the tail colour is different. The tail is usually basally annulated black and pale buffy for a considerable part of its length, behind which there is a black portion, and typically there is a white tip. In two specimens however, the white tip is absent, and the tail is then black terminally so that they are indistinguishable from the '*nagarum*' type of *erythrogaster*. One specimen has more white in the upper part of the tail than is normal, and is transitional towards *C. e. kinneari*. About seven others are normal. The underparts are as usual. This form seems to come very close to *C. e. castaneiventris* of Hainan, which is one of the early names in the species. Specimens from Hkamti weighed 12½ oz., 12¼ oz., and 14 oz.; from 20 m. N. of Hkamti (S. of Hukong Valley) 12¾ oz.

C. e. intermedius (with '*aquilo*').—This is very like *crotalius*, except for the fact that there is very little or no black colouring in the tail, the tail is coloured above and below nearly as in the back. In two specimens from Upper Burma which I refer to this race, there is a dark mid-ventral line traceable running down the centre of the red on the belly. Sometimes the tail tends to have a white tip, but this is not a constant character. Some specimens which I refer here from Nam Tamai, Upper Burma, are noted as 'Shot in jungle, very common': Weight 12.5 oz., from Tiki, Mishmi.

C. e. kinneari.—Above as usual, with dark ears, and blackish hands and feet. Sharply differing from all other allies in the colour of the tail, which is above in the majority nearly wholly white, with a conspicuous black tuft. One specimen seen has the white of the tail more greyish, less marked than the remainder. Underparts as usual; a mid-ventral (dark) line present in two, suggested in some other specimens. Tail mostly white below, with black tuft. Weight 14½ oz. (Tatkon).

C. e. gordonii.—This, so far as I am able to trace, is the first name for a more or less nondescript race of rather small

erythraeus squirrel which has the occipitonasal length of the skull averaging smaller than is usual in the species, or at least smaller than the typical race and many of its Indian allies. Many of the majority of the Chinese named races are not easily distinguished from *gordoni*, and the races from Tenasserim and the Malay States are essentially similar. The ears may tend to be brown. The tail is mostly coloured like the back, usually with a black tip, though this is not entirely constant. Face the same colour as head. Feet dark. Underparts as usual, but the colour of the red seems to vary from deep red to near orange. There is a clear dark mid-ventral line in all specimens but one.

A single specimen examined for *C. e. rubeculus* is very similar to *gordoni*, but has the tail rather lighter, without a black tip; more important is the fact that the nose and forehead are light brown. This character also distinguishes this skin from three names which antedate it and are near to *gordoni*; *ningpoensis* (SE. China), *centralis* and *roberti* (Formosa) so far as I have seen specimens. But the face in the *rubeculus* skin is like the specimen available for *C. e. bhutanensis*. This has a darker tail than the *rubeculus* skin, and there appears to be no mid-ventral line. The ears would appear to be slightly redder, in *bhutanensis*, and the tail has a short black tuft, being otherwise like the back. It is very difficult to be certain of characters for these races which, in the case of *bhutanensis*, have never again been collected since their original discovery, and the skull of which is not fully known. A note of a skin of *gordoni* states 'Mishmi name *Ada*', 'Naga name *Ankon*'

C. e. atrodorsalis.—This is an excessively variable form. It seems to take on, individually, almost any character which is diagnostic of one of the related species, and its own peculiarity, the dark mid-dorsal line on the back seems not strictly constant. The colour of the back varies from speckled greyish to light brown. In brown specimens, the head and face tend to be reddish (as in *bhutanensis* or *rubeculus*). These colour differences are not co-related with seasonal change; specimens from the Taok Plateau taken in January for instance are either grey or brown above. Nor are they sexual. On the back, to a greater or lesser extent, there is usually a black mid-dorsal stripe or line, extending from roughly the middle of the back to about the root of the tail. Its width varies from specimen to specimen, being sometimes not much more than a stripe, but more usually rather a wide band. The tail is usually ringed with yellowish and black through most of its length, but is very variable.

A skin from Attaran R., Tenasserim, has most of the central part of the tail black edged with yellowish hairs, the end yellowish; one from Moulmein has the tail nearly all black, the hairs only faintly tipped yellowish; one from 100 miles south of Moulmein is similar; one from Moulmein has a long whitish tuft at the end of the tail; one from some locality in Tenasserim has the basal part of the tail reddish orange, the end nearer white. There is a distinct tendency in this race, though it is not constant, for the face to be rather lighter or browner in colour than the head. Nearly thirty Indian skins examined have the mid-dorsal stripe clear. In the following it is very weak or almost absent; two, unnumbered, from Moulmein (one of these collected in November); 85.8.1.197, Hankaryit, near Moulmein, January; 88.2.6.4, Moulmein; 79.11.21.583, Tenasserim; 82.11.18.2, Thoungyeen Valley, Tenasserim; 8.3.9.9, Moulmein. It may however be traced in these, but is very poorly marked. Some other skins from Moulmein are normal. Hands and feet usually dark as is usual in *S. erythraeus*, but there can be a tendency for the feet to become yellowish, as in No. 8.3.9.9, Moulmein; 82.11.18.2, Thoungyeen Valley; the specimen referred to above with the orange-whitish tail from some part of Tenasserim; 88.2.6.2, Moulmein; 24.9.2.42, Taok Plateau, and perhaps 24.9.2.46, Lampea. Lower parts in the main red or yellow, but variable in colour; the throat is coloured like the head, and in some specimens a large portion of this darker colouring extends almost to the middle of the belly, which is sometimes partly coloured light yellow. In Indian skins, the belly has at least some deep red colouring (this often taking up the whole undersurface, and with or without a mid-ventral line), in all but about 4 specimens in which the underparts are mainly light yellow, with only a suggestion of the characteristic red tone. Two skins from Tavoy district however have the belly completely dull, and I regard them as representing *C. caniceps shanicus*, a form which was described as a race of *atrodorsalis*. 'Common along Ataran River and Zammi River in bamboo and high tree jungle' is noted on a skin of *atrodorsalis* from Zammi River.

External measurements.—As in Table 12, below.

Cranial characters.—The skull in the related species *C. erythraeus*, *C. flavimanus*, *C. finlaysoni*, *C. caniceps* and *C. quinquestriatus*, and their races as here understood does not differ in any conspicuous feature, and these notes are intended to cover all of those species. The skull is typically Sciurine in formation, and without special peculiarities.

TABLE 12.—*External measurements of the Indian races of Callosciurus erythraeus*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus erythraeus erythraeus</i>				
M. Rajapara, South Kamrup	250	240	53	23
M. Rajapara	253	268	54	23
F. Rajapara	237	240	53	24
M. Rajapara	235	228	55	24
M. Rajapara	231	239	52	24
M. Rajapara	252	275	55	21
M. Rajapara	238	255	56	23
F. Kulsi, Kamrup	242	250	55	22
F. Duragiri, Garo Hills	238	236	52	20
M. Tura, Garo Hills	244	222	53	19
F. Tura	215	238	50	20
F. Tura	231	241	53	21 mammae 1-1 = 4.

Callosciurus erythraeus 'wellsi' = erythraeus

F. Khonshnong, Jaintia Hills, Assam	290	242	50	23
M. Shangpung, Jaintia Hills.	240	232	50	20
M. Shangpung	265	245	57	18
Shangpung, type	235	260	51	20

Callosciurus erythraeus atrodorsalis

Taok Plateau, Tenasserim	215	202	52	20
M. Taok Plateau	214	216	52	21
M. Taok Plateau.	210	217	53	22
Taok Plateau.	201	207	54	20
F. Lampea, Tenas- serim	192	186	51	20
M. Lampea	188	158	52	19
F. Shan Mepale, Amherst	206	155	49	20
M. Shan Mepale	211	165	47	20
M. Shan Mepale	210	155	49	20
M. Hankaryit, Tenasserim	198	203	51	19

Other skins from near Moulmein, Zammi Reserve, 100 miles south of Moulmein, and many localities in Siam.

Callosciurus erythraeus erythrogaster

Syndai, Jaintia Hills	238	240	50	20
(identification provisional)				
Syndai	240	238	53	20

Other skins from Aimole, Manipur, and Dilkoosha, Cachar ('*punctatissimus*').

TABLE 12.—*External measurements of the Indian races of Callosciurus erythraeus (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus erythraeus</i> 'nagarum' = <i>erythrogaster</i>				
F. Tamanthe, Burma	234	227	55	22½
F. Tamanthe	233	230	53	23
F. Tamanthe	212	242	56½	21
F. 60 miles west of Kindat	222	209	51	21 mammae 2 pairs.
F. 65 miles west of Kindat	228	152	50	20 mammae 2 pairs.
M. 50 miles west of Kindat	235	187	53	21
M. Mikir Hills, Assam	220	230	51	19
M. Powai, Naga Hills	215	237	52	19
M. 20 miles east of Koluna, Naga Hills	225	200	45	25
M. 20 miles east of Koluno	212	200	48	20
F. Lanting, Cachar	282	275	50	21
M. Frost Coll. 287. Naga Hills	210	205	50	20

Other skins from Haingyan, Chin Hills; Mokokchung, Naga Hills, and Annam.

Callosciurus erythraeus kinneari

M. Tatkon, Burma	211	226	56½	21
M. Tatkon	221	228	58	20·25
F. Tatkon	231	212	56	20
Tatkon	221	224	56	20½
Tatkon ..	222	238	58½	21½
40 miles NW. of Kindat	232	222	55	21
M. Tatkon, type	240	233	57	22

Callosciurus erythraeus gordonii

The Indian skins, Sadiya, Assam, Watau, Bhamo, are not measured. Chinese skins have head and body 176–250 mm., tail 120–220 mm.; hindfoot 44–50 mm.; ear 12–21 mm.

Callosciurus erythraeus rubeculus (? = *hyperythrus*)

One unmeasured skin from Sungei-balik, Tenasserim.

TABLE 12.—*External measurements of the Indian races of Callosciurus erythraeus (concl'd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Callosciurus erythraeus crotalius</i>					
F.	Hkamti, Burma	245	148	56½	21½
M.	Hkamti	237	193	57	22
F.	Hkamti (west bank, Chindwin)	245	235	56.25	22.25
F.	Hkamti	219	234	56	21
F.	Hkamti	236	238	56½	20½
	Hkamti	240	239	55½	21.75
F.	Hkamti	240	241	56½	21
M.	South of Hukong Valley, Upper Chindwin	230	209	55	22
M.	Hkamti, type	245	228	52	21
<i>Callosciurus erythraeus intermedius</i> ('aquilo')					
F.	Dreyi, Mishmi	220	183	43	21
F.	Dreyi	212	176	48	20
M.	Dening, Mishmi	225	225	51	22
M.	Dening	210	207	50	21
M.	Dening	245	217	50	20
M.	Dening	220	227	51	20
M.	Dening	234	234	50	23
M.	Dening	225	239	50	20½
M.	Dening	225	230	50	21
F.	Dening	217	231	50	20
M.	Lohit Valley, Sadiya	207	205	48	20
M.	Lohit Valley	205	210	45	21
F.	Dibong River, Sadiya, type	230	210	45	20

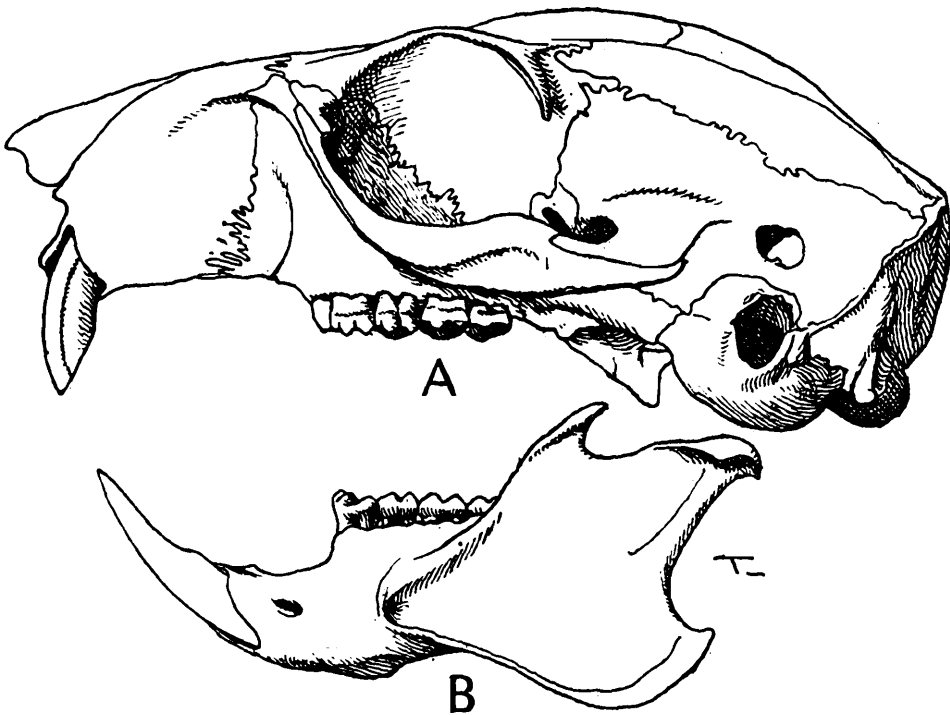
Callosciurus erythraeus bhutanensis, only the type, unmeasured, available for examination.

Callosciurus erythraeus subsp. ?, probably *intermedius*

M.	Nam Tamai, N. Burma	210	190	50	21
M.	Nam Tamai	190	180	50	19
	Nam Tamai Valley	222	187	49	21
M.	10 miles east of Hkamti Plain	220	170	49	20

The nasals are usually narrower posteriorly than anteriorly, and are not specially enlarged; the frontals appear longer than the nasals, and are wide, normally over one-third of the occipitonasal length. The anterior and posterior margins of the frontals on their junction with the parietals behind and the back of the nasals and premaxillae in front tend to be

nearly straight, with slight individual variation in shape. Postorbital process always well developed each side; from the back of the postorbital process, the parietals are ridged, but only weakly so as a rule. These ridges run backwards to the lambdoid region, and sometimes may approach each other, but very rarely are joined in the present group. They are almost joined in a skull of *C. caniceps hastilis*, Hastings Island; and this seems to be the nearest approach to a short sagittal ridge out of over one hundred and eighty Indian skulls. With very rare individual exceptions the palate of the *erythraeus* group of *Callosciurus*, including those species listed above and now under consideration, is less than half the occipitonasal length. The palatal foramina are short, and situated far in front of the toothrows. The pterygoid fossae are quite well marked and not unusually shallow. The bullae are of medium size and inflation, and not peculiar in form. Zygoma normal in formation, the jugal extending upwards to the lachrymal as usual; zygomatic plate quite well tilted upwards. The coronoid process of the mandible is well developed.



TEXT-FIG. 8. *Callosciurus erythraeus erythrogaster* (Blyth). A, lateral view of the skull; B, lower jaw of the same. Specimen from Syndai, Jaintia Hills ($\times 3$).

Dental characters.—Upper incisors reddish, of medium width or rather narrow, and usually not grooved. Five

upper cheekteeth, the pattern essentially normal Sciurine, that is to say, P. 3 much smaller than the remaining four teeth; each of these with one long inner cusp, from which four ridges extend outwards, the anterior and posterior ones forming the anterior and posterior margins of the teeth respectively; M. 3 lacking the third (or second main) ridge. Lower molars basinshaped, a cusp at each corner, the antero-internal one the highest. M. 3 tending to be dominant, and traces of extra complexities sometimes traceable, especially in worn teeth. The premolar usually the smallest tooth.

Cranial measurements.—As in Table 13, below.

TABLE 13.—*Cranial measurements of the Indian races of Callosciurus erythraeus*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus erythraeus erythraeus</i>						
F.	20.11.1.32 Tura, Garo Hills, Assam	56.6	26.5	17.1	20.7	16.5
M.	20.11.1.30 Tura	56.0	26.8	16.8	20.5	16.7
M.	21.7.8.36 Rajapara, South Kamrup	56.4	27.6	16.6	21.0	17.2
M.	21.7.8.38 Rajapara	57.4	27.5	17.0	20.0	17.2
M.	21.7.8.37 Rajapara	55.4	26.1	16.5	20.9	—
F.	21.7.8.40 Rajapara	57.1	27.1	17.0	20.0	17.0
F.	21.7.8.41 Rajapara	55.5	26.9	16.6	20.1	16.4
F.	21.1.6.50 Jaintia Hills ('wellsi')	57.3	27.6	17.8	20.4	17.5
M.	21.1.6.49 Shangpung, Jaintia Hills ('wellsi')	56.6	—	17.8	21.5	17.0

The type of *wellsi* had the occipitonasal about 56.1 mm.

Callosciurus erythraeus erythrogaster

M.	21.1.6.51 Syndai, Jaintia Hills, Assam	55.9	26.1	17.8	18.9	16.6
M.	21.1.6.52 Syndai, Jaintia Hills	56.1	26.4	17.6	20.2	16.8
F.	21.1.6.53 Syndai, Jaintia Hills	56.4	26.2	17.2	20.1	16.8

TABLE 13.—*Cranial measurements of the Indian races of Callosciurus erythraeus (contd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus erythraeus erythrogaster</i> ('nagarum')						
F.	15.5.5.64 Tamanthe, Burma	54.8	26.6	16.0	19.8	16.8
M.	15.5.5.65 Haingyan, Manipur	54.2	26.3	17.0	19.4	16.8
F.	16.3.26.20 Chin Hills, Burma	55.1	26.6	16.8	19.2	16.5
M.	16.3.26.21 Chin Hills	54.2	26.8	16.2	20.2	17.0
F.	16.3.26.22 Chin Hills	53.6	25.6	15.2	18.5	16.1
M.	20.6.7.16 Mikir Hills, Assam	54.1	26.3	16.6	19.4	16.7
M.	21.8.2.21 Mokokechung, Naga Hills, Assam	52.3	25.1	15.1	18.1	16.1

The type of *nagarum*, from Sadiya, Assam, has the occipitonasal about 54.2 mm.

Callosciurus erythraeus crotalius

M.	15.5.5.67 South of Hukong Valley, Hkamti, Burma	54.5	25.7	16.7	20.0	16.8
M.	15.5.5.68 Hkamti	54.8	25.7	16.3	19.8	16.5
F.	15.5.5.71 Hkamti	55.7	26.6	17.4	19.4	17.0
F.	15.5.5.74 Hkamti	55.4	26.4	17.7	20.1	16.7
F.	15.5.5.76 S. of Hukong Valley	55.0	26.2	17.2	20.2	16.3
F.	15.5.5.77 Hkamti	55.5	26.4	17.5	19.5	16.9

The type, from Hkamti, has the occipitonasal 54 mm.

Callosciurus erythraeus intermedius ('aquilo')

M.	20.6.7.18 Sadiya, Assam	51.2	24.8	16.0	17.8	15.6
	20.6.7.20 Sadiya	53.8	26.1	16.5	18.9	16.5
M.	21.12.5.22 Dening, Mishmi	54.5	24.8	17.0	19.0	16.8
M.	21.12.5.23 Dening	51.6	24.5	16.1	17.2	16.1
M.	21.12.5.24 Dening	54.0	25.7	16.3	19.8	16.8
M.	21.12.5.25 Dening	53.3	25.0	15.9	18.7	16.9

TABLE 13.—*Cranial measurements of the Indian races of Callosciurus erythraeus (contd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus erythraeus intermedius</i> (' <i>aquilo</i> ') (concl'd.)						
M.	21.12.5.27 Dening	54.2	25.4	16.7	19.2	16.4
M.	21.12.5.28 Dening	53.1	25.8	16.6	20.0	16.3
F.	21.12.5.30 Mishmi Hills	53.5	25.0	15.9	20.0	16.4
F.	21.12.5.31 Dening, Mishmi	53.8	26.1	17.3	19.2	15.9
F.	21.12.5.53 Tiki, Mishmi	52.2	25.2	16.3	19.6	15.9
F.	21.12.5.32 Dening	54.2	26.4	16.8	19.2	16.1
M.	32.11.1.72 Nam Tamai, North Burma	54.4	25.7	16.4	19.0	16.3
M.	32.11.1.75 Nam Tamai	54.6	25.8	15.7	19.8	16.7
M.	32.11.1.76 Nam Tamai	54.0	26.2	16.5	19.0	16.5
M.	32.11.1.80 East Hkamti Plain	54.0	25.7	15.9	18.9	17.0
F.	32.11.1.81 East Hkamti Plain	54.4	26.1	16.1	18.8	16.8

The type of '*aquilo*' has the occipitonasal length about 55.8 mm. Skulls for '*bonhotei*' from Szechuan (which also seems to be a synonym) have the occipitonasal length 53.1–53.5 mm., the palate 25.6 mm. (two skulls), the orbit about 16.5 mm.

Callosciurus erythraeus kinneari

M.	15.5.5.81 Tatkon, Burma	53.7	25.4	16.9	19.2	15.6
F.	15.5.5.83 Near Kindat, Burma	55.1	26.5	18.0	19.3	16.3
F.	15.5.5.84 Tatkon	54.4	26.0	17.4	19.9	15.8
M.	16.3.26.24 Kindat	55.8	27.1	17.6	19.5	16.6

The type has the occipitonasal about 56 mm.

Callosciurus erythraeus gordonii

F.	8.6.20.6 Watau, Bhamo	50.5	23.9	14.5	17.4	15.1
F.	8.6.20.8 Watau, Bhamo	51.8	24.5	15.3	18.3	15.7
M.	8.6.20.5 Watau, Bhamo	51.4	24.0	15.7	17.0	14.7

TABLE 13.—*Cranial measurements of the Indian races of Callosciurus erythraeus (concl'd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus erythraeus rubeculus</i> : probably synonym of <i>C. e. hyperythrus</i>						
M.	10.10.16.1 Tenasserim	51.4	25.0	16.1	18.7	15.6
<i>Callosciurus erythraeus atrodorsalis</i>						
F.	14.7.8.25 Zammi R., 100 miles S. of Moulmein, Burma	51.2	24.1	15.8	19.1	15.7
M.	88.2.6.6 Moulmein	49.0	23.5	14.7	18.6	15.4

Numerous other skulls have been measured from Siam, but most of our Indian material is broken. The occipitonasal length varies between 48 and 55.4 mm. in Siamese material.

Dimensions of the species Callosciurus erythraeus, including all races, in British Museum material.—The occipitonasal length varies between 47.2 and 57.3 mm. The head and body between 178 and 290 mm. The tail between 120 and 275 mm. The hindfoot 38–58 mm.

A note on the races of Callosciurus erythraeus

The classification of this and other species was first put into some semblance of order in a most useful paper by Robinson and Kloss (1918) in which they gave a nominal list of all Oriental Sciuridae. There are, in India, as far as known to me, seven types of *erythraeus* squirrel which at least may be roughly defined; *atrodorsalis*, a type with a mid-dorsal black patch or stripe on the back normally present, was given specific rank by Robinson and Kloss. Osgood (1932) seemed to lean towards the opinion that it was a representative of *erythraeus*, and I am fairly certain that this variable form of squirrel represents the species in Burma east of the Irrawaddy and in Siam. Apart from this, the remainder are without doubt closely related, and, as I have tried to show in the key, consist of, roughly speaking, a red-tailed form, for which the name is *erythraeus* of Pallas; a white-tailed form (*kinneari*), a black-tailed form (or tail with a long black tuft) for which I think the name *erythrogaster* should be used; and three 'nondescript-tailed forms'. Of these, one, *gordonii*, is fairly constantly

smaller than the other two. Many Chinese races come very near *gordoni*, and also the Tenasserim-Malay States races are hardly separable from it. Of those with larger skull, one, containing *castaneoventris* (Hainan, the first name), *crotalius* of India and *hendeei* of Indo-China (which is very close to or = *crotalius*) seems at least definable compared with another for which *intermedius* seems the first name ('*aquilo*' is the same). Many of these forms occur in localities close to each other, but I do not know of any cases where their ranges really overlap, so all may I think fairly safely be regarded as subspecies.

Three early names must be considered in this classification. Most uncertain of these is *griseopectus*, Blyth, 1847. This was based on a captivity specimen, of unknown locality, and I suggest that the form may be considered unidentifiable. I have, on the other hand, not seen any literature stating how *gordoni* (1871) can be distinguished from it, and it may be that the name should stand instead of *gordoni*. Anderson in describing *gordoni* stated that it was near *griseopectus*, and I could not find anything in his description stating how the two were to be distinguished. Bonhote in a paper in 1901 retained both names, separating them on an unsatisfactory character. Robinson and Kloss (1918) do not agree that *griseopectus* = *gordoni*, and quote specimens from Foochow, and Amoy, China for *griseopectus*; but the form is not regarded as a valid race in Glover Allen's list in his work on the mammals of China and Mongolia, 1940. The character usually quoted for *gordoni* and *griseopectus* is the dark mid-ventral line on the underparts. It seems, however, that this character is not constant in other races, and therefore is perhaps not one on which racial distinctions should be based, though it appears constant and well marked enough in *gordoni*.

The next name to be considered is *hyperythrus*, Blyth, which dates from 1855. This came from Tenasserim. Blanford regarded it as a synonym of *atrodorsalis*, 'a rufous variety without either black dorsal patch or white whiskers', and so apparently did Wroughton. Robinson and Kloss (1918) stated 'We are convinced that this subspecies which has generally been referred to a non-black backed form of *C. atroductalis* comes in with *erythraeus* and *C. castaneoventris* and has nothing to do with *atroductalis*. It is with difficulty separated from *rubeculus* and *youngi* principally by its deeper coloured belly, smaller size and absence of any trace of median ventral streak'. The type is in the Indian Museum, Calcutta. It came from some part of Tenasserim; according to Blyth (1863, *J. Asiat. Soc. Beng.*, 31, 1, 334) 'Hills bordering the

valley of Sitang ?' It is quoted by this author as having 'ruddy colouring on the face' (cf. my notes in the external characters for *rubeculus*) and, although I have not seen any specimens and I do not know its cranial measurements, there seem strong reasons for believing that this name should stand for the Tenasserim *gordoni*-like *erythraeus* subspecies instead of *rubeculus*, which dates from 1903. The description suggests a race of *C. erythraeus*, but not *atrodorsalis*.

The third name which has been mostly overlooked and which will certainly be required for one of the Assam or Burmese races is *Sciurus intermedius* of Anderson, 1879. It is described as like *gordoni*, but darker above, with the mid-ventral line sometimes absent, and the tail wants the subapical black band, but its extremity is washed with orange or yellow. Robinson and Kloss thought that *crotalius* was a synonym of *intermedius*; but I am more inclined to think that the Assamese *aquilo* = *bonhotei* should really be called *intermedius*. The type-locality for *intermedius*, if I understand Robinson and Kloss's paper rightly, should be taken as Dikrang Valley, Assam. Other specimens were quoted from the Duffla Hills, Assam, and Abor Hills (Sirpo Valley and Kobo). 'The form may be recognized by the absence of a grizzled median line on the belly, and by having no black tip to the tail which has the terminal hairs broadly banded with yellowish buff' according to those authors. The type is apparently in the Indian Museum. *C. e.* '*aquilo*' was not described in the days of Robinson and Kloss's revision; but both their statement and Anderson's seem to me to represent the squirrel named *aquilo* rather than *crotalius*, so I provisionally use the name *intermedius* for this.

(i) *Callosciurus erythraeus erythraeus* (Pallas)

1779. *Sciurus erythraeus* Pallas, *Nov. Spec. Quad. Glir. Ord.*, 377.

1921. *Callosciurus erythraeus wellsi* Wroughton, *J. Bombay nat. Hist. Soc.*, 27, 775. (Shangpung, Jaintia Hills, Assam.)

Type-locality.—Not certainly known, but it may be assumed that it was some part of Assam.

Range.—Specimens examined from ASSAM: Tura and Duragiri in Garo Hills; Khasi Hills; Kulsi and Rajapara in South Kamrup. Khonshnong and Shangpung in Jaintia Hills ('*wellsi*').

This race is remarkable on account of its red or reddish tail, or has the tail with a long red terminal tuft, with or without a white tip.

(ii) **Callosciurus erythraeus atrodorsalis** (Gray)

The Black-backed Squirrel

1842. *Sciurus atrodorsalis* Gray, *Ann. Mag. nat. Hist.*, **10**, 263.

Type-locality.—‘Bhutan’ (error), substitute Moulmein.

Range.—Specimens examined from TENASSERIM: Hankaryit, Lampea, 100 miles south of Moulmein, Shan Mepale (Amherst district), Thoungyeh, Taok Plateau. Attaran River; Mywadu River; Maitho (Thoungyeen River). One authentic skin from Dilkoosha, Cachar, but it is an old skin and I am inclined to doubt this locality. Siam: 20 miles west of Kampenpet, and south of it; Meping, Metaw Forest, above Paknampo, Raheng, 210 miles north of Bangkok. 28–53 miles east of Umpang; Dooweeblo; Muangpai.

This form is almost always distinguishable from all others by its black mid-dorsal stripe or band, which occasionally becomes obsolete individually, as noted at considerable length above when dealing with the skins. Skull averages smaller than the typical race.

(iii) **Callosciurus erythraeus erythrogaster** (Blyth)*

1842. *Sciurus erythrogaster* Blyth, *J. Asiat. Soc. Beng.*, **11**, 970.

1867. *Macroxus punctatissimus* Gray, *Ann. Mag. nat. Hist.*, **10**, 283. (Cachar, Assam.)

1916. *Callosciurus erythraeus nagarum* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 228. (Sadiya, Assam.)

Type-locality.—Manipur.

Range.—Specimens examined from Dilkoosha, Cachar (‘*punctatissimus*’); Syndai, in Jaintia Hills, ASSAM: MANIPUR: Aimole, and Nooribazar; for ‘*nagarum*’, ASSAM: Mikir Hills; Lanting, Cachar; Mokokchung, Powai, and 10 miles east of Kaluna in Naga Hills, also no exact locality. BURMA: 50–65 miles west of Kindat; Haingyan; Kindat and Tamanthe, west of Chindwin. Annam: Phu-qui.

This race is distinguished by its black tail, or by its very long black terminal tuft in the tail. I think it probable that ‘*punctatissimus*’ is based on uncommon unusually dark specimens, and that ‘*nagarum*’ is based on slightly lighter specimens of one race, for which *erythrogaster* is the first name.

* For ecological and other notes on specimens from central Manipur, also see Roonwal, M. L., 1949, *Trans. nation. Inst. Sci. India*, Calcutta, **3** (2), pp. 84–85; and 1950, *Rec. Indian Mus.*, Delhi, **47** (1), p. 18.—EDITOR.

(iv) Callosciurus erythraeus gordonii (Anderson)

?1847. *Sciurus griseopectus* Blyth, *J. Asiat. Soc. Beng.*, **16**, 873.
Locality unknown.

1871. *Sciurus gordonii* Anderson, *Proc. zool. Soc. Lond.*, 140.

Type-locality.—Bhamo, Upper Burma.

Range.—Specimens examined from BURMA: Watau, Bhamo. MISHMI, Aini. Sadiya in North Assam (a skin, possibly wrongly identified). Yunnan: North of Bhamo; Schweli-Salween divide; Ma-chiang-kai, Tengueh. Schweli Valley.

Possibly *griseopectus* might be the first name for this form, but its locality is unknown, and it was based on a captivity specimen. Bonhote's characters, 1901, do not convince me that it differs from *gordonii*, and other literature with which I am acquainted does not compare them. This race is the first name so far as I know for a host of smallish so-called subspecies of *erythraeus*, many of them extralimital, which differ from the typical race, *erythrogaster*, and their immediate allies, in having the skull smaller on average. Colour somewhat nondescript, and with no very striking peculiarities; normally a mid-ventral dark line present.

(v) Callosciurus erythraeus bhutanensis (Bonhote)

1901. *Sciurus erythraeus bhutanensis* Bonhote, *Ann. Mag. nat. Hist.*, **7**, 161.

Type-locality.—Bhutan. Specimens examined from BHUTAN.

As Robinson and Kloss state, this race is of somewhat doubtful value. I have seen the type and one duplicate skin. The face is reddish or light brownish, thereby differing from the majority, but whether this is a good character or an individual or seasonal variation I do not know.

(vi) Callosciurus erythraeus hyperythrus (Blyth)

1855. *Sciurus hyperythrus* Blyth, *J. Asiat. Soc. Beng.*, **24**, 474.
(Tenasserim.)

1903. *Sciurus rubeculus* Miller, *Smithson. Misc. Coll.*, **45**, 22.
(Khow-si-dhow, Trang, Siamese Malaya.) (Other specimens were quoted from Bokpyin and Sungei-balik, Tenasserim.)

Type-locality.—Region of Sittang Valley, Tenasserim. One specimen examined from TENASSERIM: Sungei-balik.

Cranially our specimen is small, like *gordonii*, although Miller said his race was 'larger than *atrodorsalis*' and gave the

greatest length of the skull as 55 mm. (Our specimen is smaller than this). The skin has the reddish forehead of *bhutanensis*, thereby differing from *gordonii*. The tail appears lighter here than in *bhutanensis*, but material seen for both is quite inadequate. Robinson and Kloss give a few rather unsatisfactory characters for distinguishing *hyperythrus* from *rubeculus*, but it seems to me most likely that Blyth's name will stand for the Tenasserim race. *Hyperythrus* was stated to have 'ruddy colouring on the face'

(vii) ***Callosciurus erythraeus intermedius***
(Anderson)

1879. *Sciurus gordonii* var. *intermedia* Anderson, *Zool. and Anat. Res. Yunnan*, 241.
1911. *Sciurus castaneiventris* (sic!) *bonhotei* Robinson and Wroughton, *J. Fed. Malay States Mus.*, 4, 234. (Chinchiensan, Szechuan, China.)
1921. *Callosciurus castaneiventris aquilo* Wroughton, *J. Bombay nat. Hist. Soc.*, 27, 601. (Dibong River, Sadiya, 600 ft., Assam.)

Type-locality.—Dikrang Valley, Assam.

Range.—Specimens seen from MISHMI, Dening, Dreyi, Lohit Valley, and Tiki; NORTH BURMA: Kachin, Nam Tamai, East Hkamti Plain, and Dibong River, Sadiya (for '*aquilo*'), and SZECHUAN: Fishankwan, Ningyuenfu, Yenchowfu, Yuchienhsien and Chinchenghsien for '*bonhotei*'

The skull averages larger than *gordonii* and the tail in this race is coloured like the back, with little or no black in it.

(viii) ***Callosciurus erythraeus crotalius***
Thomas and Wroughton

1916. *Callosciurus erythraeus crotalius* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 2, 229.

Type-locality.—Hkamti, on the Chindwin, west bank.

Range.—Specimens examined from BURMA: Hkamti, and south of Hukong Valley.

Like *C. e. intermedius*, but the tail averages darker, with some clear black colouring in it, and often edged or tipped with white. (Rarely it is black terminally, when this form becomes not easily distinguished from *erythrogaster* ('*nagarum*'). It is very similar to *C. e. castaneiventris* Gray from Hainan but the skull seems to be larger on average.

(ix) **Callosciurus erythraeus kinneari**

Thomas and Wroughton

1916. *Callosciurus erythraeus kinneari* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 229.

Type-locality.—Tatkon, west bank of Chindwin, Burma.

Range.—Specimens examined from BURMA: 40 miles west of Kindat; Nanthalet and Tatkon, west of Chindwin.

Differs from allied races in having the tail almost white for the greater part of its length, but with a dark tip. Skull larger than in *gordoni* and its allies.

18. Callosciurus flavimanus (Geoffroy)

The Yellow-handed Squirrel. Including, as races, Phayre's Squirrel and Sladen's Squirrel

1831. *Sciurus flavimanus* I. Geoffroy, in Belanger, *Voy. Indes Orient. Zool.*, 148.

Type-locality.—Tourane, Annam, Indo-China.

Distribution.—BURMA (but not west of the Chindwin River), and Indo-China.

Essentially like *C. erythraeus*, but occurring with it, or in the same general neighbourhood in parts of Burma (east of the Irrawaddy) and in Indo-China, and differing from it in the fact that the feet and hands are white or red or sandy-yellow in contrast to the limbs, and are lighter than the limbs. To this species I refer *flavimanus* and its named races from Indo-China, *phayrei* and *blanfordi* from East Burma, *sladeni*, *haringtoni* and their named races or subspecies from the Chindwin-Irrawaddy neighbourhood of Burma, *griseimanus* (Milne-Edwards, 1867), from south Indo-China, and *harmandi* Milne-Edwards, 1876, from Phu Quoc Island, Cambodia.

Typical *flavimanus* and immediate allies has the skull on average rather smaller than *sladeni* and lacks the black tail-tip of *phayrei*. The form *griseimanus* is like the typical race but as a rule the feet are whiter, the face duller, and often the underparts are less red, but it is a race which is very variable individually. The race *harmandi* seems to differ from allies in the colour of the underside of the tail.

External characters.—Essentially as in *C. erythraeus*. The tail as a rule in Indian races tends to be longer than the head and body.

Colour.—*C. f. phayrei*.—Back mainly greyish brown, the hair dark basally, then alternately ringed light and dark,

giving a speckled effect. Tail like the back above, but with a short, clear black tip terminally, constantly present. Hands and feet much lighter than limbs, pale yellowish to whitish. Lower parts pale orange to pale rufous, with a tendency for the throat to be lightest; on each side of the abdomen there is a dark or black flankstripe, which can be wide, but varies in development; it extends roughly from back of arm to front of leg. Underside of tail usually with a pale rufous line running down the centre.

C. f. blanfordi.—Is essentially similar in colour, but the dark flankstripes are only poorly developed. Sometimes however *phayrei* may be similar in this character.

Two specimens of *blanfordi*, Nyapinium, weighed $10\frac{1}{4}$ and $10\frac{1}{8}$ oz. respectively.

C. f. phayrei.—Gokteik, weight $14\frac{1}{4}$ oz.; 1 lb.; Se-en specimens weighed respectively $13\frac{1}{2}$ oz., $14\frac{1}{4}$ oz.; $11\frac{3}{4}$ oz.; $11\frac{1}{4}$ oz., and 13 oz. From Pyaunggaung, $15\frac{1}{8}$ oz., $13\frac{1}{4}$ oz. and $12\frac{3}{8}$ oz. respectively.

C. f. sladeni.—Dorsal coloration as usual speckled greenish grey. Face and forehead bright ochraceous, but the ears as a rule dark. Hands and usually much of the arms the same bright colouring as the face. Tail coloured like the back basally, but with a conspicuous reddish tip. Underparts red to reddish yellow. Underside of tail coloured as in upper side. The form '*midas*' is essentially similar, but the colour of the belly appears deeper red (more as in typical *flavimanus* or most of *erythraeus* races), and the 'ferruginous of muzzle not extending on to forehead, or on to cheeks below eyes' The feet are darker red. It is broadly very similar to *sladeni*, however, and not a very well known form. Bearing in mind the unusual number of supposed subspecies of what was formerly called *C. sladeni* in this comparatively narrow area which lies between the Chindwin and Irrawaddy Rivers, and bearing in mind the individual variation which is known to take place here in some of these so-called races, I am inclined to regard '*midas*', as a synonym of *sladeni*.

C. f. shortridgei is also in general similar, but at least quite a good series of this form averages distinctly browner dorsally than the typical race, and as a rule the face is less reddish. In two specimens the face is scarcely paler than the head. Hands and feet usually pale yellow, but in one specimen reddish. Tail brownish, its end reddish or yellowish. Under-surface usually pale, buffy, or sometimes light red. I would very much doubt whether the form described as '*fryanus*' from 50 miles south of the locality for *shortridgei* is

distinguishable from it. In this series there is some individual variation, from darker to lighter brown, above. One of the specimens has the middle of the back suffused with very light, almost golden brown. Possibly the feet tend to be slighter whiter, but there is individual variation in *shortridgei* in this character. The 'golden brown' specimen just quoted practically matches '*careyi*' which comes from the next collecting place to the south. This is a very light coloured type, back near golden brown in two specimens (reminiscent of the winter dress of *C. caniceps* if not quite as intense as that). The tail is nearly white in one specimen of '*careyi*', not so in the other two; although it has a considerable white tuft in two out of three duplicates. On this account I am inclined to place it in *haringtoni* as a synonym, although it is to a degree intermediate between that and *shortridgei*. The gradation from one so-called race to another so-called race as one goes south from Hkamti on the east of the Chindwin in these squirrels is nearly complete. Dark flankstripes are present in two specimens of '*careyi*', absent in a third.

C. f. haringtoni.—The whole dorsal surface of the animal is as a rule whitish, or buffy. One specimen from Mounkan is considerably darker than the others, and one or two skins have a light yellow brown back, about as in '*careyi*'. There is very generally a black bar across the forearm and the ankle, which makes the hands and feet appear contrasted with the limbs or part of the limbs in colour; the tail is mostly white, and only rarely has yellowish mixed with the white. Undersurface pale yellowish or ochraceous, with or without a clear black flankstripe running along each side, this stripe either present or absent in different specimens from the same locality taken at the same time. Underside of tail usually white.

C. f. millardi.—The back is dark, grizzled greyish, indistinguishable from that of *sladeni*. But the face, hands, feet and tail remain white, as in *haringtoni*. The underparts are pale, buffy.

Two specimens of *sladeni*, Kindat, weighed $13\frac{1}{4}$ oz. and $13\frac{3}{4}$ oz. respectively. Race *millardi* is noted as being 'very common' at Intha, 100 miles north of Kindat, Chindwin. A specimen of *haringtoni*, Homalin, weighed 14 oz. Specimens of *shortridgei* weigh $13\frac{5}{8}$ oz., $13\frac{7}{8}$ oz., $14\frac{1}{2}$ oz., 13 oz., $15\frac{1}{4}$ oz., $13\frac{5}{8}$ oz., $13\frac{1}{2}$ oz., and $12\frac{3}{4}$ oz., respectively. And of '*fryanus*', $13\frac{1}{8}$ oz., $13\frac{7}{8}$ oz., and $9\frac{3}{4}$ oz., respectively.

C. f. rubex.—Three specimens of this are wholly reddish (including hands, feet and tail) above and lighter red below.

The others are described as dark grizzled olive grey, washed on the back with rich ferruginous. One is intermediate, with a sort of reddish mid-dorsal area. In the detailed key above I have tried to give characters to distinguish the red phase of this from certain extralimital races of *C. finlaysoni*, which it resembles. The skull averages smaller than is usual in Indian races of *C. flavimanus*, more like that of typical *flavimanus* which differs from *rubex*, among other details, by lack of red in the tail. Weight of *rubex*, Yin, one skin, noted as $12\frac{1}{4}$ oz.

On the *sladeni* group of subspecies, I quote (Huxley, 1942), 'The differentiation of the squirrel *Callosciurus sladeni* along the Chindwin River is considered by Thomas and Wroughton, 1916, to be into numerous subspecies; their own data, however, make it probable that it is really into two colour-clines, separated by a tributary', and 'Thus, in the Burmese squirrels (*Callosciurus sladeni*)—the northern series of forms, instead of being divided into four separate subspecies, *C. s. shortridgei*, *fryanus*, *careyi* and *haringtoni*, as is done by Thomas and Wroughton (on the basis of collections from six stations only, one of which yielded types intermediate between two of the "subspecies"!) should, pending further investigation, be styled *C. s. cl. shortridgei-haringtoni*.'

External measurements.—As in Table 14, below.

TABLE 14.—*External measurements of the Indian races of Callosciurus flavimanus*

		Head and body	Tail	Hind- foot	Ear
<i>Callosciurus flavimanus phayrei</i>					
F.	Se-en, Shan States, Burma	242	258	53	$21\frac{1}{2}$
F.	Se-en	227	244	53	$20\frac{1}{2}$
F.	Se-en	229	248	52	20
M.	Se-en	245	255	50	21
M.	Se-en	245	250	53	—
F.	Gokteik, Burma	250	268	55	24
M.	Gokteik	250	263	58	24
F.	Gokteik	247	246	55	$21\frac{1}{2}$
F.	Pyaunggaung, Burma	234	240	53	$20\frac{1}{2}$
	Pyaunggaung	235	253	$53\frac{1}{2}$	$20\frac{1}{2}$
F.	Pyaunggaung	236	245	54	$20\frac{1}{2}$
M.	40 miles north of Toungoo	211	247	$51\frac{1}{2}$	20
F.	40 miles north of Toungoo	214	225	$50\frac{1}{2}$	20
M.	20 miles north of Toungoo	225	235	51	19
F.	40 miles north of Toungoo	220	246	$51\frac{1}{2}$	20

TABLE 14.—*External measurements of the Indian races of Callosciurus flavimanus (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus flavimanus blanfordi</i>				
F. Nyapinium, east bank of Irrawaddy, Burma	207	226	49	20½
F. Nyapinium	222	202	51	22
M. Nyapinium	214	?	48	21
M. Nyapinium	207	235	51	21
F. Madaya Forest, 40 miles north-east of Mandalay (not typical)	223	223	45	19
<i>Callosciurus flavimanus haringtoni</i>				
F. Homalin, Burma	238	260	58	22
M. Homalin	248	225	59	23
F. Homalin	241	246	56	22
M. Homalin	241	268	59	22
F. Homalin	234	259	59	22
F. Homalin	246	267	56½	21½
F. Mounghan, Burma	248	—	58½	21½
M. Mounghan	241	248	58	23
F. Mounghan	252	286	59½	22
F. Mounghan	260	271	56	22
The type of ' <i>solutus</i> ', unmeasured, from Homalin, examined.				
<i>Callosciurus flavimanus 'careyi' = haringtoni</i>				
F. Tamanthe, Burma	231	261	56	21
M. Tamanthe	236	262	57	22
F. Tamanthe	254	277	59	22½
F. Tamanthe	247	277	59	23
F. Tamanthe, type	254	224	56	23
<i>Callosciurus flavimanus millardi</i>				
F. 100 miles north of Kindat, Burma	230	246	53	22
F. 100 miles north of Kindat	231	269	56½	22½
M. Pyaungbyin, Burma, type	247	254	55	23
<i>Callosciurus flavimanus ruber</i>				
F. Yin, Burma	220	188	53½	19½
M. Yin	215	213	53½	20½
M. Yin	217	224	54	20
M. Yin	210	221	53	20½
F. Yin	227	157	55	21
F. Yin	218	219	53½	20
M. Type	214	254	54	22

TABLE 14.—*External measurements of the Indian races of Callosciurus flavimanus (concl'd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus flavimanus</i> 'midas' = <i>sladeni</i>				
No measured skins. Type from Myitkyina district, and one duplicate.				

Callosciurus flavimanus sladeni

F.	Kindat	245	243	56	21
M.	Kindat	247	270	58½	21½
F.	Kindat	234	239	55½	20.25
F.	Kindat	224	251	55	20½
M.	Kindat	239	236	57	21.25
M.	Kindat	228	243	57	20½
F.	Kindat	239	246	57	21
M.	Kindat	244	241	56½	21½
M.	Kindat	234	261	55	21.75
F.	Kindat	224	246	56	21
M.	Kindat	228	238	56½	22
M.	20 miles south-east of Kindat	232	246	51	21
M.	Katha	216	238	48	16
	Shwebo district	207	240	?	14
	Katha, type of 'kemmisi'	250	230	46	18
F.	Uyu River, type of 'bartoni'	227	260	51½	21½

Callosciurus flavimanus shortridgei

F	Hkamti, Burma	249	285	59	22
	Hkamti	240	278	59	22
F	Hkamti	243	283	60	22.75
F.	Hkamti	232	265	56	22.25
M.	Hkamti	233	258	57	23
M.	Hkamti	229	264	56	22.25
F.	Hkamti	231	275	55	23
F.	Hkamti	240	284	57	23
M.	Hkamti	240	222	59	21
M.	Hkamti	245	279	59	22½
F	Hkamti, type	235	262	56½	23

Callosciurus flavimanus 'fryanus' = *shortridgei*

F	Kauktaung, Burma	216	268	57	21
F	Kauktaung	244	237	58	21.25
F.	Minsin, Burma	244	284	59½	22½
M.	Minsin	243	277	60	22½
M.	Minsin	240	280	59½	23
	Minsin, type	238	273	56	22½

Cranial and dental characters.—As described above, under *C. erythraeus* (supra, p. 113).

Cranial measurements.—As in Table 15, below.

TABLE 15.—*Cranial measurements of the Indian races of Callosciurus flavimanus*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus flavimanus phayrei</i>						
M.	14.7.8.15 Se-en, Burma	55.0	25.8	17.3	19.1	17.0
M.	14.7.8.16 Se-en	53.6	25.5	16.3	18.3	16.0
F.	14.7.8.17 Se-en	55.8	26.3	16.4	—	17.5
F.	14.7.8.18 Se-en	55.5	26.8	16.7	19.6	16.9
F.	14.7.8.19 Se-en	54.5	25.9	16.9	19.6	16.7
F.	14.7.8.20 Gokteik, Burma	59.6	29.2	18.5	19.7 <i>circa</i>	18.0
M.	14.7.8.21 Gokteik	56.5	27.2	16.8	21.2	17.7
F.	14.7.8.22 Gokteik	<i>circa</i> 57.2	28.3	—	19.6	17.3
F.	14.7.8.23 Pyaunggaung, Burma	56.6	27.1	17.3	19.0	16.5
M.	14.7.8.24 Se-en	54.2	26.2	17.0	18.2	16.5
F.	14.7.8.57 Pyaunggaung	56.8	27.5	17.7	19.8	16.4
F.	14.7.8.58 Pyaunggaung	54.4	26.8	16.8	19.4	16.7
F.	14.7.19.142 Hsipaw, Burma	55.4	26.6	18.0	19.1	16.8
<i>Callosciurus flavimanus blanfordi</i>						
M.	14.7.19.142 Nyapinium, east bank of Irrawaddy, Burma	52.1	—	16.0	17.8	15.5
F.	14.7.19.147 Nyapinium	51.0	24.3	15.1	17.7	15.8
M.	14.7.19.143 Nyapinium	51.1	23.7	14.7	17.4	15.6
M.	14.7.19.144 Nyapinium	54.1	25.8	16.0	17.5	16.4
F.	14.7.19.145 Nyapinium	51.4	24.8	15.5	17.5	16.0
<i>Callosciurus flavimanus ruber</i>						
M.	15.5.5.140 Yin, Chindwin, Burma	53.5	25.2	16.9	—	16.0
M.	15.5.5.143 Yin	52.6	24.9	15.6	18.7	16.4
F.	15.5.5.144 Yin	53.0	25.7	15.4	18.6	16.3
F.	15.5.5.147 Yin	52.3	24.3	15.3	18.7	16.0

The type has the occipitonasal length about 54 mm.

TABLE 15.—*Cranial measurements of the Indian races of Callosciurus flavimanus (contd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus flavimanus sladeni</i>						
M.	15.5.5.86 Chindwin, Burma	58.1	27.5	17.9	20.8	16.7
M.	15.5.5.87 Kindat	55.3	26.1	17.3	20.4	16.5
M.	15.5.5.88 Kindat	56.0	26.5	17.6	20.4	16.6
M.	15.5.5.89 Kindat	55.2	26.4	16.5	20.5	16.5
M.	15.5.5.91 Kindat	55.8	25.8	17.1	19.7	16.5
F.	15.5.5.92 Kindat	56.3	27.2	16.8	20.2	16.9
F.	15.5.5.94 Kindat	56.1	26.4	17.3	20.3	16.7
F.	15.5.5.97 Kindat	54.3	25.3	16.0	19.4	16.4
M.	15.5.5.97A Locality ?	54.0	25.7	16.8	19.8	16.4
<i>Callosciurus flavimanus sladeni</i> ('midas')						
M.	11.7.31.1 Myitkyina district, type	57.6	26.6	18.0	20.8	17.3
<i>Callosciurus flavimanus shortridgei</i>						
M.	15.5.5.98 Hkamti, Burma	55.3	25.8	16.7	21.5	17.0
M.	15.5.5.99 Hkamti	54.9	25.8	17.2	20.8	16.9
M.	15.5.5.100 Hkamti	56.6	27.0	17.2	—	16.4
F.	15.5.5.102 Hkamti	55.8	26.3	16.8	19.8	17.2
F.	15.5.5.105 Hkamti	56.1	26.2	17.3	21.0	16.5
F.	15.5.5.107 Hkamti	55.5	25.8	16.8	19.1	16.9
F.	15.5.5.109 Hkamti	56.3	26.5	16.5	20.5	17.0
M.	15.5.5.109A Chindwin	55.1	25.3	15.8	—	17.2
M.	15.5.5.101 Hkamti	55.3	26.8	16.7	20.5	16.6

The type has the occipitonasal about 55.6 mm.

TABLE 15.—*Cranial measurements of the Indian races of Callosciurus flavimanus (concl'd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus flavimanus shortridgei</i> ('fryanus')						
M.	15.5.5.113 Minsin, Burma	56.1	26.3	17.3	19.5	17.0
F.	15.5.5.115 Minsin	56.0	26.5	17.8	21.5	16.3
F.	15.5.5.118 Minsin	55.4	26.3	16.8	19.8	16.7

The type, from Kauктаung, has the occipitonasal about 55.7 mm.

Callosciurus flavimanus millardi

F.	15.5.5.245 North of Kindat, Burma	57.5	27.6	18.2	20.7	17.5
F.	15.5.5.139A Pyawngbyin, Chindwin	53.9	25.4	17.2	19.2	16.3

The occipitonasal of the type is about 56.8 mm.

Callosciurus flavimanus haringtoni

F.	15.5.5.124 Moungkan, Burma	56.5	27.0	17.5	21.8	16.9
F.	15.5.5.125 Moungkan	57.5	26.9	17.5	21.5	16.9
M.	15.5.5.128 Homalin, Burma	56.8	27.6	15.6	21.3	17.6
M.	15.5.5.129 Homalin	55.5	26.5	17.9	20.0	16.8
F.	15.5.5.131 Homalin	55.4	26.4	17.3	20.5	17.0
F.	15.5.5.135 Homalin	55.4	25.6	16.6	—	16.6
F.	15.5.5.126 Moungkan	55.0	25.4	15.6	19.9	17.3

Callosciurus flavimanus haringtoni ('careyi')

F.	15.5.5.120 Tamanthe, Burma	57.7	27.3	17.5	20.6	17.1
F.	15.5.5.123 Tamanthe	54.2	25.7	—	—	16.5
F.	15.5.5.122 Tamanthe	55.2	26.1	17.0	19.5	16.7
M.	16.3.26.19 Tamanthe	56.7	—	16.4	20.6	16.4

The type has the occipitonasal about 57.2 mm.

Dimensions of the species Callosciurus flavimanus in British Museum material, including all races.—The occipitonasal length varies in adult between 50.1 and 59.6 mm. The head and body between 186 and 280 mm. The tail between 140 and 286 mm. The hindfoot 35–60 mm.

Key to the races.—

The Indian subspecies are keyed above (*supra*, p. 106) under the key to the races of the *erythraeus* group.

(i) **Callosciurus flavimanus phayrei** (Blyth)

1855, *Sciurus phayrei* Blyth, *J. Asiat. Soc. Beng.*, **24**, 472, 476.

Type-locality.—Martaban, Burma (types in British Museum).

Range.—Specimens examined from BURMA: East, north, and north-east of Toungoo; Gokteik, Hsipaw, Pyaunggaung, Se-en in Shan States; Martaban; TENASSERIM: Pahpoor, Wimpong, Thaton.

Among races of *C. flavimanus*, this race is fairly easily distinguished by its clear sharp black tail-tip. It has usually a clear dark flankstripe each side, and the skull is large, the occipitonasal length normally over 54 mm. It appears to be the second name in the species.

(ii) **Callosciurus flavimanus blanfordi** (Blyth)

1862. *Sciurus blanfordii* Blyth, *J. Asiat. Soc. Beng.*, **31**, 333.

Type-locality.—Ava, Upper Burma.

There is on the type skin of *C. f. blanfordi* a note which read, 'G. C. Shortridge says there is no ground near Ava suitable for this squirrel and that the nearest could be Madaya Forest and Nyapinium off Kyauk Nyaung, localities where his specimen came from.'

It is very close to *phayrei*, and might be the same as that form. Material examined has the skull a little smaller, mostly less than 54 mm., and there is a tendency for the dark side stripes to be obsolete. Elsewhere, however, presence or absence of these lines may be an individual character.

(iii) **Callosciurus flavimanus sladeni** (Anderson)

1871. *Sciurus sladeni* Anderson, *Proc. zool. Soc. Lond.*, 139.

1908. *Sciurus kemmisi* Wroughton, *Ann. Mag. nat. Hist.*, **2**, 491.
(Katha, Upper Irrawaddy, Burma.)

1914. *Sciurus sladeni midas* Thomas, *J. Bombay nat. Hist. Soc.*, **23**, 2, 198. (Myitkyina, Upper Burma.)
 1914. *Sciurus sladeni bartoni* Thomas, *J. Bombay nat. Hist. Soc.*, **23**, 2, 199. (Uyu River, 50 miles east of Homalin, Upper Chindwin, Burma.)

Type-locality.—Thigyain, Upper Burma.

Range.—Specimens examined from BURMA: Kindat (east bank), 30 miles SE. of it, Katha, and Shwebo, also Uyu River. Myitkyina ('*midas*').

With no dark tail-tip, this race has a dark greyish back, the face, hands, feet and tail mainly some shade of light reddish (the tail may be coloured as the body basally, redder terminally). Skull large, occipitonasal length over 54 mm. usually more. '*kemmisi*' and '*bartoni*' were placed in synonymy by Wroughton. The latter was based on an aberrant individual in which the muzzle and feet were lighter, 'warm buffy' instead of ferruginous.

(iv) **Callosciurus flavimanus haringtoni** (Thomas)

1905. *Sciurus haringtoni* Thomas, *Ann. Mag. nat. Hist.*, **16**, 314.
 1914. *Sciurus haringtoni solutus* Thomas, *J. Bombay nat. Hist. Soc.*, **23**, 2, 199. (Homalin, Upper Chindwin, Burma.)
 1916. *Callosciurus sladeni careyi* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 233. (Tamanthe, Upper Chindwin.)

Type-locality.—Moungkan, east bank of Chindwin, Burma.

Range.—Specimens seen from BURMA: Homalin, and Moungkan; Tamanthe ('*careyi*').

A pale race, the tail mainly white, and the whole body tending to become whitish or very pale above, pinker below. '*careyi*' tends to be intermediate between this and *shortridgei* and is slightly more light brown above as a rule. Its type-locality is 20 miles to the north of that of *haringtoni*. '*Solutus*' was placed in synonymy by Thomas and Wroughton, based on individually variable characters.

(v) **Callosciurus flavimanus rubex** (Thomas)

1914. *Sciurus sladeni rubex* Thomas, *J. Bombay nat. Hist. Soc.*, **23**, 2, 198.

Type-locality.—Apparently Yin, and not 'Lonkin, Myitkyina district' as has been quoted variously.

Range.—Specimens examined from BURMA: Yin, also a skin from Youngbintha, left bank of Irrawaddy.

This is a form which occurs in two-colour phases, one of which is nearly wholly light red, the other browner above, red below. Tail reddish at end; hands and feet red. Occipitonasal length of skull 52.3–54 mm., therefore averaging smaller than allied races of the *sladeni* section. Differing from *C. finlaysoni ferrugineus* by its red feet, when in red phase, and from other races of *finlaysoni* which antedate it as noted in the key to the races above.

(vi) ***Callosciurus flavimanus shortridgei***
Thomas and Wroughton

1916. *Callosciurus sladeni shortridgei* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 232.

1916. *Callosciurus sladeni fryanus* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 232. (Minsin, Upper Chindwin, Burma.)

Type-locality.—Hkamti, east bank, Upper Chindwin, Burma.

Range.—Specimens seen from BURMA: Hkamti, and for ‘*fryanus*’, Minsin and Kauktaung.

Close to *sladeni*, but averaging browner on the back, and face most often less reddish. This seems to be the northernmost representative for the *sladeni* branch of races. Localities for *fryanus* are 25–50 miles south of Hkamti, which is 26.5° N., 95.55° E. (the type-locality of *shortridgei*). There is little difference between the two, and I imagine they are the same.

(vii) ***Callosciurus flavimanus millardi***
Thomas and Wroughton

1916. *Callosciurus sladeni millardi* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 234.

Type-locality.—Pyaungbyin, 40 miles north of Kindat.

Range.—Specimens seen from BURMA: Pyaungbyin, and 100 miles north of Kindat.

This has the white tail, hands and feet of *haringtoni* but the dark greyish back of *sladeni*, and appears a distinct form.

I have not seen the form described as *Callosciurus sladeni vernayi* by Carter (1942), from Tapa Hka, 26.9° N., 96.16° E., Northern Burma. From the description I would say

it is probably a synonym of *C. flavimanus rubex*, when not in the reddish colour phase. It is described as like *rubex* but lacking the rich ferruginous coloration, with the tail coloured like the body throughout its length, the forefeet and lower forelegs ferruginous. Some measurements were head and body 235 mm., tail 258 mm., hindfoot 55 mm., greatest length skull 54.3 mm. The underparts are described as vinaceous rufous, lighter on chest and forelegs.

(viii) **Callosciurus flavimanus heinrichi**

Tate

See Appendix.

19. **Callosciurus finlaysoni** (Horsfield)

1823. *Sciurus finlaysoni* Horsfield, *Zool. Res. Java*, pt. 7 (unpaginated).

Type-locality.—Koh Chang Island, off Siam.

Distribution.—BURMA (east of the Irrawaddy), Siam, and Indo-China.

This species, which occurs with *flavimanus* and *erythraeus*, may be defined as with underparts black, white or red; if red, then the whole animal is usually mainly reddish or red, except in the Siamese form, *sinistralis* (and its immediate allies), which occurs with a form of *erythraeus* and is distinguished by having the root of the tail whitish or pale. The typical race is whitish in colour, and has the skull smaller than the one (red) race occurring in Burma. Some forms of this species are known to change from whitish to reddish seasonally.

External characters.—Essentially as in *C. erythraeus*. Tail usually a little longer than the head and body. Colour throughout deep red; the tail mostly red but usually with a white terminal tuft; this is not, however, a constant character. Hands and feet black. Undersurface deep red, much like the back. Underside of tail tends to be darker red than the chest and belly.

Notes from skin.—Mt. Poppa, 9 $\frac{3}{4}$ oz. 40 miles north of Pegu, 'An arboreal squirrel': 65 miles north of Pegu; 'mammariae two pairs'; 40 miles north of Pegu, 'mammariae two pairs' Mt. Poppa, weight 11 $\frac{5}{8}$ oz. and 10 $\frac{3}{8}$ oz.

External measurements.—As in Table 16, below.

TABLE 16.—*External measurements of Callosciurus finlaysoni ferrugineus*

		Head and body	Tail	Hind- foot	Ear	
M.	Lawksawk, Shan States, Burma	247	247	51	22½	
F.	Gokteik, Burma	251	240	46½	?	
	Near Toungoo	195	233	49	17	
	25 miles north of Toungoo	211	225	52½	21	
F.	Mount Poppa	214	208	52	21½	
	Mount Poppa	220	214	52	23½	
M.	Mount Poppa	211	202	49	21	
M.	70 miles north of Pegu	236	233	55	22	
F.	40 miles north of Pegu	232	248	54	20	Mammae 2 pairs
M.	Pegu Yomas	199	242	50	20	
M.	40 miles north of Pegu	225	219	52	20	
F.	65 miles north of Pegu	229	234	56	22	Mammae 2 pairs

Cranial and dental characters.—As described above, under *C. erythraeus* (*supra*, pp. 113–118).

Cranial measurements.—As in Table 17, below.

TABLE 17.—*Cranial measurements of Callosciurus finlaysoni ferrugineus in India*

		Occipi- tonasal	Palate	Nasals	Frontals	Orbit
M.	6.4.5.6 Rangoon, Burma	55.1	25.8	16.3	20.1	15.8
M.	7.7.20.10 Rangoon. Rather young	51.5	24.9	15.8	ca. 17.8	—
	7.7.20.11 Rangoon	55.1	26.5	17.4	18.8	15.9 approx.
M.	14.7.19.108 Mount Poppa, Burma	51.3	24.6	ca. 16.0	19.4	15.1
F.	14.7.19.109 Mount Poppa	53.2	25.7	16.6	20.3	15.7
F.	14.7.19.110 Mount Poppa	52.6	25.4	15.8	19.9	15.6
M.	17.4.24.12 Dainguku, north of Pegu, Burma	53.6	26.4	16.4	19.2	15.8
M.	17.4.24.13 Zamayi R., north of Pegu	54.7	26.5	16.8	20.5	16.3
F.	17.4.24.15 North of Pegu	55.3	26.4	16.4	20.0	16.3
F.	14.7.19.112 Gokteik, Burma	56.8	ca. 27.9	17.5	—	ca. 17.0
	7.7.20.13 Rangoon	52.7	25.3	15.5	19.3	16.0

Some dimensions of Callosciurus finlaysoni, including all races in British Museum.—The occipitonasal length varies between 44.6 and 57.1 mm. The head and body between 166 and 251 mm.

The Indian race (*ferrugineus*) is the second form to be named in the species.

(i) **Callosciurus finlaysoni ferrugineus** (F. Cuvier)

1829. *Sciurus ferrugineus* F. Cuvier, *Hist. nat. Mamm.*, 3, pl. 238.

1830. *Sciurus keraudrenii* Reynaud in Lesson, *Cent. Zool.*, 11, pl. 1.

Type-locality.—Pegu, Burma.

Range.—Specimens examined from BURMA: North, north-west and north-east of Toungoo; Mount Poppa; Pegu Yomas; Rangoon; Dainguka, north of Pegu; 20–70 miles north of Pegu; Gokteik and Lawksawk in Shan States.

A red squirrel, with blackish hands and feet. This character seems to distinguish it from most of the allied red squirrel subspecies from Indo-China and Siam.

20. **Callosciurus caniceps** (Gray)

The Golden-backed Squirrel

1842. *Sciurus caniceps* Gray, *Ann. Mag. nat. Hist.*, 10, 263.

Distribution.—As here understood, Malay States and small adjacent islands on the west side, Siam, TENASSERIM and adjacent small islands, BURMA, SIKKIM and Formosa.

Essentially like *C. erythraeus*, but occurring with that species throughout the greater part of its range, and always distinguished by its duller coloured underparts, which are either nearly in colour like the back, or duller. If any red appears on the ventral surface it normally appears only as flankstripes on either side of a wide greenish or greyish mid-ventral region. As thus defined the species contains those forms currently referred to it (as listed, for instance, by Chasen, 1940) and a few outlying forms such as *crumpi* from Sikkim, *folletti* from Koh Phai off Siam, *thaiwanensis* from Formosa and *shanicus* from Burma. Occasionally in extralimital races, the frontals of the skull are relatively narrow, and approximate only to about a third of the occipitonasal length. But these races may be distinguished from *Callosciurus pygerythrus*, which shares this character, by their average larger skull size. The present species in a general way seems to me to represent *pygerythrus*, and

is present where the latter is absent many times, side by side with *erythraeus* (or one of its offshoot species). The second name in the species, *concolor*, is extralimital, but seems to be one of the races which has narrow frontals as a general rule, thereby differing from the races with which are now under review. The Formosan form would appear to be distinguishable from most of the other races by details of the colour of its tail. It is not well known. *C. f. folletti* is a rather small form, with the skull a little smaller as a rule even than the Burmese race *shanicus*, and its colour is paler throughout than in *shanicus*, and with a whitish tail.

External characters of Callosciurus caniceps.—The tail is a little longer than head and body in the typical race, a little shorter as a general rule in other Indian races. The essential characters are as described above for *C. erythraeus*.

Colour.—*C. c. caniceps.*—Winter skins: the back is orange or golden reddish, but the head, arms and legs remain grey. One skin has only the hinder part of the back orange, and in summer skins sometimes the orange colouring is suggested, though not dominant. Summer skins: Greyish or brownish, the hairs dark basally, alternately ringed yellow and black. Head usually greyish. Tail greyish (hairs alternately banded black and white), with sharp and well contrasted short black tip. Hands and feet lightish grey or whitish. Underparts grey, lighter or darker, but dull; sometimes with an indistinct dark midventral line; summer skins without flankstripes. Winter skins may have part of the orange brown of the back appearing like stripes on the flanks.

C. c. epomophorus, davisoni, and Mergui Island forms. —Above possibly tending to be slightly darker than *caniceps* (*Summer pelage*), but as usual there is much individual variation in this character; the hands and feet are dark greyish, as a general rule darker than summer skins of *caniceps*; tail about as in the allied race, and with a similar black tip. Belly dull greyish or brownish; not much lighter often than the back; typical *epomophorus* has a reddish brown patch on the neck just below the ear, and on each side, a flankstripe of varying width of the same colour (sometimes these two lines nearly meet in the inguinal region). These dark reddish brown patches are as a general rule well marked in the Mergui Island forms. *C. c. davisoni* appears with few exceptions to be lighter, yellower, than *epomophorus*, and the flankpatches are as a general rule not well marked, or may become almost absent. Mergui Island skins tend to be somewhat intermediate between the two types, and will be discussed further below.

Weight 15 oz. ('*domelicus*', Kisseraing Island).

C. c. crumpi.—This form, which is not well known, seems to belong here rather than with *C. erythraeus* on account of its dull belly. It has the nose reddish brown, which will distinguish it from those races dealt with above; upper parts grizzled black and yellow, the hairs dark basally, alternately ringed black and deep yellow, the general effect rather dark; nose rather sharply contrasted reddish brown. Hands and feet dark. Underparts coloured nearly like the back, but with a faint reddy-brown tinge suggested on the abdomen, particularly on either side of the mid-line. Tail with a considerable black tuft terminally, mixed yellow and black basally.

C. c. shanicus.—This was described as a race of *atrodorsalis*, 'similar to *atrodorsalis* but without the red underside, and practically without the black patch on the back', i.e. similar to *atrodorsalis* but lacking the only two characters on which that race can be based when compared with other species and races. It is in some ways intermediate between the *atrodorsalis* and *caniceps* types, but belongs here on the colour of the belly. Colour above varies from brownish to greyish, with or without a very slight black mid-dorsal line, which in two skins (Pyaunggaung and Kalaw) is moderately well marked. Tail mixed yellowish and blackish with or without a slight black tuft. Underparts brown or greyish like the back, essentially normal dull '*caniceps*-type' with one exception in nineteen skins; this is from Gokteik, and has a yellow throat and two dull red bands down either side of the underparts, like some specimens of *atrodorsalis*. To this race I refer Nos. 85.8.1.198, Doonsa, near Moulmein, 85.8.1.195, Tavoy district, Tenasserim, 85.8.1.196, Tavoy district, and a few specimens from Siam. In this form the nose sometimes tends to be lighter brown than the back, but it is not a constant character.

Specimens of *shanicus* from Gokteik weighed 10 oz. and $8\frac{1}{8}$ oz., and from Pyaunggaung, $9\frac{1}{2}$ oz. and $8\frac{3}{4}$ oz.

Kalaw: 'Shot on a willow tree by stream' Three specimens of *crumpi* from Sedonchen weighed 11 oz., $11\frac{1}{2}$ oz., and 13 oz. The last is noted as having four mammae.

To distinguish the summer dress of *C. c. caniceps* from *C. c. davisoni* and its allies is not always easy. Bonhote (1901) separated them by saying that *caniceps* (summer) has the neck the same colour as the back, whereas in *davisoni* there is a patch of colour on the neck. Wroughton in his summary gave 'feet pale' for *caniceps*, 'feet dark' for *davisoni*. I am inclined to distinguish them by the usual presence

of flankstripes in *davisoni*, etc., which are usually absent in the summer dress of the typical race.

Bonhote when describing *davisoni* said it was like *epomophorus* (Bonhote, 1901, from Junk Seylon Island) but with the rufous patch on the neck yellowish, and the lateral lines (i.e., flankpatches) hardly visible. The next forms to be named appear to be *sullivanus* and *domelicus* from the Mergui Islands (other races named by Miller from these Islands are not represented in London). These are only compared with *davisoni*. The former is like it but smaller and darker. That it is a little smaller as judged by the skull is true; that it is darker in any way from individual specimens of *davisoni* I cannot see. Miller gave the 'greatest length' of the skull as 55 mm. (but this would be a little larger than my occipito-nasal measurement in all probability). *S. c. domelicus* was like *sullivanus* but slightly darker throughout, and the reddish lateral areas spread over whole ventral surface; none of our specimens has the reddish lateral areas spread actually over the whole belly, but the tendency for these lateral areas to encroach on the belly and nearly meet is merely characteristic of *epomophorus*, with which *domelicus* it seems was not compared. In their rufous neckpatches also, our specimens of *domelicus* are very close to *epomophorus*. Thomas later described two other races of this type from Mergui Islands.

C. c. tabaudius is supposed to be a dark insular form of *epomophorus*, the foreback tending towards rufous. Colour essentially as *davisoni* but darker throughout. But I have specimens for *davisoni* from Tenasserim, and including some which Thomas referred to that race from King Island, which are just as dark as *tabaudius*. Finally, *hastilis* ('The Hastings Island squirrel differs, on the average, by its more uniformly greyish coloration from all the other forms in the Archipelago, with the exception of *altinsularis* which is even more strongly grey'). The difference between the few specimens of '*hastilis*' and the remainder seems to me to be negligible. Thomas goes on to say, 'In referring the various Mergui squirrels (notably *bentincanus*, *domelicus*, *sullivanus*, *lucas* and *matthaeus*) to the different forms described, I would not be taken as endorsing their validity as subspecies, for it appears to me that their variability and degree of intergradation are sufficiently great to render it somewhat doubtful how far they are likely to be recognized by future writers, when the subject is revised with still more material.' Earlier in the same paper, he states, 'It is exceedingly difficult to come to any satisfactory conclusions, as in most cases the differences are at the best only average ones of slight shades of colour not

absolutely constant on the respective islands, and still less so on the mainland.' The question of this matter really is, must one fake characters because it is supposed that the squirrels of each small island must of necessity be a different subspecies? I can see not the slightest reason to do so.

I provisionally retain *sullivanus*, based on a squirrel like *epomophorus* but with the neckpatches paler, less vividly reddish or brownish. The skull averages, in both *sullivanus* for which we have topotypical material from Sullivan Island and *epomophorus* from Trang and Junk Seylon Island, smaller than in *davisoni* and a host of closely allied named races, including the other Mergui material. Our specimens labelled '*domelicus*' are not from the type-locality, and I propose to regard them as *davisoni*. On account of the size of their skulls, I regard our specimens from Malcolm Island as *sullivanus*.

External measurements.—As in Table 18, below.

TABLE 18.—*External measurements of the Indian races of Callosciurus caniceps*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus caniceps caniceps</i>				
F. Lampea, Tenasserim	200	227	55	22
M. Amherst district	226	232	52	20
M. Shan Mepale, Amherst	232	244	53	21

Other skins from Thoungyeen district, Moulmein, Tavoy, Hankaryit. etc. Tenasserim, and numerous localities in Siam.

Callosciurus caniceps davisoni

F. Bankason, Tenasserim	234	225	54	20
M. Bankason	249	227	53	21
M. Bankason	233	227	52	21
M. Bankason	235	220	53	21
F. Bankason	220	224	52	19½
M. Bankason	244	208	53	21
Bankason	242	223	53½	20
F. Bankason	246	233	54½	21
M. Bankason	237	217	52½	20
M. Bankason	245	230	54	20
M. Bankason	233	226	54	21
M. Mergui district	225	231	47	20
M. Mergui district	235	225	50	21
M. Mergui district	222	200	43	20
F. Mergui district	215	215	45	20
M. Mergui district	220	222	47	20
F. Mergui district	234	235	45	20
Mergui district	242	215	48	20

TABLE 18.—*External measurements of the Indian races of Callosciurus caniceps (contd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Callosciurus caniceps davisoni</i> (concl'd.)					
F.	Tenasserim town	230	227	52	22
M.	Victoria Point, Tenasserim	226	180	48	20
F.	King Island, Mergui Archi- pelago	226	230	46	20
M.	King Island	220	224	46	20
M.	King Island	243	185	46	20
M.	King Island	218	222	46	20
M.	King Island	227	216	46	20

The following were identified by Thomas as *domelicus*.

M.	Kisseraing Island, Mergui Archipelago	240	210	48	23
F.	Kisseraing Island	240	210	48	23
F.	Kisseraing Island	223	225	46	22
M.	Kisseraing Island	233	220	45	19

Callosciurus caniceps davisoni ('*hastilis*')

M.	Hastings Island, Mergui Archipelago	245	210	49	23
F.	Hastings Island	232	206	47	20
	Hastings Island, type	235	197	47	21

Callosciurus caniceps davisoni ('*tabaudius*')

F.	Tavoy Island, Mergui Archipelago	229	206	46	19
F.	Tavoy Island, type	242	215	50	20

Callosciurus caniceps sullivanus

M.	Sullivan Island, Mergui Archipelago	240	200	46	17
	Sullivan Island	226	190	47	20
	Malcolm Island, Mergui Archipelago	222	220	47	19
M.	Malcolm Island	220	230	47	19

The last two were identified as '*domelicus*', but seem to belong here.

Callosciurus caniceps crumpi

F.	Sedonchen, Sikkim	213	223	51	20
					mammæ 4
F.	Sedonchen	210	198	50	19
M.	Sedonchen	202	200	48	22
M.	Sedonchen, type	205	193	49	20

TABLE 18.—*External measurements of the Indian races of Callosciurus caniceps (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus caniceps shanicus</i>				
Gokteik, Shan States, Burma	214	196	50	20
Gokteik	208	209	49	20
Mongha, Shan States	183	177	?	21
M. Pyaunggaung, Burma	208	180	48	20
M. Pyaunggaung	207	194	48½	19
M. Pyaunggaung	212	197	48	21
F. Pyaunggaung	218	202	49	20
M. Gokteik, type	208	183	48	22

Other skins from Hsipaw and Maymyo.

Cranial and dental characters.—Essentially as described above, under *C. erythraeus* (*supra*, pp. 113–118).

Cranial measurements.—As in Table 19, below.

TABLE 19.—*Cranial measurements of the Indian races of Callosciurus caniceps*

	Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus caniceps shanicus</i>					
F. 12.11.8.2	47.7	22.5	14.3	14.7	14.7
Maymyo, Burma. Rather young					
M. 14.7.8.26	50.0	23.6	15.0	17.2	15.8
Pyaunggaung, Burma					
M. 14.7.8.27	49.9	23.5	15.5	17.3	15.6
Pyaunggaung					
F. 14.7.8.29	51.0	24.5	15.2	16.5	15.5
Pyaunggaung					
F. 14.7.8.30	51.1	24.1	16.0	17.4	15.6
Gokteik					
M. 14.7.9.114	49.2	23.1	15.3	17.8	15.3
Kalaw, Burma					
F. 14.7.19.115	51.7	23.4	15.5	16.8	15.5
North-east of Hsipaw, Burma					
F. 8.10.20.1	49.5	22.3	13.6	17.1	15.4
Mongha, North Shan States, Burma. Rather young					

The type has the occipitonasal 50.6 mm., the frontals 18.3 mm.

Callosciurus caniceps crumpi

M. 15.9.1.102	52.5	24.7	16.0	18.7	16.0
Sedonchen, Sikkim					
F. 15.9.1.104	53.4	25.5	16.5	19.0	16.3
Sedonchen					
F. 15.9.1.105	52.4	25.5	14.7	19.1	16.1
Sedonchen					

The type has the occipitonasal 52.1 mm. approximately.

TABLE 19.—*Cranial measurements of the Indian races of Callosciurus caniceps (contd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus caniceps caniceps</i>						
F.	22.4.13.13	54.8	25.2	17.0	19.7	16.9
	Near Thoungyen, Lower Burma					
F.	22.4.13.14	56.2	26.2	16.1	20.4	16.6
	Lampea, Tenasserim					

The rest of our Indian material is mostly broken, but I have measured many skulls from Siam. These vary between about 52 mm. and 57.7 mm. in occipitonasal length.

<i>Callosciurus caniceps sullivanus</i>						
M.	23.4.10.4	52.3	25.2	16.2	19.0	16.0
	Sullivan Island, Mergui Archipelago					
M.	23.4.10.9	52.8	25.3	15.8	19.1	16.3
	Malcolm Island, Mergui Archipelago. Old					
M.	23.4.10.10	53.3	25.3	15.3	19.0	16.0
	Malcolm Island					

The above Malcolm Island specimens were identified as *domelicus*.

<i>Callosciurus caniceps davisoni</i>						
M.	14.12.8.124	55.4	26.5	17.4	18.7	16.4
	Tenasserim town					
M.	14.12.8.125	56.6	26.6	18.0	18.6	16.7
	Bankason, Tenasserim					
M.	14.12.8.126	55.2	26.3	17.2	18.3	16.5
	Bankason					
M.	14.12.8.127	56.7	26.8	17.0	20.7	17.0
	Bankason					
F.	14.12.8.128	55.0	25.7	17.3	18.9	16.4
	Bankason					
M.	14.12.8.129	57.1	27.2	17.0	18.9	16.8
	Bankason					
M.	14.12.8.130	55.6	26.6	17.4	19.1	17.3
	Bankason					
M.	14.12.8.131	57.6	27.3	18.3	19.0	17.7
	Bankason					
F.	14.12.8.134	55.1	25.2	16.8	20.1	16.9
	Bankason					
F.	23.4.10.26	56.7	27.2	17.5	20.2	17.0
	King Island, Mergui Archipelago					
F.	14.12.8.133	57.8	26.6	18.2	20.1	17.4
	Bankason					
M.	23.4.10.23	56.4	25.8	17.1	20.3	17.0
	King Island					

TABLE 19.—*Cranial measurements of the Indian races of Callosciurus caniceps (concl'd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus caniceps domelicus</i> (perhaps not <i>domelicus</i> of Miller)						
M.	23.4.10.11 Kisseraing Island, Mergui Archipelago	56.5	27.1	16.6	20.5	17.2
M.	23.4.10.12 .. Kisseraing Island	56.0	26.4	15.1	19.4	16.1
F.	23.4.10.13 .. Kisseraing Island	55.8	26.5	16.5	19.6	16.4
F.	23.4.10.14 .. Kisseraing Island	57.6	27.1	17.3	19.7	17.2
<i>Callosciurus caniceps 'tabaudius'</i> (= <i>davisoni</i>)						
M.	23.4.10.1 Tavoy Island, Mergui Archipelago	57.0	27.7	16.5	20.5	17.6
F.	23.4.10.2 Tavoy Island	56.8	27.8	17.5	21.6	17.0
<i>Callosciurus caniceps 'hastilis'</i> (= <i>davisoni</i>)						
F.	23.4.10.7 .. Hastings Island, Mergui Archipelago	55.8	26.8	17.4	19.5	16.5
M.	23.4.10.6 Hastings Island, type	56.0	25.7	16.8	19.6	16.9

Dimensions of the species Callosciurus caniceps in British Museum material.—The occipitonasal length varies between 44.5 and 58.1 mm., the head and body between 150 and 262 mm.; the tail between 139 and 277 mm. The hindfoot between 36 and 56 mm.

Key to the Indian races of this species.—Is given above, under the general key to the *erythraeus* group of species (*supra*, p. 104).

(i) *Callosciurus caniceps caniceps* (Gray)

1842. *Sciurus caniceps* Gray, *Ann. Mag. nat. Hist.*, 10, 263.
 1847. *Sciurus chrysonotus* Blyth, *J. Asiat. Soc. Beng.*, 16, 873.
 (Amherst, Tenasserim.)
 1911. *Sciurus epomophorus fluminalis* Wroughton and Robinson,
J. Fed. Malay States Mus., 4, 233. (Meping Rapids,
 Siam.)

Type-locality.—'Bhutan' (error), substitute North Tenasserim.

Range.—Specimens examined from TENASSERIM: Amherst, Hankaryit, Lampea, Moulmein, Tavoy, Thoungyeh. SIAM:

115 miles north of Bangkok; Metaw Forest; north of Raheng; Krabin; west of Kampenpet; Nan; Nakonsawan; Meping River; above Paknampo; Sawanloki; 28 miles east of Um Pang.

(*Sciurus concolor* of Blyth, 1855, which Blanford placed in synonymy, is now regarded as a valid subspecies, from the Malay Peninsula.)

This race is golden brown dorsally in winter coloration, and seems to be the only race known to change colour so markedly in seasons. In summer pelage, it is usually distinguishable from the next by its paler feet, and its lack of flankstripes and cheekpatches, or by one or any of these characters. Occipitonasal length about 52–57 mm.

(ii) *Callosciurus caniceps davisoni* (Bonhote)

- 1901. *Sciurus epomophorus davisoni* Bonhote, *Ann. Mag. nat. Hist.*, **7**, 273.
- 1922. *Callosciurus epomophorus tabaudius* Thomas, *J. Bombay nat. Hist. Soc.*, **28**, 4, 1067. (Tavoy Island, Mergui Archipelago.)
- 1923. *Callosciurus epomophorus hastilis* Thomas, *J. Bombay nat. Hist. Soc.*, **29**, 2, 377. (Hastings Island, Mergui Archipelago.)

To this form I also refer our specimens which were identified as *Sciurus domelicus* Miller, 1903, *Smiths. misc. Coll.*, **45**, 18 (Domel Island, Mergui Archipelago), except those from Malcolm Island.

Type-locality.—Bankason, Tenasserim.

Range.—Specimens examined from TENASSERIM: Bankason, Victoria Point, Mergui district, Tenasserim town. King Island, Mergui Archipelago, and Kisseraing Island ('*domelicus*'); Tavoy Island ('*tabaudius*'); Hastings Island ('*hastilis*'); SIAM: Klong San, Manoli, Namchah, Mewong River, Paknampo, Memoh, and Tasaw.

C. c. davisoni is never golden brown in colour; the feet are usually darker than in the typical race; usually patches on the cheeks and flankpatches on the sides are at least traceable. The occipitonasal length of the skull exceeds 55 mm. in our material.

(iii) *Callosciurus caniceps sullivanus* (Miller)

- 1903. *Sciurus sullivanus* Miller, *Smiths. misc. Coll.*, **45**, 17.

Type-locality.—Sullivan Island, Mergui Archipelago.

Range.—Specimens seen from MERGUI ARCHIPELAGO: Sullivan Island and Malcolm Island.

It is like *davisoni*, but the occipitonasal length of the skull does not reach 54 mm. in our material.

(iv) ***Callosciurus caniceps crumpi* Wroughton**

1916. *Callosciurus crumpi* Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 425.

Type-locality.—Sedonchen, Sikkim, 6,500 ft.

Range.—Specimens examined from SIKKIM: Sedonchen.

This race may be distinguished from the others by its reddish brown nose, and the reddish brown tinge of the underparts, which are, however, too dark and dull for this form to be regarded as an *erythraeus* race in my opinion. There are no flankpatches. The tail is dark terminally, as is usual in *caniceps*. The skull has the occipitonasal length over 52 mm.

(v) ***Callosciurus caniceps shanicus* (Ryley)**

1914. *Sciurus atrodorsalis shanicus* Ryley, *J. Bombay nat. Hist. Soc.*, 22, 663.

Type-locality.—Gokteik, Shan States, Burma.

Range.—Specimens examined from BURMA: Gokteik, Hsipaw, Kalaw, Mongha, Maymyo, Pyaunggaung; TENASSERIM, Tavoy district. Similar specimens from SIAM, Sai Yoke, Mekongson, and SW Siam, no exact locality.

A smaller form than those above, the occipitonasal length of the skull is 51 mm. at highest, usually less. With or without a slight dark line or stripe on the back; belly dull, essentially as *caniceps* in all specimens except one available.

A note on the supposed races of this species inhabiting various islands of the Mergui Archipelago

Miller, 1903, described about eight representative races (as species!) of *C. caniceps* from various islands in the Mergui Archipelago, none of which is in the London collection. Some brief notes taken from his descriptions are as below:

1. *Sciurus bentincanus* Miller, 1903, *Smiths. misc. Coll.*, 45, 19, from Bentinck Island, Mergui Archipelago. 'External appearance essentially as in *S. davisoni*, but size somewhat greater and skull with larger, more inflated audital bullae.' Head and body 235 mm., tail 230 mm., hindfoot 57 mm. Greatest length of skull 58 mm, Zygomatic breadth 33 mm,

2. *Sciurus matthaeus* Miller, 1903, *Smiths. misc. Coll.*, **45**, 19, from St. Matthew Island, Mergui Archipelago. 'Like *bentincanus* but not as large and with reddish areas on neck and sides less strongly marked. The bullae are as large as those of *davisoni*.' Head and body 220 mm., tail 225 mm., hindfoot 53 mm. Skull, greatest length 54 mm. Zygomatic breadth 31 mm.

3. *Sciurus lucas* Miller, 1903, *Smiths. misc. Coll.*, **45**, 20. St. Luke Island, Mergui Archipelago. 'Like *matthaeus*, but ground colour of upperparts and tail strongly suffused with fulvous.' Head and body 220 mm., tail 210 mm. Hindfoot 54 mm. Skull, greatest length 54 mm. Zygomatic breadth 31 mm.

4. *Sciurus casensis* Miller, 1903, *Smiths. misc. Coll.*, **45**, 20. From Chance Island, Mergui Archipelago. 'Like *S. davisoni* but size larger and colour, particularly that of the tail, paler, and reddish areas of neck and sides brighter and more strongly contrasted with the surrounding parts. Skull closely resembles that of *davisoni*, but is slightly larger. Rostrum broader, and audital bullae more inflated anteriorly.' Head and body 250 mm. Tail 215 mm. Hindfoot 52 mm. Skull, greatest length 57 mm. Zygomatic breadth 33 mm.

5. *Sciurus altinsularis* Miller, 1903, *Smiths. misc. Coll.*, **45**, 21. From High Island, Mergui Archipelago. 'General appearance as in *casensis* but size smaller. General colour paler, upper surface of tail not lighter than back, and ferruginous markings replaced by ochraceous buff. Skull resembles *casensis* but is smaller.' Head and body 230 mm. Tail 207 mm. Hindfoot 50 mm. Skull, greatest length 54.6 mm. Zygomatic breadth 31 mm.

Whether all or any of these will be valid I am not in a position to say, as I have not seen them. Thomas seems to have thought that *altinsularis* was a valid 'very grey' race. I do not believe that every island in this region must have a special race named because it is an island, and other material from Mergui Islands (*sullivanus* excepted) I have mostly synonymized with *davisoni*. For the form *domelicus* (Miller, 1903, *Smiths. misc. Coll.*, **45**, 18, Domel Island), Miller stated it was like *sullivanus* but colours throughout slightly darker, the reddish lateral areas spreading over whole ventral surface and the black tip of the tail longer; skull with narrower and more elongate rostrum. Head and body 210 mm., tail 210 mm., hindfoot 51 mm. Greatest length of skull 54 mm., zygomatic breadth 31 mm. For *sullivanus*, described in the same paper,

'like *davisoni* but smaller and darker', skull smaller and less elongate than in *davisoni*, Miller gave the measurements head and body 285 mm., tail 205 mm., foot 51 mm. Skull, greatest length 55 mm., zygomatic breadth 33 mm.

21. *Callosciurus quinquestriatus* (Anderson)

Anderson's Squirrel

1871. *Sciurus quinquestriatus* Anderson, *Proc. zool. Soc. Lond.*, 142.

Distribution.—BURMA and Yunnan; mainly it appears to be confined to localities which are near the Yunnan-Burma border.

This rather rare squirrel is easily distinguished from all others by the colour of its underparts, which are longitudinally banded with alternate stripes coloured black and white; typically three dark stripes, two white bands. I have not seen this formation elsewhere in the genus, although of course it recalls forms like *C. erythraeus gordonii* which have the belly banded alternately dark and red.

External characters.—As described above for *C. erythraeus*, I have no note on the mammary formula, nor on the proportionate tail length of the Indian specimens. Blanford gave head and body $9\frac{1}{2}$ inches, tail without hair 9 inches. Colour above brownish speckled as usual. Tail mostly the same colour as the back, with tendency for an indistinct black terminal tuft. Hands and feet dark. Colour of underparts most unusual; throat coloured as in the head; behind which the underparts are white, with a sharp dark brown mid-ventral stripe, and two dark stripes parallel with this on either side of the white, so that there are three dark and two white stripes running down the belly. Thighs white in two specimens, not so in others. Tail below coloured about as above. I doubt whether the form named '*imarius*' by Thomas is based on anything more than individual characters. In the series for the typical race which I have examined there is much variation in the extent of the dark lower markings, some having the white bands comparatively wide, and some having them appearing only as two narrowish lines. '*Imarius*' is supposed to be a darkened local race 'differing in the greater extent and intensity of the dark lower markings and especially of the lateral ventral lines' Anthony (1941), however, recognizes two races of this species in North Burma, the typical race, which he quotes as being taken from the road between Nomoyoung and Seniku, 'much warmer in color,

a bright chestnut, than the next', and *C. q. beebi* J. Allen (1911), which he says came from the Burma-Yunnan frontier; for this form he quotes 22 specimens from eleven localities, and he makes 'imarius' a synonym of it. I have never seen *beebi*.

External measurements.—I have only one measured skin for this species, a type of a Chinese form, *C. quinquestriatus sylvester*, which measured head and body 240 mm., tail 160 mm., hindfoot 40 mm., ear 15 mm. from Schweli-Salween divide, Yunnan. Other skins for the typical race, and 'imarius', or 'beebi', from Sima, Myitkyina; Teinzo, north-east of Bhamo, Suikin, Bhamo, and west flank Mt. Imaw Bum (type of 'imarius'): Hindfoot 50-51 mm. Thomas gives 255 mm. head and body, 230 mm. tail, 49 mm. hindfoot for the type of *imarius*.

Cranial and dental characters.—Essentially as described above for *C. erythraeus*.

Cranial measurements.—

Callosciurus quinquestriatus quinquestriatus

	Occipito-nasal	Palate	Nasals	Frontals	Orbit
8.6.20.4 Bhamo, East Burma	52.8	25.7	16.7	18.2	15.7
M. 88.12.1.62 North-east of Bhamo	52.2	24.7	15.4	17.5	15.5
M. 20.8.7.6 Mount Imaw Bum (type of 'imarius')	52.5	25.5	16.1	—	16.4

Dimensions of Callosciurus quinquestriatus in British Museum material.—The occipitonasal length varies between 52.2 and 52.8 mm. The hindfoot 40-51 mm. Only one fully measured skin, the type of *sylvester*, from Yunnan, has the head and body 240 mm., the tail 160 mm.

(i) ***Callosciurus quinquestriatus quinquestriatus***
(Anderson)

1871. *Sciurus quinquestriatus* Anderson, *Proc. zool. Soc. Lond.*, 142.

1926. *Callosciurus quinquestriatus imarius* Thomas, *Ann. Mag. nat. Hist.*, 17, 640. (Western flank of Mt. Imaw Bum, Kachin, 7,000 ft., northern Burma.)

Type-locality.—Ponsee, Kakhien Hills, Yunnan-Burma border.

Range.—Specimens examined from BURMA: Bhamo, Suikin, near Bhamo; Teinzo, north of Bhamo; Sima, Myitkyina; Mt. Imaw Bum.

As noted above, Anthony makes the last a synonym of *beebei* (*Sciurus beebei* J. Allen (1911)), probably from Burma-Yunnan frontier, and retains this form as a valid race.

22. *Callosciurus pygerythrus* (Geoffroy)

The Irrawaddy Squirrel

1831. *Sciurus pygerythrus* I. Geoffroy, in Belanger, *Voy Inde Orient. Zool.*, 145.

Distribution.—As here understood, NEPAL, ASSAM, BURMA, Indo-China. Possibly south-east China also.

This species I define as with the occipitonasal length of the skull most often under 50 mm., or in some races approximating to 50 mm., combined with the fact that the frontals (= least interorbital width) are relatively narrow, often rather under a third of the occipitonasal length, or approximating to a third; rarely more and then only individually. As thus outlined it contains several Indian forms all of which were referred to 'Tomeutes' by Thomas on the structure of the baculum; *imitator* from Indo-China, and I think it possible that the form *styani* Thomas, from Chekiang and Anhwei in south-east China may have to be transferred here. At least in India this seems to be the westernmost species of the genus as far as distribution is concerned. Blanford, Wroughton, and most authors regard the Nepalese and Assamese species, *lokroides*, as a distinct species, and Thomas and Wroughton even split this into a number of 'species' which are barely or not retainable even as races. There seems to me to be no reason, however, for treating *lokroides* as a distinct species.

External characters.—Essentially as described above under *C. erythraeus*, as far as hands, feet, and tail are concerned. The baculum is said to differ, but is probably not known in some races, and *C. flavimanus phayrei* is said to be similar to this species in that structure. Mammæ 4. Tail most often slightly shorter than head and body, but not so in *stevensi* and individually variable elsewhere.

Colour.—*C. p. pygerythrus*.—Above speckled olive brownish to greyish. Hands and feet rather variable, but often the digits or the feet in part are yellow like the underparts. Tail above coloured like the back, except at the end, where there is a well marked black tip, which is short. The tail hairs alternately banded whitish and black. Face coloured

like the back. Underparts very light reddish or buff; the throat can be pale; there is slight individual variation, two skins tending to be more grey below, but as a rule the reddish tint predominates. Most of the skins for the typical race lack hip-patches, but some specimens from Tamabin have yellowish or whitish ones present.

C. p. janetta.—Is similar but the hands and feet are paler, white or buffy, and the underparts are lighter, being usually pale, white or buffy. Some specimens from Mandalay tend to be somewhat intermediate between the two races. A white or buffy hip-patch present. The Mandalay specimens agree with *janetta* in the light hands and feet. Often there is a pale or whitish line running down the centre of the tail. Back either grey or grey suffused with buffy, as pointed out by Thomas in the original description.

C. p. lokroides.—This differs from the two races above primarily in the fact that in almost all cases there is no clearly marked or contrasted black tail-tip. When the hip-patch is present it is light bright red. (These patches are, as is well known, developed seasonally.) Above speckled brownish or dark greyish; hands and feet usually dark grey. The hairs of the body dark at base, then alternately ringed yellowish and black. Tail hairs also ringed yellowish and blackish; usually there is no well marked black tip at the end. Underparts rather variable in colour, but usually dull; usually greyish, sometimes tinged with very light reddish, as in some specimens from Sikkim. A dark median line may be traceable. Bhutan-Duars specimens seem to be remarkable for a yellowish line running down the centre of the tail. This is, however, traceable in skins from other localities.

C. p. owensi.—Is essentially similar except that the posterior part of the back seems to tend to be more suffused with reddish brown. But only July skins are known. There is a median mid-ventral line, but this will not distinguish this race from *lokroides*. It is, however, on cranial characters that *owensi* seems best distinguishable. Thomas and Wroughton named this form as a subspecies of '*similis*' Gray, but later, they came to the conclusion that this name was based on the summer pelage of *lokroides*, and so placed the name in synonymy.

The following races, *stevensi* excepted, are barely distinguishable from each other and from *lokroides* in specimens which lack the hip-patch, but quite easily distinguished, at least in the case of *blythi* and *bellona*, when the hip-patch is present.

C. p. blythi.—The hip-patch when present is white. The colour is very similar to *lokroides*. The hands and feet in this, and immediate allies or synonyms, '*mearsi*', '*virgo*', vary individually from dark grey to almost whitish. There is a tendency for the feet here to be paler, at least in part, than in *lokroides*, but it seems not to be constant. The underparts are as a rule dull greyish or nondescript. One specimen has them nearly white (Namdang) but might be immature. Underside of tail often with median yellow line. The hip-patch in '*mearsi*' is supposed to be 'buffy' rather than white, but I have my doubts on the validity of this character: '*mearsi*' is not at all well known. It is supposed to be much 'greyer' than *lokroides* according to the original description. I very much doubt if this is so, although its feet may be lighter, but in any case it does not seem possible to separate it in a satisfactory manner from *blythi* in the present state of our knowledge. Only one specimen seen has the hip-patch, and this is little marked; our specimens are winter skins. The name *blythi* was overlooked when '*virgo*' was described. I cannot see the least difference between them in our material, and the name *blythi* has priority by over sixty years.

The form described as *C. p. bellona*, of which only summer skins are known, from Kin, can, however, be distinguished from *blythi* (on rather unsatisfactory material in that only skins taken in June are known). It should be restricted to the type-locality. At the back of the white thigh patch and sometimes to a certain extent on the hip, there is an ochraceous or orange rufous patch, which seems to be lacking in *blythi*. Further specimens will show whether this character is of value or not, but for the present our *bellona* skins can fairly easily be distinguished from our *blythi*, '*virgo*' and '*mearsi*' skins.

C. p. stevensi.—The whole of the underparts are deep grey, almost blue-grey, thereby differing very sharply from other races from India, though rather similar in general to the race from Indo-China. Hands and feet blackish; back rather dark; a specimen from Ledo, Naga Hills, has the head greyer than the back, its colour reminiscent of the underparts. Fur rather thick. Tail mixed yellowish and black as usual, with or without a rather vague black tuft at the end. Inner side of limbs coloured like the belly. Thomas in describing this species compared it with *atrodorsalis*, but it is difficult to see how it resembles that in the least. The Ledo specimen has a reddish hip-patch. A specimen collected December from the Kachin Hills, 150 miles north of Myitkyina, is also perhaps this race.

External measurements.—As in Table 20, below.

TABLE 20.—*External measurements of the Indian races of Callosciurus pygerythrus*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus pygerythrus owensi</i>				
F. Kauktaung, Chindwin	199	188	46	22
Hkamti	206	178	46	22
F. Minsin, Burma, type	216	202	46	23

Callosciurus pygerythrus stevensi

M. Ledo, Naga Hills, Assam	185	192	41	19
F. South of Hukong Valley	176	188	47½	20

Other skins, including the type, seen from Benichang, and between Kalek and Mishang, Abor-Miri Hills, North Assam.

Callosciurus pygerythrus pygerythrus

M. 30 miles north of Toungoo, Burma	187	188	44	19
F. 40 miles north of Toungoo	181	189	46	19
M. 20 miles north-west of Toungoo	178	166	41	18
F. 40 miles north of Toungoo	183	169	45	18
F. Tamabin, north of Pegu	160	162	42	18
45 miles north of Pegu	172	188	46	18
M. 45 miles north of Pegu	190	179	44	17
27 miles north of Pegu	192	185	42	20

Other skins from Rangoon.

Callosciurus pygerythrus janetta

F. Mingun, near Sagaing, Burma	199	200	45	21
M. Mingun	193	168	47	21
F. Mingun	184	183	44	21
Mingun	190	195	43½	20½
M. Mingun	205	191	44	21
F. Mingun	176	193	44	19
M. Mingun	192	180	43	21
F. Mandalay, Burma	201	188	46	21½
F. Mandalay	197	179	44½	21
M. Mandalay	193	187	46½	21½
M. Mandalay	196	170	45½	21
M. Mandalay	198	177	46½	21
F. Mandalay	188	194	44	21
M. Pyawbye, Burma	175	180	40	19
F. Pyawbye	177	168	39	18
M. Yin, Chindwin	183	185	44	20

TABLE 20.—*External measurements of the Indian races of Callosciurus pygerythrus (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus pygerythrus janetta</i> (concl'd.)				
F. Yin	188	178	44	21
M. Yin	176	169	43½	20½
F. Yin	185	176	42½	19
M. Yin	190	185	44	22
F. Shwebo district, Burma	201	186	49	17
M. Mount Poppa, Burma	197	186	40	20
Mount Poppa	196	174	42	19
M. Mount Poppa	200	186	44	21
M. Kyauknyaung, Irrawaddy	191	183	42	19½
F. Kyauknyaung	198	177	43½	22
M. Kyauknyaung	164	164	42	20
F. Monywa, Lower Chindwin	190	194	42	21
M. Mandalay, type	198	199	45½	21½
<i>Callosciurus pygerythrus lokroides</i>				
M. Sivok, Bengal	184	189	46	20
F. Sivok	187	184	44	19
				4 mammae
M. Sivok	187	194	45	20
F. Sivok	175	192	45	22
M. Sunachurn, Nepal	174	165	42	19
M. Lahoripowa, Nepal	178	180	40	18
M. Near Katmandu	190	155	40	18
F. Katmandu	188	169	44	16
Hetwada, Nepal	182	168	40	20
F. Katmandu	196	187	37	19
F. Lahoripowa, Nepal	193	173	36	19
M. Naivacot, Nepal	190	165	42	18
M. Katmandu	204	132	38	14
Kuvapandy, Gorkha	162	173	43	18
F. Mongpu, Darjeeling	220	170	36	14
Mongpu, Darjeeling	190	180	40	22
F. Mongpu, Darjeeling	222	170	43	16
F. Dikchu, Sikkim	190	194	41	20
				4 mammae
F. Rongli, Sikkim	186	177	43	18
				4 mammae
F. Rongli	189	180	44	19
				4 mammae
F. Rongli	174	184	44	18
M. Rongli	176	174	42	18
F. Rongli	181	178	44	18
				4 mammae
F. Pashok, Sikkim	180	193	41	18
F. Pashok	177	195	43	20
M. Pashok	187	192	44	20
F. Pashok	183	190	43	18
M. Pashok	180	194	44	19

TABLE 20.—*External measurements of the Indian races of Callosciurus pygerythrus (concl.)*

		Head and body	Tail	Hind- foot	Ear
<i>Callosciurus pygerythrus lokroides (concl.)</i>					
F	Hasimara, Bhutan Duars	178	192	42	16
F.	Hasimara	172	178	42	18
M.	Bharnabari, Bhutan Duars	170	193	41	19
M.	Bharnabari	167	187	41	20
M.	Near Shwebo	184	167	43	18
<i>Callosciurus pygerythrus blythi</i>					
F	North Cachar	170	180	42	20
	North Cachar	180	190	45	20
M.	Hatikhali, Cachar	178	198	43	18
M.	Angharakhata, Kamrup	195	—	45	20
F.	Angharakhata	193	—	44	20
	Matanga River, Kamrup	183	187	42	20
F.	Matanga River, Kamrup	192	192	43	24
M.	Matanga River, Kamrup	193	187	43	24
M.	Rangapara, Garo Hills, Assam	195	188	41	17
F.	Tura, Garo Hills	197	174	42	18
					mammæ 1-1 = 4
F.	Duragiri, Garo Hills	188	184	42	18
M.	Gologhat, Naga Hills	182	186	38	18
F.	Namdang, Naga Hills	147	173	39	18
F.	Gologhat, Naga Hills	195	185	40	15
F.	Gologhat	185	187	41	20
M.	Frost Coll. 303. Naga Hills, 5,000 ft.	210	198	45	20

Specimens also from Laitkynsao, Khasi Hills.

Callosciurus pygerythrus blythi ('mearsi')

M.	150 miles south of Kindat, Burma	185	155	42½	19½
F.	Mogaung, Burma	180	152	35	19
F.	Chinbyit, Chindwin, type	185	172	40	19

Callosciurus pygerythrus blythi ('virgo')

M.	20 miles west of Kindat	195	189	40½	18
M.	20 miles west of Kindat	204	166	44	20
M.	6 miles west of Kindat	190	187	43½	20½
M.	Kindat	209	142	42	19
F.	20 miles west of Kindat	204	210	44	19
					2 pairs mammæ
F.	8 miles south of Kindat	180	187	42	20
F.	Tatkon, Burma	185	183	44½	18
F.	Tatkon	191	181	46	20

TABLE 20.—*External measurements of the Indian races of Callosciurus pygerythrus (concl'd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Callosciurus pygerythrus blythi</i> ('virgo') (concl'd.)				
M. Tatkon	175	195	45½	18½
M. Tatkon	181	185	44	19
M. Tatkon	159	185	44½	18½
M. Tamanthe, Burma	213	196	44½	21.25
M. Homalin, Burma	182	192	43	20
F. Tamanthe	174	186	44	18
F. Hkamti, Burma	192	190	44	21
F. Kabaw Valley, Burma	207	175	42½	18
			mammae 1-1 = 4	
F. Homalin	192	185	43	19
M. Margherita, Naga Hills, Assam	196	205	39	18
F. Margherita, Nagas	200	214	35	18
M. Tatkon, type	180	160	43	20

Other specimens from Sangrachu and Mokokchung, Naga Hills.

Callosciurus pygerythrus bellona

F. Locality ?	182	170	35	15
M. Kin, Chindwin	177	173	44	19
F. Kin	178	172	42½	—
M. Kin	188	176	43½	19½
M. Kin	175	180	42½	18½
F. Kin	192	180	45	18.75
F. Kin	181	174	43	19
M. Kin, type	184	176	43½	18½

Notes from skins.—

C. p. stevensi: Skins collected February, March, July and October. One from south of Hukong Valley (near source of Chindwin) weighed 4¾ oz.

C. p. owensi: July skins only. Two weighed respectively 8¾ oz. and 9½ oz.

C. p. pygerythrus: Skins examined collected January, February, March and May.

C. p. janetta: Skins examined collected June, July, August, September, October. Maymyo, 'dropped by a hawk' Pyawbye, 'shot in Guana tree' Mandalay, weight of four specimens respectively 7 oz., 8 oz., 8½ oz. and 8¾ oz.

C. p. lokroides: Skins with clear hip-patch seen collected in months of May, July, August, October, November and December. Skins mostly without hip-patch seen collected in January, February, March, April, May, September and November. Dikchu, mammae 4, weight 9½ oz. Pashok,

weight 9 oz. 150 miles north of Myitkyina (authentic), 'shot in tree in jungle' Rongli, mammae 4 (3 specimens); 8 oz., $8\frac{1}{2}$ oz., $8\frac{3}{4}$ oz. and 7 oz. in weight. Sivok, specimens weighed 9 oz., $8\frac{1}{2}$ oz., and in two specimens, 4 mammae noted.

C. p. bellona: June skins only. Kin, weight $7\frac{3}{8}$ oz. and 6 oz. Two skins, January, Golohat in Nagas, with this name, are in all probability wrongly identified, and probably = *blythi*. One skin, Ahlaw, Kabaw Valley, February, is also possibly not authentic.

C. p. blythi: Skins seen collected February, March, April, June, October, November. The hip-patch is clearest in June and October specimens. Matanga River, weight 8 oz. Golohat, weight 6 oz. and 7.25 oz. Mammae 1-1 = 4 in two specimens. Duragiri, weight 6.25 oz. Cachar, weight 5.75 oz. '*mearsi*', October and December skins. '*virgo*', hip-patch clear, skins taken in June, July, August (several), and October (one). Hip-patch weak; skins taken in January, February, October and December. Two pairs mammae, west of Kindat. Kindat, 'one of six in a tree; three nests' Hkamti, weight $7\frac{1}{8}$ oz. Margherita, weight 8 oz.

Cranial characters.—The skull does not differ greatly from *C. erythraeus* and its immediate allies. But it averages smaller than is usual in that group; the majority of the specimens have the occipitonasal length less than 50 mm. Only in the form *owensi* do most of the specimens have this length approximating to 50 mm. The frontals (= least interorbital measurement) are relatively narrower than is usually the case in the *erythraeus* group. They approximate in width to about one-third of the occipitonasal length or often less, but only rarely a little more. Not every *pygerythrus* skull can be separated from every *erythraeus* group skull on this character, but there is a very strong tendency for the two groups to divide themselves on this character. The postorbital processes are quite well developed as a rule. Sometimes the parietal ridges join to form a short but well marked small sagittal ridge. These ridges are not very strong as a rule. Palate averages less than half occipitonasal length. Mandible with well developed coronoid process. Other characters of skull much as in the *C. erythraeus* group.

Dental characters.—Incisors reddish, and normally ungrooved. Upper cheekteeth five; essentially as described above for *C. erythraeus*. There are young specimens available in which it may be seen that the large inner cusp on the upper molars is originally composed of three cusps (the hinder one larger than the front one); these ultimately fuse

to form the one long cusp characteristic of normal adult Sciurine molars. Lower molars essentially as described for *C. erythraeus* above.

Cranial measurements.—As in Table 21, below.

TABLE 21.—*Cranial measurements of the Indian races of Callosciurus pygerythrus*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus pygerythrus pygerythrus</i>						
M.	6.4.5.9 Rangoon, Burma	47.5	22.5	13.6	15.4	14.9
F.	6.4.5.11 Rangoon	44.9	21.8	13.4	15.5	14.5
M.	17.4.24.16 Tamabin, north of Pegu, Burma	47.0	22.6	13.9	15.5	14.7
M.	17.4.24.17 Tamabin	47.4	22.5	13.8	15.1	15.0
<i>Callosciurus pygerythrus janetta</i>						
M.	14.7.19.117 Mingun, Burma. Parietal ridges almost joined	45.8	21.6	12.8	14.8	14.8
M.	14.7.19.118 Mingun	47.1	21.6	13.9	14.5	15.0
F.	14.7.19.120 Mingun. Parietal ridges joined	47.5	21.9	14.4	14.7	15.4
F.	14.7.19.123 Mingun. Parietal ridges joined	46.4	21.6	12.9	15.0	15.2
M.	14.7.19.124 Mount Poppa, Burma	45.0	21.2	13.2	15.4	14.2
F.	14.7.19.126 Mount Poppa	44.9	21.2	13.2	14.9	14.5
M.	14.7.19.133 Mandalay, Burma	47.6	22.7	13.0	14.7	15.5
M.	14.7.19.131 Mandalay	46.4	22.3	14.0	15.0	14.5
M.	14.7.19.136 Kyauk Nyaung, Irrawaddy, Burma	45.5	21.1	12.5	15.1	14.3
F.	14.7.19.137 Kyauk Nyaung. Parietal ridges nearly joined	45.7	21.4	12.2	14.2	15.1
M.	14.7.19.138 Pyawbye, Burma	44.1	21.3	11.7	13.9	14.2
F.	14.7.19.139 Pyawbye. Parietal ridges nearly joined	46.7	22.1	13.4	15.6	14.4
M.	15.5.5.150 Yin, Burma	46.4	22.0	12.9	14.7	14.7
M.	15.5.5.151 Yin	46.1	21.8	13.6	14.7	14.7
F.	14.7.19.132 Mandalay	47.4	22.7	13.2	14.5	15.1

TABLE 21.—*Cranial measurements of the Indian races of Callosciurus pygerythrus (concl.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus pygerythrus janetta</i> (concl.)						
M.	14.7.19.129 Mandalay	47.2	22.5	13.5	15.6	15.0
F.	14.7.19.134 Mandalay	46.4	21.6	12.3	15.0	15.0
M.	14.7.19.125 Mount Poppa	44.4	20.7	12.4	14.7	14.7

The type has the occipitonasal length about 46 mm.

<i>Callosciurus pygerythrus lokroides</i>						
F	15.9.1.118 Rongli, Sikkim.	49.4	23.2	14.4	16.1	15.2
M.	15.9.1.106 Darjeeling	48.0	23.5	14.1	16.8	15.0
M.	15.9.1.109 Sivok, Bengal	49.7	23.8	15.0	16.8	15.6
M.	15.9.1.111 Sivok	48.9	23.2	14.8	15.6	15.2
F.	15.9.1.113 Sivok	50.3	24.1	15.6	17.5	15.5
M.	15.9.1.114 Rongli, Sikkim.	47.3	22.8	14.1	16.4	15.0
F.	15.9.1.116 Rongli	47.9	22.8	14.3	16.2	14.5
F.	16.7.29.59 Hasimara, Bhutan Duars	49.6	24.3	14.3	16.3	14.6
F.	16.7.29.58 Hasimara	48.8	23.5	14.4	15.2	14.8
M.	16.7.29.60 Bhutan Duars	48.1	22.9	13.8	15.7	14.8
M.	16.7.29.61 Bhutan Duars	50.0	23.7	14.8	16.4	14.6
F.	23.11.5.28 Kuvapandy, NW. Nepal	47.6	22.9	14.3	16.4	14.5
F.	1938.8.2.7 East Nepal Terai	47.1	22.5	14.0	15.3	14.3
	43.1.21.59 Nepal, co-type	47.4	22.8	14.0	16.2	14.9
F.	32.11.1.67 Kachin Hills, Burma.	49.4	24.1	15.0	14.8	15.5
	91.10.7.86 Katmandu, Nepal	47.4	22.8	13.6	15.8	14.9
M.	1938.8.2.6 Katmandu	47.5	22.4	14.3	15.9	15.0
	43.1.12.94 Nepal	50.7	24.6	16.6	17.5	15.9

TABLE 21.—*Cranial measurements of the Indian races of Callosciurus pygerythrus (contd.)*

		Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus pygerythrus lokroides</i> (concl'd.)						
F.	15.9.1.115 Rongli, Sikkim	48.8	22.8	14.6	16.6	14.8
M.	15.9.1.110 Sivok, Bengal	49.7	24.0	15.4	16.6	15.2

The co-types of 'assamensis' and 'similis' have also been seen.

Callosciurus pygerythrus blythi

F.	20.11.1.36 Golohat, Naga Hills, Assam	48.4	22.9	13.5	16.5	15.6
M.	20.11.1.38 Rangapari, Garo Hills. Parietal ridges nearly joined	48.0	22.7	13.8	15.4	14.9
F.	20.11.1.41 Duragiri, Garo Hills	47.3	22.8	13.8	15.3	14.9
M.	21.7.8.44 Matanga River, North Kamrup	47.6	23.1	13.8	15.4	14.4
F.	21.7.8.47 Lankar, Cachar	46.7	22.3	13.6	14.1	14.8
M.	21.7.8.51 Hatikhali, Cachar Hills. Rather young	46.2	21.8	12.4	15.1	14.5
	Frost Coll. M. 303 Naga Hills	49.4	23.5	13.9	15.9	14.9

Callosciurus pygerythrus blythi ('virgo')

F.	15.5.5.155 Hkamti, Burma	47.0	22.8	13.9	14.5	14.5
F.	15.5.5.170 Tatkon, Burma	46.7	22.4	14.2	14.0	14.9
M.	16.3.26.27 Kindat, Burma	48.8	23.5	13.4	15.9	15.2
F.	16.3.26.30 Kindat	45.5	21.5	12.8	15.0	14.6
M.	16.3.26.31 Kabaw Valley, Burma	48.7	22.9	15.0	16.2	15.2
F.	16.3.26.32 Kabaw Valley	47.8	23.4	14.1	—	14.6
F.	20.6.7.24 Margherita, Naga Hills, Assam	49.2	23.8	14.0	16.9	15.5
F.	20.6.7.25 Margherita, Naga Hills	49.3	22.8	13.8	16.4	15.4
F.	15.1.1.154 Homalin, Burma, Parietal ridges fused	47.1	21.9	13.8	15.0	15.4

The type of 'virgo' has the occipitonasal about 47.4 mm.

TABLE 21.—*Cranial measurements of the Indian races of Callosciurus pygerythrus (concl'd.)*

	Occipito- nasal	Palate	Nasals	Frontals	Orbit
<i>Callosciurus pygerythrus blythi</i> ('mearsi')					
M. 6.7.5.9	45.5	21.7	12.6	13.7	15.3
Lower Chindwin, Burma. Rather young					
M. 15.5.5.178	46.2	22.2	14.0	16.1	15.0
Kin, Burma					
M. 16.3.26.25	44.6	21.5	13.1	15.1	14.1
Setoo, Chindwin, Burma. Adult; ridges nearly fused					

The type of 'mearsi' has the occipitonasal about 45.8 mm., the frontals about 14.7 mm. Its parietal ridges are joined.

<i>Callosciurus pygerythrus bellona</i>					
M. 15.5.5.174	45.7	21.9	13.5	15.5	14.7
Kin, Burma					
M. 15.5.5.176	46.5	23.2	13.8	14.6	15.0
Kin					
F. 15.5.5.182	47.2	22.2	14.6	15.0	15.3
Kin					
F. 15.5.5.184	46.4	22.6	13.7	14.7	15.0
Kin					
M. 15.5.5.175	44.6	21.6	13.2	15.2	14.1
Kin					

The type of *bellona* has the occipitonasal about 46.1 mm.

<i>Callosciurus pygerythrus stevensi</i>					
12.10.22.9	48.9	—	15.2	15.2	15.6
Between Kalek and Mishang, North Assam					
F. 12.10.22.10	47.5	22.8	13.5	14.9	15.5
Rotung, North Assam					
M. 20.6.7.26	48.7	23.1	14.0	15.2	15.2
Ledo, Naga Hills, Assam. Rather young					

<i>Callosciurus pygerythrus owensi</i>					
M. 15.5.5.186	50.2	23.9	15.1	15.9	16.0
Hkamti (east side Chindwin)					
F. 15.5.5.188	50.4	—	15.4	14.0	16.2
Hkamti					
F. 15.5.5.189	51.0	—	15.3	15.4	16.6
Minsin, Burma, type					

Dimensions of the species Callosciurus pygerythrus in British Museum material, including all available races.—The occipitonasal length varies between 44.1 and 52.3 mm. but only very

rarely reaches 51 mm. (perhaps three times in 85 skulls). The head and body length varies between 147 and 222 mm. The tail between 132 and 220 mm. Hindfoot 35 to 51 mm.

*Provisional key to the Indian subspecies of
Callosciurus pygerythrus*

1	(2) Larger; apparently the occipitonasal length is over 50 mm. Frontals proportionately narrower.	<i>C. p. owensi</i>	
2	(1) Smaller; the occipitonasal length only reaches 50 mm. in rare individual cases. Frontals on average proportionately wider....		3
3	(4) The underparts dark grey (near blue-grey).	<i>C. p. stevensi</i>	
4	(3) The underparts lighter..		5
5	(8) Normally with clear sharp contrasted black tail-tip.		
6	(7) Underparts less pale, reddish. Feet darker..	<i>C. p. pygerythrus</i>	
7	(6) Underparts paler, whitish. Feet paler..	<i>C. p. janetta</i>	
8	(5) The black tail-tip is in the majority of specimens absent or scarcely traceable..		9
9	(10) Thigh patches, when present, red. On the whole more specimens have slightly widened frontals and largest skulls reach 50 mm..	<i>C. p. lokroides</i>	
10	(9) Thigh patches whitish. Most of the specimens have typically narrowed frontals. Largest skulls do not reach 50 mm. in our collection.		11
11	(12) The thigh patches are white with an ochraceous patch or suffusion above them.	<i>C. p. bellona</i>	
12	(11) The thigh patches are white or whitish, lacking the ochraceous patch..	<i>C. p. blythi</i> (with 'mearsi' and 'virgo')	

**(i) *Callosciurus pygerythrus pygerythrus*
(Geoffroy)**

1831. *Sciurus pygerythrus* I. Geoffroy, in Belanger, *Voy. Inde Orient. Zool.*, 145.

Type-locality.—Pegu.

Range.—Specimens examined from BURMA: Pegu; 25–80 miles north of Pegu; Rangoon; Tamabin; north, north-west and west of Toungoo.

A race with a clear black tip at the end of the tail; the underparts usually tending to be pale reddish; the occipito-nasal length of the skull less than 48 mm. in our material.

(ii) **Callosciurus pygerythrus janetta** (Thomas)

1914. *Sciurus pygerythrus janetta* Thomas, *J. Bombay nat. Hist. Soc.*, **23**, 2, 203.

Type-locality.—Mandalay, Burma, 200 feet.

Range.—Specimens examined from BURMA: Mandalay, Kyauknaung, Monywa (east side Chindwin), Mount Poppa, Mingun, Pyawbwe, Shwebo district and Yin, on Chindwin.

Much like *pygerythrus*, but the underparts tend to be paler, more whitish, or not pale red, and the feet are as a rule paler.

(iii) **Callosciurus pygerythrus lokroides** (Hodgson)

The Hoary-bellied Himalayan Squirrel

1836. *Sciurus lokroides* Hodgson, *J. Asiat. Soc. Beng.*, **5**, 232.

1843. *Sciurus assamensis* Gray, ex-M'Clelland, *List Mamm.*, 143, *nom. nud.*

1867. *Macroxus similis* Gray, *Ann. Mag. nat. Hist.*, **20**, 281. Sikkim.

Type-locality.—Nepal.

Range.—Specimens examined from near Shwebo (one skin; locality not clear); MANIPUR, Machi; BHUTAN DUARS: Hasimara, Bharnabari; NEPAL: Aromari, Lahoripowa, Hetwada, Katmandu, Naivacot, Sunachown, Kuvapandy (Gorkha). NORTH BENGAL: Sivok. SIKKIM: Gopaldhara, Dikchu, Mongpu Hills, Nimbong, Pashok, Rongli.

This race lacks the black tail-tip of the typical race. The hip-patches are red in the season when these patches are developed. The occipitonasal length of the skull varies between 47.1 and 50.7 mm. but is mostly less than 50 mm.

(iv) **Callosciurus pygerythrus blythi** (Tytler)

1854. *Sciurus blythii* Tytler, *Ann. Mag. nat. Hist.*, **14**, 172.

1906. *Sciurus lokroides mearsi* Bonhote, *Ann. Mag. nat. Hist.*, **18**, 337. (Chinbyit, Lower Chindwin, Burma.)

1916. *Tomeutes mearsi virgo* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 3, 419, 421. (Tatkon, western bank Chindwin, Burma.)

Type-locality.—Dacca, eastern Bengal.

Range.—Specimens seen from KAMRUP. Angarakhata, Matanga River, ASSAM: Tura, Duragiri and Rangapari,

Garo Hills. Golohat and Namdang in Naga Hills. Laitkynsao in Khasi Hills. Lanka, Dilkoosha and Hatikhali in Cachar. Chinbyit, Kindat, Mogaung and Setoo, all west side Chindwin, BURMA ('*mearsi*'). Hkamti, Kabaw Valley, Homalin, Tamanthe, Tatkon, BURMA ('*virgo*'): also ASSAM: Mokokchung in Naga Hills, Margherita, Naga Hills, and Sangrachu.

This is like *lokroides* and not distinguishable from it except when the hip-patches are present, when they are white. The occipitonasal length of the largest skulls does not reach 50 mm.

(v) ***Callosciurus pygerythrus bellona*** (Thomas and Wroughton)

1916. *Tomeutes mearsi bellona* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 3, 419, 420.

Type-locality.—Kin, west side Chindwin, Burma.

Range.—Specimens seen from BURMA: Kin. Essentially like *blythi* but thigh patch white with a reddish patch above it.

(vi) ***Callosciurus pygerythrus owensi*** (Thomas and Wroughton)

1916. *Tomeutes similis owensi* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 236.

Type-locality.—Minsin, east bank Chindwin, Burma.

Range.—Specimens seen from BURMA: Minsin, Hkamti, and Kauktaung, Chindwin.

A large race; occipitonasal length 50·2 to 51 mm. in length, the frontals proportionately narrower than large skulls of *C. l. lokroides*. Skull larger than in other Indian races.

(vii) ***Callosciurus pygerythrus stevensi*** (Thomas)

1908. *Sciurus stevensi* Thomas, *J. Bombay nat. Hist. Soc.*, **18**, 2, 246.

Type-locality.—Beni-Chang, Abor-Miri Hills, northern frontier of Upper Assam, 4,000 ft.

Range.—Specimens from BURMA: south of Hukong Valley; 150 miles north of Myitkyina; ASSAM: The type-locality; Sadiya; Ledo in Naga Hills; Rotung, Beni-Chang; and between Kalek and Mishang.

The colour of the underparts, dark grey (blue-grey), distinguishes this race from all other Indian subspecies, and it

seems to be a northern type in localities as far as India is concerned. Its cranial measurements prove it to be a member of the present species. Occipitonasal length less than 50 mm.

Notes on some Burmese races

It sometimes appears that in the Chindwin River region two races of a given species occur together at certain localities, but this may be caused by their being at the locality in question but on different sides of the river. Thomas and Wroughton (1916) gave a list of squirrels collected in the Chindwin River regions, and for reference purposes I give a summary here of their lists of localities, and the species taken at each, with the nomenclature brought into line with the classification here offered.

Hkamti, 26.5° N. Lat., 95.55° E. Long.

WEST BANK: *Ratufa bicolor gigantea*. *Callosciurus erythraeus crotalius*. *Callosciurus pygerythrus blythi*.

EAST BANK: *Ratufa bicolor gigantea*. *Callosciurus flavimanus shortridgei*. *Callosciurus pygerythrus owensi*. *Dremomys rufigenis rufigenis* ('opimus'). *Callosciurus maccllellandi maccllellandi*.

Kauктаung (25 miles south of Hkamti).

EAST BANK: *Callosciurus flavimanus shortridgei* ('fryanus'). (Intermediate specimens.) *Callosciurus pygerythrus owensi*.

Minsin (50 miles south of Hkamti).

EAST BANK: *Callosciurus flavimanus shortridgei* ('fryanus'). *Callosciurus pygerythrus owensi*.

Tamanthe (65 miles south of Hkamti).

WEST BANK: *Callosciurus erythraeus erythrogaster* ('nagarum'). *Callosciurus pygerythrus blythi*.

EAST BANK: *Callosciurus flavimanus haringtoni* ('careyi'). *Callosciurus maccllellandi maccllellandi*.

Moungkan (85 miles south of Hkamti).

EAST BANK: *Ratufa bicolor gigantea*. *Callosciurus flavimanus haringtoni*. *Callosciurus maccllellandi maccllellandi*.

Homalin (105 miles south of Hkamti).

WEST BANK: *Callosciurus erythraeus erythrogaster* ('nagarum'). *Callosciurus pygerythrus blythi*.

EAST BANK: *Callosciurus flavimanus haringtoni*. *Callosciurus pygerythrus blythi*. *Callosciurus maccllellandi maccllellandi*.

Pyaungbyin (140 miles south of Hkamti).

EAST BANK: *Callosciurus flavimanus millardi*.

Tatkon (West), and Kindat (East) (180 miles south of Hkamti).

WEST BANK: *Callosciurus erythraeus kinneari*. *Callosciurus pygerythrus blythi*. *Dremomys lokriah macmillani*. *Ratufa bicolor lutrina*.

EAST BANK: *Callosciurus flavimanus sladeni*. *Dremomys rufigenis adamsoni*.

Kin (West), and Yin (East) (250 miles south of Hkamti).

WEST BANK: *Callosciurus pygerythrus bellona*.

EAST BANK: *Ratufa bicolor felli*. *Callosciurus flavimanus ruber*. *Callosciurus pygerythrus janetta*.

Genus 7. *Dremomys* Heude

1898. *Dremomys* Heude, *Mem. H.N. Emp. Chinois*, 4, 2, 54.

1908. *Zetis* Thomas, *J. Bombay nat. Hist. Soc.*, 18, 245. (*Sciurus rufigenis* Blanford.)

Type-species.—*Sciurus pernyi* Milne-Edwards.

Range.—Indo-Malayan region from NEPAL, ASSAM, BURMA, TENASSERIM, South Tibet, Szechuan, Hupeh, Yunnan eastwards to Fukien and district in South China, Formosa, Indo-China, Siam, the Malay States and Borneo.

This is not a well differentiated genus, and is extremely close to *Callosciurus*. Its chief and indeed only character of generic value is a tendency to lengthening of the rostrum, which is, however, very much less developed than in certain Indo-Malayan squirrels, and any characters which one may give for the present genus based on skulls are average rather than absolute and individuals either of this genus or of some species of *Callosciurus* will overlap them. It is, however, a matter of convenience to treat the present group as distinct from *Callosciurus*, and it is currently given generic rank.

The genus may be characterized by the fact that the nasals are normally longer than the frontals (= least inter-orbital) width; by the fact that, probably on account of the lengthening of the rostrum, the frontals average in width usually less than 30% of the occipitonasal length, or 30% at most of this length; and the orbit is relatively short, usually less than 30% of the occipitonasal length. The dentition is completely normal and without peculiarity, and the baculum is said to be of the general type found in some *Callosciurus* species. In the adult, the occipitonasal length exceeds 47 mm. This fact serves to distinguish *Dremomys* from certain small extralimital species of *Callosciurus* which rarely have the frontals as narrow proportionately as in the present genus (*C. lowi*, *C. tenuis*). But in those two species, almost always the frontal width exceeds the nasal length. Another form of *Callosciurus*, from India, *C. pygerythrus owensi*, has

unusually narrowed frontals for a *Callosciurus* and makes a distinct approach to *Dremomys*. But the orbit of that form is much longer proportionately. In three skulls of *owensi* the orbit length is 16 mm. or more. Its occipitonasal length varies between 50 and 51 mm. I have measured approximately one hundred and six *Dremomys* skulls, and only two of them have the orbit as much as 16 mm. Both these are considerably larger than *owensi*, the occipitonasal length respectively measuring 55 and 57.5 mm.

If the Bornean species can be maintained as a distinct species when compared with *D. pernyi* then there are four species belonging to this genus, three of which reach India. The earliest to be named was *Dremomys lokriah*, which is also the least typical, as it has the shortest rostrum known in the genus. It is also the commonest species in Indian territory, and is only known outside that territory by a few skins collected in south-eastern Tibet. *Dremomys pernyi* is the common species of southern China, and has been taken in Assam and parts of Burma (since Blanford dealt with the Indian species). The colour of its tail distinguishes it from the remaining species, *D. rufigenis*, which is the only species found in Indo-China, Siam and the Malay States. I am inclined to regard the Formosan form as an outlying race of *D. pernyi*.

Key to the species of Dremomys occurring in India

1 (2) The muzzle is on the whole less elongated. The orbit is proportionately longer, on average 29% of the occipitonasal length. (The underparts are bright yellow; the underside of the tail is not red, nor are the cheeks).....	<i>Dremomys lokriah</i>
2 (1) The muzzle is more elongated. The orbit is proportionately shorter, on average 28% of occipitonasal length at highest but most often less than 28%. (In Indian forms, the underparts are not bright yellow.).....	3
3 (4) The underside of the tail is bright red through most of its length. In Indian races, the cheeks are red. Generally the tooththrow is proportionately longer.. ..	<i>Dremomys rufigenis</i>
4 (3) The underside of the tail is not red. The cheeks are not red. Generally the tooththrow is proportionately shorter.....	<i>Dremomys pernyi</i>

23. *Dremomys lokriah* (Hodgson)

The Orange-bellied Himalaya Squirrel

1836. *Sciurus lokriah* Hodgson, *J. Asiat. Soc. Beng.*, 5, 232.

Type-locality.—Nepal.

Distribution.—NEPAL, SIKKIM, ASSAM, West and North BURMA, south-eastern Tibet.

This species differs from the allies in its slightly shorter rostrum, which is best indicated by the percentage (given above in the key) for the orbit against the occipitonasal length. Here the orbit is proportionately longest for the genus, and this character distinguishes the species from all races of the allied species as far as they are available to me. The rather striking colours, of the underparts, which are fiery or bright yellowish, also distinguish the species in India; but the Formosan form (*D. pernyi owstoni* Thomas, 1908) approaches the present species in the colour of its underparts, while agreeing with *pernyi* in skull characters.

External characters.—Tail shorter than head and body, as usual in this genus. Six mammae. Ear of medium size. Hands and feet as usual, with four fingers (the fourth finger slightly the longest, the third nearly as long; second and fifth shorter), and five toes; apparently six plantar pads. Tail evenly haired throughout.

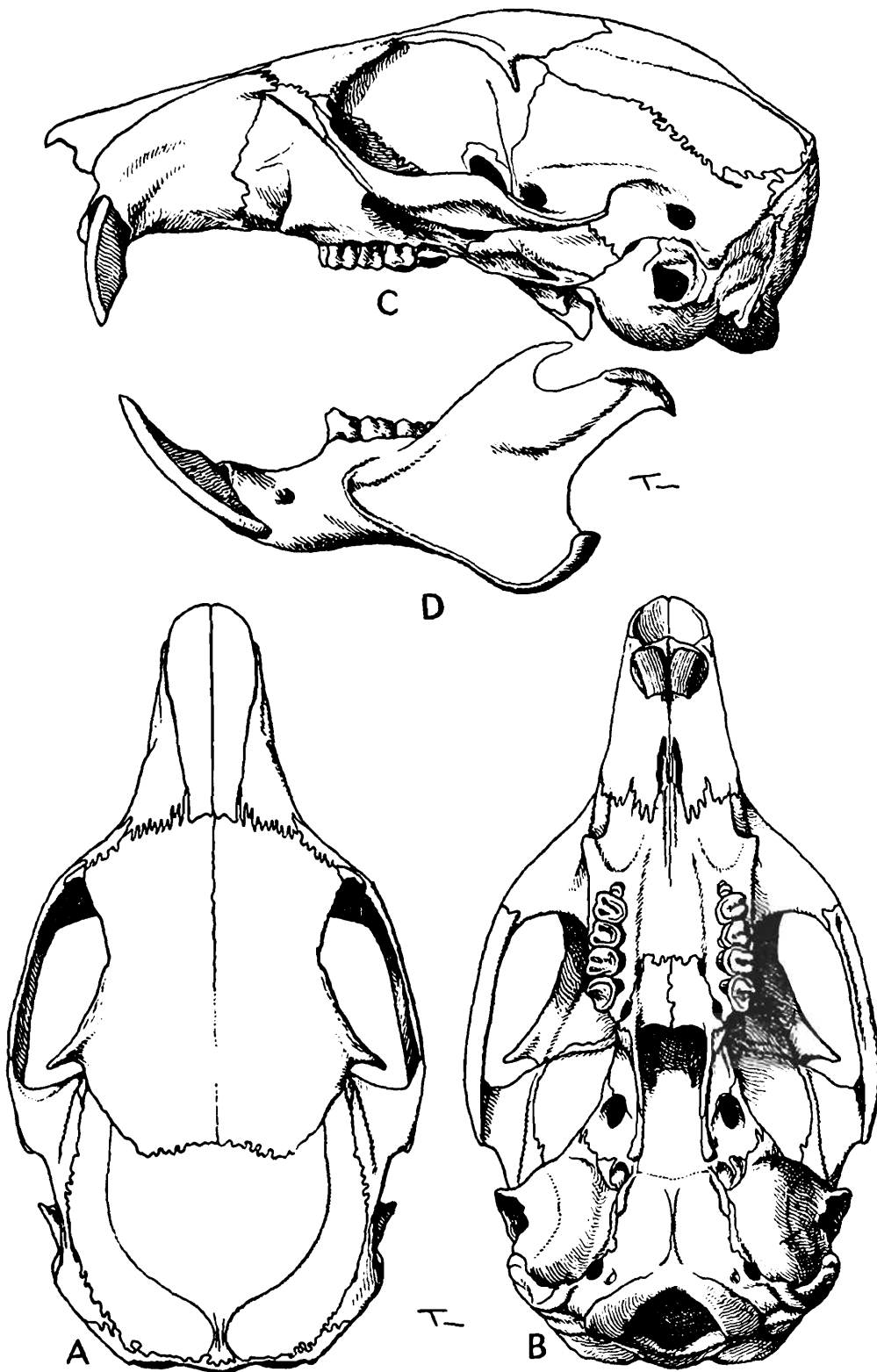
Colour.—Above dark greenish or rufous brown, finely speckled. Sometimes a black median mid-dorsal line or stripe may be developed, as in the specimens referred to *macmillani*. Usually a white spot behind the ear, but this is often not conspicuous. Tail colour above slightly variable, often blackish or dark brown throughout, its hairs apparently mostly yellowish at base, then black, and often white-tipped. Below the tail is mostly coloured as it is above; sometimes tending to be brown down the centre, and black or black mixed white at the sides. Throat and chest always yellow or red or orange, mostly bright in colour, and individually variable. This colour, which sometimes reaches over the abdomen as well, passes gradually into the colour of the sides, and is sometimes confined to the middle of the lower surface.

External measurements.—As in Table 22, below.

Cranial characters.—*Dremomys lokriah* is a medium sized squirrel, the occipitonasal length varying between about 48 and 53 mm. The rostrum is elongated, but less so on the whole than in any other species of the genus. The nasal length exceeds the least interorbital width, with about two exceptions in twenty-four measurable

TABLE 22.—*External measurements of the Indian races of Dremomys lokriah*

		Head and body	Tail	Hind- foot	Ear
<i>Dremomys lokriah lokriah</i>					
F.	Satthar, Gorkha, Nepal	165	127	40	21
	Chandragiri Pass, Nepal	165	120	45	?
M.	Hathibun, Nepal	172	146	44	21
F.	Sukiapohkri, Darjeeling	180	138	43	23
M.	Sukiapohkri	178	140	47	22
M.	Sukiapohkri	170	127	46	21
F.	Ringin, Sikkim	170	144	45	23
F.	Gangtok, Sikkim	190	120	40	?
M.	Adung Valley, North Burma	185	130	43	21
F.	Adung Valley	173	150	42	19
M.	Dreyi, Mishmi	204	136	46	20
F.	Dreyi	191	140	42	20
F.	Dreyi	179	144	41	21
	Dreyi	185	137	42	22
M.	Dreyi	201	125	43	20
M.	Dreyi	186	140	38	23
F.	Dreyi	195	143	43	22
M.	Sedonchen, Sikkim	185	139	43	22
F.	Sedonchen	187	112	44	19 6 mammae
M.	Sedonchen	174	139	44	22
M.	Sedonchen, type	171	134	44	21
<i>Dremomys lokriah macmillani</i>					
M.	Rajapara, Kamrup	175	133	39	20
F.	Duragiri, Garo Hills	187	141	43	17 6 mammae
F.	Khonshnong, Jaintia Hills	160	134	43	20
M.	Khonshnong	175	146	41	19
	Khonshnong	186	149	43	20
M.	Tura, Garo Hills, type	190	153	45	20
F.	50 miles west of Kindat, West Burma	195	144	42	19
	50 miles west of Kindat	194	142	46	21
	50 miles west of Kindat	190	152	44	19
M.	Tatkon, West Burma, type	180	156	46	20
Frost collections—					
M.	272 Naga Hills, 5,000 ft.	185	130	42	18
M.	231 Naga Hills	205	155	42	20



TEXT-FIG. 9. *Dremomys lokriah lokriah* (Hodgson). A, B, C, dorsal, ventral, and lateral views of the skull. D, lower jaw of the same. ($\times 4$).

skulls. The orbit is proportionately longer than in the allied species; averaging 29% of the occipitonasal length for each race. The frontal bones are longer than the nasals in superior aspect of skull; the postorbital processes are small and rather weak. The suture of frontals and parietals behind the postorbital processes is nearly straight in most skulls; the parietals are weakly ridged, and rarely a short sagittal crest may be formed by the ridges joining; as in No. 21.12.5.35, from Dreyi, Mishmi. The least interorbital measurement is relatively narrow, as usual in this genus, the frontals width being as a rule less than 30% of the occipitonasal length. The percentage just quoted may approximate to 30%, but with three individual exceptions does not exceed it. Occiput without peculiarity. Palate fairly wide, but less than half the occipitonasal length. Palatal foramina short, and far in front of toothrows. Pterygoid fossae as a rule rather deep and well marked, at least as compared with species like *Menetes*. Bullae evenly rounded but not very large. Zygomatic plate quite well tilted upwards, and jugal of normal Sciurine form. The mandible has a well developed recurved coronoid process. The angular portion is slightly inflected, and the portion behind between the angular and condylar process is broadly rounded.

Dental characters.—Upper incisors narrow, red, and as a rule not grooved, though grooves can be traced in at least one specimen. Five upper cheekteeth; the pattern essentially normal Sciurine and without peculiarities, including the reduction of the second main cross ridge on the third molar, which is absent. Lower molars essentially normal, the large central depression a conspicuous feature of the tooth, and retained until old age; the small inner subsidiary cusp between the two main inner cusps quite well marked in young teeth.

Cranial measurements.—As in Table 23, below.

Dimensions of the species Dremomys lokriah, in British Museum material.—The occipitonasal length varies between 48.1 and 53.2 mm. Upper tooththrow between 8 and 9.4 mm. The head and body length varies between 160 and 205 mm. The tail between 112 and 156 mm. The hindfoot 38–47 mm.

*Provisional key to the races of Dremomys lokriah **

1	(2) The belly brighter, washed with rich ochraceous.	<i>D. l. lokriah</i>
2	(1) The belly duller, washed with buffy or yellowish	<i>D. l. macmillani</i>

* Also see Appendix.

TABLE 23.—*Cranial measurements of the Indian races of Dremomys lokriah*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Dremomys lokriah lokriah</i>							
M.	15.9.1.121	50.0	23.6	8.5	16.4	16.2	14.5
	Sukiapohkri, Darjeeling						
F.	15.9.1.124	48.4	22.2	—	15.0	13.8	13.7
	Ringin, Sikkim. Rather young						
	58.6.24.91	50.5	23.7	8.2	16.4	14.8	15.0
	Nepal						
F.	15.9.1.128	50.8	23.9	8.6	15.5	14.2	14.9
	Sedonchen, Sikkim ('bhotia')						
M.	15.9.1.125	50.0	—	—	14.8	14.7	14.4
	Sikkim ('bhotia')						
M.	15.9.1.127	49.7	24.0	8.4	15.7	14.4	14.8
	Sedonchen, Sikkim ('bhotia')						
M.	15.9.1.126	51.5	24.4	8.2	15.8	14.4	14.6
	Sedonchen, Sikkim ('bhotia'). Old						
M.	21.12.5.34	50.5	23.9	8.8	15.9	15.6	15.0
	Dreyi, Mishmi ('subflaviventris')						
M.	21.12.5.35	52.2	25.8	9.1	18.2	15.9	15.7
	Dreyi ('subflaviventris'). Old						
M.	21.12.5.36	53.2	25.8	8.5	17.5	15.3	15.8
	Dreyi ('subflaviventris'). Old						
F.	21.12.5.37	51.4	24.1	8.8	17.4	15.2	15.3
	Dreyi ('subflaviventris')						
F.	21.12.5.38	50.5	24.5	8.8	16.4	14.7	14.7
	Dreyi ('subflaviventris')						
F.	21.12.5.40	49.4	23.6	9.1	16.7	15.2	14.5
	Dreyi ('subflaviventris')						
F.	21.12.5.39	50.4	24.5	9.4	16.5	16.1	15.4
	Dreyi ('subflaviventris')						
M.	32.11.1.63	50.4	23.8	8.8	15.7	15.5	14.9
	Adung Valley, North Burma						
F.	32.11.1.64	48.8	23.0	9.1	15.5	14.7	14.3
	Adung Valley. Rather young						

A co-type of *lokriah* and the type of 'bhotia' have the occipitonasal length 48.4 mm. each.

Dremomys lokriah macmillani

F.	16.3.26.39	49.3	23.1	8.7	14.5	13.6	15.1
	Chin Hills, Burma						
M.	20.6.6.14	51.2	25.4	—	16.1	14.2	15.1
	Mokokchung, Naga Hills, Assam						
F.	21.7.8.55	48.1	23.3	9.4	14.1	15.3	15.2
	Duragiri, Garo Hills, Assam ('garonum')						
	circa						
F.	21.1.6.55	48.1	22.8	8.6	15.4	13.1	14.6
	Khonshnong, Jaintia Hills, Assam ('garonum')						

TABLE 23.—*Cranial measurements of the Indian races of Dremomys lokriah (concl'd.)*

	Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Dremomys lokriah macmillani</i> (concl'd.)						
Frost collection—						
M. 231	48.7	23.4	—	15.7	13.7	15.0
Naga Hills, 5,000 ft.						

The type of '*garonum*' has the occipitonasal length 50.5 mm. and of *macmillani*, 49.7 mm.

Note on the supposed races of Dremomys lokriah

The first attempt at a racial distinction in this species was the description of *Dremomys macmillani*, a supposed new species, by Thomas, in 1916. This was supposed to have a black median dorsal stripe, and to be readily distinguishable from *D. lokriah* by 'its dorsal black line, its greyer general colour, the more completely buffy hairs of the underside, and the greater prominence and buffy colour of the postauricular patches' Unfortunately the mid-dorsal stripe seems not constant. And some forms which have been identified as *subflaviventris* tend towards a slightly darkened area on the mid back, transitional towards *macmillani*. It is, however, perfectly true that *macmillani* can be distinguished from *lokriah* and *bhotia* and *subflaviventris* by the colour of its belly, which is, as keyed by Thomas, 'washed with buffy or yellowish', whereas what he called *lokriah* and *bhotia* in that paper had the belly 'washed with rich ochraceous' ('ochraceous orange'). In the paper, which I am now referring to, Thomas split typical *lokriah* into a restricted typical race, 'general colour browner, Nepal and western Sikkim', and a new race, *bhotia*, 'general colour darker and more olivaceous, eastern Sikkim' 'A *Dremomys* resembling *lokriah* in all structural characters, but lacking entirely the suffusion of ochraceous which marks that species.' In the characterization of the new race, it is said that there are two specimens from Manipur, one corresponding with *l. lokriah* and one with *l. bhotia*, and that both types occur at Sedonchen. Personally I find it difficult to distinguish the two types, and when all material for the species is examined, it appears that certain darkish individuals have been called '*bhotia*', and

some have which are lighter coloured as well. I do not believe there is the slightest valid difference between them. A further complication was introduced by Thomas in 1922, when he resuscitated the old name *subflaviventris* Gray (*nom. nud.*), which he dated from Horsfield (1851) *Cat. Mamm. Brit. Mus.*, p. 158. 'Most nearly allied to *bhotia* with which it shares the dark greyish general colour above—but the size is larger, the skull sometimes attaining 54 mm. in length.' (A glance at the table of skull measurements above should show that there is no racial difference here between our Mishmi '*subflaviventris*' and our '*bhotia*'.) Also the 'ochraceous colour of the undersurface is more restricted to the median area' in '*subflaviventris*' which may be true but is in my opinion scarcely a sufficiently important character for any subspecific characters to be based on it. Thomas then proceeded to describe a new race, *D. l. garonum*, near the typical race 'but below instead of the yellowish wash approaching "orange ochraceous" as it does in *lokriah*, *bhotia* and *subflaviventris*, it is far paler and more yellow', seemingly he forgot to compare this with *macmillani*, of which it would appear to be a synonym.

(i) **Dremomys lokriah lokriah** (Hodgson)

Text-fig. 9

1836. *Sciurus lokriah* Hodgson, *J. Asiat. Soc. Beng.*, 5, 232.
 1843. *Sciurus subflaviventris* Gray, *Handlist Mamm. B.M.*, 144, *nom. nud.* See also Thomas, 1922, *J. Bombay nat. Hist. Soc.*, 28, 2, 429.
 1916. *Dremomys lokriah bhotia* Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 3, 418–426.

Vernacular names (from Blanford).—Lokria, *Nepal*; Zhamo, *Bhot.*; Kalli or Kalli ting-dong, *Lepcha*.

Type-locality.—Of *lokriah*, *Nepal*, of *subflaviventris*, *Assam*, and of *bhotia*, *Sedonchen*, *Sikkim*.

Range.—Specimens examined from **NEPAL**: Chandragiri Pass, Hathibun, Satthar, Gorkha; and no exact locality. **SIKKIM**, Lachen, Gangtok, Sukiapohkri, Ringin, Sedonchen and Chuntang. **MISHMI**, Dreyi. **NORTH BURMA**, Adung Valley.

Specimens of the typical race weighed respectively 5½ oz., 6 oz., 7 oz., and 7½ oz. (*Sikkim* or *Mishmi*.) *Mammæ* 6 (*Sedonchen*).

(ii) **Dremomys lokriah macmillani** Thomas *

1916. *Dremomys macmillani* Thomas, *J. Bombay nat. Hist. Soc.*, **24**, 2, 238.

1922. *Dremomys lokriah garonum* Thomas, *J. Bombay nat. Hist. Soc.*, **28**, 2, 430. (Tura, Garo Hills, Assam.)

Type-locality.—Tatkon, West Burma.

Range.—Specimens examined from ASSAM: Mokokchung, Naga Hills; Tura and Duragiri in Garo Hills; Khonshnong in Jaintia Hills; SOUTH KAMRUP, Rajapara; BURMA: Tatkon; Kabaw, 50 miles north-west of Kindat. A skin which is very similar from TIBET, Zayul.

For *macmillani*, weight $5\frac{1}{2}$ oz. (Rajapara), 5.6 oz. (Khonshnong), 6 oz. (and mammae 6), Duragiri; respectively 7 and 8 oz., Chin Hills.

(iii) **Dremomys lokriah pagus** Moore

See Appendix.

Two specimens recently received from Mr. W. J. C. Frost from the Naga Hills, no exact locality, 5,000 ft., both males, differ very markedly from each other in colour of the underparts, one being much brighter on the throat, and the other much paler. One of these has a dark mid-dorsal line, and one has not.

24. **Dremomys rufigenis** (Blanford)

The Red-cheeked Squirrel

1878. *Sciurus rufigenis* Blanford, *J. Asiat. Soc. Beng.*, **47**, 2, 156.

Distribution of species.—Malay States, Siam, Indo-China, BURMA, ASSAM, Yunnan, Szechuan, Hupeh, Kweichow and Hainan.

This species differs rather strikingly from the allies in the red coloration of the underside of the tail, and as it occurs with both allied species in various places, it is reasonable to give it specific rank. The muzzle is relatively longer and the orbit relatively shorter than in *D. lokriah*, as indicated in the key above. As well as the colour of its tail which distinguishes it, this species is inclined to differ in some cranial

* For ecological and other notes on central Manipur specimens, also see Roonwal, M. L., 1949, *Trans. nation. Inst. Sci. India*, Calcutta, **3** (2), pp. 85-86; and 1950, *Rec. Indian Mus.*, Delhi, **47** (1), pp. 18-19.—EDITOR.

details from *D. pernyi*; very generally the toothrow is proportionately longer in this species; and very generally the bullae are proportionately smaller. There are, however, some individual overlaps in various specimens of both species. Most often also the frontals tend to be a little wider proportionately than in *D. pernyi*.

The cheeks are red in colour in the Indian races. This is, however, not the case with the second named race, *D. r. pyrrhomerus* Thomas, from Hupeh, Szechuan, Kweichow, etc., in China, which is extralimital. A host of other subspecies have been named for this species, nearly all of which are so similar to the typical race that they may well be synonyms of it. But it does seem possible to retain one of the Burmese races, *D. r. adamsoni*, on average size of skull. In our specimens for this race, the occipitonasal length is always less than 53 mm. In the other races, including the typical, there are only two adult skulls (one of these not entirely complete) which has the occipitonasal length less than 53 mm. I would doubt whether the other named Indian race, *opimus*, is anything but a synonym of the typical race. It must be admitted that the character for *adamsoni* is based on only five skulls, as against more than 30 skulls for the other races.

External characters.—Tail shorter than head and body. Except for the colour, external characters without peculiarity. Colour of back not very different from *D. lokriah*, general effect speckled dark greenish brown. A pale patch behind the ears, but this is often inconspicuous. Tail above mainly black, but many of the hairs often white tipped. Cheeks (in Indian races) markedly contrasted red, the whiskers black. Chin white; belly and underparts white or grey. Sometimes the whitish area on the underside is extensive, but sometimes it is reduced nearly to a mid-ventral line between the brown of the sides. Whole of underside of tail clearly deep red throughout its length, the red bordered by black mixed white hairs at each side and terminally. The colour of the underside of the tail is constant throughout the species.

External measurements.—As in Table 24, below.

The following notes taken from skins : *adamsoni*, Kalaw; 'Shot on ground; had been eating small wild figs' Pyaung-gaung, weight $6\frac{1}{2}$ oz.; Gokteik, $8\frac{1}{2}$ oz.; Kindat, $8\frac{1}{4}$ oz.; *opimus*, Hkamti, $8\frac{1}{2}$ oz.

Cranial characters.—The skull is much like that of *D. lokriah*, but the rostrum is relatively longer. The occipitonasal length in this species varies between just under 51 mm,

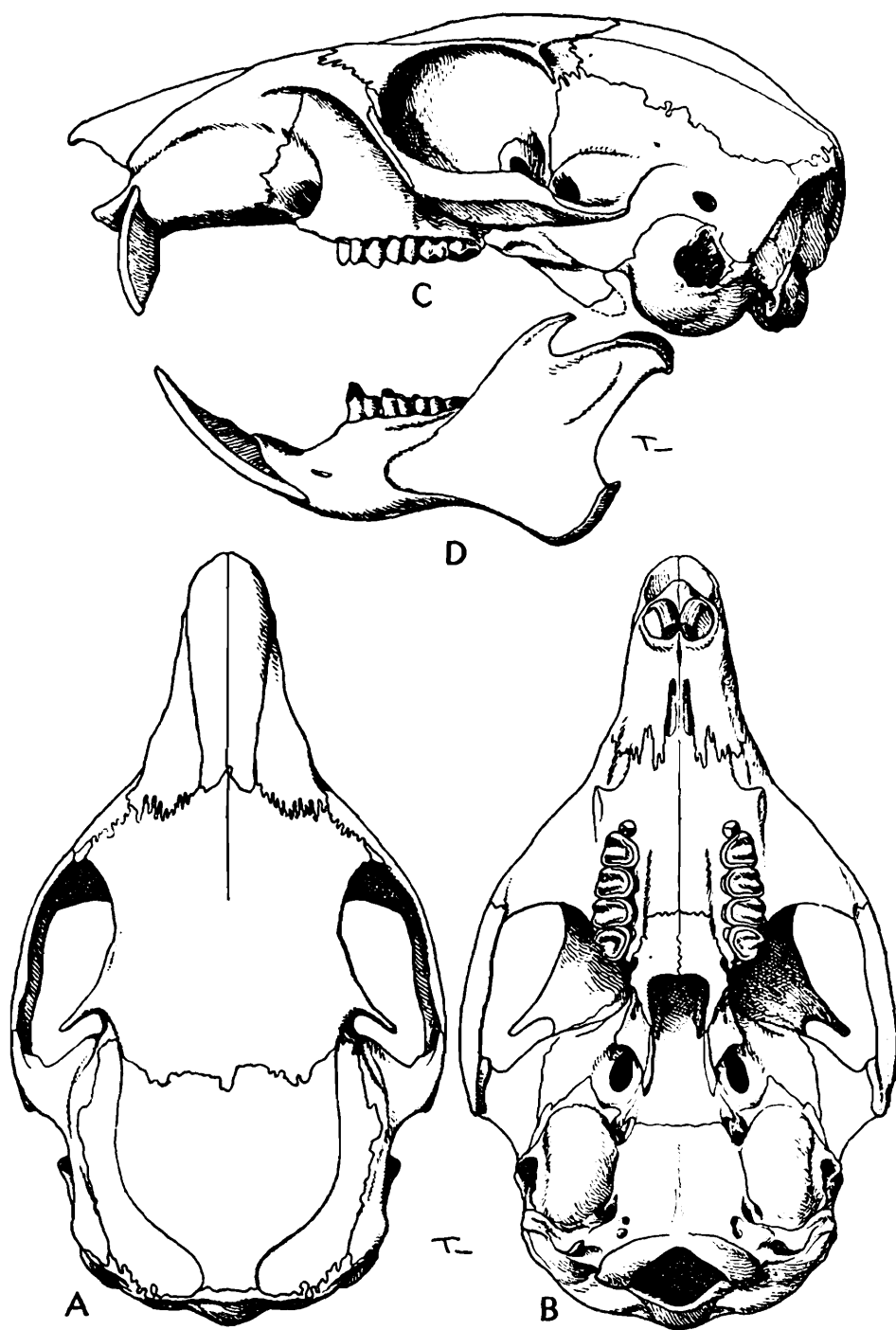
TABLE 24.—*External measurements of the Indian races of Dremomys rufigenis*

	Head and body	Tail	Hind- foot	Ear
<i>Dremomys rufigenis rufigenis</i>				
Skins seen from Mount Mooleyit, Tenasserim, but none of them measured. Many measured skins from various localities in Indo-China, and from Siam. Head and body varies between 175 and 214 mm.; tail between 132 and 180 mm.; hindfoot between 31 and 51 mm.; ear between 18 and 25 mm.				
<i>Dremomys rufigenis rufigenis</i> (' <i>opimus</i> ')				
Hkamti, Burma	202	173	50	22½
Hkamti, type	210	174	50	21

A specimen also from Mokokchung in Naga Hills.

<i>Dremomys rufigenis adamsoni</i>				
F. Kindat, Burma (east side)	192	164	49	20½
M. Kindat	195	163	50	21
M. Kindat (east side)	186	162	47	22
M. Kindat (east side)	188	177	49	21
M. Pyaunggaung, Shan States	203	154	45	21½
F. Pyaunggaung	187	138	46	20
F. Pyaunggaung	206	155	45½	20½
M. Gokteik, Shan States	208	152	46½	22
M. Maymyo, type	200	125	40	21

and 58 mm. It inclines therefore to be slightly larger than *lokriah*. The nasal length exceeds the least interorbital width, with one individual exception in about 37 skulls; in this specimen they are about equal in length. The orbit is proportionately shorter than in *D. lokriah*, and is usually less than 28% of the occipitonasal length. The frontal bones are less than 30% of the occipitonasal length as a rule, and do not exceed that percentage, at least in Indian specimens. I have seen no Indian specimens with the parietal ridges joining, but they come near together in some specimens, and probably do so ultimately. The suture of the frontals and parietals seems less straight than is usual in *lokriah*, but this is perhaps an individual character. The bullae definitely tend to be smaller than in *D. lokriah* and *D. pernyi*. Other cranial characters as described above for *D. lokriah*. Mandible with well developed coronoid process, and similar in formation to that of *D. lokriah*.



TEXT-FIG. 10. *Dremomys rufigenis rufigenis* (Blanford). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 4$).

Dental characters.—Upper incisors narrow, red and usually ungrooved; cheekteeth essentially normal Sciurine in pattern; P. 3 of medium size as usual in the genus.

Cranial measurements.—As in Table 25, below.

Dimensions of the species Dremomys rufigenis, including all available races, in the British Museum material.—The occipito-nasal varies between 50.8 and 58 mm. The toothrow between

TABLE 25.—*Cranial measurements of the Indian races of Dremomys rufigenis*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Dremomys rufigenis rufigenis</i>							
F.	88.12.1.41	53.7	25.9	9.7	17.2	15.8	14.8
	Mount Mooleyit, Tenasserim						
M.	91.10.7.81						
	circa	52.3	25.6	10.1	16.2	15.6	15.8
	Mount Mooleyit (co-type)						

The occiput of this skull is not fully complete. Besides these, I have measurements of fourteen skulls from Siam, Laos, Annam, and Tonkin. In these, the occipitonasal length varies between 52.1 and 57.5 mm. but only once under 53 mm.

Dremomys rufigenis rufigenis ('*opimus*')

M.	15.5.5.197	55.3	—	9.9	17.7	17.0	15.0
	Hkamti, Burma						
M.	20.6.6.12	55.5	26.4	—	19.0	16.5	15.5
	Mokokchung, Naga Hills, Assam						
M.	15.5.5.195	53.4	26.1	10.2	16.7	16.0	15.1
	Hkamti, type						

Dremomys rufigenis adamsoni

F.	14.7.19.157	50.8	24.2	9.2	16.0	14.2	14.0
	Kalaw, Shan States, Burma						
F.	15.5.5.194	52.4	25.7	9.5	17.0	15.6	14.8
	Kindat, Burma (east side Chindwin)						
M.	14.7.8.32	52.7	24.9	9.3	17.3	14.5	14.9
	Pyaunggaung, Shan States						
M.	14.7.8.31	52.4	25.2	8.9	16.8	15.4	14.6
	Gokteik, Shan States						
F.	14.7.8.33	52.1	25.0	9.4	16.4	15.1	14.7
	Pyaunggaung, Shan States						

The type, from Maymyo, Burma, is not fully measurable.

8.9 and 11 mm. The head and body varies between 168 and 227 mm. in apparently adult skins; tail between 113 and 185 mm. Hindfoot 31–51 mm.

Provisional key to Indian races of Dremomys rufigenis

- 1 (2) Occipitonasal length less than 53 mm. *D. r. adamsoni*
- 2 (1) Occipitonasal length normally more than 53 mm. (two exceptions in over 30 skulls, one of these with occiput incomplete) *D. r. rufigenis*

Races.—As noted above, the Indian race *adamsoni* may be retained on the average smaller size of the skull, when compared with all other skulls of races represented in the British Museum. The third Indian race, *opimus*, was only compared with *adamsoni* by its describer. Wroughton, in his key to the Mammal Summary for India, states that the tail hairs are 'markedly tipped white' in *opimus*, and 'not markedly whitened' in *rufigenis*. This is true if *rufigenis* is restricted to two co-types from Mount Mooleyit, Tenasserim; but numerous Indo-Chinese and Siamese specimens of *rufigenis* have the tail as in *opimus*, and in *D. lokriah* either character may be present individually. Personally I do not believe that *laomache*, *belfieldi*, *ornatus* or *opimus* are based on characters which are anything other than individual. I can find no cranial distinctions between any of them, and very little if any external distinctions now that a large series for the typical race is available. I would regard them all as synonyms of one widely ranging race.

(i) **Dremomys rufigenis rufigenis** (Blanford)

Text-fig. 10

1878. *Sciurus rufigenis* Blanford, *J. Asiat. Soc. Bengal*, **47**, 2, 156.

1916. *Dremomys rufigenis opimus* Thomas, *J. Bombay nat. Hist. Soc.*, **24**, 2, 237. (Hkamti, Upper Chindwin, Burma.)

Type-locality.—Mount Mooleyit, Tenasserim.

Range.—Specimens seen from TENASSERIM, Mount Mooleyit; BURMA: Hkamti; ASSAM: Mokokchung, Naga Hills. Also ANNAM, Djiring, Dakto, Thua-lua, Col-des-nuages; TONKIN, Backan, Tamdao, Kontoum, Baoha, LAOS, Nape, Xiengkhouang. SIAM: Chiangmai, Doi Sritepe, Metaw Forest, Raheng.

(ii) **Dremomys rufigenis adamsoni** Thomas

1914. *Dremomys rufigenis adamsoni* Thomas, *J. Bombay nat. Hist. Soc.*, **23**, 1, 25.

Type-locality.—Maymyo, Burma.

Range.—Specimens seen from BURMA: Maymyo, Kalaw, Gokteik and Pyaunggaung in Shan States, and Kindat (east side of Chindwin).

25. **Dremomys pernyi** (Milne-Edwards)

Perny's Squirrel

1867. *Sciurus pernyi* Milne-Edwards, *Rev. Mag. Zool.*, 230, pl. 19.

Type-locality.—Szechuan, China.

Distribution.—In China, from the states of Szechuan, Hupeh, Yunnan, Fukien, Chekiang, Anhwei, Kweichow, also Formosa. ASSAM, MANIPUR, and Western and Northern BURMA.

This species, which is the second to be named in the genus, is less common in Indian territory than its two allies. From *D. lokriah* it differs in its longer snout, and proportionately shorter orbit; from *D. rufigenis* it differs in having the lower side of the tail not red, the cheeks not red, and generally, but not always, by its proportionately shorter toothrow, narrower frontals, and larger bullae. There are many named sub-species. Most of them are based on very trivial supposed colour characters. There is no question that the form from Formosa, *D. p. owstoni*, is a valid race, or it is often given specific rank; it is the second name in the species as here understood, and is characterized by its yellow belly (the underparts grey or white in the other races) and its large size, the occipitonasal length 53.4 mm. at least in our material. One other race, from North Burma, stands right apart from all other material available to me on its large size; this is *D. p. imus*, one of the last to be named; and its occipitonasal length is 55.3–57.2 mm.; in our material 53.7 mm. seems to be the highest measurement for any of the remaining races and this out of thirty-three skulls representing about ten supposed races. The other named forms I regard as synonyms of the typical race.

External characters.—Without special peculiarity. In India, this species is at once distinguished from *lokriah* by its lack of yellow or orange underparts, and from *rufigenis* by its lack of red coloration on lower surface of tail and lack of red cheeks. Colour of back about as in the related species. Underparts greyish or whitish grey. Sometimes the genital regions are dark reddish in colour. Cheeks about the same colour as head; underside of tail tends to be yellowish or brownish in middle, the sides with black mixed white hairs.

As already noted, the North Burmese race, *imus*, is retainable on its unusually large skull. The other named Indian race, *mentosus*, is very little known and, like most so-called races of this species, is poorly characterized. Thomas, 1922, gave a key to his races of *pernyi*, and said that *mentosus* was like the race *D. p. howelli* (1922, *Ann. Mag. nat. Hist.*, 10,

401), from Ma-Chang-Kai, about 25 miles SW of Tengueh, Yunnan, which is near the Burmese border, but was smaller in size and with shorter toothrow. I have, however, specimens of *howelli* which have the toothrow as short as *mentosus*, and the toothrow of the type of the latter is not proportionately shorter than in *howelli*. It is my belief that '*howelli*', '*mentosus*' and the other named races from China cannot be separated from the typical race.

External measurements.—As in Table 26, below.

TABLE 26.—*External measurements of the Indian races of Dremomys pernyi*

	Head and body	Tail	Hind- foot	Ear
<i>Dremomys pernyi pernyi</i>				
F. Naga Hills, Assam	183	130	40	22
F. 6 miles west of Kindat, Burma type of ' <i>mentosus</i> '	184	111	42	22½
Frost Collections—				
M. 305 Naga Hills, 5,000 ft.	190	150	45	25
M. 306 Naga Hills	195	148	43	25
M. 304 Naga Hills	195	150	43	25

Unmeasured skins from Manipur, and Mokokchung (Naga Hills), also examined.

Dremomys pernyi imus

F. Adung Valley, Upper Burma	210	150	48	24
M. Adung Valley	205	165	47	25

The type, from west flank, Mount Imaw Bum, Burma, has also been examined.

Cranial characters.—This species has the rostrum long, but is much like *rufigenis* cranially with certain minor exceptions. In size the occipitonasal length varies between 48 and 57 mm., and the largest skulls are from North Burma. The nasal length exceeds the least interorbital width with one exception in about forty-one skulls measured. The orbit is relatively short, averaging less than 28% of the occipitonasal length for all races. On one Indian skull the parietal ridges are almost joined. The frontal width always appears less than 30% of the occipitonasal in this species. The bullae as a rule tend to be slightly larger than in *D. rufigenis*. Other

TABLE 27.—*Cranial measurements of the Indian races of Dremomys pernyi (concl'd.)*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Dremomys pernyi pernyi</i>							
F.	16.3.26.40	50.7	—	circa 8.3	16.1	13.7	13.8
	Chin Hills, Manipur, type of ' <i>mentosus</i> '						
M.	20.6.6.11	53.7	24.5	8.2	17.4	13.7	14.0
	Mokokchung, Naga Hills, Assam						
Frost Collections—						circa	
M.	305	50.9	23.2	8.6	16.5	13.3	13.2
	Naga Hills						
M.	306	53.7	24.3	8.2	—	14.7	13.4
	Naga Hills. Old						
M.	304	50.6	23.2	8.6	16.2	13.6	13.0
	Naga Hills						

Dimensions of the species Dremomys pernyi, including all races, as indicated in British Museum material.—The occipito-nasal length varies between 48 and 57.2 mm. The toothrow between 7.8 and 9.6 mm. The head and body varies between 142 and 220 mm. The tail between 85 (rarely under 100 mm.) and 180 mm. Hindfoot 37–49 mm.

Key to the races of Dremomys pernyi in India

- 1 (2) Occipitonasal length not under 55.3 mm. (55.3–57.2 mm.). *D. p. imus*
- 2 (1) Occipitonasal length not exceeding 53.7 mm.. . . . *D. p. pernyi*

(i) **Dremomys pernyi pernyi** (Milne-Edwards)

Text-fig. 11

1867. *Sciurus pernyi* Milne-Edwards, *Rev. Mag. Zool.*, 230, pl. 19.
 1922. *Dremomys pernyi mentosus* Thomas, *Ann. Mag. nat. Hist.*, 10, 401.

Type-locality.—Szechuan, China. Of *mentosus*, 6 miles west of Kindat, 6,000 ft.

Range.—Specimens examined from ASSAM: Mokokchung, 12 miles SE. of Kohima, and no exact locality 5,000 ft., all in Naga Hills; MANIPUR: BURMA, 6 miles west of Kindat. YUNNAN, Tsekow, Mekong Valley, Mekong-Yangtse Divide, Mekong-Salween Divide, and SZECHUAN, Nagchuka, Shoo-o-so, Yachow.

(ii) **Dremomys pernyi imus** Thomas

1922. *Dremomys pernyi imus* Thomas, *Ann. Mag. nat. Hist.*, **10**, 402.

Type-locality.—Mount Imaw Bum, west flank 7,000 ft. (lat. 26°10' N., long. 98°30' E.).

Range.—Specimens seen from BURMA: Adung Valley, Mt. Imaw Bum.

Genus 8. **Funambulus** Lesson

1835. *Funambulus* Lesson, *Illustr. Zool.*, **15**, pl. 43, 2 pp., text.

1923. *Tamiodes* Pocock, *Proc. zool. Soc. Lond.*, 215. *Sciurus tristriatus* Waterhouse.

Type-species.—*Funambulus indicus* Lesson = *Sciurus palmarum* Linnaeus.

Range.—Ceylon, and Peninsula of India, northwards to Baluchistan, the Punjab, and Nepal Terai. South-eastern Persia.

This genus contains the Indian Striped Palm-Squirrels, and it is not an easy one to define. The coronoid process of the mandible is constantly low and reduced, and this is about the only cranial character which seems to divide *Funambulus* from related genera. That it is a natural group I do not doubt, but it is not well characterized. There is a tendency towards narrowing of the frontal bones, but it is not a constant character in the different species, and in one little known species, *F. layardi*, it seems absent. The baculum apparently differs from both *Sciurus* and *Callosciurus*. It is, according to Pocock, a simple bone, without the accessory blade which is found in the eastern genera, such as *Callosciurus*. Pocock divided this genus into two on the structure of the baculum, which he stated differed in *F. tristriatus* from *F. palmarum*. Considerable confusion has been the result of this split, and it becomes clear that it is highly undesirable to form generic names based solely on this character. According to Osman Hill, for instance, (1936) the Ceylon race of *F. palmarum* agrees more with '*Tamiodes*' (*tristriatus*) in its penial characters; *sublineatus* again is quite distinct from either, while *layardi*, which seems cranially the most distinct of the species, agrees more with mainland *F. palmarum* (= restricted *Funambulus* of Pocock). The significance of these details is not well understood at the present day, and calls for further examination of more races.

The genus may be defined as relatively small squirrels, with the baculum lacking the accessory blade of *Callosciurus*

and allies (so far as known), the back clearly striped, the coronoid process of the mandible low and reduced, and a tendency (except in *F. layardi*) for the frontal bones to be narrowed. There are 5 upper cheekteeth, and the dentition is not abnormal. As a general rule the width across the postorbital processes is considerably less than half the occipitonasal length. (*F. layardi* may be an exception, but our material for that species is so poor that one can do little with it.)

Blanford placed this genus in *Sciurus* (as he did all the other genera of non-flying squirrels except *Marmota*, and recognized four species: *F. palmarum*, of Linnaeus (1766), a small species with light underparts and bright stripes on the back, the frontal bones narrowed; *F. tristriatus*, Waterhouse, 1837, essentially like the last but occurring with it extensively and always averaging larger; *F. sublineatus*, Waterhouse, 1838, which is a small species with drab, dull underparts, dull stripes on the back, and the frontal bones rather less narrowed, and *F. layardi*, Blyth, 1849, a little known species which has red underparts, moderately well marked stripes (the middle one much brighter than the outer pair), and in which apparently the frontal bones are not narrowed. Besides these, Wroughton in 1905 separated from *palmarum* the northern species which is like *palmarum* but with an extra light stripe each side, and with no reddish middle line on the underside of the tail. This species, *F. pennanti*, occurs with *palmarum* in some places, and it seems necessary to give it specific rank.

This genus is practically confined to Indian territory, but recently *F. pennanti* has been collected in south-eastern Persia.

In 1923 Pocock examined the penial characters of two species, *Funambulus palmarum* and *F. tristriatus*, and erected a new genus for the latter, '*Tamiodes*', on the results obtained. He keyed the two types as follows:—

'Glans penis ending distally in a narrow elongated point supported by the distal portion of the baculum, the orifice on the right side near the base of the slender portion and remote from the tip of the glans. Baculum a simple upcurved attenuated rod. *Funambulus* (restricted to *palmarum*).

Glans penis thick, blunted, and bilabiate distally, the orifice terminal between the upper and lower lips, the lower lip secondarily subdivided. Baculum with its terminal portion bent vertically upwards and curved forwards with a prominent inferior angle.

'*Tamiodes*' ('*tristriatus*').

I quote further from Osman Hill (1936): 'The Striped squirrels form a very difficult problem. According to

Pocock's definitions, the Ceylon race of *palmarum* would fall into the genus *Tamiodes*, whilst *layardi*, with its conical appendage on the tip of its glans, would fall into *Funambulus*. Probably *sublineatus* on the characters of its glans would fall between the two though on its baculum it would require a new genus. It seems almost absurd that different geographical races of what would otherwise be regarded as one and the same species should on their penial characters require separate genera, though theoretically one is bound to admit that this is the correct procedure. Until more species have been examined. I consider that it is best to retain *Funambulus* for all these striped squirrels, despite their penial differences'

Key to the species of Funambulus

1 (2) The colour of the underparts is deep red. The back has the mid-dorsal pale stripe much brighter than the outer pale stripes. The width of the frontal bones (= least inter-orbital measurement) approximates to or exceeds 13 mm. (Occipitonasal less than 40 mm.).	<i>Funambulus layardi</i>
2 (1) The colour of the underparts is never deep red. Normally the mid-dorsal pale stripe of the back is not much brighter than the outer pale stripes. The width of the frontal bones in skulls of similar size is normally under 13 mm., only reaching this measurement in large races of <i>F. tristriatus</i> in which the occipitonasal length usually exceeds 43 mm. (Owing to the fragmentary nature of the material available for <i>layardi</i>, it is not possible to give more exact distinguishing characters than those above).....	3
3 (4) The length of the orbit is normally less than 10 mm. The colour of the underparts is drab and dull. All the stripes of the back tend to be faint or indistinct. A small species, the occipitonasal length does not exceed 36.9 mm., and is usually less than this measurement.	<i>Funambulus sublineatus</i>
4 (3) The length of the orbit exceeds 10 mm. The colour of the underparts is usually whitish or light. The stripes of the back are clear and contrasted and well marked.	5
5 (8) The occipitonasal length of the skull is usually less than 40 mm. (about	

- 14 exceptions in 185 skulls); the length of the palate, measured from the front of the incisors to the back of the palate, is normally less than half the occipitonasal length, and normally less than 20 mm. (to the last figure, about 9 exceptions in 185 skulls) 6
- 6 (7) Back usually with five light stripes. The underside of the tail without a red line running down its centre *Funambulus pennanti*
- 7 (6) Back usually with three light stripes. The underside of the tail has a red or reddish line running down its centre for a greater or lesser extent. *Funambulus palmarum*
- 8 (5) The occipitonasal length of the skull is normally over 40 mm. The length of the palate approximates to or exceeds 20 mm., and is usually more than half the occipitonasal length. *Funambulus tristriatus*

26. *Funambulus layardi* (Blyth)

Layard's Striped Squirrel

1849. *Sciurus layardi* Blyth, *J. Asiat. Soc. Beng.*, 18, 602.

Distribution.—Ceylon, and the Western Ghats in South India.

For some reason, this species seems rare in collections, and our material is far from satisfactory for it. This rarity is very different from the status of the other species of this genus, two of which, *palmarum* and *pennanti*, are easily the commonest squirrels in India as far as British Museum material is concerned.

The present species differs from allies in having the colour of the underparts deep red; also in having the mid-dorsal pale stripe markedly brighter than the two outer pale stripes; also apparently in the skull, which, so far as I can tell from material examined, seems much less narrowed as far as the frontal and postorbital width is concerned. Thus the frontals are as wide as is in the largest skulls of *F. tristriatus*, the largest species of the genus, and the width across the postorbital processes is nearly half the occipitonasal length in the one measurable skull. Apart from the reduced coronoid process to the mandible, it is not very easy to distinguish this species cranially from larger species and races of the subgenus *Tamiops* of *Callosciurus* (i.e. *C. swinhoei* and allied forms). As far as I can see, the orbit seems a little shorter here than in *swinhoei*, and perhaps the nasals are a little

longer than is usual in that species, but the material seen for the present species is so scanty and poor that it is not possible even to be sure about these characters. Nevertheless one gets the impression that this species is very distinct from the other species of the present genus.

External characters.—Without special peculiarity. Fourth finger dominant in the manus, as usual. The tail is shorter than head and body in the type of '*signatus*'

Colour.—Above dark brown; hands and feet dark; a well marked bright yellow mid-dorsal stripe present; on either side of this are two quite wide blackish bands, which are in turn bordered by two pale narrow yellowish stripes. The tail above is black, the hairs mixed with some yellowish or whitish tips. Underparts deep red throughout, quite different from the other species of this genus. Tail apparently with a reddish central line running through most of its length. The supposed race *F. l. 'signatus'* was named by Thomas because its 'light median dorsal line, instead of being narrow (about 3 mm.) and pale buffy, is broader (nearly 5 mm.) and of a rich ochraceous or flame-colour' This is true in two skins (out of five) examined for this species, but in my opinion it is altogether premature to attempt to divide this species into races based on our extremely scanty material. We do not know if this supposed character is valid or seasonal. One of the '*signatus*' skins was collected January, another, true *layardi*, was taken in August. The remainder are undated. I am not prepared to regard '*signatus*' as a valid race in the present state of our knowledge. One of the skins noted as being 'Shot—in heavy jungle'

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Funambulus layardi</i> (' <i>signatus</i> ')				
M. Ratnapura district, Ceylon	155	145	33½	14 (February)
SE. of Ratnapura	168	?	?	?

Other skins from Mousekande, Ceylon, and no exact locality.

Cranial characters.—Unfortunately all skulls but one for this species are in fragments and not fully measurable, and the one measurable one, a type, has the frontal width not measurable. The width across the postorbital processes for that skull is nearly half the occipitonasal length, relatively much wider than in the other species as far as I have examined them. This species seems to have a wider skull than in the

allies, at least as far as the frontal width is concerned. Apart from this there seem to be no very special peculiarities. The coronoid process of the mandible is low and reduced in the few jaws available. The nasals in the adult seem to be longer than those of *Callosciurus (Tamiops) swinhoei*, but apart from that and the reduced coronoid process, it is a little difficult to distinguish them on the material available.

Dental characters.—Upper incisors yellow, narrow, and plain. Five upper cheekteeth; the pattern apparently without peculiarity. Lower molars basinshaped, and of normal Sciurine type.

Cranial measurements.—

	Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus layardi</i> 'signatus' = <i>layardi</i>						
M. 15.3.1.73	39.3	19.1	7.2	11.7	—	10.7
Ratnapura district, Ceylon, type						

A few other broken skulls have the frontals width not less than 13 mm., usually more.

Dimensions of the species Funambulus layardi, in British Museum material.—Occipitonasal, as above, 39.3 mm., and toothrow 7.2 mm. (another skull has the toothrow about 8.1 mm.). Head and body 168 mm. in one skin, 155 mm. in another. Tail 145 mm., hindfoot 33½ mm. in one measured skin available.

(i) *Funambulus layardi layardi* (Blyth)

1849. *Sciurus layardi* Blyth, *J. Asiat. Soc. Beng.*, 18, 602.

1924. *Funambulus layardi signatus* Thomas, *Ann. Mag. nat. Hist.*, 13, 241. Ratnapura, Ceylon. (For discussion of status, see above.)

Type-locality.—Ambegamoa Hills, Ceylon.

Range.—Specimens examined from CEYLON: Mousekande; Rasagalla; Ratnapur, and SE. of Ratnapura.

I have not seen the subspecies described as *Funambulus layardi dravidianus** by Robinson (1917), from the west side of the Western Ghats, Travancore.

The species was based on an immature skin and skull, and it is said that it 'differs from the type in having the top of head and cheeks rich rufous orange and the undersurface

**Funambulus layardi dravidianus* Robinson, 1917, *Rec. Ind. Mus.*, 13, 42.

yellowish orange instead of dull chestnut. Area between the light bands on back deep lustrous black' Based on a single immature specimen, this name seems of value merely in drawing attention to the fact that *F. layardi* occurs on the mainland of India as well as in Ceylon.

27. *Funambulus sublineatus* (Waterhouse)

The Dusky Striped Squirrel

1838. *Sciurus sublineatus* Waterhouse, *Proc. zool. Soc. Lond.*, 19.

Distribution.—Ceylon and South India.

A small species, differing from its allies in the fact that all the stripes of the back tend to be dull and indistinct. The colour of the underparts is drab and dull. The orbit is proportionately rather shorter than in allied species (*layardi* excepted) and is usually actually shorter. Only in one skull I have examined does this length reach 10 mm., whereas it exceeds 10 mm. in the allied species. The frontals are usually, but not invariably, proportionately a little wider than in *palmarum*, *pennanti* and *tristriatus*. The occipito-nasal length of the skull is usually less than 36 mm. This species is very easily distinguished by its combination of dull belly, faint or indistinct stripes, rather short orbit, widish frontals, and small skull.

External characters.—This is a small dark rather soft-furred squirrel with rather narrow tail, which averages a little longer than head and body in the typical race, a little shorter than this length in the Ceylon race. The hand is as usual, with four fingers, of which D. 4 is the longest; the foot has five toes, and is not peculiar in form.

Colour.—(The skins examined were collected, for the typical race in February, April, May, June and July, and for *F. s. obscurus*, in February and April). Colour dark brown, the hands and feet dark. The middle of the back, in the typical race, has four indistinct dark stripes separating three rather indistinct paler ones, these stripes all close together, and rather short. Roughly the same pattern is present in the Ceylon race, which perhaps averages darker above, but there is more distance between the pale stripes, caused by the dark bands or stripes being markedly wider than in the typical race. Tail with alternating rings of orange or whitish and black. Underparts drab dull brownish, often little lighter than the back, or rarely more greyish, but dull. Colour of tail below as in its upperpart.

External measurements.—As in Table 28, below.

TABLE 28.—*External measurements of the Indian races of Funambulus sublineatus*

	Head and body	Tail	Hind- foot	Ear
<i>Funambulus sublineatus sublineatus</i>				
Kuttyani, Travancore	130	135	25	?
Kuttyani	120	120	25	?
Kuttyani	125	120	25	?
Kuttyani	120	120	19	?
Poumudi, Travancore	114	128	25	?
Tigershola	112	119	26	12
M. Bombay Shola, Kcdaikanal	112	116	27	14
M. Huvinakadu Estate, Kutta, Coorg	120	117	30	14
Kil Kotagiri, Nilgiris	110	120	28	13
F. Travancore	114	109	22	9
Travancore	112	106	21	9

Other skins from Benhope, Shernelly, Cochin, Madras, Coonoor, Wynaad, and High Range, Trivandrum. Also co-types of '*delesserti*', from the Nilgiris.

Funambulus sublineatus obscurus

M. West Haputale, Ceylon	122	94	25	12
M. West Haputale	119	100	29	14
M. West Haputale	110	96	27	11
Pattipola, Ceylon	116	118	30	15
M. Pattipola	112	111	28½	16
Kottawa, Ceylon, type of ' <i>kathleenae</i> '	125	122	21	13

Notes from skins.—Travancore; 'shot in bamboo-jungle, common' Kutta, Coorg; 'weight 1½ oz.' Kuttyani; 'shot in isolated hill 12 miles north of Trivandrum. Very common' *F. s. obscurus*; West Haputale, Ceylon; 'jungle, fairly common' Pattipola; 'shot in the jungle very shy'

Cranial characters.—The skull is small, not reaching 37 mm. in occipitonasal length. The frontals are rather wide for a member of the present genus, though probably less wide than in *layardi*; their least width normally exceeds the length of the nasals. Suture of frontals and parietals practically straight; parietals unridged in the series seen, and there is in younger specimens a well marked and wide interparietal. Occiput weak. Palate normally less than half the occipitonasal length; palatal foramina very short, situated considerably in front of the toothrows. Pterygoid fossae of moderate depth; bullae rather small. The orbit appears to be proportionately shorter than in the allied species, perhaps excepting

layardi. The postorbital process is short and weak. Zygomatic plate well tilted upwards; zygoma normal. Mandible with the coronoid process low and reduced, the condylar process long and rather prominent, the angular showing signs of inflection.

Dental characters.—Upper incisors narrow, yellow and plain. Five upper cheekteeth; their pattern about as usual, rather simple in tendency, with the customary reduction of elements in M. 3, and with P. 3 of medium development but considerably smaller than the other upper teeth. Lower molars basinshaped and essentially normal.

Cranial measurements.—As in Table 29, below.

TABLE 29.—*Cranial measurements of the Indian races of Funambulus sublineatus*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Funambulus sublineatus sublineatus</i>							
M.	13.8.22.51	34.6	15.3	6.3	9.1	11.4	9.4
	South Coorg						
M.	19.6.2.37	34.7	16.3	6.0	10.2	11.2	9.7
	Kotagiri, Nilgiris						
	95.10.9.20	33.5	15.5	6.1	9.3	10.8	9.3
	Kuttyani, Travancore						
	95.10.9.22	33.0	15.0	6.1	9.8	10.2	9.3
	Kuttyani						
	95.10.9.23	34.5	15.8	6.1	10.2	—	9.7
	Kuttyani						
	95.10.9.24	35.4	16.4	5.8	10.6	10.4	9.5
	Kuttyani						
	95.10.9.25	34.5	16.4	6.5	9.4	10.7	9.4
	Poumudi, Travancore						
<i>Funambulus sublineatus obscurus</i>							
M.	15.3.1.74	circa 33.4	16.1	6.1	9.2	circa 10.6	9.3
	Pattipola, Ceylon						
M.	15.7.1.1	circa 36.9	18.1	circa 7.1	10.4	10.8	10.2
	Kottawa, Ceylon, type of ' <i>kathleenae</i> '						

Dimensions of the species Funambulus sublineatus, in British Museum material.—The occipitonasal length varies between 33.0 and 36.7 mm. The toothrow between 5.8 and 7.1 mm. The head and body varies between 110 and 130 mm. Tail between 94 and 135 mm. Hindfoot 19–30 mm.

Key to the races of Funambulus sublineatus

- 1 (2) The median dark stripes narrower,
so that the pale stripes of the back
are closer together. Tail often as
long as head and body . *F. s. sublineatus*
- 2 (1) The median dark stripes wider, so
that the pale stripes are placed
further apart. Tail usually shorter
than head and body *F. s. obscurus*

(i) **Funambulus sublineatus sublineatus**
(Waterhouse)

1838. *Sciurus sublineatus* Waterhouse, *Proc. zool. Soc. Lond.*, 19.
1841. *Sciurus delesserti* Gervais, *L'Institut*, 171. (Nilgiri Hills.)
1852. *Sciurus trilineatus* Kelaart, *Prodr. Faun. Zeylan*, 54. (For
status see Thomas and Wroughton, 1915, *J. Bombay nat. Hist. Soc.*, 24, 38.)

Type-locality.—Nilgiri Hills.

Range.—Specimens examined from SOUTH INDIA: Kutta, Coorg. Kotagiri in Nilgiri Hills; Kodai-kanal; Tigershola; Coonoor. Shernelly, Cochin; Benhope, Wynaad, Trivandrum, Kuttyani, Poumudi, Travancore, Madras.

(ii) **Funambulus sublineatus obscurus**
(Pelzeln and Kohl)

1886. *Sciurus palmarum* var. *obscura* Pelzeln and Kohl, *Verh. zool. Bot. Ges. Wien.*, 35, 525.
1915. *Funambulus kathleenae* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 1, 38. (Kottawa, Southern Province, Ceylon.)

Type-locality.—‘Uplands of Ceylon’

Range.—Specimens seen from CEYLON: West Haputale, Ohiya; Pattipola; Kottawa.

28. **Funambulus tristriatus** (Waterhouse)

The Jungle Striped Squirrel

1837. *Sciurus tristriatus* Waterhouse, *Charlesworth's Mag. nat. Hist.*, 1, 496–499.

Distribution.—Peninsular India.

This is the largest species of the genus. The occipitonasal length of the skull is normally more than 40 mm., and the

length of the palate approximates to 20 mm. at least, and is usually more than half the occipitonasal length. There are clear light stripes on the back, three in number, and the underparts are light or whitish. The parietal ridges of the skull in old individuals unite and fuse to form a sagittal crest. Blanford was inclined to think that the present species might be united with *F. palmarum*, as he seemed to think the latter was a semi-domesticated variety, but the cranial peculiarities of this species undoubtedly entitle it to specific rank, and on the characters of its baculum, Pocock placed it in a different genus from *palmarum*. This is not acceptable, and the baculum is now known to vary considerably within the present genus.

External characters.—As a rule large for the present genus; the tail most often is shorter than the head and body; hands and feet without special peculiarity; fourth finger usually dominant in the hand. Six plantar pads are clear on one skin, one of which, the outer posterior one, is small and reduced.

Colour.—There appears to be a seasonal change in this species. Skins taken in the summer months are mostly much more vividly striped than skins taken in the winter months, though there are individual exceptions. (Material for *tristriatus* taken in January, February, April, May, October, November, December; for *numarius* in January, April, May, June, November, December; for *wroughtoni* in January, February, May, June, December; and for *thomasi* in February and April.) In duller skins, the back above is mostly greyish; there are three narrow white or pale buff stripes on the back, rather widely separated from each other, separated by two wide brown or black bands, and on either side of the outer pale stripes there is a narrow dark band. In what I take to be the summer pelage, all these dark bands tend to be black. The head is to a greater or lesser extent reddish or reddish brown above, but very much more so in the summer skins, and this colour may be lost in some of the paler skins. Tail above a mixture of reddish or yellowish, white and black; often only the black and white colour evident. Feet usually dark. Underparts whitish or grey, at least in part, sometimes the colour of the sides encroaches on to the light median parts, but the general effect seems almost always to be light, at least as compared with *sublineatus*. Underside of the tail with a long deep reddish central portion throughout most of its length, the hairs on either side of this mixed black and white. Inguinal regions most often reddish.

External measurements.—As in Table 30, below.

TABLE 30.—*External measurements of the Indian races of Funambulus tristriatus*

	Head and body	Tail	Hind- foot	Ear
<i>Funambulus tristriatus tristriatus</i>				
M. Bonaccord, Travancore	155	137	40	?
Poumudi, Travancore	178	?	38	?
M. Poumudi	180	160	45	?
F. Travancore	175	144	30	16
F. Travancoré	174	140	30	17
M. Travancore	200	146	34	17
F. Travancore	140	136	42	16
M. Travancore	179	140	30	17
F. Travancore	178	141	31	17
M. Kuttyani, Travancore	210	168	38	?
<i>Funambulus tristriatus tristriatus</i> ('numarius')				
M. Potoli, Kanara	159	143	40	17
M. Gersoppa, Kanara	174	147	40	16
M. Potoli, Kanara	150	136	38	16
F. Potoli	163	149	40	17
F. Potoli	158	134	38	16½
F. Helwak, Satara	145	135	29	16
F. Helwak	150	127	26	16
M. Helwak	150	149	31	15
H. Helwak	154	124	32	18
M. Helwak	145	141	29	15
F. Helwak	152	129	31	16
F. Helwak	147	154	32	18
F. Helwak	153	129	31	16
F. Khed, Ratnagiri	147	135	36	15
M. Khed, Ratnagiri	140	157	36	15
M. Near Sirsi, Kanara	170	175	41	18½
F. Sirsi, Kanara	163	148	40	16
F. Devikop, Mahratta	158	147	40	17
M. Kardibetta Forest, Mysore	157	155	41	18
M. Gersoppa, Kanara	152	?	40	16½
Sagar, Mysore	170	?	39	17
M. Helwak, type	155	135	52	15
<i>Funambulus tristriatus tristriatus</i> ('thomasi')				
M. Khandalla (Young)	120	128	39	16
F. Khandalla	142	148	38	13
			Mammae 2 pairs	
F. Khandalla	145	150	38	14
M. Khandalla	140	120	37	13
F. Khandalla, type	147	130	35	15

TABLE 30.—*External measurements of the Indian races of Funambulus tristriatus (concl'd.)*

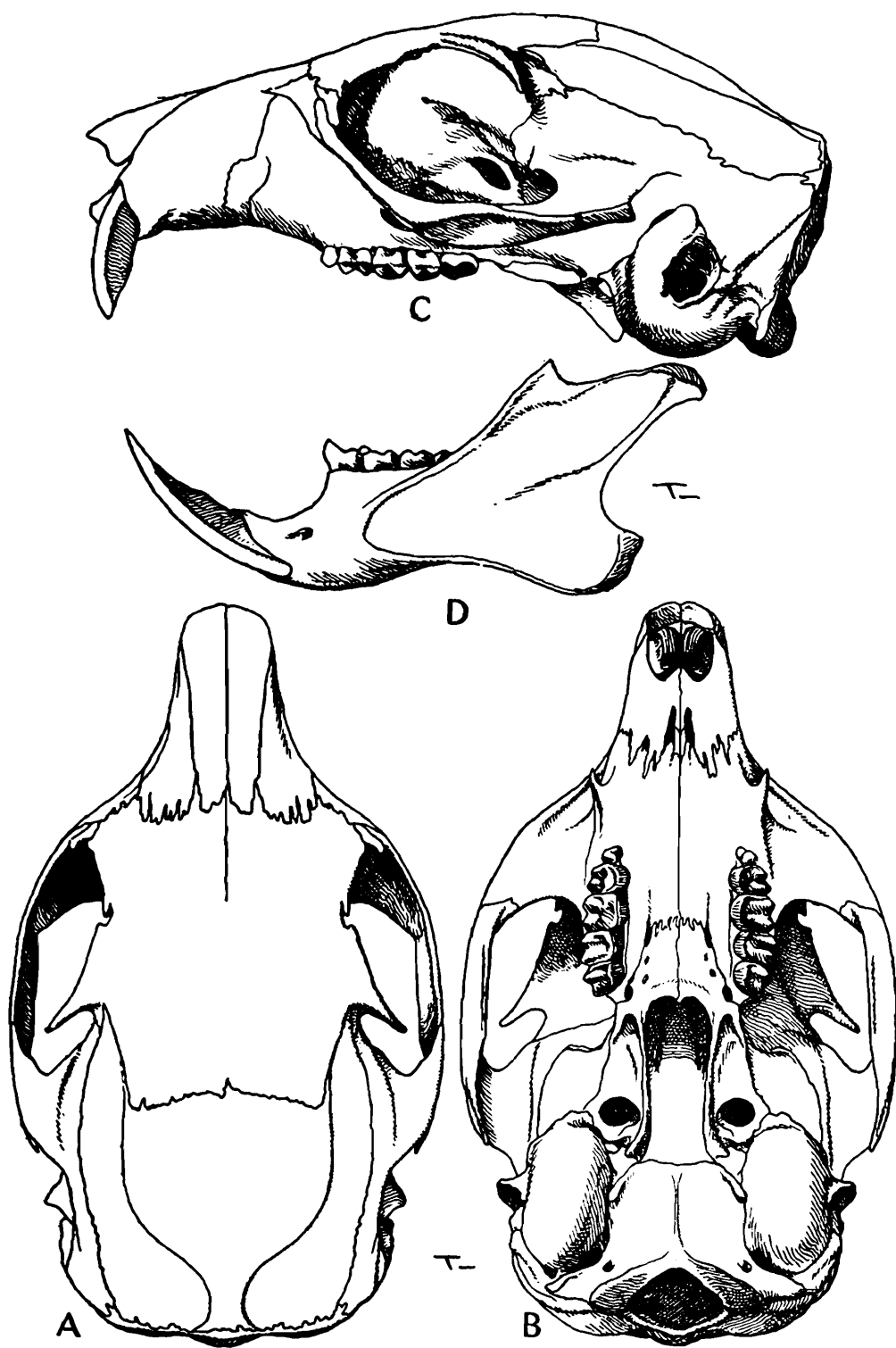
	Head and body	Tail	Hind- foot	Ear
<i>Funambulus tristriatus wroughtoni</i>				
F. Wotekolli, Coorg	188	154	44	18
F. Virajpet, Coorg	197	148	44	17½
M. Virajpet	197	157	43	18
F. Virajpet	192	154	41	17½
Makut, Coorg	196	181	45	18
M. Makut	180	160	44	17
M. Srimangala, Coorg	194	—	46	18
F. Srimangala, type	195	172	46	18

Other specimens from Cotengady Estate, Cochin, and for *F. t. tristriatus*, from Wynaad and Madras, no exact locality.

Notes from skins.—*F. t. wroughtoni*.—Kotengady Estate, Cochin; 'Trapped in coffee' 'Trapped near a Jack tree in coffee on the edge of the jungle' Shernelly, Cochin; 'Shot in jungle'

F. t. tristriatus, etc.—Helwak, 'weight 4½ oz.', also 4¼ oz., 4¾ oz. Gersoppa, Kanara; weight 5½ oz. Kuttayani, 'Shot in an isolated hill 12 miles north of Trivandrum, very common' Travancore, 4,000 ft. 'Shot in jungle, not common' Potoli, Kanara; 'Thick forest, some parts evergreen' Khandalla, W Ghats ('*thomasi*'), pregnant; 2 in utero, and mammae 2 pairs, inguinal.

Cranial characters.—Skull largest of genus, with the occipito-nasal length very rarely under 40 mm. in length. The length of the nasals normally exceeds the least width of the frontals. The postorbital processes are narrow, but of medium development, perhaps less reduced than in the smaller species. The nasals are usually nearly straight posteriorly, but there is slight individual variation in this character; the parietals also are nearly straight in front where they join the frontals. The narrowest part of the frontals is usually caused by a notch each side, in front of the postorbital processes. The parietals are ridged, and in old specimens they join to form a short but quite well marked sagittal ridge. The palate is long, nearly always over half the occipitonasal length. Palatal foramina very short, as usual. The bullae are moderately inflated but rather small. Pterygoid fossae rather well marked and deep. Zygomatic plate well tilted upwards, its outer border ridged; zygoma including the long jugal of normal Sciurine form. Coronoid process of mandible low.



TEXT-FIG. 12. *Funambulus tristriatus tristriatus* (Waterhouse). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 5$).

Dental characters.—Upper incisors red, narrow, and plain. Upper cheekteeth (five in number) of normal rather simple Sciurine pattern, with a tendency present for M. 3 to be rather small in size. Lower molars with well marked central depression (until worn out), and essentially normal.

Cranial measurements.—As in Table 31, below.

TABLE 31.—*Cranial measurements of the Indian races of Funambulus tristriatus*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus tristriatus tristriatus</i>							
M.	4.3.2.1	42.8	22.8	8.3	14.0	13.0	11.5
	North Travancore.		Teeth much worn.		Parietal ridges joined		
M.	4.3.2.2	43.0	22.7	8.2	13.7	12.6	11.5
	North Travancore.		Parietal ridges joined				
F.	4.3.2.3	44.4	22.9	8.8	14.4	13.6	12.3
	North Travancore.		Teeth much worn.		Parietal ridges joined		
	216a	42.0	21.4	8.5	12.3	12.7	11.8
	Madras						
	216b	40.5	20.6	7.7	12.5	12.6	10.7
	Madras						
<i>Funambulus tristriatus tristriatus</i> ('numarius')							
F.	12.6.29.62	40.8	21.1	8.4	12.6	11.7	11.8
	Dharwar district						
M.	12.11.28.81	42.6	21.3	7.8	13.0	12.6	12.0
	Kanara.		Parietal ridges joined				
M.	12.11.28.84	41.5	20.8	8.0	12.7	12.7	11.4
	Kanara						
M.	12.11.28.85	41.0	—	—	13.0	11.4	11.7
	Kanara						
F.	12.11.28.86	40.2	21.1	7.8	12.4	11.8	11.8
	Kanara						
M.	15.7.3.23	40.9	20.3	7.7	12.0	12.0	11.4
	Ratnagiri district						
F.	15.7.3.24	41.2	21.1	8.0	13.1	10.9	11.6
	Ratnagiri district						
M.	15.7.3.25	41.6	21.1	7.7	12.4	12.0	12.0
	Helwak, Satara						
M.	15.7.3.27	41.0	20.8	7.7	12.6	11.8	11.7
	Helwak						
M.	15.7.3.28	40.7	20.9	—	12.5	11.4	11.5
	Helwak						
F.	15.7.3.29	41.5	21.0	7.9	12.4	12.2	12.0
	Helwak.		Parietal ridges nearly joined				
F.	15.7.3.30	39.6	20.0	7.7	11.4	11.8	12.0
	Helwak						
F.	15.7.3.31	40.4	20.4	7.4	12.7	11.8	12.1
	Khed, Ratnagiri						
F.	15.7.3.33	41.4	21.0	7.5	12.6	12.4	11.5
	Helwak, Satara						

TABLE 31.—*Cranial measurements of the Indian races of Funambulus tristriatus (concl'd.)*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus tristriatus tristriatus</i> (= 'thomasi')							
M.	19.6.3.48	40.2	20.4	7.7	11.8	12.2	12.0
	Khandalla, Western Ghats						
F.	19.6.3.49	41.5	20.9	7.9	13.1	12.1	12.1
	Khandalla						

The type of 'thomasi' has the occipitonasal length 40.6 mm. and that of 'numarius', 41.8 mm.

<i>Funambulus tristriatus wroughtoni</i>							
M.	13.10.23.1	46.8	25.0	9.4	14.5	13.5	13.6
	Virajpet, Coorg			<i>circa</i>	Parietal ridges joined		
F.	13.10.23.2	47.4	25.0	9.3	15.2	14.1	12.7
	Virajpet						
F.	13.8.22.49	47.6	24.2	10.0	15.4	13.7	13.4
	Makut, Coorg.			Parietal ridges joined			
M.	21.11.5.11	44.7	23.5	9.1	14.8	12.8	12.5
	Shernelly, Cochin.			Parietal ridges nearly joined			
F.	21.11.5.12	45.6	23.7	9.0	14.7	12.8	12.8
	Shernelly						
M.	21.11.5.13	44.7	23.5	9.0	13.1	13.5	12.7
	Kotengady Estate						
F.	21.11.5.14	45.2	24.2	9.1	14.2	13.1	12.5
	Kotengady Estate.			Parietal ridges joined			
F.	21.11.5.16	45.8	24.8	8.9	14.8	13.6	12.8
	Kotengady Estate.			Parietal ridges joined			
F.	21.11.5.15	46.1	24.6	8.9	13.9	12.7	12.7
	Kotengady Estate. Parietal ridges joined						

The type has the occipitonasal length about 47.5 mm.

Dimensions of the species Funambulus tristriatus, in British Museum material.—The head and body varies between 120 and 210 mm., the tail between 120 and 181 mm. Hindfoot 26–52 mm. The occipitonasal length varies between 39.5 and 47.6 mm. (only once under 40 mm. in material examined). Toothrow 7.4–10 mm.

Key to the races of Funambulus tristriatus

- 1 (2) Occipitonasal length of skull is not less than 44.7 mm. Length of the palate not under 23.5 mm. *F. t. wroughtoni*
- 2 (1) Occipitonasal length of skull is not more than 44.4 mm. and only once

exceeds 43 mm. Length of the
palate is less than 23 mm.

F. t. tristriatus (with
'numarius' and 'tho-
masi')

In this species I am inclined to recognize two races, of which *F. t. wroughtoni* is an unusually large form. Two other forms, 'numarius' and 'thomasi', I am unable to distinguish from the typical race. Another form, *gossei*, named as a member of the '*tristriatus* group' seems to have nothing to do with this species, but to be a subspecies of *F. palmarum*.

There is little doubt that the form *F. t. wroughtoni* is a valid and distinct subspecies of *F. tristriatus*, though I am not prepared to give it specific rank, as was done by Wroughton. I doubt whether the other two races named by Wroughton can be maintained. *F. t. 'numarius'* as originally described was supposed to be 'a local race of *F. tristriatus* slightly smaller in all dimensions' When all individual specimens are taken into account, however, there is considerable size overlap between the two supposed races. The fact that our *tristriatus* skulls are a little larger as a rule than our *numarius* skulls seems to be because our skulls for the former are mainly very old. An old specimen of *numarius*, from Kanara, with a sagittal ridge present, is just as large as some of our few specimens of the typical race. In his key to the summary, Wroughton stated that the dorsal stripes were white in *tristriatus*, buff in *numarius*. But there is a good deal of individual variation in skins of both races, and I cannot distinguish the two races on this character. Specimens of either race, for instance, may sometimes have the central stripe buff, the outer ones white. *F. t. 'thomasi'* was named on the basis of five specimens, 'slightly smaller than *tristriatus* and *numarius*'; but as judged by cranial measurements, there is no size difference. The tail is supposed to be less bushy than *tristriatus* and *numarius*, and proportionately shorter than in either, but I would doubt whether it is less bushy, and of four duplicates, three have the tail longer than the head and body which is exceedingly rare in the allied races and which indicates that if anything it would average proportionately longer; the upper toothrow was supposed to be consistently shorter, the breadth of the palate less than in 'numarius'; but many duplicate specimens of 'numarius' have shorter teeth than the 'thomasi' I have examined, and I cannot detect a constant difference in the palate width between the two forms; I can see nothing else in the original description or in the specimens that will retain this race when compared with those which were named before it.

(i) **Funambulus tristriatus tristriatus** (Waterhouse)

Text-fig. 12

1837. *Sciurus tristriatus* Waterhouse, *Charlesworth's Mag. nat. Hist.*, 1, 496-499.
 1867. *Sciurus (Tamias) dussumieri* Milne-Edwards, *Rev. Zool.*, 19, 226. (Malabar.)
 1916. *Funambulus tristriatus numarius* Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 646. (Helwak, Satara district, India.)
 1917. *Funambulus tristriatus annandalei* Robinson, *Rec. Indian Mus.*, 13, 41. (Shasthancotta, western side Western Ghats, Travancore.)
 1919. *Funambulus thomasi* Wroughton and Davidson, *J. Bombay nat. Hist. Soc.*, 26, 3, 729. (Khandalla, Bombay Presidency, 2,000 ft., India.)

Type-locality.—Madras.

Range.—Specimens examined from TRAVANCORE: Bonaccord, Kuttayani, Poumudi, Wynaad, Merchiston. Madras, no exact locality. Localities for '*numarius*': MYSORE: Kardibetta Forest; Sagar. Dharwar district, and Devikop, Mahratta. Khed, Ratnagiri. Helwak, Satara. Gersoppa, Potali, Sirsi, all Kanara district. Localities for '*thomasi*': Thana in Bombay; Khandalla, west Ghats.

I have not seen the form named *annandalei* by Robinson, but Wroughton (1919) considered this indistinguishable from *tristriatus*. It was named from Shasthancotta, west side of Western Ghats, Travancore, and was described as a 'large richly coloured form allied to *tristriatus* but larger, smaller than *F. t. wroughtoni* Ryley from Coorg. The longitudinal stripes on the back narrow, whitish, traceable to neck. Saddle black, tail with white tips to hairs exceptionally well developed, anal region and midrib to tail rich chestnut' Head and body 170 mm., tail 161 mm., hindfoot 46 mm.

(ii) **Funambulus tristriatus wroughtoni** Ryley

1913. *Funambulus wroughtoni* Ryley, *J. Bombay nat. Hist. Soc.*, 22, 437.

Type-locality.—Srimangala, Coorg. 2,782 ft.

Range.—Specimens seen from COORG: Wotekolli, Virajpet, Makut and Srimangala. TRAVANCORE: Cotengady Estate; Shernelly, Cochin.

Larger than the typical race, as judged by the skull and the length of the palate, and as indicated in the key above. It is the largest form of *Funambulus* known.

29. *Funambulus pennanti* Wroughton

The Northern Palm Squirrel *

1905. *Funambulus pennanti* Wroughton, *J. Bombay nat. Hist. Soc.*, **16**, 3, 411.
 1905. *Funambulus pennantii argentescens* Wroughton, *J. Bombay nat. Hist. Soc.*, **16**, 3, 413. (Rawalpindi, northern Punjab.)
 1916. *Funambulus pennantii lutescens* Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 430. (Deesa, Palanpur.)

Type-locality.—Mandvi Taluka, Surat district.

Distribution.—Northern INDIA, south to about Dharwar district, thence northwards to SIND, BALUCHISTAN, the PUNJAB, and NEPAL TERAI. South-eastern Persia.

Specimens have been examined from.—

NEPAL TERAI: Naivacot, Banbassa, Tribeni.

KUMAON: Dela, Dhakuri, Jerna, Ramnagar, Pilibhit, Rohilkund.

South of SIKKIM: Haldibari.

PUNJAB: Siwalik Hills; Ambala; Multan, Rawalpindi, Ara, Kallar-kahar, Sodhi and Choan in Salt Range.

NORTH-WEST FRONTIER: Kohat, Peshawar.

BALUCHISTAN: Gajar, Kelat, Mand, Turbat.

SIND: Jacobabad, Kashmor, Naundero, Mirpur, Bohara, Garo, west of Sehwan, Pano Aqil.

GWALIOR: Bhind, Ghatigaon, Chorepura, Morar.

RAJPUTANA: Mount Abu; Sambhar.

CENTRAL INDIA: Sehore.

UNITED PROVINCES: Azadpur, near Delhi.

KATHIAWAR: Sihor, Talala, Sasan, Rajkot, Vankaneer, Satapur, Dhrangadhra, Sadla.

GUJERAT: Deesa, Danta, Lunwa, Palanpur, Junagadh.

CUTCH: Bhuj, Charwar, Nokania.

BENGAL: Midnipur, Daltongunj, Bihar; Jagodih, Hazaribagh. Cooch Behar.

CENTRAL PROVINCES: Lohagpur, Sipna Valley, Berar, Asirgarh, Hewra and Ganoor, Nimar; Sakot and Dhain, Hoshangabad; Chichpalli, Chanda.

BOMBAY STATE: Khandesh, Nasik, Poona, Parola, Shern-duri, Khandesh; Bhodwad, Karad and Madha, Satara; Bombay City, Dharwar district, Bundla.

* 'THE NORTHERN FIVE-STRIPED SQUIRREL' might be a more appropriate name, and would contrast well with the southern *F. palmarum* which is three-striped. The species is by no means partial to palms.—EDITOR.

The northern striped palm-squirrels were not specifically separated in Blanford's day from *Funambulus palmarum*. But the present species occurs with *F. palmarum* in various localities in the Peninsula of India, and as its external peculiarities seem constant, the present form may reasonably be given specific rank.

On the back there are normally five light stripes (instead of three as in *palmarum*). The underside of the tail lacks the reddish line running down its centre which is present in *palmarum*. In the skull, on the whole the frontals tend in *F. pennanti* to be slightly narrower than in *palmarum*, and the bullae usually tend to be slightly larger. From *tristriatus* this species is separated by its smaller size, and shorter palate, as indicated in the key to the species above; the palate in this species never reaches 20 mm. which is the normal lowest measurement for *tristriatus*. The underparts are whitish as a rule, which separates the species from the more distinct *layardi* and *sublineatus*, and the stripes are bright and well marked on the back (compare *sublineatus*). This seems to be one of the commonest species of Rodents in India.

External characters.—The tail is about as long as head and body, or a little more or less. There are 4 mammae. Feet and digits without peculiarity; as usual, no functional thumb, and fourth finger slightly dominant as a rule. The fur is short.

Colour.—The general colour of the back is brownish or greyish, the head and limbs tending to be greyish, and the feet pale, often whitish. Back with five whitish or white stripes separated by four dark brown bands. The three central light stripes are very long, and the two outer ones reduced, usually narrower and considerably shorter, but apparently always traceable. The two central dark bands (on either side of the mid-dorsal pale stripe) tend to be wider than the two outer dark bands. Sometimes the pale mid-dorsal stripe extends on to the root of the tail; the two pale stripes on either side of it are nearly as long, but the outer pale stripes seem generally only to extend between the arm and hip or front of leg on each side. Colour of tail with the hairs apparently whitish or greyish white, then blackish, then white terminally. Underparts white or whitish, sometimes dirty white. Underside of tail much as in the upper part, and lacking the red central portion of *F. palmarum* always, though sometimes tending to be light pale yellow centrally.

Wroughton divided this species into three races based on supposed colour characters. These are completely inconstant, and what he seems to have done is to have described three colour variations which it appears may take place anywhere. From his key in the mammal summary, it is stated that in *pennanti* the 'general colour is darker'. But many specimens of his two other supposed races are just as dark as any *pennanti*. For instance a specimen of '*lutescens*' from Danta, Gujerat, near the type-locality, is quite indistinguishable from a specimen of '*argentescens*' from Sind, which is a locality Wroughton quotes for that supposed race, and this in turn is essentially like a typical specimen of *pennanti* from Gwalior, whence Wroughton quotes this race. I cannot see even an average difference between *pennanti* and the others on 'general colour darker' or 'paler' as the case may be, when all specimens are examined. '*Lutescens*' was supposed to differ from '*argentescens*' in having the 'saddle strongly suffused with fulvous' instead of 'dark grey'. But whereas some '*lutescens*' skins agree in this character, many others, including the one mentioned above, do not; a specimen of '*argentescens*' from the Punjab (Salt Range) cannot be distinguished from a normal '*lutescens*'; neither can a specimen of *pennanti* from Khandesh. The specimens I quote here are taken at random out of a series of about a hundred and fifty, and can be duplicated several times.

External measurements.—As in Table 32, below.

TABLE 32.—*External measurements of the Indian 'races' of Funambulus pennanti*

		Head and body	Tail	Hind- foot	Ear	
<i>Funambulus pennanti</i>						
M.	Ghatigaon, Gwalior	144	157	37½	16½	
M.	Bhind, Gwalior	158	146	39	17	
M.	Bhind	155	141	38	17	
M.	Morar, Gwalior	155	152	39	17	
M.	Ghatigaon, Gwalior	145	135	38	16	
M.	Bhind, Gwalior	150	147	38	17	
M.	Ghatigaon, Gwalior	155	160	39	16	
F.	Ghatigaon	147	158	36½	16	
F.	Chorepura, Gwalior	150	150	37	17	
M.	Chorepura	151	145	38½	15	
F.	Ramnagar, Kumaon.	150	154	38	16	mammae 4
F.	Ramnagar	149	132	38	17	mammae 4
M.	Ramnagar	148	150	39	16	
F.	Ramnagar	147	161	37	17	mammae 4
M.	Ramnagar	143	121	37	15	

TABLE 32.—*External measurements of the Indian 'races' of Funambulus pennanti (contd.)*

	Head and body	Tail	Hind- foot	Ear	
<i>Funambulus pennanti</i> (contd.)					
F. Dela, Ramnagar	148	148	39	16	mammae 4
M. Ramnagar	141	153	38	17	
M. Jerna, Ramnagar . .	145	149	36	17	
M. Pilibhit, Rohilkund, Kumaon	147	165	40	17	
F. Ramnagar, Kumaon.	152	167	39	16	mammae 4
M. Kumaon	140	136	36	17	
F. Jagodih, Hazaribagh.	139	131	37	18	mammae 4
M. Jagodih	142	150	35	17	
F. Pilibhit, Rohilkund	145	150	37	16	mammae 4
M. Daltongunj, Bihar	142	?	37	16	
F. Chichpalli, Chanda	146	140	36	16	mammae 4
M. Chanda	136	122	37	17	
M. Chichpalli, Chanda	146	155	38	17	
M. Daltongunj, Bihar	140	152	36	16	
F. Chanda	147	163	40	17	
M. Dhain, Hoshangabad	139	139	38	17	
F. Sakot, Hoshangabad.	140	150	36	15	mammae 4
M. Lohagpur, Hoshanga- bad	140	144	37	17	
M. Asirgarh, Nimar	148	158	39	16	
M. Ganoor, Nimar	149	166	39	15	
F. Hewra, Nimar	145	142	36	16	mammae 4
F. Hewra, Nimar	144	155	39	16	mammae 4
F. Bhodwad, Khandesh	147	128	38	16	mammae 4
F. Shernduri, Khandesh	153	158	39	19	
F. Dhain, Hoshangabad	148	156	38	16	
F. Pili, Sipna, Berar	148	150	40	17	mammae 4
F. Salbani, Midnipur, Bengal	136	86	36	15	
M. Parola, Khandesh	145	137	39	16	
F. Salbani, Bengal	136	78	35	16	mammae 4
M. Parola, Khandesh	145	150	40	17	
F. Banbassa, Nepal Terai	133	126	34	16	
M. Tribeni, Nepal	157	158	39	19	
M. Tribeni	160	110	30	10	
F. Banbassa, Nepal Terai	140	140	38	19	
F. Tribeni, Nepal Terai.	154	85	36	18	
F. Mount Abu, Rajputana	139	162	38	17	mammae 4
M. Mount Abu	143	?	37	17	
M. Dharwar	153	154	39	17½	
F. Poona	140	145	37	17	
F. Poona	139	148	38	17	
F. Poona	143	169	37	16	
M. Poona	137	158	40	15	
M. Poona	111	145	38	17	(young)
F. Sehore, Central India	142	150	35	18	
F. Sehore	140	140	37	18	
F. Sehore	140	138	37	18	
M. Nasik, Bombay	142	151	37	16	

TABLE 32.—*External measurements of the Indian 'races' of Funambulus pennanti (concl.)*

		Head and body	Tail	Hind- foot	Ear
<i>Funambulus pennanti (concl.)</i>					
M.	Nasik	137	133	38	15
F.	Bombay	145	133	35	16
M.	Bombay	151	130	33	19
F.	Karad, Satara	145	163	35	15
F.	Madha, Satara	150	157	35	16
M.	Siwalik Hills	145	154	39	17
<i>Funambulus pennanti ('lutescens')</i>					
M.	Satapur, Kathiawar	137	122	37	16
M.	Rajkot, Kathiawar	146	?	38	17
M.	Sadla, Kathiawar	146	142	39	17
M.	Satapur, Kathiawar	135	149	37	16
M.	Vankaneer, Kathiawar	139	148	38	16
F.	Rajkot, Kathiawar	149	138	40	17
F.	Satapur, Kathiawar	137	166	38	17
M.	Junagadh, Kathiawar	144	152	37	17
M.	Sihor, Kathiawar	145	?	39	15
F.	Vankaneer, Kathiawar	144	148	37	17
F.	Talala, Kathiawar	144	142	37	16
M.	Talala, Kathiawar	142	155	38	16
F.	Vankaneer, Kathiawar	145	150	38	16
F.	Junagadh, Kathiawar	140	149	39	16
F.	Satapur, Kathiawar	138	?	37	17
F.	Sadla, Kathiawar	147	?	38	18
M.	Danta, Gujerat	144	155	37	17
F.	Lunwar, Palanpur	142	142	37	15
F.	Palanpur	137	156	38	18
M.	Danta, Gujerat	135	142	36	16
M.	Danta	146	136	40	17
M.	Deesa, Palanpur	140	142	36	16
F.	Palanpur	131	151	37	?
M.	Palanpur	144	151	41	16
M.	Bhuj, Cutch	138	140	35	15
F.	Bhuj	146	146	38	14
F.	Charwar, Cutch	142	154	33	15
F.	Mt. Abu, Rajputana.	129	143	36	16
M.	Deesa	131	?	35	15
F.	Danta, Gujerat	140	?	37	15
M.	Nokania, Cutch	130	?	36	16
M.	Lunwa	136	?	37	16
F.	Deesa, type	140	141	35	17
The type of <i>F. p. pennanti</i> measured					
M.	Bundla, Surat district	156	156	37	17
<i>Funambulus pennanti ('argentescens')</i>					
M.	Rawalpindi, type	133	146	33	17
F.	Kallarkahar, Salt Range	148	179	38	18

TABLE 32.—*External measurements of the Indian 'races' of Funambulus pennanti (contd.)*

		Head and body	Tail	Hind- foot	Ear	
<i>Funambulus pennanti</i> ('argentescens') (contd.)						
F.	Rawalpindi, Punjab	138	155	36	16	
M.	Multan, Punjab	166	90	41	19	
F.	Rawalpindi	117	137	36	16	
F.	Multan	155	120	41	17	
F.	Rawalpindi	120	150	35	17	
M.	Rawalpindi	140	126	37	16	
F.	Rawalpindi	134	133	38	17	
M.	Rawalpindi	117	139	33	16	
M.	Choan, Salt Range	148	157	39	17	
M.	Rawalpindi	112	133	34	15	
F.	Ara, Salt Range	143	157	39	17	
M.	Multan, Punjab	150	86	40	18	
M.	Rawalpindi	144	137	37	16	
F.	Salt Range	128	155	35	15	
F.	Multan	150	?	38	18	
F.	Rawalpindi	142	135	36	16	
M.	Rawalpindi	140	133	36	16	
F.	Locality ?	132	120	35	15	
M.	Haldbari, Coochbehar, N. Bengal	138	138	38	17	
F.	Kohat, N.W. Frontier	140	145	35	18	mammæ 2 pairs
F.	Kohat	147	155	36	19	
M.	Peshawar, N.W.F.	140	156	36	19	
	Peshawar	145	?	36	19	
F.	Turbat, Kach	132	139	38	18	
F.	Mirpur, Sind	138	125	36	15	
M.	Mirpur	134	93	35	15	
M.	Garro, Sind	133	145	35	16	
F.	Kashmor, Sind	132	103	36	16	
M.	Naundero, Sind	135	129	35	16	
M.	Jacobabad, Sind	137	134	36	15	
F.	Turbat, Kach	140	146	39	20	
F.	Naundero, Sind	141	140	38	16	
M.	Jacobabad, Sind	135	126	37	15	
M.	Mirpur, Sind	127	112	36	15	
F.	Turbat, Kach	134	140	38	19	
M.	Kashmor, Sind	145	86	33	15	
M.	Bohara, Sind	138	119	35	15	
F.	Kelat, Baluchistan	132	165	38	18	
	Mand, Baluchistan	130	153	38	18	
M.	Gajar, Kelat	128	129	36	17	
Frost collections—						
M.	10					
	Pano Aqil, Sind	138	125	38	18	
M.	35					
	Pano Aqil, Sind	150	150	35	17	
M.	36					
	Pano Aqil, Sind	140	153	35	17	young

TABLE 32.—*External measurements of the Indian 'races' of Funambulus pennanti (concl'd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Funambulus pennanti</i> ('argentescens') (concl'd.)					
F.	37				
	Pano Aqil, Sind	140	105	35	15
F.	55				
	Pano Aqil, Sind	145	130	35	15
M.	56				
	Pano Aqil, Sind	140	122	35	17
M.	70				
	Pano Aqil, Sind	135	145	35	16

Other localities for this species are: west of Sehwan, Sind; Ambala, Punjab; Sambhar, Rajputana; near Delhi.

Notes from skins.—Lunwa, mammae 4, weight $3\frac{1}{2}$ oz. Sadla, Kathiawar, mammae 4, weight $5\frac{1}{4}$ oz. and $4\frac{1}{2}$ oz. Deesa, Palanpur, $3\frac{1}{2}$ oz. Danta, Gujerat, mammae 4, weight 5 oz. and 4 oz. Hewra, Nimar, mammae 4, $4\frac{1}{2}$ oz. and $3\frac{1}{2}$ oz. Palanpur, mammae 4, weight $4\frac{1}{2}$ oz., 4 oz. and $3\frac{1}{4}$ oz. Satapur, Kathiawar, $3\frac{3}{4}$ oz. and $3\frac{1}{2}$ oz., mammae 4. Bhuj, Cutch, $3\frac{1}{2}$ oz. and $4\frac{1}{2}$ oz., mammae 4. Vankaneer, Kathiawar, mammae 4, 4 oz., $3\frac{3}{4}$ oz. and $4\frac{1}{4}$ oz. Mt. Abu $3\frac{1}{2}$ oz. and $3\frac{3}{8}$ oz., and mammae 4, 4 oz. Talala, Junagadh, $4\frac{1}{2}$ oz. and mammae 4. Rajkot, Kathiawar, 5 oz., and mammae 4, $4\frac{1}{2}$ oz. Nokania, Cutch, $3\frac{1}{2}$ oz. Rawalpindi, 'trapped in garden, arboreal' Sehore, 'vernacular *Gulari*' Multan, Punjab, 'common' Peshawar, 'fairly common locally' Khandesh, mammae 2 pairs, $4\frac{3}{4}$ oz. Kohat, mammae 2 pairs. Ara, Salt Range, weight 3.6 oz. Coochbehar, 4 oz. Dalton-gunj, 4 oz. Sihor, Kathiawar, 4 oz. Jerna, Ramnagar, $4\frac{1}{2}$ oz. and mammae 4; also from adjacent localities, $4\frac{1}{2}$ oz. and 4 mammae, and 5 oz., $4\frac{3}{4}$ oz. (mammae 4) and $4\frac{1}{2}$ oz. Satara district, $5\frac{1}{2}$ oz. Poona, 'very common', 'among palm trees on canal bank': mammae 2 pairs inguinal. Chanda, mammae 4, $4\frac{3}{4}$ oz., $4\frac{1}{2}$ oz. and $4\frac{1}{4}$ oz. Dhain, Hoshangabad, mammae 4, 4 oz. and $3\frac{1}{2}$ oz. Pilibhit, Rohilkund, mammae 4, 5 oz. Salbani, Bengal, mammae 4, 4 oz. and $3\frac{3}{4}$ oz. Ganoor, Nimar, $4\frac{3}{4}$ oz. Hoshangabad, $4\frac{1}{4}$ oz. and $3\frac{3}{4}$ oz., mammae 4. Jagodih, Hazaribagh, 4 oz., mammae 4, $4\frac{1}{2}$ oz. Gwalior, weight 4 oz., $4\frac{1}{4}$ oz., $3\frac{7}{8}$ oz. and $3\frac{1}{2}$ oz. 'Shot in tree' Parola, Khandesh, $4\frac{3}{4}$ oz. and $4\frac{1}{2}$ oz. Pili, Sipna, mammae 2 pairs, weight $5\frac{1}{4}$ oz. Different skins examined were collected in all months of the year.

Cranial characters.—The skull is small for a squirrel; the occipitonasal length does not reach 40 mm. As is usual in

most species of the present genus, the frontal bones are relatively narrow, and the postorbital processes are of medium development or are small. The parietals are ridged, and the ridges ultimately fuse to form a short but quite prominent sagittal crest. The bullae are rather large and prominent. Pterygoid fossae rather deep and well marked. Palate normally less than half the occipitonasal length. Palatal foramina short, and far in front of the tooththrows. Zygomatic plate well tilted upwards and thrown forward, its upper border tending to be strongly ridged. Mandible with low, reduced coronoid process, prominent condylar process, and the angular portion is slightly inflected.

In this species, almost without exception in the very large series measured, the nasal length exceeds the frontals width. The frontals appear to average rather narrower proportionately than in *F. palmarum*.

Dental characters.—The upper incisors are narrow, reddish, and normally plain. Five upper cheekteeth, of normal or rather simple Sciurine pattern; M. 3 relatively small, and with one less main ridge (as usual) than the teeth in front of it; P. 3 the smallest tooth but moderately well developed. Lower molars originally basinshaped and essentially normal. There is a tendency with wear for the large central depression in the lower molars to become surrounded and appear as a wide reentrant fold, but by that time the teeth have become flatcrowned and simple, and the whole pattern then soon becomes obliterated.

Cranial measurements.—As in Table 33, below.

TABLE 33.—*Cranial measurements of the Indian 'races' of Funambulus pennanti*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus pennanti</i>							
M.	5.9.9.1 Nasik, Bombay	37.1	18.3	7.2	11.8	10.0	11.9
M.	5.9.9.2 Nasik	38.4	18.7	—	11.7	10.3	11.8
F.	10.2.2.21 Sehore, Central India	37.0	18.2	7.1	11.7	9.7	11.3
<i>circa</i>							
F.	11.12.20.1 Bhodwad, Khandesh	37.8	19.3	7.1	11.4	10.9	10.9
F.	11.12.21.19 Shernduri, Khandesh.	38.1	18.9	7.6	11.7	10.5	12.1
Parietal ridges nearly fused							

TABLE 33.—*Cranial measurements of the Indian 'races' of Funambulus pennanti (contd.)*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus pennanti (contd.)</i>							
M.	11.12.21.18	38.7	19.0	7.4	11.8	11.5	12.2
	Parola, Khandesh.		Parietal ridges fused				
F.	12.3.8.14	39.2	19.5	7.1	11.9	10.7	11.9
	Pili, Berar.		Parietal ridges fused				
M.	12.6.28.18	38.9	19.2	7.3	11.6	10.7	11.7
	Asirgarh, Nimar						
				<i>circa</i>			
M.	12.6.28.19	39.0	19.5	7.5	12.2	10.4	11.7
	Asirgarh, Nimar.		Parietal ridges fused				
F.	12.6.28.20	38.0	18.9	6.9	10.7	10.5	11.4
	Asirgarh, Nimar						
F.	12.10.4.47	37.0	17.9	—	11.1	9.7	11.2
	Bhuj, Cutch.		Parietal ridges fused				
M.	12.10.4.48	37.0	17.8	—	11.0	10.0	11.0
	Nokania, Cutch						
M.	12.10.4.66	35.1	17.6	6.7	10.0	9.4	11.2
	Bhuj, Cutch.		Apparently adult				
F.	12.11.29.99	38.2	18.8	—	10.8	10.8	11.4
	Hoshangabad.		Parietal ridges fused				
M.	12.11.29.100	38.6	19.7	7.3	11.5	10.1	11.2
	Chanda, C.P.		Parietal ridges nearly fused				
M.	12.11.29.101	37.3	18.4	7.2	10.7	10.1	11.7
	Chanda						
F.	12.11.29.102	37.6	18.2	7.4	11.4	10.0	11.4
	Chanda						
F.	12.11.29.103	39.0	19.2	7.1	12.3	9.6	12.0
	Chanda.		Parietal ridges fused				
F.	13.4.15.1	36.5	17.6	7.4	11.0	10.6	11.2
	Azadpur, Delhi						
M.	13.9.18.31	37.3	18.4	7.0	12.3	10.7	11.1
	Mt. Abu, Rajputana.		Parietal ridges fused.		Old.	Teeth worn out	
F.	13.9.18.32	37.3	17.6	7.2	11.2	10.2	11.0
	Mt. Abu						
M.	13.9.18.34	36.7	18.3	7.2	10.3	10.0	11.7
	Palanpur.		Parietal ridges fused				
M.	13.9.18.33	37.5	18.2	7.1	11.3	10.0	11.7
	Palanpur						
F.	13.8.8.47	37.7	18.7	7.1	11.7	10.0	11.6
	Talala, Junagadh						
M.	13.8.8.48	38.3	18.3	7.3	11.4	10.5	11.5
	Junagadh						
F.	13.8.8.49	36.8	17.9	—	10.8	11.5	11.7
	Junagadh.		Parietal ridges nearly fused				
M.	13.8.8.50	38.4	19.1	7.4	11.8	10.6	11.6
	Rajkot, Kathiawar						
F.	13.8.8.51	37.8	18.6	—	12.2	11.1	12.0
	Rajkot						

TABLE 33.—*Cranial measurements of the Indian 'races' of Funambulus pennanti (contd.)*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus pennanti</i> (contd.)							
M.	13.8.8.52	36.6	17.8	6.8	10.8	10.6	11.2
	Satapur, Kathiawar						
F.	13.8.8.53	37.1	18.0	7.4	10.8	10.2	10.8
	Satapur						
M.	13.8.8.54	37.8	18.0	6.9	11.4	10.7	11.3
	Sihor, Kathiawar.						
							Parietal ridges joined
F.	13.8.8.55	37.3	18.5	6.9	11.6	10.3	11.2
	Vankaneer, Kathiawar.						
							Parietal ridges fused
M.	14.7.10.77	38.1	18.6	7.2	12.0	10.2	11.8
	Ramnagar, Kumaon						
M.	14.7.10.78	38.8	19.3	7.1	12.3	10.1	11.7
	Ramnagar.						Parietal ridges fused
M.	14.7.10.79	37.5	18.2	7.6	11.1	9.9	11.2
	Ramnagar						
F.	14.7.10.81	38.8	19.1	7.1	12.5	10.6	11.5
	Ramnagar.						Old. Parietal ridges fused. Teeth worn out
F.	14.7.10.82	38.2	18.9	—	12.2	10.1	11.4
	Ramnagar.						Parietal ridges fused
				<i>circa</i>			
F.	14.7.10.83	37.7	18.9	7.6	11.1	9.9	11.1
	Pilibhit, Rohilkund						
F.	14.7.10.83						
	[sic]	38.2	19.1	7.0	11.3	10.4	11.4
	Ramnagar, Kumaon.						Parietal ridges fused
F.	14.7.10.84	38.7	19.2	7.2	11.8	10.3	11.7
	Ramnagar.						Parietal ridges fused
M.	14.7.10.87	38.5	18.9	7.3	12.0	10.5	11.4
	Pilibhit, Rohilkund						
M.	15.11.2.1	36.2	18.3	7.0	10.8	9.9	10.9
	Vankaneer, Kathiawar.						Parietal ridges fused
F.	15.11.2.2	36.4	17.8	6.9	10.7	9.8	11.2
	Vankaneer.						Parietal ridges fused
M.	15.11.2.3	36.3	18.2	6.9	11.0	10.4	11.3
	Satapur, Kathiawar.						Parietal ridges fused
F.	15.11.2.4	36.6	18.2	6.8	11.6	10.3	10.8
	Satapur						
M.	15.11.2.5	37.8	18.4	7.5	11.0	10.3	11.4
	Sadla, Kathiawar.						Parietal ridges fused
F.	15.11.2.6	38.0	19.2	—	11.4	10.2	11.7
	Sadla, Kathiawar.						Parietal ridges fused
				<i>circa</i>			
M.	15.7.2.9	38.6	18.4	7.5	12.0	10.2	11.7
	Chorepura, Gwalior.						Parietal ridges fused
M.	15.7.2.10	38.2	18.4	7.0	11.8	9.8	11.2
	Chorepura, Gwalior						
F.	15.7.3.34	37.6	18.7	6.4	11.6	10.4	11.4
	Karad, Satara district.						Parietal ridges nearly fused. Old

TABLE 33.—*Cranial measurements of the Indian 'races' of Funambulus pennanti (contd.)*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus pennanti</i> (concl'd.)							
F.	15.7.3.35	37.5	18.3	7.4	11.0	10.1	11.2
	Madha, Satara						
F.	15.4.3.78	36.3	—	7.3	10.6	9.9	11.1
	Midnipur, Bengal						
M.	18.9.1.120	38.3	18.9	7.6	11.4	10.5	11.3
	Haldibari, Bengal						
M.	21.5.1.13	39.1	19.3	7.3	11.6	10.1	11.3
	Naivacot, Nepal.						
F.	1938.8.2.8	37.2	18.1	7.2	9.3	9.7	10.9
	Banbassa, West Nepal Terai						
F.	15.11.3.80	37.8	18.8	7.6	11.5	10.7	11.2
	Midnipur, Bengal						
F.	19.6.3.44	37.0	18.1	—	10.7	<i>circa</i> 10.2	11.3
	Poona						
	12.10.4.49	36.6	18.2	6.8	10.7	10.4	11.0
	Charwar, Cutch						
F.	13.9.18.35	36.3	17.5	7.0	11.4	10.1	11.2
	Lunwa, Gujerat.						
M.	15.7.2.12	36.8	18.4	—	10.4	9.3	11.4
	Chorepura, Gwalior						
M.	15.11.2.12	37.7	18.1	7.2	11.4	10.1	11.5
	Danta, Gujerat						
M.	13.9.18.104	36.5	17.9	6.9	10.4	10.0	11.3
	Deesa, Gujerat (' <i>lutescens</i> ')						
F.	15.11.2.7	35.6	17.2	7.0	10.4	9.2	11.1
	Palanpur. Teeth little worn						
M.	15.11.2.9	37.2	17.6	6.8	11.2	10.0	11.3
	Gujerat						
M.	15.11.2.10	35.2	17.3	—	10.2	10.0	10.8
	Deesa. Parietal ridges fused						
M.	15.11.2.13	35.8	17.7	7.0	10.1	9.7	11.3
	Danta, Gujerat (' <i>lutescens</i> ')						
F.	15.11.2.14	36.4	17.8	—	11.1	10.2	11.2
	Danta						
<i>Funambulus pennanti</i> (' <i>argentescens</i> ')							
M.	19.11.7.26	37.0	18.7	7.2	11.2	10.3	11.5
	Mand, Baluchistan						
F.	5.4.2.5	36.9	17.9	6.6	10.7	10.0	11.7
	Rawalpindi, Punjab.						
M.	5.11.9.10	37.5	18.2	6.5	11.7	10.6	11.4
	Rawalpindi. Parietal ridges fused						
M.	5.11.19.11	37.2	17.7	—	11.1	10.4	11.2
	Rawalpindi						
M.	5.11.19.19	38.4	18.6	6.4	11.7	10.6	11.4
	Rawalpindi						
	10.1.18.38	36.4	17.6	6.9	11.0	10.5	11.0
	Multan, Punjab						

TABLE 33.—*Cranial measurements of the Indian 'races' of Funambulus pennanti (concl'd.)*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Funambulus pennanti</i> (' <i>argentescens</i> ') (concl'd.)							
F.	10.1.8.40 Multan	37.9	18.7	7.0	12.4	10.8	11.3
M.	15.11.1.82 Jacobabad, Sind.	37.2	18.1	6.9	11.0	9.7	11.2
M.	15.11.1.83 Jacobabad	36.6	18.2	6.4	10.7	10.6	11.2
M.	19.11.8.14 Gajar, Kelat, Baluchistan.	36.6	17.7	6.4	10.6	10.2	11.4
F.	19.11.7.28 Turbat, Baluchistan.	38.3	18.6	7.4	11.8	10.5	11.8
F.	19.11.7.29 Turbat	37.8	19.1	6.8	11.7	11.0	10.7
Frost collections—							
M.	10 Pano Aqil, Sind	37.0	18.2	7.0	11.0	10.1	11.1
M.	35 Pano Aqil, Sind	37.0	18.4	6.9	10.9	10.0	11.2
F.	37 Pano Aqil, Sind	36.7	18.2	7.2	10.8	10.2	11.0
F.	55 Pano Aqil, Sind. Old.	36.5	18.4	6.1	11.6	9.9	11.0
Parietal ridges fused							

The types of *pennanti*, *argentescens* and *lutescens* have been examined.

Dimensions of Funambulus pennanti, in the British Museum material: The occipitonasal length varies between 35.1 and 39.2 mm. Toothrow 6.4–7.6 mm. The head and body varies between 111 and 166 mm. The tail between 78 (rarely under 100) and 179 mm. Hindfoot 30–41 mm.

30. *Funambulus palmarum* (Linnaeus)

The Palm-Squirrel, or Common Indian Striped Squirrel

1766. *Sciurus palmarum* Linnaeus, *Syst. nat.*, 12th ed., 1, 86.

Vernacular names.—Blanford gives the following native names for this species, but doubtless some of them also apply to *F. pennanti*:—Gilehri, *H.*; Beral, Lahki, *Beng.*; Tidra, Tu, *Kol.*; Khadi, *Mahr.*; Alalu, *Can.*; Urta, Wadar, Vodata, *Tel.*; Chitta Anathan, *Tam.*; Lena, *Cingalese*.

Distribution.—Ceylon and Peninsula of India.

Essentially apparently a southern species; its place to the north being taken by *Funambulus pennanti*. One of the commonest species of Rodent in India. 'From its abundance about cultivation and houses this species is probably a follower or "commensal" of the human race' (Blanford).

The colour of the underparts is usually white or whitish, and the back has three light stripes; the underside of the tail has a red or reddish line running down the centre for a greater or lesser extent. These characters will, either together or singly, separate this species from all but *F. tristriatus*. From this it differs in average smaller size; normally the occipito-nasal length is below 40 mm. and the length of the palate below 20 mm.; although in nearly every race, there are exceptions to these statements, they are very much in the minority. This species occurs with *tristriatus* and *pennanti* and *sublineatus*. As a general rule in this species the frontals are strongly narrowed, averaging in all except one race less than 30% of the occipitonasal length.

External characters.—The tail is perhaps rather narrow for a squirrel; it may be either rather longer or rather shorter than the head and body, and its length is a character on which it seems reasonable to base racial names in this species. The fur is short and close. There are 4 mammae, at least in the mainland races. Hand with four functional fingers; D. 4 slightly dominant, as usual, in the majority. Foot with five toes; D. 4 tending to be slightly longer than D. 2 and D. 3; fifth toe not so long as the central three, but considerably longer than the hallux; 6 plantar pads apparently present.

Colour.—Sides, limbs and back except for the saddlepatch greyish or brownish; on the back are three light stripes, which may be white or whitish or buff (sometimes all three white, sometimes all three buff, sometimes the mid-dorsal white, the lateral pale stripes buff, and so forth; but evidently an individual or seasonal character, not a subspecific one); these stripes are long and prominent, and on either side of the mid-dorsal stripe there is a dark band which on each side is bordered by the outer white stripe; this dark band may be brown or blackish, and is quite wide; on the outer side of the outer pale white stripes, there is on each side a narrow dark band. The head may be either reddish brown or grey like the sides. This character, 'face ochraceous' or not so as the case may be, was used extensively by Thomas and Wroughton in their classification of this species into races, yet it is quite obviously an individual character. The race *F. p. 'olympius'* from the high mountains of Ceylon was supposed to be with

the face 'like the head, not ochraceous' There are several skins available for this supposed race collected in March and April at Peradeniya. Four or five of them have about the brownest and most ochraceous head in more than 150 skins I have examined, and four or five of them taken at the same place in the same month have the head not red at all. Tail above usually with the hairs yellowish or pale in the middle, then blackish, and then whitish at the ends, this giving a sort of mottled blackish-whitish effect throughout. The underside of the tail has a reddish or yellowish red central line of hairs running through a greater or lesser part of its length, which is one of the chief characters for distinguishing this species from *F. pennanti*. On either side of this central portion, the hairs are mixed black and white. Lower parts white or dirty white or greyish but in the dullest specimens essentially 'bright' rather than 'dull' and thus distinguishable with ease from *F. sublineatus*.

External measurements.—As in 'Table 34, below.

TABLE 34.—*External measurements of the Indian 'races' of Funambulus palmarum*

	Head and body	Tail	Hind- foot	Ear
<i>Funambulus palmarum kelaarti</i>				
M. Hambantota, Ceylon	140	136	32	15
M. Hambantota	146	112	34½	16
M. Hambantota	147	?	35	15½
M. Hambantota	149	145	33½	15
F. Hambantota	148	144	33	15
F. Hambantota	125	130	34	16½
M. Hambantota	146	144	34½	16
Hambantota	147	114	32	15
Hambantota	129	138	32½	15½
M. Hambantota	151	125	32½	16
F. Kala-oya, Ceylon	149	160	36½	16½
F. Kala-oya	148	149	44	15½
F. Kala-oya	152	125	37	16½
F. Kala-oya	157	132	37	16
F. Kala-oya	165	163	37	16½
M. Kala-oya	145	122	37	15½
Kala-oya	148	160	35½	21
F. Kala-oya	157	170	38	17½
F. Kala-oya	137	135	36	17
M. Kala-oya	152	153	36	17
M. Apura, N.C.P., Ceylon	129	132	35	15
F. Wellawaya, Ceylon	145	136	31½	16½
F. Wellawaya	154	142	35½	17
M. Mankeni, Ceylon	144	(96)	37½	17
F. Mankeni	142	115	35	15
M. Putlam, Ceylon	143	140	38	14½

TABLE 34.—*External measurements of the Indian 'races' of Funambulus palmarum (contd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Funambulus palmarum 'olympius' = kelaarti</i>					
F.	Urugalla, Ceylon	153	146	34	16½
M.	Urugalla	150	125	37	15
M.	Urugalla	156	152	35	17
F.	Urugalla	141	162	36½	15
F.	Urugalla	137	148	35	16
F.	Urugalla	159½	160	33½	17
M.	Urugalla	156	120	37	17
M.	Urugalla	153	146	37	17
F.	Urugalla	141	149	33½	17½
	Kandy, Ceylon	150	114	37	?
M.	Ambawela, Ceylon	165	165	39	18
M.	Peradeniya, Ceylon	167	126	42	17
M.	Peradeniya	180	167	35	16
F.	Peradeniya	161	164	38	14
M.	Peradeniya	158	161	43	16
F.	Peradeniya	167	158	43	16
M.	Peradeniya	173	167	35	16
M.	Peradeniya	161	159	43	17
F.	Peradeniya	158	147	39	16
F.	Peradeniya	189	164	36	16
F.	Peradeniya	167	156	41	16
M.	Peradeniya	167	143	43	16
M.	Peradeniya	155	162	39	16½
F.	Peradeniya	156	126	36	15
F.	Urugalla, type	154	126	35½	17

Funambulus palmarum bellaricus

F.	Vijayanagar, Bellary	163	?	39	17
F.	Vijayanagar	160	150	36	17
M.	Vijayanagar	162	165	39½	17
	Gadag, Mahratta	158	149	38	17
M.	Gadag	161	121	40	17
M.	Dharwar	147	158	40	16
M.	Dharwar	167	156	40	17
M.	Hawbshavi, Dharwar	177	156	40	17
F.	Bangalore, Mysore	163	165	38	17
M.	Seringapatam, Mysore	165	152	39	18
	Samasgi, Dharwar	158	149	39	16½
F.	Seringapatam, Mysore	165	150	41	17
F.	Kolar, Mysore	156	150	38	16½
M.	Seringapatam, Mysore	164	146	41	16
	Seringapatam	156	143	38	17
M.	Vijayanagar, type	168	156	41	16

TABLE 34.—*External measurements of the Indian 'races' of Funambulus palmarum (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Funambulus palmarum robertsoni</i>				
M. Pachmiri, Hoshang- abad	140	140	36	17
F. Pachmiri	145	143	36	17 mammae 4.
F. Dhain, Hoshang- abad	147	147	37	16 mammae 4.
M. Dhain	146	?	36	18
F. Rorighat, Hoshang- abad	140	160	37	18 mammae 4.
F. Sival, Nimar	140	164	40	17
M. Asirgarh, Nimar	143	154	39	16
Kolkaz, Berar	149	111	38	18
F. Kolkaz, Berar	140	117	37	16
M. Pachmiri, type	140	146	38	17
<i>Funambulus palmarum palmarum ('bengalensis')</i>				
M. Jagodih, Hazari- bagh	143	160	39	17
M. Jagodih	141	158	37	16 mammae 4.
Gajhundi, Hazari- bagh	148	?	35	17
F. Gajhundi, type	140	146	36	15
<i>Funambulus palmarum javonicus = kelaarti</i>				
F. Udugama, Ceylon	145	127	23	15
F. Udugama	152	(95)	34½	16
F. Udugama	144	132½	36	16
M. Udugama	145	140	33½	15
M. Udugama	149	145	32½	14½
F. Udugama	142	137	21	15
F. Kottawa, Ceylon	146	138	33	15
M. Kottawa	134	131	32½	15½
M. Ranna, Ceylon	144	143	33½	16
F. Udugama, type	143	144	31	16
<i>Funambulus palmarum matugamensis</i>				
M. St. George, Matu- gama, Ceylon	148	112	38	16
F. Anasigalla, Matu- gama	150	127	38	15
M. Anasigalla	147	135	36	16
M. Anasigalla	147	157	38	13
F. Anasigalla	150	117	36	15
F. Anasigalla	135	147	36	16
M. Anasigalla	152	151	35	16
M. Anasigalla	156	(95)	35	15
F. Anasigalla	150	141	35	15

TABLE 34.—*External measurements of the Indian 'races' of Funambulus palmarum (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Funambulus palmarum matugamensis</i> (concl.)				
F. Anasigalla	139	138	32	15
F. Anasigalla	149	146	35	15
M. Anasigalla	145	140	35	15
M. Anasigalla	145	153	36	15
M. Anasigalla	140	138	35	13
M. Anasigalla	137	103	36	17
F. Anasigalla	181	148	35	15
M. Anasigalla	147	127	36	15
M. Anasigalla	164	(80)	33	15
M. Anasigalla	147	130	33	15
F. Anasigalla	149	155	36	17
M. Anasigalla	145	(53)	34	16
M. Anasigalla	145	(95)	33	16
F. Anasigalla	145	(85)	33	16
F. Anasigalla	125	124	33	15
Anasigalla	127	136	34	15
F. Anasigalla, type	136	140	35	16

Funambulus palmarum brodiei

M. Cheddikulan, Ceylon	153	152	38	16
M. Cheddikulan	155	135	38	17
M. Cheddikulan	158	152	37	16½
F. Cheddikulan	145	144	38	15½
M. Cheddikulan	152	150	42	17½
F. Cheddikulan	155	163	35½	16
Cheddikulan	148	151	37	15½
F. Cheddikulan	143	154	36	16
Cheddikulan	150	158	39	17
M. Mannar, Ceylon	156	163	39	17½

Funambulus palmarum palmarum ('comorinus')

M. Nagercoil	140	145	35	17
M. Trivandrum	159	153	38	?
M. Trivandrum	160	140	31	?
M. Trivandrum	153	147	31	?
F. Trivandrum	153	166	36	?
F. Trivandrum	150	155	40	?
Trivandrum	147	153	25	?
F. Trivandrum	155	160	38	?
Trivandrum	165	190	25	?
F. Foot of Mahendragan	145	135	36	16
M. Foot of Mahendragan	155	130	35	17
F. Foot of Mahendragan	140	150	31	17
F. Trivandrum, type	153	178	35	?

Other skins seen from Benhope, Nilgiris, and Kotagiri, Nilgiris.

TABLE 34.—*External measurements of the Indian 'races' of Funambulus palmarum (concl'd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Funambulus palmarum palmarum</i> (' <i>gossei</i> ')					
F.	Rookery Estate, Kil Kotagiri	121	121	34	17
M.	Rookery Estate	139	120	35	18
M.	Rookery Estate	120	143	34	18
M.	Rookery Estate	120	130	31	17
M.	Rookery Estate, young	118	147	37	15
F.	Gantha, Coimbatore	140	?	33	16
M.	Kotagiri, type	138	147	36	16

<i>Funambulus palmarum palmarum</i>					
M.	Kurumbapatti, Salem	136	160	39	18
	Machur	142	145	37	18
F.	Balapalli	132	160	38	17
F.*	Trinchinopoly, Madras	145	145	38	17
	Kodura, Balapalli	125	155	37	17
M.	Kurumbapatti	137	149	38	17
	Loc. ?	127	138	32	19
M.	Trinchinopoly, Madras	130	?	36	15
F.	Kurumbapatti	135	?	39	17
M.	Shevaroy Hill, E. Ghats	140	?	40	18

Notes from skins of Funambulus palmarum

Ceylon races.—

F. p. favonicus, skins seen were collected in April. Udugama; 'shot in jungle' and 'shot on palm'

F. p. kelaarti, skins seen were collected January, May, June, July, September. Wellawaya, 'shot in jungle' and 'shot near bungalow in jungle' (Kala-oya). Apura, 'shot in the town' Hambantota, 'trapped in tree'

F. p. brodiei, skins seen were collected October, November, December. Cheddikulam, 'shot in jungle' Mannar, 'trapped on tree in compound'

F. p. olympius, normal specimens, other localities than Peradeniya; skins seen collected January, February, March and April. Urugalla, 'trapped in tree in nature garden' Peradeniya specimens, with normal (not reddish) head, were collected January and April. Skins from Peradeniya with red head were collected February, March and April.

F. p. matugamensis, skins seen collected January, February, March, April, May, June, October, November and December. St. George, 'very common round the bungalow. Usually lives in the roof, and is more or less parasitical on

man' Anasigalla, 'shot in small jungle'; 'shot in bungalow about 100 yards from jungle'; 'contained 2 young' (two specimens); 'shot in rubber tree, face grey, winter coat'; 'shot in scrub on edge of a paddy field'; 'shot in high tree' 'In bushes on edge of estate, very common'; 'Cinghalese Lena'

Mainland races.—

F. p. palmarum, skins examined collected April, May, July and August.

F. p. comorinus, skins examined collected January, March, April, June, July, October. Benhope, 'common' 'Trapped in Trivandrum public gardens'

F. p. gossei, skins collected June and July. Kil Kotagiri, 'mammas 2 pairs inguinal' One specimen from 1,300 ft. alt., the others 4,100–4,500 ft.

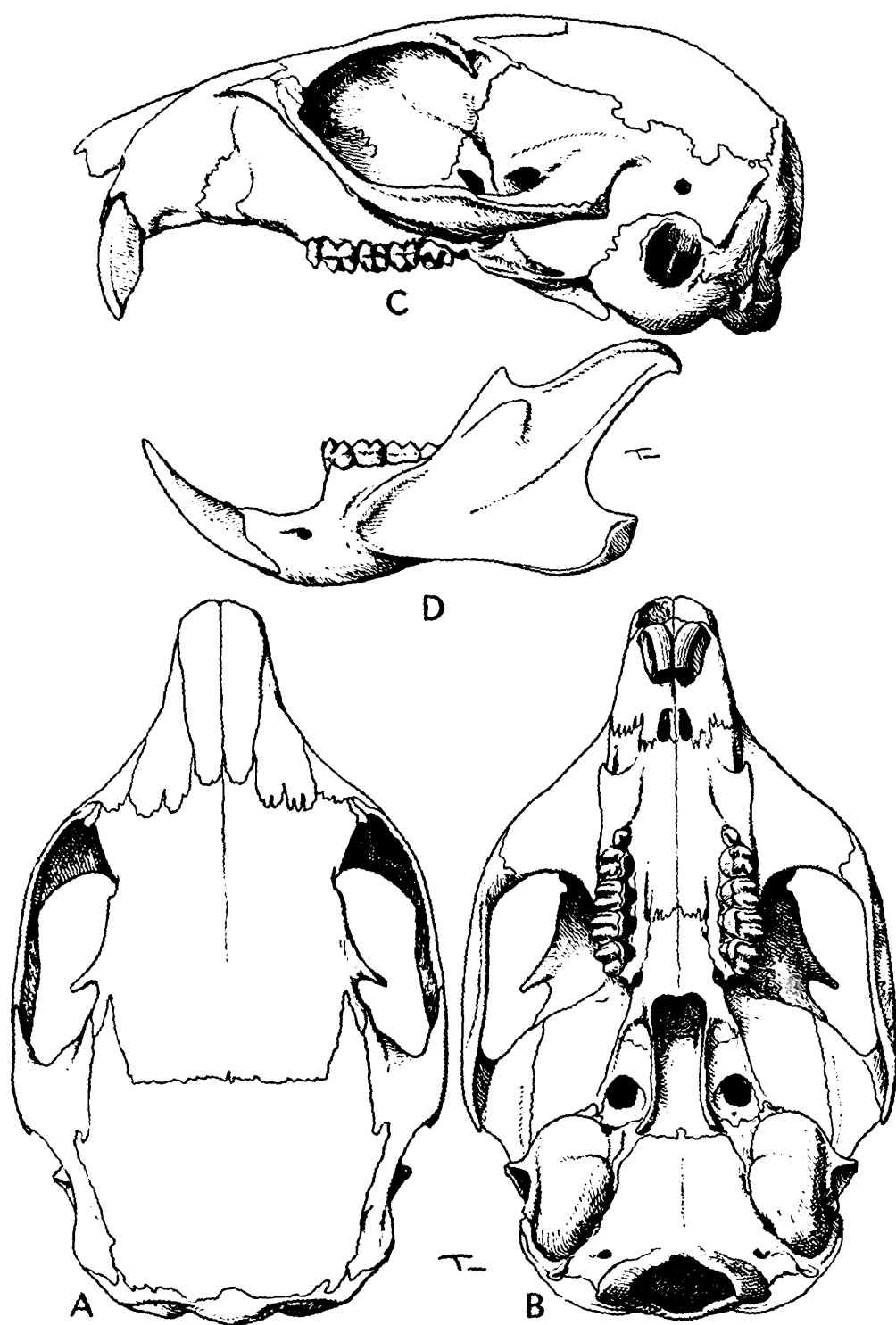
F. p. bengalensis, skins collected April and May. Gajhundi, weight $4\frac{1}{2}$ oz. and mammas 4; weight $4\frac{1}{2}$ oz. and 4 oz.

F. p. robertsoni, skins taken February, March, June, October, November. Kolkaz, weight $4\frac{1}{2}$ oz. and $4\frac{1}{4}$ oz. Pachmarhi, weight 4 oz. and mammas 4. Dhain, mammas 4; weight $3\frac{1}{2}$ oz. and $4\frac{1}{2}$ oz. Siwal, Nimar; weight 4 oz. Rorighat, Hoshangabad; mammas 4; 4 oz. Asirgarh, Nimar; $3\frac{3}{4}$ oz.

F. p. bellaricus, skins taken February, March, July, September, October, November, December Seringapatam; $3\frac{7}{8}$ oz. and $4\frac{5}{8}$ oz. 'Two tips to tail; the second specimen seen like this' (this specimen has the tail tip divided about half-way along its length, with a small extra tip on the left side) Samasgi, Dharwar, $3\frac{3}{8}$ oz. Hawbshavi, Dharwar, $4\frac{3}{4}$ oz. Vijayanagar, $3\frac{3}{8}$ oz. Bangalore, $4\frac{1}{4}$ oz.

Cranial characters.—The skull is relatively small for a squirrel. Though some specimens may reach 40 mm. in occipitonasal length, or even exceed it, they are in the minority in all races. The palate averages less than half the occipitonasal length in all races. The width of the frontals is narrow for a member of the present family, though not for this genus. With one exception (*brodiei*), this width averages below 30% of the occipitonasal length. The nasals length is often about equal to the frontals width, or may be a little longer or shorter. Posteriorly the nasals may be V-shaped or nearly straight, but it seems to be an individual character, judging from material examined, and not a racial character as was indicated by Lindsay, 1926, in the description of the race *matugamensis*. Frontals often notched in front of the postorbital processes each side; the latter are of medium

development. The parietals are ridged, although not very heavily, and ultimately these ridges may join to form a sagittal crest. Bullae moderately inflated. Pterygoid fossae moderately deep and well marked. Palatal foramina short as usual, and far in front of the tooththrows. Zygomatic plate



TEXT-FIG. 13. *Funambulus palmarum palmarum* (Linnaeus). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 5$).

well tilted upwards, its outer border well ridged; zygoma normal. Mandible as usual; coronoid reduced.

Dental characters.—Upper incisors narrow, reddish or yellow, and normally plain. Upper cheekteeth without peculiarity, of normal Sciurine form; P. 3 smallest but moderately developed; M. 3 tending to be rather small. Lower molars normal; the premolar the smallest tooth as a rule.

Cranial measurements.—As in Table 35, below.

TABLE 35.—*Cranial measurements of the Indian 'races' of Funambulus palmarum*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Funambulus palmarum palmarum</i>							
F.	7.11.25.3	39.4	19.6	7.6	11.3	11.4	11.4
	Trinchinopoly.	Parietal ridges fused		<i>circa</i>			
	8.7.28.7	37.8	—	7.6	11.0	10.5	10.5
	Madras						
F.	8.7.28.8	40.0	18.8	7.4	11.9	11.4	11.7
	Madras						
M.	8.7.28.5	39.8	—	—	11.9	11.8	11.2
	Adyan, Madras.	Parietal ridges fused					
M.	8.7.28.1	37.8	—	7.9	10.6	11.6	12.1
	Kilpauk, Madras						
<i>Funambulus palmarum palmarum</i> ('gossei')							
M.	19.6.2.34	36.6	17.8	7.4	10.8	11.6	11.6
	Coimbatore, Nilgiris.	Rather young					
F.	19.6.2.36	38.7	18.7	7.7	12.3	10.6	11.4
	Coimbatore					<i>circa</i>	
F.	19.6.2.35	37.6	18.2	7.8	10.5	10.5	—
	Kotagiri, Nilgiris						
M.	19.6.2.30	37.4	18.5	7.7	11.3	11.3	11.5
	Kotagiri, type						
<i>Funambulus palmarum palmarum</i> ('comorinus')							
F.	0.5.26.3	39.5	19.5	—	12.0	11.2	11.4
	Trivandrum, Travancore			<i>circa</i>			
M.	0.5.26.7	40.3	19.5	7.9	12.2	11.4	11.2
	Trivandrum						
M.	0.5.26.9	40.3	20.2	7.4	11.7	11.7	11.7
	Trivandrum					<i>circa</i>	
F.	0.5.26.11	39.9	19.7	—	11.7	11.6	11.9
	Trivandrum						
F.	0.5.26.12	39.3	18.9	7.8	10.7	12.3	—
	Trivandrum						

TABLE 35.—*Cranial measurements of the Indian 'races' of Funambulus palmarum (contd.)*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Funambulus palmarum palmarum</i> (' <i>comorinus</i> ') (concl'd.)							
F.	0.5.26.14	37.7	18.4	—	10.6	12.3	11.4
	Trivandrum. Rather young						
F.	0.5.26.15	39.2	18.9	—	11.5	12.2	11.3
	Trivandrum						
M.	20.4.22.1	37.7	18.8	7.1	10.4	11.0	10.8
	Nagercoil, South India						
M.	20.4.22.2	37.8	17.9	7.8	10.7	11.0	11.7
	Foot of Mahendragon						
F.	20.4.22.4	39.7	19.5	7.1	11.8	11.8	11.3
	Mahendragon						
	95.10.9.18	39.2	19.2	7.8	11.0	12.2	11.3
	Kattyani, Travancore						

The type has the occipitonasal about 39.2 mm.

<i>Funambulus palmarum palmarum</i> (' <i>bengalensis</i> ')							
M.	15.4.3.74	38.9	19.4	7.9	11.2	10.7	11.7
	Jagodih, Hazaribagh						
F.	15.4.3.75	37.5	18.6	7.6	10.5	11.2	11.4
	Hazaribagh						
M.	15.4.3.76	38.8	19.0	7.4	11.5	10.5	11.4
	Hazaribagh				<i>circa</i>		
F.	15.4.3.77	37.0	18.5	7.5	10.5	10.7	11.0
	Hazaribagh, type						

<i>Funambulus palmarum robertsoni</i>							
M.	12.3.8.12	38.7	19.0	6.7	10.5	11.7	11.7
	Kolkaz, Berar						
F.	12.3.8.13	38.5	19.4	6.9	9.8	11.6	11.4
	Kolkaz. Old				<i>circa</i>		
F.	12.6.28.16	38.0	—	—	11.3	9.8	11.9
	Asirgarh, Nimar. Parietal ridges fused						
F.	12.6.28.17	37.7	18.5	7.0	10.6	11.0	11.3
	Asirgarh						
M.	12.11.29.90	40.0	19.6	—	11.7	11.4	11.5
	Hoshangabad. Parietal ridges fused						
M.	12.11.29.91	39.1	19.0	6.9	10.5	12.2	11.7
	Hoshangabad						
F.	12.11.29.93	37.3	18.8	6.8	11.0	10.8	11.0
	Hoshangabad						
F.	12.11.29.94	37.3	17.4	6.8	10.5	10.1	11.2
	Hoshangabad						
M.	12.11.29.97	37.4	18.7	6.8	11.4	10.0	11.4
	Hoshangabad						
M.	12.6.28.15	36.6	18.0	6.9	9.4	10.7	11.3
	Asirgarh, Nimar						

The type has the occipitonasal about 39.4 mm., toothrow 6.9 mm.

TABLE 35.—*Cranial measurements of the Indian 'races' of Funambulus palmarum (contd.)*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Funambulus palmarum bellaricus</i>							
M.	12.6.29.56 Dharwar	38.4	18.5	7.8	10.9	11.4	11.0
M.	12.6.29.57 Dharwar	39.1	19.4	— <i>circa</i>	10.8	11.0	11.4
M.	12.6.29.59 Dharwar	40.4	20.0	7.7	11.0	11.2	11.9
M.	13.4.10.38 Vijayanagar, Bellary	37.6	18.3	7.3	10.7	11.1	11.0
F.	13.4.10.41 Vijayanagar	37.3	17.4	—	11.2	10.6	11.4
M.	13.4.10.40 Vijayanagar	37.8	18.8	7.6	10.9	11.4	11.4
M.	12.6.29.58 Dharwar	40.1	19.6	7.9	12.2	11.2	11.8
F.	13.4.11.57 Kolar, Mysore	38.7	19.0	7.4	11.4	10.5	11.5
M.	13.4.11.59 Seringapatam, Mysore	39.6	18.5	—	11.8	10.5	11.8
M.	13.4.11.61 Seringapatam. Parietal ridges fused	38.8	19.4	7.5	11.2	10.8	11.5
F.	98.4.2.26 Bundha, Bombay	39.2	19.9	7.8	11.2	11.3	12.1
M.	13.4.11.60 Seringapatam	39.5	18.6	7.7	12.0	10.9	11.9

The type has the occipitonasal about 39.2 mm.

<i>Funambulus palmarum matugamensis</i>							
M.	20.4.23.3 Anasigalla, Ceylon	37.7	18.7	7.2	11.1	10.1	12.0
M.	20.5.15.3 Anasigalla	39.2	19.6	7.3	11.7	11.6	11.8
M.	20.4.23.4 Anasigalla	38.3	18.7	7.4	10.8	11.8	11.6
M.	20.5.1.12 Anasigalla	39.0	19.4	7.6	11.3	10.8	11.3
M.	20.6.9.38 Anasigalla	38.4	18.9	7.3	11.1	11.3	11.5
M.	20.5.13.4 Anasigalla	37.6	19.0	7.8	11.1	11.6	11.4
M.	20.5.1.13 Anasigalla	37.5	18.3	—	11.1	11.6	11.1
F.	20.1.27.7 St. George, Matugama, Ceylon	36.2	17.7	<i>circa</i> 7.2	10.4	11.1	11.5

The type has the occipitonasal about 37.8 mm.

TABLE 35.—*Cranial measurements of the Indian 'races' of Funambulus palmarum (contd.)*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Funambulus palmarum brodiei</i>							
M.	15.3.1.76 Mannar, Ceylon	40.5	20.0	—	11.8	11.7	12.5
M.	15.3.1.77 Ceylon	38.8	19.0	7.8	10.5	12.3	11.8
M.	15.3.1.79 Cheddikulam, Ceylon	39.3	19.5	7.9	11.6	12.1	11.5
M.	15.3.1.81 Cheddikulam	39.7	19.5	7.7	11.7	12.3	10.5
F.	15.3.1.82 Cheddikulam	38.8	19.1	7.7	11.8	11.1	11.5
F.	15.3.1.83 Cheddikulam. Parietal ridges fused	39.4	19.8	—	11.8	12.2	12.0
F.	15.3.1.84 Cheddikulam. Parietal ridges fused	39.8	19.6	7.8	11.6	11.8	12.0
F.	15.3.1.85 Cheddikulam	39.1	19.1	8.0	11.1	<i>circa</i> 12.1	12.2
<i>Funambulus palmarum kelaarti</i>							
M.	15.3.1.108 Ceylon	37.5	18.2	7.5	11.4	11.8	11.3
M.	2.10.7.22 Kandy, Ceylon	41.5	20.6	8.8	12.8	11.7	12.4
F.	2.10.7.23 Kandy. Parietal ridges fused	41.4	20.2	—	13.1	12.1	11.7
M.	15.3.1.97 Apura, Ceylon. Rather young	36.3	18.2	7.5	11.1	10.9	10.9
F.	15.3.1.99 Wellawaya, Ceylon	39.2	19.2	—	12.3	12.0	11.7
F.	15.3.1.99 Wellawaya	39.5	20.1	7.7	11.9	11.1	12.1
F.	15.3.1.102 Mankeni, Ceylon	39.2	19.3	7.4	11.6	11.4	11.2
M.	15.3.1.104 Ceylon	39.6	19.6	7.7	12.5	11.4	11.3
M.	15.3.1.105 Hambantota, Ceylon. Parietal ridges fused	37.8	18.6	7.4	11.2	11.1	11.6
M.	15.3.1.107 Ceylon	39.2	19.0	7.2	11.9	11.5	11.6
F.	15.3.1.116 Kala-oya, Ceylon	38.5	—	—	11.4	11.2	11.7
F.	15.3.1.119 Kala-oya. Parietal ridges fused	38.5	19.4	7.8	11.0	11.3	11.5

TABLE 35.—*Cranial measurements of the Indian 'races' of Funambulus palmarum (concl'd.)*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Funambulus palmarum kelaarti ('olympius')</i>							
F.	6.10.9.8	36.9	17.9	7.2	10.7	10.6	11.4
	Peradeniya, Ceylon						
F.	6.10.9.9	39.6	19.7	7.9	11.7	11.0	12.2
	Peradeniya						
M.	15.3.1.87	38.5	18.5	7.9	12.0	11.1	11.7
	Peradeniya						
M.	15.3.1.89	40.9	19.9	7.9	12.3	11.5	12.0
	Urugalla, Ceylon						
M.	15.3.1.89	39.3	19.6	7.5	11.7	12.1	11.4
	Urugalla						
M.	15.3.1.90	40.1	19.7	—	12.1	12.1	12.0
	Ceylon						
F.	15.3.1.92	39.1	19.5	8.0	11.4	11.8	11.7
	Urugalla, Ceylon						
F.	15.1.1.95	39.6	19.9	8.1	11.9	11.9	11.7
	Urugalla						
F.	15.3.1.94	38.9	19.9	8.4	11.1	11.6	11.6
	Ambawela, Ceylon						
M.	6.10.9.3	41.8	20.4	—	13.2	11.7	12.1
	Peradeniya, Ceylon						
M.	6.10.9.5	41.1	20.1	7.9	13.3	11.4	12.1
	Peradeniya						
F.	15.3.1.96	38.2	18.8	7.8	11.7	11.0	11.8
	Putlam, Ceylon						
M.	15.3.1.91	40.4	19.8	—	11.9	11.2	11.8
	Urugalla, Ceylon						

The type has the occipitonasal about 39.6 mm.

<i>Funambulus palmarum kelaarti ('favonicus')</i>							
M.	15.3.1.126	38.5	19.4	—	11.9	11.3	11.8
	Udugama, Ceylon						
M.	15.3.1.123	38.6	19.1	7.9	12.5	11.9	11.5
	Rama, Ceylon						
M.	15.3.1.124	38.6	—	—	11.8	11.6	11.3
	Kottawa, Ceylon						
F.	15.3.1.125	39.4	19.5	—	11.9	11.6	11.7
	Kottawa						
F.	15.3.1.131	40.1	19.6	7.5	12.4	11.8	12.0
	Udugama, Ceylon.						
	Parietal ridges fused						

The type has the occipitonasal about 37.7 mm.

Dimensions of the species Funambulus palmarum.—The occipitonasal length varies between 36.2 and 41.8 mm. Toothrow 6.7–8.8 mm. The head and body varies between

118 and 189 mm. Tail between 103 and 178 mm. (I assume the few skins with tail measurements less than 100 to have the tail imperfect.) Hindfoot 21-44 mm.

Provisional key to the races of Funambulus palmarum

1	(2) The nasals longer, on average approximating to or exceeding 30% of the occipitonasal length in the majority of specimens....	[including 'olympius' and 'favonicus'). <i>F. p. kelaarti</i> (Ceylon,	
2	(1) The nasals shorter, on average not reaching 30% of the occipitonasal length in the majority of specimens.....		3
3	(4) The width of the frontals greater, approximating to or exceeding 30% of the occipitonasal length in the majority of specimens.....	[Ceylon). <i>F. p. brodiei</i> (North	
4	(3) The width of the frontals rarely reaching 30% of the occipitonasal length.		5
5	(6) The toothrow is shorter, 7 mm. and less, usually less.	[Provinces). <i>F. p. robertsoni</i> (Central	
6	(5) The toothrow is more than 7 mm. in length.		7
7	(10) The length of the tail is on average shorter than the head and body.		8
8	(9) Head and body rarely exceeding 156 mm. (2 exceptions in 26 skins).	[lon, Matugama). <i>F. p. matugamensis</i> (Cey-	
9	(8) Head and body length rarely is less than 156 mm. (1 exception in 16 skins).	[and Mysore). <i>F. p. bellaricus</i> (Bellary	
10	(7) The length of the tail is, in the majority of specimens, longer than the length of the head and body.	<i>F. p. palmarum</i> (with 'comorinus', 'gossei' and probably 'bengalensis'), southern India, and probably Bihar.	

As regards the key, in 92 skulls there are about 19 exceptions to the nasal percentage given (about equally divided between *kelaarti* and those which follow); about 17 exceptions to the frontal width given against *brodiei* (14 in those below *brodiei*, 3 in that race); the toothrow reaches 7 mm. only once in *robertsoni*; and individual exceptions to the tail length given for the last three races appear to be roughly 22 in about 76 skins.

Subspecies.—This species has been divided into eleven subspecies, most of which were based on supposed colour characters. I do not find these colour characters constant

when all available specimens of the species are placed together and examined. Wroughton in his Mammal Summary divided *F. palmarum* into three groups of three races: the first three were supposed to have 'pale dorsal stripes all three buff'; the next three, with 'pale dorsal stripes not all three buff; central dorsal stripe white, laterals buff'; the last group, 'all three dorsal stripes white'. It is not as easy as that! For instance, *brodiei* ('all three dorsal stripes buff') contains a specimen with a white mid-dorsal and buff lateral stripes, and a specimen with a buff mid-dorsal and white lateral stripes. I am unable to distinguish a specimen of *bellaricus* ('3 stripes white') from a specimen of *comorinus* ('3 stripes buff') in colour; I have a specimen of *comorinus* with the mid-dorsal white, the laterals buff; at least three specimens of *kelaarti* ('central dorsal white, laterals buff') with three white stripes, and a specimen of *olympius* (which should agree with *kelaarti* according to Wroughton's key) with three white stripes. A specimen of *bellaricus* ('3 white stripes') has them all buff; and so forth. Whether there is any seasonal change, or whether this colour of the pale stripes is purely individual I do not know.

The second and third names in this species are both from Ceylon, and both appear to me to be retainable. Thomas and Wroughton in 1915 wrote a paper on the Ceylonese races of *F. palmarum*, Wroughton wanted to restrict the typical race to Madras, and they compared it with their Ceylonese races. '*Favonicus*' was the first new race described from Ceylon by Thomas and Wroughton; 'general colour above darker than true *palmarum*...the saddle much darker. .the central dorsal stripe white, the lateral ones ochraceous buff .the tail below "cinnamon rufous", i.e., red rather than yellow'

They describe *palmarum* as with 'three longitudinal lines coloured cream buff; the face prominently washed with bright ochraceous...the midrib of the tail below bright ochraceous' *Kelaarti* (which dates from 1851) was next to be considered; 'size of *favonicus* and general colouring much as in that form, but all three dorsal stripes white'. The only skins I have seen for '*favonicus*' were collected in April, and it is quite incorrect to state that there is any difference in the colour of the stripes between *kelaarti* and '*favonicus*'. In a considerable series for *kelaarti* collected in five different months of the year as listed above quite half of the specimens have the central dorsal stripe white, the lateral ones buff, and it becomes obvious that '*favonicus*' is a pure

synonym of *kelaarti*. It may also be mentioned that some skins of true *palmarum* have at least some of the stripes white, and that the line of demarcation between the 'white' type and the 'buff' type in any race frequently becomes a matter of doubt. *Brodiei* was the next race noted by Thomas and Wroughton. It dates from 1849. It is supposed to be 'the form of the extreme north, most nearly approaching true *palmarum* in coloration, but larger in size' (I very much doubt the last statement, although many of our *brodiei* skins have the head and body tending to be larger than *palmarum*.) 'This form most nearly approaches true *palmarum* in colouration, but the grey face and shoulders, and above all, the red (instead of yellow) colour of the underside of the tail serve to distinguish it.' The tail below was described as 'orange rufous' (i.e., red rather than yellow), and the three dorsal stripes are buff. We have only winter skins. However, in at least two specimens the face is ochraceous, as in the typical race, and I find it quite impossible to distinguish the two races on the colour of the underparts of the tail when all specimens are examined. Lastly, *olympius*, 'a dark highland form'; 'resembling *brodiei* but much darker. The saddle commonly almost black, and the central dorsal stripe paler than the two lateral ones, often white. The lower side of the midrib of the tail is much darker chestnut than in *brodiei*' The latter statement is true, but either type can be matched by different specimens of *kelaarti*. 'Dark colour' is supposed to distinguish this race from the others on the island. But many specimens examined for *kelaarti* and some for '*favonicus*' are just as dark as any '*olympius*'. It is not clear how this form can be distinguished from *kelaarti*. In the key given by Thomas and Wroughton, the 'face is more or less bright ferruginous' for *kelaarti* and '*favonicus*', as against 'face not ferruginous' for *olympius*. But as I have noted above, at Peradeniya different specimens were taken at the same locality in the same month, some with grey face as defined for the race, others with the brightest brown forehead of any seen from the island. Later (1926), a considerable series of *F. palmarum* from Matugama came to hand, and were made the basis of a new race *matugamensis* by Lindsay. It was specially compared with '*favonicus*', although it seems to me to stand nearest to *brodiei* among the Ceylon forms. 'The face is as a rule coloured like the neck but in winter pelage gets a reddish tinge.' 'The three dorsal stripes are here all the same colour of tawny or tawny ochraceous. The tail is orange rufous below, resembling that of

brodiei.' Some of the specimens seen, however, have the mid-dorsal stripe pure white. Lindsay then gave some cranial characters for *matugamensis*, and made some statements about the shape of the nasals of the various races; 'examination of the collection as a whole shows that the shape of the nasals in the different subspecies is fairly constant; e.g., the posterior edge of the nasals in *F. p. favonicus* is deeply and sharply serrate; that of *F. p. kelaarti* is also pointed but not so deeply serrate and the nasals terminate practically in a line with the frontopremaxillary suture, while that of *F. p. olympius* is of rounded shape, almost oval, and ends well in front of the suture' I do not think that there is sufficient constancy in these characters for them to be used as basis of racial discrimination, but they did lead me towards one of the characters which I think is reasonable to use, and that is the average proportionate length of the nasals; and I think also that Lindsay was right in separating *matugamensis* from the other Ceylonese races, though it is puzzlingly like one of the more northern mainland races which antedates it (*bellaricus*). Lindsay states that in classifying 140 specimens 'reliance has been placed mainly on the characters of the skull and on the locality whence they were obtained since the variability of colour of coat and size in any one species is considerable depending on the season and the nature of the habitat' *Matugamensis* comes from country about 100 feet above sea-level in one of the moistest areas of Ceylon.

I have reached the conclusion, after working carefully through this difficult species, specimen by specimen, that in Ceylon there are probably three valid races, *brodiei*, *kelaarti* ('*olympius*', '*favonicus*' included), and *matugamensis*. Details for the reasons for this conclusion will be given below.

On the mainland, the first race to be separated from the typical was *comorinus* (Wroughton, 1905). According to Wroughton's key, it should be like *palmarum* but with 'feet like the body' instead of 'whitish' and 'general colour darker' instead of paler. It is however quite impossible to distinguish the two races when the British Museum specimens are examined, and I assume therefore that '*comorinus*' is a synonym of *palmarum*. It seems also impossible to distinguish the form '*gossei*' from this race. '*Gossei*' was described in 1919 by Wroughton and Davidson as a squirrel of the *tristriatus* group, 'markedly smaller than *tristriatus* and *numarius*, slightly smaller than *thomasi*' It was based on a few skins collected in June and July, and was 'readily distinguishable

by its small size' which is not to be wondered at as its describers only compared it with *tristriatus*, and nearly all races of *palmarum* can be distinguished from *tristriatus* by smaller size! These authors pointed out in this paper that 'the sleek coat of the *palmarum* group as compared with the rougher, more ragged-looking fur of the jungle-dwellers (i.e., *tristriatus*) is a better guide to diagnosis than size of the respective skulls' (!) Actually, apart from quality of fur often changing seasonally in squirrels, there are specimens of *comorinus* which have just as 'rough, ragged-looking' fur as 'gossei'. The latter form has the brownish colouring on the head suggested, and the stripes are white or cream. I can see no way in which this supposed form can be constantly separated from 'comorinus' which in turn I am unable to separate from the typical race.

Wroughton in 1916 described three more subspecies for *F palmarum* from more northern localities than the last three supposed races. The first of these is *bellaricus*; 'A *Funambulus* the size of *F palmarum* from which it differs in the complete absence of yellow suffusion on the forearms, shoulders, and thighs'. Dorsal stripes described as creamy white, and face more or less suffused with ochraceous 'according to season'. I cannot see much constant difference in the colour between this and the southern races, and Wroughton stated himself that 'specimens from South Mysore must be considered as intermediates, some of them approaching *bellaricus*, and some true *palmarum*'. He next described *robertsoni*, 'a sombre coloured *Funambulus*, markedly smaller than in *palmarum*'. Dorsal stripes 'buffy white': face 'suffused with ochraceous in some specimens, not in the type'. Lastly, *bengalensis*, 'resembling *robertsoni* in its small size, but distinguishable by its larger teeth and the presence of an ochraceous tinge on the flanks'. A glance at my table of measurements will show that the last two cannot be distinguished on size from true *palmarum* in either the skins or the skulls.

It becomes clear that colour is, as often in squirrels, unreliable as a basis for racial discrimination. Any division of this species into races must be on average characters rather than absolute ones, on account of individual variation. I offer a very provisional key in which I retain six races based mainly on average cranial details and external measurements. I do not think it necessary to retain more and I am not convinced that in our present state of knowledge more could be retained.

(i) **Funambulus palmarum palmarum** (Linnaeus)

Text-fig. 13

1766. *Sciurus palmarum* Linnaeus, *Syst. Nat.*, 12th ed., 1, 86.
 1814. *Sciurus penicillatus* Leach, *Zool. Misc.*, 1, 6, pl. 1. (Madras.)
 1835. *Sciurus indicus* Lesson, *Illustr. Zool.*, 15, pl. 43. Not of Erxleben, 1777.
 1905. *Funambulus palmarum comorinus* Wroughton, *J. Bombay nat. Hist. Soc.*, 16, 411. (Trivandrum, Travancore.)
 1916. *Funambulus bengalensis* Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 648. (Hazaribagh, Bihar.)
 1919. *Funambulus gossei* Wroughton and Davidson, *J. Bombay nat. Hist. Soc.*, 26, 3, 730. (Kotagiri, Nilgiri Hills.)

Type-locality.—Madras, India (selected by Wroughton).

Range.—Specimens have been examined from MADRAS, Kilpauk, Adyar, and no exact locality. Shevaroy Hill, Kodura, Balapalli Range, Kurumbapatti, Salem district, E. GHATS. Machur, Nellitore and Perumal in South India. Trinchinopoly. Trivandrum in Travancore. Benhope, Kotagiri, Kuttyani, Mahendragon, Nagercoil in Nilgiri district. Gantla, Coimbatore. Gajhundi, Hazaribagh and Jagodih, Hazaribagh, Bihar ('*bengalensis*').

Occipitonasal length 36.6–40.3 mm. Nasals averaging less than 30% of the occipitonasal, and frontals the same. Tail averages longer than the head and body (8 exceptions in about 30 skins). Head and body length 120–165 mm.

(ii) **Funambulus palmarum matugamensis**

Lindsay

1926. *Funambulus palmarum matugamensis* Lindsay, *J. Bombay nat. Hist. Soc.*, 31, 239.

Type-locality.—Anasigalla, Matugama, Western Province, Ceylon.

Range.—Specimens examined from CEYLON: Anasigalla and St. George, Matugama.

Occipitonasal length 36.2–39.2 mm. The nasals and frontals are proportionately as in the typical race. But the tail averages shorter than the head and body (about 6 exceptions in 21 skins with complete tails). Head and body length 125–181 mm. but only twice over 156 mm. in 26 skins.

(iii) **Funambulus palmarum bellaricus**
Wroughton

1916. *Funambulus palmarum bellaricus* Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 647.

Type-locality.—Vijayanagar, Bellary.

Range.—Specimens seen from BELLARY, Vijayanagar; MYSORE: Bangalore, Kolar, and Seringapatam; DHARWAR district; Dharwar, Gadag, Hawbshavi, and Samasgi. Bundha, Bombay (identification provisional).

Occipitonasal length 37.3–40.4 mm. Nasals and frontals proportionately about as in the typical race, from which it differs (like *matugamensis*) in having the tail average less than the head and body length (3 exceptions in 15 skins). The head and body length is 147–177 mm.; but only once below 156 mm. therefore averaging larger than *matugamensis* throughout. Nearly half the specimens have the hindfoot 40 mm. and more, whereas *matugamensis* does not reach this measurement. This name antedates *matugamensis*.

(iv) **Funambulus palmarum robertsoni**
Wroughton

1916. *Funambulus robertsoni* Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 647.

Type-locality.—Pachmarhi, Hoshangabad, Central Provinces.

Range.—Specimens examined from CENTRAL PROVINCES: Pachmarhi, Hoshangabad; Asirgarh and Sival, Nimar; Dhain and Rorighat, both Hoshangabad; Kolkaz, Berar.

This race seems to differ from all others in its relatively short toothrow, in which the length reaches 7 mm. in only one specimen. All other specimens available to me for other races have the toothrow exceeding 7 mm. in length.

Occipitonasal length 36.6–40.0 mm. Nasals and frontals on average about as in the typical race. Tail averaging about 100% of head and body or slightly less (definitely shorter in three skins out of nine). Head and body length 140–149 mm.

(v) **Funambulus palmarum brodiei** (Blyth)

1849. *Sciurus brodiei* Blyth, *J. Asiat. Soc. Beng.*, **18**, 602.

Type-locality.—Point Pedro, Ceylon.

Range.—Specimens examined from CEYLON: Cheddikulam and Mannar.

This race, as far as our material shows, differs from the remainder in its wider frontals, which average 30% of the occipitonasal length, and exceed 12 mm. in width in 5 out of 8 specimens. Occipitonasal length 38.8–40.5 mm. Nasals average less than 30% of the occipitonasal length. Tail averaging about 100% of head and body (longer than that length in 5 specimens, and shorter in 5). Head and body length 143–158 mm.

(vi) ***Funambulus palmarum kelaarti* (Layard)**

1851. *Sciurus kelaarti* Layard in Blyth, *J. Asiat. Soc. Beng.*, **20**, 166.
 1915. *Funambulus palmarum favonicus* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 1, 39. (Udugama, Southern Province, Ceylon.)
 1915. *Funambulus palmarum olympius* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 1, 41. (Urugalla, 1,600 ft., highlands of Central Ceylon.)

Type-locality.—Hambanlotte, Ceylon.

Range.—Specimens seen from CEYLON: Aripo, Apure, Hambanlotte, Mankeni, Kala-oya, Putlam, Wellawaya, Kandy, Peradeniya, Urugalla, Ambawela, Kottawa, Rama, Udugama.

This race seems to differ from the remainder in having average proportionately longer nasals, which in the majority of the specimens exceed 30% of the occipitonasal length. The number of individual exceptions here perhaps is rather high (nearly one-third) but it is an average rather than an absolute difference and in the other races it is rare for the nasals to be as long as this. Occipitonasal length 36.3–41.8 mm. Frontals averaging less than 30% of the occipitonasal length. Tail averages shorter than head and body (about 13 exceptions in about 58 skins). Head and body length 125–189 mm. As I have endeavoured to show above, I do not think '*olympius*' can be maintained on colour characters when compared with *kelaarti*, and I am quite sure that '*favonicus*' cannot.

Genus 9. *Ratufa* Gray

1867. *Ratufa* Gray, *Ann. Mag. nat. Hist.*, **20**, 273.
 1867. *Rukaia* Gray, *Ann. Mag. nat. Hist.*, **20**, 275, 276. (*Sciurus macrourus* Pennant.)
 1880. *Eosciurus* Trouessart, *Le Naturaliste*, **2**, 37, 291. (*Sciurus bicolor* Sparrman.)

Type-species.—*Sciurus indicus* Erxleben.

Range.—CEYLON, PENINSULAR INDIA, NEPAL, ASSAM,

BURMA, South Yunnan, Hainan, Indo-China, Siam, Malay States, Sumatra, Java, Borneo, the Natunas and other small Malayan Islands.

This genus contains very large arboreal squirrels which have only four upper cheekteeth. This character, though unique in Indian squirrels, is not a character which is regarded as of generic value elsewhere in the family. It is, in the present genus, combined with certain other marked peculiarities. The frontal bones (= least interorbital measurement) are unusually wide, sometimes as much as 40% of the occipitonasal length, and in a large number of races which I have had available for cranial measurement, on average not under 37% of the occipitonasal for any race. The palate is unusually short, averaging for the various races 45% or less of the occipitonasal length. There is no sagittal crest in the skull, and the ridges do not show signs of approaching each other on the parietals. The tail is very generally longer than the head and body. With one exception, the type (and only specimen I have seen) of a ?dwarfed island race, *nanogigas*, from Laut Island, Natunas, the occipitonasal length of the skull is in this genus not less than 60 mm. I have measured more than 200 *Ratufa* skulls (and more than 1,300 skulls measured for allied Indo-Malayan and Palaearctic species of tree-squirrels, in which the occipitonasal length does not reach 60 mm.). The sole exception is the large *Callosciurus* (*Rubrisciurus*) *rubri-venter* from Celebes, which has the skull of a *Callosciurus* but it is as large as *Ratufa*. The orbit in this genus is normally, as in tree-squirrels, less than one-third of the occipitonasal length, but occasionally, possibly on account of the enlarged size of the animals, the orbit may be as much as one-third of the occipitonasal length. According to Pocock, the baculum is more of the type of *Funambulus*, than of the eastern genera (i.e., *Callosciurus*, etc). In this character, *Ratufa* shows some approximation apparently to some African genera, and it is an interesting fact that *Ratufa* and *Funambulus* are the only squirrels other than certain flying squirrels which are found in Ceylon and the Peninsula of India. According to Pocock, the baculum lacks the accessory blade which is said to be present in *Callosciurus*, *Menetes*, and *Dremomys*. The dentition tends to be slightly peculiar, with the front premolar above suppressed, and the teeth brachyodont, with low cusps and indistinct ridges, and a distinct inclination for the teeth to be somewhat simple and patternless or for small depressions and pits to mask the essential Sciurine pattern. The character of the unusually wide frontals is shared by *Callosciurus prevosti* and that of

the very short palate by *Callosciurus macclellandi*, etc., but the combination of both these cranial characters, very large size, four upper cheekteeth and rather indistinct molar pattern is not known elsewhere in the family.

External characters.—As in species (p. 251).

Cranial characters.—The cranial characters of species of this genus vary but little from race to race, and it will be most convenient to deal with the skull and teeth characters of the genus here. The skull is large, normally over 60 mm. in occipitonasal length, and up to 81 mm. at extreme development. The nasals broad, of medium length, and rather pointed downwards anteriorly. Frontal bones long and very wide, sometimes as much as 40% of occipitonasal length at their narrowest part. Postorbital process wide, strong, large and well spread out from sides of skull. Suture of frontals and parietals at a point considerably behind the postorbital process, and usually lost in the adult. Parietals wide, faintly but definitely ridged, but the ridges do not join nor approach each other. Occiput rather low; paroccipital process quite prominent. Bullae of medium size, quite well inflated. Hamular process of pterygoid not joining bullae, but long and prominent; considerably longer than the ectopterygoid; pterygoid fossae shallow and narrow. Palate broad; and very short, considerably less than half occipitonasal length. Palatal foramina quite large and well developed as a general rule, though considerably in front of the toothrows. Zygomatic plate broad, well tilted upwards and ridged on its outside; jugal long, and zygoma of normal Sciurine formation. Mandible with quite strong coronoid process, the condylar process thick and prominent, the angular process well ridged on its lower border, and powerful.

Dental characters.—The upper incisors are narrow, opisthodont, red and plain. Only four upper cheekteeth. The cheekteeth are brachyodont, and the pattern is fundamentally as is usual in the family, but the cusps are apparently always low; front cusp of P. 4 rather central and prominent (evidently taking the place of P. 3 of other genera); M. 3 simpler than the other molars, the second central transverse ridge absent as usual; there is a distinct tendency towards presence of numerous small depressions or pits in the molars; and the pattern often becomes rather indistinct and rather simple (only with traces of many small depressions and complexities). The lower molars have at least originally the characteristic four main cusps, one at the corner of each tooth, the anterointernal one highest, but as a rule all cusps rather low; the large central depression in these teeth is as

a rule retained, and small subsidiary outer and inner cusps between the main ones are quite apparent; in addition there are many small pits or depressions often present, particularly sometimes in M. 3, which is as usual slightly the dominant lower tooth, the teeth decreasing slightly in size from M. 3 forwards. Sometimes the small pits become so numerous that they almost mask the essential Sciurine pattern of the teeth, and produce an effect vaguely reminiscent of that of *Petaurista*, though not so extreme as in that genus.

Blanford recognized three species of *Ratufa* in India, which he placed in the genus *Sciurus* with the other tree-squirrels. I see no good reason for retaining more than that number in India. Subsequent to Blanford's time, splitters like Thomas and Wroughton and Miller divided this genus into many so-called species, and Robinson and Kloss in 1918 reduced these to about nine, a classification which I followed in 1940. More recently Chasen, 1940, has shown that there are two species of *Ratufa*, a larger and a smaller one, occurring side by side throughout, in the Malay States, Sumatra, Java, and Borneo, the first names for which are *bicolor* and *affinis*. One of them, *bicolor*, occurs northwards to Nepal and Burma. In Ceylon and the Peninsula of India, there are also two species occurring side by side, one averaging smaller and one larger. The names for these are *macroura* and *indica*. *R. macroura* is the earliest name in the genus, dating from 1769, and *indica* is the second, dating from 1777. Indeed, this genus might be reduced to two species bearing these names, but the species from the eastern side of the Bay of Bengal have always been considered distinct from the western species, and, as *indica* is rather a strikingly coloured distinct form when compared with *bicolor* races, and as *macroura* has its peculiarities when compared with the Malayasian species *affinis*, I retain Blanford's classification, and recognize four species in this genus. The three Indian species may be keyed as follows :—

Key to the Indian species of Ratufa

- 1 (2) The hindlimbs are pale in colour, like the underparts. (Rather a small species, the occipitonasal length is seldom more than 69 mm. and reaches 70 mm. only in three specimens examined). *Ratufa macroura*
- 2 (1) The hindlimbs are dark like the back. (The feet may be pale.) (In Indian races of *bicolor*, the occipitonasal length is normally

not under 70 mm. In *indica*, the occipitonasal length is in material examined only less than 69 mm. in two specimens out of more than 40).

3

- 3 (4) General colour deep red, at least in part, and always with hairy red ears. (Usually a large species, the occipitonasal length at highest is 81 mm.) The forelimbs are pale. A white neckpatch. . . *Ratufa indica*
- 4 (3) General colour never deep red. Forelimbs not entirely pale normally. No white neckpatch *Ratufa bicolor*

31. *Ratufa macroura* (Pennant)

The Grizzled Indian Squirrel

1769. *Sciurus macrourus* Pennant, *Ind. Zool.*, 1, pl. 1.

Vernacular names.—Rukiya, Dandolena: *Cingalese*; Perianathan, *Tamil*.

Distribution.—CEYLON and SOUTHERN INDIA.

This species is the first to be named in the genus. It is a rather small species, with the occipitonasal length 70.5 mm. highest, but less than 70 mm. in fourteen out of seventeen skulls measured. The hindlimbs outside are pale in colour, like the lower parts, and this fact distinguishes the species from both of its allies occurring in India. The forelimbs are also pale on the outside (like *R. indica*, but unlike *R. bicolor*).

External characters.—A largish squirrel, the head and body most often over 300 mm., but not always so. In one specimen only it exceeds 400 mm. The tail normally, but not always, longer than the head and body. The ear is usually hairy, but usually not tufted, at least not so heavily as it is in *R. indica*. (The ear tuft seems to tend to be best developed in the black races.) The hand of this genus is remarkable apparently on account of the fact that the inner carpal pad is enlarged and projects inwardly, its appearance like that of a small thumb, of which this pad evidently takes the place. This formation is present in this species, and the hand is essentially as described for *R. indica* below as regards the arrangement of the digits. The feet are essentially as described below for *R. indica*. 6 mammae.

Colour.—*R. m. macroura*.—The head and the whole of the back are quite black. On the back of the neck a light brown

patch, the centre of which is white, in the two authentic skins seen. Tail mostly black above, but throughout its length edged with light grey or whitish hairs. Hands and feet black. The forelimbs and the hindlimbs are whitish practically throughout, and contrasted with the hands and feet. Cheeks below the eye black; nose brown. Underparts whitish-yellowish with black tipped hairs, tail black below, the hairs edged white. Authentic skins seen from Pattipola. (For the nomenclature of the races of this species see Thomas and Wroughton, 1915.)

R. m. melanochra.—Is essentially similar, but the tail is wholly black throughout, and the undersurface is deeper in colour, more ochraceous. Authentic skins from Anasigalla and Sinharaja Forest. Both these types seem rare.

R. m. dandolena.—This race is much the most plentifully represented in our collection, and it was on it that Blanford apparently based his description of the normal colour of the species in 1891. There is much difference individually in colour, and a sharp difference between the darkest and the lightest skins. The dorsal coloration was noted by its describer as grizzled grey, with an underlying brownish suffusion. The shoulders are usually black or blackish; there is a white neckpatch; and the top of the head is black or blackish. Tail black broadly washed with grey, sometimes tending to be wholly pale terminally, and always mottled in general effect, as in the typical race, only more so. Arms and legs pale, whitish, the hands and feet black to a certain extent (sometimes the digits only). Cheeks usually pale, or much less dark than the typical race. Underparts whitish or buffy; centre of tail below with a white line running down its length, but otherwise coloured as it is above. A few skins, from Kumbukkan and Mousekande (Ceylon), have the forepart of the back darker than is usual.

With regard to the race called '*sinhala*' by Phillips, and based on 'smaller size, and general colour grizzled lighter brown' as compared with *dandolena*, I can detect no colour difference in the material seen between it and specimens of *dandolena*, and a glance at my table of skull and skin measurements shows that there is no constant difference between this and *dandolena* in size. It is true that in both skins examined for *sinhala* the tail is shorter than the head and body, but I would like to see many more specimens before retaining the race on this character alone, as there are individual *dandolena* with the tail less than head and body length. I would doubt whether '*sinhala*' is anything but a synonym of *dandolena*.

External measurements.—As in Table 36, below.

TABLE 36.—*External measurements of the Indian races of Ratufa macroura*

		Head and body	Tail	Hind- foot	Ear
<i>Ratufa macroura macroura</i>					
F.	Pattipola, Ceylon	336	366	68	23½
M.	Pattipola	335	345	74	23½
<i>Ratufa macroura melanochra</i>					
	Kottawa, Ceylon, type	355	365	74	26
Unmeasured skins from Anasigalla, Matugama and Sinharaja Forest.					
<i>Ratufa macroura dandolena</i>					
M.	Mahaoya, Ceylon	307	344	63	22
M.	Mahaoya, Ceylon	325	335	68	23
M.	Mahaoya	330	359	64½	21½
F.	Kumbukkan, Uva, Ceylon	357	326	65½	22½
F.	Mankeni, East Province, Ceylon	316	357	65	21
F.	Mankeni	335	375	49	24½
F.	Rama, Ceylon	286½	333	62	22½
M.	Mousekande, Ceylon	374	361	66	24
M.	Wellawaya, Ceylon	410	395	70 ?	23
M.	Kurumbapatty, Salem, Eastern Ghats	310	390	78	25
M.	Kurumbapatty, Salem	310	390	74	23
F.	Chettiri Range, East Ghats	320	370	73	24
M.	Chettiri Range	290	340	70	22
F.	Wellawaya, Ceylon, type	377	415	71	26

Mammæ 6

Unmeasured skins from Foothills to west of Shrivilliputtur, Madura, North slope Palni Hills, Kombu, Coimbatore.

Ratufa macroura 'sinhala' = dandolena

	Tirrapara, Ceylon (N.C. Province)	350	346	61	25
M.	Type	344	309	63	23
From Vedichchai, Kantalai, Ceylon					

Some notes from skins.—*R. m. macroura*, 'shot in jungle, weight 2½ lb.', another weighed 2 lb. 6 oz.

R. m. melanochra, 'shot in isolated jungle on the top of small hill surrounded by rubber estates'

R. m. dandolena, Mousekande, 'weight 3 lb. 5 oz.' Chettiri Range; mammae 6, weight $2\frac{1}{2}$ lb. Eastern Ghats, weight $2\frac{1}{2}$ lb. Maya Oya, 'weight 2 lb., shot in jungle' Tirrapana, '*sinhala*', 'weight 2 lb. 8 oz.' Mankeni, 'weight 2 lb. Shot in jungle, not many about now' (October). Gammaduwa, weight 2 lb. 11 oz. Mankeni, weight $2\frac{1}{4}$ lb. Maha Oya, weight $2\frac{1}{4}$ lb. and from Combu, South Coimbatore, 'not common; usually found in tamarind trees, and singly'

Cranial and dental characters.—As for the genus (p. 242).

Cranial measurements.—As in Table 37, below.

Dimensions of the species Ratufa macroura in the British Museum material.—The occipitonasal length varies between 62.2 and 70.5 mm. The toothrow between 12.4 and 14.4 mm. The head and body varies between 286 and 410 mm. Tail between 309 and 415 mm. The hindfoot (49)–61–78 mm.

Usually, but not always, the toothrow is more than one-fifth of the occipitonasal length.

There are two very well marked races apparently, each of which has been further split into two subsidiary races. One of these, the typical, is a black animal. The other is coloured entirely differently, much lighter, grizzled and with the colours varied. This is the form apparently regarded by Blanford as the typical race, but the lighter, grizzled type is known as *R. m. dandolena*.

Provisional key to the subspecies of Ratufa macroura

1	(2) General colour not black, but light and grizzled (greyish or brownish)	<i>R. m. dandolena</i>	
	(Skins examined which were collected in January, April, May, July, August, September and October.)		
2	(1) General colour above black		3
3	(4) Tail entirely black.	<i>R. m. melanochra</i>	
	(January and April skins.)		
4	(3) Tail hairs tipped with white	<i>R. m. macroura</i>	
	(Skins collected in March and August examined.)		

R. m. dandolena is much the most common form so far as the material examined indicates, and the two last named are rare in the collection. Both are confined to Ceylon, but *dandolena* occurs on the mainland as well. I doubt, from material examined, if Phillips' race *sinhala* can be separated from *dandolena*.

TABLE 37.—*Cranial measurements of the Indian races of Ratufa macroura*

		Occipitonasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Ratufa macroura macroura</i>							
M.	15.3.1.63	67.5	29.4	14.0	21.3	24.5	22.2
	Pattipola, Ceylon						
F.	15.3.1.64	69.6	29.5	13.4	21.7	24.4	23.6
	Pattipola						
<i>Ratufa macroura melanochra</i>							
M.	20.5.1.11	70.0	30.1	14.4	22.0	25.9	23.3
	Anasigalla, Matugama, Ceylon						
	15.7.1.4	70.1	30.7	14.2	23.0	27.4	23.8
	Kottawa, Ceylon, type						
<i>Ratufa macroura dandolena</i>							
F.	15.7.1.6	66.8	29.6	13.8	20.7	25.2	22.4
	Kumbukkan, Uva, Ceylon						
M.	15.3.1.67	66.5	27.9	13.3	21.4	25.1	21.5
	Mahaoya, Ceylon						
F.	15.3.1.70	63.0	27.3	12.6	20.1	25.6	21.2
	Mankeni, Ceylon						
F.	15.3.1.71	65.3	29.0	13.2	19.1	24.5	22.0
	Mankeni						
M.	20.9.2.2	64.5	27.6	12.5	20.4	25.9	21.7
	Shrivilliputtur, Madura, South India						
F.	20.9.2.3	62.2	26.7	12.7	18.5	24.6	—
	Shrivilliputtur						
M.	23.1.13.1	62.8	26.8	12.4	20.2	24.8	21.7
	North slope Palni Hills, South India						
F.	23.1.13.2	64.7	28.7	13.3	20.0	26.6	21.7
	North slope Palni Hills						
F.	23.1.13.3	67.1	27.9	13.5	21.7	26.5	22.0
	Combu, South Coimbatore, Nilgiri Hills						
F.	23.1.13.4	67.2	29.6	13.1	21.6	25.1	22.3
	North slope Palni Hills						
M.	31.1.12.1	70.5	30.2	13.7	23.9	26.8	23.3
	Mousekande, Ceylon						
<i>Ratufa macroura 'sinhala' = dandolena</i>							
F.	31.9.11.6	66.7	—	13.2	20.5	26.7	21.4
	Tirraparra, Ceylon						
M.	31.1.12.3	63.6	27.8	12.6	20.1	23.5	21.9
	Kantalai, North Central Province, Ceylon, type						

(i) **Ratufa macroura macroura** (Pennant)

1769. *Sciurus macrourus* Pennant, *Ind. Zool.*, 1, pl. 1.
 1777. *Sciurus ceylonicus* Erxleben, *Syst. Regn. Anim.*, 416.
 1785. *Sciurus ceilonensis* Boddaert, *Elench. Anim.*, 1, 117.
 1849. *Sciurus tennentii* Blyth, *J. Asiat. Soc. Beng.*, 18, 600.
 1852. *Sciurus macrourus* van. *montanus* Kelaart, *Prod. Faun. Zeylan.*, 50.

Type-locality.—Highlands of Ceylon.

Range.—Specimens seen from CEYLON: Pattipola.

General colour black; tail hairs tipped white throughout.

(ii) **Ratufa macroura melanochra**

Thomas and Wroughton

1915. *Ratufa macroura melanochra* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 1, 36.

Type-locality.—Kottawa, Southern Province, Ceylon.

Range.—Specimens seen from CEYLON: Kottawa; Anasigalla, Matugama; Sinharaja Forest (near Ketala Patela.)

Like the last, but with wholly black tail and apparently more ochraceous belly.

(iii) **Ratufa macroura dandolena**

Thomas and Wroughton

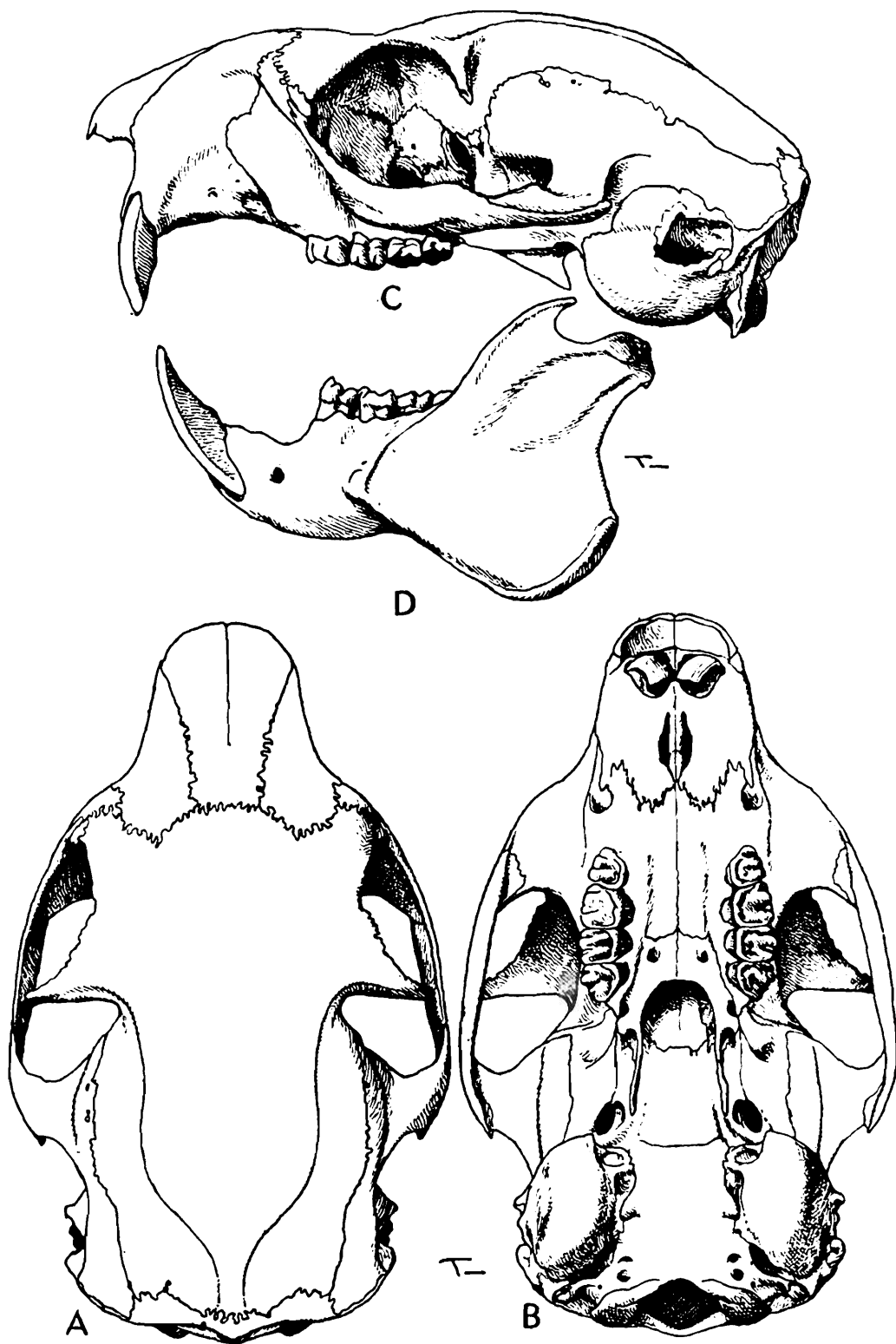
Text-fig. 14

1915. *Ratufa macroura dandolena* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 1, 36.
 1931. *Ratufa macroura sinhala* Phillips, *Ceylon J. Sci. Sec. B*, 16, 215. (Nikawewa, in the Veddichchai Game Reserve, about 10 miles south of Kantalai, Eastern Province, Ceylon.)

Type-locality.—Wellawaya, Uva, Ceylon.

Range.—Specimens seen from CEYLON: Maya Oya; Mousekande; Mankeni; Kumbukkan; Wellawaya; Rama; Hambantota; SOUTH INDIA: North slope Palni Hills; Kurumbapatti, Eastern Ghats; Foothills of Shrivilliputtur, Chettiri Range. Kombu in Nilgiris, Coimbatore, Tirrapura, in Ceylon ('*sinhala*'), also the type of the latter, which is from near Kantalai.

Robinson and Kloss (1918, p. 185) would use the name *Ratufa macroura albipes* Blyth, 1859 (*J. Asiat. Soc. Bengal*, 28, 287), for the Indian *Ratufa macroura*, thereby restricting



TEXT-FIG. 14. *Ratufa macroura dandolena* Thomas and Wroughton.
A, B, C, dorsal, ventral and lateral views of the skull. D, lower
jaw of the same. ($\times 3$).

the form *dandolena* to Ceylon. But a perusal of the literature suggests that this is a form which has dark limbs, 'uniform dull brown above and on *outside of limbs* down to feet', and therefore I suggest that this name was

not based on a form of *R. macroura* at all. Its locality is unknown, its type is apparently lost, and the name in any case seems to be preoccupied (Wagner, 1837). This name can certainly not be adopted in this sense.

32. *Ratufa indica* (Erxleben)

The Large Indian Squirrel

1777. *Sciurus indicus* Erxleben, *Syst. Regn. Anim.*, 420.

Vernacular names.—(From Blanford); Karrát, Rasu, Ratuphar, Jangli gilheri, *H.*; Kát berral, *Bengal*; Hondeng, *Kol.*; Shekra, *Mahr.*; Kes annalu, *Can.*; Bet udata, *Tem.*

Distribution.—PENINSULA OF INDIA.

A large species, the occipitonasal length of the skull averages over 70 mm. in length for all races, and in approximately forty specimens is only five times less than 70 mm. Most often the toothrow is more than one-fifth of the occipitonasal length.

This species differs from *R. macroura* in having the hindlimbs dark. The forelimbs are pale and the general colour is at least in part deep red; there is a white patch on the back of the neck and the ears are tufted and red. These colour characters are not combined elsewhere in the genus.

External characters.—A large squirrel, with the head and body over 300 mm. and up to 450 mm. and the tail averaging longer than the head and body in each race. The ear is heavily tufted and the tail bushy throughout, as usual. Hand with four fingers; fourth finger longest, the middle one longer than second and fifth; the hand broad and the inner carpal pad has a pollex-like prominence and is enlarged, and probably used for gripping. Foot very broad, with five toes, the hallux the shortest, the fifth digit rather shorter than the middle three which are nearly equal in length (fourth toe slightly dominant). Soles naked and pads large. 6 mammae.

Colour.—*Ratufa indica indica* and *R. i. superans*.—From the tufted ears and the back of the head, the whole of the upper surface is deep red throughout. The shade varies slightly from lighter to darker, but the general coloration is very distinctive. The tail is red above, the same colour of the back, and almost always has the end whitish or buffy for roughly a quarter of its length or a little more or less. (One skin, without locality, has nearly all the tail whitish.) A well developed large white patch between the ears is a conspicuous feature throughout the species. In front of this the

head is reddish or brown or sometimes dark. Outer side of hindlimbs red like the back. Feet usually red, rarely much lighter brown. The forelimbs are pale brown or whitish, the hands usually a little darker. Sides of head pale brown or light, with a reddish narrow stripe running down the sides of the neck in front of the ear. Lower parts buffy or yellowish brown. Lower part of tail either wholly red or whitish down centre, red at sides. We have two skins from Samasgi, Dharwar district; one of them is normal, but the other is transitionary towards *centralis*. Perhaps intergradation takes place here. I cannot escape the conviction that the form '*dealbata*' is based on albinistic examples. The tufted red ears remain in a skin available for examination, the whole of the rest of the back is whitish or in the lower back with a yellowish tinge; feet and tail white, forelimbs mostly white, hindlimbs with the yellowish tinge of the lower back apparent; underside mostly white. Before this form is accepted as a valid race, more specimens should be collected.

Ratufa indica bengalensis.—The original locality of this form seems not to be known. A few skins from Coorg and Mysore are very like the typical race except that the upper part of the tail is black (its end is light brown, as usual).

Ratufa indica centralis.—This seems to be the most widely distributed race, judging by the different localities from which it has been examined. The shoulders and upper part of the forelimbs are usually quite sharply contrasted black; the tail is black, as in *bengalensis*, but also to a greater or lesser degree the rump is black also, with few exceptions, as for instance the one skin from Kodura, Balapalli Range. Quite typical examples are available from as far south as the Nilgiris, although this race is typically more northern. It does not, however, occur in the same localities with any other form. The forehead tends to be dark. Other characters as in the typical race.

Ratufa indica maxima.—This is the second name in the species. It is a striking form, with most tendency for black to be present on the back. Thus it has the tail black (wholly so, without a pale tip), the rump black, and the whole of the fore part of the back black (i.e., the dark shoulders of *centralis* in this race are not two black patches separated by red, but they meet broadly behind a very short red patch on the neck which is immediately behind the white neckpatch). Very often, there is a narrow mid-dorsal area also which joins the black rump with the black shoulders, and then only the sides remain red; but this is not constant. Hindlimbs red, and usually the feet are contrasted pale. Forelimbs sharply

contrasted pale. Other characters as in *indica*. The skull in this race averages larger than in *centralis*.

External measurements.—As in Table 38, below.

TABLE 38.—*External measurements of the Indian races of Ratufa indica*

	Head and body	Tail	Hind- foot	Ear
<i>Ratufa indica indica</i>				
M. Helwak, Satara	375	405	57	29
F. Ghatmatha, Satara	342	445	61	27
F. Samasgi, SW. Dharwar	340	380	73	28
F. Samasgi	345	380	70	29
F. Devikop, S. Mah-ratta	370	425	77	33
M. Devikop	380	370	76	26
I have also examined a skin from Kanara, and type skins from the Deccan; also the type of ' <i>elphinstonei</i> ' from the Western Ghats.				
<i>Ratufa indica superans</i>				
F. Makut, Coorg	415	510	84	34½
F. Makut	400	480	90	38
F. Wotekolli, Coorg	420	490	92	33
F. Wotekolli, type	450	505	87	34½
<i>Ratufa indica bengalensis</i>				
F. Kutta, Coorg	390	418	80	33
F. Kutta, S. Coorg.	400	435	88	32
M. Kutta, Coorg	420	455	86	34
Also seen from Barampaddy Forest, Mysore.				
<i>Ratufa indica centralis</i>				
F. Bori, Hoshangabad	314	409	73	28
M. Bori, Hoshangabad	335	401	75	28
M. Bori, Hoshangabad	340	410	79	26
F. Dhain, Hoshangabad	338	433	77	28 6 mammae
M. Dhain, Hoshangabad	309	402	73	26
M. Sangajote, Chaibassa	345	425	75	28
F. Luia, Chaibassa.	323	385	74	28
M. Luia, Chaibassa.	365	425	76	30
F. Luia, Chaibassa..	355	420	76	27 6 mammae
F. Kodura, Balapalli Range, South Cuddapah	350	410	75	26
M. Balapalli Range	340	375	80	22

The following may also belong to this race, or perhaps to the next.

TABLE 38.—*External measurements of the Indian races of Ratufa indica (concl'd.)*

	Head and body	Tail	Hind- foot	Ear	
<i>Ratufa indica centralis</i> (concl'd.)					
F. Kotagiri, Nilgiri Hills	407	460	84	30	3 pairs mammar
F. Gantha, Coimbatore	365	400	79	32	
M. Kil Kotagiri, Nilgiris	340	445	77	30	
M. Bori, Hoshanga- bad, type	341	431	74	30	

A specimen also from the source of the Nerbudda 22° N. and 81° E. approximately and from Chamarajnagar, South Mysore.

<i>Ratufa indica maxima</i>					
Kukhal Shola, Palni Hills	390	?	79	27	

Other specimens from Poumudi in Travancore; Ootacoolie Estate, Malabar; Trivandrum, Travancore; Anamaad in Malabar; Kodaikanal; Kotengady Estate, Cochin.

Ratufa indica dealbata (possibly = albinistic *indica*).

F. Mahal Dangs	370	408	69	?
M. Mahal Dangs, type	369	417	75	?

Notes from skins.—

Typical race, Helwak, weight 5 lb. Samasgi, weight respectively 3½ lb. and 3 lb.

R. i. maxima, Palni Hills, 'not so common as *R. macroura dandolena*'

R. i. bengalensis, Kutta, weight of two specimens 4½ lb. and 4¼ lb.

R. i. centralis, Luia, Chaibassa, weight of 3 specimens, 2 lb., 3 lb. and 2¾ lb. One of these has 6 mammae. Bori, Hoshangabad, 2½ lb. and 2¼ lb. Dhain, Hoshangabad, 2½ lb. (mammar 6) and 2¼ lb.

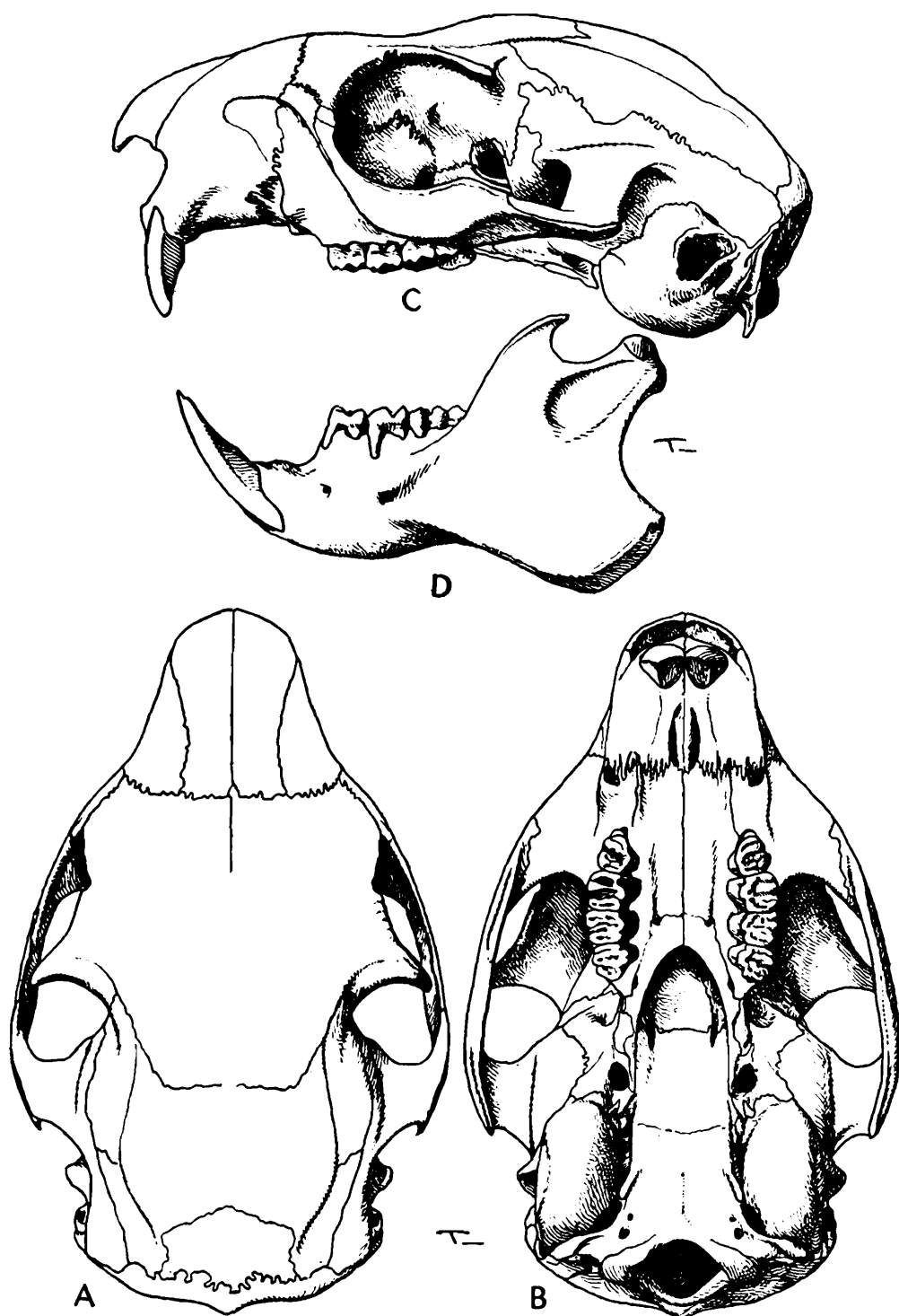
Kodura, Balapalli Range, 3 lb.

Sangajota, Chaibassa, 3 lb.

Kil Kotagiri, Nilgiris, mammae '3 pairs'

Gantha, Coimbatore, 'common in bamboo belt in fever belt at foot of Nilgiris'

Cranial and dental characters.—As above, under the genus *Ratufa* (p. 242).



TEXT-FIG. 15. *Ratusa indica indica* (Erxleben). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 3$).

Cranial measurements.—As in Table 39, below.

Dimensions of the species Ratusa indica in the British Museum material.—The occipitonasal length varies between 68 and 81 mm. Toothrow between 13·8 and 16·8 mm. The head and body length varies between 309 and 450 mm. Tail between 370 and 510 mm. Hindfoot 57–92 mm.

TABLE 39.—*Cranial measurements of the Indian races of Ratufa indica*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Ratufa indica superans</i>							
F.	13.6.21.3	79.8	34.1	16.1	26.4	32.0	23.6
	Wotekolli, South Coorg, type						
F.	13.8.22.41	77.5	35.0	16.4	25.5	30.1	24.1
	Wotekolli						
M.	13.8.22.42	81.0	34.0	15.5	28.7	30.9	24.3
	Makut, South Coorg						
F.	13.8.22.43	78.7	34.0	16.1	25.4	29.3	24.6
	Makut						
<i>Ratufa indica indica</i>							
	9.3.13.4	73.9	32.1	—	25.0	28.6	23.2
	Kanara, Bombay					<i>circa</i>	
M.	12.6.29.52	74.1	31.7	14.5	22.8	28.9	21.2
	Dharwar district. Old						
F.	12.6.29.53	73.2	31.9	14.8	23.7	26.5	23.1
	Dharwar district						
F.	12.6.29.54	69.5	29.8	14.5	23.7	25.7	22.1
	Dharwar district						
F.	12.6.29.55	68.3	29.1	14.2	22.8	24.8	21.7
	Dharwar district						
M.	15.7.3.21	73.6	—	14.9	25.0	27.4	23.1
	Helwak, Satara						
F.	15.7.3.22	74.9	31.5	15.2	23.8	25.9	23.4
	Helwak, Satara						
<i>Ratufa indica bengalensis</i>							
M.	13.8.22.24	78.7	33.1	15.1	25.0	29.8	24.5
	Kutta, South Coorg						
F.	13.8.22.45	75.4	33.6	16.8	23.1	28.6	23.9
	Kutta						
F.	13.8.22.46	75.0	32.8	14.8	24.5	27.4	24.6
	Kutta						
<i>Ratufa indica maxima</i>							
M.	21.11.5.18	76.7	33.2	15.4	23.2	29.1	24.9
	Kotengady Estate, Cochin						
M.	21.11.5.19	79.5	34.1	15.8	26.7	30.1	25.5
	Kotengady Estate						
M.	21.11.5.20	75.8	33.6	15.8	22.0	28.7	24.8
	Kotengady Estate						
F.	21.11.5.21	79.6	33.7	16.4	26.4	29.0	24.9
	Kotengady Estate						
F.	21.11.5.22	78.7	32.5	16.4	25.5	30.5	24.2
	Ootracoolie Estate, Malabar						
M.	21.11.5.23	77.3	34.0	15.3	26.1	30.6	25.1
	Anamaad Estate, Malabar						

TABLE 39.—*Cranial measurements of the Indian races of Ratufa indica (concl'd.)*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Ratufa indica maxima</i> (concl'd.)							
F.	25.10.1.14	76.3	34.1	16.2	22.3	28.1	24.4
	Kukhal Shola, South India						
F.	95.10.9.12	77.3	32.6	15.2	25.0	30.3	—
	Poumudi, near Trivandrum, Travancore						
	94.7.1.11	72.5	31.4	15.4	22.3	27.5	23.0
	Poumudi, Travancore						
	95.10.9.11	76.4	33.4	15.0	24.8	30.1	25.1
	High Range, Trivandrum, Travancore						
<i>Ratufa indica centralis</i>							
<i>circa</i>							
M.	12.11.29.57	72.6	31.0	13.8	21.7	27.3	22.7
	Hoshangabad						
M.	12.11.29.84	68.0	28.8	13.9	21.5	25.5	20.6
	Hoshangabad						
M.	12.11.29.86	72.3	30.1	13.8	21.7	28.7	22.2
	Hoshangabad						
F.	12.11.29.88	70.8	30.2	14.6	21.8	26.9	23.1
	Hoshangabad						
F.	12.11.29.89	69.8	29.7	15.1	21.4	27.5	21.4
	Hoshangabad						
M.	13.8.22.40	70.6	30.9	15.3	22.4	26.8	22.0
	Chamarajnagar, Mysore						
F.	15.4.3.72	72.1	31.3	14.3	22.6	28.1	23.1
	Luia, Chaibassa, Orissa						
M.	15.4.3.73	74.3	31.2	14.7	25.6	28.7	23.2
	Chaibassa						
F.	30.5.24.131	72.2	30.6	14.6	22.0	28.7	22.4
	Kodura, Balapalli Range						
M.	5.10.2.2	73.9	31.3	14.6	22.7	28.1	22.2
	Bori Forest, Central Provinces						
F.	5.10.2.3	73.0	31.1	14.1	22.1	28.2	22.2
	Bori Forest						
M.	15.4.3.70	74.1	31.4	14.1	22.9	29.5	23.0
	Hazaribagh						
M.	19.6.2.27	70.5	30.8	15.2	23.3	26.8	23.0
	Kotagiri, Nilgiri Hills						
F.	19.6.2.28	76.2	32.6	15.4	26.0	27.3	24.9
	Kotagiri						
F.	19.6.2.29	76.4	32.6	15.5	24.7	26.0	23.8
	Coimbatore, Nilgiri Hills						

Ratufa indica dealbata (possibly = albinistic *indica*)

F.	96.11.7.7	69.7	31.0	14.3	23.4	27.7	22.1
	Mahal Dangs						

The type of '*dealbata*' has the occipitonasal length about 71.6 mm., and the type of *centralis* is about the same size.

Key to the races of Ratufa indica

1	(6) The dorsal surface of the body red, the red not mixed with black ..	2
2	(5) The tail not black, but red with a white tip	3
3	(4) Unusually large; occipitonasal length not less than 77 mm. . . . (Skins examined were collected in January, from Coorg (Makut and Wotekolli).)	<i>R. i. superans</i>
4	(3) Smaller, the occipitonasal length not reaching 77 mm.. .. (Skins examined collected in the months of March, November and December, from Kanara, Satara and Dharwar.)	<i>R. i. indica</i>
5	(2) The tail is black (except at tip). (Skins examined collected in Feb- ruary and May, from Coorg (Kutta) and Mysore.)	<i>R. i. bengalensis</i>
6	(1) The dorsal surface of the body has some clear black patches or por- tions mixed with the red. ...	7
7	(8) Most of the back black; either with only the sides red, or the black of the shoulders and rump joined by a mid-dorsal saddlepatch or line. Tail all black. Occipitonasal length usually exceeds 75 mm.. (Skins seen were collected in April and November, from Travancore, Cochin, Malabar and the Palni Hills.)	<i>R. i. maxima</i>
8	(7) Only the shoulders and rump black (as well as the tail, which usually has a pale tip). Occipito- nasal length usually below 75 mm. (Specimens collected in January, February, May, June and July, from Hoshangabad, Chaibassa, source of the Nerbudda, Coim- batore, the Nilgiri Hills, Cuddapah, and Mysore.)	<i>R. i. centralis</i>

There are four rather well marked colour types found in this species. Whether they are really racial, or whether they are merely colour-phases is not very clear to me. Blanford thought that three of them were valid races, and later in his work on Indian mammals he named two more. But one of these, *dealbata*, based on a few skins from the region of Surat Dangs, I believe to be albinistic. No squirrel like them has been collected since, to my knowledge, and they have the look of albinos. Blanford stated the species occurred in Manipur, and there is a specimen with this locality on it in

the British Museum, but surely this skin is erroneously labelled, as the species has not been found there in recent times. Apart from *dealbata* which I think may be based on albinos, the races may be keyed roughly as above.

(i) *Ratufa indica indica* (Erxleben)

Text-fig. 15

1777. *Sciurus indicus* Erxleben, *Syst. Regn. Anim.*, 420.
 1777. *Sciurus purpureus* Zimmermann, *Spec. zool. Geogr. Quad.*, 518. (This work is unavailable, see *Bull. zool. Nomencl.*, 1950, 4, 547.)
 1785. *Sciurus bombayus* Boddaert, *Elench. Anim.*, 1, 117.
 1786. *Sciurus malabaricus* Scopoli, *Del. Insubr.*, 2, 85.
 1831. *Sciurus elphinstonei* Sykes, *Proc. zool. Soc.*, 103. (Deccan, India.)
 1897. *Sciurus indicus* var. *dealbatus* Blanford, *J. Bombay nat. Hist. Soc.*, 11, 299, pl. A, fig. 1. (Mahal Dangs, Surat.)

Type-locality.—Bombay Presidency.

Range.—Specimens examined from WEST INDIA: Helwak, Satara district; Kanara; Ghatmatha, Satara district; Devikop (about 26 miles south of Dharwar); Samasgi, Dharwar; Yellapur, North Kanara. Mahal Dangs (Surat Dangs). ('*dealbata*', ? albinistic skins.)

A red race, with the tail red except for its pale tip. Occipitonasal length not exceeding 75 mm. Hindfoot 77 mm. at most.

(ii) *Ratufa indica superans* Ryley

1913. *Ratufa indica superans* Ryley, *J. Bombay nat. Hist. Soc.*, 22, 3, 436.

Type-locality.—Wotekolli, South Coorg.

Range.—Specimens examined from COORG, Makut, Wotekolli.

Essentially like the typical race, but larger, occipitonasal length of skull 77.5–81 mm. Hindfoot 84–92 mm.

(iii) *Ratufa indica bengalensis* (Blanford)

1897. *Sciurus indicus* var. *bengalensis* Blanford, *J. Bombay nat. Hist. Soc.*, 11, 303, pl. B, fig. 2.

Type-locality.—Unknown.

Range.—Specimens examined from COORG, Kutta; MYSORE: Barampaddy Forest.

It is like the typical race, but the tail is black (with pale tip). Hindfoot size apparently nearer *superans* (80–86 mm. in our material); occipitonasal length 75–78.7 mm.

(iv) ***Ratufa indica centralis* Ryley**

1913. *Ratufa indica centralis* Ryley, *J. Bombay nat. Hist. Soc.*, 22, 3, 436.

Type-locality.—Bori, Hoshangabad, Central Provinces, 1,600 ft.

Range.—Specimens examined from HOSHANGABAD: Bori and Dhain; ORISSA, Luia, and Sangajota, Chaibassa; Source of Nerbudda River, C.P.: NILGIRIS: Kil Kotagiri, and Coonoor; CUDDAPAH, Kodura, Balapalli Range. MYSORE: Chamarajnagar. Gantha, Coimbatore, South India.

It differs from the typical race in having the tail black (pale tipped), and from *bengalensis* in having the shoulders sharply contrasted black and usually the rump black. Hindfoot 80 mm. or less, usually less. Occipitonasal length 68–76.4 mm. but only twice reaching 75 mm. in fifteen specimens.

(v) ***Ratufa indica maxima* (Schreber)**

1784. *Sciurus maximus* Schreber, *Säugth.*, pl. 217B. Text, 4, 785 (1785).

Type-locality.—Malabar.

Range.—Specimens examined from SOUTH INDIA: Travancore, near Trivandrum; Poumudi; Anamaad Estate, Malabar; Kotengady Estate, Cochin; Ootacamund; Palni Hills, Kukhul Shola; Kodaikanal.

This race differs from the remainder in having the tail wholly black; the shoulders and whole forepart of the back are black; the rump is also black, and sometimes only the sides are red. It is a large form, occipitonasal length only once below 75 mm. in nine specimens, and up to 79.5 mm. at extreme development; hindfoot 79 mm. in one skin with full measurements.

33. ***Ratufa bicolor* (Sparrman)**

The Large Malay Squirrel

1778. *Sciurus bicolor* Sparrman, *Götheborg. Samhalle Hand.* (Wet. Afd.), 1, 70.

Vernacular names.—(From Blanford): Shingsham, *Bhot.*; Satheu, *Lepcha*; Leng-theh, *Arrakan*; Sheng, Sheng apan,

Burmese; Chingkrawah, *Malay*; Meng-khan, *Talain*; Khabong, *Karen*.

Type-locality.—Western Java.

Distribution.—As here understood, NEPAL, ASSAM, BURMA, South Yunnan, Hainan, Indo-China, Malay States, Siam, Sumatra, Java, the Natunas and some smaller Malayan Islands.

This species differs from *R. macroura* in having the hindlimbs dark on the outside, and at least in Indian forms by its average larger size. From *R. indica* it differs in colour; it is never deep red in general coloration above, lacks the white nape patch, and has the forelimbs not entirely pale. Besides this, very generally the toothrow is proportionately a little shorter than in *indica*, averaging less than one-fifth of occipitonasal length for all races available to me.

External characters.—A large squirrel, size roughly as in *R. indica*. Tail longer than head and body. In certain races, as *gigantea*, *stigmosa* and *lutrina*, the ear is tufted; as a rule not so heavily as in *R. indica*. The ear is not tufted in the remaining Indian races, and in the majority of non-Indian ones, including the typical race. Hands (including the enlarged pollex-like inner pad) and feet essentially as described for *R. indica* above. Mammae 4 or 6.

Colour.—*R. bicolor gigantea*.—The whole of the dorsal coloration is black varying to blackish brown. The tail is black or dark brown throughout, and the outside of all limbs is dark, the same colour as the back. The face is mostly dark; there is a dark stripe extending downwards from the nose, and a dark spot on the chin. Lower parts buff, throat often lighter than chest and belly. Tail black below. (One skin from Mokokchung has a white tuft of hairs in the end of the tail). Ear tufted to a greater or lesser degree. Inner side of forearm usually yellow, but the yellow colour does not extend across the forearm or wrist. *R. b. 'stigmosa'* was regarded as racially separable from *gigantea* because of a small yellow patch on the hallucal side of the metatarsus. I do not find this character constant in '*stigmosa*', and it may sometimes appear in *gigantea*. I think on this account that no useful purpose is served by retaining '*stigmosa*'. The patch is present in a specimen from the Naga Hills, and suggested in one from Hkamti. Thomas described a form, *R. gigantea lutrina*, in 1916, which was essentially like *gigantea* but paler in both phases of the pelage. The tail-tip was supposed to be much paler than the rest, whereas *gigantea* has the tail-tip normally black. Typically *lutrina* is very

distinct from *gigantea*, but the tail-tip character is not constant, the tail being quite unicolorous in two out of six skins seen. Three skins collected respectively May, June, July, have the head brown, the back much lighter brown. Other skins (February, March, November, December) are unicolorous brown. Skins from as far apart as Nepal and Hkamti are not distinguishable from the latter.

Perhaps there is enough doubt over the placing of this form in synonymy for it to be retained. What I would call authentic *lutrina* with light tail tuft are specimens nos. 15.5.5.51, Tatkon; 16.3.26.17, Kabaw Valley; 15.5.5.50, Tatkon; and 16.3.26.10, Chin Hills, 35 miles west of Kindat. These could be maintained distinct from *gigantea*. But the few other B.M. skins which bear the name '*lutrina*' I would regard as specimens indistinguishable from *gigantea*.

R. b. phaeopepla.—Ear not tufted. The colour of the back is in the majority dark brown, but black specimens are present as well in the series examined. Tail wholly dark; outside of all limbs dark, but the yellow colouring of the inner side of forelimb is more extensive than is usual in *gigantea*, and extends across the wrist as a bar, to a greater or lesser degree. One specimen (from Siam) has a whitish patch on the back of the head, and another from Tenasserim is similar. Lower parts about as in *gigantea*. A skin from Thoungyeh (September) has the forepart of the back much darker than the hinder part, which is pale brown.

R. b. celaenopepla.—Is similar in general characters, but all skins seen are jet black in colour. *R. b. marana* was separated by Thomas from *phaeopepla* because 'the colour of the body when in fresh pelage is black, not brown as in *phaeopepla*'. Of skins examined, two (July) have the forepart of the back black, the hindquarters brown, one (November) is black, and two others (January) are brown. I would doubt whether this can be maintained as a race distinct from *phaeopepla*.

R. b. felli.—June skins, from Yin, are a peculiarly coloured and distinctive form. The ear is not tufted, the outside of all limbs is dark and there is the yellow bar across the forearm. The colour is dark brown on the head and shoulders, very pale light greyish brown behind the shoulders to the rump. The tail is mostly light in colour, mixed light brown and black hairs, varying in shade somewhat in different specimens, but quite distinctive compared with the other Indian forms of this group of races. Colour of underparts not very different from allied forms, perhaps rather paler. Apparently 6 mammae.

R. b. phaeopepla, *celaenopepla* and *felli* belong to the *melanopepla* section of races. They differ from *melanopepla* by their larger bullae. A few other extralimital names antedate them and belong to the same section; of these *tiomanensis* from Tioman Island is apparently a smaller form as judged by the length of skull and *fretensis* from Lankawi Island, although larger than *tiomanensis*, has usually a smaller skull than *phaeopepla* and *celaenopepla*. The colour of *felli* is different from that of other races.

External measurements.—As in Table 40, below.

TABLE 40.—*External measurements of the Indian races of Ratufa bicolor*

	Head and body	Tail	Hind- foot	Ear
<i>Ratufa bicolor gigantea</i>				
M. Lanting, Cachar Hills	385	530	90	28
F. Lanting, Cachar	380	530	90	28
M. Duragigi, Garo Hills	480	460	78	28
F. Dreyi, Mishmi	400	500	85	28
F. Dening, Mishmi	440	495	86	32
F. Tiki, Mishmi	410	510	86	33
M. Matanga River, N. Kamrup	340	580	88	32
F. Matanga River, N. Kamrup	455	550	87	32
M. Pashok, Sikkim	390	472	89	32
M. Kachin Hills, 160 miles north of Myitkyina	370	470	78	31
M. Hkamti, Burma; west bank Chindwin	405	462	88	32
F. Hkamti, west bank	415	475	90	31½
M. Mounghan, Burma; east bank Chindwin	384	475	91	30

Also seen from Nepal, including a type of '*macruroides*', and from Haingyan, Chin Hills; Katha, Burma; Mokokchung, Naga Hills.

Frost collections—

F. 347				
Naga Hills, 5,000 ft.	380	455	75	30
F. 312				
Naga Hills	470	500	90	25
F. 313				
Naga Hills	440	520	90	25

The next list is identified as '*stigmosa*'

F. Gokteik, Burma (' <i>stigmosa</i> ')	395	500	95	35
M. Gokteik	395	530	88	34
M. Kamaing, Myitkyina, Burma	356	457	77½	45
M. 55 miles north of Mandalay, Madaya Forest	343	482	?	31
M. Madaya Forest	375	508	84	29

TABLE 40.—*External measurements of the Indian races of Ratufa bicolor (concl'd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Ratufa bicolor lutrina</i>				
M. Tatkon, Burma	390	490	83	30
M. Tatkon	400	480	87	30½
M. 35 miles west of Kindat	389	449	88	30
F. Kabaw Valley, west of Kindat	365	513	88	31
F. Tatkon, type	397	520	84	32
<i>Ratufa bicolor phaeopepla</i>				
F. Thaget, Tenasserim	370	465	85	31
M. Victoria Point, Tenasserim	380	458	88½	33½
F. Bankashon, Tenasserim	405	450	87	29
<i>Ratufa bicolor phaeopepla</i> ('marana')				
M. Mount Poppa, Burma	400	495	90	28½
F. 36 miles NW. Toungoo, Burma	381	479	89	31
M. 30 miles NW. of Toungoo	354	476	82	31
F. Mount Poppa	370	475	88	31½
<i>Ratufa bicolor celaenopepla</i>				
Kisseraing Island, Mergui	374	445	70	?
M. Kisseraing Island	403	450	77	24
M. Sullivan Island, Mergui	407	400	75	29
M. King Island, Mergui	425	435	81	23
<i>Ratufa bicolor felli</i>				
F. Yin, east bank Chindwin, Burma	375	415	83	28
M. Yin	380	455	79	29
M. Yin	375	445	81	29
M. Yin	380	445	82	28
F. Yin	315	418	78	27
M. Yin	360	425	82	28
M. Yin, type	365	435	77	28

Notes from skins.—*R. b. 'lutrina'*, Chin Hills; weight 4 lb. Kabaw Valley; 3 lb., 2 oz. Tatkon; 4¼ lb.

R. b. gigantea, Tiki, Mishmi, weight 4.25 lb. Dreyi, Mishmi; 4.25 lb., mammae 6. Dening; 'mammae 3 pairs': Gokteik ('*stigmosa*'), weight 5 lb. Mokokchung (a specimen I have noted above), 'curious white tip to tail, apparently due to injury' Kamaing ('*stigmosa*'), 'shot in heavy jungle'

TABLE 41.—*Cranial measurements of the Indian races of Ratufa bicolor (contd.)*

	Occipitonasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Ratufa bicolor gigantea</i> (concl'd.)						
Frost collections—						
F. 347 Naga Hills	77.2	32.8	15.1	24.0	30.4	25.5
F. 312 Naga Hills	77.9	33.9	13.9	24.9	30.2	25.0
F. 313 Naga Hills	77.8	34.5	14.5	25.4	31.7	25.0
<i>Ratufa bicolor 'stigmosa' = gigantea</i>						
M. 14.11.31.1 Kamaing, Myitkyina district, Burma	75.5	34.2	14.4	23.7	30.5	24.1
M. 14.7.8.13 Gokteik, Shan States, Burma	77.1	33.4	14.0	25.3	31.4	24.7
F. 14.7.8.14 Gokteik	78.4	33.7	15.2	26.7	31.2	25.0
<i>Ratufa bicolor lutrina</i>						
F. 15.5.5.47 Tatkon, Burma. Old	74.0	33.2	14.5	—	31.4	25.4
M. 15.5.5.48 Tatkon	76.5	34.6	14.5	24.4	28.5	24.3
M. 15.5.5.50 Tatkon	73.9	32.5	—	23.6	30.2	22.5
M. 15.5.5.51 Tatkon	76.3	33.6	14.8	24.7	31.2	23.8
F. 16.3.26.17 Kabaw Valley, Burma	74.2	33.4	15.1	23.3	29.1	23.7
M. 16.3.26.18 Chin Hills, West Burma	73.8	33.3	14.6	21.7	—	24.7

The type has the occipitonasal about 74 mm.

<i>Ratufa bicolor felli</i>						
M. 15.5.5.54 Yin, Burma	73.3	31.7	13.7	24.3	28.1	22.7
M. 15.5.5.56 Probably Yin	71.0	31.5	14.2	23.7	29.8	23.1
M. 15.5.5.57 Probably Yin	72.8	31.3	13.9	24.8	29.1	23.5
M. 15.5.5.59 Probably Yin	70.8	31.1	14.1	24.2	27.5	22.4
F. 15.5.5.61 Yin. Old	70.5	32.0	13.9	23.8	28.2	22.7

The type has the occipitonasal about 71 mm.

TABLE 41.—*Cranial measurements of the Indian races of Ratufa bicolor (concl'd.)*

		Occipitonasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Ratufa bicolor phaeopepla</i>							
F.	14.12.8.122	74.7	32.0	13.9	23.8	30.9	23.5
	Bankason, Tenasserim						
F.	14.12.8.123	75.0	33.1	14.3	23.8	29.5	24.3
	Thagata, Tenasserim						
F.	85.8.1.153	76.2	34.1	14.7	26.4	27.9	24.5
	Thoungyeh, Tenasserim						
M.	14.12.8.121	72.4	31.4	13.7	22.6	30.2	23.3
	Victoria Point, Tenasserim						
<i>Ratufa bicolor 'marana' = phaeopepla</i>							
F.	14.7.19.106	76.4	33.8	—	26.4	30.9	25.4
	Mount Poppa, Burma. Old						
F.	27.11.18.16	75.5	33.1	14.4	24.7	29.8	24.8
	North-West of Toungoo, Burma						
F.	14.7.19.107	73.8	33.4	14.3	26.1	29.6	24.5
	Mount Poppa, type						
<i>Ratufa bicolor celaenopepla</i>							
M.	23.1.6.55	75.3	32.2	14.0	24.7	31.4	22.6
	Kisseraing Island, Mergui Archipelago						
F.	23.1.6.56	72.6	31.7	14.0	24.3	28.2	22.4
	Kisseraing Island						
M.	23.1.6.57	75.5	32.5	13.8	24.5	27.6	23.4
	King Island, Mergui Archipelago						
M.	23.1.6.58	70.0	30.7	14.2	22.9	27.4	22.0
	Sullivan Island, Mergui Archipelago.						

Dimensions of the species Ratufa bicolor, in British Museum material, including all races available.—The occipitonasal length varies between 64 and 79.5 mm. Toothrow between 12.5 and 15.2 mm. The head and body length varies between 260 (? immature) and 472 mm. The tail between 295 and 580 mm. Hindfoot 65–95 mm.

Provisional key to the races of Ratufa bicolor occurring in India

- 1 (4) Ear tufted to greater or lesser extent. No yellow bar across the forearm normally . . .
- 2 (3) Tail (except in one abnormal skin) not lighter at extreme tip *R. b. gigantea*

- (Skins examined were collected in January, February, March, June, August, October and December; of '*stigmosa*', in February, April, September and November.)
- 3 (2) Tail typically is lighter at extreme tip. : *R. b. lutrina*
 (Restricted to skins from Tatkon and Kabaw Valley, which were collected in February, May, June and July.) A somewhat doubtful race. See remarks above.
- 4 (1) Ear not tufted. The yellow of the inner side of forearm more extensive, and extends across the wrist or forearm as a bar. 5
- 5 (6) The head and shoulders much darker than the posterior part of the back, which is unusually light, greyish brown. Tail lighter than in the races below *R. b. felli*
 (Skins examined were collected in June.)
- 6 (5) The posterior portion of the back is much less light, and typically is not very different from the head and shoulders. Tail darker. (General colour above black or dark brown or a mixture of both, as in *gigantea* and *lutrina*.) .. 7
- 7 (8) The orbit is proportionately shorter, 23.4 mm. at highest in our specimens in length, but usually less than 23 mm. Tail averages less than 120% of head and body . *R. b. celaeopepla*
 (Skins examined from three Islands of Mergui Archipelago were collected in January and March.)
- 8 (7) The orbit is proportionately longer, 23.3 mm. and more but usually more than 24 mm. in length. Tail averages more than 120% of the head and body . . . *R. b. phaeopepla*
 (Skins examined were collected January, February, March, April, May, June, September and November, and of '*marana*', which is probably the same, in January and September.)

There are, very broadly speaking, three groups or sections of races in this species as now understood; the *bicolor* type, from Java, Sumatra, and Batu Islands, which has the general colour rather variegated, usually not black or brown dorsally, and which does not occur in Indian territory; the *gigantea* type, which differs from the last in its tufted or hairy ears,

and which has the back either black or brown or a mixture of both, and the *melanopepla* type, which is in colour mostly like the last, but which has the ears untufted. One or two rather aberrant forms like *felli* from West Burma, or *smithi* from Annam (colour near *bicolor* but ears tufted) do not conform to any of these types, but it is easy to refer the numerous other named races to one of the three, so far as I have seen them. *R. b. melanopepla* is from Telibon Island, Trang, and is remarkable for its small bullae. There seem too many named races in this species, and there is considerable individual variation in details of colour. The racial distinctions are often rather average than absolute.

(i) *Ratufa bicolor gigantea* (M'Clelland)

1839. *Sciurus giganteus* M'Clelland, *Proc. zool. Soc. Lond.*, 150.
 1849. *Sciurus macruroides* Hodgson, *J. Asiat. Soc. Beng.*, 18, 775.
 1923. *Ratufa gigantea stigmata* Thomas, *J. Bombay nat. Hist. Soc.*, 29, 1, 86. (Doi Sritepe, Chiangmai, northern Siam.)

Type-locality.—Assam.

Range.—Specimens examined from BURMA: Hkamti (both sides of Chindwin River); Haingyan, Chindwin; Kachin Hills; Mounkan; 100 miles north of Myitkyina; Katha; Gokteik; Kamaing, near Myitkyina; Madaya Forest, 55 miles north of Mandalay; KAMRUP, Matanga River (near Bhutan border); MISHMI; Dreyi, Dening, and Tiki; ASSAM: Mokokchung and Lakhuri in Naga Hills, and no exact locality; Lanting, Cachar; Duragiri, Garo Hills; SIKKIM: Pashok; NEPAL, no exact locality. Also from TONKIN, Chapa and Tamdao; ANNAM: Phuqui, and LAOS, Nape and Xiengkhouang, and from SIAM, Doi Sritepe and Melamoung.

Large race, with tufted ears, and the forearm without yellow bar extending across it. General colour black or dark brown or a mixture of both. Occipitonasal length of skull 73.2–78.4 mm. Tail usually more than 120% of head and body, usually dark.

(ii) *Ratufa bicolor lutrina*

Thomas and Wroughton

1916. *Ratufa gigantea lutrina* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 2, 226. (Tatkon, western bank Chindwin River, Burma.)

Essentially like brown specimens of *gigantea*, although sometimes tending to be paler in colour, but the end of

the tail is contrasted light in colour terminally. Whether this race can be maintained on this character just noted is not clear, but there is a possibility it may.

Authentic skins from BURMA: Tatkon, and Kabaw Valley, 20 miles west of Kindat, also Chin Hills, 35 miles west of Kindat. (But 3 skins bearing this name from 40 miles north-west of Kindat, and 20 miles south-east of Kindat seem to me to represent *gigantea*.)

(iii) *Ratufa bicolor phaeopepla* Miller

1913. *Ratufa phaeopepla* Miller, *Smithson. misc. Coll.*, **61**, 21, 25.

1916. *Ratufa phaeopepla marana* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, **24**, 2, 227. (Mount Poppa, Burma.)

Type-locality.—Sungei Balik, southern Tenasserim.

Range.—Specimens examined from TENASSERIM: Bankason, Maliwun, Thoungyeh, Thaget, and Victoria Point. Also from Mewong River, SIAM, and Metaw Forest, Raheng. BURMA: Mount Poppa, and north-west of Toungoo ('*marana*').

Ears not tufted. Yellow of inner side of forearm more extensive than in *gigantea*, extending across wrist or just above it. Typically the general colour is brown, but black specimens are not unknown, and in material at hand for '*marana*' individually varying from brown to black. Tail dark. Occipitonasal length of skull 72.4–76.4 mm. but only once less than 73 mm. in material at hand. Tail usually more than 120% of head and body. Orbit 23.3 mm. and more, usually more, in length.

(iv) *Ratufa bicolor celaenopepla* Miller

1913. *Ratufa celaenopepla* Miller, *Smithson. misc. Coll.*, **61**, 21, 26.

Type-locality.—Domel Island, Mergui Archipelago.

Range.—Specimens examined from MERGUI ARCHIPELAGO: King Island, Kisseraing Island, and Sullivan Island.

It is like black specimens of the last, but the orbit is proportionately a little shorter in length; 23.4 mm. and less in our specimens, but in the majority less than 23 mm., and the tail is usually less than 120% of the head and body in our specimens. Occipitonasal length of skull 70.0–75.5 mm.

(v) **Ratufa bicolor fellii** Thomas and Wroughton

1916. *Ratufa fellii* Thomas and Wroughton, *J. Bombay nat. Hist. Soc.*, 24, 2, 226.

Type-locality.—Yin, east bank lower Chindwin, Burma.

Range.—Specimens examined from BURMA: Yin.

Ear untufted, and the yellow bar present on the forearm. Tail lighter in colour than in the last two races; posterior part of back very much lighter; head and shoulders contrasted darker with the posterior part of the back as a rule. Colour striking and entirely different from allies, but only June skins available. Occipitonasal length of skull 70·8–73·3 mm. but only once reaching 73 mm., therefore smaller than is usual in other mainland races. Tail averages just under 120% of head and body.

Genus 10. **Menetes** Thomas

1908. *Menetes* Thomas, *J. Bombay nat. Hist. Soc.*, 18, 2, 244.

Type-species.—*Sciurus berdmorei* Blyth.

Range.—Indo-Malayan mainland, from BURMA, TENASSERIM, Siam, Indo-China, and Malay Peninsula, with a few small adjacent islands.

This genus contains only one species, *M. berdmorei*. Its generic peculiarity is in its specialized dentition. The cheek-teeth become flatcrowned in the adult, and lose the normal Sciurine pattern, and the folds isolate on crown surface as wide islands. The lower molars soon lose the large central depression which is characteristic of more normal or generalized squirrels, and this depression appears as a re-entrant fold or may become isolated. This character parallels some African genera, but is rare in Asiatic squirrels. Otherwise *Menetes* is a squirrel with a rather shortish tail, stripes on the back, rather a long rostrum, a long palate (usually over half the occipitonasal length), the skull of medium size, but with no very striking or extreme peculiarities. Pocock referred it to his Callosciurine branch of squirrels on the structure of its baculum, so one may infer that in its reproductive characters it is nearer *Callosciurus* and *Dremomys* than it is to *Funambulus* or *Ratufa*.

External and cranial characters.—As in the species.

34. *Menetes berdmorei* (Blyth)

Berdmore's Squirrel

1849. *Sciurus berdmorei* Blyth, *J. Asiat. Soc. Beng.*, 18, 603.

Distribution.—As in the genus *Menetes*. The typical race is from Burma. Miller in 1913 described a supposed race, *M. b. amotus*, from Domel Island, Mergui Archipelago, characterized as 'like *berdmorei* but skull with more slender rostrum'; this character is altogether too slight and unreliable for subspecific purposes. The only other race named from Indian territory, *decoratus*, is distinguishable from the other races I have seen by its colour.

External characters.—A medium sized striped squirrel, with the tail apparently always shorter than the head and body. Hand with four functional fingers, the fourth slightly the longest, the outer pair shorter than the middle pair. Five hindtoes, the hallux shortest, the fifth slightly shorter than the central three. Apparently six plantar pads. Six mammae. Colour above dark brown, finely speckled. In the race *decoratus* in which the striping seems at its maximum for the species (September specimens) there is a black mid-dorsal stripe bounded by two brown widish lines; then on either side a black stripe, then a whitish stripe, then each side another wide black stripe (making five main black stripes in all); this is in turn bordered each side by another white line which has outside it yet another darkish patch each side which is the dark flankpatch. The stripes run from about behind the shoulders to the forepart of the rump. The stripes of the typical race are fairly similar, but except in two specimens (Bankashon, December, and Banlaw, April), the mid-dorsal stripe is very poorly marked or can be absent. The first outer pair of stripes may also be weak, or almost absent. (Skins available collected December, January, March, April, June and August for the typical race. All appear quite distinct from *decoratus*.) Tail blackish, with white tipped hairs, sometimes annulated; the hairs typically rufous at base, then black, then rufous, then black, white-tipped; underparts whitish or mixed with yellowish or greyish, and apparently individually variable.

External measurements.—As in Table 42, below.

Cranial characters.—The skull gives the impression of being somewhat narrow and long, with a rather long rostrum. Its size is medium (the occipitonasal length between 45 and about 54 mm. in length). The nasals slant downwards anteriorly, and the skull is rather bowed down in front. The

TABLE 42.—*External measurements of the Indian races of Menetes berdmorei*

	Head and body	Tail	Hind- foot	Ear
<i>Menetes berdmorei berdmorei</i>				
F. Thaget, Tenasserim	206	147	47	20
F. Banlaw, Tenasserim	190	140	44	19
M. Bankashon, Tenasserim	189	136	42	21
Zamai Reserve, north of Pegu, Burma	176	135	43	19½
F. Zamai Reserve, 60 miles north of Pegu	176	140	40½	17
			3 pairs mammae	
Sullivan Island, Mergui Archipelago	210	117	40	18
Kisseraing Island, Mergui Archipelago	185	140	39	20

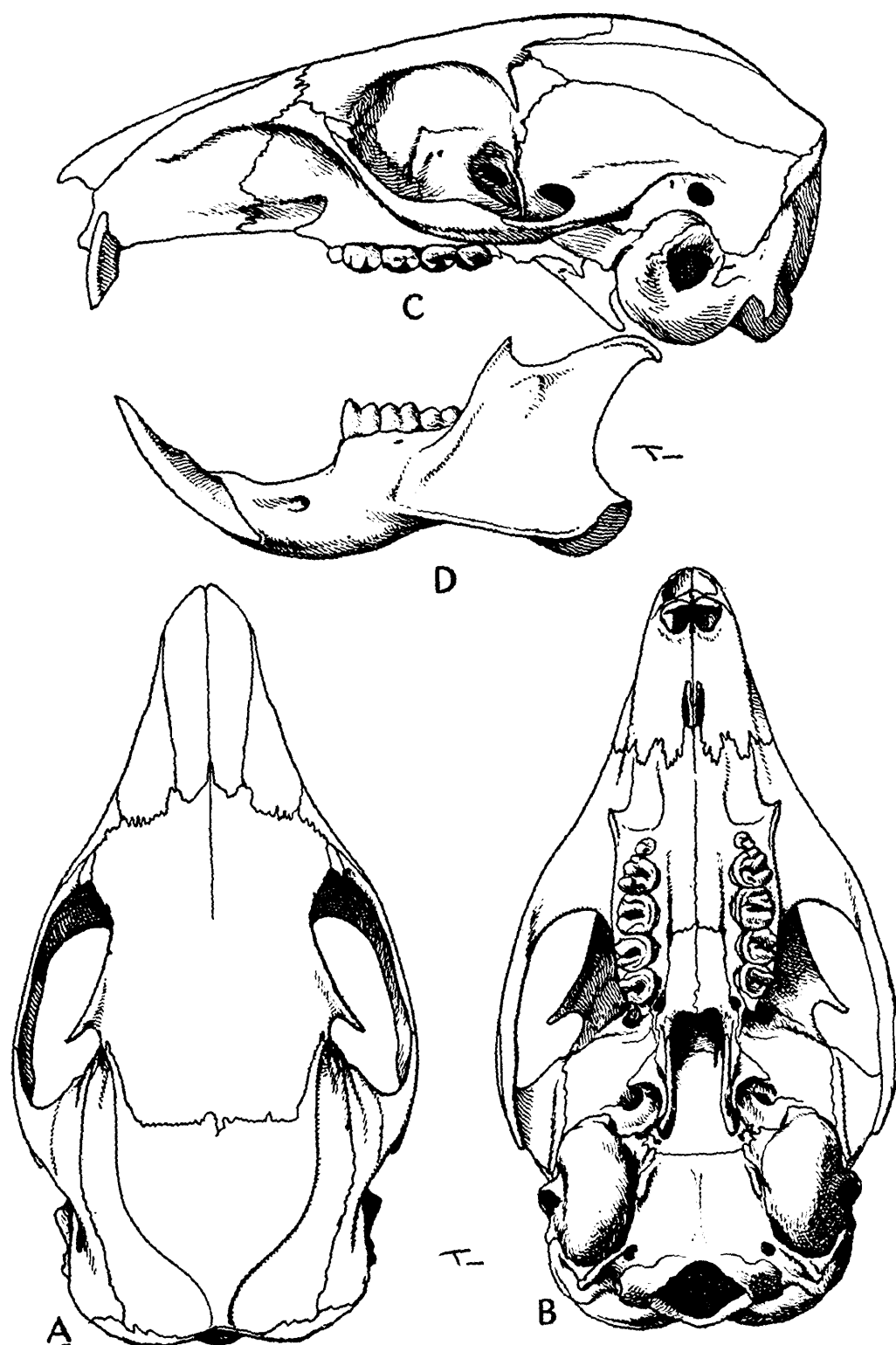
Other skins from Myawadee, Hanyaryit and Martaban, Tenasserim, and from various localities in Siam.

Menetes berdmorei decoratus

F. Mt. Poppa, Burma, type	188	175	43½	21
M. Mt. Poppa	187	164	42	20·25
Mt. Poppa	193	157	44	21½
M. Mt. Poppa	189	168	43	20½
M. Mt. Poppa	191	162½	43½	19
F. Mt. Poppa	196	148	43	20
M. Mt. Poppa	183	169	43½	20
Mt. Poppa	196	153	42½	19

frontals are rather narrow, often less than a quarter of the occipitonasal length at their narrowest portion, and always averaging less than 30% of the occipitonasal length, so more narrowed as a rule even than in *Dremomys*. They are considerably longer than the nasals, and appear longer than the parietals. The parietals are weakly ridged, but the ridges meet to form a very short sagittal ridge posteriorly in all the unbroken Indian skulls available. The postorbital process is slender, narrow, short and weak. The superior margin of the occiput is rather well ridged. Bullae of medium size. Pterygoid fossae very shallow, the ectopterygoid obsolete. Palate long, apparently always over half the occipitonasal length. Palatal foramina, as usual, very short, and far in front of the toothrows. Zygomatic plate narrow but quite well tilted upwards, its upper border ridged; canal of infra-orbital foramen tends to be short; a well developed masseter knob present at its outer lower border. Zygoma as normal

for Sciuridae, with very long jugal. Mandible without special peculiarity except that the coronoid process tends to be low, nearly as low as in *Funambulus*. It may be noted that in this genus, as in *Dremomys*, the nasal length exceeds the least interorbital width.



TEXT-FIG. 16. *Menetes berdmorei decoratus* Thomas. A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 4$).

Dental characters.—Upper incisors narrow, rather short, and red in colour, not grooved. Five upper cheekteeth, P. 3 simple but prominent and rather well developed. All the other upper teeth apparently with three roots. The main upper cheekteeth have the usual Sciurine pattern traceable, but are considerably specialized; there is a tendency for the teeth to become flatcrowned, at least as compared with genera with more normal dentition, and always the centre depression between the second and third (or two principal) ridges is deep and prominent, but with wear the two outer folds between, respectively, the first and second and the third and fourth ridges tend to wear out, leaving a pattern of round teeth with only one deep central outer fold in old age. M. 3 is not very different from the teeth in front of it, although there are the usual slight signs of ridge reduction posteriorly. Lower incisors rather long and prominent. The lower molars are considerably specialized in that the large central depression (which is characteristic of the lower teeth of squirrels with more normal dentition) becomes reduced, and takes the form of a wide re-entrant fold between the two inner main cusps. The lower teeth nearly become transversely ridged, with four suggested ridges, the first and last of which mark the anterior and posterior border of the tooth in each case, the second and third of which surround the much reduced central depression which is a deep fold between them, and, meeting near the outer side of each tooth, just separate the central depression from a small opposite re-entrant fold between the two outer cusps. As usual, the anterointernal cusp in each lower molar is the highest. The central depression is widest in M. 3, which is slightly the largest tooth. The dental specializations of *Menetes* appear quite without parallel in other Indian genera, but roughly similar specialization is present in some African genera.

Cranial measurements.—As in Table 43, below.

TABLE 43.—*Cranial measurements of the Indian races of Menetes berdmorei*

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Menetes berdmorei berdmorei</i>							
M.	14.12.8.138	48.7	25.2	10.5	14.3	13.0	14.2
	Bankashon, Tenasserim						
F.	17.4.24.20	47.7	25.4	10.4	14.0	13.0	14.6
	North of Pegu, Burma						

TABLE 43.—*Cranial measurements of the Indian races of Menetes berdmorei (concl'd.)*

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>Menetes berdmorei decoratus</i>							
M.	14.7.19.149	45.6	24.5	10.5	—	11.9	14.2
	Mount Poppa, Burma						
M.	14.7.19.153	47.2	25.4	—	13.6	12.6	14.5
	Mount Poppa						
M.	14.7.19.151	48.0	24.7	9.9	14.3	12.0	14.5
	Mount Poppa						
M.	14.7.19.152	47.5	25.1	9.8	14.9	11.9	14.5
	Mount Poppa						
F.	14.7.19.154	49.2	26.3	10.7	14.5	12.8	15.1
	Mount Poppa						
F.	14.7.19.156	48.4	25.6	—	14.0	12.5	15.1
	Mount Poppa						

The type has the occipitonasal length about 48.9 mm.

Dimensions of the species Menetes berdmorei, in British Museum material, including all available races.—The occipitonasal length varies between 45.6 and 53.8 mm. The tooth-row between 9.3 and 10.8 mm. The head and body length varies between 158 and 222 mm., the tail between 117 and 175 mm., the hindfoot between 33 and 47 mm.

Key to Indian races examined

- 1 (2) The mid-dorsal stripe and the dark stripes on either side of it more prominent and clear; the light stripes outside the last-named dark stripes tending to be more striking, and the whole striping of the animal about at maximum for the species *M. b. decoratus*
- 2 (1) The mid-dorsal stripe normally obsolete or weak, and the dark stripes on either side of it on the whole weaker and less developed; the light stripes as a rule less striking, and the whole striping of the animal less clear and weaker.. *M. b. berdmorei*

It should be stated that only September specimens are available for the first-named, and that one specimen of the typical race from Banlaw (the second in the measured skins list above) makes some approach towards the coloration

found in *decoratus*. So far as I can see, the race *mouhotei* which antedates *decoratus* is nearer the typical race in colour.

(i) **Menetes berdmorei berdmorei** (Blyth)

1849. *Sciurus berdmorei* Blyth, *J. Asiat. Soc. Beng.*, 18, 603.
(Thoungyeen district, Lower Burma.)
1861. *Sciurus mouhotei* Gray, *Proc. zool. Soc. Lond.*, 137.
(Cambodia, Indo-China.)
1913. *Lariscus berdmorei amotus* Miller, *Smithson. misc. Coll.*,
61, 21, 24. (Domei Island, Mergui Archipelago.)

Range.—Specimens examined from BURMA, 36–70 miles north of Pegu; Martaban; TENASSERIM: Bankashon; Banlaw; Hankaryit; Mywadu; Thaget. Kisseraing Island and Sullivan Island, Mergui Archipelago. SIAM: 50–90 miles south-east of Bangkok; Klong-ban-pai, Patinju, Peninsular Siam.

(ii) **Menetes berdmorei decoratus** Thomas

Text-fig. 16

1914. *Menetes berdmorei decoratus* Thomas, *J. Bombay nat. Hist. Soc.*, 23, 1, 24.

Type-locality.—Mount Poppa, Burma.

Range.—Specimens examined from the type-locality (up to about 4,000 feet).

Five specimens of the latter race from Mt. Poppa weighed respectively 8 oz., 7 oz., 6 oz., 6½ oz. and 6½ oz. Typical race: 70 miles north of Pegu (N. Zamayi Reserve); mammae 3 pairs. A specimen from Bankashon, Tenasserim, weighed 7½ oz. and one from Kisseraing Island weighed 6 oz.

Genus 11. **Marmota** Blumenbach

1779. *Marmota* Blumenbach, *Handb. Naturgesch.*, 1, 79.
1780. *Arctomys* Schreber, *Säugth.*, pls. 207–211, text 4, 721–743.
(*Arctomys marmota* = *Mus marmota* Linnaeus.)
1922. *Marmotops* Pocock, *Proc. zool. Soc.*, 1200. (*Mus monax* Linnaeus, from North America.)

Type-species.—*Marmota alpina* Blumenbach = *Mus marmota* Linnaeus, from the Alps.

Range.—Widely distributed in Central Europe, Asia, and North America. In America, ranging through the greater part of Canada and the United States. In the Old World, the range is approximately: Europe; French Alps, North Italy, Switzerland, the Carpathian Mountains, Poland, Russia (steppes of Rivers Don, Denez, Middle and Lower

Volga, Mid Ural, etc.); Russian Asia, from the southern and eastern borders of Russian Turkestan, and southern Siberia, including the Altai region, Transbaikalia, and in the Far East, the Verhoiansk Mountains, the Anadyr region, and Kamtchatka; Chinese territory, from Manchuria, Mongolia, Chinese Turkestan, Tibet, and the states of Kansu, Szechuan and Yunnan; Indian territory: the northern mountains from CHITRAL and KASHMIR through the NORTH PUNJAB to NEPAL and SIKKIM. Afghanistan.

This genus is very distinct from other genera of Sciuridae which occur in Indian territory, and its peculiarities may be briefly summed up as follows: external form suited to terrestrial and fossorial life; the form badger-like rather than squirrel-like, the tail short, slightly to considerably less than half the head and body length; the hand has the middle finger the longest instead of the fourth which is the longest in tree-squirrels. The size of the skull is in Europe and Asia very large, larger than in other Sciuridae, the occipitonasal length measuring over 83 mm. on all skulls available in the British Museum, and often more than 100 mm. The condylobasal length may be nearly as long as, or as long as, the occipitonasal length. There is a heavy sagittal crest present in the adult skull, and the braincase is flattened. The orbit is long (as in the flying squirrels), clearly over one-third of the occipitonasal length, as is usual in Palaearctic ground-squirrels (the allied genera *Citellus*, *Spermophilopsis*, *Tamias* and *Atlantoxerus*), but differing from all Indian tree-squirrels in this character. P. 3 is large and functional. The palate is long, well over half the occipitonasal length as a rule; the skull is powerfully ridged for jaw muscle attachment and the incisors are rather powerful.

Blanford believed that there were three species of *Marmota* ('*Arctomys*') in Indian territory, but Wroughton thought that *M. 'hodgsoni'* of Blanford was a synonym of *himalayana*, and it appears that Wroughton's classification is correct.

It appears that there are two valid species of *Marmota* in India.

Key to the species of Marmota in India

- 1 (2) The tail is long, at least clearly over one-third of head and body length (as far as can be traced in our somewhat inadequate material, in India averages about 47% of the head and body length) . *M. caudata*
- 2 (1) The tail is short, as far as can be ascertained, at most one-third of head and body length, usually less *M. bobak*

35. *Marmota caudata* (Jacquemont)

The Long-tailed Marmot

Text-fig. 17

1844. *Arctomys caudatus* Jacquemont, *Voy. dans l'Inde*, 4, Zool., 66.

Vernacular name.—Drun, *Kashmiri*.

Arctomys caudatus of Blanford, but not *Marmota caudata* of Russian authors.

Range.—Central Asia, from Pamir, Fergana, the Samarkand district, Afghanistan, Chinese Turkestan, KASHMIR, and CHITRAL.

This species differs, as just indicated in the key, from the majority of Palaearctic marmots by the fact that it has a longish tail, which approaches half the length of the head and body. In my belief there are three races of this species. Typical *caudata*, from Kashmir, is entirely distinct from all others on account of the large dark saddlepatch on the yellow of the back. The next two names in the species were published the same year, namely *dichrous* of Anderson, and *aurea* of Blanford, both 1875. The former, from Afghanistan, has the underparts unusually dark compared with the other members of the species. It is not known from Indian territory, and is, in fact, so little known, that its specific position is by no means certain. It is my belief that *M. c. aurea* is the correct name for the Russian Turkestan marmots which Russian authors call *Marmota caudata*, but which is distinct from typical *caudata* by lacking the large dark saddlepatch. Later names as '*littledalei*', '*stirlingi*', etc., I believe to be synonymous with *aurea*.

Regarding the status of *aurea*, however, it must be admitted that in Blanford's publication in *Yarkand Miss. Mamm.*, 1879, plate XI, there is a figure of an animal which is obviously *M. c. caudata* and which is supposed to represent *aurea*. Blanford thought there was individual or sexual variation in the amount of black-tipped hairs on the back of this form. I can only say that two examples of *aurea*, from the type-locality, have no dark saddlepatch, and are not certainly distinguishable in colour from the race *flavinus* which is of course antedated by the name *aurea*. If by chance it should be found that *aurea* is, in Western Chinese Turkestan mountains, a form in two-colour phases, one like typical *caudata* with dark saddlepatch and as in the above figure, and one like typical *flavinus* marmots, with no saddlepatch, then in

any case I think the name *caudata* should be restricted sub-specifically to the Kashmir marmot (in the present state of our knowledge) on account of the latter's distinctly larger average skull in fully adult material when compared with other marmots which I here call *M. c. aurea*, and not one of which in our material shows any signs of a dark dorsal saddle-patch.

Authentic *aurea* specimens which I have examined are females, and their colour is totally different from the females of true *caudata* from Kashmir.

External characters.—Very large in size, as indicated by measurements given above, and with the tail long, nearly half the length of the head and body. Ear small. Fur fairly thick. Tail heavily haired throughout. Hand with four fingers, all bearing thick and powerful claws; middle finger slightly longer than fourth, which is longer than second; fifth finger shortest. Thumb vestigial. Hindfoot five-toed; the three middle digits longer than the outer pair, the hallux slightly the shortest. Apparently six plantar pads present. Ten mammae traceable in one dried skin.

Colour.—Of the typical race; head usually (but not always) dark; back mostly black, with a very long large black saddlepatch which runs backwards over the shoulders, its length varying in different specimens, but sometimes almost approaching the tail. The sides yellowish and the limbs similar except that there is often a reddish tinge on the forelimbs. Tail mixed yellowish and black, black terminally. Face brown, blackish round the eye. Lower parts brown to reddish brown; with two exceptions there is a distinct brown midventral area which is deeper in colour than the sides. In *M. c. aurea* and allied forms or synonyms there is no dark saddlepatch. The colour of the back varies from what Thomas described as 'rich orange tawny' to 'golden buffy'. The tail is yellowish, usually with a black tuft, the belly reddish, brownish or yellowish. Notwithstanding the fact that the Pamir form described as *littledalei* is more golden or orange in colour than specimens seen for *aurea* and '*flavinus*' (which surely is not distinguishable from *aurea*), I am inclined to think that all these golden long-tailed marmots, *stirlingi* included, are really all one form. Colour distinctions may well be individual variations rather than of racial value, and none of these forms is well known. *M. c. stirlingi* from Chitral, known by one specimen, was described as with the general colour approximating to the rich orange-tawny of *littledalei* but with the belly hairs 'broadly brown basally' and with the sides and neck grizzled greyish; these

characters were supposed to distinguish it from *aurea*, *littledalei* and *flavinus*. I have my doubts on their validity.

External measurements.—

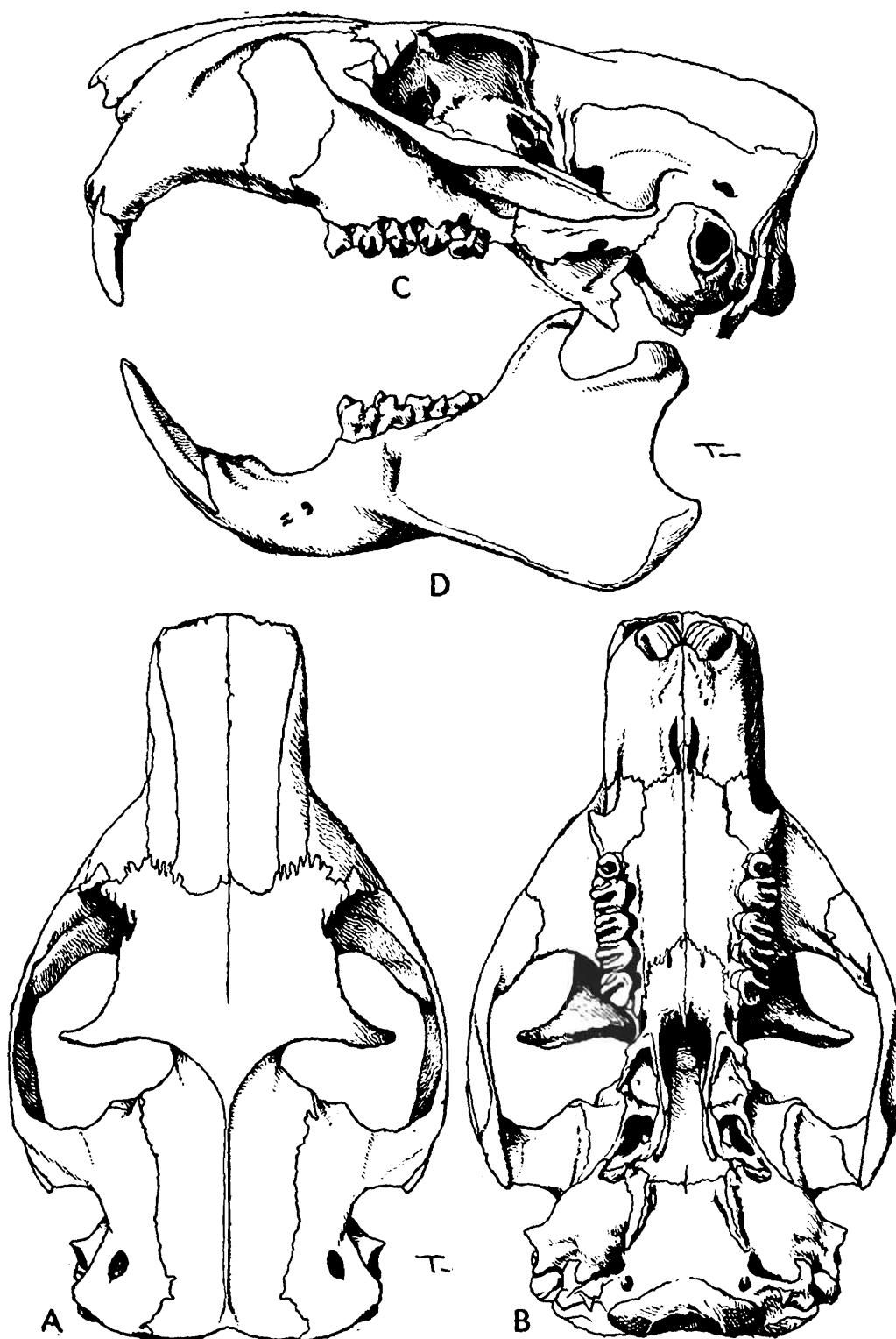
	Head and body	Tail	Hind- foot	Ear
<i>Marmota caudata caudata</i>				
F. Kagan Valley, Hazara .	500	240	88	27
M. Kagan Valley .	565	270	95	30
F. Kagan Valley	530	250	100	30

Other skins seen from Deosai, Baltistan; Burzil Pass, Kashmir; north of Tilel Valley, Kashmir; between Wardwan and Kashmir, and the type of *M. c. stirlingi*, from Chitral.

The following notes are taken from skins of the typical race.—Kagan Valley; 'common from 9,500 up; weight 10 lb.' Hills between Wardwan and Kashmir (taken 1902), 'old and heavy with young; marmots are out of fur this season' Kagan Valley; 'common above 10,600 feet'

Cranial characters.—Skull very large for a Sciuroid rodent, the occipitonasal length most often over 100 mm. in the typical race, slightly less than 100 mm. in other races examined. The nasals long, mostly over 40% of the occipitonasal length, and rather broad; the frontals wide, but narrowest immediately behind the lachrymals; behind them the postorbital processes are very prominent, wide and outstanding. Behind the postorbitals, strong ridges fuse to form a long and sharp sagittal crest which extends backwards to the lambdoid ridge. The parietals are rather narrow and the squamosal bones large. Braincase rather flat; occiput not particularly high, but strongly upstanding and ridged. Paroccipital process large and prominent. The palate is wide and long, considerably over half the occipitonasal length. The palatal foramina situated far in front of the toothrows, and reduced in proportion to the size of the animal. Posterior portion of palate with a central spinous process usually present. Pterygoid fossae relatively shallow. Bullae of medium size. As in the flying squirrels, the orbit measurement is very long in this genus, always clearly more than one-third of the occipitonasal length. The zygomatic plate is quite high and strongly tilted upwards, with a strong ridge along its upper border, and on the lower outer side of the infraorbital foramen there is a prominent small knob for muscle attachment. Jugal very long, in contact with lachrymal, and the zygoma rather powerful; posteriorly the

jugal extends backwards under the squamosal root of the zygoma. Mandible with powerful coronoid process, strongly ridged lower border of the angular process, and high condylar process.



TEXT-FIG. 17. *Marmota caudata* (Jacquemont). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 2$).

Dental characters.—Upper incisors rather wide, yellowish in colour as a rule, their anterior face with traces of numerous faint grooves. Five upper cheekteeth. P. 3 is large, though less than half the size of P. 4, functional, and cuspidate; the other main cheekteeth appear constricted internally, owing to the apparent narrowness of the large main inner cusp. From this inner cusp there are, as usual, the four ridges extending to the outer border of the teeth, in P. 4, M. 1 and M. 2; the centre ridges being the main ones. M. 3 has the same essential formula, and the third ridge is not obliterated; but it tends to be turned backwards, so that the fold between it and the ridge in front of it is wider than in the other teeth. The cusps of the teeth are high, and the ridges between them deep (except the hindmost ridge which seems to tend to become reduced on the main teeth). The teeth are hypsodont on the inner side. Lower molars with two high outer cusps, and one high inner cusp; the inner cusp the highest and placed anteriorly, the posterointernal cusp scarcely developed; a large inner depression, and a slight ridge joining the two outer cusps and separating a small re-entrant fold between them from the large main central depression. In size the third lower molar is slightly dominant.

Cranial measurements.—

		Occipito- nasal	Palate	Toothrow	Nasals	Frontals	Orbit
<i>Marmota caudata caudata</i>							
F.	8.10.3.16	101.0	55.3	23.1	39.9	26.3	33.7
	Hazara, N.W.F.P.	Rather young					
F.	8.10.3.17	99.1	55.5	22.5	40.1	26.5	33.4
	Hazara						
F.	8.7.6.27	100.5	56.5	22.5	40.3	26.3	35.0
	Hills between Wardwan and Kashmir						
F.	10.12.2.25	106.5	60.5	23.5	44.5	28.4	35.4
	Kagan Valley, N.W.F.P.						
	88.3.20.5	101.4	54.8	—	41.2	25.3	34.6
	Kashmir, topotype						
	77.11.23.3	89.7	50.1	22.2	35.6	—	—
	Burzil Pass						

The type skull of *M. c. stirlingi* is broken and cannot be measured. Thomas (1916) stated, in his description of the latter, that its toothrow was 20 mm. whereas in *aurea*, *littledalei* and *flavinus* the toothrow was about 21 mm. When

all skulls are measured I do not find that this is a valid distinction for *stirlingi*. I have seen skulls for the other supposed races with toothrow about as short as in *stirlingi*.

Dimensions of Marmota caudata, as indicated by British Museum material, including all available races.—The occipitonasal length varies between 88.5 and 106.5 mm. The upper toothrow between 20.3 and 23.3 mm. The head and body length varies between 450 and 565 mm. in the few measured skins available; the tail between 220 and 270 mm., the hindfoot between $78\frac{1}{2}$ and 100 mm.

Key to the races of Marmota caudata inhabiting India

1	(2) A large dark saddlepatch on the back, noticeably contrasted with the sides . . .	<i>M. c. caudata</i>
2	(1) No dark saddlepatch on the back	<i>M. c. aurea</i>

(i) **Marmota caudata caudata** (Jacquemont)

1844. *Arctomys caudatus* Jacquemont, *Voy. dans l'Inde*, 4, Zool., 66.

Type-locality.—Kashmir.

Range.—Specimens examined from KASHMIR: Burzil Pass (about 50 miles north-north-east of Srinagar); hills between Wardwan and Kashmir; Deosai, Baltistan; north of Tilel Valley; Kagan Valley, Hazara, N.W.F.P.

(ii) **Marmota caudata aurea** (Blanford)

1875. *Arctomys aureus* Blanford, *J. Asiat. Soc. Beng.*, 44, 106, 123.

1909. *Arctomys littledalei* Thomas, *Ann. Mag. nat. Hist.*, 3, 259.

1909. *Arctomys littledalei flavinus* Thomas, *Ann. Mag. nat. Hist.*, 3, 259.

1916. *Marmota stirlingi* Thomas, *J. Bombay nat. Hist. Soc.*, 24, 2, 341.

Type-locality of aurea.—Kaskasu Pass, mountains west of Yarkand, Chinese Turkestan; of *littledalei*, Alai Mountains, Pamir, of *flavinus*, Hissar Mountains, 100 miles east of Samarkand, and of *stirlingi*, Chitral, head of Chitral Nullah, 11,000 ft.

Range.—Specimens examined from CHITRAL; head of Chitral Nullah (type of '*stirlingi*'); also CHINESE TURKESTAN: Kaskasu Pass, west of Yarkand; SAMARKAND district; Hissar Mountains. PAMIR: Alai Plateau; Sary-tash in Alai Valley; and FERGANA, no exact locality.

Differing from the typical race in lacking the large black saddlepatch on the back, so far as available material shows and on average in the smaller size of the skull. (Only one out of eight specimens for *aurea* available for measurement has the occipitonasal length exceeding 100 mm.)

36. *Marmota bobak* (Müller)

The Bobak Marmot, from Poland

1776. *Mus bobak* Müller, *Natursyst. Suppl. Regist.*, 40.

Vernacular names (from Blanford).—Jabra, *Bhotia*; Brin, *Kashmir*; Pfif, *Niti*; Kadia-piu, *Phya*, *Tibetan*; Chibi, *Bhotia of Sikkim*.

Distribution of species.—Poland, Russia (Ukraine, Don, middle and lower Volga, Transvolga, southern Urals), parts of Kazakhstan, the Altai steppe, southern Transbaikalia, Manchuria, Mongolia, Tibet, western China (Kansu, Szechuan, Yunnan), northern India, from KASHMIR, NORTHERN PUNJAB and NEPAL to SIKKIM.

Short-tailed marmots, the tail at most about one-third of head and body length. The fur of the body short. It is difficult to define valid species of the short-tailed marmots in Europe and Asia. In my opinion it is more than likely that the whole lot could be regarded as so many races of *Marmota marmota* Linnaeus, the Alpine marmot, and the first name in the genus. Pocock wished to restrict the genus to that species, on account of the fact that the thumb is suppressed in *M. marmota*, not entirely so in the other races or species. This character to my mind is not a character of even sub-specific value, but I hesitate to use such drastic classification as the referring of all Asiatic short-tailed marmots to the type as so many races. The next name in the genus in Eurasia is *Marmota bobak*, and the third name appears to be *himalayana*, the Indian race, which dates from 1841. It so happens that there is special resemblance between *bobak* and *himalayana* in that both have as a general rule noticeably short fur, a curious character in an animal which lives in a cold climate. I propose to regard *himalayana* as a race of *bobak*, with the statement that its distinctions from the Alpine marmot are only on colour and fur thickness, characters which might well be regarded as racial.

It seems that the Indian *himalayana* may be distinguished from *bobak* by its larger size, but our material for *bobak* is very inadequate. The only data I am able to give is that two

skulls for *bobak* from Russia in the British Museum have the occipitonasal length 96-97½ mm., whereas all but one of our *himalayana* skulls, Chinese localities included, are more than 100 mm. in occipitonasal length. This is, I think, a fairly safe character because no other *Marmota* skulls in the British Museum from all Europe and Asia reach 100 mm. in length in this species group, so that *himalayana* seems to stand apart from all the others on size of skull. But if really adequate material for all races came to hand, it might be an average rather than an absolute difference. Some of the long-tailed marmots, including typical *caudata*, have the skull as large as *himalayana*.

External characters.—The fur is shorter in this species than in *Marmota caudata*, and the tail is considerably shorter, less than one-third of the head and body length. Otherwise, including the small ear, the characters are as much as described above for *M. caudata*. The middle finger dominant in the hand, and proportions of digits about as in the related species. Thumb sometimes untraceable. Claws strong and prominent.

Colour.—Above pale greyish tawny, very much less striking than *caudata*, nearly uniform, and with a certain suggestion or admixture of black hairs; fur dark brown basally, pale terminally. Tail usually but not always with a blackish tip at the end. Underparts paler than back, greyish to pale yellowish. Apparently 10 or 12 mammae can be present. The feet as a rule are rather pale.

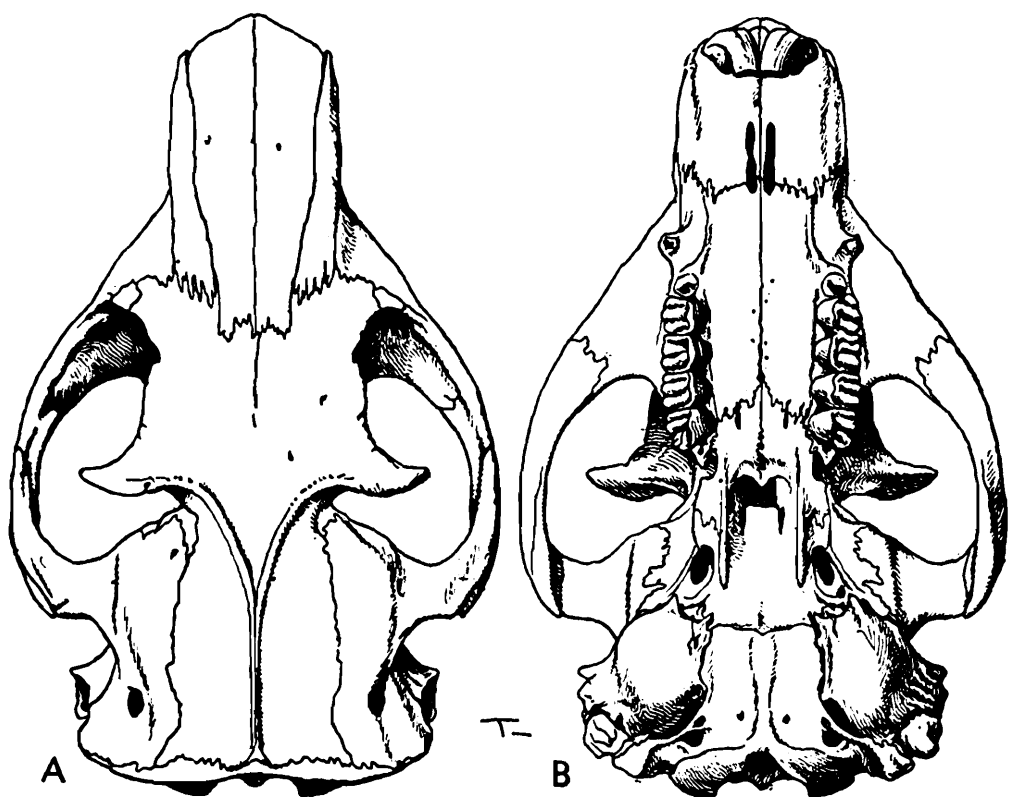
External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>M. bobak himalayana</i>				
M. Lingti, Lahul	600	180	95	27
M. Lingti, Lahul	630	193	104	27
M. Lingti, Lahul	520	160	90	26
F. Lingti, Lahul	660	190	95	26
Hoti, Garwhal, Tibet border	550	140	90	?

Other skins, unmeasured, seen from Khardong, Ladak; Skardu in Baltistan, Tyan, Ladak; Sissoo, Lahul; Sassar Pass, Ladak; Digr, Ladak; Nepal; Sikkim; east border of Tibet; east of Atunsi, Yunnan; Szechuan, etc.

Cranial and dental characters.—Essentially as described above for *Marmota caudata*. In all specimens of *M. b. himalayana*, the Indian race, the upper incisors tend to be white in colour. Possibly the occiput tends to be a little stronger and more upstanding in *himalayana* than in *caudata*,

and there is a little more tendency for the upper incisors to be more pro-odont, so that the condylobasal tends to exceed the occipitonasal length. *M. b. himalayana* usually has the occipitonasal length more than 100 mm. in length, but this is not apparently the case with typical *bobak*.



TEXT-FIG. 18. *Marmota bobak himalayana* (Hodgson). A, B, dorsal and ventral views of the skull. ($\times 2$).

Cranial measurements.—

		Occipito- nasal	Palate	Tooth- row	Nasals	Frontals	Orbit
<i>M. b. himalayana</i>							
M.	23.9.1.38	96.5	58.0	24.1	40.5	21.8	35.2
	Lingti, Lahul.	Not entirely adult					
M.	23.9.1.39	107.6	61.9	23.8	46.7	26.7	38.9
	Lingti, Lahul						
M.	23.9.1.40	101.5	59.7	23.7	44.4	25.2	36.6
	Lingti, Lahul						
F.	23.9.1.41	104.8	60.4	24.7	45.7	26.5	36.7
	Lingti, Lahul						
	91.10.7.97 c.	101.0	57.3	—	—	25.3	35.8
	Sikkim						
M.	5.12.5.2	101.4	58.5	23.3	43.8	24.4	36.0
	Hoti, Garwhal, Tibet border						

Another specimen of this (?) race from Hoti, Garwhal, has the occipitonasal length 109 mm., the largest specimen available. A lectotype of *hemechalanus* Hodgson, from Tibet (broken), also available for examination. Adult skulls also seen from Kansu, Szechuan, and Yunnan in China (four in number), have the occipitonasal length over 100 mm.

Dimensions of the species Marmota bobak, as indicated by British Museum material, including bobak, himalayana and sibirica.—The occipitonasal length varies between about 96 mm. and about 109 mm. The upper toothrow between 21.7 and 23.8 mm. The head and body between 368 and 660 mm. The tail between 122 and 193 mm. The hindfoot 76–104 mm.

(i) **Marmota bobak himalayana** (Hodgson)

The Himalayan Marmot

Text-fig. 18

- 1841. *Arctomys himalayanus* Hodgson, *J. Asiat. Soc. Beng.*, **10**, 777. Nepal.
- 1843. *Arctomys hemachalanus* Hodgson, *J. Asiat. Soc. Beng.*, **12**, 410. Nepal.
- 1847. *Arctomys tibetanus* Gray, *Cat. Hodgson's Coll. B.M.*, 24.
- 1872. *Arctomys robustus* Milne-Edwards, *Nouv. Arch. Mus. Bull.*, **7**, 92. Moupin, Szechuan, China.
- 1879. *Arctomys hodgsoni* Blanford, *Yarkand Miss. Mamm.*, **35**. Nepal.

Type-locality.—Nepal.

Range.—Specimens seen from SIKKIM, no exact locality; NEPAL, no exact locality; LAHUL, Lingti and Sissoo; LADAK: Dakpo, Digr, Hoti, Garwhal; Niti, Garwhal; Khardong; Tyan; Skardu, Baltistan; Sassar Pass. YUNNAN, Atunsi and east of it; Mekong-Yangtze Divide; SZECHUAN, Mountains, no exact locality, and Yangpinka; KANSU, Taochow. TIBET, Thungla, and no exact locality. (Chinese skins identified as '*robusta*'.)

From material examined there seems little doubt that the form *robusta*, from China, is nothing more than a synonym of the earlier name *himalayana*.

Family II. HYSTRICIDAE

Porcupines

Distribution.—Warmer parts of the Old World, eastwards to Celebes, Flores, Borneo and Palawan, south to the larger

Malay Islands, Ceylon, South Arabia and South Africa, the northern limit being approximately Central Italy; the Caucasus Mountains, southern and eastern Russian Turkestan, Kashmir, and the Chinese states of Szechuan and Shensi.

Large to extremely large rodents, with the angular portion of the lower jaw strongly distorted outwards by the masseter muscles, the root of the lower incisor extending up behind the distorted part of the angular process; infraorbital foramen considerably enlarged for muscle transmission; zygomatic plate narrow and completely below the infraorbital foramen. The frontal bones wide and not constricted, except in the genus *Trichys*. A tendency present, most marked in the genus *Hystrix*, for the nasal bones to be unusually large and inflated. Zygoma powerful and prominent, with relatively long jugal bone. Bullae relatively small. Dental formula I. 1/1, C. 0/0, P. 1/1, M. 3/3 = 20. The cheekteeth moderately to strongly hypsodont, rooted, flatcrowned, with narrow inner and outer folds which isolate in the adult on the crown surface. Milk premolar long retained. Externally very highly specialized by modification of the fur into spiny covering, even the tail sharing in the general spiny specialization, its end either bearing a copious cluster of hollow quills which are rattled together by the animal when alarmed and thus used as a danger signal, or in less specialized genera, its end bearing a tuft of bristles which at least in *Atherurus* can be used to a certain extent in the same way. The form robust, terrestrial. Fibula not fused with the tibia. Five hind toes. Generally there are intermixed with the spines of the back some spines which are exceptionally thickened and modified into quills, but this is not the case in Asiatic species of *Atherurus* and in *Trichys*.

This family differs entirely from all other Asiatic rodents by its specialized spiny covering and by the formation of the lower jaw. There are four genera, all of which occur in Asia, although one, *Thecurus*, does not reach the mainland, being confined to Sumatra, Borneo and Palawan, and another, *Trichys*, only reaches the mainland in the Malay States, its other localities being Sumatra and Borneo. The two remaining genera occur in India.

Some authors prefer to divide the Hystricidae into two subfamilies Hystricinae and Atherurinae. There is, certainly, a wide distinction between the *Hystrix* group (*Hystrix* and *Thecurus*), on the one hand, and the *Atherurus* group (*Atherurus* and *Trichys*), on the other, but not so much, in

my opinion, that it is a matter of necessity to give each of these groups subfamily rank.

The main difference, apart from some cranial characters which are to a certain extent bridged by the genus *Thecurus*, is that in the *Atherurus* group the tail is long, its end bearing a cluster of modified bristles at its end, whereas in the *Hystrix* group, the tail is shortened, its end bearing a group of hollow rattling-quills. In *Atherurus* the anterior zygoma root is placed further forward (over P 4) than in *Hystrix*, in which it is situated more over the middle of the toothrow. The cheekteeth tend to be more hypsodont in *Hystrix*, and the size is as a rule larger, with much more specialized spiny covering, including the quills on the back (which are, however, developed in the African species of *Atherurus*).

Special works of reference on the Hystricidae include :

- Pocock, 1922, *Proc. zool. Soc. Lond.*, p. 365, External characters of some Hystricomorph rodents.
 Lyon, 1907, Porcupines of the Malay Peninsula; *Proc. U.S. Nat. Mus.*, 32, 575.
 Ellerman, 1940, *Fam. Gen. Liv. Rodents*, 1, 197.
 Lönnberg, 1923, On the Chinese porcupine, *Hystrix subcristata* Swinhoe, with remarks on other members of the genus; *Ark. Zool.*, 15, 18, 1.

Key to the Indian genera

- 1 (2) The nasals are short, confined to the rostrum, not widened, usually less than 30% of the occipitonasal length, or 30% at most. In length they do not exceed 29.4 mm. in skulls available. The tail is long, varying from one-third to one-half of head and body length (where measured skins are obtainable), its end bearing a cluster of highly modified bristles which are each alternatively expanded and contracted. The spiny covering is not at a very high degree of specialization, and there are no true quills on the back. The occipitonasal length is at most 100 mm., usually less. The anterior zygomatic root is situated approximately over the premolar *Atherurus*
- 2 (1) The nasals are long, inflated, not confined to the rostrum, widened at least to a certain extent and in the Indian species are usually at least half the occipitonasal length or slightly less. In length they

are not less than 57.3 mm. in the Indian skulls available, and are usually over 60 mm. The tail is short, less than one-fifth of head and body length (where measured skins are available) in the majority, its end bearing a cluster of highly modified hollow 'rattling-quills'. The spiny covering is at a high degree of specialization; true quills are always present on the back. The occipitonasal length is not less than 117.5 mm. The anterior zygomatic root is situated further backwards, approximately over the middle of the tooththrow.. ..

Hystrix

Some of the figures given in the key for *Hystrix* refer to the Indian species only. There are species in the Malay Peninsula and Islands which have shorter, smaller nasals than either of the Indian ones or any of the African ones, but these always have the nasals conspicuously larger than in *Atherurus*. The Javanese porcupine, *Hystrix javanicum*, can have the occipitonasal length as small as 103.6 mm. but *Thecurus*, which genus is essentially like *Hystrix* in external characters but has the nasals narrow, confined to the rostrum, and quite as in *Atherurus* in structure, can sometimes have the occipitonasal length well below 100 mm. The fourth genus, *Trichys*, is externally like *Atherurus* except that the bristles of the tail are simpler, and the spiny covering is even weaker, but it differs quite strikingly in cranial characters, having postorbital processes, narrowed and constricted frontals, a groove running along the outer side of the jugal and a differently shaped lower jaw.

Genus 12. *Atherurus* Cuvier

1829. *Atherurus* F. Cuvier, *Dict. Sci. nat.*, 59, 483.

Type-species.—*Hystrix macrourus* Linnaeus.

Range.—Indo-Malayan region from ASSAM, TENASSERIM, Southern China in part (Szechuan and Hainan), Indo-China, the Malay States, and Sumatra. Tropical Africa.

This genus, containing the brush-tailed porcupines, is very distinct from *Hystrix*, and more primitive. As indicated in the key, it may be characterized by its short, uninflated nasals, and its long tail, details of the structure of which will

be described below. The first-named species in the genus is also the only species which occurs in Asia.

External and cranial characters.—As in the single species described below.

37. *Atherurus macrourus* (Linnaeus)

The Asiatic Brush-tailed Porcupine

1758. *Hystrix macroura* Linnaeus, *Syst. nat.*, 10th ed., 1, 57.

Vernacular name.—Landak, *Malay*.

Type-locality.—Is taken as being Malacca.

Distribution.—The Asiatic range of the genus.

External characters.—Smaller than is usual in *Hystrix*. No crest of hairs on head. Neck, shoulders and belly covered with shortish bristles. The main bristles of the back, though prominent, are not much elongated, and in the Asiatic species they appear not to be modified into true quills. The main strengthened bristles tend to be dark terminally, and can be lighter basally. Tail quite long, in specimens I have seen over one-third of head and body length, and can be over half that measurement. It bears scales through much of its length, with short spiny bristles between, which do not hide the scales. At its end it bears a cluster of highly modified bristles, which are light in colour and alternately expanded and contracted (each bristle with three, four or five expansions). Proportions of hands and feet much as in *Hystrix* as regards the digits; on the hindfoot the hallux slightly shorter than fifth toe, which is rather shorter than second toe, which is slightly shorter than the central pair of digits; on the hand, thumb vestigial, the two middle digits longer slightly than the outer ones. Claws powerful on all digits except the thumb. The specialized portion at the end of the tail is only a little shorter, apparently, than the spiny normal portion.

Colour.—Above dark brown, the end of many of the bristles whitish, giving in general a mottled effect; the terminal caudal bristles whitish; the belly mostly whitish. The whitish character of the underparts well marked in skins available for the typical race and for the Indo-Chinese *stevensi*, which I think is a synonym of the typical race, but less marked in two skins available for *zygomaticus*, and, as described by Thomas, in *assamensis*. Weight $4\frac{1}{2}$ lb. (according to Thomas) in the type of *assamensis*.

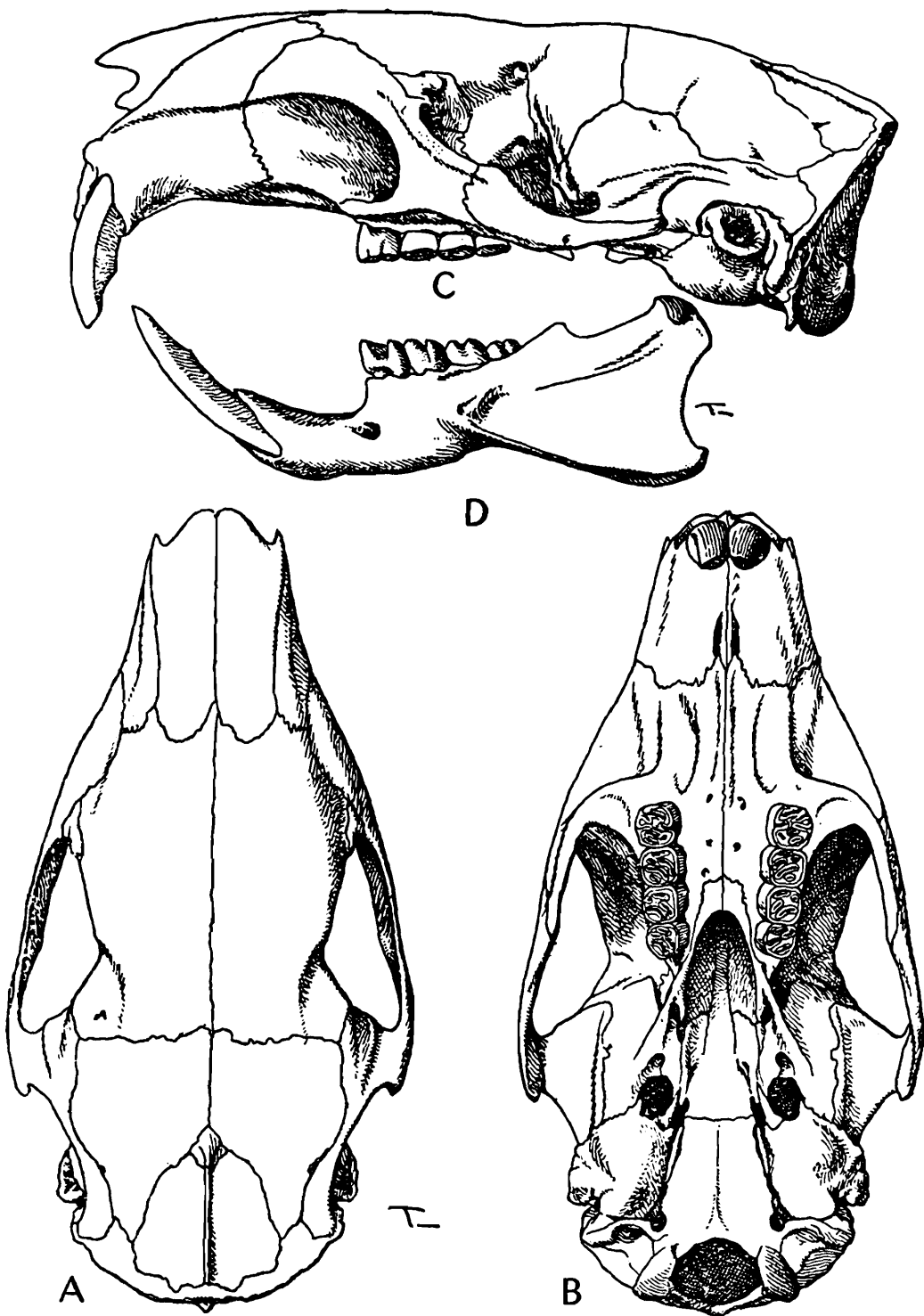
External measurements of the Indian races.—

	Head and body	Tail	Hind- foot	Ear
<i>A. macrourus macrourus</i>				
Thoungyeh, Tenasserim	?	?	70	40

This is the only skin I have for the typical race which bears measurements.

<i>Atherurus macrourus assamensis</i>				
M. Cherrapunji, Assam, type	420	220	65	34

Cranial characters.—The skull is large for a rodent but small for a member of the present family; only one skull in the British Museum reaches 100 mm. in occipitonasal length. Nasals short, confined to rostrum, tending to be slightly wider in front than behind, extending back only to about level of front of infraorbital foramen. Frontal bones much longer than nasals, and scarcely constricted, their narrowest part about at level of middle of orbit, their combined width over one-quarter of occipitonasal length. Suture between frontals and parietals nearly straight; interparietal large and prominent. There is quite a sharp and well marked sagittal ridge. Occiput prominent and well ridged in the middle, as in more fossorial rodents. Paroccipital process not lengthened and fairly closely applied to bullæ. The bullæ are not large in this family, and but little inflated. The toothrow is rather short and appears to be set rather far forward in the skull, and there is a space about double the length of M. 3 between the hinder molars and the pterygoid fossae, which are narrow. The palate is normally less than half the occipitonasal length, and is rather narrow and rather conspicuously pitted with many small holes. Palatal foramina very strongly reduced, as normal in this family, and situated far in front of the toothrows; the foramina short and very narrow. Infraorbital foramen without special canal for nerve transmission on its inner side, the foramen well open, zygomatic plate below it narrow; anterior zygoma root situated about over P. 4; jugal long, considerably broader in front than behind, not approaching lachrymal. Mandible with the angular portion only weakly distorted outwards by the muscle, not very typical for the family, and the coronoid process very low, almost vestigial.



TEXT-FIG. 19. *Atherurus macrourus macrourus* (Linnaeus). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 2$).

Dental characters.—Upper incisors red (in mainland specimens), not much thickened, and not grooved, their roots usually forming a swelling just behind the palatal foramina near or in the premaxillo-maxillary suture. Upper cheek-teeth narrow and rather small, the toothrow normally less than one-fifth of occipitonasal length, the teeth not differing

conspicuously in size, each tooth with one main inner, and three main outer folds; these folds soon isolate as islands on the flatcrown surface, the islands narrow, and often subdividing with wear. Lower molars with one main outer, and three main inner folds, reversing the pattern of the upper series, as in the upper teeth, the folds isolate as narrow islands.

Cranial measurements.—Porcupines prove difficult to measure accurately with the machine which I use for such large numbers of smaller rodents as mice and their allies, and squirrels. The occipitonasal length exceeds the condylobasal length. The palatal foramina have ceased to have much value in this family, so I omit them. The bullae are also omitted; they vary but little in the different species of Hystricidae.

	Occipito- nasal	Palate	Diastema	Toothrow	Nasals
<i>Atherurus macrourus macrourus</i>					
M. 85.8.1.340	100.0	—	—	18.4	29.3
Thoungyeh, Tenasserim					
<i>Atherurus macrourus assamensis</i>					
M. 20.11.1.77	93.1	43.6	27.4	c. 16.1	28.5
Cherrapunji, Assam, type					

Dimensions for the species Atherurus macrourus, including all races represented in the British Museum.—The occipitonasal length varies between 84 and 100.1 mm., but the specimen with the '84' measurement has not got M. 3 fully cut, and the next smallest specimen is about 90 mm. in occipitonasal length. The toothrow varies between 15.3 and 18.4 mm. The nasals between 24.5 and 29.4 mm. in adults. The head and body length in the few measured skins seen varies between 350 and 530 mm., the tail between 163 and 245 mm., the hindfoot between 57 and 79 mm.

From India I have seen only the two skins referred to above.

*Provisional key to Indian races of
Atherurus macrourus*

- 1 (2) Upper toothrow in adult skulls
with M. 3 fully cut is not less than
17.8 mm. *A. m. macrourus*
- 2 (1) Upper toothrow is about 16.1 mm.,
or clearly less than 17 mm. *A. m. assamensis*

A note on the races of Atherurus macrourus.—

Probably if a large number of specimens for this genus were collected, it would be impossible to divide it into subspecies. At present it appears it can be divided into two groups, the typical race (probably including *stevensi* Thomas, 1925, from Tonkin) which has large teeth, the upper toothrow more than 17 mm., and apparently lighter underparts, and a short-toothed group, for which the first name seems to be *zygomatiscus* (Miller, 1903, from Pulau Aor, Johore) and which has a shorter toothrow (less than 17 mm.) and perhaps usually darker, drabber underparts. But it must be borne in mind that few specimens are available for each race. The Assam brush-tailed porcupine seems only known by one specimen. It seems to combine the rather long nasals of the typical race with the shorter toothrow of *zygomatiscus* and its immediate allies. Its nasals seem to be longer than the measurements given by G. Allen for the Hainan race, which is not represented in London.

(i) **Atherurus macrourus macrourus** (Linnaeus)

Text-fig. 19

1758. *Hystrix macroura* Linnaeus, *Syst. nat.*, 10th ed., 1, 57.

Type-locality.—Malacca.

Range.—Specimens examined from TENASSERIM, Thoung-yeh; MALAYA: Jalor; Province Wellesley. PENANG Island. It also occurs in Sumatra, according to Chasen.

(ii) **Atherurus macrourus assamensis** Thomas

1921. *Atherurus assamensis* Thomas, *J. Bombay nat. Hist. Soc.*, 27, 3, 598.

Type-locality.—Cherrapunji, Assam.

Range.—Only known from the neighbourhood of the type-locality.

It is like *A. m. macrourus*, but with actually shorter toothrow. The type skull is slightly larger than any skulls examined for the races *A. m. zygomatiscus* and *A. m. tionis*, and the nasals are larger than in any skull examined for these insular races.

Genus 13. **Hystrix** Linnaeus

1758. *Hystrix* Linnaeus, *Syst. nat.*, 10th ed., 1, 56.

1823. *Acanthion* F. Cuvier, *Mem. Mus. Hist. nat. Paris*, 9, 425.
(*Acanthion javanicum* Cuvier from Java. Valid as a subgenus.)

Type-species.—*Hystrix cristata* Linnaeus from Italy.

Distribution.—From Flores, Celebes, Borneo, Java, Sumatra, the Malay States, Siam, Indo-China, southern China, north to Szechuan and South Shensi, east to Fukien, westwards through BURMA, ASSAM, and NEPAL to KASHMIR, thence southwards through the PENINSULA of INDIA to CEYLON: BALUCHISTAN, Afghanistan, Persia, Syria, Israel, Asia Minor, southern Arabia; Transcaucasia and southern parts of Russian Turkestan. Italy and Sicily. North Africa, and through most of Tropical Africa south to the region southern Cape Province.

This genus contains specialized, short-tailed porcupines, in which the nasal bones are widened and lengthened to a greater or lesser degree; the nasals over 41 mm. in length in all Asiatic, North African and European species available, never confined to the rostrum, sometimes enlarged and broadened to a fantastic degree. The species with the largest nasals is the type, and the species with the smallest nasals is *H. javanica*, from Java, on which the subgeneric or generic name *Acanthion* was based. In 1912 Miller proposed to restrict the genus *Hystrix* to those porcupines in which the nasal inflation was at the maximum ('nasal bones extending to glenoid level'), and stated that only Italian and African porcupines belonged to it. But as subsequently pointed out by Lönnberg (1923), one arrives at bizarre results if one follows Miller's classification. The South African *H. africae-australis*, indistinguishable externally from the type-species, seems to go into *Acanthion* (nasals relatively short), and the Indian and Chinese *H. hodgsoni*, which has all the external characters of *H. javanica* (type of *Acanthion*), seems to come into *Hystrix*. In 1940 I treated *Acanthion* as a subgenus based on the external characters. When all species of the genus are compared, there are intermediate species between the two extremes of nasal inflation, and it is quite impossible to give *Acanthion* generic rank based on nasal inflation alone.

Hystrix is here restricted to the species with the long crest on the head, the many-ringed quills, and the large caudal rattling-quills. The first-named species in the genus is the type, *Hystrix cristata*, from Italy and North Africa. It has enormous nasals; specimens available to me have the nasals averaging over 60% of the occipitonasal length. This species

does not occur in Asia. The earliest name for a crested porcupine from Asia is *H. indica* Kerr, 1792, the Indian crested porcupine. This is the only Asiatic species of crested porcupine, and it has a very wide range in western India and southern West Asia. It is clearly distinct from the type, having much shorter and narrower nasals. It is further remarkable as being easily the largest rodent in Asia, North Africa, Europe and Australia as judged by the skull length; I have measurements for almost all specimens of all rodent species in the British Museum for the Continents just mentioned.

Acanthion is based on the porcupines of eastern Asia which have less specialized external characters; the crest abortive, or absent; the body quills one-ringed, and the caudal rattling-quills smaller, so far as I have seen skins. To this subgenus belongs the Indian *H. hodgsoni*, which has relatively long nasals, and the Chinese *H. subcristata* seems to be a well marked race of it. In the Malay States, Sumatra, Java, Borneo, Flores, etc., there is an allied group of species with relatively short nasals; to this group belong *H. brachyura* Linnaeus and *H. javanica* Cuvier. Both of these have the nasals less than half the occipitonasal length in skulls which I have examined.

Key to the subgenera of Hystrix

1	(2)	External spiny covering less specialized; no crest of hairs on the head or this very poorly developed and weak; main quills of the back are mostly white terminally and basally and always have only one dark ring in the middle; caudal hollow rattling-quills less developed, the cylindrical portion measuring roughly 23 mm. or less (in Indian skins). 	<i>Acanthion</i>
2	(1)	External spiny covering at highest development: a long and profuse growth of long bristles on the head forming a long crest; main quills of the back very long and always with several alternating rings of blackish and white; caudal hollow rattling-quills highly developed, the cylindrical portion in a specimen from India measuring about 60 mm..	<i>Hystrix</i>

Subgenus (a) **Acanthion** Cuvier

1823. *Acanthion* F. Cuvier, *Mem. Mus. Hist. nat. Paris*, 9, 425.

Porcupines with the main quills of the body bearing only one dark ring, with the caudal hollow rattling-quills not at maximum development, and with the crest of hairs on the head absent or abortive. Nasals may be considerably more than half occipitonasal length (as in Indian species) or considerably less than half occipitonasal length (as in Malay Island and Malay States species).

One species occurs in India, which has long nasals. The first name for it appears to be *H. hodgsoni* Gray.

38. **Hystrix hodgsoni** (Gray)

The Crestless Himalayan Porcupine (Crestless
Himalayan Porcupine and Bengal
Porcupine of Blanford)

Text-fig. 20

1847. *Acanthion hodgsoni* Gray, *Proc. zool. Soc. Lond.*, 101.

Vernacular names (according to Blanford).—Anchotia dumsi, Nepal; Sathung, Lepcha; O-e, Limbu; Midi, Cachari; Subondem, Manipuri; Suku, Kuki; Sisi, Daphla; Tuigon, Soke, Liso, Vikha, Sekru, Naga; Sajru, Bengali; Phyu, Burmese.

Type-locality.—Nepal.

Distribution.—As here understood. NEPAL, ASSAM, BURMA, TENASSERIM, Siam, Indo-China, and southern China, east to the state of Fukien, north from Yunnan and Szechuan to South Shensi, according to Glover Allen, and Hainan.

External characters.—In general tending to be a little smaller than *Hystrix indica*, but not always so individually, this species differs by the fact that the crest of hairs on the head and neck is in the adult absent or abortive, and by the fact that the quills of the back have only one dark ring, being in the majority white terminally and basally. The quills are unusually thick and powerful in the specimen below of *H. h. klossi*. The caudal rattling-quills are very poorly developed in *H. hodgsoni*, and the living animal makes far less noise with them than does the large African crested porcupine which externally resembles *H. indica*. Thus in the specimen listed below from Hathibun, one of the caudal rattling-quills measures only 16½ mm. (The same measurement in a specimen of *indica* was about 60 mm.) The *klossi* skin has the

caudal rattling-quills rather better developed, but still small. One of these measures nearly 23 mm. Hands and feet much like those of *indica*, possibly with less tendency for the claws to be overhung by hairs.

Colour.—Varying from greyish-silverish brown to blackish brown, with the quills as above described, mainly white basally and terminally, with one dark ring each. Belly the same colour as back, usually a whitish collar traceable in front of neck. Caudal rattling-quills light in colour as usual; spines on the tail often with a dark ring on them, and not wholly white. In the *klossi* skin there is an abortive but quite noticeable little crest of white hairs on the head. A head from Chinkiang, Lower Yangtse, South China, represents a porcupine with an abortive crest present, in general similar to that of *klossi*.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Hystrix hodgsoni hodgsoni</i>				
M. Hathibun, Nepal	600	100	87	36

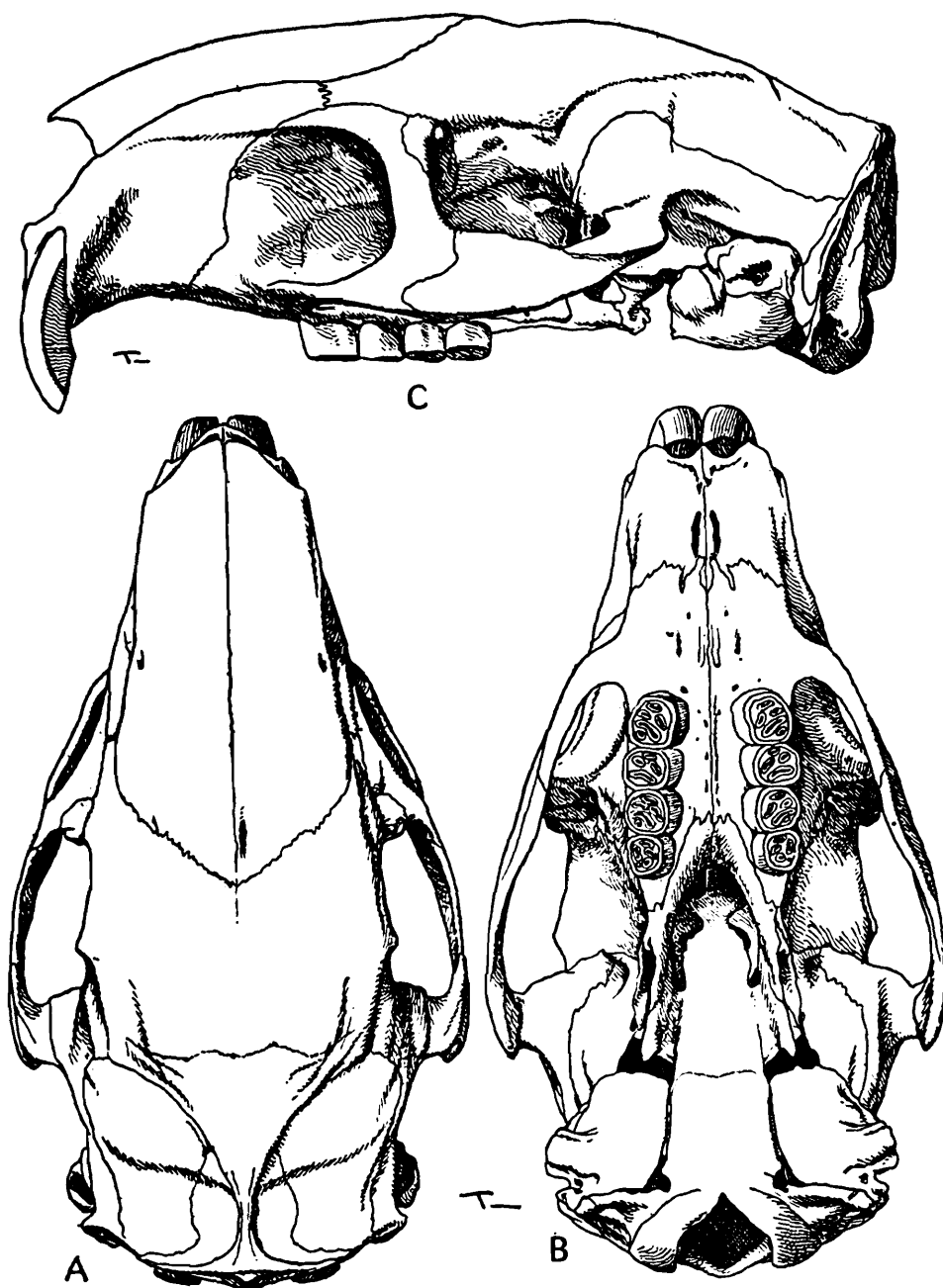
Unmeasured skins from Nepal, no exact locality; Sikkim, no exact locality; and Longpa in Naga Hills ('*bengalensis*'). Blanford stated the weight was 16–20 lb.

<i>Hystrix hodgsoni</i> ' <i>klossi</i> ' = <i>subcristata</i>				
M. Klong-yai, Siam	735	115	93	44

This is the only skin I have seen of this race which bears measurements, and as may be noted from its locality, it is not from Indian territory.

Cranial characters.—The skull is very large, not under 115 mm. in adult in occipitonasal length, and can be over 140 mm. In *subcristata* it is considerably arched in its upper profile; rather less so in the typical race. The nasal bones are very long, and considerably broadened, always noticeably longer than the frontals, and more than half the occipitonasal length. The hinder borders of the nasals which are about their widest part are more or less curved and U-shaped where they meet the frontals. Frontals very wide, the narrowest part of the skull being about at the level of junction of the frontals with the parietals, and near the posterior zygomatic root. Interparietal bone originally large and projected forwards to about half-way between the lambdoid region and the parietal-frontal suture; a strong and powerful sagittal

crest formed by the united ridges from near the front of interparietal backwards to the lambdoid crest; occiput high, upstanding, ridged and powerful. Paroccipital process large but not elongated as sometimes in Hystricomorph rodents, closely applied to the bullae, which are relatively small and flat. Pterygoid fossae situated considerably behind the tooth-rows and excessively narrowed and reduced. Palate of medium width; over half occipitonasal length measured from its posterior portion to the front of the incisors; palatal foramina excessively small, situated just behind upper incisors.



TEXT-FIG. 20. *Hystrix hodgsoni* (Gray). A, B, C, dorsal, ventral and lateral views of the skull. ($\times 2$).

Infraorbital foramen large, with no canal for nerve transmission, and zygomatic plate narrow and wholly below it. Lachrymal of medium size, upper zygomatic root situated approximately over middle of toothrow; zygoma powerful and prominent, but simple, the jugal long, gradually getting broader in the anterior portion, but not approaching lachrymal. Mandible with coracoid well developed but lower than condylar process; the angular portion is very strongly distorted outwards beside and outside the long lower incisor root.

Dental characters.—Upper incisors thick and powerful, usually yellow, and plain, their roots extending to just in front of premolars, and usually forming a swelling in that place on the lower surface of skull. Milk premolar long retained; four upper cheekteeth, these teeth not greatly differing in size, flatcrowned, with narrow re-entrant folds which isolate as narrow islands, the pattern fundamentally that of one inner, three outer folds in the upper series, but the folds isolating as islands on crown surface and subdividing. Often four isolated outer islands on the upper teeth. The cheekteeth are strongly hypsodont. Numerous cusp spaces more or less arranged in three rows visible in a specimen of *hodgsoni* with P. 4 cutting. Lower molars reversing the pattern of the upper series, one main outer, three (or four) main inner folds, these folds isolating and dividing on crown surface as islands. The teeth are semi-rooted.

Cranial measurements.—Porcupines are not easy to measure accurately, and there is a certain margin of error in these very large skulls, so that measurements should be taken as approximate. The occipitonasal in this species exceeds the condylo-basal length. Toothrow is upper toothrow crowns.

		Occipito- nasal	Palate	Diastema	Toothrow	Nasals
<i>Hystrix hodgsoni hodgsoni</i>						
M.	21.10.4.35	119.1	—	31.0	26.7	66.1
	Hathibun, Nepal (approx.)					
	58.6.24.36	circa 119.5	56.7	30.3	22.5	—
	Nepal					
	79.11.21.637	117.5	62.3	30.5	25.0.	61.3
	Nepal					
	45.1.8.8	118.9	62.3	32.4	25.2	64.6
	Nepal. (Lectoparatype)					
	53.8.16.11	119.0	61.0	30.5	24.2	?
	Nepal. (Lectotype of <i>alophus</i> Hodgson)					

Ridges on parietals not joined.

Cranial measurements (contd.).—

		Occipito- nasals	Palate	Diastema	Toothrow	Nasals
<i>Hystrix hodgsoni subcristata</i>						
M.	22.12.22.20 .	134.1	68.3	35.6	26.9	73.7
	Okotso, Naga Hills, Assam ('millsi')					
M.	22.12.22.21 .	125.3	67.4	34.1	24.5	66.1
	Okotso ('millsi')					
	22.12.22.23 .	125.5	67.5	35.9	27.1	69.5
	No locality ('millsi')					
F.	21.7.16.4 .	130.0	—	—	28.7	68.2
	Sangrachu, Naga Hills, type ('millsi')					

Another skull from Changsui, Naga Hills, is not adult.

Chinese skulls available measure: occipitonasal 125.5—*circa* 138 mm., toothrow 24.9–28.2 mm., and nasals 71.4–76.8 mm.

Hystrix hodgsoni subcristata ('klossi')

	14.12.8.224 .	141.1	73.5	38.0	29.1	79.3
	Bankashon, Tenasserim					
M.	14.2.8.223 .	146.2	76.6	39.2	30.2	75.5
	Tenasserim town, type					
	14.8.22.31 .	132.6	69.4	36.5	28.4	71.2
	Siam, 12° N., 99.5° E.					
M.	15.11.4.220 .	138.6	71.1	35.6	28.9	71.0
	Klong Yai, SE. Siam					

The last two are not from Indian territory, but are the only other skulls available, and are added for completeness.

Dimensions of the species Hystrix hodgsoni, as indicated by British Museum material, including all races available.—The occipitonasal length varies between 117.5 and 146.2 mm. The toothrow between 22.5 and 30.2 mm. The nasals between 60 and 79.3 mm. The head and body adult between 600 and 735 mm., tail 100–115 mm., hindfoot 87–93 mm. The only skins I have seen bearing measurements are the two noted above.

Key to the Indian races of Hystrix hodgsoni

- 1 (2) Small race, the occipitonasal length does not exceed 119.5 mm. in the adult. Length of nasals about 66 mm. at highest. Caudal rattling-quills on the tail are less well open (at least compared with *klossi*; no skins available for *subcristata*).

H. h. hodgsoni

- 2 (1) Larger races, the occipitonasal length is not less than 125.3 mm. in adult skulls with M. 3 fully cut. Length of nasals about 66 mm. at lowest, usually more. Caudal rattling-quills on the tail are more open and developed (in *klossi*)

H. h. subcristata ('*klossi*' and '*millsi*' included)

From G. Allen's published measurements of *subcristata* I cannot see how '*klossi*' can be separated cranially. Thomas thought they differed in colour, but colour varies individually in porcupines.

In 1940, I divided what I now believe to be a single species into two sections of a specific group, based on external characters, the first section containing *hodgsoni* only, from Nepal, the second containing *H. subcristata* Swinhoe, 1870, the southern Chinese porcupine, and its Hainan subspecies (which I have never seen), and the forms named *klossi* and *millsi* by Thomas, both from India. I now believe that although *hodgsoni* is a distinct small north-western race, all these forms might well be regarded as a single species.

Anthony (1941) has recorded the Chinese porcupine *H. subcristata* from Gangfang and Hpimaw in North Burma, being the first record for Indian territory, and on re-examining our material as based on skulls, I cannot see any way of regarding *millsi* Thomas as anything but a synonym of *subcristata*. It is complicated somewhat by the fact that the external characters of *millsi* are unknown, and I have never seen a skin of *subcristata*; but in the present state of our knowledge I do not know how *millsi* is distinct cranially from *subcristata*; our skulls seem very similar, and individual differences in *millsi* more or less cover individual differences in *subcristata*. Also it seems that the form *klossi* cannot be distinguished from *subcristata*. From these forms, *hodgsoni* differs in its smaller size, and shorter nasals. Thomas, Wroughton, and others agree in regarding *H. bengalensis* Blyth, 1851, as synonymous with *hodgsoni*, although Blanford (who had never seen a specimen) retained it as a valid species. I have never seen a specimen, but see no good reason to doubt the identification of Thomas and Wroughton.

(i) *Hystrix hodgsoni hodgsoni* (Gray)

1847. *Acanthion hodgsoni* Gray, *Proc. zool. Soc. Lond.*, 101. (June, 1847.)
 1847. *Hystrix alophus* Hodgson, *J. Asiat. Soc. Beng.*, 16, 771. (August, 1847.)
 1851. *Hystrix bengalensis* Blyth, *J. Asiat. Soc. Beng.*, 20, 170. (Bengal.)

Type-locality.—Nepal.

Range.—Specimens examined from NEPAL, Hathibun and no exact locality, including lectotypes of *hodgsoni* and '*alophus*'. SIKKIM, no exact locality. ASSAM: Longpa in Naga Hills.

A small race, with the caudal rattling-quills very poorly developed and narrowed; the skull small, occipitonasal length less than 120 mm. in all material available; nasals averaging roughly 53% of the occipitonasal length, and always over half that measurement; toothrow usually over one-fifth of the occipitonasal length. This race stands well apart from *subcristata* on account of its small size and rather weakly developed external spiny specialization. Probably the crest is always less suggested than in *subcristata*.

This porcupine was very well described by Hodgson, 1847 (August), under the name of *Hystrix alophus*. There are 8 mammae according to that description.

(ii) *Hystrix hodgsoni subcristata* Swinhoe

1870. *Hystrix subcristata* Swinhoe, *Proc. zool. Soc. Lond.*, 638.

1916. *Acanthion klossi* Thomas, *Ann. Mag. nat. Hist.*, 17, 139. (Tenasserim town.)

1922. *Acanthion millsii* Thomas, *J. Bombay nat. Hist. Soc.*, 28, 2, 431. (Sangrachu, Naga Hills, Assam.)

Type-locality.—Foochow, Fukien, south-eastern China.

Range.—Chinese range of the species as noted above; specimens examined from TENASSERIM: Tenasserim town and Bankashon; Siam, 12° N., 99° E. on Tenasserim border, and Klong Yai in South-East Siam (the above localities refer to '*klossi*'). ASSAM: Sangrachu, Okotso and Changsii, all Naga Hills ('*millsii*').* Annam: Hue, Ninh-hoa. South China: Kiukiang in North Kiangsi, Lower Yangtse.

Larger than the typical race; occipitonasal length in adult with M. 3 fully cut is over 125 mm. Caudal rattling-quills of the tail, as judged by *klossi*, more open and more developed; spiny covering at rather higher degree of specialization than the typical race, so far as ascertainable from material available. Nasals between 51% and 56% of occipitonasal length individually always over half the occipitonasal length. Toothrow usually over one-fifth of the occipitonasal length.

* Also recorded from central Manipur (see Roonwal, M. L., 1949, *Trans. nation. Inst. Sci. India*, Calcutta, 3 (2), pp. 108-109; and 1950, *Rec. Indian Mus.*, Delhi, 47 (1), pp. 58-59.—EDITOR.

Subgenus (b) **Hystrix** Linnaeus

As here understood, porcupines with highest degree of specialization of spiny covering; the caudal rattling-quills very large and well open, of maximum development; a long crest of hairs present on the head; main quills of the body much lengthened, and bearing numerous alternating rings of black and white on each one. The nasals may be slightly less than half the occipitonasal length, or slightly more, or about half that length, as in the Indian species, or very much more than half the occipitonasal length, as in the type-species.

There is only one species of crested porcupine in Asia. It differs from the Italian and North African *H. cristata* Linnaeus in its shorter, narrower nasals. The prior name for it seems to be *H. indica* Kerr, 1792, which antedates both *leucura* Sykes, 1831, which has been in current use and *hirsutirostris* Brandt, 1835 (which name Russian authors use), and which seems to be the same.

39. **Hystrix indica** Kerr

The Indian Crested Porcupine

Text-figs. 21, 22

- 1792. *Hystrix cristata* var. *indica* Kerr, *Anim. Kingd.*, 213. (India.)
- 1831. *Hystrix leucurus* Sykes, *Proc. zool. Soc. Lond.*, 103. (Deccan, India.)
- 1851. *Hystrix zeylonensis* Blyth, *J. Asiat. Soc. Beng.*, 20, 171. (Ceylon.)
- 1865. *Hystrix malabarica* Selater, *Proc. zool. Soc. Lond.*, 353. (Cochin, southern India.)
- 1911. *Hystrix hirsutirostris blanfordi* Müller, *S.B. Ges. nat. Fr. Berlin*, 121. (Jalk, 3,000 m., Baluchistan.)
- 1912. *Hystrix cuneiceps* Wroughton, *J. Bombay nat. Hist. Soc.*, 21, 771. (Nokania, Cutch.)

Vernacular names (from Blanford).—Sayi, Sahi, Sayal, Sarsel, etc., *Hindi*; Sajru, *Bengali*; Dumsi, Chotia-dumsi, *Nepal*; Saori, Chaodi, *Guzrati*; Salendra, *Mahr. of the Ghats*; Sinkor, *Sindhi*; Sikhan, *Baluch.*; Shkunr, *Pushtu*; Hoigu, *Gond.*; Jekra, *Korku*; Jiki, *Ho-Kol*; Yed, Mul-handi, *Can.*; Yeddupandi, *Tel.*; Mullanpanni, *Tam.-Mal.*; Hitava, *Cingalese*.

Type-locality.—India.

Range.—Specimens examined from NEPAL, no exact locality. KUMAON, Horai. PUNJAB, Tochi Valley, Bonnu district; Saharunpur, Siwaliks. KASHMIR, Ashkote. BALUCHISTAN, Khojdar; SIND, Mirwal, Mirpur, Gambat (Khairpur). RAJPUTANA, Sambhar. CUTCH, Nokania. UNITED PROVINCES,

Bijnor. CENTRAL INDIA, Sehore. CENTRAL PROVINCES, Hoshangabad. PENINSULA: Dharwar. Deccan. Nilgiri Hills. Shambalgamur in Palni Hills. TRAVANCORE, Cochin. CEYLON: St. George, Matugama; Gammaduwa and Mousekande.

Distribution of species.—From CEYLON northwards to NEPAL and KASHMIR, thence westwards through BALUCHISTAN to Afghanistan, Russian Turkestan (Turkmenia, Semirechya, Kopet-Dag and Kara-Kum regions), Transcaucasia (Talysh), Persia, eastern Asia Minor, Syria, Israel, Iraq and the Aden district of South Arabia

The name '*malabarica*' was based on a specimen in which the quills are partly red and black (instead of white and black). This peculiarity is known to occur individually in the East African *H. cristata galeata* and seems an individual colour variation. Blanford placed the name '*zeylonensis*' (Blyth, 1851) in synonymy of *H. leucura* = *indica*. This was based on a specimen 'sent alive by Mr. Layard' Its description suggests that it was not based on *H. indica*.

External characters.—The form is robust, heavy and terrestrial, the size very large, as indicated above the head and body length to 744 mm. in the few skins available which bear measurements; Blanford gave head and body up to 32 inches. There is a long crest of thin bristles on the head, commencing on the forehead and extending to the back of the head; these hairs may exceed a foot in length. Shoulders and belly covered with coarse bristles. The whole of the back covered with long and well developed quills, which may be nearly two feet in length sometimes in this genus, and which are frequently shed during life. There is a profuse growth of long narrow quills on the back of the present species, which tend to hide the thicker and more powerful quills on the back, which are sharp and do the real damage should the animal wish to attack and charge backwards at an object. These quills may be either white or black terminally, but on each of them there are several alternating bands of black and white. Tail short, usually less than one-fifth of the head and body length. It is covered with several short, apparently white quills, mixed with the hollow rattling-quills, which in this species are large and well developed. These are long and cylindrical and attached to the tail by a thin 'stalk' When alarmed, the animal rattles and shakes them together. Hands and feet broad. The thumb is vestigial, the other four fingers robust, with thick claws, the middle two longest, the claws covered apparently by bristle hairs. The pads, five of which seem traceable in dried skins, large and broad, particularly the one adjacent to the thumb. The

hindfoot broad, with probably six pads; fifth toe slightly shorter than second, which is slightly shorter than the middle two; hallux well developed, but a little shorter than the fifth toe; toes with claws covered by bristle hairs. According to Blanford, there are six mammae. A juvenile specimen from Mirwah, Khairpur, Sind, seems to lack the crest, but as its quills are hardly properly developed or are only starting to resemble those of the adults, perhaps the crest only comes when the animal is older.

Colour.—Blackish brown on shoulders and below, excepting that the tail quills are white, and the main body quills are, as described above, more or less longitudinally banded blackish and white. There is a white band on the cheeks and throat which forms a collar. I see no colour differences between any of the specimens available, including those from Persia, Iraq and Arabia, except that one from Cochin ('*malabarica*' of Sclater) has some of the tail quills reddish and some of the body quills mixed reddish with black (and others white and black as usual). The main quills in this species are most often white terminally.

External measurements of Hystrix indica.—

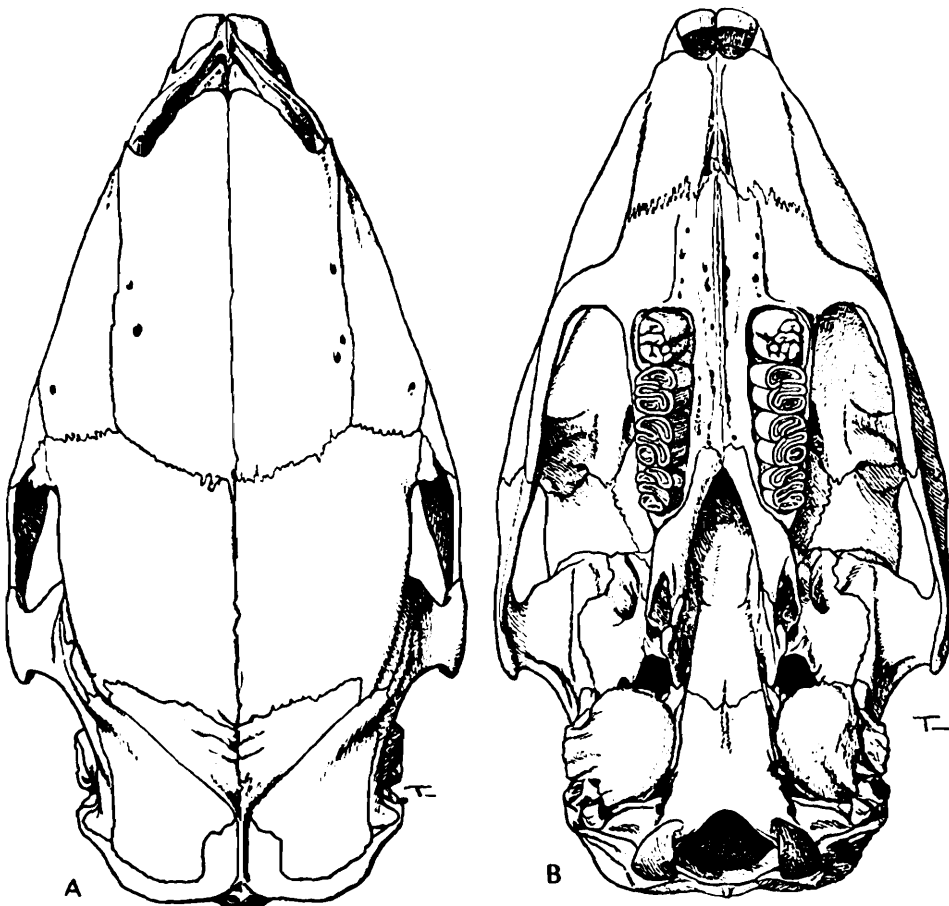
	Head and body	Tail	Hind- foot	Ear
M. Nokania, Cutch (type of ' <i>cuneiceps</i> ')	680	88	96	42
Mirpur, Sukkur, Sind	642	93	85	35
Mirwal, Khairpur, Sind	633	140	89	45
Gambat, Khairpur, Sind	713	142	95	43
Sehore, Central India	700	100	98	40
F. Shambalgamur, Palni Hills	740	210	96	47
M. Khojdar, Baluchistan	720	130	105	42
36.1.22.11. Mousekande, Ceylon	744	111	98	47
(Weight 30 lb. 10 oz.)				

Unmeasured skins have been examined from Sambhar in Rajputana, from Cochin and an authentic skin from Nepal with long crest. The weight is noted as 30 lb. in a specimen from Sehore, where it is noted as being 'very common': another skin has the weight noted as 19½ lb.

Cranial characters.—Skull largest of Asiatic rodents at extreme development. Nasals not much widened for a porcupine of this genus, and not very much lengthened; on average as a rule just under half the occipitonasal length. Eleven out of thirty-one skulls measured have the nasals just over half the occipitonasal length; most of these are old specimens. The nasals extend back about to lachrymal level, the

premaxillae extending back to the same level, and are proportionately wide on the junction with the nasals posteriorly. Frontal bones nearly straight on meeting the nasals, broad and unconstricted, as a rule appearing not so long as the nasals, but longer than the parietals. The interparietal appears in young skulls to be similar to that of *H. hodgsoni*, but is not traceable in the fully adult skulls, the parietals very powerfully ridged, and a long strong sagittal crest present in the adult. Occiput upstanding, strong, and powerfully ridged. Paroccipital process large, closely applied to the bullae, which are relatively small and not peculiar in form. Pterygoid fossae very narrow as in *H. hodgsoni*, and situated well behind level of M. 3.

Palate of medium width, considerably higher than the basioccipital region, longer than half the occipitonasal length but difficult to measure accurately from the front of the incisors. Palatal foramina very small and narrow, far in front of toothrows. Infraorbital foramen well open, and zygomatic plate narrow and completely below it; anterior zygoma root about over level of middle of toothrow. Zygoma powerful,



TEXT-FIG. 21. *Hystrix indica* Kerr. A, B, dorsal and ventral views of the skull. ($\times 2$).

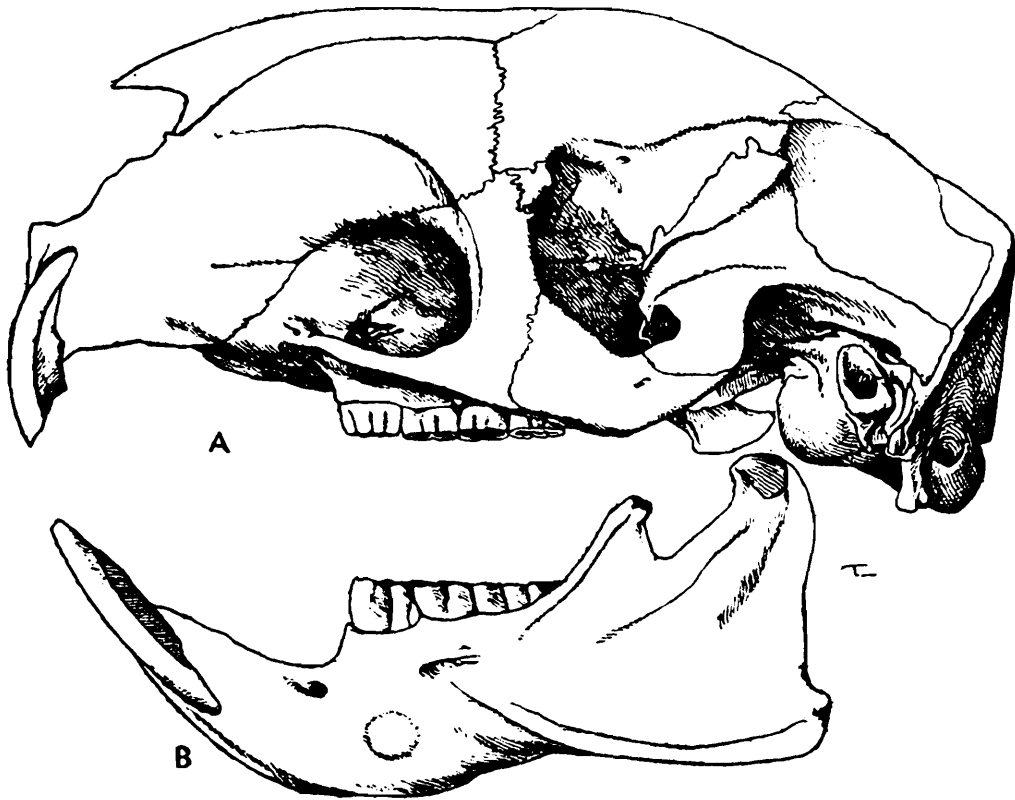
the jugal broader in front than behind, and long, but not approaching lachrymal. Mandible with coronoid lower than condylar process, but not vestigial; angular portion strongly and powerfully distorted outwards, its lower outer side powerfully ridged.

Dental characters.—Upper incisors usually yellow, fairly thick and not grooved, their roots usually forming a slight knob on diastema in front of premolars. Pattern of upper cheekteeth about as usual in the family, most often with four isolated outer islands and one inner fold. The milk premolar long retained. P. 4 and M. 3 when cut appear to have three longitudinal rows of cusps traceable, but the teeth quickly become flatcrowned, and with the pattern indicated above. One specimen from the Punjab has the usual four upper teeth and a small posterior molar about half the size of M. 3 behind M. 3, suggesting that here, as is often in rodents (cf. Dipodidae, Muridae), reduction of teeth has taken place from behind, and that possibly the cheektooth formula should be written as P. 2/2, M. 2/2 instead of, as more usual, P. 1/1, M. 3/3. Lower cheekteeth reversing the pattern of the upper series. Lower incisor root extends inside the distorted angular process nearly to the condyle.

I would doubt if this species can be divided into races on cranial characters unless almost every series from each locality is given a racial name. Certainly I think most of the characters given for '*cuneiceps*' by Wroughton are individual. The size for the type of this supposed race is no smaller than specimens from Ceylon and Nepal; in fact, it is larger. There may, however, be a tendency here for the skull to be slightly wider behind in more northern specimens, than southern ones, as indicated by Wroughton; but I believe it is individual rather than racial.

Seven skulls from Ceylon average rather smaller than nineteen skulls from various places on the peninsula, northwards to Baluchistan and Kashmir. Two skulls from Nepal, one of them not fully adult, are smaller still. Perhaps the Nepalese *indica* is racially distinct, but the material seen is not very adequate. Ceylon skulls have the nasals over half the occipitonasal length, and the percentage of nasals against occipitonasal length is slightly longer for Ceylon than for the mainland. The two Nepal skulls have shorter nasals on average than is usual. The occipitonasal length varies between 127 mm. and 130 mm. for Nepal; 129.5 and 146 mm. for Ceylon, but only over 140 mm. in two out of seven specimens; and between 133 mm. and 161 mm. for the mainland other than Nepal; the smallest of these is an apparently

adult specimen from Sind (133 mm.); the next is the type of Wroughton's '*cuneiceps*' which has the occipitonasal about 139.6 mm.; others are over 140 mm. and about half of them over 150 mm. The largest is a specimen from the United Provinces. For the time being I propose to treat all these forms as belonging to one race.



TEXT-FIG. 22. *Hystrix indica* Kerr. A, lateral view of the skull. B, lower jaw of the same. ($\times 2$).

Cranial measurements.—As in Table 44, below.

In this species the condylobasal length may or may not be greater than the occipitonasal length, perhaps according to the animal's age. I omit the palate measurement as it is too difficult to measure accurately on adult skulls. The occipitonasal length of larger skulls must be taken as approximate.

Dimensions of the species Hystrix indica as indicated by British Museum material, including specimens from Persia, Iraq and South Arabia.—The occipitonasal length varies between 127 mm. and 161.4 mm. The nasals between 57.3 and 82.3 mm. The upper toothrow between 28.0 and 36.8 mm. but normally not over 35.6 mm. The head and body length varies between 633 and 744 mm. The tail between 75 and 210 mm. The hindfoot between 85 and 105 mm.

TABLE 44.—*Cranial measurements of the Indian races of Hystrix indica*

	Occipito- nasal	Diastema	Toothrow	Nasals
<i>Hystrix indica</i>				
	<i>circa</i>			
3.4.12.1	153.0	48.3	36.0	78.8
Datta Khel, Tochi Valley, Bonnu district, Punjab. This specimen has five upper cheekteeth. Old				
10.12.2.40	159.0	48.5	34.4	76.6
Sehore, Central India				<i>circa</i>
10.12.2.41	155.8	50.5	30.0	75.3
Sehore, Central India	<i>circa</i>			
12.6.29.125	157.0	43.8	35.2	80.8
Dharwar district				
F. 15.11.1.128	141.1	38.5	30.6	69.1
Gambat, Khairpur, Sind				
M. 15.11.1.125	133.0	40.1	32.1	65.7
Mirwah, Khairpur, Sind				
M. 19.11.8.33	143.7	43.4	34.3	69.8
Khojdar, Baluchistan				
F. 19.11.8.34	146.0	42.9	35.6	74.0
Khojdar, Baluchistan				
25.12.5.2	146.0	44.8	34.6	71.7
Ashkote, Kashmir				
M. 26.10.8.68	150.8	46.5	33.9	77.3
Saharunpur, Siwaliks	<i>circa</i>	<i>circa</i>		
26.10.8.69	163.0	48.8	34.6	82.3
Bijnor, United Provinces.	Condylbasal about		163.8 mm.	
26.8.10.70	151.0	44.1	32.3	72.2
Bijnor, United Provinces				
29.10.19.6	150.0	44.1	30.6	72.4
Horia, Kumaon	<i>circa</i>			
31.1.10.10	148.0	46.5	—	71.6
Hoshangabad				
65.1.30.10	141.6	41.6	32.6	72.1
Cochin. ('malabarica')				
79.11.21.636	140.5	42.7	—	65.8
Deccan. (Young, P. 4 cutting)				
88.2.5.25	148.0	43.1	31.3	70.2
Nilgiri Hills				
88.2.5.24	146.5	42.5	30.2	75.1
Nilgiri Hills	<i>circa</i>			
M. 12.1.9.11	139.6	41.4	32.5	72.7
Nokania, Cutch. (Type of 'cuneiceps')				
Other skulls from Sambhar, Rajputana and Shambagamur, South India.				
Ceylon specimens.—				
M. 20.2.8.14	145.0	39.5	31.7	70.4
St. George, Matugama, Ceylon				

TABLE 44.—*Cranial measurements of the Indian races of Hystrix indica (concl'd.)*

		Occipito- nasal	Diastema	Toothrow	Nasals
<i>Hystrix indica</i> (concl'd.)					
M.	31.9.11.7 Gammaduwa, Ceylon	138.0	40.1	30.4	70.9
M.	36.1.22.11 Mousekande, Ceylon	139.7	37.2	32.0	68.8
	1937.10.8.5 Gammaduwa, Ceylon	136.4	38.0	30.8	66.5
	1937.10.8.6 Gammaduwa, Ceylon	129.5	38.7	28.9	70.7
	76.5.30.6 Ceylon	<i>circa</i> 145.0	42.0	32.3	76.8
	88.4.12.5	136.0	38.3	28.0	<i>circa</i> 64.7
Nepal specimens.—					
	508a Nepal	127.0	38.5	30.8	57.3
	47.7.22.8 Nepal. (Young, M. 3 cutting)	130.1	38.9	—	62.7

Family III. DIPODIDAE

Jerboas and Birch-Mice

Distribution.—East Europe, northern Asia, North Africa and North America.

Rather small to very small rodents in which the infra-orbital foramen is very strongly enlarged for muscle transmission, the zygomatic plate is narrow and completely below the infraorbital foramen, and the lower jaw has the angular portion not distorted outwards by a specialized limb of masseter lateralis. The angular portion frequently shows signs of inflection, and may be perforated. Dental formula I. 1/1, C. 0/0, P. 1/0 or 0/0, M. 3/3 = 18 or 16. When present the extra upper premolar is very small as a rule. It is possible that the cheektooth formula would be more correctly written as P. 2/1 or 1/1, M. 2/2, as there is a specimen of *Allactaga elater* in the British Museum which has an extra tooth at the back of the molar series, suggesting that perhaps a hind molar was suppressed, as is thought to be the case in the family Muridae. The cheekteeth are rooted; the essential pattern of the upper series, in the Indian subfamilies, is one of two longitudinal rows of cusps, as in the Cricetinae. The folds

between the laminae which bear the cusps are wide. Some genera have the cheekteeth flatcrowned. The fibula is reduced and fully fused with the tibia. Externally in all genera except *Sicista*, the external form is modified for bipedal saltatorial life, with short forelimb, immensely elongated hind-foot and hindlimb, and immensely elongated tail, the general result being something like a miniature kangaroo. In the more specialized subfamilies the three central metatarsal bones fuse to form a cannonbone, a character not known elsewhere in the Order Rodentia. In Dipodinae also some of the cervical vertebrae tend to become fused. The infraorbital foramen has a separate canal for nerve transmission. The skull is rather generalized apart from the infraorbital foramen structure in the lowest members, as *Sicista*, but in *Allactaga* and higher jerboas it is very specialized, with the zygoma in two sharply contrasted portions, and with very wide frontals; also in some genera, but not those occurring in India, the mastoids and bullae are strongly enlarged. In progressive species there is reduction present in the digits of the hindfoot, so that ultimately three toes only are present and in all higher jerboas only three toes reach the ground, and the outer toes are more or less functionless.

The distribution of the family is largely Palaearctic, with one group occurring in Canada and the United States and another extending somewhat into northern and north-eastern Africa.

Twelve genera occur in Asia. The subfamily Dipodinae contains two rather distinct branches, one, with large to very large bullae, orthodont incisors, smaller ears, three toes only, baculum present and anterior vertical portion of the zygoma more broadened, containing the genera *Jaculus*, *Dipus*, *Stylodipus*, *Paradipus*, etc., is western and northern in range and although the first named occurs in Persia and the second and third in Chinese Turkestan, this branch is not known from India; the other, with smaller bullae as a rule, proodont incisors, larger ears, five toes usually (though only three are functional), no baculum and anterior vertical portion of the zygoma less broadened, contains the genus *Allactaga* and the related genera *Pygeretmus* and *Alactagulus*. One species of *Allactaga* reaches Indian territory in Baluchistan. The subfamily Euchoreutinae, while agreeing with the Dipodinae in having the three central metatarsal bones fused to form a cannonbone, differs in various details such as having the jugal not in two sharply contrasted portions, the cheekteeth with unusually high cusps, the frontals narrowed and the ear enormously enlarged; there is a single genus *Euchoreutes*

which occurs in Chinese Turkestan and inner Mongolia. One genus of the subfamily Cardiocraniinae (*Salpingotus*) is believed to occur in Afghanistan; the other species are chiefly Mongolian. This subfamily has the metatarsals unfused, though in many other characters there is specialization present towards the higher type of jerboa, as in the enormous mastoids and bullae, and the jugal which is in the two contrasted portions. The subfamily Zapodinae is mostly Nearctic in distribution, but there is a genus, *Eozapus*, in the states of Kansu and Szechuan in China. The metatarsals are unfused, the bullae are small and uninflated, the zygoma is simple. The external characters are modified towards saltatorial life. The closely related subfamily Sicistinae contains a single genus, which occurs in Kashmir in North India, which differs in not being adapted for saltatorial life but in which the form is essentially like a small long-tailed mouse, as well as in some details of the cheekteeth.

Special works of reference on this family to be recommended are :

- Vinogradov, 1925, *Proc. zool. Soc. Lond.*, 577. Structure of external genitalia of Zapodidae and Dipodidae.
- Vinogradov, 1930, *Bull. Acad. Sci. Leningrad*, 331. Cranial characters of genera of Family Dipodidae.
- Vinogradov, 1937, *Inst. zool. Acad. Sci. de l'URSS, Ser. 13*, 3, No. 4. Family Dipodidae (a monograph of the family, with figures of cranial, dental, skeletal and reproductive characters of all principal species, and distribution maps; Russian with English résumé).
- Lyon, 1901, *Proc. U.S. nat. Mus.*, 7, 23, 659. Comparison of the osteology of jerboas and jumping-mice.
- Pocock, 1922, *Proc. zool. Soc. Lond.*, 659. External characters of *Scarturus* and other jerboas, compared with *Zapus* and *Pedetes*.

Key to the subfamilies.—See pp. 5–8, *supra*.

Subfamily (a) SICISTINAE

Generalized Dipodides with the three central metatarsals not fused to form a cannonbone, the bullae not particularly inflated, the zygoma simple, the frontals constricted and the form of the skull essentially Murine except as regards the infraorbital foramen; 4/3 cheekteeth, which are biserially cuspidate, and the external form not modified for bipedal saltatorial life. Size very small, among the smallest of Asiatic rodents. There is only one genus.

Genus 14. **Sicista** Gray

1827. *Sicista* Gray, *Griffith's Cuvier Anim. Kingd.*, 5, 228.

1840. *Sminthus* Nordmann in Demidoff, *Voy. Russie*, 3, 49.
(*Sminthus loriger* Nathusius.)

Type-species.—*Mus subtilis* Pallas from western Siberia.

Range.—Europe and Asia; from Norway, Denmark, North Germany, Czechoslovakia, Rumania, Bulgaria, northern and southern Russia, Russian Turkestan and southern Siberia eastwards to the island of Sakhalin and the Ussuri district, Chinese Turkestan, Szechuan and Kansu in China, and KASHMIR in northern India.

There are three species (or groups of species) in this genus, which may be roughly classified as follows: *Sicista subtilis*, Pallas, the type and first name in the genus, has a dark stripe running down the back, the tail proportionately shorter than is usual in the genus (in B.M. specimens averaging about 118% of head and body), and the foot usually less than one-quarter of the head and body length. *Sicista betulina*, Pallas, is like the last but has a proportionately longer tail and the hindfoot is usually over a quarter of the head and body length. *Sicista concolor* is much like *betulina*, but has no dark stripe on the back. Only the last named occurs in India. It was not dealt with by Blanford because in his day it was not known from Indian territory.

40. **Sicista concolor** (Büchner)

1892. *Sminthus concolor* Büchner, *Mel. Biol. Acad. St. Petersb.*, 13, 267; *Bull. Acad. Imp. Sci. St. Petersb.*, 3, 107.

Type-locality.—From the mountains of Sining in Kansu, China.

There are four named forms of *Sicista* in extreme western or western China, and in Kashmir. Their precise status is not at the present day clearly known and whether they are even distinguishable from each other is not known. These forms are, in order of naming:—

Sicista concolor concolor, Büchner, 1892, as above.

Sicista concolor leathemi, Thomas, 1893, *Ann. Mag. nat. Hist.*, 11, 184, from the Krishnye Valley, Wardwan, Kashmir.

Sicista concolor flavus, True, 1894, *Proc. U.S. nat. Mus.*, 17, 341, from Kashmir.

Sicista concolor tianschanica, Salensky, 1903, *Ann. Mus. St. Petersb.*, 8, 17, from the Tian-Shan Mountains.

I have never seen *S. c. flavus*, but we have a few specimens of the other races. *S. c. leathemi* is, in any case, the first name for a *Sicista* from Kashmir, if it can be proved distinct from *S. concolor*.

We have only two specimens of *S. c. concolor* available for comparison, and unfortunately neither is adult. The tail proportions of *leathemi* available to me are shorter than in our (sub-adult) *concolor* specimens, but longer than in the measurements given for *concolor* by Glover Allen, for the type specimen. The only two skulls present for *leathemi* do, however, show one character, which may or may not be constant, that distinguishes them from *concolor* and *tianschanica*, namely that the palate is proportionately shorter in *leathemi*. In the present state of our knowledge on these very rare Central Asian forms, that is about all that can be said.

Sicista concolor may be defined specifically, as with no dark mid-dorsal stripe on the back, and with a long hindfoot, usually over a quarter of head and body length, and a long tail, on average over 140% of head and body. The distribution of the species is Russian and Chinese Tianshan, and north to the Siberian Altai, Kansu and Szechuan in China, and Kashmir. There is a related form in the Ussuri region of East Siberia and Sakhalin, and, I believe, another in the Caucasus.

External characters.—The external form in *Sicista concolor* is essentially like a small unicolorous mouse, with a very long tail, which in the Kashmir race averages over 160% of the head and body, and with a rather long, narrow hindfoot, which is more than a quarter of the head and body length, but less than one-third of that length (in other Asiatic Dipodidae available to me, the skins of which bear measurements, the hindfoot is over one-third of head and body length, and very often over half that length). The ear is large, over one-fifth of head and body length. The fur of the body is thick and soft. The claws are not enlarged, and the digits of the hand are not peculiar in proportions; as is usual in the Order the pollex is clawless and rudimentary. The hindfoot is narrow, with the three centre toes subequal and longest; fifth toe reaching about half-way up the fourth; hallux reaching only about to base of first toe, and clawed. Tail very long, not well haired, the scales visible, but with a certain growth of short hairs through its length, and tending to be very finely pencilled at end.

Colour.—The back is dull greyish brown more or less throughout, slightly paler on the sides, definitely so on the belly, which is lightish grey, with suggestion of a white line

on the throat behind which the belly is at its darkest. Tail clearly to obscurely bicolor, in the four skins available to me, nearly white below, darker above. Feet lighter than the back but possibly tending to be less light than in *tianschanica*.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
M. Rupal, Astor	67	109	18½	14½
F. Rupal, Astor	67	117	19	14
M. Kaghan Valley, N.W.F.P.	66	110	?	14

Another juvenile skin from Malangan, Kagnarg Mountains, Kashmir, 11,000 ft.

The last skin was identified as *tianschanica*, which, judging by the scanty material available to me, is barely distinguishable externally from *leathemi*. The Kaghan Valley skin is essentially like the other specimens of *leathemi*.

Cranial characters.—Size extremely small, occipitonasal length about 20 mm. The skull has a rather pointed rostrum, with the nasals extending back about to level of lachrymals. Frontals moderately constricted, the constriction placed considerably behind the lachrymals. Parietals about as long as frontals, their anterior borders not straight but together nearly forming the base of an 'O'. Interparietal well developed. No ridges on the frontals, or these very weak. Occipital region not particularly strong, and without peculiarity. Bullae quite prominent and well developed, but not particularly enlarged compared with higher members of the family; roughly 17% or 18% of occipitonasal length; palate rather wide, short, less than half occipitonasal length in all forms available to me for the species, and shortest of all in this race; a spinous process present at the back of the palate in one unbroken skull; palatal foramina long, in the neighbourhood of 20% of occipitonasal length, which is uncommon among Asiatic rodents. Infraorbital foramen very large, wider below than above, with separate canal for nerve transmission next to the premaxillae. Nasals slanting somewhat over the incisors anteriorly. Jugal very long, broader in front than behind, and slanting gradually towards the lachrymal, with which it is not in contact. Mandible with well developed coronoid process, the angular part apparently not perforated, the jaw without peculiarity.

Dental characters.—Upper incisors yellow, orthodont, narrow, and ungrooved. Front upper premolar very small, though with some cusping apparent. M. 3 reduced, only about

half the size of M. 2, M. 1 and M. 2 about equal in size. M. 1 and M. 2 have four main cusps, the outer ones tending to be slightly wider than the inner ones, these cusps situated roughly at the corners of the teeth, the folds between them rather wide. Traces of subsidiary ridges present in front of the anteroexternal cusp and between the two main external cusps. M. 3 reduced, with elements rather indistinct. Three lower teeth, M. 3 little reduced, not much smaller than M. 2. The lower molars are biserially cuspidate, as in the upper cheekteeth, but the folds separating the cusps appear as a rather more important element in the teeth, and the subsidiary ridges appear on the inner side; there is a subsidiary ridge behind the main posterointernal cusp as well as in front of it, in M. 1 and M. 2.

Cranial measurements.—

		Occipito- nasal	Palate	Foramina	Bullae	Toothrow	Frontals
F.	94.10.2.1	20.1	8.8	4.4	3.4	2.9	3.8
	Kagnarg Mountains, Kashmir						
M.	93.4.15.1	20.3	8.9	4.1	?	3.1	4.1
	Krishnye Valley, Wardwan, type						

Other skulls, not fully measurable, from Rupal, Astor, Kaghan Valley, NW Frontier, and Astor Valley.

Dimensions of the species Sicista concolor, as indicated by material available in the British Museum.—The occipitonasal length varies between 18 mm. and 21 mm. in adult skulls, the upper toothrow between 2.8 and 3.1 mm. The head and body varies between 50 mm. and 71 mm., the tail 98–117 mm., the hindfoot 17–19 mm. The tail averages over 140% of head and body length in all races available to me, the hindfoot is over a quarter of head and body length in all specimens seen.

(i) ***Sicista concolor leathemi*** (Thomas)

The Kashmir Birch-Mouse

1893. *Sminthus leathemi* Thomas, *Ann. Mag. nat. Hist.*, **11**, 184.

Type-locality.—Krishnye Valley, Wardwan, Kashmir.

Range.—Specimens examined from KASHMIR: The type-locality; Rupal, Astor; Kagnarg Mountains (Malangan); Kaghan Valley.

Like *S. c. concolor* but, as far as the material available shows, with a proportionately shorter palate. Tail usually about 110 mm. longer than in adult *concolor*.

(ii) ***Sicista concolor flavus* (True)**

1894. *Sminthus flavus* True, *Proc. U.S. nat. Mus.*, 17, 341.

Type-locality.—Central Kashmir, 11,000 ft.

I have never seen this form. The description below is abridged from that of True. I have made this form a race because it seems probable that the four Central Asiatic forms of *Sicista* are not likely to be more than racially distinct from each other.

The type measured, head and body 69.8 mm. Tail 107.9 mm. 'From *S. concolor*, Büchner, the present species differs in the buffy colour of the sides of the body and head, the white undersurfaces, the brownish forefeet, the white claws and the coloration. The upper premolar and last molar are in line with the other molars and the last molar is also elongated. The nasals are longer. From the species described by Mr. Thomas under the name of *S. leathemi*, the present species appears to differ in the yellowish rather than rufous coloration of the body, the brown colour of the back of the forefeet and the uniform brown colour of the extremity of the tail on both upper and undersurfaces.—The tail is approximately the same length in *S. flavus* and *S. concolor* or about one-half longer than the head and body. This proportion is exceeded in *S. leathemi* which has the tail one and four-fifth times the length of the head and body.'

Subfamily (b) DIPODINAE

Specialized Dipodidae, with the three central metatarsals fused to form a cannonbone, the jugal in two portions, a horizontal and a vertical, these portions forming a sharp angle with each other, widened skull, with wide frontals and large lachrymal, bullae often much inflated (but not so in the Indian genus); externally highly modified for bipedal saltatorial life, with very elongated tail, very elongated hind-foot which has three functional toes or three toes only, hind-limb much longer than forelimb, and tendency for the cheek-teeth to be more flatcrowned than in the last group dealt with.

Distribution.—North Africa, Russia and northern Asia.

The metatarsal bones of the Indian species (*Allactaga elater*), compared with *Sicista* and with most of the other leading genera of Dipodidae, are well figured by Vinogradov, 1937.

As indicated above, there are two rather well-defined branches of this subfamily, of which only one occurs in India, the *Allactaga* group (subfamily Allactaginae of Vinogradov). Its main characters are: incisors proodont; bullae usually comparatively small; ears relatively large; three functional, two functionless toes; and the baculum absent (Vinogradov). The infraorbital foramen is very widely open and the vertical branch of the zygoma is not greatly broadened. The palatal foramina are elongated, proportionately longer than in the *Dipus-Jaculus* group of genera.

One genus only occurs in India, only in Baluchistan so far as at present known.

Genus 15. *Allactaga* Cuvier

1836. *Allactaga* F. Cuvier, *Proc. zool. Soc. Lond.*, 141.

Type-species.—*Mus jaculus* Pallas = *Dipus sibiricus major* Kerr (see G. Allen, 1940, p. 1067).

Range.—Eastern Europe and Asia; from southern Russia across Russian Turkestan eastwards to the Altai and Transbaikalia, and across northern China from Sinkiang to Mongolia, Kansu, Shansi, Chihli, etc. From Egypt, Syria, Asia Minor, Iraq, Persia and Afghanistan eastwards to BALUCHISTAN in North-West India.

There are about nine species of this genus known, one of which, *Allactaga elater*, occurs in India. The species may be roughly divided into groups as follows: *sibirica* group, *A. sibirica*, Turkestan eastwards to Mongolia, in which M. 3 is very small, scarcely larger than P. 4, and the size of the animal is moderate, hindfoot 66–88 mm.; *major* group, *A. major* and allies, South Russia, Turkestan, and the Altai Steppe, M. 3 considerably larger than P. 4, size large, hindfoot over 70 mm., often over 80 mm.; and the *elater* group, *A. elater* and related species, Caucasus and Turkestan eastwards to Mongolia, Asia Minor eastwards to Baluchistan, like the last group in dental proportions, but smaller, hindfoot not over 70 mm. About six species are referable to the *elater* group. Only *A. elater* occurs in India.

41. *Allactaga elater* (Lichstenstein)

1825. *Dipus elater* Lichstenstein, *Abh. k. Akad. Wiss. Berlin*, 155.

Vernacular name.—*Khani*, in Afghanistan (Blanford).

Type-locality.—Eastern Kazakhstan.

Range.—North Caucasus and Transcaucasia; Russian Turkestan, where it is common, east to Saissan; Zungaria; Asia Minor, Persia, Afghanistan and Baluchistan.

Smallest species of the genus. Occipitonasal length not exceeding 28.3 mm. Upper toothrow not over 5.5 mm. Hindfoot 55 mm. at highest.

External characters.—The form is like that of a miniature kangaroo, with the forelimb much shorter than the immensely elongated hindlimb, and with the tail very strongly elongated, often over half as long again as head and body, and averaging in measured skins available to me 148% of head and body. The hindfoot is over half the head and body length. The ear, as is usual in *Allactaga*, is very large, being over one-third of head and body length. The tail is heavily tufted terminally; the colour of the tuft is strikingly contrasted black and white. The claws of the four main fingers are well developed, as is usual in jerboas, and the thumb, though clawless, is less reduced than is often the case in rodents. The hindfoot is very long and very narrow, an adaptation to saltatorial life. It has only three toes reaching the ground. The centre one of these is longest, and each toe bears a large blunt pad underneath the claw, which is as long as or longer than the claw. On each side of the hindfoot there is a short though clawed more or less functionless digit; these digits do not reach the ground, and do not reach nor approach the bases of the 2nd and 4th toes. The tail is hairy throughout, but except at its end the hairs are very short, though they hide the scales. For about one-third of its length at the end the tail bears a tuft of long hairs, which are first white, then black on each side, and then white terminally.

Colour.—The back is more or less sand coloured, as is usual in jerboas, light brown or fawn sometimes flecked with black. The belly and throat are white. There is a white band on the outside of each thigh. Tail light brown except the tuft. Feet usually whitish or white above.

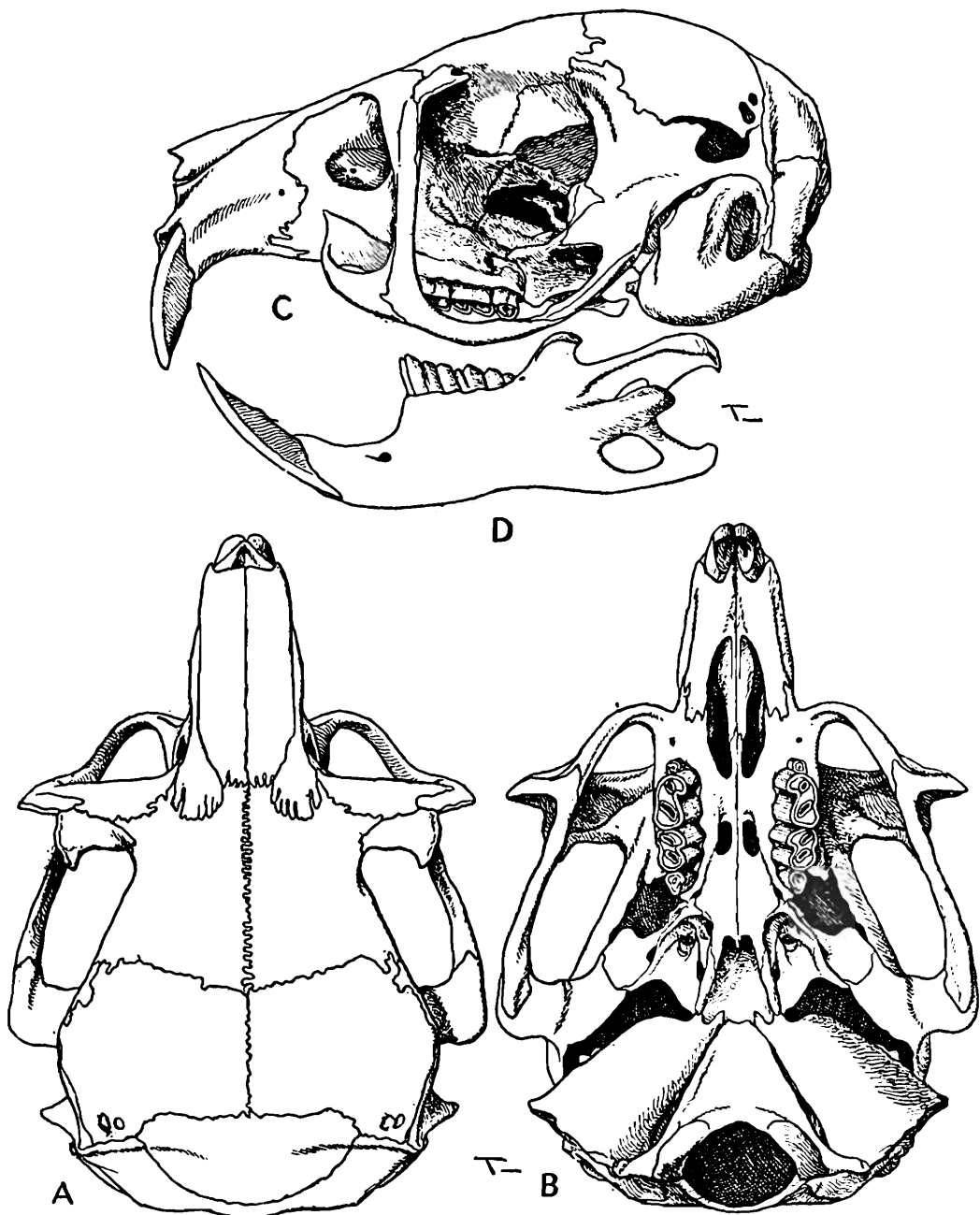
External measurements of Indian specimens of Allactaga elater indica.—

	Head and body	Tail	Hind- foot	Ear
F. Sourab, Baluchistan	90	158	52	36
				8 mammae

There are various old and badly made skins, which do not bear measurements, in the British Museum from Afghanistan or India for this race, and nine skins recently collected in Afghanistan by Mr. J. L. Chaworth-Musters. There is also an unmeasured skin from Khorassan in Persia.

Cranial characters.—The skull has broad nasals but a rather short rostrum owing to the fact that the upper incisors are much thrown forward. The lachrymals are large, the frontals very wide, but narrower immediately behind the lachrymals than further back on the skull; behind the lachrymals they are evenly divergent backwards, and are unridged. The parietals are somewhat broader than the frontals, and their anterior border, where they meet the frontals, is almost entirely straight. The interparietal is present, but rather narrow from before backwards. The occipital region of the skull is rather weak. The bullae are of moderate size, not much inflated, averaging in this race roughly 21% of the occipito-nasal length, which is much smaller than in some *Dipodidae* (for instance, *Jaculus*), which may have the bullae over one-third of the occipitonasal length. The pterygoid fossae are much deeper than in *Sicista*. The palate is long (and is difficult to measure accurately, owing to the angle of the incisors); it extends well behind the toothrows and has a spinous process present behind as a rule. There is usually a pair of short foramina between the toothrows. The front palatal foramina are very long, usually in this genus over one-fifth of the occipitonasal length. The infraorbital foramen is very widely open, with a separate canal for nerve transmission on its lower inner side. The zygomatic plate slants forward and its front edge is well in front of the level of the lachrymal. The jugal is very long, extending up to the lachrymal; it is, as already indicated, in two sharply contrasted portions, which almost form a right angle with each other. The zygoma is quite strong. Mandible weak; there is a large perforation of foramen in the angular portion, the coronoid is low, and just below the condylar process the lower incisor root forms a prominent and conspicuous knob on the outer side of the jaw.

Dental characters.—Upper incisors white, ungrooved, and strongly thrown forward (proodont). Upper cheekteeth relatively complex in pattern; P. 4 excessively small; M. 3 also small and reduced, but much larger than P. 4. M. 1 and M. 2 of nearly equal size; these teeth become nearly flat-crowned; each has a well marked inner re-entrant fold, and three outer re-entrant folds, the middle one much the smallest, but retained; probably the pattern is derivable from a type



TEXT-FIG. 23. *Allactaga elater indica* Gray. A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 7$).

of tooth which had two strong inner cusps and three outer cusps with a subsidiary ridge entering into the pattern between the second and third outer cusps, and perhaps traces of a subsidiary ridge behind the main posteroexternal cusp. In old age, the folds isolate and the pattern becomes obliterated. Lower cheekteeth three, M. 3 not much smaller than M. 1 and M. 2. There appear to be originally two outer, three inner folds in M. 1 and M. 2, with an extra one in front of M. 1; M. 3 has one outer, one or two inner folds. The pattern changes considerably during life.

Cranial measurements.—I have only one skull from India for this species. Other skulls, which agree fairly well with this one, have been examined from Tehran in Persia, and from Ghazni and Simkoh in Afghanistan.

	Occipito- nasal	Foramina	Bullae	Toothrow	Frontals
<i>Allactaga elater indica</i>					
F. 19.11.8.55 Sourab, Baluchistan	26.4	5.2	5.6	5.3	9.3

Dimensions of the species Allactaga elater, as indicated by the British Museum material available.—The occipitonasal length varies between 25.1 and 28.3 mm. The upper toothrow varies between 4.3 and 5.5 mm. The head and body length varies between 86 mm. and 125 mm. (usually not as much as 125 mm.). The tail between 128 and 177 mm. The hindfoot between 48 and 55 mm. The hindfoot averages over half head and body length in all races available to me, and the tail is most often on average over 150% of the head and body, both proportions being unusually long for a rodent, but not out of the ordinary for a member of the present subfamily.

The Indian race is the second name in the species, apparently.

(i) *Allactaga elater indica* Gray

The Smaller Afghan Jerboa

Text-fig. 23

1842. *Allactaga indica* Gray, *Ann. Mag. nat. Hist.*, **10**, 262.

1863. *Allactaga bactriana* Blyth, *Cat. Mamm.*, 110:

Type-locality.—Simkoh Hills, Afghanistan.

Range.—Specimens examined from BALUCHISTAN, Sourab. Also from AFGHANISTAN: Kandahar, Ghazni and Simkoh. PERSIA, from Tehran, and Kain district, Khorassan.

It is much like *A. elater elater*, the northern race, but the frontals average proportionately narrower in width, and the palatal length averages somewhat greater, perhaps indicating that the incisors are slightly more proodont. More important is the fact that the upper toothrow tends to be slightly longer; all skulls available to me for *indica* have the upper toothrow over 5 mm. in length, whereas our *elater* skulls from Djarkent

and another Turkestan locality have the upper toothrow less than 5 mm.

Wroughton (1919) was erroneous in referring this form to the genus *Alactagulus*, which is quite distinct from *Allactaga*, having simpler cheekteeth (the upper main teeth with only two external folds) and lacking the small anterior premolar.

Another species of this genus which occurs very close to British Indian territory, and which might be discovered to occur in India, is

Allactaga hotsoni

1920. *Allactaga hotsoni* Thomas, *J. Bombay nat. Hist. Soc.*, **26**, 4, 936 (from Kant, Sib, Persian Baluchistan).

It has much larger bullae than is usual in the genus, which are over one-quarter of the occipitonasal length. Apart from that it is not very remote from *A. elater*. The occipitonasal length of the type, which is, I believe, the only specimen known, is about 29.5 mm., and the hindfoot length is about 58 mm.

Yet another species, *Allactaga williamsi*, which is a larger animal than *A. elater* (hindfoot over 60 mm., toothrow over 6 mm.) is now known to occur in Afghanistan.

Family IV. MUSCARDINIDAE

Dormice

Distribution.—Africa, Europe, and Asia except Malay region and Islands.

Small rodents in which the infraorbital foramen is open for muscle transmission, though not very widely so; the zygomatic plate is, in Asiatic subfamilies, tilted upwards to a greater or lesser degree beside the infraorbital foramen; and the lower jaw is with the angular portion not distorted outwards by the masseter muscle. The angular portion often shows signs of inflection and sometimes is perforated, as in some Dipodidae. Dental formula I. 1/1, C. 0/0, P. 1/1 or 0/0, M. 3/3 = 20 or 16. (Here as in other Muroid rodents it is, of course, possible that the molars are 2/2 and the premolars 2/2 or 1/1 and that reduction has taken place from behind by the suppression of the hind molars). The pattern of the cheekteeth is distinctive when the family is compared with the Muridae; they are rooted and brachyodont, with a series of ridges extending across the surface of the crowns;

either cuspidate, in primitive genera like *Dryomys*, or flat-crowned in more progressive genera like *Platacanthomys*. The pattern of cuspidate, primitive, genera is somewhat reminiscent of that of the squirrels. The jugal bone is long. Usually the caecum is absent in this subfamily, but this is not the case in the genus *Typhlomys*. The skull is often somewhat generalized, with the frontals well constricted, though this is not the case in *Platacanthomys*. Except in the Platacanthomyinae, the bullae are strongly inflated, sometimes extremely so. The tail is usually fully haired and usually shorter than the head and body (*Typhlomys* excepted). In all Asiatic genera available to me the palate is rather strikingly shortened. The typical subfamily is quite easily distinguishable from the Muridae by a combination of the various characters indicated, but the Platacanthomyinae are an intermediate or annectant group. The fibula is fully fused with the tibia and there are five toes to the hindfoot. Nearly all members of this family are semi-arboreal or arboreal in habit. It is certain that there are at least two subfamilies in Asia belonging to this family (unless the Platacanthomyinae are given family rank); there is another in Tropical Africa.

The subfamily Platacanthomyinae is wholly Indo-Malayan in distribution, where it is confined to the mainland. There are two genera, *Platacanthomys*, which is Indian, and *Typhlomys*, a much smaller, longer-tailed genus with more poorly haired tail, fur not spiny, skull weakly or not ridged and possessing a caecum (according to Oldfield Thomas), all of which characters distinguish it well from *Platacanthomys*. It has not yet been taken in India, but occurs fairly close to Indian territory at Chapa in North Tonkin. It was originally described from Fukien in South-East China.

The Muscardininae is a Palaearctic group of rodents. Only one genus reaches Indian territory and only in the North-West Frontier. Five genera are available to me and there is one more which is not represented in the British Museum, from Russian Turkestan. Four of the widely distributed genera occur in Continental Europe and all of them reach some part of Asia; *Muscardinus* (Asiatic Turkey) and *Glis* (Turkey, Persia, Kopetdag Mountains) have the cheek-teeth flatcrowned, differing from *Eliomys* (Sinai, Syria) and *Dryomys*, which ranges through much of southern and eastern Russian Turkestan east to Zungaria, and from Turkey through Persia and Afghanistan to the North-West Frontier; both these genera have cuspidate molars. The other genus which I have examined is *Glirulus*, from Japan, which has smaller bullae than its allies.

A good account of the characters of the four well-known genera which occur in Europe is given by Miller (1912).

Key to the subfamilies.—See pp. 5–8, *supra*.

Subfamily (a) MUSCARDININAE

Typical Dormice, with very large bullae, and the zygomatic plate tilted upwards; cheekteeth 4/4. Usually the palate is more ossified than in *Platacanthomyinae*. Caecum absent, so far as known. Only one genus reaches Indian territory.

Genus 16. *Dryomys* Thomas

1906. *Dryomys* Thomas, *Proc. zool. Soc. Lond.*, 1905, 2, 348 (as a subgenus of *Eliomys*).

1907. *Dyromys* Thomas, *Ann. Mag. nat. Hist.*, 20, 406. To replace *Dryomys*, under the impression that it was preoccupied. (See Simpson, 1945, *Bull. Amer. Mus. nat. Hist.*, 85, 92, footnote.)

Type-species.—*Mus nitedula* Pallas.

Distribution.—From Switzerland, North Italy, and Czechoslovakia eastwards through the Balkan States to Greece, central and southern Russia, southern and eastern parts of Russian Turkestan, Asia Minor, Persia, Afghanistan, eastwards to Zungaria and NORTH-WEST FRONTIER in Indian Territory.

Dryomys was not dealt with by Blanford because in his day it was not known to occur in India.

This genus has almost universally been called '*Dyromys*' by authors until Simpson's recent paper on the classification of Mammals (1945). I quote his remarks, page 92, 'Thomas proposed *Dyromys* on grounds of preoccupation of the prior name by *Dryomys* Philippi, 1900, but on his own showing and by any possible reasonable interpretation, there is no such genus or name as *Dryomys* Philippi, 1900. The reference in Philippi is to *Drymomys* Tschudi (itself invalid), for which '*Dryomys*' Philippi is an obvious and unmistakable misprint with no standing under any rules or usages of nomenclature. *Dryomys* Thomas, 1906, is therefore valid'

The genus was proposed as a subgenus of *Eliomys* and strictly it is not more than that. It merely differs from *Eliomys* in that the tail is more uniformly haired, and the premolars are less clearly cuspidate. The size is smaller than in the two species of *Eliomys*, and the skull is less ridged, perhaps, and the shape of the parietals differs in front. It is, undoubtedly, very closely allied to *Eliomys*, and is less well marked than any other genus of rodent in Asia which I have adopted. There is only one species.

42. *Dryomys nitedula* (Pallas)

Text-fig. 24

1779. *Mus nitedula* Pallas, *Nov. Spec. Quad. Glir. Ord.*, 88.*Type-locality*.—The region of the Lower Volga, Russia.

The characters of this species will be outlined below, when dealing with the Indian race. Its generic characters, compared with *Eliomys*, are indicated above; from most other genera it differs, like *Eliomys*, in having the molars basin-shaped, weakly ridged, and not flatcrowned; the toothrow is proportionately shorter than in *Glis* and *Muscardinus*; the dental differences of these four genera are well figured by Terzi in Ellerman (1940), or Miller (1912). From *Glirulus*, the four genera under discussion are all distinguished by proportionately larger, less flattened bullae. In *Dryomys* the angular portion of the mandible is perforated (as it is in *Muscardinus* and *Eliomys* but not in the other genera of this subfamily, as far as available to me).

The range of the species is the same as for the genus.

External characters.—The ear is prominent, though less than one-fifth of the head and body length, and seems fairly constantly longer in the Asiatic race *picta* than in the typical race from Europe. The size is relatively small and the fur is soft. The tail is evenly distichous throughout its length, and is most often rather shorter than the head and body, usually between 80 and 90% of the head and body in this race. Hand with four functional digits, their proportions and claws not peculiar. Foot with apparently six plantar pads; the hallux bears a claw, but is shorter than the other four toes, the fifth of which is nearly as long as the central three. The foot somewhat broad, and suggesting an arboreal type. There are 8 mammae according to Miller (1912).

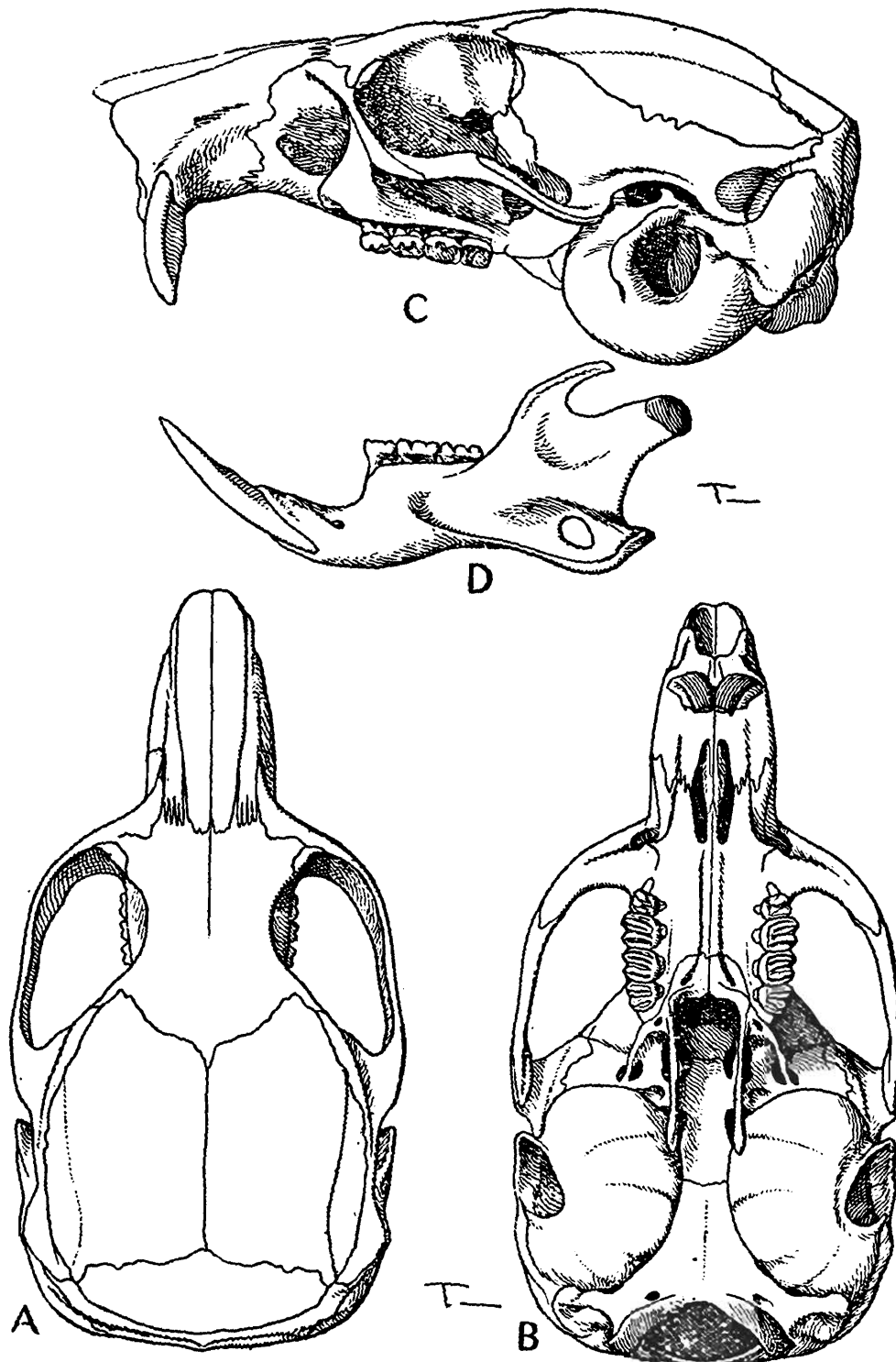
Colour.—The back is, in the two Indian skins, rather yellowish brown, with the tail more grey, edged and terminated by white hairs. The belly is lighter than the back, whitish grey. The throat and cheeks are white. There is a clear black line extending from the ear round the eye to the nose.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
M. 7.6.8.4	100	80½	19	16
Kurram Valley, North-West Frontier				

There is one other skin from this locality, and others from Paghman in Afghanistan and from Persia.

Cranial characters.—The skull has quite a long rostrum, and long rather narrow nasals. The frontals are strongly constricted, this constriction being placed at a point considerably behind the lachrymal level. Parietals nearly straight where they meet the frontals, then sloping forwards rather abruptly each side, but in general much less sharply so, and



TEXT-FIG. 24. *Dryomys nitedula* (Pallas). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 3\frac{1}{2}$). (After Ellerman, 1940, p. 617.)

Dental characters.—Upper incisors narrow, yellow, and ungrooved. Upper premolar small, not well cuspidate, though apparently there are two main outer cusps. The three molars each with one long main inner cusp (reminiscent of those of Sciuridae, in which probably there were originally three inner cusps which became fused together), and two main outer cusps, which are quite high; and three ridges between the anterior and posterior margins of each tooth; originally there are four depressions, one behind the anterior margin of the tooth, and one behind each of the three ridges. Crowns concave when cut. M. 3 smaller than M. 2. The pattern not very clear in the adult. Lower premolar considerably smaller than the other three teeth; there are apparently four main ridges across each tooth originally, and three reduced ridges traceable between them; two inner and three outer cusps traceable on main lower teeth originally. The pattern becomes indistinct with wear.

Cranial measurements.—The occipitonasal length is in this genus longer than the condylobasal length. I have only one Indian skull for this genus, but other specimens for the Indian race have been examined from Tehran in Persia and Paghman in Afghanistan.

M.	7.6.8.4	Occipito-nasal	Palate	Foramina	Bullae	Tooththrow	Frontals
		28.3	11.2	3.1	8.4	3.7	3.7
	Kurram Valley, North-West Frontier						

Dimensions of the species Dryomys nitedula, as indicated by the British Museum material, including about eight named subspecies from various parts of Europe and Asia.—The occipitonasal length varies between 25.4 mm. and 29.6 mm. in adult skulls. The upper toothrow between 3.7 and 4 mm. The head and body length varies between 71 and 115 mm., the tail between 57 mm. (possibly imperfect) and 94 mm., the hindfoot between 18 and 23 mm. The tail is shorter than the head and body with rare exceptions (four in about 32 skins).

The second name in the species is the race which occurs in India, although so far as I can see it is barely distinguishable from the typical Russian and Continental European race.

(i) *Dryomys nitedula picta* (Blanford)

Blanford's Dormouse

1875. *Myoxus pictus* Blanford, *Ann. Mag. nat. Hist.*, **16**, 311.

Type-locality.—Kohrud in Persia.

Range.—Specimens examined from N.W. FRONTIER, Kurram Valley. Also PERSIA, the type-locality, Mahum, and Tehran. AFGHANISTAN: Paghman.

Essentially like *D. n. nitedula* of Russia and Continental Europe, but generally the ear is larger. It varies between 15 and 17 mm. in skins available to me, whereas in the European race the ear is almost always less than 15 mm.

Subfamily (b) PLATACANTHOMYINAE

Specialized and aberrant Dormice with very small bullae, the palate less perfectly ossified than in the typical group, the cheekteeth 3/3, completely flatcrowned, with the transverse ridges always clearly marked, the general pattern more distinct as a rule, and the zygomatic plate narrowed though tilted upwards. Caecum present or absent. The frontals considerably wider than in Muscardininae.

A key to this subfamily compared with the Muscardininae was given when dealing with families and subfamilies of Rodents occurring in Asia, above. Two genera only are known in this subfamily, one of which is confined to Peninsular India. Its generic characters include several specializations, as, apparently, a clawless, opposable hallux; spiny fur; bushy tail; heavily ridged frontals, etc.

Genus 17. **Platacanthomys** Blyth

1859. *Platacanthomys* Blyth, *J. Asiat. Soc. Beng.*, **28**, 288.

Type-species.—*Platacanthomys lasiurus* Blyth.

Range.—Southern India (Malabar, Coorg, Travancore).

Blyth placed this genus in the 'Myoxidae' (which is an older but invalid name for the present family) when he described it. Blanford treated it as a subfamily of Muridae, but most recent authors agree in placing it in the Muscardinidae, except those who give it family rank, which is in my opinion quite unnecessary.

There is only one species known, so it will be most convenient to deal with its generic and specific characters together.

43. **Platacanthomys lasiurus** Blyth

The Malabar Spiny Dormouse

Text-fig. 25

1859. *Platacanthomys lasiurus* Blyth, *J. Asiat. Soc. Beng.*, **28**, 289.

Type-locality.—Alipi, Malabar.

Range.—Specimens examined from COORG: Virajpet. Mysore-Kanara border (Neria, Cardamom Jungles, near Charmadi); TRAVANCORE: Bonaccord, Trivandrum, Eva Gardens.

External characters.—Among Indian Rodents this species is easily distinguished by its combination of spiny fur, clawless hallux, and bushy tail. The size is larger than *Dryomys*, the head and body always over 100 mm. in adult. The ear is large and prominent; although it is usually less than one-fifth of head and body length it is only a little shorter than the hindfoot. The whiskers appear very large and prominent. The back is wholly covered by short flat spines which tend to extend on to the head. They are not powerful weapons of defence in so far as one can handle skins and rub them up the wrong way without drawing blood, and are not to be compared in effectiveness with the covering of a Porcupine, but no doubt they serve their purpose well enough. The tail is haired throughout, with no scales visible. Basally it is narrower in appearance and least well haired, but the hairs gradually increase in length towards the end of the tail, which is then thick and bushy. Mammæ 1—1 = 4. Feet broad. There are four well developed fingers and the thumb is clawless and rudimentary. The hindfoot is broad. The

hallux lacks a claw, and is probably at least partly opposable; it scarcely reaches past the base of the first toe, and is roughly opposite the large pads at the base of the toes. (According to Blanford there are seven or eight plantar pads in this genus). The other toes are all well developed, the fifth but little shorter than the central three, with moderately prominent claws and apparently a largish pad at the base of the claw on each toe.

Colour of the back is dark reddish brown, the tail hairs the same colour as the back. Underparts rather sharply contrasted whitish; tail the same colour below as above. In the specimens available to me the feet are but little paler than the back.

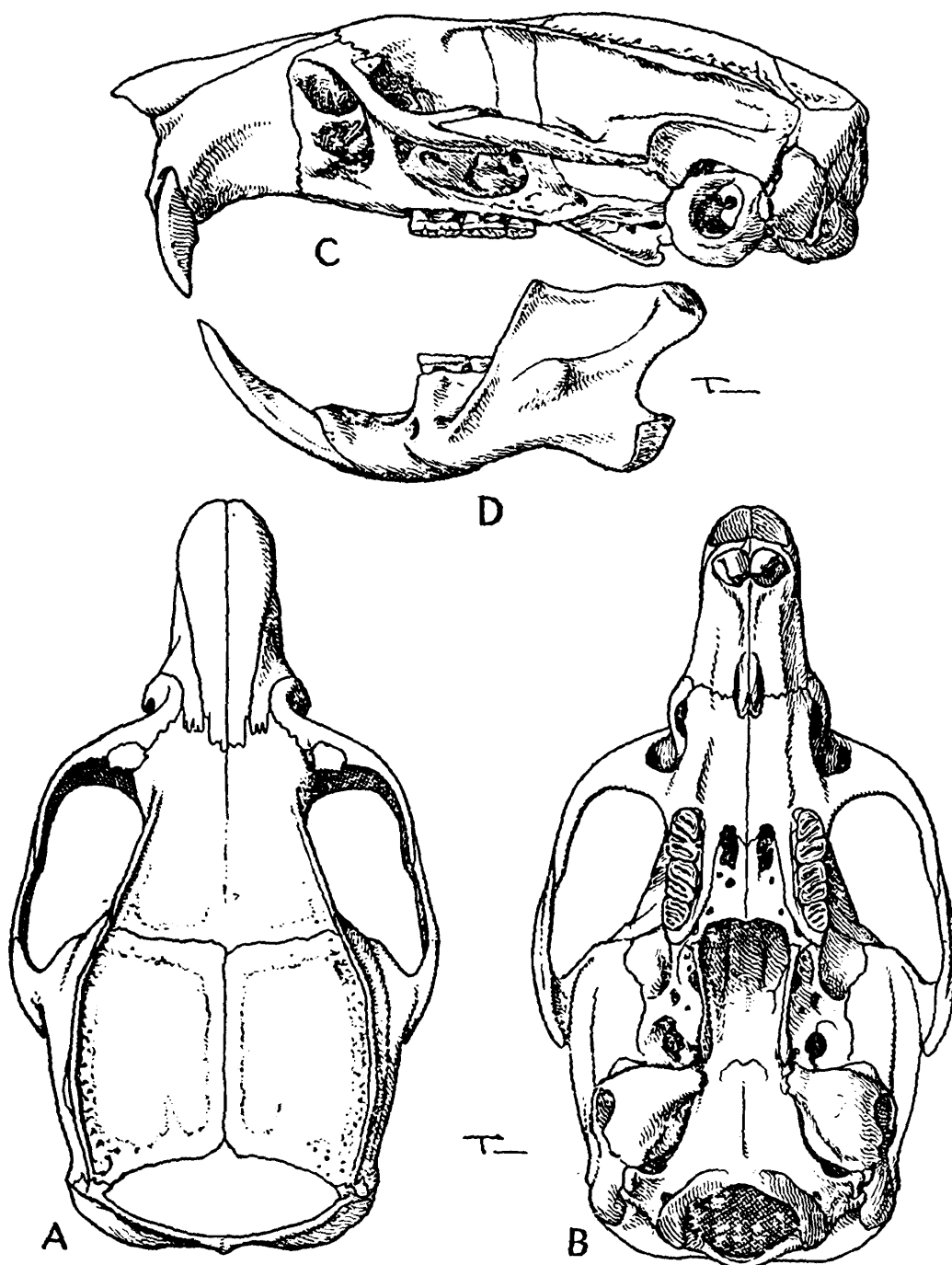
The weight is noted as varying between $1\frac{7}{8}$ and $2\frac{7}{8}$ oz. in different specimens in the Virajpet series. One skin seen bears the note 'mammaria always 4'. Specimens have also been seen from Bonaccord, Trivandrum, and from South Malabar, and from Neria, Cardamom Jungles, near Charmadi, Mysore-South Kanara border, on the label of which is noted 'fairly common, caught for me by one of the Jungle people in their holes which are situated about 20 ft. from the ground in large trees. They resemble woodpeckers' nests' The two Travancore specimens were 'Trapped in jungle, rare'

External measurements.—

	Head and body	Tail	Hind- foot	Ear
M. Virajpet, South Coorg	130	93	25	24
M. Virajpet	134	101	25	24
F. Virajpet	136	100	24	23
M. Virajpet	123	87	25	$23\frac{1}{2}$
F. Virajpet	137	76	26	24
F. Virajpet	128	106	$25\frac{1}{2}$	24
M. Virajpet	138	100	25	22
F. Virajpet	140	104	25	23
M. Virajpet	137	92	$26\frac{1}{2}$	23
F. Virajpet	118	93	26	24
M. Virajpet	130	87	25	$22\frac{1}{2}$
M. Travancore, 4,000 ft.	131	80	21	21
F. Travancore, 4,000 ft.	125	83	20	21

Cranial characters.—Skull modified in the manner often found in Indo-Malayan Muridae which are adapted for arboreal life; rostrum appearing rather short; frontals very wide, narrowest at a point slightly behind lachrymal level, and heavily ridged on their outer sides, these ridges extending right back along the parietals and more or less surrounding the braincase. Parietals nearly straight where they meet the frontals, and even wider than the frontals. (In this species

the width of the frontals is on average more than one-fifth of the occipitonasal length). Interparietal very large, wide and conspicuous, extending right across the back of the skull. Occiput low. Bullae small, flattened, and reduced, very different from those of the Muscardininae, on average roughly 12% of the occipitonasal length. The pterygoid fossae shallow. The palate short, considerably less than half occipitonasal length though less shortened than in *Dryomys*; a very large pair of foramina present between the toothrows,



TEXT-FIG. 25. *Platacanthomys lasiurus* Blyth, ♂. A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 2\frac{1}{2}$). (After Ellerman, 1940, p. 628.)

in most cases almost as long as the toothrows. The front pair of palatal foramina are short, reduced, less than one-tenth of occipitonasal length (which is uncommon for a Myomorph Rodent though not unknown elsewhere in this family), and often shorter than the second pair between the toothrows. Jugal rather long, not approaching lachrymal, zygoma narrow. Infraorbital foramen narrow, slightly wider above than below, the zygomatic plate beside it strongly tilted upwards but very narrow. According to Miller and Gidley, in this group masseter lateralis profundus extends its line of attachment along upper zygomatic border to side of the rostrum above the infraorbital foramen. The mandible is stronger than in *Dryomys*. It has no perforation in the angular part, which shows signs of inflection. The coronoid is very little higher than the condylar process, though there is slight variation in this respect; the distance from the coronoid back to the condylar process is considerable, and is almost a straight line.

Dental characters.—Upper incisors plain, red or yellow in front. Three upper cheekteeth. These are flatcrowned. M. 1 and M. 2 have one inner fold which cuts right across the tooth dividing it into two parts. The anterior of these divisions is again divided by an outer re-entrant fold; the posterior of these divisions is divided twice, by two re-entrant folds on the outer side. Thus there are four outer, one inner folds in these teeth, or elements corresponding to five outer, two inner cusps. M. 3 is reduced in size, though evidently on the same plan as regards its pattern. The pattern of these cheekteeth is more definite than in Muscardiniinae. With wear some of the folds can become isolated on crown surface. Evidently the teeth are cut very much in the condition just described, and the pattern is long preserved. All the upper cheekteeth are three-rooted (two specimens examined on this character). Lower cheekteeth each with four long re-entrant folds, the front one usually isolated on crown surface, the others placed externally, these folds dividing the tooth into five main slanting transverse ridges.

Cranial measurements.—From this genus I have omitted the foramina measurement, as the palatal foramina are here very reduced, being rarely over 3 mm. and under one-tenth of occipitonasal length. The occipitonasal length in this genus exceeds the condylobasal.

Dimensions of the species *Platacanthomys lasiurus*.—The occipitonasal length varies between 31.2 and 34.4 mm. The upper toothrow between 5.3 and 5.8 mm. The head and body length varies between 118 and 140 mm., the tail, shorter

		Occipito- nasal	Palate	Bullae	Toothrow	Frontals
<i>Platacanthomys lasiurus</i>						
M.	2.8.7.1 Bonaccord, Travancore	34.3	15.9	4.3	—	7.2
M.	12.1.9.8 Mysore-South Kanara boundary	32.7	15.3	4.0	5.5	7.3
F.	12.1.9.9 Mysore-South Kanara boundary	33.5	16.2	4.1	5.5	6.5
M.	13.8.22.52 Virajpet, South Coorg. (Rather young)	32.8	15.2	3.8	5.8	7.3
M.	13.8.22.53 Virajpet	34.3	15.5	4.0	5.5	6.7
M.	13.8.22.54 Virajpet	34.4	15.8	4.4	5.8	6.9
M.	13.8.22.56 Virajpet	33.1	15.3	4.0	5.7	7.0
F.	13.8.22.58 Virajpet	32.3	15.0	4.1	5.7	7.2
F.	13.8.22.60 Virajpet	34.1	16.1	3.7	5.6	6.6
F.	13.8.22.61 Virajpet	33.2	16.2	3.9	5.5	7.0
F.	13.8.22.62 Virajpet	34.1	15.7	4.1	5.7	7.0
F.	13.8.22.63 Virajpet	33.5	16.2	4.3	5.6	7.1
M.	22.8.28.1 Travancore. (Rather young)	32.2	—	4.0	5.5	7.0
F.	22.8.28.2 Travancore, 4,000 ft.	34.1	15.3	3.8	5.5	7.1
	60.5.13.1 Malabar (co-type)	31.2	14.1	4.1	5.6	6.1
	95.10.9.26 Trivandrum	32.7	15.4	3.7	5.3	6.8
	95.10.9.27 Eva Gardens, Travancore	34.3	16.6	4.2	5.5	7.0

than the head and body, averaging 70% in our specimens, between 76 and 106 mm., the hindfoot is 21–26 mm.

Family V. RHIZOMYIDAE

Bamboo-Rats

Distribution.—Indo-Malayan region, from Nepal, Assam, Burma, Siam, Indo-China, southern China (east to Fukien, north to Szechuan), the Malay Peninsula and Sumatra.

Medium sized Murine Rodents which are considerably specialized towards subterranean life, and in which the zygomasseteric structure is unusual. As is normal for Murine

Rodents, the infraorbital foramen is open for muscle transmission, and the zygomatic plate is tilted upwards, but the infraorbital foramen is narrow, reduced, situated at the top of the region of the zygomatic plate, and the masseter muscle extends its line of attachment on the inside of the infraorbital foramen, which is nearly straight below (instead of V-shaped as in the majority of Murines), its neural portion obliterated. Lower jaw with the angular portion not distorted outwards, but with the root of the long lower incisor forming a knob next to the condylar process on the outer side. Dental formula I. 1/1, C. 0/0, P. 0/0, M. 3/3 = 16, the cheekteeth flatcrowned, with inner and outer re-entrant folds which isolate on the crown surface as islands. Skull and external form considerably modified towards subterranean life. Five hindtoes.

The family as here understood is restricted, among living genera, to *Rhizomys* and *Cannomys*, both of which occur in India. Some authors refer the African *Tachyoryctes* to this family. That genus however has not got such a specialized infraorbital foramen as in Rhizomyidae as here understood, and the cheekteeth differ considerably in detail. This group of genera has no special connections, with the family Spalacidae, in which Blanford and earlier authors placed them, except that both are probably offshoots of Cricetine Muridae which have taken to underground life, and have become specialized for this kind of life in quite different ways from each other.

In Blanford's day all the bamboo-rats were referred to a single genus *Rhizomys*. Thomas in 1915 proposed to divide *Rhizomys* into three genera, *Rhizomys*, *Nyctocleptes* and *Cannomys*. In my opinion there is no good reason for giving *Nyctocleptes* generic rank, but *Cannomys*, containing the smaller bamboo-rats, is a specialized form which I think may reasonably be given generic rank.

There are four valid species in this family. All of them occur in some part of Indian territory.

Special works of reference on this family are Forsyth Major, 1897, on the Malagasy Rodent genus *Brachyuromys*, *Proc. zool. Soc. Lond.*, 695, and various short papers by Oldfield Thomas.

Key to the Indian genera

- 1 (2) The incisors extremely pro-odont
(indicated in cranial measurements by the fact that the diastema usually approaches or exceeds 40% of the occipitonasal

length (averages for the various races varying between 39% and 43%). M. 1 is larger than M. 2, and not worn below its level. The condylobasal length less than 55 mm.

Sole pads normal, not granulated

Cannomys

- 2 (1) The incisors less extremely pro-odont (the diastema is less than 40% of occipitonasal length (average of the various races varying between 30% and 36%)). M. 1 is often smaller than M. 2, often worn below its level. The condylobasal length is not less than 57 mm. The sole pads granulated

Rhizomys

Genus 18. *Cannomys* Thomas

1915. *Cannomys* Thomas, *Ann. Mag. nat. Hist.*, 16, 57.

Type-species.—*Rhizomys badius* Hodgson.

Range.—Nepal, Sikkim, Assam, Burma southwards to Tenasserim, and Siam where it is common.

As indicated in the key above, this genus may be distinguished from *Rhizomys* by its more pro-odont upper incisors, and its smaller size, as well as by its more normal sole pads, and by the more normal proportions of M. 1, which is not smaller than M. 2. The ridges of the skull unite in the adult to form a long sagittal crest. In common with other *Rhizomyidae*, the skull is highly specialized towards subterranean life.

External and cranial characters.—As in the single species described below.

44. *Cannomys badius* (Hodgson)

The Bay Bamboo-Rat

1841. *Rhizomys badius* Hodgson, *Calcutta J. nat. Hist.*, 2, 60, 410.

Vernacular names.—(Blanford) *Yukrov*, *Kakhyen*; *Khai*, *Burmese*.

External characters.—The external form is considerably specialized for underground life, the eyes and ears small, the tail shortened, and the claws rather prominent. The fur is nearly always thick and soft, though it varies somewhat in texture, and is thinnest in the Mount Poppa series (*C. b. pater*). The tail is short, although it may be over one-third

of the head and body length, and it is apparently covered with skin, not scales and not hairs, or its hairs are scarcely traceable. The hindfoot has the three central toes the longest, the hallux not much shorter than the fifth toe, the hindclaws prominent. The forefoot has the middle digit the longest, the second and fourth slightly shorter, the fifth shorter than the fourth, and the thumb appears to bear a small claw, though it is much smaller than the fifth finger. Mammæ 2-2 = 8.

Colour is as a rule brown in some shade, described by Blanford as 'chestnut, bay or ashy brown'. The ear is more or less hidden by the fur. There can be a white headspot present, this being particularly noticeable in the Toungoo series in the specimens examined. The belly is about the same colour as the back. Sometimes it is sparsely furred, particularly in the Mount Poppa series (*C. b. pater*). One specimen, from 25 miles north of Toungoo, has a white patch extending across the belly.

The specimens from the Shan States, named *plumbescens* by Thomas, are typically, not always, different from the remainder, being more or less purplish black in colour. Five specimens available to me are quite clearly distinct from other Indian skins on this character. But three skins from similar localities are not, but are coloured more as in typical *badius*, which suggests that perhaps *plumbescens* is a colour phase or individual colour variety of the normal rather than a valid race.

External measurements.—As in Table 45, below.

TABLE 45.—*External measurements of the Indian races of Cannomys badius*

			Head and body	Tail	Hind- foot	Ear
<i>Cannomys badius badius</i>						
Frost collections—						
M.	402	Bishampur, Manipur	225	65	30	10
M.	403	„	210	60	28	10
F.	405	„	200	60	28	10
F.	412	„	200	60	28	10
M.	413	„	210	75	32	10
M.	414	„	210	66	30	10
M.	415	„	210	60	28	10
F.	424	„	195	57	28	10
M.	425	„	200	55	30	10
F.	426	„ Reddish in colour	195	60	25	10
M.	427	„	225	70	30	10
F.	432	„	210	74	?	10
M.	436	„	215	60	32	10

TABLE 45.—*External measurements of Cannomys badius (contd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Cannomys badius badius</i> (concl'd.)					
M.	202 Naga Hills, 5,000 ft.	195	60	30	10
F.	203 "	205	62	30	10
F.	207 "	190	58	30	10
F.	208 "	202	61	30	10
F.	217 "	195	60	30	10
M.	218 "	180	47	30	10
F.	226 "	210	58	28	12
F.	227 "	190	50	28	9
F.	228 "	175	45	30	10
F.	234 "	205	40	28	10
F.	235 "	205	60	30	10
M.	236 "	190	55	30	10
M.	Sunachurn, Nepal	256	64	36	14
M.	Hasimara, Bhutan Duars	193	58	30	10
M.	Hasimara	200	64	32	—
F.	Hasimara	196	96	31	10
M.	Hasimara	196	65	30	10
M.	Rajapara, South Kamrup	190	65	27	10
F.	Rajapara	190	61	30	10
M.	Rajapara	177	69	29	9
F.	Rajapara	180	65	31	10
M.	Rajapara	228	65	31	19
M.	Rajapara	192	57	30	9
F.	Mikir Hills, Assam	227	47	30	8
				Mammae 2-2 = 8	
M.	Khonshnong, Jaintia Hills, Assam	208	60	30	10
F.	Khonshnong	248	66	32	10
F.	Khonshnong	205	60	28	10
M.	Khonshnong	215	55	35	10
F.	Khonshnong	168	50	25	9
M.	Khonshnong	243	67	40	10
M.	Hot Springs, Jaintia Hills.	213	62	28	9
F.	Gologhat, Naga Hills	205	64	29	15
				Mammae 2-2 = 8	
M.	50 miles west of Kindat, Chin Hills, Burma	237	59	30½	10
M.	Kaduchang, 40 miles west of Kindat	205	68	31	11
F.	50 miles west of Kindat	212	77	32	10½
F.	20 miles west of Kindat	208	62	31	10
				Mammae 2 pairs plus 2 pairs	

Other (unmeasured) skins from Darjeeling (Narbong), Manipur and Khasi Hills, Assam.

TABLE 45.—*External measurements of Cannomys badius (concl'd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Cannomys badius castaneus</i>				
M. Toungoo district, Burma	195	77	29	7
— Qwetha, Toungoo district	147	41	?	?
F. 25 miles north of Toungoo	183	63	27	9½
F. 25 miles north of Toungoo	174	57½	28	9
M. 25 miles north of Toungoo	181	59	28	10½
Other (unmeasured) skins from Wimpong, Thaton, Tenasserim.				
<i>Cannomys badius castaneus</i> (' <i>plumbescens</i> ') 8 mammae (not typical)				
Maymyo, Burma	219	66	?	12
Gokteik, Shan States (type)	200	77	31	10
F. Gokteik	198	83	31	?
F. Gokteik	188	63	28	9
M. Pyaunggaung, Shan States	206	70	28	8½
Maymyo	180	75	30	?
<i>Cannomys badius pater</i>				
— Mount Poppa, Burma, type	219	64	30	11½
M. Mount Poppa	218	83	34	10
M. Mount Poppa	235	80	33	14½
F. Mount Poppa	216	75	34	11

The following notes taken from the skins examined:—

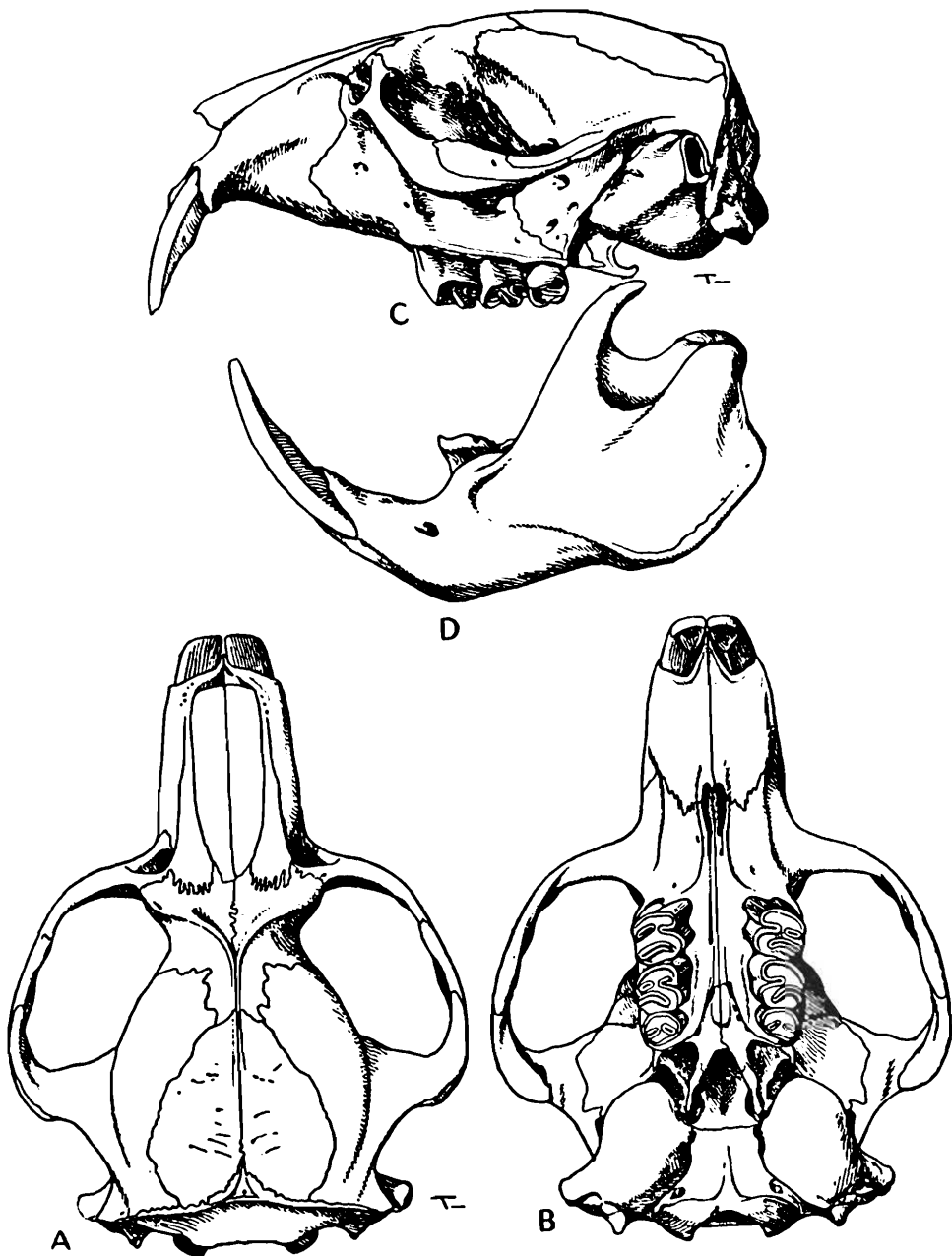
Mammae 8, noted in 4 skins, two from Kindat region, one from Mikir Hills, one from Toungoo.

Weight; typical race, five skins respectively are noted as weighing 4¾ oz. (? immature), 7½ oz., 8 oz., 9 oz. and 10½ oz. respectively. Three skins *plumbescens*, weigh 7¼, 7½ and 8⅝ respectively. Three skins for *pater*, respectively 14 oz., 15 oz. and 2 lb.

Cranial characters.—As already indicated, the skull is fossorial. The ridges, which are strong, fuse at a point about level with the least interorbital width, and continue more or less joined together backwards over the parietals until they join the lambdoid crest. They are rarely strongly fused; the sagittal ridge is suggested rather than actually present. The nasals are quite broad, and the parietals appear somewhat narrow and shortened. The interparietal is mostly not traceable in skulls available. The occipital regions is prominent, strengthened, and upstanding, and the paroccipital process is largish, closely applied to the bulla. A prominent ridge runs across the back of the skull at right angles to the

fused parietal ridges. The zygoma is exceptionally powerful, and the zygomata are widely spreading. The jugal bone is quite prominent for a Murine Rodent, although it is supported in front by a long arm of the maxillary zygoma root. The diastema is very prominent, the premaxillae and maxillae bones' underside being powerful and curving upwards from the toothrow to the incisors; the palate is narrow between the molars and considerably raised up, so that it is at a higher level than the front incisors, perhaps excepting their tips, and is also at an abruptly higher level than the floor of the brain-case. The palatal foramina are very shortened for a Murine Rodent, set considerably in front of the toothrows, and rather narrowed. The posterior nares are narrow, the pterygoid depressions on either side of them and in front of the bullae are very deep, and rather wide. The bullae are not particularly reduced or enlarged, and are of a peculiar shape, with the external meatus somewhat directed upwards and appearing on either side of each end of the lambdoid crest at the back of the skull; below, beside and in front of these the bullae are quite inflated. Zygomatic plate strongly tilted upwards; the infraorbital foramen nearly straight below, confined to the top of the zygomatic plate. The foramina are open for muscle transmission, but not very widely so. Mandible robust, with powerful coronoid process, the angular portion rounded but rather narrow and reduced, the root of the long lower incisor forming a powerful knob on the outer side of the condylar process, this knob about as high as the condylar process.

Dental characters.—Upper incisors red or yellow, immensely thick and strongly thrown forwards, not grooved, their roots extending backwards to about the level of the second upper molar. Upper molars; M. 1 is larger than M. 2, and M. 3 is smaller than M. 2. The cheekteeth flatcrowned, the pattern originally apparently one of three outer, one inner re-entrant folds in M. 1, M. 2 with two outer and one inner folds, M. 3 as a rule with only two isolated islands on it; all the outer folds tend to isolate as islands. The front outer fold of M. 1 is soon lost, and the whole pattern is ultimately obliterated. The enamel surrounding the folds is thick. Moderately worn lower teeth have the hinder molar almost three lobed, being divided by two deep folds which nearly cross the tooth and run parallel to each other; second molar roughly similar, but one of the folds more obviously external, and the other, anterior one, internal; M. 1 slightly the largest tooth, with traces of two outer, three inner folds. These folds soon isolate on crown surface.



TEXT-FIG. 26. *Cannomys badius badius* (Hodgson). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 4$).

Cranial measurements.—In this species the condylobasal length exceeds the occipitonasal measurement. In condylobasal length the largest skull measured is 21.1.5.21, from Nepal, with a length of 54.8 mm. The occiput = top of foramen magnum to top of lambdoid crest, a measurement which I only use in Rodents with extremely fossorial skull. The palate is not measurable in this species, owing to the set of the incisors, and owing to the angle in which they are set it is not possible to measure the bullæ accurately. The palatal foramina are very small and cease to be of value in this family as far as cranial distinctions are concerned.

Cranial measurements.—As in Table 46, below.

TABLE 46.—*Cranial measurements of the Indian races of Cannomys badius*

		Occipito- nasal	Diastema	Toothrow	Frontals	Occiput
<i>Cannomys badius badius</i>						
M.	15.5.5.240	42.5	17.2	11.1	9.6	9.7
	Kaduchang, west of Kindat, Burma					
F.	15.9.5.2	42.3	16.8	9.9	9.0	9.5
	Kabaw, Chindwin, Burma					
	16.3.25.108	44.8	17.7	11.0	9.6	10.5
	Narbong, Darjeeling					<i>circa</i>
F.	16.3.26.79	43.4	18.9	11.2	10.2	9.8
	West of Kindat, Burma					
F.	16.3.26.80	45.8	18.3	10.6	9.4	10.4
	West of Kindat					
M.	16.3.26.81	44.0	18.0	10.3	9.8	10.6
	West of Kindat					
F.	16.3.26.82	43.8	17.7	10.1	9.8	9.1
	West of Kindat					
M.	16.7.29.81	46.3	19.2	11.0	9.3	10.7
	Hasimara, Bhutan Duars					
F.	16.7.29.83	43.7	17.3	10.6	9.5	10.2
	Hasimara					
F.	20.6.7.57	44.2	18.8	10.0	9.7	10.4
	Gologhat in Naga Hills, Assam. Teeth much worn					
F.	20.6.7.58	46.7	19.5	11.7	9.5	10.5
	Mikir Hills, Assam <i>circa</i>					
M.	21.1.5.21	48.0	21.3	(9.9)	9.6	—
	Sunachurn, Nepal. (Teeth worn out)					
M.	21.1.6.88	47.3	20.1	10.4	10.1	10.1
	Khonshnong in Jaintia Hills, Assam					
F.	21.1.6.91	45.7	19.7	10.6	9.2	10.2
	Khonshnong					
F.	21.1.6.92	44.7	18.5	10.0	9.3	10.1
	Khonshnong					
F.	21.1.6.93	46.8	19.0	10.7	9.8	10.0
	Khonshnong					
M.	21.7.8.58	42.6	16.9	9.6	8.8	10.3
	Rajapara, South Kamrup					
M.	21.7.8.59	43.4	17.3	10.5	8.7	9.3
	Rajapara					
F.	21.7.8.62	41.0	16.6	9.4	8.7	9.1
	Rajapara					
F.	21.7.8.63	42.9	18.0	(9.7)	9.2	9.7
	Rajapara. Teeth worn out					
	58.6.24.96	43.8	16.8	10.8	9.2	10.5
	Sikkim					
	79.11.21.390	41.0	16.0	10.3	9.0	9.4
	Sikkim					

TABLE 46.—*Cranial measurements of Cannomys badius (contd.)*

		Occipito- nasal	Diastema	Toothrow	Frontals	Occiput
<i>Cannomys badius badius</i> (concl'd.)						
Frost collections—						
M.	202	44.1	17.1	9.8	9.5	9.3
	Naga Hills					
F.	203	44.6	18.9	10.1	9.8	10.3
	Naga Hills		<i>circa</i>			
F.	207	42.4	16.5	10.0	9.4	8.4
	Naga Hills					
F.	217	42.5	17.2	9.6	9.9	10.7
	Naga Hills					
M.	218	41.5	17.0	9.5	9.2	9.3
	Naga Hills					<i>circa</i>
F.	226	45.1	18.8	10.2	9.9	11.2
	Naga Hills. Old					
F.	227	42.8	16.8	9.9	9.9	9.9
	Naga Hills					
F.	228	40.1	15.4	9.6	9.3	8.2
	Naga Hills. Youngish					
F.	234	43.8	18.9	9.4	8.9	9.8
	Naga Hills					
F.	235	44.0	18.8	9.8	9.4	10.7
	Naga Hills. Old					
M.	420	46.1	18.4	10.5	9.5	10.3
	Bishampur, Manipur					
M.	403	43.6	16.7	—	9.8	9.9
	Bishampur					
M.	404	40.9	15.4	9.9	9.2	8.2
	Bishampur. Youngish					
F.	412	43.4	17.6	10.7	9.4	9.7
	Bishampur					
M.	413	44.7	17.3	10.6	9.5	10.0
	Bishampur					
M.	415	43.2	17.8	10.0	9.1	9.2
	Bishampur					
F.	424	42.9	17.7	10.6	9.2	9.7
	Bishampur					<i>circa</i>
F.	426	42.5	16.0	9.8	9.0	8.5
	Bishampur. Youngish			<i>circa</i>		
M.	427	45.7	19.0	10.8	9.4	10.5
	Bishampur. Old. 4 roots M. 1					
M.	428	45.0	18.4	10.2	9.4	10.0
	Bishampur. Old		<i>circa</i>	<i>circa</i>		
F.	432	46.3	19.4	11.0	9.3	10.4
	Bishampur. Old					
M.	436	44.7	18.7	10.6	9.4	10.1
	Bishampur					

TABLE 46.—*Cranial measurements of Cannomys badius (concl'd.)*

		Occipito- nasal	Diastema	Toothrow	Frontals	Occiput
<i>Cannomys badius pater</i>						
M.	14.7.19.229 Mount Poppa, Burma	47.6	21.5	—	8.5	13.2
F.	14.7.19.232 Mount Poppa	44.8	19.8	10.6	8.5	11.3
F.	15.9.5.1 Mount Poppa	47.2	20.3	11.4	8.0	10.8

The type is rather smaller than these three, with an occipitonasal length of about 43.7 mm.

Cannomys badius castaneus

	88.12.1.57 Kokarest, South Tenasserim	38.0	14.2	9.1	8.1	10.3
F.	88.12.1.58 Kokarest	38.6	15.0	9.2	8.5	10.2
F.	89.7.30.1 Tenasserim	<i>circa</i> 39.4	16.3	9.2	8.5	7.8
F.	14.7.8.49 Gokteik, Burma (' <i>plumbescens</i> ')	39.3	15.8	9.0	7.9	8.2
F.	14.7.8.50 Gokteik (' <i>plumbescens</i> ')	41.6	17.3	9.1	7.5	9.4
M.	14.7.8.51 Pyaunggaung, Burma (' <i>plumbescens</i> ')	41.7	16.5	8.8	8.1	10.1

The occipitonasal length in the type of *plumbescens* is 42.4 mm.

Dimensions of the species Cannomys badius, including Siamese specimens.—The occipitonasal length varies between 38 and 48 mm., the condylobasal length between 41.1 and 54.8 mm. Upper toothrow varying between 8.8 and 11.7 mm. Head and body length varies between 147 and 256 mm., the tail between 40 and 96 mm., the hindfoot between 25 and 40 mm.

Key to the Indian races of Cannomys badius

- 1 (2) Upper toothrow not over 9.2 mm. in length. Averaging smaller, head and body most often less than 200 mm., occipitonasal length most often less than 40 mm. in length [*'plumbescens'*]
C. b. castaneus (including
- 2 (1) Upper toothrow not under 9.4 mm. in length, and usually more. Averaging larger, head and body most

- often more than 200 mm.; occipitonasal length over 40 mm. in all skulls examined... .. 2
- 3 (4) Height of occiput is usually 10·8 mm. and more. Width of frontals at narrowest part about 8·5 mm. and less. Diastema averages proportionately longer. Fur tending to be shorter or harsher, and colour tending to be slightly lighter. *C. b. pater*
- 4 (3) Height of occiput does not reach 10·8 mm. (one exception). Width of frontals at narrowest part is 8·7 mm. and more. Diastema averages proportionately shorter. Fur tending to be less short or harsh, and colour tending to be slightly darker. .. *C. b. badius*

It may be desirable to give here a few notes on the various races. Those available to me are, in order of naming—

C. b. badius Hodgson, 1841, Nepal.

C. b. minor Gray, *Ann. Mag. nat. Hist.*, 10, 266, December, 1842, Siam.

C. b. castaneus Blyth, 1843, ? Arakan.

C. b. pater Thomas, 1915. Mount Poppa, Burma.

C. b. plumbescens Thomas, 1915. Gokteik in North Shan States.

It is not very easy to divide this species into subspecies in a convincing manner, as was indicated by Thomas in his revision of the genus in 1915.

The typical *C. b. badius*, in which is included specimens from Nepal, Sikkim, various parts of Assam, Manipur, Bhutan Duars, and West Burma (west of the Chindwin), can be described as a largish race with large teeth which are seldom much below 10 mm. in length. The occipitonasal length is over 40 mm. The fur is most often thick, and the colour nondescript, but not blackish in skins available to me. The diastema is usually under 20 mm. in length. The occiput is with one exception less than 10·8 mm. I doubt whether the Siamese race can be separated from this. The head and body length varies between 168 and 256 mm.

C. b. pater, from the Mount Poppa district in Burma, is possibly a valid race (or ? family party) which can be distinguished from the typical series. The fur is shortish in skins available to me from the type-locality, the belly is poorly furred, and the colour is lightish on the body, and particularly the region of the head, which has a slightly reddish tinge;

the appearance is reminiscent of a small *Nyctocleptes*. The size is large, head and body 216–235 mm. Cranially this series has the occipitonasal length over 43 mm. The diastema is over 20 mm. in two skulls, and nearly 20 mm. in a third. The occiput height is in the duplicate skulls available 10·8 mm. and more (to 13·2 mm.). The toothrow is at least 10 mm. The frontals are more narrowed proportionately than in the other races. Some specimens from the Toungoo region which have been identified as *pater* almost certainly belong to the next race.

C. b. castaneus was thought to have come from Arakan. Thomas, however, stated that Tenasserim specimens were typical, and its characters seem more or less based on Tenasserim and south Burmese specimens. In the Shan States there is a series of skins which tend towards being black in colour, which Thomas called *C. castaneus plumbescens*. We have specimens from Maymyo, Gokteik and Pyaunggaung which are distinguishable from all others in colour, but one or two specimens from the same localities are not typical and cannot be distinguished, as noted by Thomas. I am inclined to think that these series merely represent a colour phase rather than a valid race. Typical *castaneus* seems to be a nondescript small thick-furred race (Toungoo and Tenasserim). Its characters, compared with typical *badius*, are largely based on smaller size, and smaller teeth. The occipitonasal length is more often less than 40 mm. The cheekteeth are small, upper toothrow not over 9·2 mm. The diastema is well below 20 mm. in length, and the occiput is 10·3 mm. at highest. The head and body length is small; 147–195 mm. in the typical series, 170–219 mm. in *plumbescens*, but only once over 206 mm.

Apart from the small teeth of *castaneus* (which appears to be quite a constant character), the differences between any of the races of *Cannomys badius* are more average than absolute.

(i) *Cannomys badius badius* (Hodgson)

Text-fig. 26

1841. *Rhizomys badius* Hodgson, *Calcutta J. nat. Hist.*, 2, 60, 410.

Type-locality.—Nepal.

Range.—Specimens examined from NEPAL: no exact locality and Sunachurn. SIKKIM: Narbong, Darjeeling. ASSAM: Mikir Hills; Golohat and 5,000 ft. in Naga Hills; Khasi Hills, Khonshnong and Hot Springs, Jaintia Hills; MANIPUR:

Booribazar, Bishampur. BHUTAN DUARS: Hasimara. KAMRUP: Rajapara. WEST BURMA: Kabaw Valley, 20 miles south-west of and 50–65 miles west of Kindat; Kadakchang in Chin Hills.

Characters as indicated above in the key. Occipitonasal length over 40 mm., occiput relatively smaller than in *C. b. pater*. Frontals proportionately wider as a rule and diastema proportionately shorter than in that race. Other characters as described above.

(ii) *Cannomys badius castaneus* (Blyth)

1843. *Rhizomys castaneus* Blyth, *J. Asiat. Soc. Beng.*, 12, 1007.

1915. *Cannomys badius plumbescens* Thomas, *Ann. Mag. nat. Hist.*, 16, 315.

Type-locality.—Of *castaneus*, believed to be Arakan, and of *plumbescens*, Gokteik in North Shan States, Burma.

Range.—Specimens examined from BURMA: 25–36 miles north of Toungoo; Maymyo; Qwetha; Gokteik, Pyaunggaung and Se-en in Shan States. TENASSERIM: Kokarest; Wimpong (Thaton).

This race seems quite clearly distinguishable from the typical, and the Siamese form, and *pater*, by its small teeth, the upper tooththrow not exceeding 9.2 mm. in specimens examined.

As a general rule also this form is smaller than is usual in the allied races, and the occipitonasal length is often below 40 mm. in length. The form named *plumbescens* by Thomas is typically very distinct from all others owing to its dark purplish black colour, but this is not a constant character, and normally coloured individuals occur with the blackish specimens. I therefore regard this character as most likely to be a melanistic variation rather than a really valid racial character. It does not seem to be co-related with any other character except the small teeth, which indicates that '*plumbescens*' is nearer *castaneus* than *badius*. Rather surprisingly the Siamese race is nearest typical *badius* in almost all its characters, rather than *castaneus*. It is difficult to define characters to keep the Siamese race apart.

(iii) *Cannomys badius pater* Thomas

1915. *Cannomys pater* Thomas, *Ann. Mag. nat. Hist.*, 16, 315.

Type-locality.—Mount Poppa, Burma.

Range.—Only known from the type-locality, as far as I am aware.

Nearest to the typical race, but skull tending to be more angular and specialized, the occiput higher, the diastema proportionately longer, the frontals proportionately narrower, etc. Fur tending to be shorter and harsher, particularly ventrally, and tending to be slightly lighter than is usual in colour. Upper toothrow over 10 mm., and occipitonasal length over 40 mm. Perhaps with a larger series this form would not be distinguishable from the typical race, but at present it seems definable. The occiput of the only male skull I have seen is considerably higher than that of any other specimen for any of the other races, but the remainder, females, have the occiput only a little higher than the largest male *badius*, or in the case of the type, not quite so high as some specimens of *badius*.

Genus 19. *Rhizomys* Gray

1831. *Rhizomys* Gray, *Proc. zool. Soc. Lond.*, 95.

1832. *Nyctocleptes* Temminck, *Bijdr. nat. Wetensch.* Amsterdam, 7, 5. (*Mus sumatrensis* Raffles). Valid as a subgenus.

Type-species.—*Rhizomys sinensis* Gray.

Range.—From southern China (states of Szechuan, Yunnan, and thence south-eastwards to Fukien), ASSAM, BURMA, TENASSERIM, Indo-China, Siam and the Malay States to Sumatra.

With the characters of the Rhizomyidae. Differing from *Cannomys* by the fact that the incisors are less extremely pro-odont, the diastema being clearly less than 40% of the occipitonasal length, by the fact that the sole-pads are granulated (not very clearly discernible on dried skins), and by the fact that M. 1 is often not the dominant tooth, and is often worn below the level of M. 2 (a rare character in Muroid Rodents). The size is evidently always larger than *Cannomys*, judging by adult skulls.

Key to the subgenera of Rhizomys

1 (2) Incisors more pro-odont, the diastema approximating to 36% of the occipitonasal length (sometimes slightly more individually). M. 1 is scarcely smaller than M. 2. Toothrow shorter, clearly less than one-fifth of the occipitonasal length	<i>Nyctocleptes</i>
2 (1) Incisors less pro-odont, the diastema is usually less than one-third	

of occipitonasal length, or at most approximating to 34% of it. M. 1 is normally smaller than M. 2 in the adult. Toothrow is more than one-fifth of the occipitonasal length.

Rhizomys

Subgenus (a) **Nyctocleptes** Temminck

1832. *Nyctocleptes* Temminck, *Bijdr. nat. Wetensch.* Amsterdam, 7, 5.

Type.—*Mus sumatrensis* Raffles.

This subgenus, which is distinguishable from the typical by the characters I have just indicated in the key, contains a single species. There is no constant difference between the two subgenera in size, though Thomas, 1915, indicated to the contrary. According to that author, the two posterior sole-pads in *Nyctocleptes* are conjoined, the 'palm and sole-pads low, hardly raised above the general surface, granulated'; those of *Rhizomys* s.s. being described as 'distinct, granulated, the two posterior sole-pads separated, although enlarged'

45. **Rhizomys sumatrensis** (Raffles)

The Large Bamboo-Rat

1821. *Mus sumatrensis* Raffles, *Trans. Linn. Soc. Lond.*, 13, 258.

Vernacular names.—(Blanford); Pwe. *Burmese*; Tikus bulo, *Malay*.

Type-locality.—Malacca.

Range.—Sumatra, Malay Peninsula, Siam, Annam Tenasserim and Burma north to the Shan States. It is the only *Rhizomys* which occurs in Sumatra, which is the south-eastern limit for the range of the genus.

The characters of this species, which are roughly those as indicated above in the key to the subgenera, coupled with large size (occipitonasal length at highest 84.8 mm., condylo-basal length up to 93.7 mm.), will be dealt with below, under the subspecies which occurs in India.

The second name in the species (other than two which are thought to be synonymous with the typical race) is *R. s. cinereus*, M'Clelland. This race is in all probability valid, compared with the typical, southern race, on colour characters.

External characters.—As is usual in the family, modified for fossorial life. Apparently the tail is less reduced than in

other Rhizomyidae. Both the typical race and *cinereus* have the tail averaging 39% of the head and body, which is longer than in allied species. The fur in *R. sumatrensis* is short and poor, and on the belly tends almost to disappear altogether in some specimens. The tail is almost naked but appears to be mostly skin-covered rather than obviously scaly. Eyes and ears very small. Hand broad, with claws quite thick and prominent; apparently the small thumb is not or scarcely clawed, and is very reduced, sometimes not more than a small knob or pad. Fifth finger shorter than the second, third and fourth fingers, the middle one the longest. Hindfoot broad, with powerful claws, the three middle toes longer than the fifth one which is in turn longer than the somewhat reduced but clawed hallux. The pads granulated; the two posterior sole-pads joined, partly at least. Mammae 2-3 = 10.

Colour.—Greyish brown or yellowish brown in the majority, always with a certain number of white tipped hairs on the back, and with a distinct tendency towards a slight blackish patch or line on the head and forepart of the back, outside which the cheeks are reddish or reddish brown in the Indian specimens, to a greater or lesser extent even in the largest skins, but most marked in the smaller immature skins. This red on the cheeks is absent in all specimens examined by me for the Malayan typical race, except three rather small young specimens. Belly slightly paler than back, usually yellowish brown with some white tipped hairs present throughout. Tail wholly brown or brown with yellowish tip.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Rhizomys sumatrensis cinereus</i>				
M. Thaget, Tenasserim	415	186	65	20
M. Thaget, Tenasserim	245	115	46	18
F. Thaget, Tenasserim	390	200	66	21½
M. Banlaw, Tenasserim	265	102	47	19½
M. Banlaw, Tenasserim	390	154	68	21½
M. Tenasserim Town	295	119	51	19
F. Tenasserim Town	455	172	66	23
F. Maymyo district, Burma.	260	110	58	29
Se-en, Hsipaw, Burma	430	186	70	25
M. Pyaunggaung, Shan States, Burma	480	175	77	36
M. Mamsam Falls, Shan States	370	140	61	22

Other skins seen from Hoixuan in Annam, Metaw Forest, Raheng, Siam and Mewong River, Siam, also Pahang, Telom River.

Weight varying between $4\frac{1}{2}$ and $11\frac{1}{2}$ lb. on skins seen. (From Thaget, $5\frac{1}{4}$ lb.; from Tenasserim Town, $4\frac{1}{2}$ and $6\frac{1}{2}$ lb.; from Pyaunggaung, 71 lb. and $11\frac{1}{2}$ lb. From Se-en, 8 lb. and from Banlaw, $5\frac{1}{4}$ lb.)

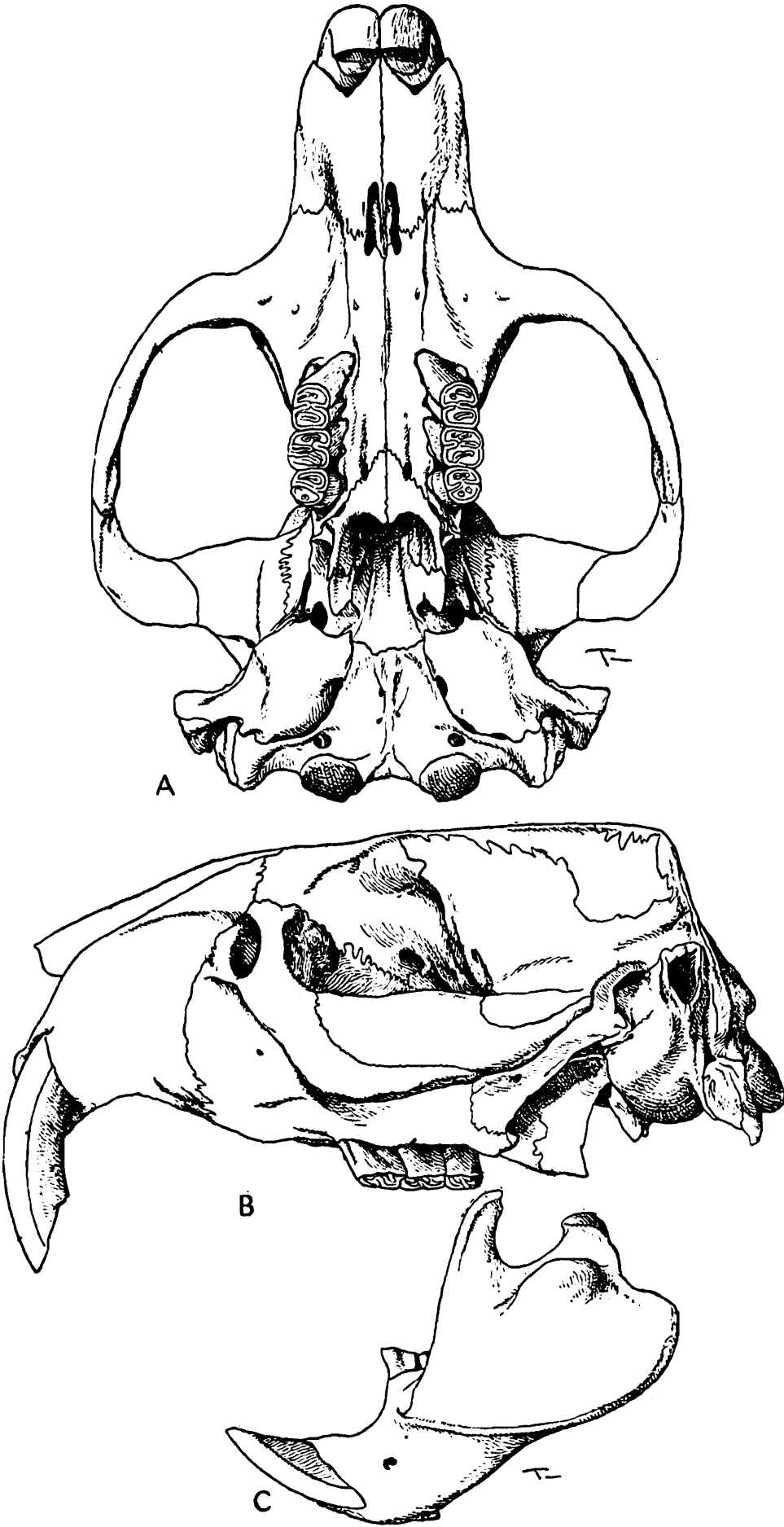
One from Mee Taw Forest, Raheng, Siam, is noted as having been 'Dug out of burrow with four young'.

Cranial characters.—(The characters, used by Thomas in 1915 to distinguish between *Rhizomys* s.s. and *Nyctocleptes*, of the anteorbital foramina and posterior nares are apparently not constant).

Skull very large, at extreme development probably the largest known for a Murine Rodent from Asia, or near this limit. The nasals rather wider in front than behind; frontals strongly narrowed, their narrowest part being set far behind the lachrymal level, and rather nearer the posterior zygomatic roots; immediately behind this narrowed part, the ridges fuse and form a raised and powerful sagittal ridge which extends back to the lambdoid crest. Occiput prominent and powerful, in mainland skulls usually more than a quarter of the occipito-nasal length, sloping slightly backwards from region of lambdoid so that the top of the foramen magnum is situated behind this region; paroccipital process rather prominent, closely applied to the bullae. Basi-occipital region of skull powerful and well ridged; posterior nares moderately wide, the pterygoid fossae beside them very deep but noticeably narrowed. Palate not specially narrowed; palatal foramina narrow, short, and far in front of the toothrows. Rostrum prominent, but the upper incisors less thrown forward than in *Cannomys*. Bullae shaped much like those of *Cannomys*, though perhaps a little less inflated. Zygomata very powerful, widely spreading, the jugal large, but not so large as the descending process of the maxillae in front of it. Infraorbital foramen rather circular, small and with the zygomatic plate strongly tilted upwards below it. Mandible with high, rather recurved coronoid process; the angular portion rather reduced, the lower incisor forming a very prominent knob beside and on outer side of the condylar process.

Dental characters.—M. 1 is not conspicuously smaller than M. 2 as a rule, though it may be worn down to a lower level than that tooth. Upper incisors thick, red and plain, their roots extending back about to level of the hinder part of M. 1. In the upper series, M. 3 is smaller than M. 2. The essential

TEXT-FIG. 27. *Rhizomys sumatrensis cinereus* M'Clelland. A, B, ventral and lateral views of the skull. C, lower jaw of the same. ($\times 3$).



pattern seems to be one in which there are three outer and one inner re-entrant folds, in at least M. 1 and M. 2; elements of M. 3 somewhat indistinct in most of the skulls; the islands isolate on crown surface, and the pattern changes somewhat during life. Cheekteeth rather hypsodont. In the lower molars, M. 1 seems usually narrower than the other teeth; apparently one main outer, two main inner re-entrant folds on all teeth; M. 1 with traces of extra complexities; the pattern changing considerably with wear.

Cranial measurements.—The occipitonasal length is taken from the tip of the nasals to the top of the foramen magnum, making this measurement as long as possible. The condylobasal length exceeds the occipitonasal length; largest specimen. *circa* 93·7 mm., No. 14.7.8.53.

		Occipito- nasal	Diastema	Toothrow	Frontals	Occiput
<i>Rhizomys sumatrensis cinereus</i>						
M.	14.7.8.52	82·1	31·7	14·2	15·2	20·5
	Pyaunggaung, Shan States, Burma					
M.	14.7.8.53	84·8	31·1	14·2	14·1	20·1
	Pyaunggaung					
F.	14.7.8.55	80·3	29·1	15·2	14·7	20·2
	Se-en, Hsipaw, Shan States, Burma. Old					

The next three specimens are rather young.

M.	14.12.8.219	72·6	27·6	12·6	12·1	20·0
	Tenasserim town					
F.	14.12.8.220	73·2	26·5	12·8	12·4	20·1
	Thaget, Tenasserim					
M.	14.12.8.222	73·6	26·4	14·2	14·3	18·4
	Banlaw, Tenasserim					

Another juvenile skull from Ataran, 50 miles south of Moulmein, and another labelled 'Mergui'

Dimensions of the species Rhizomys sumatrensis, including the typical race and the Sumatran race, as indicated by material in the British Museum.—The occipitonasal length varies between 64·0 and 84·8 mm. The toothrow between 12·2 and 15·2 mm. The head and body between 245 and 480 mm. The tail between 102 and 200 mm. The hindfoot between 46 and 77 mm. The condylobasal length of the largest skull is 93·7 mm.

(i) **Rhizomys sumatrensis cinereus** M'Clelland

Text-fig. 27

1841. *Rhizomys cinereus* M'Clelland, *Calcutta J. nat. Hist.*, 2, 456.1877. *Rhizomys erythrogenys* Anderson, *Proc. Asiat. Soc. Beng.*, 150.
(Salween Hill Tracts, Burma.)*Type-locality*.—Moulmein, Tenasserim.*Range*.—Specimens examined from BURMA: Maymyo; Pyaunggaung, Mamsam Falls and Se-en, all in Shan States; 50 miles south of Moulmein (Ataran). TENASSERIM: Banlaw; Thaget; Tenasserim Town. ANNAM: Hoi-zuan. SIAM: Me-wong River; 80 miles north of Bangkok; Metaw Forest, Raheng. Lower Siam, no exact locality. PAHANG, Telom River.It is like *R. sumatrensis* of the Malay States, but tends to differ in colour, with the red on the cheeks more clearly marked than in those specimens of the typical race I have seen.Both races seem to have the red on the cheeks present in young specimens; in the typical race this seems lost in adults, but in *cinereus* it can usually be traced or is retained.Subgenus (b) **Rhizomys** GrayThis differs from subgenus *Nyctocleptes* in having the incisors less proodont so that the diastema is usually less than one-third of the occipitonasal length or only a little over a third of it, and in the longer toothrow, which is on average more than a fifth of the occipitonasal length in all races available. Also in the fact that M. 1 is fairly consistently smaller than M. 2, and in the adult is worn down to a lower level than that tooth.

There are two species in this subgenus. When all available subspecies are compared they are difficult to define, but may be keyed as below:—

Key to the species of the subgenus Rhizomys

- 1 (2) The occiput, measured from top of foramen magnum to top of lambdoid ridge, is always more than a quarter of the occipitonasal length. The fur is very thick, and the general colour is greyish or grey. *Rhizomys sinensis*
- 2 (1) The occiput height is normally less than a quarter of the occipitonasal length, and only exceeds this

length in very old or aberrant individuals. The general effect of the colour of the body is typically dark brown with many white tipped hairs intermixed, but if the colour is lighter then the fur is short.

Rhizomys pruinosus

The lighter short-furred races of the last named species are from Siam and the Malay States.

Mr. Frost secured a good series of adult *pruinosus* from the Naga Hills and Manipur. These skulls cover all the characters given for the form '*senex*' by Thomas and I therefore conclude that the latter is a synonym of the typical race.

One form of *sinensis* occurs in northern Burma; this is a larger animal, as judged by the skull, than typical *sinensis*, but comes very near *R. s. vestitus* Milne-Edwards, from Szechuan. It may well be a synonym of *vestitus*, although it averages very slightly larger. G. Allen states they differ in colour, 'drabby grey' in one, 'pinkish grey' in the other. I am unable to agree with this. We have a small series (about ten) for these two races. When all of them are mixed up, it becomes quite impossible to sort them into two groups of five, the one representing *wardi*, the other *vestitus*, in colour, and the two forms seem absolutely indistinguishable externally.

46. *Rhizomys sinensis* Gray

The Chinese Bamboo-Rat

1831. *Rhizomys sinensis* Gray, *Proc. zool. Soc. Lond.*, 95.

Type-locality.—South China, probably the State of Kwan-tung.

Distribution.—Szechuan, Hupeh, Yunnan, Kwantung, Fukien, and NORTH BURMA.

A thick-furred, greyish, species with the occiput relatively higher than in *R. pruinosus*, sometimes very heightened, particularly in the group of races to which the Indian form belongs.

External characters.—The fur of the back is very thick and soft in all races. The external form, as usual in the family, is considerably modified for underground life, with eyes and ears small and the tail short. (The tail only about one-fifth of head and body length in the Indian race.) Tail not fully haired but with a certain amount of hair throughout its

length, and apparently covered with skin rather than obvious scales, at least as compared with most Muridae. Hand with powerful claws; middle finger the longest, second finger almost as long, fourth finger rather shorter than second, fifth finger considerably shorter than fourth; thumb shortest but clawed and not vestigial; the pads clearly granulated. Hind-foot with powerful claws, the two outer toes about equal in length, considerably shorter than the fourth toe which is in turn markedly shorter than the second and first toes which are subequal and longest. The sole-pads are granulated to a degree, and the two posterior ones are mostly free. Mammae 1-3 = 8 (visible in one skin).

Colour above brownish grey, perhaps tending in the Indian race to be slightly darker on the head. The specimen whose measurements are given above is different in colour from the others, being much lighter, the back in part almost whitish grey. Belly light grey, nearest whitish in the specimen measured above. Cheeks white. The colour seems somewhat individually variable. Glover Allen says that *wardi* differs from *vestitus* in that whereas the latter is a decided 'pinkish grey' in tint, *wardi* is 'much darker', a 'uniform dark drabby grey without sufficient brown to make any contrast between the bases and tips of the hairs'. From the material examined there is perhaps an average difference, but I find it not easy to separate the two races on colour alone, and one *wardi* whose measurements are given below might be tending towards albinism, but is the lightest of the series seen for both races.

	Head and body	Tail	Hind- foot	Ear
<i>Rhizomys sinensis wardi</i>				
F. North-East Upper Burma, west bank Maikla-Salween Divide, 26° N., 98° E.	440	90	55	20

Other specimens seen from north-west flank of Likiang Range in Yunnan, and Pass east of Langpinghsien.

These measure between 370 and 372 mm. head and body, 60-90 mm. tail; 49-51 mm. hindfoot. Also the type has been examined, from Mt. Imaw Bum, Upper Burma.

Cranial characters.—The skull is large, in condylobasal length frequently as large as in *Nyctocleptes*, with the upper incisors less proodont than in that; upper profile of skull appearing more arched, the rostrum sloping downwards more anteriorly. Narrowest part of frontals about in middle of

skull, above which the ridges unite to form a raised and heavy sagittal crest which extends backwards to the lambdoid ridge. Occiput high and upstanding, powerfully ridged (the occiput in our series averages proportionately a little lower than for our series of *vestitus*); zygomata powerful and widely spreading as usual in the family; palate moderately narrow; palatal foramina short, situated considerably in front of the toothrows. Posterior nares rather narrow; pterygoid fossae very deep. Bullae about as usual in the family. Infraorbital foramen slightly variable in shape, but not essentially different from other members of the family. Lower jaw with high, coronoid, and conspicuous knob on outer side formed by the root of the lower incisor, this knob tending to be slightly lower than the condylar process.

Dental characters.—Upper incisor brown or yellow, thick, not much thrown forwards, and not grooved. First upper molar the smallest tooth in the series, and in adult always worn to a lower level than M. 2. M. 3 is smaller than M. 2. The pattern of the upper teeth is essentially that of three outer and one inner re-entrant folds on all the teeth, the inner fold of M. 3 tending to stretch right across the tooth. In the lower series, M. 1 is the smallest tooth. There are usually two or three isolated islands on each tooth in the adult.

Cranial measurements.—

	Occipito- nasal	Diastema	Toothrow	Frontals	Occiput
<i>Rhizomys sinensis wardi</i>					
F. 20.8.7.16	74.8	24.6	17.0	9.6	21.5
Mt. Imaw Bum, Kachin, N. Burma					
M. 22.10.21.16	77.1	25.0	15.5	10.0	19.5
South of Langpinghsien, 26-27° N., 98-28° E., NE. Burma					
F. 26.5.11.22	71.4	24.3	15.1	9.6	18.0
West of North Maikla-Salween Divide, NE. Upper Burma.					

The type has the occipitonasal length measuring about 78.1 mm.

Dimensions of Rhizomys sinensis, including all races available, as indicated by British Museum material.—The occipitonasal length varies between 56.7 and 78.1 mm. The toothrow between 11.9 and 17 mm. The head and body between 250 and 440 mm. in the very few measured skins available (but Allen gives measurements as low as 216 mm. for the small Fukien race *davidi*). The tail varies apparently

between 40 and 95 mm. The hindfoot between about 35 and 60 mm. The largest skull has the condylobasal length about 82.8 mm.

(i) **Rhizomys sinensis wardi** Thomas

1921. *Rhizomys wardi* Thomas, *J. Bombay nat. Hist. Soc.*, **27**, 3, 504.

Type-locality.—Mt. Imaw Bum, Kachin Province, 9,000 ft., northern Burma.

Range.—Specimens examined from NORTH BURMA: Mt. Imaw Bum. West of Maikla-Salween Divide; Pass east of Langpinghsien. YUNNAN: Likiang Range; Hills north-west of Tengueh.

It is essentially like *R. s. vestitus* of Szechuan and Hupeh, but it is a trifle larger in skull length (our skulls measuring 71.4–78.1 mm. in length, but only once under 74.8 mm., whereas *vestitus* measured in our series 69.1–73.6 mm. but only once over 71 mm.). Perhaps therefore it is merely composed of a group of very large individuals of *vestitus*.

47. **Rhizomys pruinosus** Blyth

The Hoary Bamboo-Rat

Text-figs. 28, 29

1851. *Rhizomys pruinosus* Blyth, *J. Asiat. Soc. Beng.*, **20**, 519.

1915. *Rhizomys senex* Thomas, *Ann. Mag. nat. Hist.*, **16**, 313.
From Yunnan, China (probably near Mongtse (Mengtsz)).

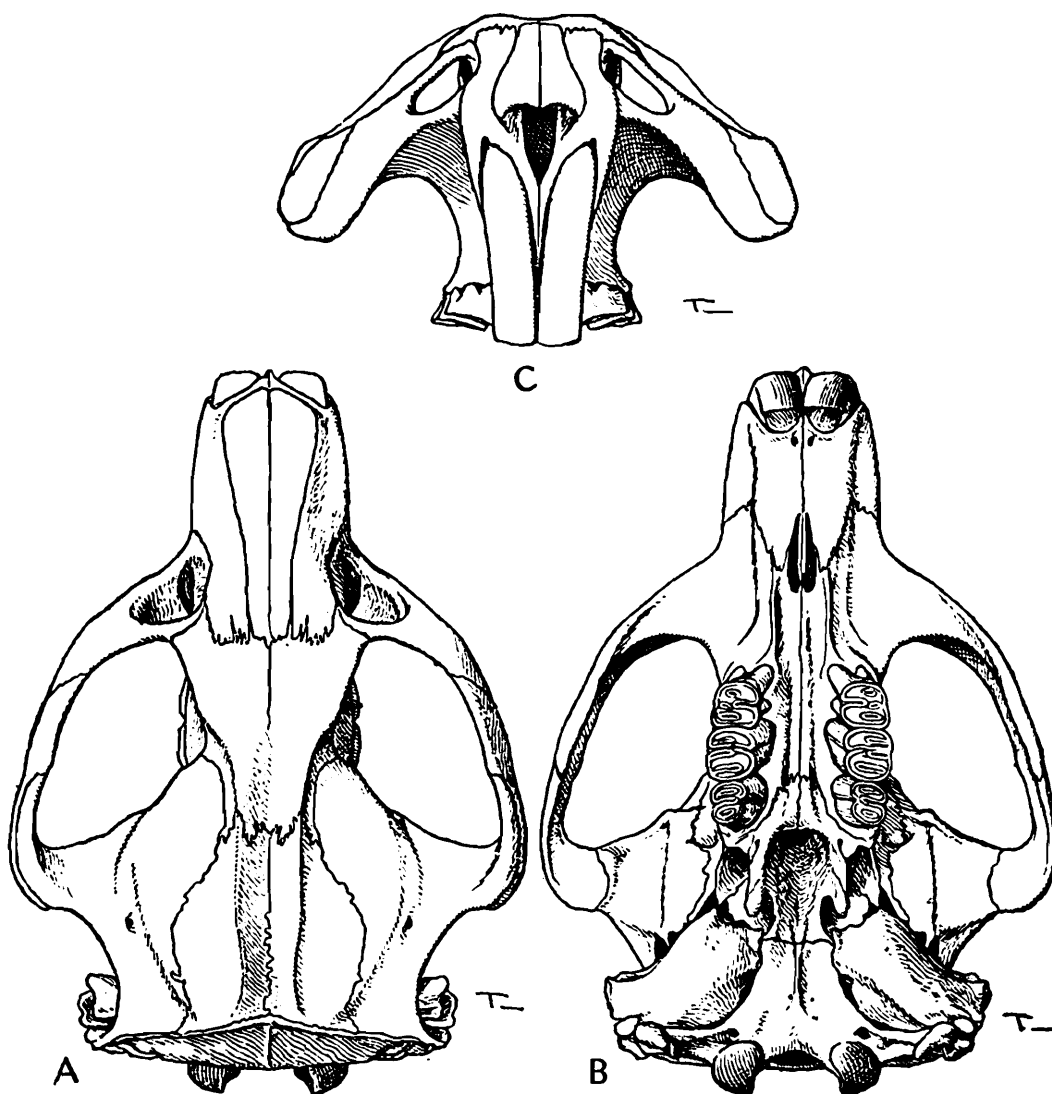
Type-locality.—Cherrapunji, in Khasi Hills, Assam.

Distribution.—ASSAM, EASTERN BURMA, Yunnan, Kwantung, Indo-China, Siam, and Malay Peninsula.

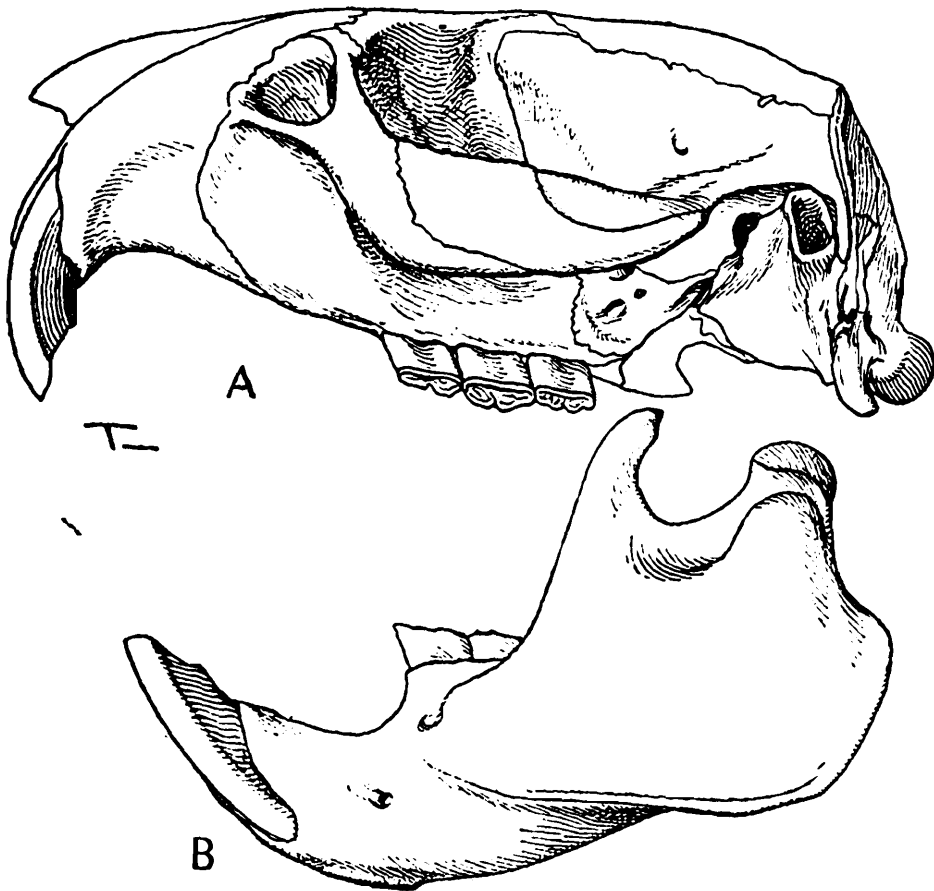
Range.—Specimens examined from ASSAM: Cherrapunji in Khasi Hills; Mokokchung in Naga Hills; Naga Hills, 4,000 ft. MANIPUR: Bishampur; between Mongsench and Chantongia. EAST BURMA: Mountains east of Bhamo. YUNNAN, near Mongtse. TONKIN, Ngai-tio and Backan. ANNAM, Dakto. LAOS, Xiengkhouang.

Specimens have also been examined (for *pruinosus*) from Mokokchung in Naga Hills, Assam; and between Mongsench and Chantongia, Manipur. Two specimens from Cherrapunji, females, weighed 1.12 lb. and 1.20 lb. respectively. Both have the mammae 1–3 = 8.

This species is not so highly specialized as *R. sinensis* in that the occiput is relatively lower, being only rarely individually as much as a quarter of the occipitonasal length, and only in one specimen as high as 16 mm. (out of about twenty-eight measured). In the Indian race, and in general, the colour of the body is quite different from *R. sinensis*, being dark almost chocolaty brown throughout but mixed with many white-tipped hairs which give a general grizzled effect, the general result unmistakable from the point of view of identification. The parietal ridges of the skull may be separate or joined, but they never fuse into the excessively sharp high sagittal ridge of larger races of *R. sinensis*. I have seen only three skulls for this species in which the occiput is as high as a quarter of the occipitonasal length; these are all from Indian territory.



TEXT-FIG. 28. *Rhizomys pruinosus* Blyth, ♀ A, B, C, dorsal, ventral and front views of the skull. ($\times 1\frac{1}{2}$). (After Ellerman, 1940, pp. 647, 648.)



TEXT-FIG. 29. *Rhizomys pruinosus* Blyth, ♀. A, lateral view of the skull. B, lower jaw of the same. ($\times 1\frac{1}{2}$). (After Ellerman, 1940, p. 648.)

External characters.—Externally modified for underground life, as in other members of the family. In *pruinosus* the tail is over one-third of the head and body length, apparently, but I have no very reliable measurements for the other races. Fur fairly thick in the Indian race; very short and harsh in the Siamese race *pannosus*. Proportions of the hands and fingers much as in *R. sinensis*, the proportionate length of the fingers being as in a human hand, although the thumb is of course much more reduced. Hindfoot similar to that of *R. sinensis* the second and third toes being slightly dominant. Sole-pads granulated to a degree; the two posterior ones apparently free. Mammae usually $1-3 = 8$ but sometimes $2-3 = 10$ in the species.

Colour entirely different from *sinensis* and *vestitus* in the Indian race, and considerably different from *pannosus*. It is dark brown throughout, with numerous whitish or white hairs spread over the back, giving a grizzled effect throughout; lower parts dark but with a somewhat silvery effect owing to the whitish hairs, the fur of the belly tending to be shorter

than that of the back. Feet dark. Cheeks tend to be very slightly lighter than the rest of the body.

External measurements.—

		Head and body	Tail	Hind- foot	Ear
	Khasi Hills, Assam	?	?	34	11
F.	Cherrapunji, Assam	278	100	46	19
F.	Cherrapunji	256	105	50	18
	Mountains east of Bhamo, Yunnan border district	?	?	49	20
Frost collections—					
F.	445	270	98	45	20
	Bishampur, Manipur				
M.	302	310	105	45	20
	Naga Hills, 4,000 ft. (Not entirely adult.)				
F.	320	300	110	50	20
	Naga Hills				
F.	321	305	110	50	20
	Naga Hills				
M.	330	320	115	50	20
	Naga Hills				
F.	252	350	120	52	25
	Naga Hills				

Fur shorter than the others, and lacking the white-tipped hairs over the back.

Cranial characters.—The skull is in general like that of *R. sinensis (wardi)* although it is less angular, and less large than in the Burmese race of *sinensis*; the parietal ridges ultimately approach each other and may join but are never so far as I have seen tightly fused together as in *wardi*, and appear less raised up than in *wardi*. Occiput lower than in *sinensis* races, but not dissimilar in general formation. The other cranial characters much as described for *R. sinensis*.

Dental characters.—Including the fact that M. 1 is the smallest tooth in the upper series, and fairly constantly worn below level of M. 2, much as in *R. sinensis*. M. 1 appears 4-rooted in two skulls from Tonkin. M. 2 is also 4-rooted in one skull.

Cranial measurements.—

		Occipito- nasal	Diastema	Toothrow	Frontals	Occiput
F.	20.11.1.43	59.0	17.7	12.7	10.2	14.3
	Cherrapunji, Assam. (Topotype.)					
M.	21.8.2.24	55.5	17.1	11.8	10.8	13.8
	Mokokchung, Naga Hills, Assam					

Cranial measurements (contd.)

		Occipito- nasal	Diastema	Toothrow	Frontals	Occiput
F.	88.12.1.60 Mountains east of Bhamo, East Burma (' <i>senex</i> ')	61.3	19.1	12.8	11.8	15.7
Frost collections—						<i>circa</i>
F.	252. Naga Hills, 4,000 ft.	64.0	22.5	14.4	9.9	15.0
F.	320 Naga Hills	60.3	20.1	13.0	10.7	13.7
F.	321 Naga Hills	60.3	19.7	13.1	11.1	?
M.	330 Naga Hills. Old.	64.3	22.7	13.0	10.0	16.7
F.	445 Bishampur, Manipur.	61.0	19.1	13.4	10.3	15.5
M. 3 unusually small						

Dimensions of the species Rhizomys pruinosus, all available races included, as indicated by British Museum material.—The occipitonasal length varies between 55.5 and 68 mm. The toothrow between 11.5 and 15 mm. The head and body length varies between 265 and 350 mm. The tail between 98 and 135 mm. The hindfoot between 34 and 50 mm. The condylobasal length is at highest 70.1 mm.

Family VI. MURIDAE

Rats and Mice, Hamsters, Voles, Gerbils, etc.

Distribution.—World-wide.

This family, which is by far the largest family of mammals, comprises essentially those forms with enlarged but not extremely enlarged infraorbital foramen, which is usually modified into a wider upper portion for muscle transmission and a narrower lower one for nerve transmission; usually the zygomatic plate is tilted upwards to a greater or lesser degree; and the lower jaw is without extreme abnormalities. The fibula is fused with the tibia. The family is distinguished from the Muscardinidae by the dental pattern, which varies greatly but is never as in that family; and from the Rhizomyidae by lacking the zygomasseteric peculiarities of that family.

Four subfamilies occur throughout northern Asia, and one of these is dominant throughout Tropical Asia. A key to these subfamilies has already been given (*supra*, pp. 5-8), and their details will be discussed at greater length below.

American authors prefer to divide this family into two, Muridae (Murinae only as here dealt with), and Cricetidae (including Cricetinae, Gerbillinae, and Microtinae).

Another subfamily, the Myospalacinae, containing a single genus *Myospalax*, is common in northern and central China and parts of Siberia, but does not reach Indian territory.

Subfamily (a) CRICETINAE

Muridae in which there are only two main rows of cusps in the upper molars, the laminae bearing these cusps separated by well marked inner and outer re-entrant folds; or, more rarely, the cheekteeth become flatcrowned and prismatic. They are rooted. In the Palaearctic genera, two of which reach India, the molars are biserially cuspidate, as described above. The skull in the majority of genera lacks any extreme specialization.

American authors restrict the family Muridae to those mice with three rows of cusps in the upper molars, and place the present group, the Microtinae, the Gerbillinae and others, in a special family, the Cricetidae. It appears, however, that the Cricetinae merely lack three rows of cusps in the upper series because the centre row of Murinae has become reduced. It is still traceable in some primitive American genera, and a genus from Madagascar; but in the Palaearctic members of the group and in many American genera, the centre row has become lost.

This is the dominant subfamily of Muridae in America, where there are more than forty genera. In the Old World, the group is less common; it is absent altogether in the Indo-Malayan and Australian regions, where the Murinae are dominant. There are five Palaearctic genera, two of which reach North India; one genus is known from southern Africa, and a few from Madagascar.

In the Palaearctic region, one genus, *Calomyscus*, which is south-west Asian in distribution, differs from the others in being essentially Murine (or Gerbilline) in external form, with long rather hairy tail, and it is said to lack cheekpouches. It also has simpler teeth than the others. The other four genera are more Microtine in form, and adapted for life in cold climates. They all have the tail short and reduced, at most half head and body length, and sometimes nearly as short as the hindfoot. Cheekpouches are said to be present in all.

These genera are somewhat distinctive among Cricetinae by their dental details, notably by the deep pits which isolate

between each pair of cusps in the upper molars. *Cricetus* (Germany and the Balkans eastwards to middle Siberia) and *Mesocricetus* (Caucasus, Syria, Persia, Turkey, Bulgaria and Rumania) differ from the two remaining genera in their specialized skulls, with powerfully developed ridges which may unite in the adult, the palate is very long, over half the occipitonasal length. The tail is extremely short in these two genera, which differ from each other principally in the shape of the infraorbital foramen. The two remaining genera have much more normal Murine skulls; *Phodopus* (Siberia and northern China) has the feet broadened and densely hairy; *Cricetulus* has the feet normal. The latter has the widest range in the Palaearctic, as will be noted below, and contains the greatest number of species. It reaches North-West India.

Special work of reference.—Argyropulo, 1933, *Z. Säuget.*, 8, 3, 133. A general revision of the Palaearctic genera.

Key to the Indian genera of Cricetinae

1 (2)	Tail long, normally longer than the head and body length. Foot long, not much under a quarter of head and body length, and well over one-fifth of this length. Ear long, more than one-fifth of head and body length. M. 1 with five cusps. No pits between the main cusps of the upper molars. M. 3 ring-shaped	<i>Calomyscus</i>
2 (1)	Tail short, in Indian species less than half of head and body length. Foot short, less than one-fifth of head and body length. Ear usually less than a fifth of head and body length. M. 1 originally with six cusps. At some time during the animal's life, there is a deep pit between each pair of main cusps of the upper molars. M. 3 less reduced, not ring-shaped	<i>Cricetulus</i>

According to Argyropulo, who has revised the Asiatic genera, cheekpouches are present in *Cricetulus*, absent in *Calomyscus*. In *Calomyscus*, the ear is about a quarter of head and body length, and the foot over this length in Indian specimens, but not so in those from Afghanistan.

Genus 20. **Calomyscus** Thomas

1905. *Calomyscus* Thomas, *Abstr. Proc. zool. Soc. Lond.*, 24, 23.

Type-species.—*Calomyscus bailwardi* Thomas.

Distribution.—South-West Russian Turkestan (Kopetdag Mountains), Persia, Afghanistan, and BALUCHISTAN, Transcaucasia.

This genus, notwithstanding the fact that some American authors seek to make what is in my opinion too wide a distinction between Palaearctic and American Hamsters, is a very close ally of the dominant North American genus *Peromyscus*, and merely differs in having slightly more specialized simplified molars and in the fact that the coronoid process is not specially reduced. It is not close to the other Palaearctic Cricetinae. As noted above in the key, the form is essentially Murine, with a long tail, hindfoot, and ear. There are no pits between the pairs of cusps in the upper molars; M. 3 is ring-shaped; and M. 1 has five cusps.

There is one species. We have not very many Indian specimens, but there is a good series available for examination collected by Mr. Chaworth-Musters in Afghanistan.

48. **Calomyscus bailwardi** Thomas

The Mouse-like Hamster

1905. *Calomyscus bailwardi* Thomas, *Abstr. Proc. zool. Soc. Lond.*, 24, 23, and *Proc. zool. Soc. Lond.*, 524-6.

Type-locality.—From Mala-i-mir, 70 miles north-east of Ahwaz, in Persia.

Distribution.—As in the genus.

External characters.—Form mouse-like but with a rather hairy tail. The tail is longer than the head and body in our material. Fur soft. Ear very large, in Indian material usually over a quarter of head and body length. Tail fairly evenly haired throughout, but the hairs not hiding the scales, and tufted terminally. Hand with four functional fingers, of which the middle pair are slightly longer than the outer pair, and a very reduced thumb. Foot rather long, usually over a quarter of head and body length in Indian material; fifth toe not quite so long as the three middle digits; hallux clawed, but set lower on the foot than the fifth toe, and shorter than that. The foot is rather narrow. There are said to be six mammae, and cheekpouches are said to be absent.

Colour.—The back is as a rule pinkish sand-coloured, with a certain admixture of black hairs present or suggested. Head and outer side of limbs coloured as in back. Underparts pure white throughout. Hand and feet white. Tail dark brown above, white below, its tuft white.

External measurements of the Indian races of Calomyscus bailwardi.—

	Head and body	Tail	Hind- foot	Ear
<i>Calomyscus bailwardi bailwardi</i> ('baluchi')				
Kelat, Baluchistan	79	95	21	19
M. Kelat	72	82	20	18
M. Harboi, Baluchistan	73	87	21	18
M. Harboi	77	96	21	19
M. Kelat, type, 'baluchi'	75	89	21	18

Calomyscus bailwardi hotsoni

M. Gwambuk Kaul, Baluchistan, type	72	77	19	18
F. Gwambuk Kaul (50 miles south by west of Pangjur)	65	78	18	17

Cranial characters.—The skull has a prominent and rather pointed rostrum, considerable interorbital constriction, and a rather wide and flat braincase, which is nearly unridged. There is a large and wide interparietal present. Occiput weak and rather flattened. The bullae are of medium size (about 15-16% of the occipitonasal length), and tend to be rather flat. Pterygoid fossae very flat and shallow. Palatal foramina rather long, about 18-19% of the occipitonasal length. The toothrow averages shorter proportionately than in other species of Palaearctic Cricetinae. The jugal bone is rather long for a Murine rodent. The infraorbital foramen is not peculiar in formation, and the zygomatic plate is about straight anteriorly. The mandible has the coronoid process well developed, and the angular portion rather small.

Dental characters.—Upper incisors narrow, opisthodont, yellow and plain; the nasals project forwards over the incisors anteriorly. First upper molar with five cusps, the front one near the front of the tooth, but pointing outwards; behind this are two inner and two outer slightly alternating cusps, the inner ones slightly in front of the outer ones; there are two alternating well marked folds each side, the inner ones being slightly anterior to the outer ones. M. 2 with four

cusps; much like M. 1 but lacking the front cusp, and with the front inner fold reduced; M. 3 small, simple, and ring-shaped. The folds of the upper molars do not appear as pits between the cusps, thereby differing from *Cricetulus* and allied genera. First and second lower molars with two main alternating folds each side (but the anteroexternal one in M. 2 is reduced), and two main alternating cusps each side; traces of a posterointernal cusp present behind the second inner fold, and in the front of M. 1 there is a small anteroexternal cusp. The inner folds slightly anterior to the outer ones. M. 3 nearly simple, and small.

Cranial measurements of the Indian races Calomyscus bailwardi.—

		Occipito- nasal	Palate	Foramina	Bullae	Tooththrow	Frontals
<i>Calomyscus bailwardi bailwardi</i> (' <i>baluchi</i> ')							
F.	19.11.7.67	25.7	12.0	5.0	3.8	3.5	3.9
	Kelat, Baluchistan						
M.	19.11.7.65	25.5	12.1	5.0	3.8	3.4	4.2
	Kelat, Baluchistan, type of ' <i>baluchi</i> '						
<i>Calomyscus bailwardi hotsoni</i>							
M.	19.11.7.63	24.2	11.1	4.7	3.9	3.3	3.7
	Gwambuk Kaul, Baluchistan, type						
F.	19.11.7.64	23.6	11.0	4.5	3.7	3.1	3.8
	Gwambuk Kaul. Old						

Dimensions of the species Calomyscus bailwardi, in British Museum material.—The occipitonasal length varies between 23.6 and 26.4 mm. Toothrow 3.1–3.6 mm. The head and body length varies between 65 and 89 mm., the tail between 72 and 98 mm., hindfoot 18–21 mm.

This species was not discovered in Blanford's day, and does not appear in Wroughton's list as it was not known to occur in India when his summary was published.

Thomas described two races of this species in Baluchistan, one of which, *baluchi*, was placed in synonymy of the typical race by Argyropulo, and was supposed to differ by its smaller ear. The other, *hotsoni*, is regarded as valid, but its characters amount to little and it may well be a synonym.

Provisional key to the races of Calomyscus bailwardi

- 1 (2) Occipitonasal length 24·7 mm. and more *C. b. bailwardi*
 2 (1) Occipitonasal length 24·2 mm. and less.. *C. b. hotsoni*

Neither of these two types are well known.

(i) Calomyscus bailwardi bailwardi Thomas

1905. *Calomyscus bailwardi* Thomas, *Abstr. Proc. zool. Soc. Lond.*, 24, 23, and *Proc. zool. Soc. Lond.*, 524.
 1920. *Calomyscus baluchi* Thomas, *J. Bombay nat. Hist. Soc.*, 26, 4, 939. (Kelat, Baluchistan.)

Type-locality.—Mala-i-mir, 70 miles north-east of Ahwaz, Persia.

Range.—Specimens examined from Persia: Mala-i-mir, Persopolis, and Shiraz. BALUCHISTAN: Kelat and Harboi.

(ii) Calomyscus bailwardi hotsoni Thomas

1920. *Calomyscus hotsoni* Thomas, *J. Bombay nat. Hist. Soc.*, 26, 4, 939.

Type-locality.—Gwambuk Kaul, about 30 miles south-west of Pangjur, 2,700 ft., Baluchistan.

Range.—Specimens examined from BALUCHISTAN: Gwambuk Kaul. The form inhabiting Kopetdag, Russian Turkestan ('*mystax*', Kashkarov, 1925), is supposed to be the same. I have seen a specimen from Kopetdag.

Genus 21. Cricetulus Milne-Edwards

1867. *Cricetulus* Milne-Edwards, *Ann. Sci. nat.*, 7, 376.
 1903. *Urocricetus* Satunin, *Ann. Mus. St. Petersb.*, 7, 573. (*Urocricetus kamensis* Satunin.)
 1914. *Tscherskia* Ognev, *Moskva Dnev. zool. otd. obsc. liub. jest.*, 2, 102. (*Tscherskia albipes* Ognev = *Cricetulus triton nestor* Thomas, from Korea. Valid as a subgenus.)
 1928. *Cansumys* G. Allen, *J. Mamm.*, 9, 244. (*Cansumys canus* G. Allen, a subspecies of *Cricetulus triton* de Winton.)
 1933. *Allocricetulus* Argyropulo, *Z. Säuget.*, 8, 133. (*Cricetus eversmanni* Brandt, from northern Kazakstan. Valid as a subgenus.)

Type-species.—*Cricetulus griseus* Milne-Edwards, a subspecies of *C. barabensis* Pallas, from Siberia.

Distribution.—Greece, southern Russia, Russian Turkestan, Chinese Turkestan, southern parts of Siberia eastwards to

the Pacific coast, Manchuria, Mongolia, and northern China, states of Kansu, Shensi, Shansi, Chihli, Shantung, Tibet, KASHMIR, BALUCHISTAN, Persia, Asia Minor, Israel, Syria, Afghanistan.

Differing from *Calomyscus* in the more Microtine external form, with shortened tail, short foot and ear; and in the more complex dentition, and as indicated in the key above. Cheekpouches said to be present.

There are at least seven well marked species of this genus in the Palaearctic region, and possibly one or two more which are not represented in the British Museum. These may be very briefly characterized as follows: *C. (Tscherskia) triton*, South Ussuri region in Russian territory, and Korea, Chihli, Shantung, Shensi and Kansu in China; with enlarged bullae, deep pterygoid fossae, skull with clear ridges on the frontals and parietals; occipitonasal more than 32 mm. in length; tail tending to exceed half the length of the head and body. In the remainder, the bullae are proportionately smaller, the pterygoid fossae are shallow, the ridges of the skull are weak or absent, and the occipitonasal length is less than 31 mm., the tail is less than half the head and body length. *C. (Allocricetulus) evermanni*, south-eastern Russia (east of the Volga), Kazakstan to Saissan, and Mongolia; the interparietal is reduced, the coronoid process higher and the tail shorter, apparently, than in the remainder. From our material, also, the palate is proportionately longer. *C. lama*, Tibet; the bullae small and flat, the tail long, bicolor, about 45% of head and body; *C. alticola*, tail short, white, only a third of head and body length; Tibet and KASHMIR. In the remaining species, the bullae are large, and well inflated. *C. longicaudatus*, with rather long tail, nearly half head and body length, and (in our material) relatively longer palatal foramina; Mongolia, Kansu, Shansi, Chihli, and possibly elsewhere. *C. barabensis*, the tail averages less than a third of head and body, and the back has a mid-dorsal stripe. The type is a race of this species, which is from Siberia, from the Ussuri region westwards to the Barabinsk Steppes, also Manchuria, Mongolia, Chihli, Shantung, Shensi. *C. migratorius*, like the last, but lacking the mid-dorsal stripe on the back. Greece, southern Russia, Russian Turkestan, Caucasus, Afghanistan, Persia, Asia Minor, Syria, Israel, Chinese Turkestan, KASHMIR and BALUCHISTAN.

Cricetulus is the second generic name in the Old World Cricetinae. It differs from *Cricetus*, which antedates it in its much less specialized skull; the condylobasal length is not, normally, as long as the occipitonasal length; the ridges on

the frontals and parietals are most often absent; the frontals are proportionately wider than in *Cricetus*, and the palate is shorter.

Key to the species of Cricetulus inhabiting India

1	(2) The bullae small, flat, about 14% or less of occipitonasal length.	<i>Cricetulus alticola</i>
2	(1) The bullae large, well inflated, usually over 17% of the occipitonasal length.	<i>Cricetulus migratorius</i>

Blanford thought there were three species (referred by him to *Cricetus*) in Indian territory, namely *C. phaeus* (Pallas, 1779, now regarded as a race of *C. migratorius* and restricted, apparently, to part of the U.S.S.R.), 'head and body $3\frac{1}{2}$ to 4 inches long, Gilgit, 5,000–9,000 ft.; *C. fulvus*, Blanford, Gilgit, occurring with the last, head and body about $4\frac{1}{2}$ inches long, and *C. isabellinus*, de Filippi, 1865, head and body 5.3 inches long. He thought it was doubtful whether these three should be regarded as species or varieties, and recorded the last as from Gilgit. All three names are now regarded as races of *C. migratorius* Pallas, and *C. m. fulvus* is, according to our material, a valid race. My classification of Cricetinae is based entirely on that of Argyropulo, 1933, and differs from it very little; indeed, only in giving *C. alticola* specific rank. This author referred all these three forms to *C. migratorius*. I do not know what Blanford is referring to as '*C. phaeus*'. Wroughton ignored all three names, and only dealt in his summary with *C. alticola*, from Ladak, but this again is erroneous in the fact that in the British Museum material there are two quite distinct species in Indian territory, as I have keyed above.

49. *Cricetulus migratorius* (Pallas)

The Little Grey Hamster

1773. *Mus migratorius* Pallas, *Reise*, 2, 703.

Type-locality.—From the region of the Ural River, western Siberia.

Distribution.—Greece, South Russia, Russian and Chinese Turkestan, south to KASHMIR, BALUCHISTAN, Afghanistan, Persia, Asia Minor, Syria, Israel. As a general rule the tail is under a third of the head and body length.

A species with the characters indicated in the discussion on the various species above; particularly with large bullae,

which distinguishes it from *C. alticola*, and with no mid-dorsal stripe on the back, which serves to distinguish it from *C. barabensis*, a northern species which is extremely closely related to it, and the place of which it takes, apparently, in south-western Asia and South-East Europe.

External characters.—The fur is thick, and the form is thickset and heavy. Tail strongly shortened, most often just under a third of the head and body length, relatively well haired, but with scales visible. Ear rather large and prominent; most often longer than or as long as the hindfoot, which is rather short, and broad. The sole may be partly hairy, but is not densely so, as a rule. Four functional fingers, the thumb vestigial. Foot with short toes; the hallux shorter than the other four digits, which do not vary a great deal in length; the fifth the shortest. There are said to be 8 mammae. Cheekpouches are present (noted on several skins, both for *fulvus* and *migratorius*).

Colour.—Generally light grey above throughout; occasionally darker grey, as in a topotype from the Volga, and a specimen from South Waziristan (which appears immature); underparts as a rule pure white throughout. Dorsal fur black basally. Occasionally specimens may tend towards sandy brown above, but light grey seems to be normal. The tail is mostly white or light.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Cricetulus migratorius migratorius</i>				
M. Kelat, Baluchistan	78	?	15	20

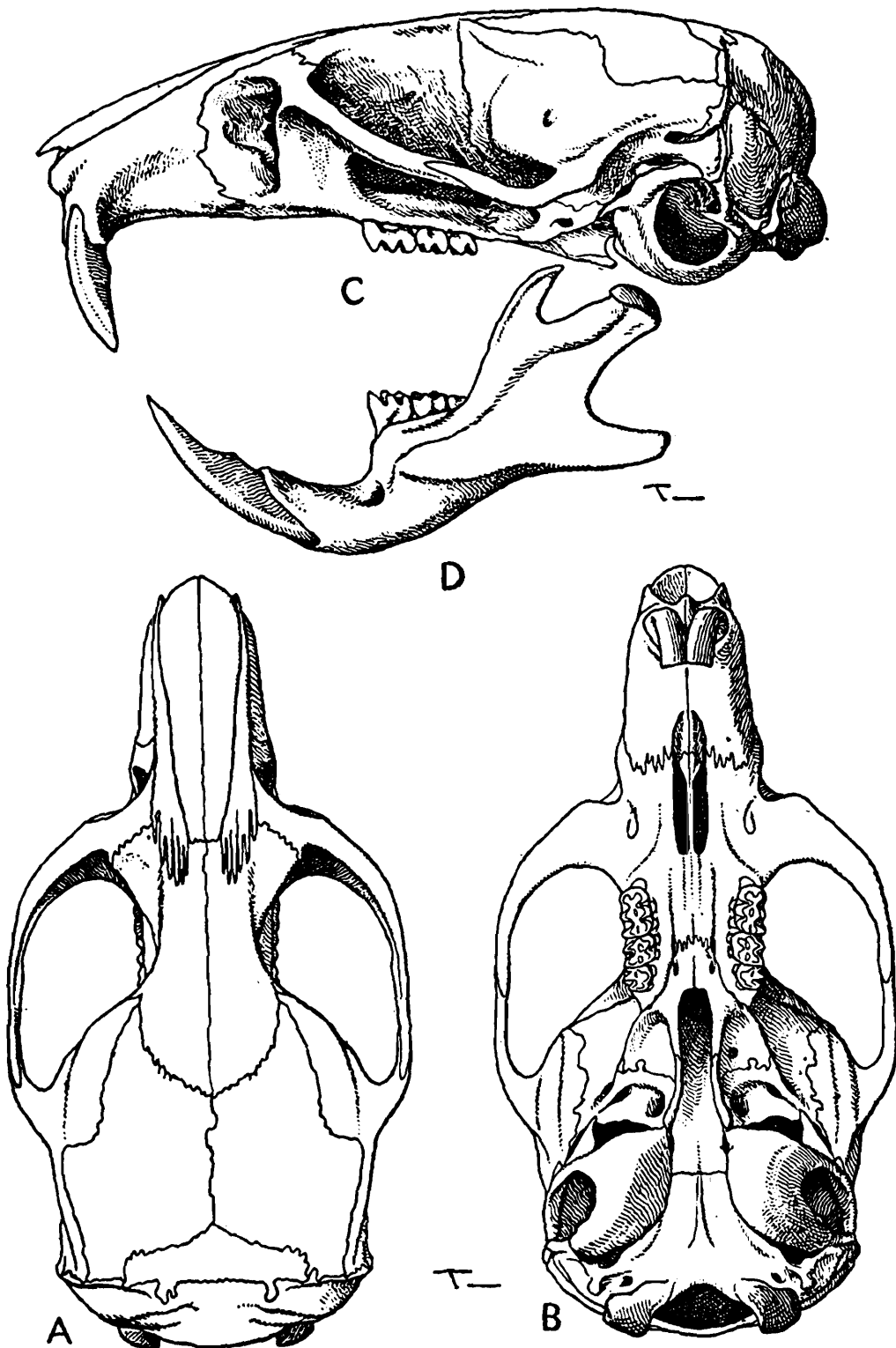
I have numerous skins from Persia, Asia Minor and elsewhere, but this seems to be the only Indian one available. 43 skins from all localities in British Museum average, head and body about 94 mm., tail about 29 mm., hindfoot about 16 mm., ear about 19 mm.

Cricetulus migratorius fulvus

I have no measured Indian skins. Six specimens from Chinese Turkestan given an average of: head and body about 96 mm., tail about 30 mm., hindfoot about 16 mm., ear about 16 mm.

Cranial characters.—The skull is rather narrow in general appearance, but is not heavily ridged. Nasals quite long and prominent, tending to be somewhat narrower posteriorly than anteriorly. Parietals not ridged until extreme old age and then not heavily so. Interparietal tending to be somewhat narrow (from front to back), but well developed.

Considerable interorbital constriction present. Occiput rather weak, and little ridged. Bullae well inflated and large, roughly 16-18% of the occipitonasal length. Pterygoid fossae rather shallow. The palate is generally less than half



TEXT-FIG. 30. *Cricetulus migratorius migratorius* (Pallas), ♂. A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 3\frac{1}{2}$). (After Ellerman, 1941, p. 430.)

the occipitonasal length. The palatal foramina are long, about 18% or more of the occipitonasal length as a rule. Zygoma narrow, with shortened jugal; infraorbital foramen normal, and zygomatic plate about straight anteriorly. Mandible with very prominent coronoid process, which is curved backwards; and rather narrow angular process; a deep curved space separates both from the condylar process, which is wider than either in the majority of specimens.

Dental characters.—Upper incisors of medium width or narrow, yellow and plain. M. 1 with six cusps originally, the cusps high and well marked; there are three laminae, each bearing a pair of these cusps, and these laminae are separated by a deep inner and outer re-entrant fold each side; between each pair of cusps is a deep pit so that there are three deep pits in the centre of the tooth, and these pits tend to isolate; originally they are probably caused by a backward prolongation of the outer re-entrant fold. M. 2 with two laminae, two central pits, and four cusps (i.e. like M. 1 with the anterior lamina absent). M. 3 relatively small, resembling M. 2 but on a reduced and rather more indistinct scale. Ultimately the whole pattern wears out, though often traces at least of the central pits remain. First lower molar with three main inner, two outer re-entrant alternating folds, and three well marked cusps each side (traces also of a postero-internal cusp). Second lower molar like the front one, only lacking the front pair of cusps. Third lower molar not very different from the second one, but reduced in size and rather less distinct.

Cranial measurements.—

		Occipito- nasal	Palate	Foramina	Bullae	Toothrow	Frontals
<i>Cricetulus migratorius migratorius</i>							
M.	21.7.14.5	28.6	13.9	5.2	5.4	4.1	3.9
	Ladha, south Waziristan						
F.	21.7.14.6	28.6	13.5	5.7	5.4	4.0	4.2
	Ladha, south Waziristan						

Several other skulls examined from Asia Minor, Persia, one from region of Baku, Russia.

Cricetulus migratorius fulvus.

F.	81.3.1.17	26.7	12.8	5.0	5.0	4.6	4.1
	Gilgit, Kashmir. Rather young						

Three other specimens from Chinese Turkestan (Karakorum Mountains).

Dimensions of the species Cricetulus migratorius, in British Museum material.—The head and body length varies between 76 and 130 mm., the tail between 15 and 37 mm., hindfoot 12–20 mm. (very rarely as much as 20 mm.). The occipito-nasal length varies between 24·6 and 30·6 mm., the toothrow 3·7–4·6 mm.

Provisional key to the Indian races of C. migratorius

1	(2) The toothrow at least 4·4 mm. in length, and proportionately longer	<i>C. m. fulvus</i>
2	(1) The toothrow at most 4·1 mm. in length, and proportionately shorter.	<i>C. m. migratorius</i>

There are several races of this species; too many are named. The Persian one is named as *isabellinus* (1865), a probable synonym of *cinerascens* Wagner, 1848, from Syria. But I am not able to distinguish Persian specimens with certainty from our somewhat scanty Russian material. Our material for the second name in the species, *arenarius* Pallas, 1773, is altogether too poor for one to be able to gather what its characters might be, but Blanford's race *fulvus*, which is one of the earlier names in the species, seems to stand quite apart from our considerable material for the typical and other races on account of its relatively long toothrow. Other Indian material I have to place in the typical race for the time being on account of uncertainty as to what the distinguishing characters of that race are supposed to be, and lack of Russian material with which to compare. But specimens examined from the Caucasus, the Aral Sea region, Persia, Asia Minor, Israel, and Baluchistan seem to represent one form, and not to be certainly distinguishable from each other.

There is another darker race in northern Asia Minor, and another shorter-tailed race in Djarkent, Samarkand region, Tianshan and Zungaria, but both of these are extralimital, and antedated by the two Indian names.

(i) **Cricetulus migratorius migratorius** (Pallas)

Text-fig. 30

1773. *Mus migratorius* Pallas, *Reise*, 2, 703.

1865. *Cricetulus isabellinus* de Filippi, *Viaggio in Persia*, 344. (Persia.) (*Cricetus phaeus* (Pallas, 1779, *Nov. Sp. Quad. Glir. Ord.*, 261) and *Cricetus isabellinus* of Blanford, 1891, *Fauna Brit. India*, 436, 437.)

Type-locality.—Region of the Ural River, U.S.S.R.

Range.—Specimens examined from RUSSIA: Volga; TURKESTAN: Cap Urga, south-west of Aral Sea; PERSIA: Shiraz,

Bagh Rezi, Kazvin, Khorassan, Menzil, Sakiz. BALUCHISTAN: Kelat. NORTH-WEST FRONTIER: Ladha, South Waziristan. CAUCASUS: Talysh Mountains, Baku; near Alexandropol, Erivan; ASIA MINOR: Baibort, Changria, Kara-Dagh, 30 miles north-west of Konia, Murad-dagh, Smyrna, Van. ISRAEL: Rehoboth (skin).

(ii) ***Cricetulus migratorius fulvus* (Blanford)**

1875. *Cricetus (Cricetulus) fulvus* Blanford, *J. Asiat. Soc. Beng.*, **44**, 2, 108.

Type-locality.—Plains of Eastern Turkestan, Pamir and Wakhan.

Range.—Specimens examined from Chinese Turkestan: North side of Karakorum Mountains, Alveza Kazan, Kashgar (junction of Sanju Pass and River Karakara), Surhad Wakkan, and Punja Wakkan. KASHMIR: Gilgit.

It appears to be like the typical race, but with a longer toothrow.

Note from a skin from Chinese Turkestan: 'Gregarious; two large cheekpouches, red toe pads; gravid female, eight young'.

50. ***Cricetulus alticola* Thomas**

The Ladak Hamster

1917. *Cricetulus alticola* Thomas, *Ann. Mag. nat. Hist.*, **19**, 455.

1922. *Cricetulus alticola tibetanus* Thomas and Hinton, *Ann. Mag. nat. Hist.*, **9**, 180. Tingri, 14,000 ft., Tibet.

Type-locality.—Shushul, Ladak, 13,500 ft.

Range.—Specimens examined from TIBET: Tingri and Dzakar Chu. Teza, on UPPER SUTLEJ. LADAK: Khardong, Durgu village and Shushul.

This species differs sharply from *C. migratorius* and its allies in having the bullae small, flattened, and only about 14% of the occipitonasal length. In this character, it diverges from normal *Cricetulus*, and makes an approach towards the genus *Phodopus*, which contains two species peculiar on account of their hairy feet and excessively short tails as well as their relatively reduced bullae. *C. alticola* has the external characters more as in *Cricetulus*. It is very closely allied to a Tibetan species *C. lama* Bonhote, 1905, which antedates it, and Argyropulo made it a race of that. However, the tail proportions in the two species are very different. The tail is short, only about a third of head and body length in *C.*

alticola, whereas in *C. lama* it is roughly 45% of the head and body. I, therefore, tentatively regard the present species as valid, but it may be that intermediate forms will be discovered in which case Argyropulo's classification would be correct. *C. lama* is not a well known form.

External characters.—Essentially as described above for *C. migratorius*; tail about a third of the head and body length; foot usually a little longer than the ear.

Colour.—Above grey, with whitish hands and feet; underparts mainly light grey, therefore differing in this character from *C. migratorius*. Tail white.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Cricetulus alticola</i>				
M. Shushul, Ladak	100	29	17	15
M. Khardong, Ladak	90	33	16	13½
M. Khardong	93	35	15	15
F. Durgu Village, Ladak	85	29	16	14
M. Teza, Upper Sutlej	82	30	16	15
M. Shushul, type	98	31	15½	15

Cranial and dental characters.—Essentially as in *C. migratorius*, except for the fact that the bullae are small, reduced, and flat (roughly 14% of the occipitonasal length).

Cranial measurements.—

	Occipito- nasal	Palate	Foramina	Bullae	Toothrow	Frontals
<i>Cricetulus alticola</i>						
F. 6.10.3.4	24.8	?	5.0	3.4	3.9	4.3
Shushul, Ladak.	Rather young					
M. 6.10.3.13	26.4	12.4	5.2	3.8	3.7	4.1
Shushul, Ladak, type						

Another broken skull from Upper Sutlej Valley examined.

Note that the bullae are actually considerably smaller than those of *C. migratorius* listed above.

Dimensions of the species Cricetulus alticola, in British Museum material.—The occipitonasal length varies between 24.8 and 26.4 mm. Toothrow 3.7–4 mm. Head and body length varies between 82 and 103 mm., tail between 27 and 37 mm., hindfoot 15–18 mm.

Subfamily (b) GERBILLINAE

Muridae in which the cranial and external specializations are leading towards saltatorial life. That is to say, the skull is of the type which is found elsewhere in jumping rodents. The braincase is rather widened, the bullae tend to become inflated, sometimes enormously so, the zygoma is narrowed, and slopes upwards rather abruptly anteriorly, the rostrum tends to be narrow. The zygomatic plate is considerably thrown forwards anteriorly, and is tilted upwards and typically Murine. The coronoid process of the mandible is small and reduced, and the jaw is rather weak, with a wide curved space separating the condylar and angular processes behind. Except in one genus, the upper incisors are grooved. There is often a second pair of foramina (between the tooth-rows) in the palate, and the front pair are long and narrow as a rule. Externally the form is modified towards saltatorial life, with long tail, in the Indian species, rather long foot, etc. The tail is moderately hairy. Some gerbils habitually proceed by jumping on the hindlegs, as in jerboas, but there is surprising lack of information as to which species do so and which do not. The molars of this subfamily are hypsodont, and ultimately become rootless in one Central Asiatic genus. They tend to become simple-prismatic in type, i.e. M. 2 roughly 8-shaped, M. 1 with two folds each side. M. 3 is always small. In primitive genera, however, signs of biserial cusping are evident in the upper molars.

The group is Old World in distribution. It is common throughout Africa, and perhaps the majority of species reside in that continent. It is, however, well represented in Asia. The northern boundary for its range seems to be the Caucasus, Russian Turkestan, Transbaikalia, Manchuria, Mongolia, and the southern limit in Asia roughly from northern China (Kansu, Shensi, Chihli, etc.), through Sinkiang; Nepal Terai westwards and southwards to Ceylon; west of Baluchistan occurring throughout South-West Asia west to Arabia and Asia Minor. The group is wholly absent from the Malayasian region, and is not known east of Nepal Terai in India. Half a dozen genera occur in Asia, and three of these reach India. These will be dealt with in some detail below. Others from Asia include *Rhombomys*, Chinese Turkestan, Mongolia, Russian Turkestan, North Persia, unique in the subfamily in that the cheekteeth are rootless; *Brachiones*, based on a peculiar, small species from Chinese Turkestan and Mongolia in which the frontals are unusually widened, the palatal foramina shortened, the nasals short, the superior aspect of

the skull being almost triangular; and *Psammomys*, which is North African and also occurs in Israel and part of Arabia, much like *Meriones* but with plain upper incisors and rather short tail. Another very interesting Palaearctic genus which occurs in Egypt and Algeria is *Pachyuromys*, in which the tail is strongly shortened and club-shaped, and the mastoids are excessively inflated, the bullae in the British Museum specimens averaging up to 48% of the occipitonasal length.

On this subfamily see Ellerman, 1947, *Proc. zool. Soc. Lond.*, 117, 269, and on the genus *Meriones*, Chaworth-Musters and Ellerman, *Proc. zool. Soc. Lond.*, 117, 478.

Key to the Indian genera of Gerbillinae

- 1 (2) The upper molars are strictly simple prismatic at all times, with no signs of cusps. The folds of the upper molars mostly equal in size (or if not, then the inner fold tends to be slightly longer than outer fold). Laminae of molars always joined, and the folds nearly meet in the middle line of the tooth. (In the Indian species, the occipitonasal length of the skull exceeds 31 mm., and the tail is never dark above and below, and pale along the sides.) .. *Meriones*
- 2 (1) The upper molars are not strictly simple prismatic in type, but at least originally there are clear signs of cusps or clear constrictions on the laminae representing cusp spaces. Laminae of molars not always joined, and the general dental effect is more complex and angular.
- 3 (4) Zygomatic plate unusually strongly thrown forwards and angular. Nasals long, usually more than 40% of the occipitonasal length. Bullae relatively small, not much over a quarter of occipitonasal length, or may be less than this percentage. Palate long, clearly over half occipitonasal length. The main outer folds of upper molars tend to be larger than the inner ones. Length of the occipitonasal is not less than 38.5 mm. The tail (in the Indian species) is dark above and below, and pale along the sides. *Tatera*

4 (3) Zygomatic plate less exaggerated.

Nasals (in Indian species) not reaching 40% of the occipitonasal length. Bullae proportionately larger. Palate not reaching half occipitonasal length (in Indian specimens). The main inner folds of the upper molars are larger than the outer ones. Length of the occipitonasal not exceeding 37 mm. (in the Palaearctic region; in India, not reaching 31 mm.).

Tail not coloured as above

Gerbillus

In Blanford's day, all the gerbils of India were referred to as *Gerbillus*. Later, by Lataste and others, this genus was variously subdivided, and ultimately became much oversplit. I offered a revision of the genera in 1941, reducing them to twelve in the subfamily. Simpson, 1945, is of the opinion that I retained too many, and reduces them to ten, suspecting that a more synthetic detailed study would properly reduce this number. It does, however, seem reasonable to retain the seven Palaearctic genera which I have mentioned above.

Genus 22. *Gerbillus* Desmarest

1804. *Gerbillus* Desmarest, *Nouv. Dict. Hist. nat.*, **24**, Tab. Méth.: 22.

1881. *Dipodillus* Lataste, *Le Naturaliste*, Paris, **1**, 506. *Gerbillus simoni* Lataste, from Algeria. Valid as a subgenus.

Type-species.—*Gerbillus aegyptius* Desmarest = *Dipus gerbillus* Oliver from Egypt.

Distribution.—South, East, North and northern West Africa; South-West Asia, from Arabia, Israel and South Persia eastwards to the PUNJAB, BALUCHISTAN, SIND, GUJERAT and KATHIAWAR.

Small Gerbils in which the molars are originally clearly biserially cuspidate. The detailed characters by which this genus may be distinguished from *Tatera*, which it most resembles in the structure of the cheekteeth, are given in the key above. However, sometimes in African races, the bullae may be proportionately as small as in *Tatera*.

There are two groups of species in this genus which occur side by side throughout the range of the genus, in the Palaearctic region, one in which the soles are naked, and one in which the soles are at least partly hairy. Formerly both were given generic rank, *Gerbillus* being restricted to the hairy-soled group, and *Dipodillus* being used for the naked-soled group. However, this is not considered a character

of generic value elsewhere, and in the allied genus *Meriones* either type of sole structure may occur, so that it is clear that *Dipodillus* is not more than of subgeneric value.

Key to the subgenera of Gerbillus

1	(2) Soles entirely naked.	<i>Dipodillus</i>
2	(1) Soles at least partly hairy.	<i>Gerbillus</i>

Subgenus (a) *Dipodillus* Lataste

1881. *Dipodillus* Lataste, *Le Naturaliste*, Paris, 1, 506.

Based on *Gerbillus simoni* Lataste (*Gerbillus dasyurus simoni*), from Algeria.

There seem to be six Palaearctic species in this subgenus; two of these reach India, and two are confined to North Africa. The other two are from the Aden district of Arabia; *G. famulus* Yerbury and Thomas, which is like *G. nanus* but larger in size, and *G. poecilops* Yerbury and Thomas, which is not unlike *G. dasyurus* but larger in size and with proportionately short tail and ears.

Key to Indian species of subgenus Dipodillus

1	(2) Bullae larger, 8.1 mm. and more in length, approximating at least to 30% of the occipitonasal length	<i>Gerbillus nanus</i>
2	(1) Bullae smaller, normally less than 30% of the occipitonasal length; their actual length 7.9 mm. and less.	<i>Gerbillus dasyurus</i>

It must be noted that the measurements for the bullae given in this key refer only to the Indian races. These two species are not very widely separable from each other, and *dasyurus* has priority; but they seem to occur together, or at least in the same general neighbourhood, from the deserts of western India westwards to Algeria.

51. *Gerbillus dasyurus* (Wagner)

Wagner's Gerbil

1842. *Meriones dasyurus* Wagner, *Arch. Naturg.*, 8, 1, 20.

Type-locality.—Sinai. This is the earliest name for a species of subgenus *Dipodillus* from Asia.

Distribution.—According to the classification here offered, the species ranges from Algeria, Libya, Egypt, to Israel, Iraq, Arabia, thence to NORTH-WEST FRONTIER, PUNJAB,

SIND, GUJERAT and KATHIAWAR. It contains essentially the generalized *Dipodillus* gerbils of Asia and North Africa, with relatively small bullae, and small size (the occipitonasal length not reaching 29 mm. in our material for Palaearctic races). Doubtless also the species ranges in Kenya, the Sudan, and Somaliland, but the precise status of forms inhabiting those parts of tropical Africa has not been ascertained during the compilation of this work.

External characters.—Very small in size, the head and body 90 mm. at highest. Fur soft. Tail extremely long, most often exceeding 150% of the head and body length, fairly well haired throughout its length, slightly tufted terminally. Manus with four well developed digits bearing quite prominent claws in proportion to the size of the animal, and a very small but traceable thumb. Hindfoot long, but usually under 30% of the head and body, rather narrow, the soles quite naked, the three central toes markedly longer than the two outer ones; fifth toe reaching well past base of fourth; hallux reaching about base of second. Ear large, 10–13 mm. in length.

Colour.—Above mostly pale sandy brown, the hairs darker basally, and sometimes some of the dark basal part of the hairs show, mixing the sandy brown of the back with a blackish suffusion. Feet pale or whitish. Underparts wholly white. Tail usually clearly bicolor, darker above, paler below, but in a few specimens it is almost wholly pale.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Gerbillus dasyurus indus</i>				
M. Muli, Kathiawar	74	103	19½	12
Muli (? immature)	57	85	18	10
M. Lunwa, Palanpur	73	109	19	12
F. Chakri, Salt Range, Punjab	58	91	20	12
M. Gambat, Sind, type	72	117	22	13

Frost collection. Most of these lack skulls, and so their identification must be regarded as provisional.

F. 4.	Tirth Laki, Indus, Sind	87	115	20	12
F. 19.	Panoaqil, Sind	90	118	20	12
M.	Laki hill, Ranikot, Sind	70	91	21	10
	Sehwan, Sind	65	110	20	10
M.	Sehwan	75	123	20	10
	Sehwan	60	93	20	10
F.	Indus River, Sind	65	125	20	10
M.	Tirth Laki, Sind	75	122	21	11
F.	Sanu, Sind	75	125	21	10
F.	Sehwan	80	121	21	10
F.	Sanu	70	133	20	10

Notes from skins.—Lunwa, Gujerat; weight $\frac{5}{8}$ oz. Muli, Kathiawar; weight, $\frac{1}{2}$ oz. and $\frac{1}{4}$ oz.

Cranial characters.—Skull very small, the occipitonasal length about 27 mm. at most. Nasals narrow, the rostrum straight, not bowed down in front. Frontals ridged, but not very powerfully so, evenly divergent backwards, narrowest just behind lachrymals. Suture of frontals and parietals nearly straight, interparietal wide and large. Zygomatic plate only moderately thrown forwards and mastoids not prominent when skull is viewed from above. Bullae large for a Murine Rodent, but usually under 30% of the occipitonasal length, and not very much inflated for a Gerbilline. Pterygoid fossae shallow, reduced; hamulars joining bullae. Front palatal foramina narrow and long, and there is in the small series of skulls available a well marked second pair of slitlike foramina between the toothrows. Zygoma narrow; zygomatic plate fairly well thrown forwards and ridged superiorly. Mandible about as in *Meriones hurrianae*, with weak coronoid process, the angular narrow and drawn backwards to a degree, the root of the lower incisor visible under and beside the coronoid.

Dental characters.—Upper incisors opisthodont, yellow, one-grooved. The upper molars less simple, at least originally, than in *Meriones*, and originally with clear signs of biserial cusping. M. 3 ring-shaped and very small; M. 2 with a shallow outer and a deep inner fold, roughly dividing the tooth into two lobes; M. 1 with two folds each side; the front lamina caused by these folds is single, narrower than the others; the other laminae appear to be biserially cuspidate; the second inner fold is very wide, larger than the others, and at the back of the tooth the outer cusp tends to be slightly anterior to the inner one which has a heel which appears on the outer border of the tooth behind the outer cusp. Sometimes the laminae are divided, not joined, and the general effect even of worn teeth is more complex than in *Meriones*. Lower molars; M. 3 very small, ring-shaped; M. 2 with two laminae, and M. 1 with three laminae; at least the second lamina of M. 1 and sometimes others of the laminae with signs of biserial cusping.

For the related species *G. nanus* and *G. gleadowi* I have only by me skulls with rather more worn teeth than those for *G. d. indus*. Nevertheless it is clear that their molars are more complex in detail than in *Meriones*. The unusually large second inner fold in M. 1, for instance, is traceable in all.

Cranial measurements.—

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals
<i>Gerbillus dasyurus indus</i>								
M.	13.8.8.88	25.6	12.6	4.1	7.1	3.4	9.4	5.3
	Muli, Kathiawar							
M.	13.9.18.89	25.3	12.5	4.2	c. 7.0	3.2	8.8	5.2
	Lunwa, Palanpur							
M.	20.6.1.1	26.0	12.4	4.4	7.7	3.0	9.6	4.6
	Kasi Bridge, South Waziristan							
M.	15.11.1.100	25.1	12.1	4.3	7.8	3.1	9.1	4.3
	Gambat, Sind, type							
F.	Frost coll. 4	27.4	13.6	4.7	7.9	3.2	10.6	4.7
	Tirth Laki, Indus, Sind. Old							

Dimensions of the species Gerbillus dasyurus, in British Museum material.—The occipitonasal length varies between 24.5 and 28.8 mm. but in adult probably 25 mm. is the minimum, or nearly so. Toothrow 3–4.1 mm. Head and body length varying between 57 and 92 mm. Tail varies between 65 and 122 mm. Hindfoot 18–26 mm.

Most often in this species the hindfoot is less than 30% of the head and body.

The Indian race was last to be named among Palaearctic subspecies, and it is extremely difficult to give characters which will distinguish all named races of this species because many of them are very little known. It can be stated with some certainty that the typical race, from Sinai, Iraq, and Israel, averages larger than the other races, and is almost always larger than the Indian race individually. The next name to be considered, *G. d. simoni*, from Algeria, stands out among the races of this species by having proportionately smaller bullae. The next name, *lixa* Yerbury and Thomas from Aden district, is little known, but the few specimens we possess average distinctly shorter in tail length than in the Indian subspecies. An Egyptian race, *G. d. amoenus*, seems rather near the Indian form; generally its frontals appear somewhat narrower than adult Indian material. A few other named North African forms which antedate *indus* are very rare and little known.

(i) ***Gerbillus dasyurus indus* (Thomas)**

1920. *Dipodillus indus* Thomas, *J. Bombay nat. Hist. Soc.*, 26, 4, 935.

Type-locality.—Gambat, Khairpur, Sind.

Prior to this publication, the present form was referred to *Gerbillus nanus* Blanford.

Range.—Specimens examined from SIND: Gambat, Khairpur; Tirth Laki, and Laki Hill, Ranikot; Sanu; Sehwan; Indus River; Panoaqil; PUNJAB: Chakri, Salt Range. NW FRONTIER: Kasi Bridge, South Waziristan; GUJERAT: Lunwa, Palanpur. KATHIAWAR: Muli.

A relatively small race, length of the occipitonasal in adult skulls about 25–27 mm., width of the frontals about 4.3–5.4 mm. (usually exceeding 4.3 mm.), bullae averaging about 28% of the occipitonasal length, and the tail most often exceeding 150% of head and body length.

52. *Gerbillus nanus* Blanford

The Little Gerbil

1875. *Gerbillus nanus* Blanford, *Ann. Mag. nat. Hist.*, 16, 312.

Distribution.—As here understood, from BALUCHISTAN westwards to South Persia, Arabia, Israel, south Egypt, Tunis, and Algeria.

This is essentially like *Gerbillus dasyurus*, but with larger bullae, which average more than 30% of the occipitonasal length. Throughout its range it occurs in the same general localities as *G. dasyurus*, though in India the two seem not to occur together. The typical race has an unusually long tail, over 160% of the head and body on average, and a long foot, averaging more than 30% of head and body, so far as ascertainable from the somewhat limited material available. It differs in its longer tail and foot from the Arabian race, *G. d. arabium*, and the Algerian race, *G. d. garamantis*, but is extraordinarily like a race from South Egypt, *G. d. mackiligini*, which has however a slightly shorter ear as a rule.

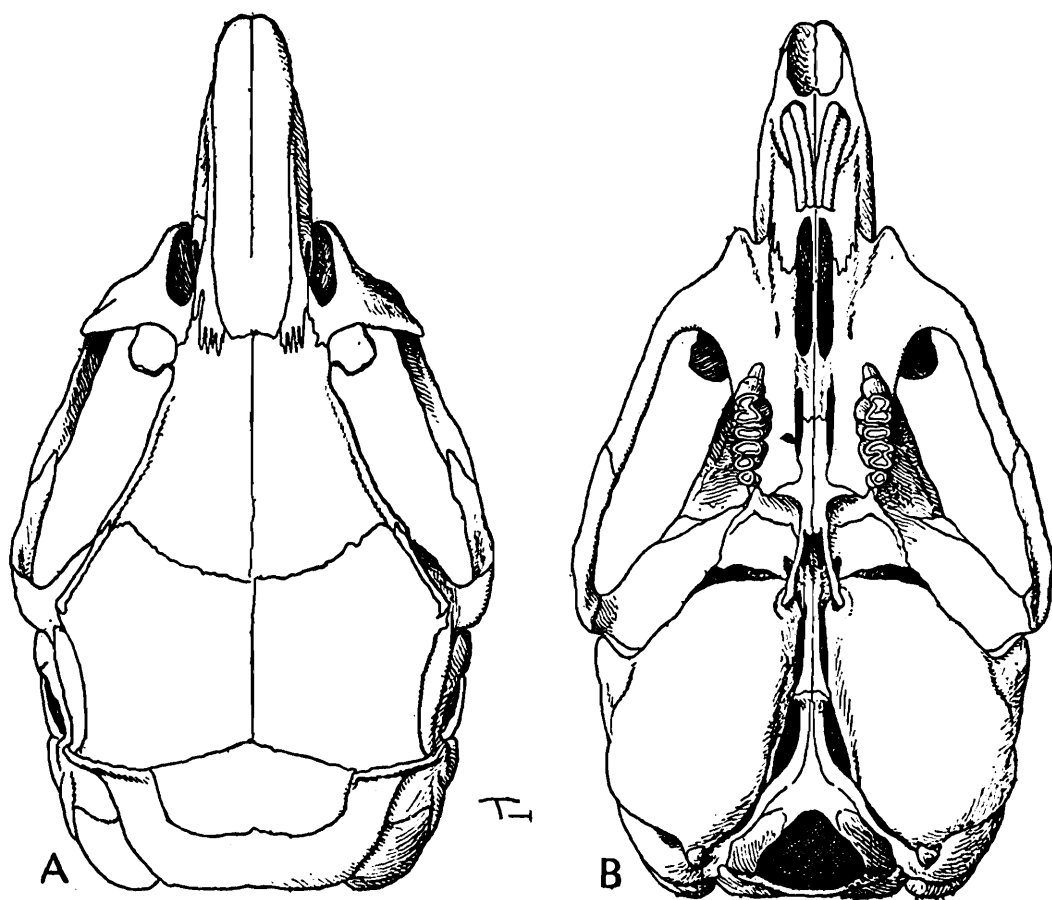
External characters.—Much as in *G. d. indus*; tail more noticeably tufted in the small series of skins available, and foot longer, over 30% of head and body, and in length 23–24 mm. instead of 22 mm. and less for *G. d. indus*. Soles naked, as usual for the subgenus. Ear larger than in *G. d. indus*, 13–15 mm. (about 19% of head and body length).

Colour.—Above pale sandy brown, the hairs darker basally. Tail clearly bicolor, well tufted; dark above, whitish below, the tuft at the end appearing mostly dark. There is a considerable growth of short hair on it throughout its length. Underparts wholly white, and cheeks white.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Gerbillus nanus nanus</i>				
F. Dander, 90 miles east of Turbat, Baluchistan	72	106	23	13
M. Pasri, Baluchistan	69	126	24	14
M. Kuldar, 85 miles east by north of Turbat	78	122	24	15

Cranial characters.—The skull is much like that of *G. d. indus*, apart from its larger bullae, but tends to be larger, although not reaching 30 mm. in occipitonasal length. The bullae are larger than in the related species, and approximate to 30% of the occipitonasal length.



TEXT-FIG. 31. *Gerbillus nanus nanus* Blanford. A, B, dorsal and ventral views of the skull. ($\times 7$).

Otherwise much as in the related species, including mandible and grooved incisors. For dental characters, see note under *G. dasyurus*, p. 385, *supra*.

Cranial measurements.—

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals
<i>Gerbillus nanus nanus</i>								
M.	19.11.7.60	27.8	13.5	4.7	8.7	3.3	10.4	4.7
	Pasri, Baluchistan							
M.	19.11.7.61	27.5	13.5	4.8	8.2	3.3	10.0	5.0
	Kuldar, Baluchistan							
F.	19.11.7.62	?	12.4	4.5	8.2	3.2	?	4.5
	Dander, Baluchistan.		(Nasals broken)					

Another skull from Muscat, East Arabia, has the occipitonasal about 25.1 mm., the bullae 8.1 mm.

Dimensions of the species G. nanus, in British Museum material.—The occipitonasal length varies between 24.4 and 28.6 mm. Toothrow 2.9–3.7 mm. The head and body length varies between 65 and 95 mm., tail between 82 and 140 mm. (rarely under 90 mm.), hindfoot 18½–25 mm. (rarely under 20 mm.).

(i) ***Gerbillus nanus nanus* Blanford**

Text-fig. 31

1875. *Gerbillus nanus* Blanford, *Ann. Mag. nat. Hist.*, **16**, 312.

Type-locality.—Gedrosia, west of Gwadar, Baluchistan.

Range.—Specimens examined from BALUCHISTAN: Dander, Kuldar, Pasri. East Arabia: Muscat.

Subgenus (b) ***Gerbillus* Desmarest**

Differing from *Dipodillus* in the fact that the soles of the hindfeet are at least partly hairy. The distribution is as in the genus *Gerbillus*.

In the Palaearctic region, there are two well known and long established species, which occur together throughout North Africa, and occur together in Israel, *Gerbillus gerbillus* Olivier, 1800, the lesser Egyptian Gerbil, occipitonasal length almost always less than 30 mm. in length, and *Gerbillus pyramidium* Geoffroy, 1825, the greater Egyptian Gerbil, occipitonasal on average exceeding 30 mm. in length. Besides these, it appears there are two species of *Gerbillus* in South-West Asia. One of these, *G. cheesmani* Thomas,

from Iraq and Arabia, is the size of *G. gerbillus*, but differs from both the Egyptian species in having the bullae large, averaging over 31% of the occipitonasal length, whereas in the North African species they average under 30% of this length. The other species is the Indian one, *G. gleadowi* Murray. It is not so distinct as *cheesmani*. It is a border-line species in size, on the whole apparently agreeing with *G. gerbillus* but the occipitonasal length can reach 30 mm. individually. The bullae are smaller than in *cheesmani*, about as in some forms of *gerbillus* in size. It was formerly very imperfectly known, but Mr. Frost has recently taken a fine series of some twenty-five specimens in Sind, which enable me to state that its tail is unusually long, most often more than 160% of the head and body length. This unusually high percentage is not reached (on average) in any race of *G. gerbillus* or *G. pyramidium* from the Palaearctic known to me. As the geographical range of *gleadowi* is very widely separated from either of the ranges of those two species, and as its bullae are clearly smaller than those of *G. cheesmani*, I tentatively regard the Indian form as a species.

53. *Gerbillus gleadowi* Murray

The Little Hairy-footed Gerbil

1886. *Gerbillus gleadowi* Murray, *Ann. Mag. nat. Hist.*, 17, 246.

Type-locality.—Beruto, 15 miles south-west of Rehti, in the Mirpur-Drahrki Taluka of the Rohri district, Upper Sind.

Range.—Specimens examined from SIND: Rohri; Thar and Parkar (Hara); Gulamjo Goth, Umankot. PUNJAB: Chakri, Salt Range. GUJERAT: Lunwa, Palanpur.

Distribution.—INDIA: Punjab, Sind, Gujerat.

Differing from *Gerbillus gerbillus*, to which it appears nearest in size of skull, in its proportionately longer tail, which averages over 160% of the head and body length. Size as a rule smaller than in *G. pyramidium*. Bullae proportionately smaller than in *G. cheesmani*; tail apparently proportionately longer than in either *pyramidium* or *cheesmani*.

External characters.—Form essentially small Gerbilline (head and body length not reaching 100 mm.), the tail exceptionally long, and well tufted terminally. Ear rather prominent, 10–14 mm. in length, apparently proportionately shorter than in Indian species of *Dipodillus*. Forefoot with large claws and digits about as described for *G. dasyurus*; its sole hairy to a degree. Hindfoot long, most often over a third

of the head and body length, or approximating to that length, the three central toes considerably longer than the outer pair; fifth toe rather long, markedly longer than hallux. The sole of the hindfoot is hairy more or less throughout, and according to Blanford there are no distinct pads. Not very much seems to be known about this Gerbil which has been very imperfectly represented in the British Museum until Mr. Frost recently obtained for us about twenty-five specimens from Sind.

Weight, 1 oz. (Lunwa); 0.75 oz. (Chakri, Salt Range).

Colour.—Pale sandy, sometimes light reddish, brown above, the dorsal hairs darker basally. Feet white; underparts white. Tail bicolor, faint brown above, white below, the tuft at the end with some dark brown present.

External measurements.—

		Head and body	Tail	Hind- foot	Ear
F.	Hara, Thar and Parkar, Sind	94	132½	25	13
F.	Chakri, Salt Range, Punjab	77	125	27	12
M.	Lunwa, Palanpur	90	137	27½	13
Frost collections—					
F.	6 Gulamjo Goth, Sind	80	130	28	12
F.	8 „	85	138	28	14
M.	9 „	90	135	28	14
	79 Umankot, Sind	80	?	27	13
M.	89 „	75	135	28	14
M.	88 „	82	125	28	10
F.	91 „	75	125	28	12
M.	102 „	92	130	25	15
M.	111 „	75	125	27	11
M.	115 „	95	?	30	14
M.	126 „	85	145	26	12
M.	127 „	85	136	28	13
F.	128 „	70	130	27	12
M.	129 „	83	175 (?)	28	13
F.	130 „	85	?	28	11
M.	133 „	85	140	28	12
F.	135 „	78 ?	135	27	12
F.	136 „	75	140	27	12
M.	137 „	85	130	26	12
M.	138 „	85	145	29	14
M.	143 „	90	135	29	13
F.	144 „	85	130	26	13
F.	146 „	85	?	25	12
M.	147 „	85	125	28	14
F.	150 „	75	135	26	11

Cranial characters.—The skull is nearly or about 30 mm. in occipitonasal length. The bullae appear to be on average 29% of the occipitonasal length. The skull does not differ

conspicuously from that of *G. d. indus*, apart from rather larger size. The frontals are quite well ridged. Mandible and grooved upper incisors as usual. For dental characters see note under *G. dasyurus*, p. 385, *supra*.

Cranial measurements.—

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals
M.	13.9.18.88 Lunwa, Palanpur, Gujerat	29.8	14.5	4.5	8.4	3.7	11.1	5.7
F.	86.2.25.1 Rohri, Upper Sind, type	28.2	13.4	4.3	8.3	3.7	?	5.1
Frost collections—								
M.	115 Umankot, Sind	30.2	14.7	4.8	9.3	3.7	11.3	6.5
M.	9 Gulamjo Goth, Sind	29.8	14.6	4.7	8.9	3.8	11.1	5.8
M.	79 Umankot, Sind	28.1	13.7	4.5	8.4	3.9	10.7	5.4
M.	89 Umankot	28.0	13.7	4.6	8.5	3.6	10.3	5.8
F.	91 Umankot	27.0	13.2	4.1	8.2	3.8	9.8	5.4
M.	111 Umankot	27.7	13.5	4.4	8.2	3.7	10.0	5.5
M.	127 Umankot	29.5	14.3	4.8	8.8	3.8	11.2	5.9
F.	128 Umankot	28.8	13.6	4.5	8.7	3.6	10.6	5.6
M.	129 Umankot	27.7	13.2	4.3	8.6	3.6	9.9	5.4
M.	133 Umankot	29.1	14.1	4.5	c. 8.5	3.7	11.1	5.5
F.	135 Umankot	28.1	13.7	4.4	8.5	3.4	10.5	5.6
F.	136 Umankot	28.0	13.8	4.4	8.2	3.4	10.9	5.4
M.	137 Umankot	28.3	13.5	4.7	8.2	3.9	11.0	5.6
F.	150 Umankot.	28.7	14.2	5.0	8.3	3.6	11.0	5.5
(Foramina measurement represents the longer side)								
F.	146 Umankot	28.2	13.8	4.8	8.2	3.7	10.5	5.3
M.	143 Umankot	28.7	14.1	4.8	8.8	3.8	10.4	5.4
F.	144 Umankot	28.8	14.2	4.7	8.9	3.8	11.1	5.3
M.	147 Umankot	29.0	14.3	5.0	8.2	3.8	10.8	5.8

Dimensions of G. gleadowi.—The occipitonasal length varies between 27.0 and 30.2 mm. Toothrow 3.4–3.9 mm. Head

and body length varies between 70 and 94 mm. Tail between 125 and 175 mm. and hindfoot 25–30 mm. The hindfoot is usually more than one-third of the head and body length.

Genus 23. **Tatera** Lataste

1882. *Tatera* Lataste, *Le Naturaliste*, Paris, 2, 126.

1917. *Taterona* Wroughton, *J. Bombay nat. Hist. Soc.*, 25, 1, 40.
(*Gerbillus afra* Gray from South Africa.)

Type-species —*Dipus indicus* Hardwicke.

Distribution.—CEYLON, INDIA northwards at least to PUNJAB, thence westwards through BALUCHISTAN to Persia, Iraq, northern Arabia and Syria. Tropical Africa, widely distributed, southwards to Cape Province. The easternmost limit in India is Nepal Terai.

This genus is like *Gerbillus* in having relatively complex molars, which are originally biserially cuspidate. It contains larger species, with rather stronger occiput, and with the zygomatic plate immensely thrown forward. The bullae tend to be rather small, for members of the present subfamily.

There is one valid species in Asia, which is one of the commonest of Indian Rodents.

54. **Tatera indica** (Hardwicke)

The Indian Gerbil or Antelope-Rat

1807. *Dipus indicus* Hardwicke, *Trans. Linn. Soc. Lond.*, 8, 279.

Vernacular names (Blanford).—Harna mus (*Antelope-Rat*), H.; Jhenku indur, Beng.; Pandhara undir, Mahr.; Yeri yelka, Wadari; Tel yelka, Yenadi; Billa ilei, Canarese.

Distribution.—Asiatic range of the genus *Tatera*. Characters include those of the genus, as indicated above. The zygomatic plate is extremely thrown forwards and powerful. Most often the occipitonasal length exceeds 40 mm. (38.5–48.8 mm.). The nasals are very long, usually over 40% of the occipitonasal length. The palate is long, usually over half the length of the occipitonasal. Often the bullae are less than one-quarter of the occipitonasal length, and they rarely average much more than this length. The palatal foramina are long. The colour of the tail is peculiar and distinctive, being dark above and below, pale along the sides. The hindfoot has the sole naked. The tail is longer than the head and body.

This species was divided into seven species (!) by Wroughton. In my second volume of the *Living Rodents* I made them all races of the first named, *T indica*, and I think that only four of them can properly be retained as valid races, as will be discussed below.

External characters.—Large gerbils, head and body length in largest specimens exceeds 200 mm. Tail almost always longer than head and body; in some races over 120% or even over 130%. The tail is quite well haired, and tufted, and its colour is distinctive. Ear over one-tenth of head and body length, its length over 20 mm. Hand with four well developed fingers and a rudimentary (though clawed) thumb; claws not enlarged. Foot rather long, sometimes over a quarter of head and body length, never averaging as much as 30%; the sole naked to the heel; the three middle toes markedly longer than the outer pair; the fifth toe longer than the hallux; the foot appears narrow. Mammæ 8.

The peculiar tail colour, dark above and below, with a pale stripe on each side, seems constant enough in the very large series I have examined for India in this species, but it varies in degree of development individually, and seems weakest in Baluchistan specimens.

Colour.—Above light brownish varying from sandy brown or rarely brownish grey to near reddish. Within the typical race different specimens individually vary as just indicated. The underfur is grey or dark, and sometimes some of the dark hairs show through on the back. Lower parts white. The tail through most of its length is dark above and below (sometimes black), and pale along the sides; it is most often black in the terminal tuft, but this tuft can be white. Feet usually white.

External measurements.—As in Table 47, below.

TABLE 47.—*External measurements of the Indian races of Tatera indica*

	Head and body	Tail	Hind- foot	Ear
<i>Tatera indica indica</i>				
M. Edalabad, East Khandesh	120	168	39	23
M. East Khandesh	116	215	43½	25
F. Sival, Nimar	167	190	38	23
				mammæ 8
M. Asirgarh, Nimar	178	205	41	23
F. Dhain, Hoshangabad	157	197	37	23
				mammæ 8

TABLE 47.—*External measurements of Tatera indica (contd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Tatera indica indica</i> (contd.)					
F.	Chanda	150	191	39	23
					mammae 8
M.	Rorighat, Hoshangabad	165	184	38	24
	Mundra, Sangor	148	192	39	23
	Mundra, Sangor	157	198	38	23
F.	Chanda	141	189	37	20
					mammae 8
M.	Motimajiti, Kathiawar	158	169	35	22
M.	Keshod, Junagadh	163	168	38	22
F.	Talala, Junagadh	163	188	38	22
					mammae 8
F.	Rajkot, Kathiawar	157	185	38	22
					mammae 8
F.	Vankaneer, Kathiawar	156	184	40	24
M.	Danta, Gujarat	159	195	37	25
M.	Danta	172	196	37	23
F.	Palanpur	161	185	37	23
					mammae 8
F.	Ramnagar, Kumaon	153	175	37	24
F.	Pilibhit, Rohilkund, Kumaon	149	186	36	23
					mammae 8
M.	Dela, Ramnagar	145	189	38	23
M.	Ramnagar	149	190	37	23
M.	Midnipur, Bengal	178	205	40	24
M.	Salbani, Midnipur	177	200	41	25
F.	Chorepura, Gwalior	161	198	38	22
F.	Daltongunj, Bihar	168	198	38	25
M.	Daltongunj	162	189	39	25
F.	Poona	164	177	39	20
M.	Poona	120	155	?	?
M.	Damthal, Kangra	166	187	40	23
F.	Damthal, Kangra	174	201	36	24½
M.	Damthal, Kangra	189	200	37	23
M.	Damthal, Kangra	179	187	37	22
	Hazaria, Patheghatta, Nepal	137	178	39	24
M.	Kotri, Sind	140	190	38	22
F.	Chakdulla, Campbellpore.	133	137	37	23
F.	Kotri, Sind	142	185	35	23
M.	Tribeni, Nepal Terai	122	135	37	22
Frost collections (<i>adults</i>)—					
F.	Gulamjo Goth, Sind	145	173	35	20
M.	"	145	165	38	24
M.	Panoaqil, Sind	165	188	40	25
M.	"	160	185	40	23
F.	"	160	190	35	25
F.	"	155	178	38	25
F.	"	150	180	35	25
F.	"	135	170	35	22
F.	"	155	190	40	22
M.	"	150	175	38	23

TABLE 47.—*External measurements of Tatera indica (contd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Tatera indica indica</i> (concl'd.)					
F.	Panoaqil, Sind	145	180	35	24
M.	"	135	160	38	24
	"	130	?	35	22
F	"	135	160	38	25
<i>Tatera indica indica</i> ('dunni')					
M.	Handisera, Ambala, Punjab	165	176	36	22
M.	Ambala	145	162	37	22
M.	Handisera	135	158	37	20
M.	Ambala (young)	117	115	31	21
F.	Handisera	154	163	36	22
M.	Ambala	155	166	36	22
M.	Ambala, type	160	203	37	24
	Gandhala, Salt Range	163	192	37	21
M.	Gandhala	166	191	37	23
M.	Gandhala	159	173	36	24
F.	Gandhala	143	170	35	21
	Sakesar, Salt Range	163	171	36	22
M.	Sakesar	140	186	31	?
M.	Sakesar	155	165	35	22
F.	Sakesar	162	187	37	23
M.	Mogli, Salt Range	157	170	36	24
M.	Mogli	163	170	37	23½
F.	Mogli	128	164	36	23
F.	Dhalwal, Salt Range	162	183	36	23
F.	Chakri, Salt Range	162	175	36	23
				mammae 2.2=8	
F.	Chakri	162	178	37	25
				mammae 2.2=8	
F.	Chakri	171	186	36	23
M.	Chakri	157	156	35	23
F.	Chakri	151	190	38	24
F.	Chakri	169	187	36	23½
M.	Chakri	170	160	36	23
	Rohtas, Salt Range	150	170	36	23½
	Rohtas	140	148	35	24
	Rohtas	150	180	35	24
M.	Rohtas	164	183	37	24
	Ara, Salt Range	173	192	38	25
M.	Ara	180	186	39	25
F.	Ara	146	161	35	23
				mammae 2.2=8	
F.	Ara	162	164	35	23
	Madhopur, Punjab	155	190	38	24
	Kallarkahar, Punjab	168	175	36	23
F.	Kallarkahar	157	179	35	22
M.	Madhopur	180	195	39	25
F.	Kallarkahar	163	186	37	22
M.	Madhopur	165	190	37	24
M.	Madhopur	160	200	37	25

TABLE 47.—*External measurements of Tatera indica (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Tatera indica indica</i> ('sherrini')				
F. Thar and Parkar, Sind	154	170	35	23
M. Thar and Parkar	156	164	37	23
F. Jacobabad, Sind	143	166	36	24
F. Jacobabad	155	176	37	23
M. Jacobabad	165	193	37	24
F. Sukkur	153	178	36	23
F. Shikarpur, Sind	140	143	31	20
Jacobabad	152	187	36	24
M. Las Bela, Baluchistan	147	185	38	24
Jacobabad, type	162	191	37	24
<i>Tatera indica indica</i> ('persica')				
M. 24 miles south of Turbat, Baluchistan	153	175	36	25
F. Pangjur, Baluchistan	165	196	40	26
F. Pangjur	132	162	37	24
F. Pangjur	155	185	40	26
M. Pangjur	156	187	40	27
M. Pangjur	150	170	37	25
F. Nag, 27.23° N., 65.9° E.	150	175	38	23
F. Nag	175	190	40	26
M. Mand, Baluchistan, 25.7° N., 62.3° E.	140	175	38	26
M. Khojdar, Baluchistan	155	172	39	25
F. Turbat, Baluchistan	135	172	37	23
M. Turbat	154	185	38	25
<i>Tatera indica indica</i>				
F. Edlabad, Khandesh	165	199	39	24½
M. Edlabad	121	146	39	22½
M. Edlabad	130	170	40	24
M. Edlabad	156	190	39½	24½
F. Edlabad	165	199	39	24.3
F. Edlabad	124	174	39½	23
F. Pachora, Khandesh	133	176	41	23½
M. Pachora	133	152	41	24
M. Pachora	132	150	40	24
M. Mundra, Sangor	145	186	39	23
F. Mundra, Sangor	150	180	37	23
				mammæ 8
F. Erandal	160	142	40	19
F. Jalgaon	165	176	40	21
M. Jamner	186	200	45	22
M. Amalur	176	151	41	22
F. Bhuswal	159	172	40	22
F. Poona	132	170	40	25
M. Poona	137	167	39	22
F. Above Poona, 2,000 ft.	166	180	40	24

TABLE 47.—*External measurements of Tatera indica (contd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Tatera indica indica</i> (concl'd.)				
F. Bhattu Hissar	127	148	35	20
F. Bhattu Hissar	141	179	36	24
F. Chakdulla, Campbellpore	137	174	36	23
F. Jhalar, Campbellpore	144	185	39	23
F. Chakdulla	132	165	35	23
F. Damthal, Kangra	175	193	37	23
M. Damthal	173	175	37	23
M. Damthal	175	182	37	23
F. Damthal	173	190	38	25
			mammae 2-2=8	
M. Rajkot, Kathiawar	173	204	37	22
M. Deesa, Palanpur	150	159	38	24
<i>Tatera indica ceylonica</i>				
M. Mankeni, Ceylon	168	231	47	23½
F. Wellawaya, Uva, Ceylon	160	197	43	23½
M. Maha Oya, East Province, Ceylon	159	203	45	24
M. Maha Oya	179	200	45	25
F. Maha Oya	177	214	44½	24½
M. Maha Oyo	180	211	47	24
M. Hambantota, South Province, Ceylon	170½	202	43	25
F. Hambantota	162	196	42½	25
F. Hambantota	161½	198	42	22½
M. Hambantota	169	?	46	24½
F. Anasigalla, Matugama, Ceylon	173	210	47	24
M. Anasigalla	185	222	45	23
M. Welligatta, Ceylon	160	193	44	24
F. Cinnamon Gardens, Colombo	184	203	43	26
M. Kwantidiya, Matugama	180	215	47	24
<i>Tatera indica hardwickei</i>				
M. Helwak, Satara	181	202	44	25
F. Ghatmatha, Satara	149	170	41	23
M. Gersoppa, Kanara	183	222	44	23
M. Gersoppa	180	222	43½	23
F. Gersoppa	197	215	47	25
F. Dharwar	182	211	43	25
F. Dharwar	190	205	45	23½
F. Dharwar	176	219	42	25
M. Dharwar	197	200	44	24
F. Dharwar	184	213	43	25
M. Hawbshavi, south Dharwar	203	205	42	22
M. Dharwar	200	202	43	24
F. Kardibetta Forest, Mysore	167	189	42	22

TABLE 47.—*External measurements of Tatera indica (concl'd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Tatera indica hardwickei</i> (concl'd.)				
F. Kardibetta Forest	180	218	44½	23
Konkan	162	187	46	25
F. Konkan	171	171	38	23
M. Konkan	145	187	42	22
F. Kolaba district, Konkan	160	?	41	22
M. Konkan	165	174	40	21
M. Sukalwadi, Konkan	152	200	43½	23½
M. Virajpet, South Coorg	194	175	43	25
F. Ghatmatha, Satara	166	209	42	26
<i>Tatera indica cuvieri</i>				
M. Seringapatam, South Mysore	183	210	43	25½
M. Kolar, East Mysore	189	218	44	25
F. Seringapatam	172	223	45	25
F. Kurumbapatti, Salem district	140	193	41	25
M. Kurumbapatti (Eastern Ghats)	156	210	45	25
M. Balapalli, South Cuddapah	149	203	43	25
Shevaroy, Eastern Ghats	153	219	43	25
M. Balapalli (Palkonda Hills)	153	212	43	25
M. Chettiri Range, Salem district	135	226	42	25
M. Chettiri Range	151	213	42	26
F. Shevaroy, Eastern Ghats	147	217	41	25
Kurumbapatti	153	234	43	25
M. Trinchinopoly	146	200	44	20
M. Vijayanagar, Bellary	177	199	43	24
F. Vijayanagar	162	226	40½	24½

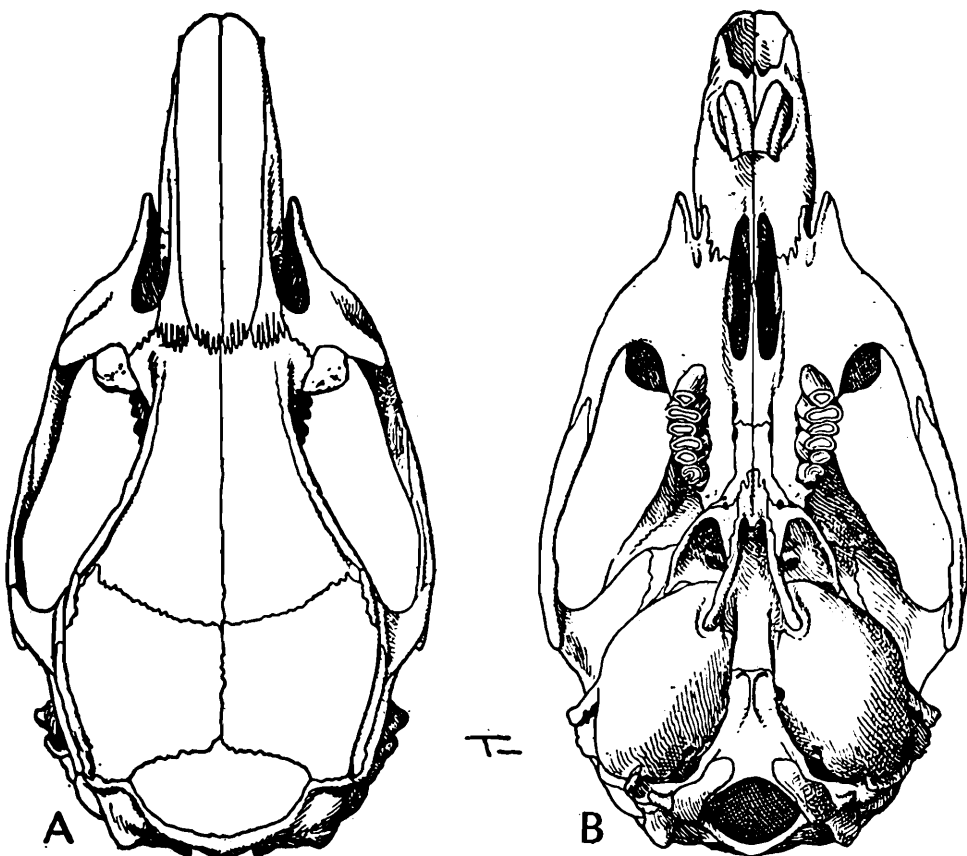
Notes from skins.—

- T. i. ceylonica* : Colombo : trapped in cinnamon gardens.
Mankenì : trapped on edge of jungle.
Anasigalla, Matugama : dug out of an anthill,
seems fairly common; 'Coolies consider them
very good eating'
Welligatta : trapped in open grass.
Mahaoya : trapped in jungle, and trapped by
roadside.
Hambantota : trapped in Palmyra Palm scrub.
- T. i. hardwickei* : Konkan : caught in open lands of red soil.
Kardibetta Forest, Mysore : in small patch of
open country, weight 6¾ oz.
Sukalwadi, Konkan : trapped in a field.
Malwan, Konkan : trapped on the seashore.
Gersoppa, Kanara : weight 7½ oz.
Helwak : weight 7¾ oz.

- T. i. cuvieri* : Seringapatam : weight 8 oz.
 Vijayanagar : weight $3\frac{1}{4}$ oz.
 Masinigudi, Nilgiris : trapped under a hedge near cultivation.
 Seringapatam : weight $4\frac{1}{2}$ oz.
- T. i. indica* : Keshod, Kathiawar : trapped in hedge, weight $6\frac{1}{2}$ oz.
 Talala, Kathiawar : mammae 8; weight $6\frac{1}{2}$ oz.
 Damthal, Kangra : mammae 2-2 = 8.
 Chanda : mammae 8; weight $4\frac{1}{2}$ oz. and 4 oz.
 Mundra, Sangor : weight $4\frac{1}{2}$ oz. ; mammae 8 ; weight 6 oz. and 5 oz.
 Poona : in cactus and rocks by a pond.
 Ramnagar, Kumaon : mammae 8; weight $4\frac{1}{2}$ oz. and 5 oz.
 Deesa, Palanpur : weight 5 oz.
 Dhain, Hoshangabad : trapped on sandy ground ; 8 mammae ; weight $5\frac{1}{2}$ oz.
 Chorepura, Gwalior : weight 4.75 oz.
 Near Ambala, Punjab : sandy soil near cotton crops ; trapped in a cactus hedge.
 Siwal, Nimar : mammae 8; weight 5 oz.
 Tribeni, Nepal Terai : trapped in camp.
 Daltongunj, Bihar : weight 6 oz. and $5\frac{1}{2}$ oz.
 Salbani, Midnipur : weight 7 oz. and 8 oz.
 Thar and Parkar, Sind : trapped in garden.
 Rajkot, Kathiawar : weight $6\frac{3}{4}$ oz. and $7\frac{1}{2}$ oz. ; mammae 8.
 Pilibhit, Rohilkund : mammae 8, weight $4\frac{3}{4}$ oz.
 Vankaneer, Kathiawar : mammae 8; weight $4\frac{1}{2}$ oz.
 Danta, Gujerat : weight $6\frac{1}{2}$ oz. and $6\frac{1}{4}$ oz.
 Palanpur : mammae 8; weight 7 oz.
 Rorighat, Hoshangabad : trapped near cultivation ; weight $5\frac{1}{4}$ oz.
 Asirgarh : trapped in hedge near cultivation ; weight $7\frac{1}{4}$ oz.
 Motimajiti : weight 7 oz.

Cranial characters.—The skull is large in size, and is very generally more than 40 mm. in occipitonasal length. (The largest skull which I have seen, with an occipitonasal of 48.8 mm., is from the Tigris River, Iraq). The nasals are unusually long, over 40% of the occipitonasal with very rare exceptions. The zygomatic plate is immensely thrown

forwards on either side of the rostrum in front of the infra-orbital foramen. The frontals narrowest part is just behind the lachrymals; on either side they are powerfully ridged, but the ridges are much more exaggerated in old specimens than in young ones. The parietals are rather short; their suture with the frontals is nearly straight or but slightly curved, and on either side of the skull there is a tendency for a slight postorbital projection to be present at the junction of the frontals and parietals. Interparietal bone large and well developed, its sutures retained in old individuals. The occiput is well ridged and quite upstanding and strong, and the paroccipital process is well developed. The mastoids do not show when the skull is viewed from above. The bullae, though well inflated for a Murine Rodent, are small for a Gerbilline; in some races they are usually under a quarter of the occipitonasal length, and they are never very much over that figure; perhaps 27% would be the maximum.



TEXT-FIG. 32. *Tatera indica cuvieri* (Waterhouse). A, B, dorsal and ventral views of the skull. ($\times 4$).

They are thus no more inflated in size than in some forms of Australian *Rattus* (Murinae). The hamular processes join

the bullae, and the posterior part of the palate is narrowed and specialized; on either side in front of the bullae is a wide deep space bounded by the pterygoid fossae. A narrow but evident pair of foramina between the toothrows. Anterior palatal foramina large and long (usually roughly 18% of the occipitonasal length or a little less or more). Zygoma narrow, with shortened jugal, the anterior zygoma root broadened, the zygomatic plate ridged above and very powerfully projected forwards, its anterior border curved round to a greater or lesser degree. Mandible with low coronoid process, wide curved space between the angular (which is drawn backwards to a degree) and the condylar processes, and with the lower incisor root visible below the coronoid.

Dental characters.—Upper incisors narrow, markedly opisthodont, clearly one-grooved, and yellow. The upper molars tend to become a series of transverse plates in the adult, but almost always with some trace of cusp spaces; M. 3 small, but at least originally bilaminate, the second lamina very small and reduced; M. 2 with two plates; M. 1 with three, the front one of these single, the second pair with originally spaces for two cusps. There are two folds each side of M. 1 and one each side of M. 2, and there is a distinct tendency for the outer re-entrant folds to be larger than the inner ones, which is the reverse of the case in *Gerbillus*. Sometimes a posteroexternal heel may be traced on the hinder lamina of M. 1. With wear the pattern becomes lost, but the dentition of Asiatic *Tatera* may almost always be distinguished from the allied genera which occur in India by its tendency for the outer folds of the upper molars to be dominant (as well as a general tendency towards complexity which is not seen in *Meriones*.) In several specimens the hinder lamina of M. 2 is clearly biserially cuspidate. In the lower molars, M. 3 appears ring-shaped and very reduced; M. 2 consists of two transverse plates, and M. 1 of three transverse plates. The second lamina in M. 1 is rarely clearly biserially cuspidate. Sometimes signs of this cusping is traceable on some of the other laminae, but apparently not often.

Cranial measurements.—As in Table 48, below.

Dimensions of the species Tatera indica, including all races, in British Museum material.—The occipitonasal length varies between 38.5 and 48.8 mm. Toothrow 4.9–7.3 mm. (only once reaching 7 mm. in over 150 specimens). The head and body length varies between 116 and 203 mm. The tail varies between 115 and 234 mm. Hindfoot 31–47 mm.

TABLE 48.—*Cranial measurement of the Indian races of Tatera indica*

	Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals width
<i>Tatera indica indica</i>							
7.11.24.2 Sind	41.3	21.6	7.9	11.2	5.4	17.0	6.7
7.11.22.13 Khandesh	43.6	23.3	8.6	10.9	6.2	18.8	7.3
7.11.22.7 Khandesh. 4 roots M. 1	41.0	21.3	7.9	10.8	?	17.2	6.3
7.11.22.8 Khandesh	45.6	24.4	8.6	11.5	6.5	19.5	7.4
7.11.22.9 Khandesh	41.7	21.7	8.0	11.2	6.1	18.0	6.9
7.11.22.11 Khandesh	48.1	25.4	9.3	12.2	6.9	20.8	7.6
7.11.22.2 Khandesh	42.1	23.0	8.2	10.4	6.2	19.5	7.2
M. 8.1.22.1 Edlabad, Khandesh. Young	38.7	19.4	6.5	10.0	5.7	15.7	6.8
F. 8.1.22.4 Edlabad, Khandesh	circa 39.6	20.6	7.4	10.7	6.1	?	7.2
10.2.8.1 Edlabad, Khandesh	43.6	23.2	8.5	11.2	6.1	19.0	7.5
F. 10.2.8.2 Edlabad, Khandesh	44.0	23.2	8.2	10.8	6.1	19.4	7.5
F. 10.2.8.3 Edlabad, Khandesh	42.2	22.9	8.2	10.3	6.2	18.8	7.1
10.2.8.4 Pachora, Khandesh	44.6	23.2	8.3	11.6	6.3	20.4	7.1
F. 10.2.8.5 Pachora, Khandesh	46.7	24.1	8.7	12.1	6.3	19.8	8.1
M. 12.6.28.21 Asirgarh, Nimar	45.4	23.1	8.7	11.7	6.3	19.1	7.9
F. 12.6.28.22 Asirgarh, Nimar	42.4	21.8	8.0	10.5	6.1	18.1	7.3
M. 12.11.29.104 Mundra, Sangor	43.7	22.6	7.8	11.1	6.1	19.4	7.8
M. 12.11.29.105 Mundra, Sangor	41.5	21.7	7.9	10.9	6.1	17.7	7.5
F. 12.11.29.106 Mundra, Sangor	41.5	21.9	8.1	10.7	6.0	18.3	7.2
F. 12.11.29.107 Mundra, Sangor	42.4	22.7	8.2	10.8	5.9	18.7	7.5
M. 12.11.29.108 Hoshangabad	44.0	22.5	7.9	10.3	6.2	19.6	6.6
F. 12.11.29.109 Hoshangabad	43.7	23.1	7.9	10.5	6.3	18.4	6.4
F. 12.11.29.110 Chanda, C.P.	41.5	21.4	7.7	11.1	?	17.2	7.2

TABLE 48.—*Cranial measurements of Tatera indica (contd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals width
<i>Tatera indica indica (contd.)</i>								
F.	12.11.29.111	40.1	20.1	7.3	10.6	5.7	15.7	7.1
	Chanda							
M.	13.8.8.56	44.8	23.8	9.1	11.3	5.7	18.5	6.8
	Rajkot, Kathiawar.		Old					
M.	13.8.8.57	44.3	23.7	8.7	11.5	c. 6.1	19.1	7.1
	Rajkot, Kathiawar							
M.	13.8.8.58	45.0	23.3	8.2	11.4	6.4	19.7	7.6
	Rajkot							
F.	13.8.8.59	42.4	22.3	7.9	10.5	6.3	17.4	6.6
	Rajkot							
M.	13.8.8.60	44.3	23.5	8.2	11.4	5.7	18.7	6.5
	Motimajiti, Kathiawar							
M.	13.8.8.61	43.8	23.0	8.7	11.1	?	18.8	7.3
	Motimajiti							
F.	13.8.8.62	44.2	23.4	8.6	11.5	6.0	18.2	7.1
	Talala, Junagadh, Kathiawar							
F.	13.8.8.63	42.0	21.9	7.7	10.7	5.9	17.4	7.3
	Vankaneer, Kathiawar							
M.	13.9.18.56	44.6	23.1	8.0	11.7	5.8	18.2	7.1
	Danta, Gujarat							
M.	13.9.18.57	44.2	23.0	8.2	11.7	?	18.7	7.3
	Danta, Gujarat							
F.	13.9.18.58	42.6	22.1	7.5	11.6	5.8	18.0	6.8
	Palanpur							
M.	13.9.18.59	42.0	?	7.5	11.2	6.1	16.8	6.2
	Deesa, Palanpur							
F.	14.7.10.89	41.3	21.5	7.4	10.6	c. 6.1	17.3	6.5
	Pilibhit, Rohilkund, Kumaon							
M.	14.7.10.90	41.8	22.2	7.5	10.0	5.8	17.0	6.8
	Ramnagar							
M.	14.7.10.92	40.2	21.4	7.0	10.5	5.9	16.3	7.3
	Ramnagar							
F.	15.7.2.14	43.8	22.4	7.4	11.3	6.2	c. 19.5	7.0
	Chorepura, Gwalior							
M.	15.4.3.84	43.6	22.5	8.5	10.5	6.1	19.0	6.8
	Daltongunj, Bengal							
F.	15.4.3.86	46.4	24.2	9.1	11.4	6.6	19.9	7.5
	Daltongunj							
M.	15.4.3.87	46.8	24.4	8.8	11.4	?	19.8	6.9
	Midnapur, Bengal							
M.	19.6.3.52	40.0	21.1	7.5	10.3	5.8	17.3	6.8
	Poona							
F.	19.3.6.55	42.3	21.6	8.3	11.2	5.7	18.6	7.4
	Poona. Old							
F.	25.6.10.22	41.5	21.5	7.5	11.2	?	18.0	6.9
	Kotri, Sind. Old, teeth worn out							
F.	25.6.10.20	40.3	21.8	7.3	11.7	5.6	16.4	6.5
	Jhalhi, NW. Punjab							

TABLE 48.—*Cranial measurements of Tatera indica (contd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals width
<i>Tatera indica indica (contd.)</i>								
	56.5.6.86	46.5	24.5	9.5	12.3	6.5	19.0	7.8
	'Kashmir' (?). Old							
	79.11.21.504	41.3	21.8	7.7	c. 11.7	6.6	18.1	6.5
	Mussoorie							
M.	80.11.11.17	42.0	22.2	8.1	10.8	6.2	17.8	6.7
	Palamoa.—?							
	88.6.18.16	41.8	22.6	8.0	11.4	5.3	17.7	7.3
	Much, Bolon Pass.—?							
	91.10.7.103	43.5	22.6	8.2	?	5.8	19.7	6.9
	Kohistan							
F.	15.3.4.85	45.0	23.6	8.8	10.7	6.1	19.4	7.2
	Daltongunj, Bengal							
Frost collections—								
M.	11	44.1	22.8	8.0	11.4	6.0	18.7	7.3
	Panoaqil, Sind							
F.	5	39.8	20.8	7.7	10.8	5.9	17.0	6.7
	Gulamjo Goth, Sind							
F.	14	43.1	22.1	c. 8.0	11.1	5.6	18.4	6.8
	Panoaqil							
F.	15	41.2	21.5	7.5	11.1	6.0	17.2	6.7
	Panoaqil							
M.	20	42.0	21.4	8.0	11.3	5.5	17.4	7.0
	Panoaqil							
M.	21	41.5	21.3	8.0	11.4	5.5	17.3	6.7
	Panoaqil							
M.	22	38.7	19.9	6.8	10.3	5.4	15.2	6.6
	Panoaqil							
	23	38.5	?	7.4	10.3	5.4	16.0	6.5
	Panoaqil							
F.	24	40.2	21.0	8.0	10.4	5.5	17.7	7.0
	Panoaqil							
The following were identified as <i>T. i.</i> 'sherrini'.								
	7.11.24.1	40.4	21.7	7.8	11.1	5.4	16.7	6.7
	Thar and Parkar, Sind							
M.	15.11.1.89	41.3	21.7	7.8	11.1	5.5	17.3	6.8
	Jacobabad, Sind							
M.	15.11.1.90	42.3	22.3	7.8	12.1	5.7	17.2	6.6
	Jacobabad							
F.	15.11.1.93	42.1	21.9	7.6	11.8	5.2	18.4	7.4
	Sukkur, Sind							
M.	19.11.8.41	43.2	22.8	7.8	11.6	5.5	19.2	6.6
	Las Bela, Baluchistan							
F.	15.11.1.91	38.5	20.3	7.5	10.8	5.1	16.3	6.5
	Jacobabad, Sind							

TABLE 48.—*Cranial measurements of Tatera indica (contd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals width
<i>Tatera indica indica</i> (concl'd.)								
F.	15.11.1.92 Jacobabad	39.7	20.6	7.1	11.1	4.9	17.2	6.6

The type of '*sherrini*' has the occipitonasal length about 41.5 mm.

The following were identified as *T. i.* '*dunni*'.

M.	8.3.3.2 Handisera, Punjab	41.9	21.5	7.5	10.9	5.9	18.2	7.3
M.	8.3.3.3 Handisera	39.8	20.9	7.2	11.3	6.1	16.6	7.0
F.	8.3.3.4 Handisera	41.2	21.8	7.8	10.4	5.7	15.9	?
M.	9.4.6.11 Ambala, Punjab; paratype	41.4	21.9	7.5	11.3	5.9	17.1	6.5
M.	9.4.6.12 Ambala	39.8	21.1	7.5	10.3	5.6	15.7	6.4

The type of '*dunni*' has the occipitonasal about 43.5 mm.

Tatera indica indica ('*persica*')

M.	19.11.7.30 Turbat, Baluchistan	43.8	23.1	8.1	11.5	6.5	18.3	6.5
M.	19.11.7.31 Turbat	43.4	22.6	7.5	12.6	6.2	17.1	7.5
F.	19.11.7.32 Turbat	43.1	21.8	7.9	11.7	5.8	18.3	7.0
M.	19.11.7.33 Mand, Baluchistan	43.5	22.4	7.6	c. 11.7	?	18.6	6.6
M.	19.11.7.34 Dagja, Baluchistan	44.1	23.1	8.2	12.2	6.1	19.1	6.9
M.	19.11.7.35 Turbat, Baluchistan.	47.2	24.6	8.5	12.5	6.4	20.1	7.4
M.	19.11.7.37 Pangjur, Baluchistan	45.4	23.2	7.5	12.0	6.0	19.8	7.1
M.	19.11.7.39 Pangjur	42.2	21.7	7.8	11.0	5.8	18.1	6.8
F.	19.11.7.39 Pangjur	41.7	21.7	7.1	11.7	5.9	17.8	6.7
M.	19.11.8.40 Khojdar, Baluchistan	44.5	23.4	7.8	12.4	6.3	18.2	7.4
F.	19.11.7.40 Pangjur, Baluchistan	45.3	24.1	8.4	12.0	6.6	19.3	7.3
F.	19.11.7.41 Pangjur	44.3	22.9	7.7	12.5	5.7	18.8	7.3
F.	19.11.7.42 Pangjur. Old. Teeth worn out	46.4	24.1	8.3	12.2	?	21.6	7.6

TABLE 48.—*Cranial measurements of Tatera indica (contd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals width
<i>Tatera indica indica</i> (' <i>persica</i> ') (concl'd.)								
F.	19.11.7.44	43.7	22.4	8.2	11.6	5.7	18.7	6.7
	Nag, Baluchistan							
F.	19.11.7.45	47.1	25.1	9.1	11.9	6.8	21.3	7.6
	Nag							
M.	19.11.7.36	48.5	24.2	8.8	12.5	6.4	22.0	7.7
	Pangjur, Baluchistan. Old							

From these figures it appears that the race might stand on average largish bullae (over 12 mm. in half of these above); but the above skulls contain a certain proportion of very old specimens. The race was named from Persia, and in six other skulls from Persia, the bullae do not reach 12 mm. nor does the occipitonasal length reach 45 mm.

Tatera indica cuvieri

F.	11.7.18.9	40.2	20.6	7.2	9.3	6.1	16.6	6.6
	Venguela, Konkan.							
	(Perhaps represents <i>hardwickei</i> , skin not traced)							
M.	13.4.10.58	45.0	22.8	7.8	10.4	6.5 c.	19.5	7.6
	Vijayanagar, Bellary							
F.	13.4.10.59	40.2	20.9	7.0	10.3	5.8	16.8	6.7
	Vijayanagar							
F.	13.4.10.60	42.8	21.6	7.5	10.6	5.7	17.8	6.8
	Vijayanagar							
F.	13.4.10.61	41.7	21.7	7.8	9.9	6.1	17.8	7.1
	Vijayanagar							
M.	13.4.11.63	44.0	22.6	7.8	10.2	6.5	18.9	7.5
	Seringapatam, South Mysore							
F.	13.4.11.64	45.2	23.6	8.2	10.5	6.4	19.1	6.7
	Seringapatam. Old							
M.	13.4.11.65	42.9	22.1	7.7	10.6 c.	5.8	17.9	7.3
	Kolar, South Mysore							
F.	13.4.11.66	43.4	22.6	8.0	11.1	6.5	18.0	7.0
	Kolar, Mysore							
	89.1.29.1	39.8	20.7	7.1	10.4	5.7	16.0	7.1
	Kadapa, Madras							

Tatera indica hardwickei

F.	11.1.16.12	43.5	23.0	9.1	11.0	6.0	17.8	7.3
	Konkan, Bombay							
M.	11.7.18.8	43.3	21.7	7.9	10.6	6.1	19.7	7.1
	Sukalwadi, Konkan							
F.	12.5.1.3	42.3	22.4	8.7	10.4	6.2	17.5	6.6
	Malwan, Konkan							
M.	12.6.29.64	46.2	24.4	9.1	10.1	6.5	19.7	6.8
	Dharwar district							
M.	12.6.29.66	47.1	24.0	9.2	10.2	6.6	20.1	6.9
	Dharwar district							

TABLE 48.—*Cranial measurements of Tatera indica (contd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals width
<i>Tatera indica hardwickei</i> (concl'd.)								
F.	12.6.29.67	46.1	23.7	9.0	10.8	6.7	19.7	6.9
	Dharwar district							
F.	12.6.29.68	47.4	24.5	8.9	12.0	6.9	21.1	7.3
	Dharwar district. Old							
F.	12.6.29.69	46.0	24.1	8.9	11.4	6.4	19.9	7.4
	Dharwar district							
	12.6.29.70	47.5	25.0	8.8	10.8	6.7	20.8	7.0
	Dharwar district							
M.	12.11.28.89	47.2	24.5	9.4	11.1	6.5	20.2	7.9
	Gersoppa, North Kanara							
M.	12.11.28.90	c. 43.3	22.7	8.7	10.7	5.7	?	6.8
	Gersoppa, North Kanara							
M.	12.11.28.91	47.1	24.5	9.0	11.2	6.6	20.5	7.6
	Gersoppa, Kanara							
F.	12.11.28.92	47.7	25.2	10.1	11.1	6.3	21.1	7.5
	Gersoppa, Kanara							
M.	12.11.28.93	42.8	22.3	8.6	9.0	6.2	17.9	7.1
	Kardibetta forest, Mysore							
	12.11.28.94	45.2	23.9	8.7	10.7	6.1	18.7	7.5
	Kardibetta forest, Mysore							
M.	12.11.28.95	42.0	21.7	7.5	10.1	6.4	17.7	6.7
	Kardibetta forest							
F.	12.11.28.96	42.0	22.2	7.9	c. 9.8	6.5	17.2	7.4
	Kardibetta forest							
M.	13.8.22.68	47.4	24.5	9.3	11.2	6.6	18.9	7.3
	Virajpet, Coorg							
M.	15.7.3.36	46.5	24.3	9.2	10.5	6.4	20.1	7.8
	Ratnagiri district							
M.	15.7.3.37	46.5	23.6	9.1	10.9	c. 5.8	19.3	7.5
	Satara district							
F.	15.7.3.38	45.9	24.5	9.4	10.7	6.6	19.8	7.5
	Satara district							
F.	15.7.3.39	44.7	22.7	8.8	10.2	6.3	19.4	6.8
	Ghatmatha, Satara							
	551c	47.4	25.5	9.3	11.3	6.6	20.8	7.3
	Mahratta							
<i>Tatera indica ceylonica</i>								
M.	15.3.1.132	46.1	23.3	7.6	11.3	6.0	19.7	7.5
	Mankeni, Ceylon							
F.	15.3.1.133	46.3	23.7	8.2	11.1	5.7	20.5	?
	Ceylon. Old							
M.	14.3.1.134	48.2	24.1	8.4	?	6.1	c. 20.5	7.7
	Welligatta, Ceylon							
F.	15.3.1.135	46.4	23.3	8.0	11.2	6.6	19.8	8.0
	Ceylon. (The foramina measurement represents the longer side)							

TABLE 48.—*Cranial measurements of Tatera indica (concl'd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Nasals	Frontals width
<i>Tatera indica ceylonica</i> (concl'd.)								
M.	15.3.1.136 Ceylon	46.3	24.0	8.0	10.3	6.2	19.6	7.8
M.	15.3.1.137 Hambantota, Ceylon	46.1	22.9	8.2	10.8	6.0	19.9	8.1
F.	15.3.1.138 Ceylon	45.0	22.3	7.8	10.2	5.5	19.1	7.5
F.	15.3.1.139 Hambantota	44.6	22.4	7.5	10.5	6.5	18.7	8.1
M.	15.3.1.140 Maha-oya, Ceylon	46.3	23.7	8.3	10.9	6.6	20.4	8.1
M.	15.3.1.141 Maha-oya	45.8	23.7	8.4	10.8	5.9	19.5	7.7
M.	15.3.1.142 Maha-oya	44.4	23.1	8.1	10.8	6.1	19.0	7.2
F.	15.3.1.143 Maha-oya	46.7	23.4	7.9	11.5	6.5	18.7	8.2
M.	20.5.1.16 Anasigalla, Matugama, Ceylon	46.6	23.9	8.6	11.2	6.5	20.4	7.5
M.	20.5.1.17 Anasigalla	43.7	21.8	7.5	10.5	5.6	19.1	8.2
F.	20.5.1.18 Anasigalla	46.2	24.0	8.0	11.0	5.9	19.8	7.7
M.	20.9.26.48 Matugama, Ceylon, 4 roots M. 1	46.8	? c.	8.2	11.2	?	19.9	8.4

The type has the occipitonasal length about 43.9 mm.

The Indian races of Tatera indica may be provisionally keyed as follows :—

- 1 (2) Hindfoot rarely reaching 41 mm. in length. (This measurement is reached seven times in 145 skins.) At least in the adult specimens, the hindfoot is less than a quarter of head and body in the majority. The tail is on average less than 120% of the head and body. The bullae average more than a quarter of the occipitonasal length.
- 2 (1) Hindfoot rarely as low as 41 mm. (The exceptions number seven out of 52 skins; of these three are below it.) The bullae are small, averaging less than a quarter of the occipitonasal in length. . .

T. i. indica (including
'persica', 'sherrini'
'and dunnii')

3	(4)	The hindfoot is usually less than a quarter of the head and body length. The tail averages less than 120% of the head and body.	<i>T. i. hardwickei</i>	
4	(3)	The hindfoot is usually more than a quarter of the head and body length. The tail averages 120% or more of the head and body length		5
5	(6)	The length of the tail approximates to 120% of the head and body. Occipitonasal length usually more than 45 mm..	<i>T. i. ceylonica</i>	
6	(5)	The length of the tail usually exceeds 130% of the head and body. Occipitonasal length rarely reaches 45 mm..	<i>T. i. cuvieri</i>	

Wroughton divided this species into six races (species of that author) based on colour, but it becomes very clear when all duplicates are looked through together that not one of his supposed colour characters can stand, as individuals in the typical race will completely bridge the gulf between 'sherrini', 'dunni', 'persica', etc.; or in other words there are many specimens referable to *indica* which are just as 'drab grey' as 'sherrini' is supposed to be, and just as 'pinkish buff' as 'dunni' is supposed to be. Nor, in my opinion, can 'persica' be retained on colour. The latter does on the whole seem to tend to be possibly slightly thicker-furred and possibly slightly paler than is usual in *indica*, but as usual there are individuals which could be referred to either, and it grades into types like 'dunni'. On external measurements, and on some cranial characters, the earlier named races and the Ceylon race may, apparently, be retained. The three southern races, *hardwickei*, *ceylonica* and *cuvieri*, do not differ from each other in colour, contrary to Wroughton's statements, any more than do the northern *indica*, 'sherrini' and 'dunni', when all available specimens are seen.

(i) *Tatera indica indica* (Hardwicke)

1807. *Dipus indicus* Hardwicke, *Trans. Linn. Soc. Lond.*, 8, 279.
 1838. *Gerbillus otarius* Cuvier, *Trans. Linn. Soc. Lond.*, 2, 144.
 1906. *Tatera persica* Wroughton, *Ann. Mag. nat. Hist.*, 17, 477, 496. Seistan, Persia.
 1917. *Tatera sherrini* Wroughton, *J. Bombay nat. Hist. Soc.*, 25, 1, 43. Jacobabad, Sind.
 1917. *Tatera dunni* Wroughton, *J. Bombay nat. Hist. Soc.*, 25, 1, 43. Ambala, Punjab.

Type-locality.—Between Benares and Hardwar, United Provinces.

Range.—Specimens examined from *Persia: Chahabar, Seistan, Dagja; BALUCHISTAN: Khojdar, Mand, Nag, Pangjur, Turbat ('*persica*'). Las Bela in BALUCHISTAN, and SIND, Jacobabad, Sukkur, Shikarpur, Thar and Parkar ('*sherrini*'). PUNJAB: Handisera, near Ambala; Madhopur, Kallarkahar, Ara, Chakri, Dhalwal, Gandhala, Mogri, Rohtas, Sakesar, in the Salt Range ('*dunni*'). For *indica*, localities are: KUMAON, Dela, Mussoorie, Rohilkund, Ramnagar. NEPAL TERAI: Hazaria, Tribeni. PUNJAB: Dhamtal, Jhalki, Campbellpore (Jhalar and Chakdulla). KATHIAWAR: Junagadh, Keshod, Motimajiti, Talala, Rajkot, Vankaneer. GUJERAT: Deesa, Danta, Palanpur. SIND: Kotri, Panoaqil, Gulamjo Goth. GWALIOR, Chorepura. BIHAR: Daltongunj, Midnipur, Salbani. CENTRAL PROVINCES: Chanda, Asirgarh (Nimar), Sival, Rorighat, Hoshangabad, BOMBAY: Edlabad, Khandesh, Pachora, Khandesh, Mundra, Sangor, Poona, Dhain, Hoshangabad. Ahmadnagar. CUTCH, Mandra. Also the following localities, not traced at the time of writing: Bhattu Hissar, Jalgaon, Jamner, Amalur, Bhuswal. (One skull labelled '*Kashmir*', but I doubt this locality.)

Head and body 116–189 mm. Tail 115–215 mm. Hind-foot 31–45 mm. but rarely reaching 41 mm. (7 skins only out of 145). More often than not the hindfoot is below a quarter of the head and body length. Tail averages less than 120% of the head and body. Bullae largish, averaging more than a quarter of the occipitonasal length.

(ii) *Tatera indica hardwickei* (Gray)

1843. *Gerbillus hardwickei* Gray, *List. Mamm.*, 132.

Type-locality.—Dharwar.

Range.—Specimens examined from BOMBAY: Mahratta, Ghatmatha, Satara, and Helwak. Ratnagiri, Gersoppa, Kanara. Dharwar and Habwshavi. MYSORE, Kardibetta Forest. COORG: Virajpet, Kolaba district, Konkan. Malwan and Sukalwadi, Konkan.

Head and body 149–203 mm. Tail 170–222 mm. Hind-foot 38–47 mm., but only twice under 41 mm. in material available. Most often the hindfoot is less than a quarter of the head and body length, and the tail is less than 120% of head and body. Bullae small, averaging less than a quarter of the occipitonasal length. The skull tends to be larger than in *indica*, occipitonasal length in most specimens reaches 45 mm., whereas in the typical race, this measurement is not often reached.

(iii) **Tatera indica ceylonica** Wroughton

1906. *Tatera ceylonica* Wroughton, *Ann. Mag. nat. Hist.*, **17**, 477, 499.

Type-locality.—Ceylon.

Range.—Specimens examined from CEYLON: Anasigalla, Colombo, Hambantota, Kwantidiya, Maha-oya, Mankeni, Wellawaya, Welligatta.

Head and body 159–185 mm. Tail 193–231 mm. Hind-foot $42\frac{1}{2}$ –47 mm. The hindfoot usually more than a quarter of the head and body length in specimens examined. The tail averages about 120% of the head and body. The bullae relatively small, as in the last race. Size of skull large; occipitonasal length, as in *hardwickei*, most often about 45 mm., or more.

(iv) **Tatera indica cuvieri** (Waterhouse)

Text-fig. 32

1838. *Gerbillus cuvieri* Waterhouse, *Proc. zool. Soc. Lond.*, 56.

Type-locality.—Arcot, Madras.

Range.—Specimens examined from EASTERN GHATS: Salem district, Shevaroy Hills, Kurumbapatti, Balapalli Range. SOUTH INDIA: Trinchinopoly; Kolar and Seringapatam, Mysore; Kadapa, Madras; Vijayanagar, Bellary. Arcot, Madras. Nilgiri Hills (Masinigudi, 3,500 ft.).

Head and body 135–189 mm. Tail 193–234 mm. Hind-foot $40\frac{1}{2}$ –45 mm., but only once under 41 mm. and usually exceeding that measurement. The foot is usually more than a quarter of the head and body length. The tail seems proportionately longer than in other races, usually exceeding 130% of the head and body. The bullae are small, averaging less than a quarter of the occipitonasal length; the majority of the specimens do not reach 45 mm. in occipitonasal length. This is the second named race referable to the species.

Genus 24. **Meriones** Illiger

1811. *Meriones* Illiger, *Prodr. Syst. Mamm.*, 82.

1919. *Cheliones* Thomas, *Ann. Mag. nat. Hist.*, **3**, 265. *Gerbillus hurrianæ* Jerdon. Valid as a subgenus.

1933. *Pallasiomys* Heptner, *Z. Säugt.*, **8**, 150. *Gerbillus erythrorus* Gray. Valid as a subgenus.

1937. *Parameriones* Heptner, *Bull. Soc. nat. Moscou, Biol.*, **46**, 190. *Gerbillus persicus* Blanford. Valid as a subgenus.

1947. *Sekeetamys* Ellerman, *Proc. zool. Soc. Lond.*, **117**, 270, 271. *Gerbillus calurus* Thomas from Sinai. Valid as a subgenus.

Type-species.—*Mus tamariscinus* Pallas, from the Ural River district, Kazakstan.

Distribution.—North Africa, from Morocco, Algeria, Libya, Egypt, south to the Sudan and Asben. South-West Asia, from Arabia, Israel, Syria, Asia Minor, Persia, Afghanistan. INDIAN TERRITORY: NORTH-WEST FRONTIER, BALUCHISTAN, PUNJAB, RAJPUTANA, KATHIAWAR, GUJERAT, SIND and CUTCH. Russian territory: Caucasus, common through Russian Turkestan, and in Transbaikalia. China: from Sinkiang, Mongolia, and states of Chihli, Kansu, Shensi and Shansi; Manchuria.

This genus contains gerbils in which the molars are strictly simple-prismatic in type apparently throughout life, and show no signs of cusps. It is the second name of generic value in the subfamily in Asia, being only antedated by *Gerbillus*.

There are about a dozen species of this genus. Four of them reach India, but three of them only occur west of the Indus River.

Typical *Meriones* is based on *M. tamariscinus* Pallas. This does not reach India, but is mainly Russian in distribution (Caucasus and Turkestan), with an allied species *M. blackleri* in Asia Minor, Syria and Persia. Characters for the typical subgenus, compared with those subgenera here dealt with, are: soles of hindfoot hairy, compare *Parameriones*; ear longer, over one-tenth of head and body length, and claws of manus less prominent, compare *Cheliones*; bullae small, averaging 28% or less of the occipitonasal length in our material, compare *Pallasiomys*.

The other species will be discussed below.

Key to the Indian subgenera of Meriones

- 1 (2) The ear reduced, less than one-tenth of the head and body length. Foreclaws enlarged. Skull somewhat bowed down anteriorly. (Sole partly haired. Bullae small, less than one-third of occipitonasal length). *Cheliones*
- 2 (1) The ear large, over one-tenth of head and body length. Foreclaws less prominent. Skull not bowed down anteriorly.

- 3 (4) Soles of hindfeet naked. The bullae small, usually below 31% of occipitonasal length. . . . *Parameriones*
- 4 (3) Soles of hindfeet hairy. The bullae large, in Asiatic species averaging more than 31% of the occipitonasal length. . . . *Pallasiomys*

Subgenus (*a*) **Cheliones** Thomas

1919. *Cheliones* Thomas, *Ann. Mag. nat. Hist.*, 3, 265.

Based (as a genus) on *Meriones hurrianae* and containing only that species. I reduced the group to subgeneric rank in my last volume (1949) on the rodents and I think that status is correct.

The species is characterized by its somewhat fossorial modifications. Briefly, it may be summed up as standing apart from other species of *Meriones* by its reduced ear, which is under one-tenth of the head and body length in almost every one of the numerous specimens examined; the foreclaws are prominent; the skull is shaped rather differently from other Indian species, as indicated in the key above, and the bullae are, for a member of the present genus, small, as in the type-species. The sole is hairy, at least in part.

55. **Meriones hurrianae** (Jerdon)

The Indian Desert Gerbil

1867. *Gerbillus hurrianae* Jerdon, *Mamm. India*, 186.

1919. *Cheliones hurrianae collinus* Thomas, *J. Bombay nat. Hist. Soc.*, 26, 726. (Kohat, North-West Frontier Province, 1,000–1,700 ft.)

Type-locality.—Hissar, Punjab.

Range.—Specimens examined from SIND: Chalchra, Habb Valley, Thar and Parkar, Gambat, Kotri, Mirpur, Sukkur, Virawar, Umankot. CUTCH: Bhuj, Chalwar, Chitrod, Nokania, Rhodamotha. KATHIAWAR: Dhrangadhra, Muli, Motimajiti, Sadla. GUJERAT: Danta, Palanpur. RAJPUTANA: Chajli, Ding. The type-locality.

For '*collinus*', localities are Persia: Chahabar. Afghanistan: Attock. BALUCHISTAN: Dasht, Nal, Wadh. Chambar. NORTH-WEST FRONTIER: Kohat.

Distribution.—From CUTCH, KATHIAWAR, RAJPUTANA and GUJERAT northwards to RAJPUTANA, the PUNJAB?, BALUCHISTAN, NORTH-WEST FRONTIER, just over the border into Afghanistan and Persia.

With characters as indicated above. Tail most often, but not always, shorter than head and body length.

External characters.—Moderately large, head and body normally over 100 mm. Fur short and ear short. The tail is rather short, being most often shorter than the head and body, and the soles are hairy, at least in part. The ear is almost always less than one-tenth of the head and body length, a rare character in the genus. The fur is very short and harsh compared with other Indian species of *Meriones*. The tail is well haired and tufted to a degree, essentially as in *M. l. erythrourea* in appearance. Hand with four well developed fingers and a small thumb; the four main digits bear very prominent claws which are considerably enlarged compared with the other species (though not as compared with some really subterranean rodents). The thumb bears a small claw. Hindfoot with well developed claws, the proportions of the digits about as in *M. persicus*; sole well haired as a rule, but some specimens have the hairiness of the sole but little developed, and there are usually some bare patches, as on the heel. Mammae 8.

Colour.—Above light brownish grey. Some specimens tend to be reddish brown, but these are in the minority. Feet light brown to whitish. Underparts vary from pale yellow through dirty white to nearly pure white. Tail wholly yellow basally and usually below, but above with usually a black tuft at the end, this black colouring continuing forward as a narrow line along the terminal part of the tail above for a greater or lesser degree.

External measurements.—As in Table 49, below.

TABLE 49.—*External measurements of Meriones hurrianæ*

	Head and body	Tail	Hind- foot	Ear	
<i>Meriones hurrianæ</i>					
	Palanpur	124	124	29	10
F.	Palanpur	123	109	27	9 mammae 8
M.	Palanpur	136	?	29	10
F.	Palanpur	119	110	27	10 mammae 8
M.	Palanpur	109	110	27	9
F.	Palanpur	122	107	28	10 mammae 8
F.	Palanpur	123	121	28	10
M.	Palanpur	131	121	29	11
M.	Palanpur	116	120	28	10
M.	Mirpur, Sukkur,				
	Sind	106	100	30	12
	Gambat, Khairpur,				
	Sind	120	116	30	10

TABLE 49.—*External measurements of Meriones hurrianæ (contd.)*

	Head and body	Tail	Hind- foot	Ear	
<i>Meriones hurrianæ</i> (contd.)					
M. Thar and Parkar district, Sind	129	118	29	8	
M. Virawar, Sind	98	71	19	8	
F. Gambat	118	135	30	11	
M. Sukkur	123	112	29	11	
F. Mirpur, Sukkur	132	110	30	11	
F. Kotri, Sind	129	155	33	12	
M. Mirpur, Sukkur	123	135	31	12	
F. Mirpur	130	?	30	12	
Chalchra, Thar and Parkar	127	117	27	10	
F. Gambat, Khairpur	130	108	34	12	
F. Gambat, Khairpur	133	130	32	11	
F. Kotri, Sind	128	164	33	12	
F. Gambat	110	130	30	11	
F. Gambat	120	157	30	11	
F. Gambat	143	123	30	12	
M. Dhrangadhra, Kathiawar	119	110	28	9	
M. Muli, Kathiawar	118	114	29	10½	
F. Dhrangadhra	122	118	28	10	mammæ 8
M. Dhrangadhra	130	117	28	11	
M. Muli	112	119	29	10	
M. Dhrangadhra	120	116	27	9	
F. Sadla, Kathiawar	113	102	27	10	mammæ 8
M. Motimajiti, Kathiawar	128	119	28	10	
F. Dhrangadhra	118	113	28	10	mammæ 8
M. Nokania, Cutch	123	106	29	10	
M. Chalwa, Cutch	116	120	31	10	
F. Rhodamotha, Cutch	111	108	27	9	mammæ 8
F. Rhodamotha	122	122	30	10	mammæ 8
F. Bhuj, Cutch	115	112	27	11	mammæ 8
M. Chitrod, Cutch	113	109	29	10½	
F. Chitrod	110	114	28	10½	mammæ 8
Rhodamotha, Cutch	124	116	27	9	
M. Danta, Gujarat	118	115	27	11	
F. Danta	123	113	27	9	mammæ 8
M. Ding, Rajputana	140	122	30	10	
M. Chajli, Rajputana	125	111	23	10	
M. Ding	140	112	30	10	
M. Ding	122	115	38	10	
Frost collections—					
F. Umankot, Sind	110	105	27	10	
M. „	115	127	27	10	
F. „	100	110	27	10	
M. „	115	120	28	10	
M. „	115	125	25	10	
M. „	125	140	30	10	

TABLE 49.—*External measurements of Meriones hurrianae (concl'd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Meriones hurrianae (concl'd.)</i>					
F.	Umankot, Sind	115	112	29	10
F.	"	115	110	28	10
F.	"	115	115	28	10
F.	"	115	112	28	10
F.	"	115	?	28	10
M.	"	115	?	28	10
F.	"	110	100	29	10
F.	"	110	115	28	10
M.	"	140	125	29	10
F.	"	120	100	28	10
F.	"	120	120	27	10
M.	"	120	110	29	10
F.	"	110	128	26	10
M.	"	125	?	29	10
<i>Meriones hurrianae ('collinus')</i>					
	Chambar, Baluchistan, 26.8° N., 64.42° E.	125	130	33	12
M.	Wadh, Baluchistan	128	142	32	12
F.	Nal, Baluchistan, 27.4° N., 66.13° E.	127	128	32	12
M.	Chambar	134	148	33	12
F.	Wadh, 27.20° N., 64.20° E.	120	130	32	11
M.	Nal	135	142	34	13

Notes from skins.—

Near Peshawar : 'edge of cultivation, sandy soil'

Kohat : 'shot in cultivation'.

Chalwar, Cutch : weight 3 oz. From sandy plain.

Chajli, Rajputana : in sandy soil, seen in daytime.

Ding, Rajputana : shot in sandy soil; over burrows; and by daylight.

Palanpur : mammae 8 in four specimens; weight varies between $2\frac{1}{8}$ oz., $2\frac{3}{8}$ oz.; $2\frac{1}{2}$ oz., $2\frac{3}{4}$ oz., 3 oz., $3\frac{1}{4}$ oz., and $3\frac{1}{2}$ oz.

Danta, Gujerat : mammae 8; weight 2.75 oz.

Chitrod, Cutch : weight $2\frac{1}{2}$ and $2\frac{1}{4}$ oz., mammae 8.

Nokania, Cutch : weight 2.75 oz. Bhuj, mammae 8, weight 2 oz.

Rhodamotha : mammae 4 pairs; weight $2\frac{1}{4}$ oz. and 3 oz.

Dhrangadhra, Kathiawar : mammae 8 (two specimens).

Weights, respectively, $2\frac{1}{2}$ oz., $2\frac{5}{8}$ oz., $2\frac{3}{4}$ oz. and 3 oz.

Sadla, Kathiawar : mammae 8; weight 2.25 oz. Muli, weight 2 oz. and 2.75 oz. Motimajiti, weight $3\frac{1}{2}$ oz.

Thomas in 1919 divided the north-western specimens of this species as a race *M. h. collinus*, on colour characters, chiefly the 'whole undersurface . . . broadly and prominently washed with strong buffy, the bases of the hairs being dark slaty, the total ventral colour resulting being conspicuously darker than *hurrianae*, in which the hairs are usually washed with white or pale buffy, and their bases either wholly white or at most pale slaty'. But I do not find these characters or the others he suggested very constant. Specimens from Sind seem intermediate. There is, however, a distinct tendency for the typical race as restricted by Thomas to have the tail shorter than the head and body, whereas in *collinus* the tail tends to be longer than the head and body. Again, specimens from Sind are intermediate. We have very many more specimens for *hurrianae* than for *collinus*, and of these about a quarter of the *hurrianae* skins have the tail long, as in *collinus*, which I should imagine, therefore, is most likely to prove a synonym. It is true that our skulls for *collinus* tend to average a little larger than our *hurrianae*, as pointed out by Thomas, but we have many more for the latter than for the former; and there are many overlaps.

Cranial characters.—Compared with other Indian species of *Meriones*, the skull is somewhat bowed down anteriorly and the rostrum gives the impression of being rather short. Nasals somewhat narrow; zygomatic plate strongly thrown forward on each side of the infraorbital foramen, this fact being a feature of the superior aspect of the skull. Frontals rather long and wide, narrowest just behind the lacrymals, rather evenly divergent backwards, and powerfully ridged along their sides, the ridges often forming an evident post-orbital knob about where the frontals join the parietals. The suture of the frontals and parietals is nearly straight. Interparietal long, wide and prominent. Mastoids visible in superior aspect of skull, but not very conspicuous. Occiput quite strong, between the inflated mastoids, and paroccipital process quite large, closely applied to the bullae. The bullae average less than 30% of the occipitonasal length, but are nevertheless well inflated for a Muroid Rodent. Anteriorly they join the hamular processes and are close to the back of the palate; pterygoid fossae flat and rather reduced. Anterior palatal foramina long and narrow; usually a second p between the toothrows are present, but may sometimes very reduced, and are never very large. Zygoma narrow slanting rather abruptly upwards in front to the lacrym region; zygomatic plate powerfully thrown forwards, anterior edge somewhat rounded. Mandible with weak sh

coronoid process, and narrow angular portion. The root of the lower incisor is visible under the coronoid. The back of the jaw between the narrow angular and the condylar process is rounded, the angular portion being considerably drawn backwards.

Dental characters.—Upper incisors yellow, opisthodont, and one-grooved. Upper molars relatively simple. M. 3 is very small, ring-shaped. M. 2 is eight-shaped, being cut by two nearly equal folds (an inner and an outer) into two plates; M. 1 has two folds each side, cutting the tooth into three plates. The folds nearly meet in the middle line of the teeth, and the laminae are joined. Lower molars in pattern essentially as in the upper series; M. 3 simple, ring-shaped; M. 2 cut into two plates by a fold each side; M. 1 with two folds each side; the front lamina usually is smaller than the second and third. The inner folds tend to be longer than the outer ones.

Cranial measurements.—As in Table 50, below.

TABLE 50.—*Cranial measurements of Meriones hurrianæ*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
M.	9.4.6.17 Punjab	32.5	16.8	5.5	9.5	4.5	6.3
M.	10.1.18.42 Ding, Rajputana	33.2	16.1	?	10.0	5.1	?
	10.2.8.6 Chalcra, Sind	33.8	17.8	5.2	9.2	5.1	6.6
M.	11.3.13.2 Hara, Thar and Parkar, Sind	32.5	17.3	5.1	10.4	5.0	6.8
M.	11.3.13.3 Hara, Thar and Parkar	33.3	17.1	6.1	9.8	4.8	6.7
M.	11.3.13.4 Hara, Thar and Parkar	34.2	17.5	5.5	9.7	?	7.2
F.	12.10.4.50 Bhuj, Cutch	33.5	17.0	4.7	10.2	5.2	6.5
M.	12.10.4.51 Nokania, Cutch	35.2	18.2	5.9	10.7	5.1	7.0
M.	12.10.4.53 Chitrod, Cutch	33.3	17.3	5.0	9.4	5.2	7.0
F.	12.10.4.54 Chitrod, Cutch	32.8	16.9	4.6	9.6	5.1	6.1
F.	12.10.4.57 Rhodamotha, Cutch	33.2	17.2	5.2	10.2	?	6.6
M.	13.9.18.60 Palanpur	35.5	18.5	5.2	9.9	5.2	7.3
M.	13.9.18.61 Palanpur. Old	35.3	19.6	6.0	10.3	5.5	6.9

TABLE 50.—*Cranial measurements of Meriones hurrianæ (contd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
F.	13.9.18.62 Palanpur	32.3	17.1	5.3	9.2	4.8	6.5
F.	13.9.18.63 Palanpur	33.7	17.6	5.4	9.6	4.8	7.1
F.	13.9.18.65 Danta, Gujerat	32.8	17.0	5.7	9.7	4.9	6.1
M.	13.8.8.76 Dhrangadhra, Kathiawar.	34.8	18.4	5.7	9.8	5.2	7.3
M.	13.8.8.79 Dhrangadhra, Kathiawar	34.9	18.6	6.4	9.7	5.1	7.4
M.	15.11.1.94 Mirpur, Sind	34.3	17.6	5.5	10.1	5.0	6.5
M.	15.11.1.95 Mirpur, Sind	34.4	17.8	5.3	9.9	?	6.8
F.	15.11.1.97 Gambat, Sind	36.7	c. 19.7	6.3	10.7	5.4	7.1
F.	15.11.1.98 Gambat	34.3	17.3	5.8	10.1	4.4	6.7
F.	15.11.1.99 Gambat	34.3	18.0	5.2	9.8	4.6	6.4
M.	19.2.21.8 Dhrangadhra, Kathiawar	32.3	17.3	5.4	9.1	5.0	7.0
F.	25.6.10.19 Kotri, Sind	36.3	19.0	6.2	10.8	5.3	6.7
M.	12.10.4.55 Rhodamotha, Cutch	33.5	18.0	5.6	9.8	?	6.6
Frost collections—							
F.	82 Umankot, Sind	31.5	16.6	5.5	9.7	5.1	6.2
M.	83 Umankot	32.9	16.4	5.7	10.2	4.8	6.2
M.	94 Umankot	33.1	17.2	5.4	9.8	4.7	6.5
F.	112 Umankot	33.4	17.7	5.5	9.7	5.0	6.2
F.	114 Umankot.	33.0	16.6	5.0	10.2	4.9	6.0
M.	116 Umankot	34.6	18.2	5.7	10.4	?	7.1
F.	117 Umankot	32.0	16.3	5.5	9.8	5.0	5.9
F.	118 Umankot	32.0	16.2	5.0	9.2	4.8	6.5
F.	119 Umankot	32.3	17.1	4.9	9.4	4.9	6.5
F.	120 Umankot	31.0	16.1	4.6	9.5	?	6.1
M.	125 Umankot	32.1	?	5.5	?	4.8	6.7

TABLE 50.—*Cranial measurements of Meriones hurrianae (concl'd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
F.	132 Umankot	31·7	16·5	5·4	10·1	5·3	6·8
M.	139 Umankot	35·2	19·0	5·7	9·9	5·7	7·3
F.	140 Umankot	34·3	17·0	5·3	10·0	5·0	6·4
M.	148 Umankot	34·0	17·3	5·8	10·2	5·3	6·6
F.	149 Umankot.	33·8	17·5	5·6	9·1	5·5	6·5
M.	151 Umankot	34·2	17·9	5·4	9·7	5·2	7·4

Meriones hurrianae ('*collinus*')

M.	6.10.11.1 Kohat, NW. Frontier	35·3	19·0	6·1	?	5·0	6·4
F.	6.10.11.2 Kohat	34·2	17·9	5·7	10·2	5·0	6·5
M.	19.11.7.47 Chambar-Kohra, Baluchistan	35·5	18·4	6·2	10·6	5·0	6·0
M.	19.11.8.48 Wadh, Baluchistan	36·4	18·7	6·5	10·8	5·1	7·2
F.	19.11.8.49 Wadh. Rather young	33·9	17·1	5·8	10·5	4·8	5·8
F.	19.11.8.51 Nal, Baluchistan	36·2	18·2	5·7	10·6	5·5	6·2
M.	19.11.5.80 Nal	36·2	18·6	6·2	10·8	4·9	6·8
F.	76.3.10.1 Dasht, Baluchistan. Old (worn out)	38·0	19·6	6·7	11·4	—	7·5

The type has the occipitonasal about 36·2 mm.

Dimensions of Meriones hurrianae, in British Museum material.—The occipitonasal length varies between 31 and 38 mm. Toothrow 4·5–5·7 mm. The head and body length varies between 98 and 143 mm. (adults over 100 mm.). Tail between 71 and 164 mm. (at least 100 with one exception). Hindfoot 19–38 mm.

Subgenus (b) **Parameriones** Heptner

1937. *Parameriones* Heptner, *Bull. Soc. nat. Moscou, Biol.*, **46**, 190.

Based, as a subgenus, on *Meriones persicus* Blanford, and characterized by the fact that the soles are naked, therefore

bearing a similar relationship to *Meriones* s.s. that subgenus *Dipodillus* does to *Gerbillus* s.s. in the genus *Gerbillus*.

I restrict it to two species, *M. persicus* and *M. rex* Yerbury and Thomas, from Aden district in South Arabia, in which the bullae are small, usually though not always under 30% of the occipitonasal; not averaging as high as 31% in any race. *M. rex*, which is antedated by *persicus*, differs from that species in its differently shaped skull (relatively wider frontals), shorter tail, etc.

56. *Meriones persicus* (Blanford)

Blanford's Jird

1875. *Gerbillus persicus* Blanford, *Ann. Mag. nat. Hist.*, 16, 312.

(The name 'Jird' is used for Gerbils of the genus *Meriones* from North Africa.)

Type-locality.—Kohrud, 150 miles north of Isfahan, Persia.

Distribution.—Persia, South-West Turkestan (Kopet-dag region), BALUCHISTAN. Westwards to Transcaucasia. Mr. Chaworth-Musters informed me that he obtained a specimen in Afghanistan.

A largish species with well tufted, long tail, naked soles to the hindfeet, and small bullae. Lacking the fossorial specializations characteristic of the subgenus *Cheliones*. Skull less bowed anteriorly than in *Cheliones*. Tail usually over 120% of head and body length, or approximating to that figure.

This species was not dealt with either by Blanford or Wroughton, but was subsequently discovered in Baluchistan.

External characters.—Rather large for the present subfamily, as indicated by measurements below. Fur soft. Ear large, over 20 mm. in length in Indian specimens. Tail long, usually over 120% of head and body, hairy and heavily tufted terminally. Hand with four well developed fingers bearing quite large claws, thumb rudimentary. Foot long, although less than 30% of head and body, as a rule; sole quite naked, to heel, although there is a certain growth of hair along the hallucal side, but this never approaching the outer side. The three centre digits are longer than the outer pair, and the fifth toe is considerably longer than the hallux. (The fifth toe reaches about half-way up the length of the fourth, but the hallux only reaches about the base of the second toe).

Colour.—Above buffy, the hairs darker basally; feet whitish or white; underparts white. Tail bicolor; brown above, white or pale brown below, the tuft blackish.

External measurements.—

		Head and body	Tail	Hind- foot	Ear
<i>Meriones persicus persicus</i>					
F.	Kelat, Baluchistan	130	160	36	21
M.	Kelat	142	167	37	22

(Skull not measurable; perhaps represents *baptistae*.)

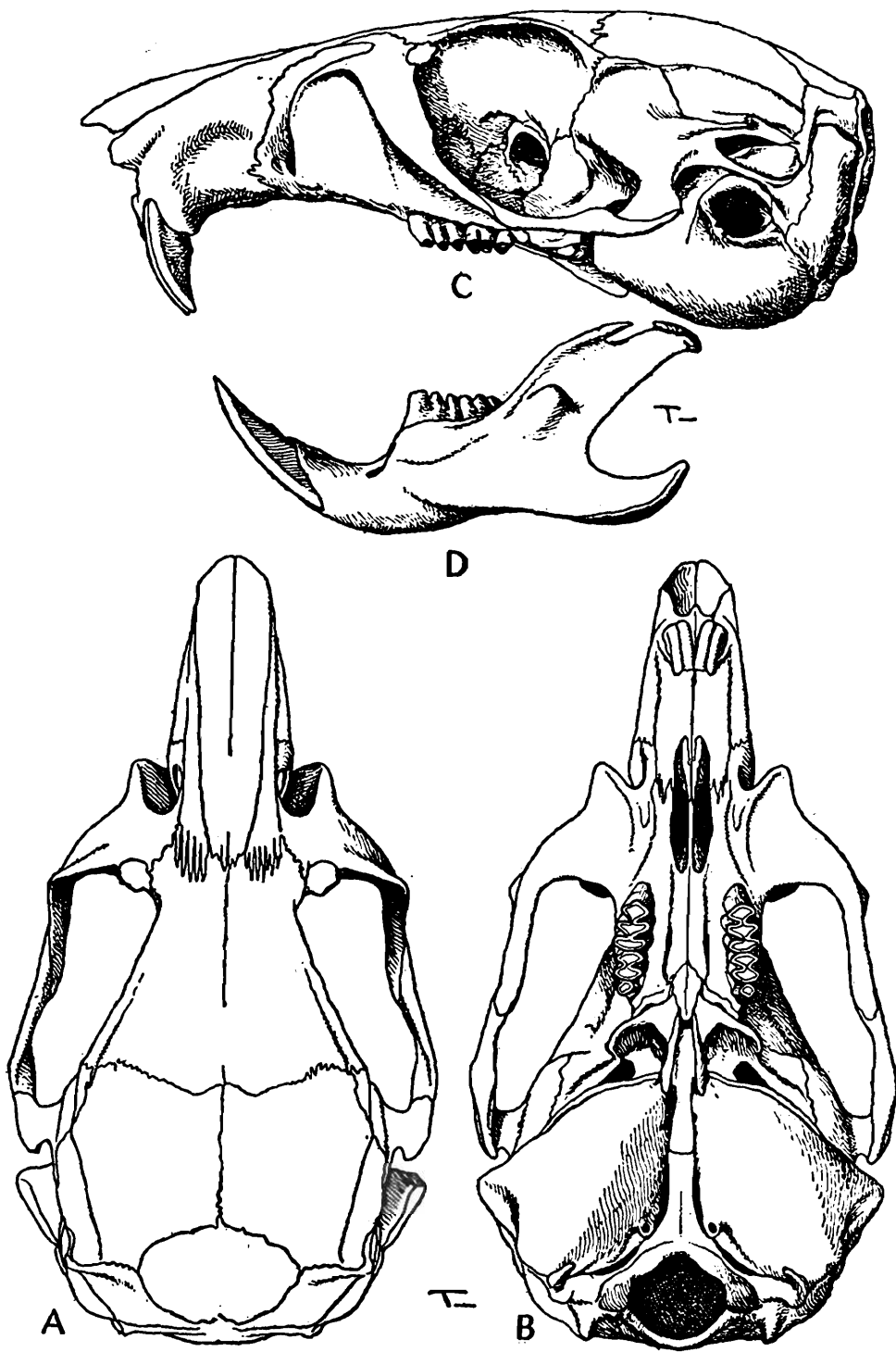
<i>Meriones persicus baptistae</i>					
F.	Kelat, Baluchistan	134	170	37	23
M.	Kelat	123	170	38	23
M.	Kuldur, 85 miles west of Turbat, Baluchistan	127	157	35	22
	Pasht Kuh, Baluchistan, about 27° N., 65·12° E., type	132	156	36	23

Cranial characters.—As compared with *M. hurrianae*, the rostrum is much straighter and the skull is less bowed anteriorly. The frontals appear less heavily ridged, though ridges are present. These features render the skull distinguishable at a glance when compared with *M. hurrianae*, but apart from them, the skull is much as described for that species. Mandible of essentially similar type. The bullae tend to be larger in Indian specimens than in Persian ones, and average in India about 30% of the occipitonasal length as a rule.

Dental characters.—Upper incisors yellow, opisthodont, one-grooved. Upper molars essentially as in *M. hurrianae*, but the inner fold, particularly in M. 2, tends to be longer than the outer one, and possibly the cheekteeth are slightly less hypsodont. Lower molars as in the related species.

Cranial measurements.—

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Meriones persicus persicus</i>							
F.	19.11.8.42 Kelat, Baluchistan	40·3	21·4	8·2	11·8	5·8	6·5
<i>Meriones persicus baptistae</i>							
M.	19.11.7.68 Kuldur, Baluchistan	41·1	20·8	8·4	12·2	5·6	6·3
M.	19.11.7.71 Kelat, Baluchistan	40·1	20·3	7·3	12·5	5·7	6·6
F.	19.11.7.72 Kelat	41·0	21·5	7·6	12·3	5·7	7·3
M.	19.11.7.69 Kuldur, type	43·0	22·5	8·7	13·3	5·5	7·7



TEXT-FIG. 33. *Meriones persicus persicus* (Blanford). A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. ($\times 5$).

Dimensions of Meriones persicus, in British Museum material.—The occipitonasal length varies between 40 and 43.7 mm. Toothrow 5.2–5.8 mm. The head and body length varies between 123 and 161 mm. Tail between 156 and 190 mm. Hindfoot 35–41 mm.

*Provisional key to the races of Meriones persicus
occurring in India*

1	(2)	The bullae larger, 12.2 mm. and more, and averaging over 30% of the occipitonasal length.....	<i>M. p. baptistae</i>
2	(1)	The bullae smaller, not normally exceeding 11.9 mm. and less than 30% of the occipitonasal length	<i>M. p. persicus</i>

Races.—The subspecies of this species are difficult, in that three proposed names (*persicus*, *ambrosius* and *baptistae*) all seem distinct and yet all seem to occur together. Our material for this species is limited and it is more than possible that all three names are really based on one very individually variable form. On the other hand, there is a distinct line which can be drawn between our *M. p. persicus* and our *M. p. baptistae* on the size of the bullae, when all available skulls for the species are measured. It appears, however, that both types occur at Kelat. I am not, in this case, prepared to give *baptistae* specific rank even if the two races do appear to occur together. Occasionally there are cases of two subspecies apparently occurring together. The Kelat specimen of *persicus* (19.11.8.42), with smaller bullae than the other *baptistae* specimens noted above, was apparently not collected in the same year as the *baptistae* specimens; there is no altitude on the labels, but the two might occur, for instance, at different altitudes and it seems not proved that they actually occur together; a parallel case to this may be met with in Sumatra, as noted by Chasen, in the squirrel *Lariscus insignis*, the race of which, *L. i. niobe*, apparently occurs with the typical race but in reality both are said to occur at different altitudes, though both may be collected apparently at the same place and on the same day. Possibly something similar occurs in this case. Or possibly when numerous specimens of *M. persicus* come to hand, it will be proved that in reality the measurements which I give as being characteristic for the bullae of the two races would overlap so that *baptistae* would then go into synonymy. At present, with our limited material, I propose to retain *baptistae*.

(i) **Meriones persicus persicus** (Blanford)

Text-fig. 33

1875. *Gerbillus persicus* Blanford, *Ann. Mag. nat. Hist.*, 16, 312.

Type-locality.—Persia; co-type in *British Museum* from Kohrud.

Range.—Specimens examined from: BALUCHISTAN: Kelat. Persia: Mala-i-mir, Shiraz and Kohrud.

(ii) ***Meriones persicus baptistae* Thomas**

1920. *Meriones persicus baptistae* Thomas, *J. Bombay nat. Hist. Soc.*, 26, 934.

Type-locality.—Pasht-kuh, South-West Baluchistan, about 27.2° N., 65.12° E.

Range.—Specimens examined from BALUCHISTAN: Pasht-kuh, Kuldur, Kelat, Turbat.

Thomas thought the Kelat series represented true *persicus*, but as indicated above, except for one specimen, the remainder agree more with *baptistae* in size of the bullae.

Subgenus (c) ***Pallasiomys* Heptner**

1933. *Pallasiomys* Heptner, *Z. Säuget.*, 8, 150.

Based as a genus upon those species of *Meriones* with enlarged bullae. I ignored it in my last volume on the rodents on account of intermediate species, but I now think that it is valid as a subgenus. Its type is *M. libycus erythroua*. Half-a-dozen species, according to the classification offered here, are recognized.

Of the species belonging to this subgenus the first to be named was *M. meridianus* Pallas, 1773, from Turkestan, the Caucasus, Sinkiang, Mongolia and northern China. This species is usually smaller than the forms inhabiting India, and its bullae are not so inflated as in the race *M. crassus swinhoei*. The two species which reach India occur together from west of the Indus to Algeria and may always be distinguished by the colour of their hindclaws. Both have larger bullae normally than the related *M. shawi*, which occurs with them from Israel to Algeria.

Key to Indian species of the subgenus Pallasiomys

1 (2) Hindclaws dull. In Indian race the bullae are extremely enlarged, about 38% of the occipitonasal length.	<i>Meriones crassus</i>
2 (1) Hindclaws dark. In Indian race the bullae are about 34% of the occipitonasal length.	<i>Meriones libycus</i>

57. *Meriones libycus* Lichstenstein

The Libyan Jird

1823. *Meriones libycus* Lichstenstein, *Verz. Doubl. Mus. Berlin*, 5.

Type-locality.—Egypt.

Distribution.—Algeria, Morocco, Libya, Egypt, Arabia, Persia, Afghanistan, BALUCHISTAN, Israel, Syria, Iraq, Sinkiang, Russian Turkestan (widely distributed), Transcaucasia.

Larger than the related northern species *M. meridianus*; hindclaws, dark. One race reaches north-western India.

The sole is hairy in *M. l. erythrourea*. The bullae are proportionately larger, the tail proportionately shorter and less tufted than in *M. persicus*.

External characters.—Moderately large gerbils. Fur soft. Ear of moderate size, smaller than in *persicus*, and in most of our specimens less than 20 mm. Tail well haired, tufted, but the tuft less exaggerated than in *M. persicus*. Digits of forefoot about as usual. Hindfoot with the sole well haired nearly throughout except for a conspicuous bare patch on the heel. The toes about as in *M. persicus*, in proportions. Hindfoot over a quarter of head and body length, but apparently tending to be shorter proportionately than in *persicus*. Tail also proportionately shorter. Colour above light sandy brown with a certain admixture of blackish suggested. Underparts white. Tail yellowish brown for most of its length, but the tuft is black and in front of the tuft the black hairs continue as a thin dark line for a greater or lesser extent of the upper part of the terminal half of the tail. Feet whitish.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Meriones libycus erythrourea</i>				
M. Kelat, Baluchistan	118	127	34	18
— Quetta, Baluchistan	?	?	33	20

Other skins from Kazvin, Persia, 200 miles east of Dead Sea, Beersheba, Israel; head and body up to 143 mm., tail up to 170 mm. Hindfoot 30–36 mm.

Cranial characters of Meriones libycus erythrourea.—Superior aspect of skull much like that of *M. persicus* except that the frontals are powerfully ridged and that the mastoids

tend to show a little more when the skull is viewed from above. Otherwise the skull differs conspicuously from that of *M. persicus* only in the considerably larger bullae, which are more than one-third of the occipitonasal in length as a rule, and which appear to have the auditory meatus and region in front of it more inflated, and the suprameatal triangle tends to be larger.

Dental characters.—Essentially as described above for *M. hurrianae*.

Cranial measurements.—

	Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Meriones libycus erythrourus</i>						
M. 19.11.8.43	40.0	20.3	7.5	13.9	5.1	7.3
Kelat, Baluchistan						

Other skulls, Kazvin in Persia, and Afghanistan; occipitonasal 38.7–40.1, bullae 12.8–13.8 mm.

Dimensions of Meriones libycus, in British Museum material.—The occipitonasal length varies between about 34.1 (rather young) and 44.1 mm. Toothrow 4.2–6.2 mm. The head and body length varies between 110 and 173 mm. Tail between 96 and 181 mm. Hindfoot 28–39 mm.

***Meriones libycus erythrourus* (Gray)**

The Afghan Gerbil or Jird

1842. *Gerbillus erythroure* Gray, *Ann. Mag. nat. Hist.*, 10, 266.

Type-locality.—Sahlabad, about 12 miles south-west of Kandahar, Afghanistan.

It differs from the typical race, *M. libycus* of Egypt, in its proportionately larger bullae.

Range.—Specimens examined from BALUCHISTAN: Kelat, Sourab, Quetta. Afghanistan: Kandakar. PERSIA: Kazvin. Similar form from Russian Turkestan, Fergana.

This is the first name for an Asiatic race. It differs from the typical *M. libycus* in its proportionately larger bullae, which average more than one-third of the occipitonasal length in Asiatic races, less than one-third in the north African races.

58. Meriones crassus Sundevall

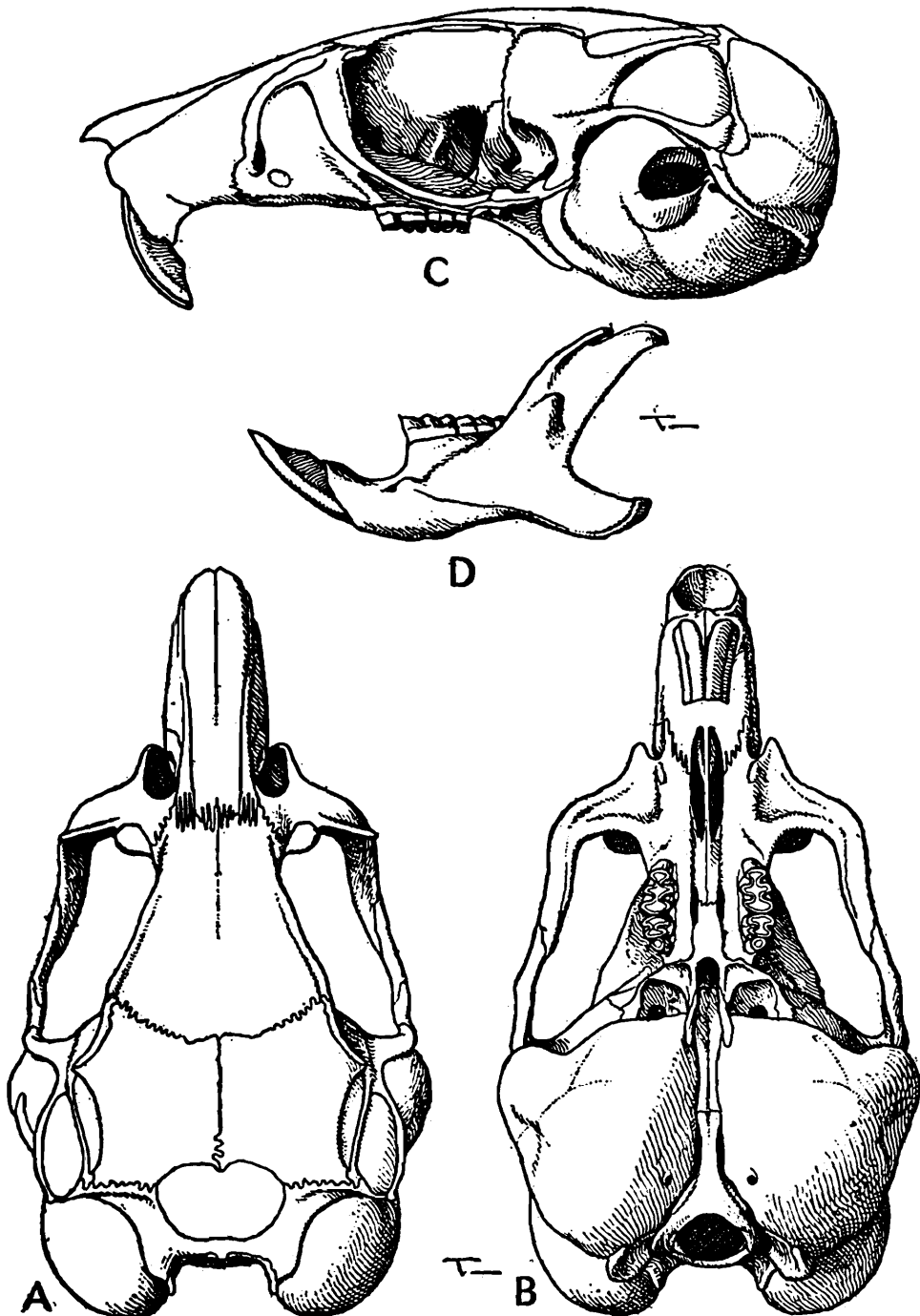
Sundevall's Jird

Text-fig. 34

1842. *Meriones crassus* Sundevall, *K. Svenska Vetensk. Akad. Handl.*, 233.

Type-locality.—Sinai.

Distribution.—Algeria, Libya, Egypt, Sudan, Asben;



TEXT-FIG. 34. *Meriones crassus* Sundevall, ♀. A, B, C, dorsal, ventral and lateral views of the skull. D, lower jaw of the same. (×2). (After Ellerman, 1941, p. 526.)

Arabia, Israel, Persia, Iraq. Afghanistan and NORTH-WEST FRONTIER.

This species is essentially like *M. libycus*, but occurs with it extensively and differs in having the hindclaws dull in colour. In some of the races, including the typical and the Indian one, the bullae are at maximum inflation for the genus *Meriones*.

External characters of M. crassus swinhoei.—Not extremely different from *M. l. erythrourus* but apparently smaller. Sole of hindfoot well haired. Tail tufted, but not very prominently so. Colour apparently much as in *M. l. erythrourus*. Fur thick.

External measurements.—Skins seen from Wana, South Waziristan, and Kandahar, Afghanistan.

(The skin from Wana has inch measurements on it; head and body 4.1, tail 3.9, foot 1 inch, and ear 0.59.)

Cranial characters of Meriones crassus swinhoei.—Like those of *M. l. erythrourus* (apart from rather smaller size), but differing in the enormously inflated mastoids and bullae, which are about 38% of the occipitonasal length, and at maximum for the genus. Mastoids showing much more conspicuously in superior aspect of skull, projecting backwards clearly behind level of occiput. Frontals not very heavily ridged. The suprameatal triangle of the bullae is very large. Mandible and other characters of skull as usual; rostrum straight, not bowed down (i.e. not as in *M. hurrianae*).

Dental characters.—Including the grooved incisors, normal for the genus (as described under *M. hurrianae* above).

Cranial measurements of M. crassus.—

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Meriones crassus swinhoei</i> .							
M.	21.7.14.2	35.4	17.5	6.3	13.5	4.5	5.6
	Wana, South Waziristan						
M.	21.7.14.3	32.5	15.9	5.6	12.9	3.9	5.4
	Wana, South Waziristan						

Dimensions of Meriones crassus, in British Museum material.—The occipitonasal length varies between 32.5 and 41.9 mm. Toothrow 3.9–5.6 mm. Head and body length varies between 105 and 156 mm. Tail between 104 and 172 mm. Hindfoot 27–37 mm.

(i) **Meriones crassus swinhoei** (Scully)

Swinhoe's Jird

1881. *Gerbillus swinhoei* Scully, *Ann. Mag. nat. Hist.*, 8, 228.*Type-locality*.—Gatai, Afghanistan.*Range*.—Specimens examined from Afghanistan: Gatai, Kandahar. NORTH-WEST FRONTIER: Wana, South Waziristan.

This race is not well known, and its type specimen is juvenile. It seems to be most like the typical race, with the bullae extremely enlarged in a similar manner, but to differ from it in smaller size. We have two adult specimens for *swinhoei*. Soles mainly hairy, as in *M. libycus*.

Subfamily (c) MICROTINAE

Muridae in which the skull and teeth and most often the external characters are highly specialized. The skull is massive and angular and the ridges for jaw muscle attachment are normally more apparent than in lower Muridae, and modify the skull to a greater extent. There is as a rule a squamosal crest developed on each side; the zygomatic plate is very strong and tilted well upwards, and the infraorbital foramen is small and narrow. The ridges on the skull when they fuse tend to do so further forwards than in other rodents and are joined in the interorbital region rather than on the parietals. There are deep pits usually present for muscle attachment between the molars and the outer side of the lower jaw, and the pterygoid fossae are often deepened and specialized. The zygomatic plate is never cut back above anteriorly. The orbit is somewhat shifted forward, compared with primitive Muridae, and the rostrum is rather short. All Palaearctic Microtinae have large bullae, averaging more than one-fifth of the occipitonasal length, and they frequently contain spongy bone within. Very often the condylobasal length exceeds the occipitonasal length. Nearly always the palate is more than half the occipitonasal in length, and nearly always the toothrow is over one-fifth of the occipitonasal length, in Palaearctic species.

Dentally, the specialization is that in the majority of genera the cheekteeth have become rootless. The cheekteeth are complex in structure, prismatic. There is a tendency for the third upper molar to be longer than the second; this tooth is the most variable and often the most complex in the upper jaw. The first lower molar is the dominant and most complex tooth in the lower jaw.

Externally, the form is specialized towards life in cold climates; the tail is short, seldom as much as half the length of the head and body, and is hairy. Some genera as *Ellobius* are extremely modified towards subterranean life.

The characters of this subfamily have been monographed by Hinton, 1926, *Monograph of Voles and Lemmings*, Vol. I. Details of evolution, jaw muscle structure, dentition and cranial modifications of fossil and living genera will be found in that work.

Blanford, and following him Wroughton, regarded the voles as belonging to the Cricetinae, but this is unquestionably erroneous, and all modern authors recognize the present subfamily. They are the most specialized of living Muridae.

It is essentially a northern group and the only Indian species are confined to the north of the country (the Himalayas), which form their southernmost boundary in Asia.

There are fifteen genera in the Palaearctic. (Some authors recognize more than this.) An outline to the classification of these (and it is far from being an easy group to classify), is as follows:—

- (a) Group *Lemmi*: with the cheekteeth rootless, and the lower incisor short, wholly lingual to molars. External form usually extremely modified for life in Arctic climates. Genus *Dicrostonyx*; Arctic regions of U.S.S.R. and Canada to Greenland; molars complex in pattern; foreclaws developing a seasonal modification of antler-like outgrowths (which are shed periodically) on second and third fingers; external specializations at highest development.

Genus *Lemmus*: molars much simpler than the last; no periodically shed outgrowths on the second and third fingers, but otherwise external characters nearly as specialized as in the last; Scandinavia, Arctic regions of U.S.S.R. and Canada.

Genus *Myopus*: near *Lemmus*, but with less specialized external characters; Scandinavia, North Russia, Siberia, and Mongolia.

- (b) Group *Microti*: with the cheekteeth rooted or rootless, but with the lower incisor long, passing from lingual to labial side of the molars. Two aberrant genera might well be separated from these as type of a third group (in fact one of them has recently been given group rank (Simpson, 1945)); both are modified for underground life, and both have rooted cheekteeth, which have M. 3/3 reduced

in size and small, a very rare character for the group.

Prometheomys, Caucasus Mountains, with enormously enlarged foreclaws but the skull rather generalized in formation; and *Ellobius*, Caucasus, South Russia, Turkestan, southern Siberia, Sinkiang, Mongolia, Persia, Afghanistan and BALUCHISTAN, in which the foreclaws are normal, but the skull is modified out of all proportion for fossorial life, with enormously enlarged incisors, lengthened diastema, lower incisor root forming a prominent process on the mandible outside the condylar process, the outer wall of the infraorbital foramen abnormal, the posterior palate specialized about as in *Microtus* and allies, etc.

The more normal *Microti* of the Palaearctic can be classified roughly as follows: In two genera the cheekteeth remain rooted; *Dolomys*, Yugoslavia, a larger form with the posterior part of the palate slightly more specialized, and the tail long, and *Clethrionomys*, one of the most widely distributed and generalized genera of Microtinae, which ranges throughout Europe and most of northern Asia and in North America (its southern borders in Asia are approximately Asia Minor, Russian Turkestan, Szechuan, thence north-eastwards to Chihli); posterior palate terminating as a simple transverse shelf; tail proportionately shorter and size smaller than in *Dolomys*. This is, among Palaearctic Microtinae, the least specialized and most Murine of known living genera. In the remainder, the cheekteeth are rootless, as far as is known. A group of Central Asiatic genera are fairly obviously offshoots of *Clethrionomys*, and only differ from that really in having rootless cheekteeth. The posterior palate is similar to *Clethrionomys*. All of these occur in Indian territory and their characters and distributions will be dealt with in detail below; they include *Alticola*, *Hyperacrius* and *Eothenomys*, of which the latter is the least specialized, and *Hyperacrius* the most. In the remainder, the posterior palate terminates with the median process converted into a sloping septum between the posterolateral pits, the inner borders of these pits continuous with tip or sides of median process. *Lagurus*, South Russia, Russian and Chinese Turkestan, Mongolia, also Central Siberia (and North America in part) is a specialized genus in which the external form is about as highly modified in the specialized Lemmings (*Lemmus* or *Dicrostonyx*), and which also has various cranial peculiarities which separate

it from those which follow; its first lower molar has five closed triangles. The number of closed triangles on the first lower molar may be used, apparently, to divide the remainder (or rather, to restrict the dominant genus, *Microtus*). *Microtus*, which has numerous species ranging in North America, northern Asia, and Europe, and a representative in Libya (North Africa), can be restricted to those species in which the first lower molar has four or five closed triangles. One species has been taken in North Burma, the first Indian record for true *Microtus*. Of those genera in which the first lower molar has only three closed triangles, *Arvicola* stands apart somewhat by its combination of large size, angular skull, long tail, and slight modifications towards subterranean or aquatic life; its range is throughout most of Europe, and Russian Asia in part, Asia Minor, Persia, North Syria. The remainder could, in my opinion, be referred to *Pitymys* which is a long standing genus and which, as I understand it, ranges across most of Europe (except British Isles and Scandinavia) and large parts of Asia (India included, exact details below), as well as in central and eastern North America. From this I am inclined to separate the Afghanistan genus *Blanfordimys*, based on a single species which has unusually large bullae and very weak ridges to the skull (mostly not traceable). It does, however, come near the subgenus *Phaiomys* of *Pitymys*, but a considerable series recently received from Afghanistan suggests that it is reasonable to give it generic rank.

Special works of reference on Microtinae include—

Hinton, 1926, *Monograph of Voles and Lemmings*, 1.

Miller, 1896, *North American Fauna*, No. 12. Genera and subgenera of Microtinae.

Miller, 1912, *Catalogue of Mammals of Western Europe*, p. 610.

Key to the Indian genera of Microtinae

- 1 (2) M. 3/3 reduced in size. The cheek-teeth rooted in adult. Cranially abnormally modified for subterranean life; the incisors extremely proodont and enlarged; the root of the lower incisor forming a prominent process outside the condylar process of the lower jaw. Infraorbital foramen lacking external plate or covering and not narrow. (The tail is very strongly shortened, mostly shorter than the hindfoot.

- In the Indian species, the ridges of the skull fuse to form a sagittal ridge which extends backwards over the parietals to the lambdoid crest. Posterior palate as described below for *Microtus* and *Pitymys*) ..
- 2 (1) M. 3/3 not reduced in size; the cheek-teeth rootless. Skull without the abnormal modifications as described above. When the ridges of the skull fuse they do so in the interorbital region and never form a ridge extending backwards over the parietals. Infraorbital foramen narrow. 2
- 3 (8) Posterior palate terminating as a simple transverse shelf. .. 4
- 4 (5) The supraorbital ridges fuse to form a median interorbital crest in the adult. The palate is proportionately longer. The external form is more or less fossorial. (Cheekteeth with long-drawn-out appearance.)
- 5 (4) The supraorbital ridges remain separate in the adult. The palate is proportionately shorter. The form is not fossorial.. 6
- 6 (7) Cheekteeth with wide folds, and long-drawn-out appearance *Alticola*
- 7 (6) Cheekteeth with narrow folds, and crowded appearance . . . *Eothenomys*
- 8 (3) Posterior palate terminating with the median process converted into a sloping septum between the posterolateral pits, the inner borders of these pits continuous with tip or sides of median process . 9
- 9 (10) First lower molar with three closed triangles .. . *Pitymys*
- 10 (9) First lower molar with (in Indian species) five closed triangles.. *Microtus*

The genus *Pitymys* was regarded by Hinton, Miller, and others, as only European and North American. Miller and other authors refer the genera or subgenera *Neodon* and *Phaiomys*, which are the Indian representatives, to *Microtus* as subgenera. Hinton gave both generic rank. If both are to be regarded as *Microtus*, then *Pitymys* is indefinable. *Pitymys* contains a lot of species and is currently given generic rank. The logical step seems to me to refer *Neodon* and *Phaiomys* to it as subgenera (and the American *Pedomys* as well). This would give the genus a range more or less

across the Holarctic region. The differences between *Neodon*, *Phaiomys*, and *Pitymys* do not seem to me to be of generic value.

I offer an alternative key to the nine well established species of Microtinae from India (except *Pitymys irene*). It is based on characters other than the cheekteeth and structure of the back of the palate, and it shows that these species can be identified by external measurements and by cranial measurements (the occipitonasal, the palate, and in some cases the bullae).

Alternative key for species of Microtinae

1 (2)	The tail much shorter than hindfoot, less than one-tenth of head and body. The ear vestigial (about 4 mm.). Skull with incisors enormously thrown forward and enlarged. The infraorbital foramen is not narrowed	<i>Ellobius fuscocapillus</i>	
2 (1)	The tail more than one-fifth of head and body, and longer than the hindfoot. The ear not vestigial (at least 7 mm., normally more). Skull with more moderate, less enlarged incisors. The infraorbital foramen is narrowed		2
3 (4)	The tail exceeds half the length of the head and body (constantly in Indian material)	<i>Microtus clarkei</i>	
4 (3)	The tail is rarely as much as half the length of the head and body, and is never as long as this on average for any race.		5
5 (12)	The length of the palate approximates to or exceeds 60% of the occipitonasal length, or is little below it		6
6 (7)	The bullae are more than a quarter of occipitonasal length	<i>Pitymys leucurus</i>	
7 (6)	The bullae are less than a quarter of occipitonasal length		8
8 (9)	The ear is about 13% of head and body length	<i>Pitymys sikkimensis</i>	
9 (8)	The ear is about 9–11% of the head and body length		10
10 (11)	Occipitonasal length not exceeding 24 mm.	<i>Hyperacrius fertilis</i>	
11 (10)	Occipitonasal length not less than 25.4 mm.	<i>Hyperacrius wynnei</i>	
12 (5)	The palate is considerably less than 60% of the occipitonasal length (averages below 55%)		13

- 13 (14) Tail very short, less than a quarter
of head and body length, in most
specimens. *Alticola stoliczkanus*
- 14 (13) Tail less shortened, more than a
quarter of head and body length. 15
- 15 (16) Underparts much lighter. *Alticola roylei*
- 16 (15) Underparts much darker. . . *Eothenomys melanogaster*

Genus 25. *Eothenomys* Miller

1896. *Eothenomys* Miller, *North Amer. Fauna*, No. 12, 45.

1896. *Anteliomys* Miller, *North Amer. Fauna*, No. 12, 47.
(*Microtus chinensis* Thomas, from Szechuan, China.)

Type-species.—*Arvicola melanogaster* Milne-Edwards.

Distribution.—Southern China, from Kansu, Szechuan, Yunnan, Fukien and adjacent States, Formosa, North Indo-China, NORTH BURMA, NORTH ASSAM.

Originally proposed as a subgenus of *Microtus*, this group is now currently given generic rank. It is the second generic name for those voles which resemble *Microtus* in having rootless molars, but differ from it and resemble *Clethrionomys* in having the posterior palate terminally as a simple transverse shelf.

It is antedated by *Alticola* and could be regarded as a subgenus of that. The pattern of the cheekteeth appears different, however, with the folds less open and less well marked. Pectoral mammae, so far as is known, are absent in this genus, present in *Alticola*. But mammary formula varies in rodents and is certainly not a character on which to base generic names. *Anteliomys* has also been given generic rank, but, as Glover Allen points out, there are intermediate species between the type of *Eothenomys* and that of *Anteliomys* and it seems no longer possible to retain *Anteliomys*, now that more species are known. There appear to be five species of *Eothenomys* ('*Anteliomys*' included), or five species certainly referable to the group. Glover Allen recognized more, but these were regarded by Hinton as based upon non-adult specimens of a species of *Clethrionomys*. The first name in the genus, *E. melanogaster*, characterized by its complex first and second upper molars, is the only species occurring in Indian territory.

59. *Eothenomys melanogaster* (Milne-Edwards)

Père David's Vole

1872. *Arvicola melanogaster* Milne-Edwards, in David, *Nouv. Arch. Mus.* 7, *Bull.*, 93 (footnote). (Moupin, Szechuan, China.)

Distribution.—As in the genus *Eothenomys*.

A vole with the generic characters as indicated above under *Eothenomys* and differing from its immediate allies by having three clear inner folds in the first upper molar and two clear inner folds in the second upper molar; therefore with an extra posterointernal heel in M. 1 and M. 2. The tail is most often rather long, though less than half the length of the head and body.

External characters.—Very dark, thick-furred voles. The tail is as a rule less than half the head and body length and is moderately haired, the hairs not hiding the scales. Ear short; usually over one-tenth of the head and body length, but sometimes not much more. Claws not enlarged; four functional fingers on the hand, the thumb vestigial. Five toes; the hallux rather shorter than D. 5, which is shorter than the central three. 5 or 6 plantar pads, according to Anthony. Mammae 0-2 = 4, so far as known. Colour dark brown above and little lighter below. Tail apparently mostly dark in the Indian skins. One of the Burmese specimens has two patches each side, of pure white hairs on the hips, doubtless due to some abnormality or disease.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Eothenomys melanogaster libonotus</i>				
F. Dreyi, Mishmi	110	40	16	11
	Mammae 2 pairs, inguinal			
M. Dreyi	118	36	16	11½
M. Dreyi, type	105	34	17	13

<i>Eothenomys melanogaster cachinus</i>				
F. Kachin Province, type	108	56	19	15
M. Adung Valley, Burma	93	40	17	12
Adung Valley	107	45	19	14
F. Adung Valley	100	45	18	13
M. Adung Valley	100	48	18	13
F. Adung Valley	100	38	18	13
M. Adung Valley	102	46	18	12

Notes from skins.—Adung Valley: 'trapped in jungle, common' Dreyi, Mishmi: weight 1.10 oz. Mammae 2 pairs, inguinal.

Cranial characters.—The skull is rather weak in general appearance for a Microtine and lacks the angularity which is found in higher voles. Often the frontals tend to be

relatively wider than in *Alticola*, though not always so. The nasals are quite long and the braincase tends to be rather flat. The squamosal crests each side of the front of the braincase are well developed and the interparietal is quite large. The ridges on the parietals are rather weak when present, and they do not show any signs of coming together in the interorbital region. Occiput rather weak and low. Bullae large and well inflated and varying somewhat in size in the different races. The palate is simple and unspecialized posteriorly, ending as a transverse shelf as in lower Microtines. Palatal foramina long, sometimes exceeding one-fifth of the occipitonasal length. Pterygoid fossae deep and large. The bullae lack spongy tissue within. Infraorbital foramen narrow, and zygomatic plate wide and much tilted upwards, as is usual in Microtinae. Zygomata well spread out from the skull and jugal relatively short. Mandible angular and powerful, with well developed coronoid process, deep pits outside the toothrows for muscle insertion, and the lower border of the angular portion thick and well ridged.

Dental characters.—Upper incisors broad, yellow, and normally plain. M. 1 and M. 2 complex, more complex than in other species of the genus. M. 1 has an anterior loop, three alternating closed triangles (one outer, two inner) and a posterior loop consisting of two confluent triangles; and there are two outer, three inner folds in this tooth. M. 2 has three more or less transverse loops, with two folds each side; M. 3 has three transverse loops, the posterior one the largest, in this tooth there may be two or three inner folds. The allied species of the genus *Eothenomys* usually lack the second inner fold in M. 2 and the posterointernal angle of M. 1. The number of inner salient angles in M. 3 has been used for racial division of the present species by both Hinton and G. Allen. Anthony has, however, written at some length showing that this is scarcely a character on which to base such divisions, when large series of these voles are examined. I quote his notes, 1941, on *E. m. libonotus*: 'the last upper molar is extremely variable, in crown pattern, in this series from Burma, and the differences do not seem to be co-ordinated with age or locality. The typical pattern for this tooth, to follow the original description of *libonotus*, should be three salient angles on both inner and outer faces. This is true of many of our specimens, but a number show four salients on the inner face, a few have four on the outer face, others have four on both inner and outer faces. Occasionally a skull has the last upper molar on one side with a 3-3 pattern, its mate on the other side with a 3-4 pattern. Most of the

variation in this tooth is confined to the last loop, which ranges from small and simple to elongated and complex'.

Second and third lower molars with two transverse loops, and two folds each side; first lower molar with posterior loop, two transverse loops (closed from each other) and then a transverse loop which is confluent with the anterior loop; four inner, three main outer folds as a rule.

Cranial measurements.—

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Eothenomys melanogaster libonotus</i>							
F.	22.12.5.56 Dreyi, Mishmi	24.6	13.2	5.0	?	6.4	4.4
M.	21.12.5.54 Dreyi, type	25.2	13.3	4.9	?	6.2	4.5
<i>Eothenomys melanogaster cachinus</i>							
F.	20.8.7.14. Mount Imaw Bum, Burma. Type	26.2	14.3	5.1	6.0	6.6	4.7
M.	32.11.1.119 Adung Valley, North Burma	25.5	13.3	5.1	5.4	6.0	4.0
M.	32.11.1.120 Adung Valley	25.8	13.7	5.3	5.5	6.4	3.8
F.	32.11.1.123 Adung Valley	25.6	13.7	5.3	5.4	6.3	3.5
M.	32.11.1.128 ¹ Adung Valley. Rather young	24.1	12.3	4.8	c. 5.0	5.7	4.3
Usually in these the occipitonasal exceeds the condylobasal length.							
M.	32.11.1.121 Adung Valley	25.8	13.9	5.2	5.7	6.2	4.1

Dimensions of Eothenomys melanogaster, in British Museum material, all races included.—The occipitonasal length varies between 21.7 and 27.6 mm. Toothrow between 5.1 and 6.9 mm. The head and body length varies between 87 and 134 mm., the tail between 22 and 57 mm. (or 80 mm. in one specimen), hindfoot 15–20 mm.

Provisional key to Indian races of E. melanogaster

- 1 (2) Tail apparently proportionately shorter, about one-third of head and body length or not much more.
Adult skulls apparently smaller .. *E. m. libonotus*
- 2 (1) Tail apparently longer, more than one-third of head and body length.
Adult skulls are larger .. *E. m. cachinus*

Externally, Indian races of this species differ from *Alticola roylei* races by being much darker below in colour.

Indian subspecies.—The two Indian races of this species were among the last to be named. Our material for them is so poor that, with the knowledge that Anthony in his recent paper on the mammals collected in North Burma obtained over one hundred specimens for each race, I feel that any characters I can give for their retention will most likely be ridiculous.

Both Hinton and (in the Chinese material) Glover Allen have published keys for the races of this species. Both are based primarily, so far as the races are concerned, on the number of salient angles in the third upper molar. Hinton's characters are absolutely correct so far as the British Museum material goes, but unfortunately we do not possess very many specimens for any of the races, and according to Anthony the character is individually variable for both races in North Burma. Glover Allen for no apparent reason divided this species into three species, for one of which he uses a wrong (antedated) name. Anthony, unfortunately, does not give any characters to distinguish the two Indian races.

Hinton states that *cachinus* has, typically, four outer, four inner salient angles. *Libonotus* comes in a different section of his key with three inner, three outer salient angles each side. In our material, *libonotus* stands out from all other races by its proportionately shorter tail, which averages only about one-third of the head and body length. *E. m. cachinus*, which I take to include the Adung Valley specimens, is somewhat noteworthy for its small bullae. So far as this species is available to me, they average smaller than in other races. In the typical race, the bullae are usually more than a quarter of the occipitonasal. Probably this race may be retained chiefly on this character. According to Hinton, the bullae in *libonotus* are small, but in material examined they are not measurable. With our somewhat sketchy material, it is not possible to say more at present.

(i) *Eothenomys melanogaster cachinus* (Thomas)

1921. *Microtus* (*Eothenomys*) *melanogaster cachinus* Thomas, *J. Bombay nat. Hist. Soc.*, 27, 504.

Type-locality.—Mount Imaw Bum, Kachin Province, 9,000 ft.

Range.—Specimens seen from the type-locality, and UPPER BURMA: Adung Valley.

(ii) **Eothenomys melanogaster libonotus** Hinton

1923. *Eothenomys melanogaster libonotus* Hinton, *Ann. Mag. nat. Hist.*, **11**, 151.

Type-locality.—Dreyi, Mishmi Hills, 5,140 ft.

Range.—Specimens examined from the type-locality.

Both of these are recorded from numerous localities in NORTHERN BURMA by Anthony (not occurring together).

Genus 26. **Alticola** Blanford

1881. *Alticola* Blanford, *J. Asiat. Soc. Beng.*, **50**, 2, 96.

Type-species.—*Arvicola stoliczkanus*, Blanford.

Distribution.—KUMAON and NORTH NEPAL, PUNJAB, KASHMIR, NORTH-WEST FRONTIER, Afghanistan, Chinese Turkestan, Mongolia, Tibet, Kansu, southern and eastern parts of Russian Turkestan, Siberian Altai and Sayan Mountains. Always, apparently, inhabiting high mountains.

This is the first generic name for those voles with the simple, *Clethrionomys*-like posterior palate, and with rootless molars (as in *Microtus*). It differs from *Eothenomys* in the long-drawn-out appearance of the cheekteeth, caused by the folds being more widely open. There are, as far as is known, pectoral mammae present. I have not been able to find any cranial distinctions between the two genera when all species available are taken into account and it may well be that in the future *Eothenomys* will be regarded as a subgenus of *Alticola*. As, however, the two groups are easily distinguished by the appearance of the cheekteeth and the colour of the animals, I retain both as genera.

A large number of names have been based on various forms of the present genus from Central Asia. Hinton has keyed those which are represented in the British Museum. Most of these have in the past been treated as full species, although many if not all are inadequately known. The subgenus *Platycranius* is confined to Russian Asia and stands well apart from the typical subgenus by reason of its peculiarly flattened skull. Hinton recognized two groups of species in *Alticola* s.s., and I propose to regard these two groups as the two valid species.

Key to the species of Alticola inhabiting India

- i (2) M. 3 reduced, with very short heel and only two clear inner salient angles. (One or at most two inner folds.) Tail very short,

- usually less than one-quarter of head and body *Alticola stoliczkanus*
- 2 (1) M. 3 less reduced, with at least three inner salient angles (and three inner folds traceable). Tail less shortened, usually over 30% of the head and body.. *Alticola roylei*

60. *Alticola roylei* (Gray)

Royle's Vole

1842. *Arvicola roylei* Gray, *Ann. Mag. nat. Hist.*, 10, 265.

This would appear to be the first name in the species. It is as here understood the typical race of a group which occurs in KUMAON, KASHMIR, NORTH-WEST FRONTIER, Afghanistan, southern and eastern Russian Turkestan, Sinkiang and Mongolia, and perhaps elsewhere.

I include in it all *Alticola* voles with the third upper molar not specially reduced and with the tail relatively longer, approximating to 30% or more of the head and body; essentially the *roylei* group of Hinton (1926).

Generally the tail is bicolor in Indian races of this species, but some of the Siberian and Chinese races have the tail white.

External characters.—Thick-furred voles, not specially modified for underground life, the tail usually more than 30% of head and body length, rarely slightly less (29%, apparently, in *glacialis*) but over one-quarter of head and body length, and quite well haired. Ear averaging about one-tenth of head and body in the typical race, but less reduced in the other races. Hand with four functional fingers, the claws not enlarged. Foot with five toes as usual; heel tending to be rather hairy. Mammae 2-2 = 8 in the four better known races, but 1-2 = 6 in one specimen. Colour above rich dark brown, pale brown below. In the closely allied race *cautus*, the underparts are more grey. The tail bicolor, dark above, pale below. In *blanfordi* (at least the specimens referred by Hinton to *lahulus*), the colour of the back is not very different and the underparts are about as in *cautus*; typical *blanfordi* was stated by Hinton to be rather light greyish brown above, with a very slight rufous tinge, with underparts greyish white darkened by the slaty hair bases. *A. r. montosa* is near *roylei* above, the underparts silvery grey. Tail clearly bicolor. Finally, three skins identified as *albicauda* by Hinton seem greyer dorsally than the majority (pale reddish grey, the hairs dark plumbeous at base, with a subterminal

ring of pale yellow, and brown tips, the peculiar pale tint of the back being produced by the mingling of these three colours, as described by Hinton). Below white, the hairs grey based. Tail obscurely bicolor in our specimens. There is not a lot of difference in colour in these various types. The feet tend to be pale or whitish in them all.

The three skins which Hinton called *albicauda*, I am more inclined to refer to *A. r. glacialis* Miller (1913), for the following reasons: *albicauda* was based on a skin with a white tail, and in which the tail was about 40% of the head and body (as in *blanfordi* or *montosa*), whereas our skins from Baltistan now under discussion have the tail under one-third of the head and body (roughly as the type of *glacialis*) and not entirely white (as in *glacialis*). The latter was based on a series of 46 specimens, and from figures published by Hinton the tail is about 34% of the head and body, or strongly shortened. Its type measured, head and body 116 mm., tail 40 mm. (or roughly one-third of head and body). Compare the type of *albicauda*, head and body 107 mm., tail 44 mm. (about 41%).

If these skins are referred to *glacialis* the form *A. r. albicauda* (*Alticola albicauda* True, 1894, *Proc. U.S. nat. Mus.*, 17, 12) will still apparently be only known by one specimen, which seems very near *blanfordi* or *montosa*, but with a white tail.

Its type-locality is Braldu Valley, Baltistan.

Since I wrote the above, Schwarz (1939, 665) separated these specimens as *Alticola acmaeus*. He says it differs from *glacialis* by the sharp line of demarcation and the white belly (the colour of the legs in *glacialis* is washed buffy, as in *albicauda*), by the tips of the hairs on the back being chocolate instead of black and by the shorter tail, which is nearly completely white (in *glacialis* it is more or less bicolor). He gives measurements of the type as head and body 104 mm., tail 32 mm., hindfoot 21 mm., condylobasal 25.5 mm., zygomatic breadth 13.7 mm., nasals 7.9 mm., upper molars (crowns) 6.1 mm., diastema 7.3 mm. These characters seem slight and direct comparison with the type of *glacialis* seems needed.

External measurements.—As in Table 51, below.

Notes from skins of Alticola roylei.—

A. r. glacialis: Nahr Nullah, caught in wall near cultivated land. Caught in cliff (150 feet above the locality of the last).

TABLE 51.—*External measurements of the Indian races of Alticola roylei*

		Head and body	Tail	Hind- foot	Ear	
<i>Alticola roylei roylei</i>						
F.	Phurkia, Kumaon	112	38	18	12	8 mammae
M.	Phurkia	111	33	20	12	
M.	Phurkia	102	35	19	13	
M.	Phurkia	113	38	19	12	
M.	Phurkia	110	38	19	12	
F.	Phurkia	107	38	18	13	8 mammae
F.	Phurkia	106	39	18	12	8 mammae
F.	Phurkia	?	36	19	11	8 mammae
F.	Phurkia	109	35	18	13	8 mammae
M.	Phurkia	104	36	19	13	
<i>Alticola roylei montosa</i>						
M.	Pyas, Kishtwar	104	50	20	15	
M.	Tullian, Kashmir . .	106	46	20	13	
F.	Sonemurg, Kashmir	126	58	?	16	8 mammae
M.	Sugga Nullah, Kashmir	102	42	21	15	
M.	Sugga Nullah	108	47	21	15	
F.	Gugai, Kashmir	109	47	20	15	
						mammae 1-2 = 6
F.	Gulmerg, Kashmir	124	45	20	15	
F.	Kagan Valley, N.W.F.P.	114	51	19	13	
F.	Kagan Valley	115	41	18	13	
F.	Kagan Valley	114	40	18	14	mammae 8
F.	Rupal, Astor	107	42	18	15	
F.	Rupal, Astor	85	37	18	13	
F.	Safed Koh, NW. Frontier	121	40	19	16	
M.	Danlong, Kishtwar	104	41	18	13	
M.	Shenkagarh, Astor	107	40	18	13½	
M.	Rupal, Astor	98	45	18	14	
F.	Pahlgahm	102	46	20	15	
M.	Dangail, Kishtwar	109	46	19	13	
<i>Alticola roylei blanfordi</i> ('lahulius')						
M.	Kyelang, Lahul	100	31 (or 51)	19	15	
M.	Pattan Valley, Lahul	100	46	19	15	
M.	Pattan Valley	98	45	18	15	
F.	"	97	35	18	15	
F.	"	97	44	18	15	
F.	"	105	45	17	15	
						mammae 2-2 = 8
M.	Kyelang	110	54	19	17½	
F.	Pattan Valley	97	43	18	15	
F.	"	91	41	17½	15	

TABLE 51.—*External measurements of Alticola roylei (concl'd.)*

		Head and body	Tail	Hind- foot	Ear
<i>Alticola roylei blanfordi</i> (' <i>lahulius</i> ') (concl'd.)					
F.	Pattan Valley	100	45	17½	15
M.	"	92	41½	18	15
M.	"	100	48	18	15
	Zinzingear, Lahul	101	45	19	14½
	Sissu, Lahul	104	40	19	14
F.	Jagatsukh, Lahul	110	47	20	14
M.	"	117	44	18	14
F.	"	107	45	19	15
F.	"	101	42	18	14
					mammae 2-2 = 8
M.	Koksar, Lahul	101	35	18	14
M.	Jagatsukh	112	38	18	14
F.	"	114	47	18½	14
M.	"	110	41	18	14
<i>Alticola roylei cautus</i>					
F.	Rahla, Lahul, type	118	44	19	14
F.	Rahla	108	39	18	14
F.	Rahla	109	36	18	14
M.	Rahla	108	38	19	14
F.	Rahla	115	44	19	14
M.	Rahla ..	116	41	19	14
F.	Rahla	116	40	19	14
F.	Rahla	103	36	18	14
F.	Rahla	112	44	19	14
F.	Rahla	98	40	18	14
F.	Rahla	104	38	23	14
F.	Rahla	115	39	19	14
F.	Rahla	111	40	18	15½
					mammae 2-2 = 8
M.	Rahla	107	43	19	14
F.	Rahla	107	37	18	15
					mammae 2-2 = 8

Alticola roylei glacialis

Three skins, from Nahr Nullah, Baltistan, about 12,000 ft. Measurements in inches; respectively,

head and body 4.25, 4.2 and 3.9,
tail 1.4 1.25 and 1

Hinton gave the measurements of the type of *A. blanfordi* (in alcohol), as head and body 115, tail 52, foot 19 mm.

A. r. blanfordi : Lahul: mammae 2-2 = 8 in two specimens.
A. r. montosa : Kagan Valley: 'shot outside ruin about which it was alternately scampering and nibbling grass. Four young inside, two

pairs mammae.' 'Trapped in house.'
'Caught in juniper scrub feeding on wild
rhubarb. Active, bold little beast.'

Shenkagarh, Astor: trapped among rocks.

Gugga Nullah: trapped on bank of river.

At the same locality; holes numerous on
ground lately covered by snow; 6
mammae, pectoral 2, ventral 4.

Sonemurg, Kashmir: trapped under rock
by subterranean stream in forest, suck-
ling mother. Mammae 8.

Pyas, Kishtwar: trapped in jungle.

Pahlgahm: trapped in bank.

A. r. cautus: Rahla, Lahul: weight 1.15 oz., mammae
2-2 = 8. Another contained 4 foetuses.

A. r. roylei: Phurkia, Kumaon: weight $1\frac{1}{8}$ oz., $1\frac{3}{8}$ oz.,
 $1\frac{1}{4}$ oz., $1\frac{5}{8}$ oz., $1\frac{1}{2}$ oz., $1\frac{3}{4}$ oz. and 1 oz.;
mammae 8 noted in five specimens.

There is an *Alticola* skin in the British Museum which I do not identify, from above Lidarwat, Kashmir, 10,000 ft. It has the appearance of *roylei*, but a long tail (head and body 4 inches, tail 2.1 inches = over half head and body length). Its skull is 28.3 mm. in occipitonasal length; the bullae, 6.9 mm., seem too small for *blanfordi* or *montosa*. Its palate, 14.6 mm. suggests *montosa*, but its toothrow, only 5.7 mm., suggests *blanfordi*. One can do little with an isolated specimen as this, but it would be interesting to obtain more from that locality.

We have no skulls for *Alticola glacialis*, but three skins seem to have the tail more reduced, less than one-third of the head and body length, than in the other races. Two of these have this length below 30% of the head and body, the third does not. It may be a retainable race.

Cranial characters.—The skull is that of a fairly typical non-specialized Microtine; it lacks the angularity characteristic of more progressive genera. The squamosal crests are present and fairly well developed, and the interparietal is present and large. The ridges of the frontals do not as a rule approach each other, nor are they very strong. The interorbital constriction is marked but not excessive. Palatal foramina long, usually more than 20% of the occipitonasal length. The palate is generalized and simple posteriorly, as in *Eothenomys*. Pterygoid fossae deep and large, the hamular processes joining the bullae, which are large and well inflated, but smaller in the typical race than in the other

aces. Infraorbital foramen, zygoma, and zygomatic plate typically Microtine and normal. The bullae lack spongy tissue within. The mandible has the coronoid well developed and the angular process rather small.

Dental characters.—Upper incisors broad, usually yellow but often somewhat pale, and plain. The cheekteeth have the folds rather wide and well open, and are with a long-drawn-out appearance which is readily distinguishable from the pattern of *Eothenomys*, although somewhat difficult to describe. M. 1 with anterior loop and four alternating closed triangles (two main folds each side). M. 2 with anterior loop and three closed triangles, of which two are external, one internal (and two main outer, one main inner folds). M. 3 has a straight anterior loop, followed by three small triangles, which are often not fully closed (two outer, one inner), followed by a long straight posterior loop with a faint or moderate indentation on its inner side. Three inner folds can be traced or are present in this tooth. Third lower molar with three transverse loops; second lower molar with posterior loop, and four alternating closed triangles; first lower molar with posterior loop, and five alternating triangles, of which the first four (after the posterior loop) are closed, the fifth being merged into the anterior loop.

Cranial measurements.—As in Table 52, below.

TABLE 52.—*Cranial measurements of the Indian races of Alticola roylei*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Alticola roylei roylei</i>							
M.	14.7.10.220	26.4	13.5	5.6	6.1	5.9	4.4
	Phurkia, Kumaon						
M.	14.10.7.221	26.6	13.8	5.3	6.4	6.4	4.4
	Phurkia. Condylbasal 26.8 mm. (Unless stated to the contrary, the condylbasal is less than the occipitonasal in these specimens.)						
M.	14.7.10.222	25.7	13.2	5.3	6.0	6.0	4.0
	Phurkia						
F.	14.7.10.225	26.3	13.5	6.0	5.8	6.7	4.0
	Phurkia. (Foramina, 6.0 longest side)						
F.	14.7.10.227	26.5	14.3	5.6	6.2	6.6	3.9
	Phurkia. Condylbasal 27.1 mm.						

The type has the occipitonasal length about 25.0 mm.

TABLE 52.—*Cranial measurements of Alticola roylei (concl'd.)*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Alticola roylei blanfordi</i>							
Not registered—							
	Kangra						
	Valley	25.7	13.2	5.2	6.4	5.8	3.7
M.	8.3.9.17	27.2	13.3	5.4	6.8	5.8	3.7
	Nultan Valley, Gilgit, type						
	81.3.1.22	27.6	?	c. 6.1	c. 7.0	5.8	4.1
	Gilgit. Lectotype						
F.	HWW. 2808	27.0	14.1	5.3	?	5.7	?
	Locality ? 'lahulius'						
F.	HWW. 2798	25.5	13.1	4.9	6.6	5.5	3.7
	Locality ? 'lahulius'						
M.	HWW. 2796	25.3	12.6	5.1	6.8	5.9	3.7
	Pattan Valley, Lahul, 'lahulius'						
<i>Alticola roylei montosa</i>							
Musters collections—							
	NWF. 1	28.3	14.4	5.7	7.0	6.4	4.1
	Safed Koh, North-West Frontier.	(Identifications provisional)					
M.	8.10.3.10	c. 25.7	14.0	5.8	6.4	6.2	4.0
	Kagan Valley, Hazara, 'imitator'						
	10.1.18.60	27.8	14.6	5.6	6.8	6.3	4.1
	Kashmir						
F.	13.1.19.20	27.8	15.0	5.3	7.1	6.2	3.4
	Sonemarg, Kashmir						
M.	Crump 520	25.1	13.7	5.4	6.4	5.6	3.5
	Danlong, Kishtwar						
M.	Crump 926	26.0	13.6	4.8	6.6	5.7	4.0
	Shenkagalu, Astor						
M.	Crump 882	25.5	13.0	5.3	6.4	6.0	3.7
	Rupal, Astor						
F.	Crump 983	26.4	13.4	5.1	6.5	5.9	3.7
	Pahlgahm						
M.	Crump 481	26.2	?	5.3	6.6	6.4	3.7
	Dangail, Kishtwar						
<i>Alticola roylei cautus</i>							
Type, HWW.							
M.	2384	27.1	14.6	5.7	c. 6.3	6.4	4.1
F.	HWW. 2364	26.4	13.6	5.7	c. 6.1	6.3	3.7
	Rahla, Lahul						
F.	HWW. 2385	26.1	14.1	5.3	?	c. 6.6	3.9
	Rahla						
F.	HWW. 2345	25.9	13.8	5.3	c. 6.5	6.4	4.0
	Rahla						
M.	HWW. 2361	26.7	14.4	5.6	?	6.6	4.3
	Rahla						
F.	2336	25.6	13.5	5.2	c. 6.3	5.8	3.8
	Rahla						

Dimensions of Alticola roylei, including all races, in British Museum material.—The occipitonasal length varies between 25.0 and 28.3 mm. Upper toothrow between 5.5 and 6.7 mm. The head and body length varies between 85 and 126 mm., tail 29–58 mm.; hindfoot 17–23 mm.

Provisional key to the races of Alticola roylei in India

1	(2) The tail is, in British Museum material, less than one-third of the head and body ..	<i>A. r. glacialis</i>	
2	(1) The tail averages at least one-third of head and body length. ..		3
3	(6) Bullae relatively small, less than one-quarter of the occipitonasal length. Tail averaging less than 40% of the head and body.		4
4	(5) Ear 13 mm. and less. Underparts less grey.	<i>A. r. roylei</i>	
5	(4) Ear 14 mm. and more. Underparts more grey .	<i>A. r. cautus</i>	
6	(3) Bullae relatively large, usually approximating to one-quarter of occipitonasal length or exceeding it. Tail averages more than 40% of the head and body. ..		7
7	(8) Length of the palate is (with one exception in a small series) 13.3 mm. and less. Length of the upper toothrow less than 6 mm.. .. .	[(with 'lahulus') <i>A. r. blanfordi</i>	
8	(7) Length of the palate is (with one exception) 13.4 mm. and more. Length of the upper toothrow is most often more than 6 mm.	<i>A. r. montosa</i>	

The characters separating the last two are poor, but I cannot find better ones. According to Hinton's measurements, the zygomatic width is 14.5 mm. in three skulls for *blanfordi*, 14.9 mm. and more in three for *montosa*. This may be a good distinguishing character. The zygomatic breadth is a measurement which I have abandoned in my work on cranial distinctions in rodents, owing to the high percentage of skulls in which the zygomata are broken and the measurement is unobtainable.

Subspecies.—The first names for this specific group are all, with one exception, Indian; the exception being *argentata* Severtzov, 1879 ('*argurus*' Thomas, 1909), from Russian Turkestan, a form with apparently a longer tail than any of the Indian races, which is white in colour, so far as I know.

A. r. roylei may apparently be restricted to Kumaon. (See discussion in Hinton, 1926, *Monogr. Voles and Lemmings*, 1, 313). The ear is on average about one-tenth of head and body length, therefore rather shorter than in the allies, and the tail averages about one-third of head and body length in our specimens. The bullae are small, less than one-quarter of the occipitonasal length.

A. r. cautus is very close to it but the belly tends to be greyer rather than browner, and the ear is constantly slightly larger (14 mm. and more instead of 13 mm. and less). The tail averages slightly longer, about 36% of the head and body.

In the remaining races, the bullae are larger, most often more than one-quarter of the occipitonasal length, or approximately that length. Both the next two have the tail normally over 40% of the head and body length. I do not find it easy to separate *montosa* from *blanfordi*. Hinton says that in *blanfordi* the skull is 'long, narrow, and delicately built'; in *montosa*, the skull is 'broader and more heavily built'. Cranially, nearly always the teeth tend to be shorter in *blanfordi* than in *montosa*, so far as I can see from our material; and nearly always the palate tends to be shorter in *blanfordi* than in *montosa*, but in each case there are overlaps.

Hinton separated a series taken in Lahul as *A. blanfordi lahulius*, stating that this form is darker in colour, and has shorter nasals and less inflated bullae than in *blanfordi*, but the latter name is so very poorly known that it seems to me to be altogether premature to attempt to divide it into races, even if it was given specific rank, as by previous authors. The bullae of the types of *blanfordi* seem not to be larger than all skulls I have measured for *lahulius*. Hinton says the nasals measure 7-7.8 mm. for *lahulius* as against 8.3 mm. in one skull for *blanfordi*. Until further typical material comes to hand for *blanfordi*, I prefer to regard '*lahulius*' as a synonym.

(i) *Alticola roylei roylei* (Gray)

1842. *Arvicola roylei* Gray, *Ann. Mag. nat. Hist.*, 10, 265.

Type-locality.—Kumaon (Wroughton, Hinton).

Range.—Specimens examined from KUMAON: Phurkia.

This race has small bullae and a rather reduced ear. The tail is about one-third of the head and body on average.

(ii) **Alticola roylei cautus** Hinton

1926. *Alticola roylei cautus* Hinton, *Monogr. Voles and Lemmings*, 1, 313.

Type-locality.—Rahla, Kulu Valley, Lahul.

(It occurs 8,500–9,200 ft., at lower levels in Lahul than *blanfordi*). Specimens examined from LAHUL: Rahla.

Like the typical race, but with the ear slightly larger constantly, the tail a little longer proportionately, and the underparts averaging greyer.

(iii) **Alticola roylei blanfordi** (Scully)

The Gilgit Vole

- 1880 *Arvicola blanfordi* Scully, *Ann. Mag. nat. Hist.*, 6, 399.
 1926. *Alticola blanfordi lahulius* Hinton, *Monogr. Voles and Lemmings*, 1, 309. (Kyelang, Lahul, 10,380 ft.)

Type-locality.—Gilgit (at altitudes between 9,000 and 10,000 ft.).

Range.—Specimens examined from KASHMIR: Nultan Valley, LAHUL (altitudes 10,000–14,000 ft.): Kyelang, Kangra Valley, Pattan Valley, Sissu, Koksar, Jagatsukh.

This race has large bullae and the tail averages more than 40% of the head and body. In both of these characters it differs from the typical race. My reasons for provisionally treating Hinton's form *lahulius* as a synonym are given above.

(iv) **Alticola roylei montosa** (True)

1894. *Arvicola montosa* True, *Proc. U.S. nat. Mus.*, 17, 11.
 1905. *Microtus imitator* Bonhote, *Ann. Mag. nat. Hist.*, 15, 197. (Tullian, 11,000 ft., Kashmir.)

Type-locality.—Central Kashmir, 11,000 ft.

Range.—Specimens examined from KASHMIR: Gulmerg, Gugai, Kagan Valley, Hazara, Pyas, Kishtwar, Rupal, Astor, Sonemarg, Gugga Nullah, Tullian, Danglong and Dangail, Kishtwar, Pahlgham, Shenkagalu, Astor, Safed Koh in NORTH-WEST FRONTIER.

This race is very close to *blanfordi*, and it is difficult to keep it separate by average cranial characters such as a tendency for the palate to be longer, and also the toothrow. Perhaps also the zygomatic breadth is greater. A specimen from Afghanistan (Paghman) is similar in general details to this race.

(v) **Alticola roylei glacialis** Miller

1913. *Alticola glacialis* Miller, *Proc. Biol. Soc. Washington*, **26**, 197.

Type-locality.—Chogo Lungma glacier, Baltistan, 11,000 ft. Kashmir.

Range.—Specimens examined from KASHMIR: Nahr Nullah in Skardu, Baltistan, about 12,000 ft.

This race apparently has a shorter tail than in allies, and our specimens appear slightly paler grey dorsally than in the allied races. Schwarz (1939) says these specimens are not true *glacialis* and separates them as *acmaeus*, which would be at most a race of *A. roylei*.

61. **Alticola stoliczkanus** (Blanford)

Stoliczka's Vole

1875. *Arvicola stoliczkanus* Blanford, *J. Asiat. Soc. Beng.*, **44**, 2, 107.

This species has M. 3 reduced, with only two salient angles on the inner side in the adult, and the tail is very short, roughly 22% on average of the head and body length in our specimens, and is white in colour. The species seems to be confined to Kashmir, Tibet, the region of Mount Everest, etc., and to be quite clearly specifically distinguishable from *A. roylei*.

External characters.—The tail averages less than one-quarter of head and body length, and is white in colour and very well haired throughout. It is usually not much longer than the hindfoot. Fur thick and soft. Hand with four functional digits; the claws not enlarged. The thumb vestigial, clawless. Foot with rather reduced hallux, which is shorter than the fifth toe, which in turn is shorter than the three central digits. Sole hairy in part behind. Ear rather large, approximating to about 15% of head and body.

Colour (stracheyi).—Light yellowish brown above as a rule, the fur slate coloured basally, underparts whitish, the hairs darker basally, and the slate colouring showing on the majority. Cheeks tend to be white. Tail wholly white; feet pale.

Khardong, Ladak; 'Found nest under large rock and secured two young' 'Trapped on river bank'

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Alticola stoliczkanus stracheyi</i>				
Rupshu, Ladak	120	22	?	?
F. Lingti, Lahul	88	24	20	15
F. Lingti Plain	90	25	20	15
M. Lingti Plain	92	26	20	15
F. Lingti Plain	118	30	20	16
F. Lingti Plain	90	25	20	15
F. Kyinlung, Lahul	97	24	19	15
F. Kyinlung, Lahul	102	22	19	16
F. Kyinlung, Lahul	100	24	19	16
F. Khardong, Ladak	113	19	19	14
M. Khardong, Ladak	106	18	18	14
M. Rusela, Upper Sutlej	98	20	17	14
Chipchak River, Dipsang Plains, Ladak	101	14	18	15

Cranial and dental characters.—Essentially as in *A. roylei*, except for the third upper molar. The braincase, as pointed out by Hinton, tends to appear a little shorter than in the related species. Third upper molar reduced, with an anterior loop, then two clear triangles (one inner, one outer), and then a short straight posterior loop; only two clear inner angles in this tooth, and only one or at most two clear inner folds. The posterior loop is directed backwards. The posterior loop may or may not be over half the length of the crown of the tooth in material available.

Cranial measurements.—

	Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Alticola stoliczkanus stracheyi</i>						
F. 4.5.4.9	27.2	14.7	5.7	6.5	6.1	4.0
Rupshu, Ladak (' <i>crisetulus</i> ').	Condylbasal 27.4 mm.					
F. 6.12.3.19	26.2	14.4	5.3	?	5.9	3.7
Khardong, Ladak.	Condylbasal 26.7 mm.					
F. 7.9.6.7	24.6	13.2	5.4	6.1	5.5	4.0
Chipchak River, North Ladak						
F. 36.4.12.7	27.3	14.3	5.7	6.7	6.1	3.8
Mipal Valley, East Ladak. (Subsp. ?)						

Other skulls from Kurram Valley (young) and one from Tibet.

Dimensions of Alticola stoliczkanus, in British Museum material.—The occipitonasal length varies between 24.6 and

27.3 mm. Toothrow 5.5–6.1 mm. Head and body length varying between 88 and 120 mm. Tail 14–30 mm. Hindfoot 17–20 mm.

Key to the races of Alticola stoliczkanus (according to Hinton)

- “ M. 3 is more reduced but more normal in appearance; the posterior loop short and broad, forming less than half the length of the crown. *A. s. stoliczkanus*
 M. 3 is less reduced, its form most peculiar, the posterior loop long and narrow and forming fully half the length of the crown ” *A. s. stracheyi*

The typical race is from the Kuenlun Mountains, Ladak, and is not authentically represented in the British Museum. But whether the form described as *stracheyi* by Thomas is in reality a valid subspecies or whether it is a synonym, I do not know. There seems very little difference between the two from descriptions from both Blanford and Hinton.

But both types of tooth seem to me to be represented individually within our limited series for *stracheyi*. Blanford divides the two on colour; ‘light ferruginous brown’ for *stoliczkanus*, ‘light brown, with a grey tinge’ for *stracheyi*. Until the type of *stoliczkanus* can be compared with material for *stracheyi*, not much more can be suggested regarding their supposed distinctions.

(i) ***Alticola stoliczkanus stracheyi* (Thomas)**

1880. *Arvicola stracheyi* Thomas, *Ann. Mag. nat. Hist.*, 6, 332.

1899. *Microtus cricetulus* Miller, *Proc. Acad. nat. Sci. Philadel.*, 294. (Tso-Kyun, 16,000 ft., Ladak).

Type-locality.—Ladak (according to Hinton, 1926).

Range.—Specimens examined from TIBET: Massimik Pass. Rusela, on UPPER SUTLEJ. LAHUL, Lingti and Kyelang. KASHMIR: (Ladak), Chipchak River; Khardong; Kurram Valley; Pandong; Rupshu; Mipal Valley, East Mount Everest, NEPAL.

Another form to be considered as *Alticola stoliczkanus* (?) *acrophilus* Miller, 1899 (*Microtus acrophilus*), from the Ladak side of the Karakorum Pass. It is not represented in London and, as far as I have traced, only known by one specimen. ‘Closely related to *A. stoliczkanus* from which it is readily

distinguished by its shorter tail and much paler colour'. In my opinion, too much attention has been paid to supposed colour details in this genus (as in many more Indian rodents) and in *Alticola* there are too many forms which are imperfectly known for one to be able to give characters to retain them with certainty.

61(a) *Alticola bhatnagari* Biswas and Khajuria

See Appendix.

Genus 27. *Hyperacrius* Miller

1896. *Hyperacrius* Miller, *North Amer. Fauna*, No. 12, 54.

Type-species.—*Arvicola fertilis* True.

Distribution.—Kashmir and Punjab, NORTH INDIA.

This group, proposed as a subgenus by Miller, was given generic rank by Hinton, 1926, and merits that distinction. It is like *Alticola* and probably an offshoot from it, but with more specialized external form which is to a degree modified for fossorial life, and in particular the skull is more specialized, the frontal ridges fusing to form a median interorbital crest (thereby more advanced than in the related *Alticola* and *Eothenomys*). The cheekteeth are like those of more specialized *Alticola*, i.e. *A. stoliczkanus*, with relatively reduced M. 3.

The palate appears to be proportionately longer than in the allied genera, averaging nearly or over 60% of the occipitonasal length. It remains relatively generalized posteriorly, as in *Alticola*. Four named forms are known. One of these, *aitchisoni* Miller, is so imperfectly known that it might be regarded as unidentifiable. Apart from this, it appears that two species may be tentatively recognized in the present state of our knowledge.

Key to the species of Hyperacrius

1	(2) Larger animal, the occipitonasal length not less than 25.4 mm., the upper toothrow not less than 6.2 mm. in material examined.	<i>Hyperacrius wynnei</i>
2	(1) Smaller animal, the occipitonasal length not exceeding 24.0 mm. in material available; the upper toothrow 6.2 mm., and less, usually less	<i>Hyperacrius fertilis</i>

62. *Hyperacrius wynnei* (Blanford)

The Murree Vole

1881. *Arvicola wynnei* Blanford, *J. Asiat. Soc. Beng.*, 1880, **49**, 2, 244.

Vernacular name.—Kanis, *H.* (Blanford).

Type-locality.—Murree, Punjab, 7,000 ft.

Range.—Specimens examined from PUNJAB: Murree, Gharial. KASHMIR: Sardalla. NORTH-WEST FRONTIER: Doonglagali.

This is the first name in the genus and as indicated above is the largest species. Typically from the Punjab, it is also known from Kashmir.

External character.—Fur soft, described by Hinton as 'very soft and velvety, dense and mole-like' The tail is most often more than one-third of the head and body, and is fairly well haired. Ear short, only rarely reaching 10 mm. in length, and less than one-tenth of the head and body length. Hand with four functional fingers, D. 5 the shortest, the claws considerably enlarged; thumb vestigial, but usually clawed. Foot normal; the two outer toes shorter than the three inner ones, the claws prominent. Colour above in the majority dark brown; Hinton describes two colour phases in this species, upperparts yellowish brown varying between 'cinnamon brown' and 'Prout's brown', more or less darkened by the slaty bases of the hairs, sometimes the back greyish brown rather than yellowish brown, for the light phase, and varying between lustrous seal brown and glossy blackish brown in the dark phase. Underparts greyish or brownish, sometimes with a wood brown suffusion produced by the light hair tips. Tail clearly to obscurely bicolor.

According to Hinton, there are 6 mammae.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
<i>Hyperacrius wynnei</i>				
Doonglagali, N.W.F.P.	117	32	18	8
F. Murree, Punjab	116	43	18½	8
F. Murree	100	35	18	9
F. Murree	105	37	17	8½
F. Murree	104	37	18	8½
F. Murree	105	38	17	8
F. Murree	119	38	19	8½
M. Murree	108	37	19	9
M. Murree	112	41	19	10

	Head and body	Tail	Hind- foot	Ear
<i>Hyperacrius wynnei</i> (concl'd.)				
M. Murree	116	39	18	9½
F. Murree	112	44	19½	9
M. Murree	104	45	18	10
M. Murree	100	38	18	9
M. Murree	101	40	18	8½
F. Murree	114	38	18	9
F. Murree	110	38	18	9
F. Murree	108	37	18½	9
M. Murree	103	40	18	8½
M. Murree	114	39	19	9
M. Murree	110	38	18	10
F. Murree	115	28	18	9
M. Murree	106	37	18	9
M. Murree	100	37	18	9
F. Murree	107	41	19	10
F. Murree	112	44	18	9
M. Murree	110	37	18	9
M. Murree	107	40	19	8
F. Gharial, Punjab	122	23	17	10
F. Sardalla, Kashmir	84	33	16	8
F. Sardalla	84	32	17	8
F. Sardalla	92	34	17	8
F. Sardalla	86	35	16	8
M. Sardalla	87	32	16	8

Note: Kashmir skins are all smaller than Punjab series.

Notes from skins.—Murree, 'trapped at burrow in forest' Weight 1.5 oz. (3 specimens). Dunglagali, 'killed by cat just outside house' Gharial, 'found in grass ground in pine forests; mole-like in habits' Sardalla, 'trapped under the roots of a tree'

Cranial characters.—The skull is large for the present genus, the occipitonasal exceeding 25 mm. in length, so far as the scanty material available shows. It tends to be more angular than in the related genera *Alticola* and *Eothenomys*, and the ridges of the frontals fuse to form a median interorbital crest. They are fused in the majority of skulls seen for this genus. The nasals are not narrowed posteriorly. The squamosal crests and the interparietal are well developed. The occiput and lambdoid ridge appear somewhat stronger than in immediate allies. The bullae are relatively small, less than one-quarter of the occipitonasal length as a rule, but not smaller than in all forms of *Eothenomys* and *Alticola*. The palate is proportionately longer than in the two allied genera. Posteriorly it is simple. The palatal foramina tend to be narrow, but are not proportionately shorter than

in some forms of *Eothenomys*, though they seem more reduced than in *Alticola*. Pterygoid fossae deep. Infraorbital foramen narrow, zygomatic plate powerfully tilted upwards, and zygoma normal for the group. The mandible has the root of the lower incisor tending to form a process or knob below the condylar process. The coronoid process is strong and well developed.

Dental characters.—Upper incisors very wide, proodont to a degree, ungrooved and yellow. (Traces of grooving of the incisors may appear individually in the related species *H. fertilis* and may appear individually in many genera of Microtinae). M. 1 and M. 2 normal, i.e. as described above for *Alticola roylei*. M. 3 reduced, with two main folds each side, the posteroexternal one widest, the posterior loop very short; the tooth not dissimilar to that of *A. stoliczkanus*, but with shorter posterior loop. The folds of the cheekteeth lack cement, are wide open, and the general appearance is 'long-drawn-out' as in *Alticola*, not 'crowded' as in *Eothenomys*. Second and third lower molars with three transverse loops, without closed triangles; M. 1 with posterior loop, an inner closed triangle, two confluent triangles in front of that, and then two more confluent triangles opening into the anterior loop; sometimes none of the triangles is fully closed.

In this genus, the bullae lacks spongy tissue within, as in *Alticola* and *Eothenomys*. I have examined one specimen for this species to check the character of the lower incisor as described below for *Ellobius* and as normal for the *Microtus* group of genera; namely, that it passes under the toothrow from the inner to the outer side of the molars.

Cranial measurements.—

	Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals	
<i>Hyperacrius wynnei</i>							
	8.3.9.18	28.8	17.3	?	6.8	6.9	?
	Murree. Co-type.	Condylobasal	29.3 mm.				
M.	73.4.16.8	25.8	15.2	4.6	6.2	6.2	4.1
	Locality ?	Ridges fused.	Condylobasal	27.0 mm.			
M.	89.1.26.1	25.4	15.7	4.3	5.6	6.5	4.2
	Murree, Punjab.	Ridges fused.	Condylobasal	26.6 mm.			
	421b	26.1	15.6	5.4	?	6.8	4.5
	Locality ?	Ridges fused.	Condylobasal	26.8 mm.			
F.	HWW.						
	4311	27.4	16.8	5.2	?	7.2	4.1
	Locality ?	Ridges fused					

Dimensions of Hyperacrius wynnei, in British Museum material.—The occipitonasal length varies between 25·4 and 28·8 mm., the upper toothrow between 6·2 and 7·2. The head and body length varies between 84 and 122 mm., the tail between 23 and 45 mm., the hindfoot 16–20 mm.

63. **Hyperacrius fertilis** (True)

True's Vole

1894. *Arvicola fertilis* True, *Proc. U.S. nation. Mus.*, 17, 10.

Essentially like *H. wynnei*, but, as noted in the key above in detail, the size seems constantly smaller.

Distribution.—KASHMIR.

External characters.—Fur soft. Tail relatively shorter than in the allied species, less than 30% of the head and body, with rare exceptions. Ear reduced, most often less than one-tenth of head and body length in *brachelix*, just over this percentage in the typical race. Hands and feet about as in the related species.

Colour.—Above dark brown; below dull ochraceous, the hairs slaty based. Tail usually bicolor, dark above, pale below.

External measurements.—As in Table 53, below.

TABLE 53.—*External measurements of the Indian races of Hyperacrius fertilis*

	Head and body	Tail	Hind- foot	Ear
<i>Hyperacrius fertilis fertilis</i>				
M. Bogamana Glen, Hazara	108	26	16	12
M. Bogamana Glen	107	25	16	11
F. Bogamana Glen	102	26	15	12
F. Bogamana Glen	110	28	17	12
F. Gulla Nullah, Kashmir	111	19	14	10
Gugga Nullah	111	22	14	10
M. Gugga Nullah	95	24	15	10
M. Kagan Valley, N.W.F.P.	93	27	15	8
M. Kagan Valley	103	22	15	10
F. Kagan Valley	94	28	15	10
F. Rattoo, Gilgit	102	23	15	10
F. Pyas, Kishtwar	104	30	16	11
F. Tullian, Kashmir	105	28	17	12
M. Tullian	106	28	16	14
M. Tullian	91	38	15	12
F. Kagan Valley	111	26	16	11

TABLE 53.—*External measurements of Hyperacrius fertilis (concl'd.)*

	Head and body	Tail	Hind- foot	Ear
<i>Hyperacrius fertilis brachelix</i>				
F. Dangail, Kishtwar (probably represents the typical race)	106	44	19	13½
M. Leddar Valley, Kashmir	94	24	?	9
M. Pahlgahm, Kashmir	98	26	16	8
M. Surez, Leddar, Kashmir	99	25	19	10
F. Rupal, Astor	89	23	14	10
M. Astor Mang, Kashmir	87	26½	?	7
F. Chelum Valley, Kashmir	94	25	18	9
M. Dodri Pass	98	23	15	9
M. Visirrim, Kashmir	95	19	15	9

Notes from skins.—‘In a grass nest at the end of a burrow’ (Kashmir). Mammae 1-2 = 6 (one skin). Kagan Valley: ‘feeding at edge of snow on ridge top’ Rattoo, Gilgit: ‘trapped in house, common’ Gugga Nullah, Kashmir: ‘caught in house’ (two specimens). Kagan Valley: ‘very common about 9,000-13,000 ft.’ Bogamana Glen, Hazara: ‘lives in colonies, which spring to life as snow melts, about May’ One skin was noted as being trapped with a meat bait.

Cranial and dental characters.—Essentially as in *H. wyneei* but smaller, the occipitonasal length not exceeding 24 mm. in material available. The lower molars are on the same general plan, but there seems individual variation in the first as to which of the triangles are closed; sometimes none is, and sometimes nearly all seem to be so; others vary between the two extremes. Hinton states that the interstephanic portion of the frontals are more reduced and the zygomata are unusually elevated. The nasals are often very narrowed behind but this is not a constant character.

Cranial measurements.—As in Table 54, below.

Dimensions of Hyperacrius fertilis, in British Museum material.—The occipitonasal length varies between 22.1 and 24.0 mm. Toothrow 5.5-6.2 mm. The head and body length varies between 87 and 111 mm., the tail between 19 and 44 mm., hindfoot 14-19 mm.

Provisional key to the races of Hyperacrius fertilis

- 1 (2) The ear most often more than one-tenth of the head and body in length. *H. f. fertilis*
- 2 (1) The ear most often less than one-tenth of the head and body in length. *H. f. brachelix*

TABLE 54.—*Cranial measurements of the Indian races of Hyperacrius fertilis*

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
<i>Hyperacrius fertilis fertilis</i>							
Condylobasal normally exceeding occipitonasal length, and can exceed 25 mm.							
F.	8.7.6.94	23.3	14.2	4.5	c. 5.2	5.8	3.9
	Kishtwar						
F.	8.10.3.13	23.8	14.2	4.8	4.7	5.8	3.6
	Kagan Valley, Hazara.						
M.	10.1.18.61	23.0	13.7	4.1	?	5.9	3.6
	Gugga Nullah, Kashmir.						
F.	8.10.3.12	22.2	13.3	4.2	5.3	5.7	3.8
	Kagan Valley.						
M.	8.10.3.11	22.5	13.9	4.4	5.3	5.6	3.6
	Kagan Valley						
M.	10.1.18.62	22.1	13.7	4.6	?	5.7	3.8
	Gugga Nullah						
M.	12.11.26.14	24.0	14.5	5.2	5.7	6.2	3.6
	Kagan Valley						

Hyperacrius fertilis brachelix

(Condylobasal length exceeds occipitonasal in all specimens, the maximum, No. 6.10.3.12, 25.2 mm.) Ridges fused in all these specimens.

M.	5.1.5.4	22.2	13.0	4.1	c. 5.0	5.5	3.8
	Kashmir						
M.	5.1.5.5	22.3	12.7	4.1	5.4	5.7	3.9
	Kashmir						
M.	5.1.5.6	23.2	13.1	3.7	5.0	5.5	3.9
	Kashmir.						
F.	5.1.5.9	23.7	13.7	4.1	?	5.8	4.0
	Kashmir						
F.	5.1.5.10	23.3	14.2	4.5	5.6	5.8	3.6
	Kashmir						
F.	6.10.3.12	23.2	14.5	4.3	?	5.7	3.6
	Jogila Pass, Ladak						
F.	12.11.26.18	22.2	13.9	4.6	?	6.0	3.7
	Kagan Valley						
M.	12.11.26.16	23.4	14.3	4.4	5.1	5.8	3.7
	Bogamana Glen, Hazara						

Hinton was inclined to doubt whether the form *brachelix* was retainable, based solely on the size of the ear. Nevertheless, there seems an average difference between the two forms in this character.

(i) **Hyperacrius fertilis fertilis** (True)

1894. *Arvicola fertilis* True, *Proc. U.S. nat. Mus.*, 17, 10.

Type-locality.—Pir Panjal Mountains, Kashmir, 8,500 ft.

Range.—Specimens examined from KASHMIR: Bogamana Glen, Kagan Valley (Hazara), Rattoo, Gilgit, Pyas, Kishtwar, Tullian, Gugga Nullah. (Perhaps the first locality should be spelt Bogarmang Glen). Dangail, Kishtwar.

(ii) **Hyperacrius fertilis brachelix** (Miller)

1899. *Microtus (Hyperacrius) brachelix* Miller, *Proc. Acad. nat. Sci. Philad.*, 290.

Type-locality.—Nagmarg, Kashmir, 9,000 ft.

Range.—Specimens examined from KASHMIR: Astormang, Chalan Valley, Dodri Pass, Leddar Valley, Leyseh, Rupal, Surez, Visirrim, Wardwan Valley, Dachgam, Aru Ravine, Pahlgahm, Dubian, Preslang Ravine, Zogi-la Pass.

It does not seem possible to identify with certainty the form described as *Hyperacrius aitchisoni* Miller, 1897, *Proc. Biol. Soc. Washington*, 11, 141, from Gulmerg, Kashmir. It is most likely a race of *fertilis*, but might perhaps be a race of *wynnei*. The type and ? only known skull is in fragments. According to Hinton, it is 'outwardly resembling *fertilis* but distinguished by its larger size, hindfoot 18 mm., and by its apparently yellower colour'. (But we have two or three specimens of *H. f. brachelix* with the hindfoot as large as or even exceeding this measurement.) 'Colour on back bistre slightly darkened with blackish and fading rapidly on sides into the lightly yellowish wood brown of belly. Tail obscurely bicoloured, dark brown above, light yellowish-brown below. Feet dusky' (Miller).

Genus 28. **Microtus** Schrank

1798. *Microtus* Schrank, *Fauna Boica.*, 1, 1, 72.

1887. *Lasiopodomys* Lataste, *Ann. Mus. Civ. Stor. nat. Genova*, 2a, 4, 268. *Arvicola brandti* Radde, from north-eastern Mongolia. Valid as a subgenus.

1901. *Stenocranius* Kastschenko, *Ann. Mus. St. Petersb.*, 6, 167. *Arvicola slowzowi* Poliakoff = *Mus. gregalis* Pallas. Valid as a subgenus.

1908. *Chionomys* Miller, *Ann. Mag. nat. Hist.*, 1, 97. *Arvicola nivalis* Martins, from Switzerland.

Type-species.—*Microtus terrestris* Schrank = *Mus arvalis* Pallas, from Germany.

Distribution.—Throughout Europe, and most of North America. In Asia, occurring throughout Siberia and Russian Asia, Japan, Formosa, from Mongolia and Manchuria south to Yunnan, Sinkiang, NORTH BURMA, Afghanistan, Persia, Turkey in Asia, Syria and Israel, Libya.

This is the first generic name for a typical Microtine (though not the first generic name in the subfamily). It is essentially restricted to specialized voles in which the posterior palate terminates with the median process converted into a sloping septum between the posterolateral pits, the inner borders of these pits continuous with the tip or sides of median process; the cheekteeth are rootless; and the first lower molar has four or five closed triangles.

Many species occur in the Palaearctic region. One of these is now known to occur in North Burma. It belongs to the typical subgenus and is fairly easily distinguished from its allies by the combination of five closed triangles to the first lower molar, a normal third upper molar (with three re-entrant folds each side), a long tail, which is usually over half the length of the head and body (a rare character in the genus) and an extra posterointernal triangle in the second upper molar. These characters are not combined elsewhere, to my knowledge, in Palaearctic *Microtus*.

64. *Microtus clarkei* Hinton

Clarke's Vole

1923. *Microtus clarkei* Hinton, *Ann. Mag. nat. Hist.*, **11**, 158.

Type-locality.—Kiukiang-Salween Divide, Yunnan, China, 28° N.

Range.—Specimens examined from YUNNAN: Likiang Range; Kiukiang-Salween Divide. NORTH BURMA: Adung Valley and 28·8° N., 97·24° E.

Distribution.—Yunnan and northern BURMA.

A large vole with head and body exceeding 100 mm.

External characters.—A largish dark vole, with thick fur, and a long tail, which is over half the length of the head and body in all but one of the specimens in the B.M. The ear is not reduced in size, averaging about 12% of the head and body. Tail moderately haired, with a slight pencil terminally, but for most of its length the scales are not concealed. Hand as usual with four functional fingers, the claws not enlarged; foot with five toes, not peculiar in formation, the three central ones longer than the two outer ones. The plantar pads are probably normally five in number.

Colour.—Dark brown above, underparts slate grey, the hairs silver-tipped. Tail imperfectly bicolor, slightly paler below.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
M. Adung Valley, North Burma	107	60	20	15
Adung Valley, 12,000 ft.	105	60	19	15
F. Adung Valley	110	61	20	16
F. Adung Valley	112	63	20	15

In addition to the above specimens, there are two more voles collected by Kingdon Ward in NORTH BURMA, 28·8° N., 97·24° E. These have '*Neodon*' written on their labels but obviously represent *M. clarkei*, judging by the length of their tails and the fact that the first lower molar appears to have five closed triangles. (One of them has four closed triangles one side of the jaw, five on the other). In both *M. 2* is complex as usual.

Their measurements are as follow :

	Head and body	Tail	Hind- foot	Ear
F. FKW. 11 Burma, 28·8° N., 97·24° E.	107½	60	20	12½
M. FKW. 7 Burma, 28·8° N., 97·24° E.	120	65	20	15

	Occipito- nasal	Palate	Foramina	Bullae	Toothrow	Frontals
F. FKW. 11 Burma, 28·8° N., 97·24° E.	27·1	15·4	5·4	6·4	6·7	3·7
M. FKW. 7 Burma, 28·8° N., 97·24° E.	27·5	16·2	5·6	6·2	6·7	3·8

The ridges of the skull are not fused in either specimen.

Notes from skins.—Adung Valley; 'trapped in jungle, common' and 'trapped on open meadow, common'

Cranial characters.—Rather a large Microtine, with fairly angular skull; squamosal crests quite well developed; parietal's anterior borders projecting forward sharply into the back of the frontals on each side, just behind the squamosal crests, so that they are almost the shape of an inverted V anteriorly; interparietal large and well developed. Least interorbital measurement proportionately narrower than in *Alticola* and its immediate allies. The ridges on the frontal bones fuse to form a median interorbital crest in fully adult

skulls; I have seen specimens from Yunnan with this specialization present, although the Burma material does not contain any specimens with fused ridges. Palatal foramina of medium length, usually less than one-fifth of the occipitonasal length. Bullae moderately inflated but on average below one-quarter of the occipitonasal length. Pterygoid fossae deep; the hamulars joining the bullae; posterior palate specialized, as described in detail above in the key to the genera. Infraorbital foramen narrow and small, as is usual in normal *Microtinae*; zygomatic plate broad, powerfully tilted upward, its superior border well ridged. Zygomata well spread out from the sides of the skull; jugal relatively short. Mandible robust, with well developed coronoid process, and rather small angular process.

Dental characters.—Upper incisors broad, reddish in colour, not obviously grooved. M. 1 with anterior loop, four alternating closed triangles and a posterointernal heel suggested. M. 2 with an anterior loop, three alternating closed triangles, and an obvious posterointernal heel (which is characteristic also of the species inhabiting Britain, *M. agrestis*, but which is not a common character within the genus). M. 3 with three re-entrant folds each side, consisting of an anterior loop, three alternating closed triangles, and a posterior loop with a clear and deep inner fold in it. Third lower molar with three, transverse loops; second lower molar with a posterior loop and four alternating closed triangles; first lower molar with a posterior loop, in front of which are five closed triangles (two outer, three inner), in front of which is an anterior loop, with an indentation present or suggested on each side of it.

Cranial measurements.—

		Occipito- nasal	Palate	Foramina	Bullae	Toothrow	Frontals
M.	32.11.1.122	27.0	15.1	5.1	6.5	6.6	3.9
	Adung Valley, North Burma. Ridges free						
F.	32.11.1.125	28.2	16.1	5.4	6.6	6.3	3.9
	Adung Valley. Ridges approaching each other						
F.	32.11.1.126	27.1	15.2	5.0	6.3	6.3	3.8
	Adung Valley. Ridges approaching. Condylbasal 27.2 mm.						
F.	32.11.1.127	27.6	15.6	5.0	6.2	6.4	3.9
	Adung Valley. Ridges almost fused. Condylbasal 27.6 mm.						

Condylbasal shorter than occipitonasal in the first two skulls.

Dimensions of Microtus clarkei, in British Museum material.—The occipitonasal length varies between about 26.4

and 28.6 mm. Toothrow 6.2–6.7 mm. The head and body length varies between 105 and 134 mm. Tail 60–67 mm. Hindfoot 19–21 mm.

Genus 29. *Pitymys* McMurtrie

1831. *Pitymys* McMurtrie, Cuvier's *Anim. Kingd.*, American ed., 1, 434.
 1849. *Neodon* Hodgson, *Ann. Mag. nat. Hist.*, 3, 203. *Neodon sikimensis* Hodgson. Valid as a subgenus.
 1863. *Phaiomys* Blyth, *J. Asiat. Soc. Beng.*, 32, 1, 89. *Phaiomys leucurus* Blyth. Valid as a subgenus.

Type-species.—*Psammomys pinetorum* LeConte, from Georgia, United States.

Distribution.—As here understood, eastern and central North America; Continental Europe south of the Baltic, and Russia; in Asia, occurs in Asia Minor (subgenus *Pitymys*); Russian Turkestan (near Samarkand district), SIKKIM, Yunnan, Szechuan and Kansu (subgenus *Neodon*), Chinese Turkestan, Tibet, KASHMIR to MOUNT EVEREST (subgenus *Phaiomys*).

This genus is based primarily on the fact that normally there are only three closed triangles on the first lower molar (instead of four or five, as in *Microtus*). On this point I quote Hinton (1926), to the effect that 'the possession of M. 1 (lower) of three closed triangles only, on the one hand, or of four or more on the other, has been a distinction of generic importance since Pliocene times, at least'

It must be admitted that the character is not strictly constant in *P. irene*, though the majority of specimens agree with normal members of the genus. There seem no other characters to distinguish *Pitymys* from *Microtus* when all species are taken into consideration. The characters given by Hinton for *Phaiomys* and *Neodon* are so slight that I am not persuaded they are of generic value as that author maintained. Many authors refer *Phaiomys* and *Neodon* as subgenera to *Microtus*, but then *Pitymys* becomes indefinable, and would also have to go into *Microtus*; indeed, Russian authors regard it as a subgenus of the last named, but American and western European authors usually retain it. *Pitymys* is supposed to be 'evidently modified for fossorial life' when compared with *Microtus*, but its specializations in that direction are in no way extreme, and it is no more fossorial in external specializations than is *Phaiomys*, which is referred to *Microtus* by many authors. It may be said that characters which have in the past been used for generic

purposes in this group such as mammary formula, number of plantar pads, and exact details of dental pattern have in many cases proved inconstant as soon as large numbers of specimens have been collected. It is a convenience to retain *Pitymys* as a genus, but in my opinion this can only be done if *Phaiomys*, *Neodon* and the Nearctic *Pedomys* are referred to it as subgenera.

In Asia, *Pitymys* may be divided into three subgenera, two of which occur in India. It may be defined as like *Microtus* but normally with only three closed triangles to the first lower molar. *Pitymys* s.s., occurring in Europe, North America, and Turkey in Asia, contains species slightly but evidently modified for fossorial life, in which the supra-orbital ridges of the skull remain separate apparently at all times. *Phaiomys* contains Central Asiatic species in which the supraorbital ridges fuse to form a median crest, the third upper molar is strongly reduced in elements, and the bullae are proportionately enlarged. The external form is fossorial, with prominent claws and shortened ear and tail. *Neodon* contains forms in which the supraorbital ridges fuse to form a median crest, but in which the bullae are usually smaller than in *Phaiomys*, the third upper molar is most often less reduced (though perhaps not always so), the external form is generalized, with proportionately longer ear and tail.

Key to the subgenera of Pitymys inhabiting India
(based on Indian species of *Neodon* only)

1	(2)	Bullae proportionately larger, usually more than 6.5 mm. in length. Foreclaws slightly enlarged. Ear reduced, averaging 10-11% of head and body length. Tail shorter, less than 30% of head and body length on average. M. 3 strongly reduced, with two folds each side, and a short heel.	<i>Phaiomys</i>
2	(1)	Bullae proportionately smaller, only very rarely as much as 6.5 mm. in length. Foreclaws not enlarged. Ear larger, about 13% on average of head and body length; tail longer, over 40% of the head and body on average; M. 3 less reduced, with three inner folds, two or three outer ones	<i>Neodon</i>

Subgenus (*a*) **Phaiomys** Blyth*

1863. *Phaiomys* Blyth, *J. Asiat. Soc. Beng.*, **32**, 1, 89.

Contains voles with three closed triangles on the first lower molar, a reduced third upper molar, the supraorbital ridges fusing to form median crest in adult, and slight but evident external fossorial modifications.

It should perhaps be noted that subgenus *Phaiomys* of Glover Allen's Monograph of Chinese and Mongolian Mammals (II, p. 878) is not *Phaiomys* as here understood. The Chinese and Mongolian species referred to *Phaiomys* by Allen were separated as *Lasiopodomys* (Lataste, 1887) by Hinton, on account of the fact that, so far as known, their first lower molar has five closed triangles. According to the classification which I offer here, these species would be regarded as a subgenus (*Lasiopodomys*) of *Microtus*.

65. **Pitymys leucurus** Blyth†

Blyth's Vole

1863. *Phaiomys leucurus* Blyth, *J. Asiat. Soc. Beng.*, **32**, 89.

1875. *Arvicola blythi* Blanford, *J. Asiat. Soc. Beng.*, **44**, 2, 107.

(If this species should be referred to *Microtus* (which was called *Arvicola* in Blanford's time), then *leucurus* Blyth would be preoccupied by *leucurus* Gerbe, 1852, a race of *Microtus nivalis*. *Arvicola* is now restricted to the European water-vole).

Vernacular name.—Phise, *Ladak* (Blanford).

Type-locality.—Lake Chomoriri (Tsomoriri), Ladak.

Distribution.—Chinese Turkestan, Tibet, KASHMIR, MOUNT EVEREST.

External characters.—Fur moderately thick. Ear reduced, averaging about one-tenth of the head and body or very

* For a discussion of the date and authorship of the genus *Phaiomys*, see footnote below for No. 65, *Pitymys leucurus* Blyth.—EDITOR.

† For a discussion of date, nomenclature, etc., also see M. L. Roonwal (1953, *J. zool. Soc. India*, Calcutta, **5**, 1, pp. 41–43), who has pointed out that the authorship of this species should be 'Blyth (in Theobald, 1862, *J. Asiat. Soc. Bengal*, Calcutta, **31**, p. 519)' instead of 'Blyth, 1863'. Theobald, 1862, whose paper has been almost universally overlooked, was the first to use the name '*Phaiomys leucurus* Blyth'. He gave a recognizable description of the only known species, *leucurus*, but no separate description of the genus *Phaiomys*, and wanted to associate the authorship to Blyth. The type-specimen of *leucurus* is in the collection of the Zoological Survey of India, Calcutta.—EDITOR.

slightly more. Tail short, less than 30% of the head and body normally, and well haired. Hand with four fingers, their claws prominent and slightly enlarged; fifth finger the shortest, thumb vestigial but usually with a minute claw. Foot with five toes, the hallux the shortest; D. 5 shorter than the central three; claws well developed; sole partly hairy. Colour of typical race above pallid, yellowish brown, the fur darker basally. Underparts yellowish or greyish. Tail well haired, mostly whitish. Feet whitish. The allied Indian races, as far as they are represented, have the back darker, greyer; *everesti* described as 'rather dark earthy grey', the underparts tending to be slightly darker. The tail light in *everesti*, but obscurely bicolor in *petulans*.

External measurements.—As in Table 55, below.

TABLE 55.—*External measurements of the Indian races of Pitymys leucurus*

	Head and body	Tail	Hind- foot	Ear
<i>Pitymys leucurus leucurus</i>				
F. Harong Valley, Ladak	98	29	18	11
F. Meruk, Ladak	128	34	19	12½
F. Harong, Ladak	121	32	18½	12
F. Tsok Chumo, Ladak, 15,000 ft.	117	32	?	?
M. Harong Valley	119	33	19	12½
M. Harong Valley	120	32	18½	12
F. Above Tsomorin, Ladak	114.3	34.9	?	?
<i>Pitymys leucurus petulans</i>				
M. Teza, Upper Sutlej	110	31	17	11
F. Teza	112	30	17	11
M. Teza, type	102	33	16	10
<i>Pitymys leucurus everesti</i>				
M. East Mount Everest, type	101	30	18	11
F. East Mount Everest	110	26	17	13

Cranial characters.—The skull is massive and angular; the frontal ridges fuse in the adult to form a median inter-orbital ridge. The interorbital constriction is considerable, and the squamosal crests are well developed. The anterior borders of the parietals appear more nearly straight than in some allied genera and species. Nasals wider anteriorly than posteriorly; interparietal well developed. The bullae, which contain spongy tissue within, are very large and well

inflated in this species, and are more than one-quarter of the occipitonasal length as a rule, sometimes as much as 30%. Pterygoid fossae deep. Posterior palate as in *Microtus*. The palatal foramina are narrow, but not long compared with some *Microtinae*; at least, not as much as one-fifth of the occipitonasal length. The palate is long in this species, usually over 60% of the occipitonasal length. The infra-orbital foramen is narrow and the zygomatic plate high and upstanding, as usual. The zygoma is normal, with relatively short jugal. In the mandible, the root of the lower incisor tends to form a small knob below the condyle; the angular portion is rather narrow and the coronoid process is well developed.

Dental characters.—Upper incisors proodont, yellow, broad and plain. M. 1 normal, with an anterior loop, and four alternating triangles; M. 2 normal, with an anterior loop, and three alternating triangles (two outer, one inner); M. 3 strongly reduced for a *Microtine*, with an anterior loop, followed by two closed triangles, then a reduced posterior loop, the folds two on each side; as a rule the posterointernal fold is the most marked. Third lower molar with three transverse loops; second lower molar with posterior loop and four alternating closed triangles; first lower molar with posterior loop, three alternating closed triangles, and two confluent triangles which are merged into the anterior loop (usually four main inner, two or three main outer folds present).

Cranial measurements.—As in Table 56, below.

Dimensions of Pitymys leucurus, in British Museum material.—The occipitonasal length varies between 24.2 and 27 mm. Toothrow 5.7–6.8 mm. The head and body length varies between 95 and 156 mm. Tail between 26 and 35 mm. Hindfoot 16–22 mm.

Provisional key to the races of Pitymys leucurus in India

1	(4) The bullae 7.1 mm. and more in length.	2
2	(3) Dorsal coloration darker, grey	<i>P. l. petulans</i>
3	(2) Dorsal coloration sandy, lighter . . .	<i>P. l. leucurus</i>
4	(1) The bullae about 6.5 mm. in length.	<i>P. l. everesti</i>

There are two well-marked races of this species known to me, based on the size of the bullae. They are large, nearly 30% of the occipitonasal length in *leucurus*; smaller, nearer one-quarter the occipitonasal length in *waltoni* Bonhote, 1905, from Tibet, which is the second name for which skulls

TABLE 56.—*Cranial measurements of the Indian races of Pitymys leucurus*

		Occipito- nasal	Palate	Foramina	Bullae	Toothrow	Frontals
<i>Pitymys leucurus leucurus</i>							
Condylobasal length exceeds occipitonasal in all; maximum 29.1 mm., No. 4.5.4.8.							
F.	4.5.4.6	26.6	16.6	4.9	8.2	6.5	3.7
	Ladak. Median ridges fused						
F.	4.5.4.7	27.0	?	5.2	8.1	6.7	3.9
	Ladak. Ridges almost fused						
F.	4.5.4.8	27.0	16.4	4.7	8.0	6.8	3.8
	Ladak. Ridges almost fused						
M.	6.10.3.9	26.3	16.4	5.3	7.6	6.4	3.7
	Harong Valley, Ladak. Ridges almost fused						
F.	6.10.3.11	26.2	16.3	5.1	7.5	6.5	3.6
	Harong Valley, Ladak. Ridges about fused						

Other skulls examined from Tibet.

Pitymys leucurus petulans

M.	10.12.2.27	24.3	15.3	4.7	7.1	6.1	3.7
	Upper Sutlej Valley, type						

Pitymys leucurus everesti

M.	22.3.2.20	24.2	15.2	4.7	6.5	6.4	3.8
	East Mount Everest, type						

are measurable in our collection. The form described by Wroughton as *waltoni petulans* is in reality very close to the typical race and has large bullae. It can, however, be retained on colour characters, as far as I can see. *Everesti*, the last name, is barely distinguishable from *waltoni*; but, as far as I can see, the palatal foramina of the type of *waltoni* measured 4 mm. only (the occipitonasal length 24.9 mm.), whereas in the type of *everesti*, although the occipitonasal is 24.2 mm., the foramina are much longer, 4.7 mm. I therefore retain it provisionally.

(i) *Pitymys leucurus leucurus* (Blyth)

1863. *Phaiomys leucurus* Blyth, *J. Asiat. Soc. Beng.*, 32, 89.

1875. *Arvicola blythi* Blanford, *J. Asiat. Soc. Beng.*, 44, 2, 107.

Type-locality.—Tsomoriri, W Ladak.

Range.—Specimens examined from TIBET: Tinki, Dzong, Tatzeng, Tingri. Chinese Turkestan: Fort Sugeyt, and

Mandalyk. LADAK: Harong Valley. Meruk, Rupshu, above Tsomorin; near Tankse, Tsokr Chumo, 15,000 ft.

Bullae large. Colour sandy, pale: 'trapped in short grass by river' (Harong Valley). 'Uterus contained 7 embryos the size of split peas' (Ooti Rupshu).

(ii) **Pitymys leucurus petulans**
(Wroughton)

1911. *Microtus (Phaiomys) waltoni petulans* Wroughton, *J. Bombay nat. Hist. Soc.*, **20**, 931.

Type-locality.—Teza, Upper Sutlej Valley.

Range.—Specimens examined from the type-locality.

Bullae large. Colour drab, grey.

(iii) **Pitymys leucurus everesti**
(Thomas and Hinton)

1922. *Phaiomys everesti* Thomas and Hinton, *Ann. Mag. nat. Hist.*, **9**, 182.

Type-locality.—East Mount Everest, 17,000 ft.

Range.—Specimens examined from the type-locality. Bullae small. Colour nearly as in *petulans*. 'Colonial in turf slopes'

Subgenus (b) **Neodon** Hodgson

1849. *Neodon* Hodgson, *Ann. Mag. nat. Hist.*, **3**, 203.

This contains voles with normally three closed triangles on the first lower molar, and in which the supraorbital ridges of the skull ultimately fuse to form a median crest. The external characters are not modified for fossorial life. Almost always the bullae are proportionately smaller than in subgenus *Phaiomys*. The tail and ear are proportionately longer on average than in that subgenus.

Pitymys sikimensis, the Indian species, and the type of *Neodon*, is the first name in this subgenus. I am acquainted with two other valid species belonging to this subgenus, both of which differ from *sikimensis* in dental details, and also, as far as I can tell, in having the bullae averaging proportionately larger, and in having the tail averaging proportionately shorter. These are *P. carruthersi* Thomas, from Russian Turkestan, a smaller species than *sikimensis* judging by the size of the skull, and *P. irene*, from Kansu, Szechuan and

Yunnan, which differs from *carruthersi* in its relatively shorter palate and shorter tail, so far as our material shows.

When working through some unidentified skins in the British Museum I came across a specimen from North Burma, 28.8° N., 97.24° E., which I identify as *Pitymys irene forresti*, Hinton, and thus it becomes necessary to add this species to the Indian list.

Key to the species of the subgenus Neodon inhabiting India

- 1 (2) First lower molar with two pairs of confluent triangles in front of the three closed ones. The upper toothrow most often is more than one-quarter of the occipitonasal length. Bullae relatively smaller. *Pitymys sikimensis*
- 2 (1) First lower molar with only one pair of confluent triangles in front of the three closed ones. The upper toothrow is normally less than one-quarter of the occipitonasal length. Bullae relatively larger . . . *Pitymys irene*

Usually the race *P. i. forresti* has a shorter tail than *sikimensis* but the Indian specimen is abnormal in this respect.

66. *Pitymys sikimensis* (Hodgson)

The Sikkim Vole

1849. *Neodon sikimensis* Hodgson, *Ann. Mag. nat. Hist.*, 3, 203.

1863. *Arvicola thricolis* Gray, *Cat. Hodgson's Coll. Brit. Mus.*, ed., 2, 10, *nom. nud.*

Vernacular names.—(Blanford); Phalchua, *Nipalese*; Chik-yu, *Karanti*; Sing phuchi, *Tibetan*.

Type-locality.—Sikkim.

Range.—Specimens examined from EAST BHUTAN: Me la. SIKKIM: Changu, Kapup, Gnatong, Lachen, Thangu. Kola-pokri, Nepal-Sikkim frontier.

Distribution.—SIKKIM and BHUTAN.

With the characters of the subgenus *Neodon* as indicated above, and differing from *Phaiomys* in the smaller bullae, the larger ear, and the longer tail. The tail is, however, less than half the length of the head and body, compare *Microtus clarkei*, from which it also differs in the proportionately longer palate, and proportionately longer toothrow. The bullae are also, as a rule, smaller than in the Indian *Microtus*. The first lower molar is unusually complex, with as a rule five inner, four outer folds.

External characters.—Dark thick furred voles, with the ear not reduced (approximating to 13% of the head and body length), the tail less than half the head and body length but usually over 40% of it, moderately haired. Foreclaws not enlarged. Feet and digits normal, about as described for *Microtus clarkei*. Blanford states the mammae are 8, but the only skins which I have with notes on the point state that they are 6.

Colour.—Above, deep dark brown; below, pale brown or greyish. Tail bicolor, dark above, paler below. Dorsal fur darker basally than terminally.

	Head and body	Tail	Hind- foot	Ear	
M. Changu, Sikkim	98	44	19	12	
F. Lachen, Sikkim	113	48	21	16	6 mammae
M. Lachen	115	52	21	15	
M. Lachen	114	50	20	15	
F. Lachen	101	44	22	14	
F. Thangu, Sikkim	98	38	19	14	
M. Kapup, Sikkim	97	42	18½	12	
F. Kapup	97	38	19	12	
F. Lachen, Sikkim	119	51	21	16	6 mammae
M. Gnatong, Sikkim	98	42	19	14	

Also seen from Kolapohri, Nepal-Sikkim border.

Notes from skins.—Lachen; mammae 6; 1½ oz. in weight (two specimens). Gnatong; weight 1 oz. Other weights noted are: 1¾ oz. (Lachen), ¾ oz. (Thangu and Kapup) and 1 oz. (Kapup); 'trapped inside my tent' (Kolapokri).

Cranial characters.—The skull is angular and well ridged, and the frontal ridges ultimately come together to form a sharp and well developed median interorbital ridge; about on a level with the squamosal crest these ridges divide, and are continued backwards over the parietals well separated from each other, to the outer sides of the interparietal and the lambdoid ridge. Squamosal crests quite well developed. Interparietal large. Bullae relatively small, much smaller than in *P. leucurus*, averaging less than one-quarter of the occipitonasal length. Posterior palate specialized as in *Microtus*, and as described above in detail in the key to the genera. The palate is long, usually over 60% of the occipitonasal length, as in *Hyperacrius* and in *P. leucurus*. Palatal foramina long, usually more than one-fifth of the occipitonasal length. Infraorbital foramen, zygomatic plate, and zygoma essentially normal for the group, the infraorbital foramen high and narrow as usual. Coronoid process of

Cranial measurements (contd.)

		Occipito- nasal	Palate	Palatal foramina	Bullae	Toothrow	Frontals
M.	15.9.1.219	26.8	16.6	5.4	6.2	6.7	4.4
	Lachen. Ridges nearly fused						
F.	15.9.1.220	26.1	16.2	5.3	6.0	6.8	4.0
	Lachen. Ridges fused						
F.	15.9.1.221	27.0	16.3	5.3	?	6.8	4.0
	Lachen. Ridges fused						
F.	15.9.1.222	27.1	16.0	5.3	6.5	6.7	3.8
	Lachen. Ridges fused						
F.	15.9.1.223	24.8	14.5	4.7	6.2	6.1	4.0
	Thangu, Sikkim. Ridges nearly fused						
F.	33.11.6.1	28.3	17.2	6.2	6.4	6.7	3.8
	Me la, East Bhutan. Ridges fused and strong						
	Unregistered	25.9	15.5	5.0	5.7	6.5	4.0
	Locality? Ridges fused						

Dimensions of Pitymys sikimensis.—The head and body length varies between 97 and 119 mm. Tail 38–52 mm. Hind-foot $18\frac{1}{2}$ –22 mm. The occipitonasal length varies between 24.8 and 28.3 mm. Toothrow 6.1–7 mm.

67. Pitymys irene (Thomas)

1911. *Microtus irene* Thomas, *Abstr. Proc. zool. Soc. Lond.*, 5 ;
Proc. zool. Soc. Lond., 173.

Type-locality.—Ta-tsien-lu, Szechuan.

Distribution.—China; States of Kansu, Szechuan, and Yunnan. One specimen in the British Museum from extreme NORTH BURMA.

Characters.—Cranially much as in *P. sikimensis*, except that the palate averages a little shorter, the toothrow shorter, and the bullae a trifle larger. Dental characters differing in detail; there is no posterointernal heel in M. 2 as a rule, as figured by Hinton, and in the Indian specimen. M. 3 tends to be rather more reduced and in the Indian specimen has only two inner folds clear on one side (but three on the other). First lower molar definitely simpler, with posterior loop, three alternating closed triangles, then only one pair of confluent triangles which are nearly divided from the anterior loop; four inner, three outer folds in this tooth. The incisors bear traces of faint grooves in the Indian specimen.

Colour.—Essentially as described above for *P. sikimensis*.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
FKW. 12 M. Burma, 28·8° N., 97·24° E., 11,000 ft.	105	45	17½	15

This specimen has a longer tail than any Chinese skin I have seen.

Cranial measurements.—

	Occipito- nasal	Palate	Foramina	Bullae	Toothrow	Frontals
FKW. 12 M. Burma, 28·8° N., 97·24° E.	25·5	15·2	5·6	6·4	6·1	3·9

Skull ridges approached but not fused. Condylbasal 26·8 mm.

Dimensions of Pitymys irene, in British Museum material.—The occipitonasal length varies between 20·7 and 27·4 mm. (the smallest specimen belongs to the Kansu race *P. i. oniscus*). Toothrow 5·0–6·4 mm. The head and body length varies between 80 and 134 mm. Tail 22–45 mm. Hindfoot 13–20 mm.

Glover Allen preferred to retain *forresti* as a species distinct from *irene*, differing in its larger size and darker colour, but he said that it might prove but a large southern subspecies, after all, and I propose to treat it as such, because the difference in size of the head and body length between this and *irene* is overlapped by many specimens in our material and the skull only averages larger in this race than in *irene* and is not always actually so.

(i) **Pitymys irene forresti** Hinton

1923. *Neodon forresti* Hinton, *Ann. Mag. nat. Hist.*, **11**, 156.

Type-locality.—Mekong-Yangtze Divide, Yunnan, 27·30° N.

Range.—Specimens examined from BURMA: 28·8° N., 97·24° E. Yunnan: Mekong-Yangtze Divide, Mekong-Salween Divide.

Genus 30. Ellobius Fischer

1814. *Ellobius* Fischer, *Zoognosia*, **3**, 72.

Type-species.—*Mus talpinus* Pallas, from Russia.

Distribution.—Southern Russia (from the Ukraine eastwards), Siberia (southern parts, to the Pre-Altai Steppe, etc.), Russian Turkestan where it is common, Mongolia and Chinese Turkestan, Turkey in Asia, Persia, Afghanistan, BALUCHISTAN.

This is by far the most aberrant genus of Microtine known. It has the cheekteeth rooted in the adult, and the third upper and lower molars are reduced in size. The skull is extremely modified for subterranean life, as is indicated in detail below; the incisors are very much enlarged, and the root of the lower one appears conspicuously on the outer side of the mandible by the condylar process. The infraorbital foramen is abnormal. The frontals are relatively wide and there is hardly a marked squamosal crest. The tail is very short. The posterior palate is specialized as in *Microtus*. In the Indian species, the ridges of the skull fuse to form a sagittal crest which extends over the parietals.

There are, according to Vinogradov and as apparent in the material available to me, three species in this genus; the first named and more northern (Russian and Chinese) species is *Ellobius talpinus*, which has the supraorbital ridges not fused in the adult, the interparietal present, and the palatal foramina less extremely reduced. It appears to be a smaller species than the Indian *fuscocapillus*; the latter differs from it in having the ridges fused to form a sagittal crest which reaches the lambdoid ridge, and in having no interparietal and in having the palatal foramina excessively reduced. *E. lutescens* Thomas, from Transcaucasia, Asia Minor and Persia, is close to *fuscocapillus* but the sagittal ridge does not reach the lambdoid crest, and it appears that the size of the skull is rather smaller.

68. *Ellobius fuscocapillus* (Blyth)

The Quetta Mole-Vole

1842. *Georychus fuscocapillus* Blyth, *J. Asiat. Soc. Beng.*, 10, 928, *nom. nud.*; 1843, *J. Asiat. Soc. Beng.*, 11, 887.

Type-locality.—Quetta, Baluchistan.

Range.—Specimens examined from BALUCHISTAN: Mach, near Quetta. Afghanistan: Gulran; Karaolkhana. Probably the form '*intermedius*', Scully, 1887, from Herat, Afghanistan, is the same.

Distribution.—BALUCHISTAN, Afghanistan, Kopet-Dag region of Russian Turkestan, Persia.

With the characters as indicated above. Occipitonasal length exceeding 30 mm. in our material.

External characters.—Extremely modified for subterranean life. The eye is reduced, and the ear is vestigial. The tail is much shorter than the hindfoot, being reduced nearly to a stump. It is hairy. Hand of fossorial type, with quite

large claws (though not extremely enlarged as in some subterranean rodents), the thumb very short but clawed; the fifth finger rather markedly shorter than the fourth, which is in turn shorter than the third and second. The middle finger probably dominant. Foot with five well developed toes, the outer pair noticeably shorter than the middle three; apparently six plantar pads; the hand appears to be somewhat larger than the foot. In one specimen the sole tends to be hairy, but not so in another. Colour possibly variable, as the two skins seen differ from each other. The Baluchistan specimen is above very pale brown, with the head blackish, the lower parts grey, but not extremely different from the back. A skin from Afghanistan is much more light yellow brownish dorsally.

External measurements.—

	Head and body	Tail	Hind- foot	Ear
Mach, 20 miles south-east of Quetta, Baluchistan	143	12	21	4

Cranial characters.—Compared with a normal Microtine, the skull is changed beyond recognition as an adaptation towards fossorial life. The upper incisors are immensely powerful and proodont, and are thrown forward far beyond the level of the nasals, which are not large. The zygomata are very widely divergent. The frontals are moderately narrowed and behind them the parietal ridges fuse to form a long sagittal crest, which is not very strongly marked but which extends backward to join the lambdoid ridge; this is quite different from the normal Microtine, in which the ridges when they fuse do so in front over the interorbital region. There is no interparietal in this species. The lambdoid ridge extends right across the back of the skull and is very strong. The occiput is powerful but not particularly heightened. Co-related with the enlargement of the upper incisors, the diastema is unusually large, being about 40% of the occipitonasal length. The palatal foramina are excessively reduced, less than one-tenth of the occipitonasal length and situated just in front of the toothrows and far behind the back of the incisors. The palate is well raised above the general level of the floor of the braincase. Posteriorly it is specialized, essentially as in *Microtus*, the spinous process a sloping septum between the posterolateral pits, the inner borders of these pits joining the septum. Pterygoid fossae very deep. Bullae rather flattened and long, widely separated behind, closer to each other where they join the

hamular process in front. Zygoma very broad; jugal shortened to a degree but wide and rather prominent. Infraorbital foramen rather round, large, and not as usual; there seems to be no separate portion for nerve transmission, and the zygomatic plate is relatively narrow beside it and slightly curved backward on the outside of the foramen, whereas generally in Murine rodents the zygomatic plate is straight or thrown forward in front, beside the infraorbital foramen. The mandible has a high recurved coronoid process, considerably higher than the reduced condylar process, beside which the root of the lower incisor appears as a conspicuous knob, nearly as high as the condylar; the angular portion is reduced and closely approximated to the bottom of the back of the incisor root. In this genus the squamosal crests are weak, scarcely marked.

Dental characters.—The upper incisors are white in colour, immensely proodont, and plain. The lower incisors are white, and as just indicated their roots extend to the back of the lower jaw and form a well marked knob outside the condylar process. The cheekteeth are rooted. There are no closed triangles in the upper molars; M. 1 has two folds on each side of it; M. 2 with two outer, one inner well marked folds; M. 3 small and reduced, considerably smaller than M. 2, with one main well marked fold each side, besides these a small posterointernal fold and a small anteroexternal fold can be traced. (I have seen no specimens for this species in which the teeth develop roots, but we have very few for this species in the British Museum. For other species, I have specimens with the prismatic pattern of the teeth obliterated owing to the teeth taking root and the pattern wearing out). First lower molar long, with four inner, three outer re-entrant folds, the triangles confluent, not closed off from each other; M. 2 has two folds each side; M. 3 is similar to M. 2, but smaller. In one specimen available for examination on the point, the lower incisor passes under the bases on M. 1 and M. 2 on the inside, but M. 3 is turned over so that the outside of its base or roots join the lower incisor.

Cranial measurements.—

		Occipito- nasal	Diastema	Foramina	Toothrow	Frontals
F	19.11.7.85	33.2	13.5	3.2 or 3.5	7.8	6.1
	Mach, Baluchistan					

Condylobasal approximately 33.8 mm. Zygomatic width 26.3 mm.

In these skulls, the bullae cannot be measured accurately. As will be seen, the palatal foramina vary markedly in length on different sides of the palate; the shorter side is less than one-tenth of the occipitonasal length. Other skulls available from Afghanistan.

Dimensions of the species Ellobius fuscocapillus, in British Museum material.—The occipitonasal length varies between 30.5 and 33.2 mm. The upper toothrow 7.5–7.8 mm. Head and body (2 skins) 118–143 mm. Tail 12–13 mm. Hind-foot 20–21 mm.

Continued in Part 2