THE FAMILIES AND GENERA OF LIVING RODENTS

BRITISH MUSEUM
(NATURAL HISTORY)

THE FAMILIES AND GENERA OF LIVING RODENTS

BY

J. R. ELLERMAN

WITH A LIST OF NAMED FORMS (1758–1936)

BY

R. W. HAYMAN and G. W. C. HOLT

VOLUME I. RODENTS OTHER THAN MURIDAE

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THIS WORK IS
DEDICATED
TO THE MEMORY OF
MY FRIEND
WILLIAM COX

PREFACE

As the result of several years devoted to a careful study of the rich recent collections belonging to this museum, the author has prepared the following review of the families and genera of living Rodents; he has also supervised the preparation by Mr. R. W. Hayman and Mr. G. W. C. Holt, members of the Museum staff, of a list of all the species and subspecies of rodents, described from the 10th edition of Linnaeus's *Systema Natura*, 1756, down to the end of 1936. Such a review and such a list have long been two of the most needed desiderata of zoologists.

The author has endeavoured in each case to find out not only what characters have been assigned to a given genus, but what characters it in fact possesses, and to test their value and constancy. Genera are recognized by their intrinsic characters; a mere geographical differentiation of genera does not exist. Whenever the author has been able to study a genus for himself he has included it in his "Keys"; when not seen personally he merely gives a note of the ascribed characters. The carrying through of this great examination has led to a considerable reduction in the number of genera here recognized; thus, of 440 forms or groups given, at some time or another, full generic rank, only 343 (151 non-murine, 192 murine) are now regarded as valid genera. Indeed, had the Museum collections of North American Rodents been more extensive, and had it been possible to make a really detailed survey of the South American Muridae, a further much-needed reduction of genera would doubtless have taken place.

With regard to major classification, the author excludes the Duplicidentata from the Order Rodentia. He reviews the more recent classifications of the Order (so restricted), to wit, those of Oldfield Thomas, 1896; Tullberg, 1899; Weber, 1904 and 1928; Miller & Gidley, 1918; and Winge, 1924. He then proposes a new classification of the families and genera, which, while necessarily sharing some features with one or other of the older systems, on the whole appears to be a great improvement upon any of the systems previously proposed.

Of great interest is the chapter on distribution and the conclusion reached by the author that, as regards its peculiar Muridae, Australasia may be claimed as an evolutionary centre. That view, in face of the characters of the group in question and the very high antiquity of the Order, appears to me to be perfectly sound.

To conclude these general remarks the author is to be congratulated on having performed a colossal task, and we are indebted to him for providing an honest one-man view which cannot fail to be of service to all who wish to study this great and complex Order in future.

With regard to the list of named forms, every endeavour has been made to make it complete and accurate, but it is too much to hope that nothing has escaped the compilers.

The beautiful drawings of skulls and teeth prepared by Mr. A. J. Engel Terzi greatly enhance the value of this work; with the exception of Figs. 62, 63, 90, 96, 112, 115, 118, 119, 146, 164, 167, 170, 173 and 184, by the same artist, but originally published in Miller's *Catalogue of the Mammals of Western Europe*, 1912, all the figures have been specially drawn for this volume.

Owing to the heavy work undertaken by the artist and to the prevalent war conditions, considerable delay has occurred in the publication of Vol. I, which deals with the general matters discussed above and with the families and genera of non-murine rodents.

Vol. II, dealing with the murine rodents, is already in type; in order to avoid further delay it is proposed to issue it immediately without waiting for the preparation of its full complement of figures.

Vol. III, to be published later, will be an "Atlas" containing all the figures of Vol. I repeated; the full complement of figures for Vol. II; to these it is hoped to add drawings of some of the more interesting and important external characters and of dissections of jaw muscles.

MARTIN A. C. HINTON,
Keeper of the Department of Zoology.

British Museum (Natural History)
25th March, 1940

AUTHOR'S FOREWORD

In 1896 Oldfield Thomas proposed a classification of Simplicidentate Rodents in which he recognized 156 genera.

In 1904, Trouessart in his *Catalogue of Mammals* listed 205 genera of this section of mammals.

At the present day, more than four hundred and forty forms have been given, at some time or another, full generic rank, so that in the last thirty-five years there has been an increase of approximately two hundred and forty genera.

The object of this work is primarily to inquire into the status of these named genera, and to give, in each family and subfamily, a key which will indicate as reasonably, clearly and briefly as possible, the differences between such genera as are supported on characters which appear constant through the various groups, and worthy of generic recognition.

This has led on the one hand to a careful study of the classification of the families and superfamilies or major groups of all authors who have attempted an arrangement of the Order based on adequate material and including all the principal leading genera of all families as recognized to-day (Thomas, 1896; Tullberg, 1899; Weber, 1904, 1928; Miller & Gidley, 1918; and Winge, 1924), and on the other hand to the collection of a list of all named forms (species and subspecies) which have been named in the order since Linnaeus (1758), up to and including the year 1936.

It is not my intention to enter into a detailed description of the skeleton, soft parts, etc., of each genus; this has been done already in a far more competent manner than I could attempt (Tullberg, 1899). Ninety-nine out of a hundred genera are based on cranial, dental, and external characters, or to put it more crudely, "skull and skin" characters. This work is based almost entirely on these characters. It must be noticed that in cranial, dental and external characters, very many specimens of a species or genus may usually be at hand for examination, so that whether such a character is constant or not can generally be checked easily; generic names based on skeleton, soft parts, or characters such as the baculum, which has been used for generic names (here not retained) in the Sciuridae, can as a rule only be examined for one species and often one specimen of a genus; therefore it is not possible to give full notes on such a character throughout a whole genus or, if it is so, the notes refer to a restricted number of specimens only. Under these circumstances, it seems wiser not to pay too much attention to names which have been based solely on such characters.

This work is based entirely on the collection of the British Museum, to the authorities of which I am much in debt for their kindness and consideration throughout the compilation of this work. No genus which is not represented in that collection is included in my keys; as it is difficult to include in a key any form which has not been examined, and in the case of certain Muridae, impossible. However, there are only five non-Murine genera at present unrepresented in London, and about sixteen (out of nearly two hundred) Muridae; notes on these will be included, but generally speaking no comments. Of the genera which are included, I have endeavoured to give in each case the approximate range, the number of forms at present recognized (to 1936), a list of these forms, and a short description of the main cranial, dental and external characters.

Concerning the dental characters, in this Order, great difference of opinion exists regarding the homologies of the various parts of each tooth. American authors use in the main a series of names for each cusp which are figured and explained by Goldman, North Amer. Fauna, 43, p. 11, 1918; Miller & Gidley, 1918, divide the greater part of the Order into "tritubercular" and "quadritubercular" series; Winge apparently uses quite a different theory which he takes throughout Mammalia; and Hinton uses still a different notation. With the exception of the Murinae, in which a series of eight or sometimes nine main cusps go through the entire subfamily, no attempt has been made in this work to use a definite formula; I have endeavoured to describe the dentition of each genus as I see it, and am content to leave the working out of cusp homologies to those with more experience than I have.

The view that the dental pattern of modern Rodentia is generally speaking derived from a much more complex pattern than is now present, expressed by Hinton, Monograph of Voles and Lemmings, 1926, Evolution of Molars, pp. 102–124, is here accepted. However, it is not the purpose of this paper to enter into an argument as to whether this view is correct, or the view frequently held that a complex dentition in a living Rodent is a secondarily acquired one. Take for instance two cases, *Hapalomys*, a very complex-toothed Rat (Murinae) as compared with *Rattus* (normally a simple-toothed Rat); in this work, *Hapalomys* is considered the primitive type, *Rattus* the specialized one; but turn these views round, and the two genera will still be at the opposite end of two extremes, which is broadly speaking what I set out to prove in each case.

So far as the list of named forms of each genus is concerned, I list those which are named, making no attempt to guarantee the validity of any subspecies or species. How many of these names will ultimately be reduced to synonymy is not clear; but I believe that very many of them will prove invalid with more material available. I have attempted in each case in which a genus has not been revised, where possible, to divide the genera into "specific groups" as is now done by American authors. These groups indicate certain characters within the different species of each genus, but must be regarded as provisional. The attitude, however, is held that a list of names in some semblance of order, no matter how provisional, is better than a string of meaningless alphabetical names. At least I hope it gives a start to those who are interested in the characters which run through the species of the various genera. I expect however that a large number of South American Mice (Cricetinae) will have for the time being to be abandoned, and listed alphabetically. It is perhaps not too much to hope that these lists will act as a deterrent to authors who rush to give names to new forms before consulting all the literature on the genus in question.

Though great care has been taken I can give no guarantee that the list of named forms is complete, particularly in the case of some of the older synonyms, to which less attention has been paid than to names described more recently. The list was originally based on that of Trouessart (Cat. Mamm. Viv. et Foss, 1904); names which appear in synonymy in this work have in most cases been included here as they appear in Trouessart's list, and their position has not been verified. I have listed sixty-four hundred forms which are supposed to be valid at the present day. Subspecies, except in cases of a genus which is definitely revised, are listed as far as possible geographically. Each named form is listed under its present accepted name, or the name which appears to be correct; in many cases not under the generic name under which it was described, for instance "*Sminthus loriger*," Nathusius, 1840, is now listed as "*Sicista subtilis loriger*," etc., etc.

The Order is absolutely dominated by one family, the Muridae, both in number of genera and named forms, as proved by the following figures, which must be taken as approximate.

Twenty-two families of Rodents other than Muridae:

151 valid genera containing 2,773 named forms.

Family Muridae:

192 valid genera containing 3,600 named forms.

I have had therefore to divide the work into two volumes, the first of which contains all Rodents not belonging to the family Muridae, the second devoted entirely to that family.

This work is based solely on Rodents which are living, or assumed to be living, though I have added short notes on the fossil history of each family, chiefly from a distributional point of view.

My sincere thanks are due to the officials of the British Museum for their kind help and consideration throughout the time I have been preparing this work; especially I must mention Captain Guy Dollman, who originally made it possible for me to undertake this review; Mr. M. A. C. Hinton, who has undertaken the task of editing the work; Mr. Hayman and Mr. Holt, who have between them got together the references and type localities of more than sixty-four hundred names in the Order, and the former for much assistance in dealing with some of the species of the more unwieldy genera; Dr. Tchernavin, who has translated several papers from Russian, enabling me to give some details concerning the distribution of the various groups of Rodents occurring in the U.S.S.R.; Mr. A. J. Engel Terzi, who has made drawings of the more important genera; Mr. J. L. Chaworth-Musters, to whom I am indebted for nearly all my knowledge of Palaearctic Rodents; also I must thank Mr. E. R. Newman, who has given me much help throughout the compilation of the work, and Miss R. Blizard and Mr. F. C. Hitch, who have assisted during the later stages. Lastly I would thank my wife for numerous working drawings of specimens and continuous help in other ways. The indulgence of readers is sought for any typographical or other small errors in this work. The writing of the book itself was finished in June last, but the revision of the final proofs had not been completed when war broke out. Since then it has been possible for me to give only the most cursory and intermittent attention to such revision.

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100.	do.	do.	397
101.	*Funisciurus pyrrhopus leonis*, Thomas . .	Skull × 2	410
102.	do.	do.	411
103.	do.	Cheekteeth × 8	411

FIG.			PAGE
104.	*Xerus rutilus*, Cretzchmar	Skull × $1\frac{1}{2}$	419
105.	do.	do.	419
106.	*Spermophilopsis leptodactylus*, Lichtenstein	Skull × $1\frac{1}{2}$	424
107.	do.	do.	424
108.	*Tamias dorsalis*, Baird	Skull × $2\frac{1}{2}$	427
109.	do.	do.	428
110.	*Citellus citellus*, Linnaeus	Skull × 2	438
111.	do.	do.	438
112.	do.	Cheekteeth × 5	439
113.	*Marmota marmota*, Linnaeus	Skull × 1	456
114.	do.	do.	456
115.	do.	Cheekteeth × 2	457
116.	*Cynomys ludovicianus*, Ord	Skull × 1	464*a*
117.	do.	Cheekteeth × 3	464*a*
118.	*Castor fiber*, Linnaeus	Cheekteeth × $1\frac{1}{2}$	464*a*
119.	do.	Skull × $\frac{1}{2}$	465*a*
120.	*Heteromys anomalus*, Thompson	Skull × $2\frac{1}{2}$	473
121.	do.	do.	473
122.	do.	Cheekteeth × 9	474
123.	*Perognathus hispidus*, Baird	Skull × $3\frac{1}{2}$	481
124.	do.	do.	481
125.	do.	Cheekteeth × 17	482
126.	*Dipodomys merriami melanurus*, Merriam	Skull × $2\frac{1}{2}$	495
127.	do.	do.	495
128.	do.	Cheekteeth × 13	496
129.	*Thomomys perpallidus*, Merriam	Skull × $2\frac{1}{2}$	508
130.	do.	do.	509
131.	do.	Cheekteeth × 6	509
132.	*Anomalurus fraseri jacksoni*, de Winton	Skull × $1\frac{1}{2}$	538
133.	do.	do.	538
134.	do.	Cheekteeth × 5	539
135.	*Idiurus macrotis*, Miller	Skull × $3\frac{1}{2}$	544
136.	do.	do.	545
137.	do.	Cheekteeth × 15	545
138.	*Pedetes surdaster larvalis*, Hollister	Skull × 1	550
139.	do.	do.	550
140.	do.	Cheekteeth × 4	551
141.	*Ctenodactylus gundi*, Rothman	Skull × $1\frac{1}{2}$	557

FIG.			PAGE
142.	*Ctenodactylus gundi*, Rothman	Skull × $1\frac{1}{2}$	557
143.	do.	Mandible × $1\frac{1}{2}$ Cheekteeth × 7	558
144.	*Sicista subtilis loriger*, Nathusius	Skull × 4	565
145.	do.	do.	565
146.	do.	Cheekteeth × 9	566
147.	*Zapus hudsonius*, Zimmermann	Skull × $3\frac{1}{2}$	570
148.	do.	do.	570
149.	do.	Cheekteeth × 15	571
150.	*Euchoreutes naso*, Sclater	Skull × 3	578
151.	do.	do.	578
152.	do.	Cheekteeth × 11	579
153.	*Allactaga euphratica*, Thomas	Skull × $2\frac{1}{2}$	581
154.	do.	do.	581
155.	do.	Cheekteeth × 8	582
156.	*Jaculus jaculus*, Linnaeus	Skull × $2\frac{1}{2}$	594
157.	do.	do.	594
158.	do.	Cheekteeth × 11	595
159.	*Graphiurus hueti*, Rochebrune	Skull × $2\frac{1}{2}$	605
160.	do.	do.	605
161.	do.	Cheekteeth × 10	606
162.	*Eliomys quercinus*, Linnaeus	Skull × $2\frac{1}{2}$	614
163.	do.	do.	614
164.	do.	Cheekteeth × 10	615
165.	*Dyromys nitedula*, Pallas	Skull × $3\frac{1}{2}$	617
166.	do.	do.	617
167.	do.	Cheekteeth × 10	618
168.	*Glis glis*, Linnaeus	Skull × 2	621
169.	do.	do.	621
170.	do.	Cheekteeth × 10	622
171.	*Muscardinus avellanarius*, Linnaeus . . .	Skull × $3\frac{1}{2}$	624
172.	do.	do.	624
173.	do.	Cheekteeth × 10	625
174.	*Platacanthomys lasiurus*, Blyth	Skull × $2\frac{1}{2}$	628
175.	do.	do.	628
176.	do.	Cheekteeth × 10	629
177.	*Typhlomys cinereus*, Milne-Edwards . . .	Skull × 4	630
178.	do.	do.	630

FIG.			PAGE
179.	*Typhlomys cinereus*, Milne-Edwards . .	Cheekteeth × 14	631
180.	*Lophiomys imhausi*, Milne-Edwards . . .	Skull × $1\frac{1}{2}$	633
181.	do.	do.	634
182.	do.	Cheekteeth × 5	634
183.	*Spalax monticola dolbrogeae*, Miller . . .	Skull × $1\frac{1}{2}$	639
184.	do.	Cheekteeth × 5	640
185.	*Rhizomys pruinosus*, Blyth	Skull × $1\frac{1}{2}$	647
186.	do.	do.	647
187.	do.	do.	648
188.	do.	do.	648
189.	do.	Cheekteeth × 5	649

(N.B.—In the figures of cheekteeth the left-hand figure (in a few cases lettered *a*) shows the upper tooth row of the right side seen from below; the right-hand figure (occasionally lettered *b*) shows the lower tooth row of the left side seen from above.)

LIMITS OF THE ORDER RODENTIA

In 1912 (Science, New York, n.s. XXXVI, p. 285), Gidley proposed a separate Order for the Rodentia Duplicidentata (Leporidae and Ochotonidae), and restricted the Order Rodentia to the great mass of animals usually known as Rodentia Simplicidentata. This division is currently accepted by American authors, usually not so elsewhere (excepting Flower, 1927, Vertebrate List, Zool. Soc. London, 1828–1927, Mammals, p. 239).

Whether it is a classification that is likely to be universally followed seems open to question. Gregory in his excellent work The Orders of Mammals, Bull. Amer. Mus. N.H. XXVII, 1910, inclined to the contrary opinion, though stating that no fossil forms have yet been discovered that will connect the Duplicidentata with the Simplicidentata.

I can only say that in my opinion the Lagomorpha may reasonably be regarded as an Order distinct, and that for the purposes of the present work they are regarded as such. The fundamental differences in the appearance of those parts of the skull to which jaw-muscles are attached may surely at once be stated in the Lagomorpha to be a much more important character than the retention of the functionless second upper incisor which seems to be quoted always as the main difference between the two groups.

To those of the contrary opinion I must plead guilty of saying: notes on the characters of three hundred and forty-five genera containing sixty-four hundred forms proved enough work for one; I do not look for extra forms to include in an Order as vast as this; and I have no intention of including in this Order forms which may very well not belong there. Before including the Lagomorpha in the Order, let us wait until an intermediate family is discovered fossil between the two groups. Because the fact that both Rodents and Lagomorphs are adapted for gnawing does not seem to prove conclusively that they must of necessity be so nearly related as to be included in the same Order.

The Order Rodentia, therefore, as here understood, has been defined by Miller & Gidley 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. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}=22$ permanent teeth; incisors scalpriform 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."

For further notes on the essential characters of the Order see Tullberg, Ueber das System der Nagetiere, 1899; Flower & Lydekker, Mammals Living and Extinct, 1891, pp. 443–448; Gregory, Orders of Mammals, 1910, p. 323; Weber, Die Säugetiere, II, p. 238, 1928; Gidley, Science, n.s. XXXVI, p. 285 (the separation of the Order Lagomorpha from Rodentia, and differences between the two Orders); Parsons, 1894, Proc. Zool. Soc. London, p. 251, Myology of Sciuromorphine and Hystricomorphine Rodents, etc.

VARIATION

THE great variation or diversity in structure within the Order is one of the features that makes it such an interesting study; it is perfectly safe to say that nowhere among all Orders of mammals is such diversity found in a single Order with the possible exception of the Marsupials.

Great specialization has been attained independently again and again within this order for various modes of life. Among these may be mentioned extreme modification for aquatic life, most developed in *Hydromys* and immediate allies (Muridae, Hydromyinae); *Ichthyomys* and immediate allies (Muridae, Cricetinae); to a lesser degree in *Ondatra* (Muridae, Microtinae), *Myocastor* (Echimyidae), and *Castor* (Castoridae); modification attaining a high degree for arboreal life; two families contain "flying" genera, with a flying membrane which enables them to take flying leaps from tree to tree (Sciuridae, Pteromys group), and all genera of Anomaluridae except *Zenkerella*); in non-flying arboreal types, the Erethizontidae show great specialization of the feet, the hallux sometimes being replaced by a broad movable pad (*Coendou*, *Echinoprocta*, *Chaetomys*); and many Muridae (Murinae) of the Indo-Malayan region have a fully opposable hallux, as *Hapalomys*, *Vandeleuria*, *Chiropodomys*, *Chiromyscus*, etc. Many genera are fully modified for underground life, with Mole-like appearance, and either immensely developed incisors, or immensely developed claws for digging. In the Muridae, examples are *Ellobius* and *Prometheomys* (Microtinae), *Notiomys* (Cricetinae), and *Myospalax* (Myospalacinae). The Spalacidae (*Spalax*) go a step further than any in that even the eyes are suppressed. The Geomyidae, quite unrelated to the above, are all as highly specialized for underground life as any Murine; as are the African Bathyergidae, another isolated group. And in South America, certain Hystricoid genera, as *Ctenomys* and *Spalacopus*, have taken to this form of life and become just as modified in external form. High specialization towards bipedal saltatorial life is developed in three or possibly four unrelated families, with Kangaroo-like form and elongated hindlimbs and tail; the Dipodidae (all genera except *Sicista*), the Pedetidae, the Heteromyidae (*Dipodomys* and *Microdipodops*), and probably one member of the Muridae, *Notomys* (Murinae), from Australia. Also perhaps some Gerbils.

Cursorial specialization, with form like that of a primitive Ungulate, and reduction of the digits of the hindfoot to three has taken place twice in South America, in the Dasyproctidae, and in the Caviidae (*Dolichotis*).

Great specialization of the covering of the body into spines is shown in the Hystricidae, being in this family at extreme development superior to that of any other Rodent and perhaps any other Mammal. Other families which have a more or less specialized spiny covering are the Erethizontidae (most effective!), certain genera of Echimyidae (not highly developed), and certain Muridae, as in some species of *Rattus*, and in *Acomys*; also to a lesser degree in the Cricetine genus *Neacomys*. One genus of Muscardinidae, *Platacanthomys*, is spiny. And in two families of Rodentia extraordinary and abnormal development in the skull has taken place, the Cuniculidae, with their enormous bony cheekplates, and the Lophiomyidae, in which the temporal fossae are roofed in by bony plates.

PREVIOUS CLASSIFICATIONS OF ORDER

OLDFIELD THOMAS, 1896

(Proc. Zool. Soc. London, 1896, p. 1012)

(Suborder SIMPLICIDENTATA)

A. ANOMALURI
Family Anomaluridae
Anomalurus, Idiurus.
B. SCIUROMORPHA
Family Sciuridae
Subfamily Sciurinae
(*a*) *Rheithrosciurus, Xerus, Sciurus, Tamias, "Spermophilus"* (=*Citellus*), *Cynomys, "Arctomys"* (=*Marmota*)
(*b*) *Eupetaurus, Petaurista, "Sciuropterus"* (=*Pteromys*)
Subfamily Nannosciurinae
Nannosciurus
Family Castoridae
Castor
C. APLODONTIAE
Family Aplodontiidae
Aplodontia
D. MYOMORPHA
Family "Gliridae"
Subfamily "Glirinae"
Glis, Eliomys, Muscardinus, Graphiurus
Subfamily Platacanthomyinae
Platacanthomys, Typhlomys
Family Muridae
Subfamily Hydromyinae
Hydromys, Xeromys, Chrotomys
Subfamily Rhynchomyinae
Rhynchomys
Subfamily Phloeomyinae
Phloeomys
Subfamily Gerbillinae
Gerbillus, Pachyuromys, Psammomys, Meriones, Rhombomys
Subfamily Otomyinae
Otomys, "Oreinomys" (= *Otomys*)

Subfamily Dendromyinae
Deomys, Dendromus, Steatomys, Malacothrix, Leimacomys
Subfamily Murinae
Mus, Nesokia, Cricetomys, Malacomys, Lophuromys, Saccostomus, Acomys, Arvicanthis, Golunda, Vandeleuria, Chiropodomys, Batomys, Carpomys, "*Chiruromys*" (= *Pogonomys*), *Hapalomys, Pithecheir, Crateromys,* "*Craurothrix*" (= *Echiothrix*), *Mastacomys, Uromys, Conilurus*
Subfamily Lophiomyinae
Lophiomys
Subfamily "Sigmodontinae"
"*Hamster*" (= *Cricetus*), *Mystromys, Brachytarsomys, Nesomys,* "*Hallomys*" (= *Nesomys*), *Brachyuromys, Hypogeomys, Eliurus, Gymnuromys, Onychomys, Peromyscus, Rhipidomys, Tylomys, Holochilus, Sigmodon, Oryzomys, Reithrodontomys, Eligmodontia, Neotomys, Reithrodon, Phyllotis, Scapteromys, Ichthyomys, Akodon, Oxymycterus, Blarinomys, Notiomys*
Subfamily Neotominae
Neotoma, Xenomys, Hodomys
Subfamily Microtinae
Phenacomys, "*Evotomys*" (= *Clethrionomys*), *Microtus, Synaptomys, Lemmus, Dicrostonyx, Ellobius*
Subfamily "Siphneinae"
"*Siphneus*" (= *Myospalax*)
Family SPALACIDAE
Subfamily Rhizomyinae
Rhizomys, Tachyoryctes
Subfamily Spalacinae
Spalax
Family GEOMYIDAE
Geomys, Thomomys
Family HETEROMYIDAE
Subfamily Dipodomyinae
Dipodomys, "*Perodipus*" (= *Dipodomys*), *Microdipodops*
Subfamily Heteromyinae
Perognathus, Heteromys
Family BATHYERGIDAE
Bathyergus, Georychus, "*Myoscalops*" (= *Heliophobius*), *Heterocephalus*)
Family DIPODIDAE
Subfamily "Sminthinae"
"*Sminthus*" (= *Sicista*)
Subfamily Zapodinae
Zapus
Subfamily Dipodinae
Dipus, Allactaga, "*Platycercomys*" (= *Pygeretmus*), *Euchoreutes*

E. HYSTRICOMORPHA

Family PEDETIDAE

Pedetes

Family OCTODONTIDAE

Subfamily Ctenodactylinae

Ctenodactylus, Massoutiera, Pectinator, Petromys

Subfamily Octodontinae

Ctenomys, Aconaemys, Spalacopus, Octodon, Abrocoma

Subfamily "Loncherinae"

(*a*) *Dactylomys, Thrinacodus, Kannabateomys, "Loncheres"* (= *Echimys*)

(*b*) *"Thrichomys"* (= *Cercomys*), *Cercomys, Carterodon, Mesomys, "Echinomys"* (= *Proechimys*)

Subfamily Capromyinae

Myocastor, Capromys, Plagiodontia, Thryonomys

Family HYSTRICIDAE

Hystrix, Atherura, Trichys

Family ERETHIZONTIDAE

Subfamily Erethizontinae

Erethizon, Coendou

Subfamily Chaetomyinae

Chaetomys

Family CHINCHILLIDAE

Chinchilla, Lagidium, Lagostomus

Family DASYPROCTIDAE

Dasyprocta, "Coelogenys" (= *Cuniculus*)

Family DINOMYIDAE

Dinomys

Family CAVIIDAE

Cavia, Dolichotis, Hydrochoerus

This classification is admittedly nothing more than a rearrangement and bringing up to date of an earlier classification of Alston. It may at once be discarded as unnatural, as being based mainly on the character of the fusion or separation of tibia and fibula. In the "Myomorpha" of Alston these bones are fused; in the "Sciuromorpha" and "Hystricomorpha" they are separate.

Alston states that "in the few cases in which the cranial differences fail us in separating the Sciurine Rodents from the Murine, and the latter from the Hystricine, the complete ankylosis of the lower part of the tibia and fibula in the second group comes to our aid." As Bathyergidae (which have Hystricine mandible formation) are placed in "Myomorpha" on account of the fibula structure, presumably this was considered the chief character in placing a Rodent systematically.

But a Rodent did not become a Rodent because its fibula fused or remained separate. If Flower and Lydekker's book Mammals Living and Extinct is looked through with relation to the classification of other Orders, it may be seen that in one *family* of Insectivora, the Centetidae (now I believe known as Tenrecidae), in one branch of the family the tibia and fibula are described as fused (Oryzorictinae, p. 638), in the other branch they are distinct (Centetinae, p. 637). If therefore these two conditions may exist in the same family of Insectivora, the character is surely one which can scarcely be used for superfamily arrangement in another Order.

A Rodent becomes a Rodent because it gnaws, and its gnawing is done with its incisors (which do not vary throughout the genera of modern Rodentia sufficiently for any superfamily grouping to be arranged on this account), and with its jaw-muscles; and the jaw-muscles have modified those portions of the skull, to which they are attached, in various ways throughout the larger groups, as recognized by all other authors who have comparatively recently attempted a classification of the Order. I venture to suggest that if *Rattus*, for example, had never taken to gnawing, whatever the condition of its hindleg bones it would not be classed in the present Order to-day; or if *Oryzorictes* had by chance taken to this form of life and developed the characteristic Rodent skull, dentition, and jaw-muscle arrangement, whether or not its tibia and fibula were fused, it would automatically have come under the heading of "Rodent" as understood to-day. If the Order is to be dumped into three superfamilies or "waste-paper baskets" the "Sciuromorpha," "Myomorpha," and "Hystricomorpha" (into which as I see it the families will not naturally go), it should be on a very different basis from that of Alston and Thomas, and more like that of Tullberg (below), with a separate group "Bathyergomorpha" for the Bathyergidae, and probably one also for the Aplodontiidae, the Sciuromorph branch to include Geomyidae, the Myomorph branch to include Ctenodactylidae, Anomaluridae and Pedetidae, etc.

TULLBERG, 1899

(Ueber das System der Nagethiere, Nova Acta Reg. Soc. Sci. Upsaliensis, vol. XVIII, No. 1)

(Suborder SIMPLICIDENTATI)

Tribus 1. HYSTRICOGNATHI

Subtribus 1. *BATHYERGOMORPHI*

Family Bathyergidae

(*Georychus*, *Bathyergus*)

Subtribus 2. *HYSTRICOMORPHI*

Family Hystricidae

(*Hystrix*, *Atherura*)

Family Caviidae

("*Coelogenys*" (= *Cuniculus*), *Dasyprocta*, *Cavia*, *Dolichotis*, *Hydrochoerus*)

Family Erethizontidae

(*Erethizon*, *Coendou*, *Chaetomys*)

Family CHINCHILLIDAE
(*Chinchilla*, *Lagidium*, *Lagostomus*)
Family "AULACODIDAE"
("*Aulacodus*" (= *Thryonomys*))
Family ECHINOMYIDAE
Subfamily "Myopotamini"
("*Myopotamus*" (= *Myocastor*))
Subfamily Echinomyini
Echinomyes
("*Echinomys*" (= *Proechimys*), "*Nelomys*" (based on a species of *Cercomys*), *Kannabateomys*)
Octodontes
("*Habrocoma*" (= *Abrocoma*), *Octodon*, *Spalacopus*, *Ctenomys*)
Family PETROMYIDAE
(*Petromys*)

Tribus 2. SCIUROGNATHI
Subtribus 1. *MYOMORPHI*
Sectio 1. *Ctenodactyloidei*
Family CTENODACTYLIDAE
(*Ctenodactylus*)
Sectio 2. *Anomaluroidei*
Family ANOMALURIDAE
(*Anomalurus*)
Family PEDETIDAE
(*Pedetes*)
Sectio 3. *Myoidei*
Subsectio 1. Myoxiformes
Family "MYOXIDAE"
(*Graphiurus*, "*Myoxus*" (= *Glis*), *Eliomys*, *Muscardinus*)
Subsectio 2. Dipodiformes
Family DIPODIDAE
("*Sminthus*" (= *Sicista*), *Zapus*, *Dipus* (based on *Jaculus*), *Allactaga*)
Subsectio 3. Muriformes
Family SPALACIDAE
("*Siphneus*" (= *Myospalax*), *Spalax*, *Rhizomys*, *Tachyoryctes*)
Family NESOMYIDAE
(*Gymnuromys*, *Nesomys*, *Eliurus*, *Brachyuromys*, *Brachytarsomys*)
Family CRICETIDAE
(*Cricetus*)

Family LOPHIOMYIDAE
(*Lophiomys*)
Family ARVICOLIDAE
(*Ellobius*, *Arvicola*, *Neofiber*, "*Fiber*" (=*Ondatra*), "*Cuniculus*" (=*Dicrostonyx*), "*Myodes*" (=*Lemmus*))
Family HESPEROMYIDAE
(*Hesperomys* (based on *Peromyscus*), *Neotoma*, *Sigmodon*, *Nectomys*, *Oxymycterus*)
Family MURIDAE
Subfamily Murini
(*Mus*, *Nesokia*, *Chiropodomys*, "*Hapalotis*" (based on *Notomys*), *Hydromys*, *Dendromus*, *Steatomys*, *Saccostomus*, *Cricetomys*, *Deomys*, *Lophuromys*)
Subfamily Phloeomyini
(*Phloeomys*)
Subfamily Otomyini
(*Otomys*)
Family GERBILLIDAE
(*Gerbillus*, *Psammomys*)

Subtribus 2. *SCIUROMORPHI*

Sectio 1. *Sciuroidei*
Family "HAPLODONTIDAE"
("*Haplodon*" (=*Aplodontia*))
Family SCIURIDAE
(*Sciurus*, "*Sciuropterus*" (=*Pteromys*), "*Pteromys*" (=*Petaurista*), "*Arctomys*" (=*Marmota*), *Cynomys*, "*Spermophilus*" (=*Citellus*), *Tamias*)

Sectio 2. *Castoroidei*
Family CASTORIDAE
(*Castor*).

Sectio 3. *Geomyoidei*
Family GEOMYIDAE
Subfamily Dipodomyini
("*Perodipus*" (=*Dipodomys*), *Dipodomys*, *Perognathus*, *Heteromys*)
Subfamily Geomyini
(*Geomys*, *Thomomys*)

This is in my mind perhaps the best classification of the Order that has been done. The only points which seem unnatural are the too close association of Aplodontiidae with Sciuridae, the lumping together of all the Old World Murine "burrowers" as a family Spalacidae (*Rhizomys*, *Myospalax*, *Tachyoryctes*, *Spalax*), and the lumping together of the Dasyproctidae and Cuniculidae with the Caviidae.

MAX WEBER, 1904, 2nd ed., 1928

(Die Säugetiere, 1928, II, p. 238)

(Living forms only)

(Suborder SIMPLICIDENTATA)

Tribus 1. HAPLODONTOIDEA
  Family "HAPLODONTIDAE"
    (*Aplodontia*)
Tribus 2. SCIUROIDEA
  Family SCIURIDAE
    (*Sciurus*, *Neosciurus*, *Rheithrosciurus*, *Callosciurus*, *Tamiasciurus*, *Ratufa*, *Heliosciurus*, *Funisciurus*, *Nannosciurus*, *Funambulus*)
  Family PTEROMYIDAE
    (*Eupetaurus*, *Pteromys* (= *Petaurista*), "*Sciuropterus*" (= *Pteromys*), *Glaucomys*)
  Family XERIDAE
    (*Xerus*, *Geosciurus*)
  Family TAMIIDAE
    (*Tamias*, *Eutamias*, *Citellus*)
  Family MARMOTIDAE
    (*Cynomys*, *Marmota*)
Tribus 3. CASTOROIDEA
  Family CASTORIDAE
    (*Castor*)
Tribus 4. GEOMYOIDEA
  Family HETEROMYIDAE
    (*Dipodomys*, *Heteromys*, *Perognathus*)
  Family GEOMYIDAE
    (*Geomys*, *Thomomys*)
Tribus 5. ANOMALUROIDEA
  Family ANOMALURIDAE
    (*Anomalurus*, *Idiurus*, *Zenkerella*)
  Family PEDETIDAE
    (*Pedetes*)
Tribus 6. "MYOXOIDEA"
  Family "MYOXIDAE"
    (*Graphiurus*, *Muscardinus*, *Glis*, "*Dryomys*" (= *Dyromys*), *Eliomys*)
  Family PLATACANTHOMYIDAE
    (*Platacanthomys*, *Typhlomys*)
Tribus 7. DIPODOIDEA
  Family SICISTIDAE
    (*Sicista*)

Family DIPODIDAE
(*Zapus*, *Allactaga*, "*Scarturus*" (=*Allactaga*), *Dipus*, *Jaculus*, *Euchoreutes*, *Pygeretmus*)

Tribus 8. MYOIDEA

Family SPALACIDAE
(*Spalax*, *Rhizomys*, *Tachyoryctes*, "*Myotalpa*" (=*Myospalax*))

Family NESOMYIDAE
(*Brachyuromys*, *Nesomys*, *Brachytarsomys*, *Eliurus*)

Family MURIDAE

Subfamily Cricetinae
(*Cricetus*, *Mesocricetus*, *Cricetulus*, *Mystromys*, *Hesperomys*, *Peromyscus*, *Oryzomys*, *Reithrodontomys*, *Sigmodon*, *Tylomys*, *Holochilus*, *Nectomys*, *Eligmodontia*, *Ichthyomys*)

Subfamily Lophiomyinae
(*Lophiomys*)

Subfamily Microtinae
(*Lemmus*, *Myopus*, *Dicrostonyx* (group Lemmi); *Ellobius* (group Ellobii); "*Evotomys*" (=*Clethrionomys*), "*Fiber*" (=*Ondatra*), *Microtus*, *Pitymys*, *Arvicola* (group Microti))

Subfamily Murinae
("*Epimys*" (=*Rattus*), *Mus*, *Apodemus*, *Micromys*, *Nesokia*, *Phloeomys*, *Pithecheir*, *Cricetomys*, *Saccostomus*, *Otomys*, "*Oreomys*" (=*Otomys*), *Dendromus*, *Deomys*, *Mastacomys*, *Leporillus*, *Uromys*, *Mallomys*, *Conilurus*, "*Chiruromys*" (=*Pogonomys*))

Subfamily Gerbillinae
(*Gerbillus*, *Pachyuromys*, *Meriones*, *Rhombomys*, *Psammomys*)

Subfamily Hydromyinae
(*Hydromys*, *Leptomys*, *Xeromys*, *Celaenomys*, *Chrotomys*, *Crunomys*, *Rhynchomys*, "*Craurothrix*" (=*Echiothrix*))

Tribus 9. BATHYERGOIDEA

Family BATHYERGIDAE
(*Bathyergus*, *Georychus*, "*Myoscalops*" (=*Heliophobius*), *Heterocephalus*)

Tribus 10. HYSTRICOIDEA

Family HYSTRICIDAE
(*Hystrix*, *Atherura*, *Trichys*)

Family ERETHIZONTIDAE
(*Erethizon*, *Coendou*, *Chaetomys*)

Family CAVIIDAE

Subfamily Dinomyinae
(*Dinomys*)

Subfamily Dasyproctinae
("*Coelogenys*" (=*Cuniculus*), *Dasyprocta*, *Myoprocta*)

Subfamily Caviinae
(*Cavia*)
Subfamily Hydrochoerinae
(*Hydrochoerus*, *Dolichotis*)
Family CHINCHILLIDAE
(*Chinchilla*, *Lagidium*, "*Vizcacia*" (=*Lagostomus*))
Family CAPROMYIDAE
(*Myocastor*, *Capromys*, *Plagiodontia*)
Family OCTODONTIDAE
(*Echimys*, *Octodon*, *Ctenomys*)
Family CTENODACTYLIDAE
(*Ctenodactylus*, *Pectinator*, *Petromys*)
Family THRYONOMYIDAE
(*Thryonomys*)

So far as Superfamily grouping is concerned, this classification is followed in the present book, with some modifications, as for instance the separation of Pedetidae from Anomaluridae; also following Tullberg I cannot credit that the Ctenodactylidae should be referred to the Hystricoid branch (*Petromus* is here transferred to the Echimyidae), and also on account of intermediate forms I am unable to find characters to keep the Muscardinidae separate as a superfamily from the Muroidae.

Several of Weber's divisions into families appear unnecessary or unnatural, as the dividing up of the Sciuroidea into five "families"; the retention of the old family Spalacidae; the retention of the "family Nesomyidae"; the lumping together of *Dinomys*, *Cuniculus* and *Dasyprocta* with the Caviidae; and the formation of a subfamily Hydrochoerinae including *Dolichotis* (obviously very nearly allied to *Cavia*) against the Caviinae with *Cavia* only.

MILLER & GIDLEY, 1918

(Journ. Washington Acad. Sci., VIII, No. 13, p. 431, 1918)

The Order, including Rodentia as here understood only (the Lagomorpha not included), is divided into five superfamilies based on zygomasseteric structure.

Superfamily SCIUROIDAE
Three-cusped series
Family SCIURIDAE
Subfamily Sciurinae (the entire family except the two following groups)
Subfamily Nannosciurinae
(*Nannosciurus*, *Myosciurus*, *Sciurillus*)
Subfamily Pteromyinae (Flying-Squirrels)
Family GEOMYIDAE
Subfamily Entoptychinae (fossil)
(*Entoptychus*)

Subfamily Geomyinae (North American Pocket-Gophers)
Family HETEROMYIDAE (North American Pocket-Mice and Kangaroo-Rats, Oligocene (*Heliscomys*) to Recent)
Four-cusped series
Family ADJIDAUMIDAE (fossil)
(*Adjidaumo*)
Family EUTYPOMYIDAE (fossil)
(*Eutypomys*)
Family CHALICOMYIDAE (fossil)
(*Chalicomys* (*Steneofiber*) and related genera; *Trogonotherium*, *Palaeocastor*, *Eucastor* and related genera)
Family CASTORIDAE
(*Castor*)
Family CASTOROIDIDAE (fossil)
(*Castoroides*)

Superfamily MUROIDAE
Three-cusped series
Family MUSCARDINIDAE
(*Eliomys*, *Dyromys*, *Glis*, *Muscardinus*, also *Leithia* (fossil))
Four-cusped series
Family ISCHYROMYIDAE (fossil)
(*Ischyromys*)
Family CRICETIDAE
Subfamily Cricetinae (Cricetinae, Sigmodontinae, Neotominae and Nesomyinae of authors)
Subfamily Gerbillinae (Gerbillinae of authors)
Subfamily Microtinae (Microtinae of authors)
Subfamily Lophiomyinae
(*Lophiomys*)
Family PLATACANTHOMYIDAE
(*Platacanthomys*, *Typhlomys*)
Family RHIZOMYIDAE
Subfamily Tachyoryctinae
(*Tachyoryctes*)
Subfamily Rhizomyinae
(*Rhizomys* and related genera)
Subfamily Braminae (fossil)
(*Bramus* (= *Ellobius*), a Microtine; see Hinton, Monogr. Voles & Lemmings, I, p. 87, 1926)
Family SPALACIDAE
Subfamily Myospalacinae
(*Myospalax*)
Subfamily Spalacinae
(*Spalax*, Recent; *Prospalax* (fossil))

Family MURIDAE
Subfamily Dendromyinae (Dendromyinae of authors)
Subfamily Murinae (Murinae of authors)
Subfamily Phloeomyinae
(*Phloeomys*)
Subfamily Otomyinae
(*Otomys*)
Subfamily Hydromyinae (Hydromyinae of authors)
Superfamily DIPODOIDAE
Three-cusped series
Group A
Family PARAMYIDAE (fossil)
(*Paramys*, *Mysops*, *Prosciurus* and related genera)
Group B
Family GRAPHIURIDAE
(*Graphiurus*)
Group C
Family ALLOMYIDAE (fossil)
(*Allomys*, *Haplomys*, *Meniscomys*, *Mylagaulodon*)
Family APLODONTIIDAE
(*Aplodontia*, Recent; *Liodontia*, fossil)
Family CYLINDRODONTIDAE (fossil)
(*Cylindrodon*)
(Position of group doubtful)
Four-cusped series
Group A
Family PSEUDOSCIURIDAE (fossil)
(*Pseudosciurus*)
Group B
Family MYLAGAULIDAE (fossil)
(*Mylagaulus*, *Ceratogaulus*, *Epigaulus*)
Group C
Family ANOMALURIDAE
(*Anomalurus*)
Family IDIURIDAE
Subfamily Idiurinae
(*Idiurus*)
Subfamily Zenkerellinae
(*Zenkerella*)
Group D
Family SCIURAVIDAE (fossil)
(*Sciuravus*)
Family ZAPODIDAE
Subfamily Theridomyinae (fossil) (Theridomyidae of authors)
Subfamily Sicistinae
(*Sicista*, Recent; ?*Eomys*, fossil)

Subfamily Zapodinae
(*Eozapus*, *Zapus*, *Napaeozapus*)
Family Dipodidae
Subfamily Protoptychinae (fossil)
(*Protoptychus*)
Subfamily Dipodinae (Dipodidae of authors, who recognize Zapodidae as a distinct family)
Family Ctenodactylidae
(*Ctenodactylus* and related genera)
Family Pedetidae
(*Pedetes*)

Superfamily BATHYERGOIDAE
Family Bathyergidae (Bathyergidae of authors)

Superfamily HYSTRICOIDAE
Lateralis series.
Group A.
Family Hystricidae
Subfamily Hystricinae
(*Hystrix*, *Acanthion*, *Thecurus*)
Subfamily Atherurinae
(*Atherurus*, *Trichys*)
Family Erethizontidae
(New World Porcupines except *Chaetomys*; fossil genera, *Asteromys*, *Eosteiromys*, *Parasteiromys*, *Steiromys*; ?*Phiomys*, ?*Metaphiomys*)
Family Echimyidae
Subfamily Echimyinae
(Spiny Rats, provisionally including *Chaetomys*; Hutias (*Capromys*, *Plagiodontia*, etc.); many extinct genera, among them *Acaremys*, *Boromys*, *Brotomys*, *Colpostemma*, *Eocardia*, *Eoctodon*, *Graphimys*, *Gyrignophus*, *Haplostropha*, *Heteropsomys*, *Homopsomys*, *Isobolodon*, *Prospaniomys*, *Protadelphomys*, *Protacaremys*, *Sciamys*, *Scleromys*, *Spaniomys*, *Stichomys*, *Strophostephanus*, *Tribodon*)
Subfamily Octodontinae
(*Ctenomys*, *Octodon*, *Octodontomys*, *Spalacopus*. Amongst fossil genera are *Cephalomys*, *Dicoelophorus*, *Eucoelophorus*, *Litodontomys*, *Neophanomys*, *Palaeoctodon*, *Phtoramys*, *Pithanotomys*, *Plataeomys*, *Scotomys*)
Family Petromyidae
(*Petromys*)
Family Myocastoridae
(*Myocastor* and related fossil genera)
Family Thryonomyidae
(*Thryonomys*)

Family DINOMYIDAE
(Includes the living *Dinomys* and extinct genera *Amblyrhiza*, *Briaromys*, *Discolomys*, *Elasmodontomys*, *Gyriabrus*, *Megamys*, *Neoepiblema*, *Olenopsis*, *Potamarchus*, *Tetrastylus*)

Family CUNICULIDAE
(*Cuniculus*)

Family HEPTAXODONTIDAE (fossil)
(*Heptaxodon*; ?*Morenia*)

Group B

Family DASYPROCTIDAE (Dasyproctidae of authors with *Cuniculus* removed, and *Neoreomys* (fossil) added)

Family CHINCHILLIDAE
(*Chinchilla*, *Lagostomus*, "*Viscaccia*" (= *Lagidium*); extinct genera: *Euphilus*, *Perimys*, *Pliolagostomus*, *Prolagostomus*, *Scotaeumys*, *Sphaeromys*)

Family ABROCOMIDAE
(*Abrocoma*)

Medialis series

Family CAVIIDAE (Caviidae of authors, with *Hydrochoerus* and allies removed; extinct genera: *Anchimys*, *Neoprocavia*, *Orthomyctera*, *Palaeocavia*, *Plugatherium*, *Procardiotherium*)

Family HYDROCHOERIDAE
(*Hydrochoerus* and extinct allies, *Plexochoerus*, *Prohydrochoerus*, *Protohydrochoerus*; perhaps *Cardiomys*, *Caviodon* and *Cardiotherium*)

Great attention has been paid to this classification, on which the present work was originally based. It attends much more strictly to detail characters than either those of Weber or Winge. But it seems to break down where the "Dipodoidae" (for instance, *Graphiurus*) and Muroidae are compared; it does not appear good classification to separate *Graphiurus* from the Muscardinidae so far that it is placed in another superfamily; moreover, it appears that the Murine genus *Deomys* has the "Dipodoid" zygomasseteric structure as defined by Miller & Gidley, and should be referred to that superfamily if this classification was maintained. As already noted by Wood in his monograph of Heteromyidae, there is a very wide distinction between the zygomasseteric structure of *Paramys*, and the Mylagaulidae and that of the Dipodidae, both referred to "Dipodoidae" of Miller & Gidley; from descriptions *Paramys* and Mylagaulidae have similar zygomasseteric structure to that of *Aplodontia*, here considered the most primitive living Rodent as regards this arrangement; Wood states, "The character of zygomasseteric structure as given by Miller & Gidley . . . includes widely different types, which appear to have reached their present condition in widely different manners. In *Paramys* and the Mylagaulidae . . . the zygomatic plate is nearly horizontal because that is the primitive condition for Rodents, and the growing masseter has not as yet effected any great change. In the Dipodidae . . . the zygomatic plate is horizontal because the masseter has passed through the infraorbital fenestra and, on expanding, has forced the zygoma down until it becomes even lower than in the primitive forms."

In Miller & Gidley, the families appear in some cases to be over-split. For the undesirability of separating "Cricetidae" from Muridae, see Hinton, Monogr. Voles & Lemmings, 1926, p. 121.

WINGE, 1924

(Pattedyr Slaegter, vol. II, Rodentia, p. 1)

The Order is divided into nine families, one of which, the Leporidae, corresponds to the Suborder Duplicidentata or Order Lagomorpha.

1. LEPORIDAE
   (Leporini: *Palaeolagus* (fossil), *Lepus;* "Lagomyini": "*Lagomys*" = *Ochotona*)
2. "HAPLODONTIDAE"
   Allomyini (fossil)
   Allomys
   Ischyromyini (fossil)
   Paramys, *Sciuravus*, *Ischyromys*
   Mylagaulini (fossil)
   Mylagaulus, *Ceratogaulus*
   "Haplodontini"
   "*Haplodon*" = *Aplodontia* (sole living genus)
3. ANOMALURIDAE
   Pseudosciurini (fossil)
   Pseudosciurus, *Sciuroides*
   Trechomyini (fossil)
   Trechomys
   Anomalurini
   Anomalurus, "*Aethurus*" = *Zenkerella*, *Idiurus*
   Theridomyini (fossil)
   Theridomys, *Issiodoromys*, *Archaeomys*
   Pedetini
   Pedetes
4. DIPODIDAE
   Eomyini (fossil)
   Eomys
   Dipodini
   "Sminthi"
   "*Sminthus*" = *Sicista;* "*Jaculus*" based on *Zapus*
   Euchoreutae
   Euchoreutes
   Dipodes
   "*Scirtetes*" = *Allactaga*, *Dipus*

Spalacini

Spalax

5. "MYOXIDAE"

Graphiurini

Graphiurus

"Myoxini"

"Myoxi"

Eliomys, *Leithia* (fossil), *Hypnomys* (fossil), "*Myoxus*" = *Glis*, *Muscardinus*

Platacanthomyes

Platacanthomys

6. MURIDAE

Rhizomyini

Cricetodontes (fossil)

Cricetodon, *Eumys*

Rhizomyes

Nesomys, *Brachytarsomys*, *Gymnuromys*, *Eliurus*, *Brachyuromys*, *Tachyoryctes*, *Rhizomys*

Cricetini

Criceti

Cricetus, *Calomyscus*, *Lophiomys*, "*Siphneus*" = *Myospalax*

Hesperomyes

Hesperomys, *Sigmodon*, *Neotoma*, "*Habrothrix*" (apparently based on *Akodon*), *Oxymycterus*, *Ichthyomys*, *Scapteromys*, "*Calomys*" (species or genera referred to this group not clear), *Rhipidomys*, *Nectomys*

Arvicolae

"*Hypudaeus*" (= *Clethrionomys* plus *Dolomys* plus *Phenacomys*), "*Fiber*" = *Ondatra*, *Ellobius*, *Arvicola* (including *Microtus*), *Dicrostonyx*, "*Myodes*" = *Lemmus*

Murini

Mures

Mus, "*Spalacomys*" = *Nesokia*, *Phloeomys*, *Crateromys*, *Carpomys*, *Echiothrix*, *Rhynchomys*, *Lenomys*, *Vandeleuria*, *Chiropodomys*, *Hapalomys*; *Chiruromys*, *Notomys*, *Mastacomys*, *Zyzomys*, "*Hapalotis*" = *Conilurus*; *Acomys*, *Cricetomys*, *Saccostomus*, *Steatomys*, *Dendromus*, *Deomys*, *Oenomys*, *Otomys*

Gerbilli

Gerbillus, *Rhombomys*

Hydromyes

Xeromys, *Crunomys*, *Hydromys*, *Chrotomys*, *Celaenomys*

7. HYSTRICIDAE

Bathyergini

Bathyergus, *Heterocephalus*, *Georychus*, *Heliophobius*

Hystricini
Hystrices
Trichys, *Atherura*, *Hystrix*
"Sphinguri"
Steiromys (fossil), *Erethizon*, "*Sphingurus*" = *Coendou*, *Chaetomys*
Capromyini
"*Aulacodus*" = *Thryonomys*, "*Myopotamus*" = *Myocastor*, *Capromys*, "*Plagiodon*" = *Plagiodontia*; *Isobolodon* (fossil)
Ctenodactylini
Petromys, *Pectinator*, *Ctenodactylus*
Dasyproctini
Dinomyes
Dinomys; *Elasmodontomys* (fossil)
Dasyproctae
Dasyprocta; *Neoreomys* (fossil); "*Coelogenys*" = *Cuniculus*
Caviae
Schistomys, *Eocardia* (both fossil), *Cavia*, *Dolichotis*, *Hydrochoerus*
"Eriomyini" = Chinchillini
"Eriomyes"
"*Eriomys*" = *Chinchilla*, *Lagidium*
Lagostomi
Scotaeumys, *Perimys* (both fossil), *Lagostomus*.
Octodontini
Echinomyes
Cercomys (= what?, not *Cercomys* as here understood), *Dactylomys*, *Thrinacodus*, "*Lasiuromys*" = *Isothrix*, "*Loncheres*" = *Echimys*, "*Echinomys*" = *Proechimys*, "*Nelomys*" = *Cercomys*, *Mesomys* (based evidently on *Clyomys* and *Euryzygomatomys*); *Carterodon*
Octodontes
Acaremys, *Sciamys* (both fossil); *Dicolpomys* (fossil); "*Habrocoma*" = *Abrocoma*, "*Schizodon*" = *Aconaemys*, *Spalacopus*, *Octodon*, *Ctenomys*

8. SCIURIDAE
Castorini
Eutypomys, *Steneofiber*, *Euhapsis* (all fossil), *Castor*; *Trogontherium*, *Castoroides* (fossil)
Sciurini
Sciuri
Tamias, *Otospermophilus*, *Sciurus*, *Pteromys*, *Eupetaurus*, *Xerus*
"Arctomyes"
"*Arctomys*" = *Marmota*, "*Spermophilus*" = *Citellus*, *Cynomys*

9. "SACCOMYIDAE" = Heteromyidae
Gymnoptychini
Gymnoptychus (= *Adjidaumo*? fossil)

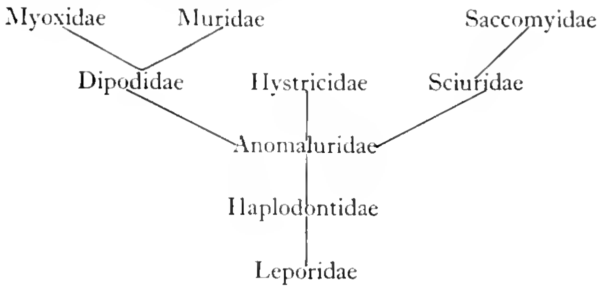
"Saccomyini"

Heliscomys (fossil), "*Saccomys*" = *Heteromys*, *Perognathus*, *Dipodomys*

Geomyini

Pleurolichus, *Entoptychus* (both fossil), *Thomomys*, *Geomys*.

"I Form af Stamtrae" (phylogenetic tree)



The theory behind this work is brilliant, but the detailed characters are incorrect many times, and the nomenclature is deplorable. The classification of the "Hystricidae" seems in particular unnatural, with the inclusion of the Bathyergidae, the lumping together of Hystricidae and Erethizontidae, the whole family based more or less on the formation of the paroccipital process which in the British Museum material seems at any rate in *Dactylomys* and *Capromys* a variable character even within a genus. Further, if I understand the work rightly, the infraorbital foramen is supposed to transmit muscle (or to have transmitted muscle, which cannot be proved), in many groups in which it does not do so (Sciuridae, Castoridae, Geomyidae, Heteromyidae, Bathyergidae). *Pedetes* is regarded as with "fibula free," which is not so; M.1 is regarded as larger than M.2 in Cricetini and Murini, which is not constant (*Anisomys* agreeing with Winge's Rhizomyini in this character, as do some Neotropical Cricetines), etc., etc.

OUTLINE OF CLASSIFICATION HERE ADOPTED

THE present classification is a combination as far as possible of points which appear to be correct from the five classifications listed above. It is based on characters which are constant throughout all the various genera referred to each family, and has been the subject of great care and observation.

The Order is here divided into twelve superfamilies. In case it may be thought that too many of these are retained, and that forms which share characters have been too widely separated, I would quote a passage from Wood, who in his review of fossil and recent Heteromyidae, states, "The most important point to be emphasized is that 'parallelism, parallelism, more parallelism and still more parallelism' is the evolutionary motto of the Rodents in general."

I have already stated that the Order is dominated to such a degree by one family, the Muridae, that it is necessary to devote a separate volume to that family alone. It is necessary, therefore, for me to place this group last on the list (certainly not because it is considered the most highly specialized!); I, therefore, take first the group called Hystricognathi by Tullberg, in which the mandible is more highly specialized, and last the Sciurognathi of Tullberg, which includes the Muridae, and in which the mandible is comparatively unmodified.

With regard to the structure of the tibia and fibula, the following skeletons have been examined:

"Fibula reduced, fully fused with the tibia in lower portion"

Pedetidae: *Pedetes*
Bathyergidae: *Bathyergus*, *Georychus*
Geomyidae: *Geomys*
Spalacidae: *Spalax*
Dipodidae: *Alactagulus*, *Allactaga*, *Jaculus*, *Sicista*
Lophiomyidae: *Lophiomys*
Muscardinidae: *Glis*, *Eliomys*, *Muscardinus*
Muridae. (As this group is not dealt with in the present volume, less attention has been paid to them, as they are clearly separable from other families without this character. However, it has been checked in a very small number: *Mus* and *Apodemus* representing Murinae; *Mesocricetus* and *Phodopus* representing Cricetinae; *Gerbillus* and *Pachyuromys* representing Gerbillinae; and *Tachyoryctes* and *Brachyuromys* representing Tachyoryctinae.)

All examined are perfectly clear in this character, with the exception of *Glis*, in which the bones are widely separate, and only fused at extreme base.

No Heteromyidae are available for examination, but *Dipodomys* as figured by Howell agrees with the other Rodents.

"Fibula not reduced, not fully fused in lower portion with the tibia"

Ctenodactylidae: *Ctenodactylus*, *Pectinator*
Anomaluridae: *Anomalurus*
Aplodontiidae: *Aplodontia*
Castoridae: *Castor*
Sciuridae: *Petaurista*, *Citellus*, *Spermophilopsis*, *Sciurus*, *Xerus*, *Tamias* and *Marmota*
Echimyidae: *Dactylomys*, *Octodon*, *Aconaemys*, *Ctenomys*, *Capromys*, *Myocastor*, *Thryonomys*, *Isothrix*, *Petromus*
Erethizontidae: *Erethizon*, *Coendou*, *Chaetomys*
Dasyproctidae: *Dasyprocta*
Cuniculidae: *Cuniculus*
Hystricidae: *Hystrix*, *Thecurus*, *Atherurus*
Caviidae: *Cavia*, *Dolichotis*, *Hydrochoerus*
Chinchillidae: *Chinchilla*, *Lagidium*, *Lagostomus*

No skeletons of *Dinomys* nor of the Idiurinae are available.

In this group, *Castor* appears in the adult to have fusion suggested in these bones, though not complete, and the Hystricoid *Myocastor* seems precisely similar, another interesting case of parallel development in these two unrelated genera. The fibula is becoming reduced in *Ctenomys*. But much the most interesting result obtained is that in the skeletons seen of the three genera of Chinchillidae, *Chinchilla*, *Lagidium* and *Lagostomus*, the fibula, though still not fully fused, is excessively reduced, slender and threadlike; the reduction reaching an extreme degree in *Lagostomus*, which one might have expected to be not the case.

It must be noted that, with regard to the formation of the forefoot, the extreme reduction, almost or completely to disappearing point of the pollex, is such a usual feature that no attention has been paid in the classification to this character.

HYSTRICOGNATHI

Lower jaw highly specialized, either by distortion outwards of the angular process by masseter lateralis, or by a conspicuous ridge extending along outside of mandible below level of the toothrow for attachment of masseter medialis. Angular portion of mandible never pulled inwards (inflected), and lower incisor root never forming conspicuous knob beside condylar process.

1. Bathyergomorph Series

Infraorbital foramen not or scarcely transmitting muscle.

First Superfamily. BATHYERGOIDAE

Mandible with angular portion strongly distorted outwards by specialized limb of masseter lateralis. Infraorbital foramen not or scarcely transmitting muscle. Zygomatic plate narrow, completely beneath the infraorbital foramen, not broadened for attachment of masseter lateralis.

Skull much modified for fossorial life. Jugal moderately long, or in *Heterocephalus* shortened, and Murine. Bullae without special peculiarities.

Cheekteeth $\frac{3}{3}$, $\frac{4}{4}$, or in *Heliophobius*, at full dentition, $\frac{6}{6}$ (in this genus the cheekteeth are normally not all in place together). Cheekteeth rooted, but extremely hypsodont, near simplification in pattern.

A tendency present for the upper incisors to extend behind the toothrow, at extreme development into the pterygoids.

Fibula fully fused with the tibia below. Digits of hindfoot five. External form much modified for underground life.

Malleus and incus fused (Tullberg). Radiale and intermedium separate (Tullberg; fused in all other members of the Order examined by him except Ctenodactylidae).

Family 1. BATHYERGIDAE

With the characters of the Superfamily.

Group Bathyergi

Bathyergus, Heliophobius, Georychus, Cryptomys.

Group Heterocephali

Heterocephalus.

(A key to all generic groups here recognized will be given below, when dealing with the families.)

2. Hystricomorph Series

Infraorbital foramen much enlarged for muscle transmission.

Second Superfamily. HYSTRICOIDAE

Mandible with angular portion distorted outwards by specialized limb of masseter lateralis. Infraorbital foramen very large, always transmitting muscle. Zygomatic plate remaining narrow, and beneath the infraorbital foramen, not broadened for attachment of masseter lateralis.

Skull usually broad, lacking interorbital constriction in the majority. Paroccipital process usually well developed, prominent. Jugal normally not approaching lachrymal; frequently with downwardly or upwardly directed process present. Bullae variable; in certain groups much inflated.

Cheekteeth $\frac{4}{4}$, the premolars not reduced in size in the majority; the pattern flatcrowned, reduced heptamerous, laminate, or sometimes approaching complete simplification.

Fibula not becoming fused with the tibia high on the leg, and usually, but not always, not specially reduced. Digits of hindfoot 5, 4, or 3.

Malleus and incus fused (Tullberg).

Family 2. ECHIMYIDAE

Cheekteeth rooted or rootless; when rootless or strongly hypsodont the pattern not a series of transverse plates. Digits of hindfoot 5, excepting Thryonomyinae. Bullae well inflated, sometimes extremely so. Feet never abnormally specialized for arboreal life. Spiny covering present or absent, but when present, never to an extremely specialized degree. External form never modified for cursorial life. Paroccipital process long, either curved forwards under the bullae, or lengthened and standing apart from bullae. Zygoma very generally complex, with downwardly or upwardly directed processes present.

Subfamily ECHIMYINAE

Cheekteeth not hypsodont, and not simplified in pattern; usually the pattern is reduced heptamerous. Bullae not abnormally inflated, except *Clyomys*. Paroccipital process curved forwards under the bullae. Externally Rat-like or slightly modified for arboreal life, sometimes with spiny covering developed.

Echimys, *Isothrix*, *Diplomys*; *Proechimys*, *Hoplomys*, *Cercomys*, *Euryzygmatomys*, *Clyomys*, *Carterodon*, *Mesomys*, *Lonchothrix*.

Subfamily CAPROMYINAE

Like the Echimyinae, but cheekteeth evergrowing, the re-entrant folds well filled with cement, so that simplification of pattern is suggested. Upper molars with more than one external re-entrant fold. Paroccipital process usually but not always standing apart from bullae. External form arboreal or terrestrial; fur not developing spines.

Procapromys (not seen), *Capromys*, *Geocapromys*.

Subfamily PLAGIODONTINAE

Cheekteeth evergrowing, the upper series with only one external re-entrant fold, which is unusually deep and placed obliquely; the single inner re-entrant fold also unusually deep, and running parallel to the outer fold. Paroccipital process considerably lengthened. Zygoma simple.

Plagiodontia.

Subfamily DACTYLOMYINAE

Cheekteeth rooted, abnormally broadened, nearly prismatic in appearance, and evidently with pattern not changing much during life. Paroccipital process either standing apart from the bullae, or curved forwards under them. Habits (said to be) arboreal; a tendency present towards elongation of the two central digits of forefoot and hindfoot.

Thrinacodus, *Dactylomys*, *Kannabateomys*.

Subfamily MYOCASTORINAE

Cheekteeth extremely hypsodont, but not evergrowing, reduced heptamerous in pattern, the pattern changing little during life. Bullae reminiscent of the type found in Castoridae, though less specialized than in that family. Skull prominently ridged for attachment of muscles. External form considerably specialized for aquatic life. Paroccipital process much lengthened, the lateral process of paroccipital process enlarged.

Myocastor.

Subfamily ABROCOMINAE

Cheekteeth evergrowing, the upper series more or less simple, the lower series prismatic, and complex. Auditory bullae much inflated, the paroccipital process curving forwards under them. Part of lachrymal canal open on side of rostrum.

Abrocoma.

Subfamily OCTODONTINAE

Cheekteeth evergrowing, both upper and lower series nearly or completely simplified. Bullae and paroccipital process as in Abrocominae. No part of lachrymal canal open on side of rostrum. External form generalized or modified for underground life.

Octomys, Aconaemys, Octodon, Octodontomys; Spalacopus; Ctenomys.

Subfamily PETROMYINAE

Cheekteeth strongly hypsodont, nearly complete simplification in pattern, but not evergrowing. Auditory bullae much inflated. External form without special peculiarities.

Petromus.

Subfamily THRYONOMYINAE

Digits of hindfoot reduced to four. Cheekteeth moderately hypsodont, rooted, the re-entrant folds well marked and surrounded by heavy enamel. External form heavy, terrestrial-fossorial. Auditory bullae of moderate size; paroccipital process lengthened, standing apart from the bullae. Incisors much thickened, the upper ones heavily three-grooved. Skull massive, excessively prominently ridged for muscle attachment. Shoulder-blade abnormal (Tullberg).

Thryonomys.

Family 3. DINOMYIDAE

Cheekteeth evergrowing (?) or excessively hypsodont, the pattern a series of transverse plates. External form heavy, terrestrial. Digits of hindfoot four. (Incisors thick, bullae moderate, paroccipital process not lengthened, no part of lachrymal canal open on side of rostrum, and angular portion of mandible powerfully distorted outwards, compare Chinchillidae.)

Dinomys.

Family 4. ERETHIZONTIDAE

Externally more specialized than in the Echimyidae; feet becoming abnormally modified for arboreal life, the hallux in progressive forms being replaced with a broad movable pad (and skeleton of foot correspondingly much modified).

Tail muscular, prehensile in progressive genera. Fur conspicuously spinous, the spines not long, and not modified into thick circular quills. Bullae relatively large; paroccipital process not lengthened. Zygoma usually simple. Cheekteeth typically with wide re-entrant folds (parallel—Anomaluridae), or in *Chaetomys* with structure much as in complex-toothed Echimyinae.

Subfamily CHAETOMYINAE

Orbit almost surrounded by greatly thickened jugal and short postorbital process. Cheekteeth with narrow re-entrant folds. Spiny covering weakly developed. (Feet at highest specialization.)

Chaetomys.

Subfamily ERETHIZONTINAE

Orbit large; skull without postorbital process; jugal not specially thickened. Cheekteeth with very wide re-entrant folds. Spiny covering at maximum specialization. (Feet moderately to extremely specialized.)

Erethizon, Echinoprocta, Coendou.

Family 5. DASYPROCTIDAE

External form highly modified for cursorial life; digits of hindfoot reduced to three; clavicles suppressed. Part of lachrymal canal open on side of rostrum. Bullae relatively large; paroccipital process not specially lengthened. Cheekteeth strongly hypsodont, but not evergrowing, the re-entrant folds narrow, isolating on crown surface with wear as narrow islands.

Myoprocta, Dasyprocta.

Family 6. HYSTRICIDAE

External form heavy, terrestrial; digits of hindfoot five. Fur always conspicuously spinous, in progressive species attaining specialization in this respect not known elsewhere in the Order. Tail always with modified bristles or quills present. Spines of body usually partly modified into thick circular quills. Skull in progressive species characterized by great inflation of nasal bones. Auditory bullae relatively small. No part of lachrymal canal open on side of rostrum. Paroccipital process not specially lengthened. Zygoma simple. Cheekteeth moderately to extremely hypsodont, but not evergrowing, their pattern paralleling that present in Dasyproctidae. Clavicles present but incomplete. Lungs abnormal (Tullberg). Centrale not free (Tullberg; this character unique in the Order so far as known except Cuniculidae).

Group Atheruri

Trichys; Atherurus.

Group Hystrices

Thecurus, Hystrix.

Family 7. CUNICULIDAE

Skull extremely modified by growth of conspicuous bony cheekplate, a structure not known elsewhere in the Order. Cheekteeth strongly hypsodont, but not evergrowing, their pattern like that present in Dasyproctidae and Hystricidae, but rather more complex. External form heavy, terrestrial. Digits of hindfoot five. Clavicles present, but incomplete. Paroccipital process considerably lengthened. Centrale not free (Tullberg; on this character see remarks under family Hystricidae).

Cuniculus.[1]

Family 8. CHINCHILLIDAE

Cheekteeth evergrowing, the pattern a series of transverse plates. Lower jaw with angular portion rather weakly distorted outwards, the jaw to a certain degree transitionary towards that of the Cavioidae. Digits of hindfoot four or three (probably three functional only in all genera). Jugal tending to approach the lachrymal, or to come in contact with it. Some part of lachrymal canal open on side of rostrum. Incisors relatively thin. A tendency present towards extreme inflation of mastoids and bullae. Paroccipital process relatively short (*Chinchilla*, *Lagidium*), or considerably lengthened (*Lagostomus*). Fibula extremely slender, much reduced (skeletons of the three genera have been examined).

Group Chinchillae

Chinchilla, *Lagidium*.

Group Lagostomi

Lagostomus.

Third Superfamily. CAVIOIDAE

Essential characters as in Hystricoidae except: angular portion of mandible not distorted outwards by specialized limb of masseter lateralis; masseter medialis the chief agent in modifying form of lower jaw, the outer side of which has a long and conspicuous ridge extending below and beside toothrows for attachment of this muscle. Cheekteeth evergrowing, relatively simple, but with sharp folds present, the effect more or less prismatic. Malleus and incus fused (Tullberg).

Family 9. CAVIIDAE

With the characters of the Superfamily. Paroccipital process moderately to extremely enlarged; bullae normally prominent. Cheekteeth strongly unilaterally hypsodont. Digits of hindfoot reduced to three; external form ambulatory or cursorial. Clavicles suppressed. Tibia and fibula as in normal Hystricoidae. Part of lachrymal canal open on side of rostrum, except in *Dolichotis*.

[1] = "*Coelogenys*."

Subfamily CAVIINAE

Paroccipital process not excessively lengthened. M.3, upper series, not enlarged. Pattern of cheekteeth relatively simpler. Palate shortened from before backwards.

Group Caviae

Cavia, Galea, Caviella; Kerodon.

Group Dolichotides

Dolichotis.

Subfamily HYDROCHOERINAE

Paroccipital process excessively lengthened. M.3 upper series extremely enlarged and elongated. Cheekteeth with more complex pattern. Palate not shortened from before backwards. (Size largest in the Order.)

Hydrochoerus.

SCIUROGNATHI

Lower jaw not highly specialized, never with the angular portion distorted outwards, and never with long conspicuous ridge extending below level of toothrow for attachment of masseter medialis. Angular portion of mandible may be strongly pulled inwards (inflected). In some genera, the root of the lower incisor forms conspicuous knob beside the condylar process.

1. Sciuromorph Series

Infraorbital foramen not or scarcely transmitting muscle.

Fourth Superfamily. APLODONTOIDAE

Infraorbital foramen not transmitting muscle. Masseter lateralis not extending attachment on outer side (forepart) of zygomatic plate, which remains narrow and unspecialized, completely below the infraorbital foramen. Mandible with angular portion inflected to an abnormal degree.

Skull fossorial in aspect. Jugal lengthened. Bullae with neck directed horizontally outwards, and region of braincase greatly widened.

Cheekteeth $\frac{5}{4}$, evergrowing, near complete simplification of pattern.

Fibula not reduced, nor fused with the tibia high on the leg. Malleus and incus free (Tullberg).

Family 10. APLODONTIIDAE

With the characters of the Superfamily.

Aplodontia.

(This family is doubtfully referred to the Sciuromorph series, and is regarded as one of the most isolated and primitive living Rodents.)

Fifth Superfamily. SCIUROIDAE

Infraorbital foramen not or scarcely transmitting muscle. Masseter lateralis superficialis with anterior head distinct from zygoma, and masseter lateralis extending its line of attachment on to zygomatic plate, which is to a greater or lesser degree broadened and tilted upwards, the muscle typically rising upwards on zygomatic plate to superior border of rostrum. Mandible with angular process sometimes strongly inflected (*Cynomys*); usually with a tendency for this formation to be present.

Skull with, in progressive species, well developed postorbital processes present (these processes always traceable). Jugal long, usually approaching or reaching the lachrymal. Bullae without special modifications, usually prominent.

Cheekteeth $\frac{5}{4}$ or $\frac{4}{4}$, cuspidate, very rarely approaching simplification, in which cases (*Lariscus*, *Rheithrosciurus*) the original pattern may usually be traced; the pattern normally a series of transverse ridges and corner cusps (in the upper series), the lower series most often basin-shaped, with cusps at each corner. Cheekteeth rooted, brachyodont or hypsodont.

Fibula not fused with the tibia. Digits of hindfoot five. External form modified for arboreal or terrestrial life; a flying-membrane may be present, attached to sides; tail always completely haired.

Malleus and incus free (Tullberg).

Family 11. SCIURIDAE

With the characters of the Superfamily.

Group Pteromyes

Belomys, *Trogopterus*, *Pteromyscus*, *Petaurista*, *Aeromys*, *Pteromys*, *Hylopetes*, *Petinomys*, *Eoglaucomys*, *Glaucomys*, *Petaurillus*, *Iomys*, *Eupetaurus*.

Group Sciuri

Myosciurus, *Nannosciurus*, *Sciurillus*; *Microsciurus*, *Syntheosciurus*, *Sciurus*, *Tamiasciurus*, *Callosciurus*, *Funambulus*, *Dremomys*, *Ratufa*, *Menetes*, *Lariscus*, *Glyphotes*, *Rheithrosciurus*, *Rhinosciurus*, *Hyosciurus*, *Heliosciurus*, *Paraxerus*, *Funisciurus*, *Protoxerus*, *Myrsilus*, *Epixerus*; *Atlantoxerus*, *Xerus*, *Spermophilopsis*; *Sciurotamias*, *Tamias*; *Citellus*, *Marmota*, *Cynomys*.

Sixth Superfamily. CASTOROIDAE

Zygomasseteric structure essentially as in Sciuroidae. Mandible without special peculiarities.

Skull with no well-marked postorbital process; jugal lengthened, approaching lachrymal, and extremely broadened anteriorly. Bullae with neck directed outwards and upwards.

Cheekteeth $\frac{4}{4}$, extremely hypsodont, but not evergrowing, the pattern flatcrowned, reduced heptamerous, the enamel folds narrow, the pattern changing little during life.

Fibula not fused with the tibia, but tending to become reduced, so that in adult life fusion is suggested.

Digits of hindfoot five. Externally much specialized for aquatic life. Caudal vertebrae broadened; tail naked, much broadened and flattened (unique in the Order in structure and appearance).

Malleus and incus free (Tullberg).

Family 12. CASTORIDAE

With the characters of the Superfamily.

Castor.

Seventh Superfamily. GEOMYOIDAE

Zygomasseteric structure closely resembling that of the Sciuroidae; infraorbital foramen extremely reduced, and rather more modified; mandible with angular portion somewhat reduced. Large externally-opening cheekpouches present. Skull highly fossorial (Geomyidae), or becoming specialized by extreme inflation of auditory bullae and braincase, and narrowing of rostrum ("saltatorial type") (progressive Heteromyidae). Jugal always short; sometimes the zygomatic arch may be complete without it; in Heteromyidae, the whole zygoma is threadlike.

Cheekteeth $\frac{4}{4}$, hypsodont, usually near complete simplification of pattern, and often evergrowing.

Fibula (so far as known) fully fused with the tibia, high on the leg. Digits of hindfoot five, or in saltatorial genera may be reduced to four.

Malleus and incus free (Tullberg).

Family 13. HETEROMYIDAE

Mastoids in progressive genera greatly inflated. Zygoma extremely narrowed. Infraorbital canal "with orifice protected from muscle pressure by countersinking in a vacuity which extends transversely through rostrum" (Miller & Gidley). External form Murine or modified for saltatorial life. Cheekteeth rooted except in *Dipodomys*, and as a rule less simplified than in Geomyidae.

Subfamily HETEROMYINAE

Cheekteeth preserving pattern for a longer time; auditory bullae not specially inflated; form Murine.

Heteromys, *Liomys*.

Subfamily DIPODOMYINAE

Cheekteeth losing their pattern earlier; auditory bullae and mastoids considerably to abnormally inflated; external form Murine or saltatorial. (In *Dipodomys* the cheekteeth are rootless and simple.)

Group Perognathi

Perognathus; *Microdipodops*.

Group Dipodomyes

Dipodomys.

(The arrangement of this family is based on the classification of Wood, 1935.)

Family 14. GEOMYIDAE

Mastoids not inflated. Zygoma robust, the jugal extremely shortened. Infraorbital foramen with its "orifice protected from muscle pressure by countersinking in an oblique sulcus" (Miller & Gidley). External form and cranial characters highly modified for underground life. Cheekteeth in living genera always evergrowing and always, excepting the premolar, completely simple.

Thomomys, Geomys, Pappogeomys, Cratogeomys, Platygeomys, Orthogeomys, Heterogeomys, Macrogeomys, Zygogeomys.

2. Myomorph Series

Infraorbital foramen always clearly enlarged for muscle transmission.

Eighth Superfamily. ANOMALUROIDAE

Infraorbital foramen much enlarged for muscle transmission; masseter lateralis not extending its line of attachment on to forepart of zygomatic plate, which remains completely beneath the infraorbital foramen, and is narrow. Mandible without special peculiarities.

(It may be noted that in this and the next three superfamilies, Pedetoidae, Ctenodactyloidae, and Dipodoidae, the zygomasseteric structure as regards the arrangement of the forepart of the skull (infraorbital foramen and zygomatic plate) is very similar to that of Hystricoidae and Cavioidae).

Skull not abnormal in the typical subfamily; in the Idiurinae, much modified by abnormal enlargement of infraorbital foramen, much constricted palate, thickened incisors, etc. Jugal long. Bullae large, but not abnormally inflated.

Cheekteeth $\frac{4}{4}$, rooted, not hypsodont, the pattern typically reduced heptamerous, the re-entrant folds wide.

Fibula, so far as known, not fused with the tibia (no skeletons of *Zenkerella* and *Idiurus* available for examination). Digits of hindfoot five. External form suited to arboreal life; usually a flying-membrane present, attached to sides. Underside of the tail with scaly outgrowths near the body. Malleus and incus free (Tullberg).

Family 15. ANOMALURIDAE

With the characters of the Superfamily.

Subfamily ANOMALURINAE

Infraorbital foramen not greatly enlarged. Palate not much narrowed. Incisors moderate; toothrows not reduced. "Anterior point of masseteric insertion on mandible beneath hinder part of M.1" (Miller & Gidley). (Flying-membrane present.)

Anomalurus, *Anomalurops*.

Subfamily IDIURINAE

Infraorbital foramen extremely enlarged, the zygomatic plate projected forwards to a point nearly immediately behind the incisors. Palate much narrowed. "Anterior point of masseteric insertion on mandible in front of P.4" (Miller & Gidley). Incisors much thickened from before backwards. Toothrows strongly reduced. (Flying-membrane present or absent.)

Zenkerella; *Idiurus*.

Ninth Superfamily. PEDETOIDAE

Zygomasseteric structure not essentially different from that of the Anomaluroidae (infraorbital foramen extremely enlarged, the zygomatic plate projected forwards, much as in Idiurinae).

Skull with extremely broad frontals; jugal much thickened, lengthened, ascending to lachrymal; mastoids extremely inflated.

Cheekteeth $\frac{4}{4}$, evergrowing, and near complete simplification in pattern.

Fibula reduced and fully fused with tibia high on the leg. Digits of hindfoot four. Externally much modified for bipedal saltatorial life. Metatarsal bones normal, not tending to fuse (compare specialized Dipodidae).

Malleus and incus free (Tullberg).

Family 16. PEDETIDAE

With the characters of the Superfamily.

Pedetes.

Tenth Superfamily. CTENODACTYLOIDAE

Zygomasseteric structure not essentially different from that of the Anomaluroidae in so far as it affects the general shape of the skull. Infraorbital foramen large but not abnormally so. Mandible with the angular portion drawn backwards to a degree, but not distorted outwards; coronoid process absent; a weak short ridge may be developed, reminiscent of the "medialis ridge" of Cavioidae, though much less developed than in that superfamily.

Skull considerably modified, flattened, the jugal long, the zygoma in two portions, a horizontal and a vertical (parallel—Dipodinae). Auditory bullae and mastoids much inflated.

Cheekteeth at full dentition $\frac{4}{4}$, the premolars lost in the adult, or $\frac{4}{4}$ (*Pectinator*). The teeth evergrowing, and near complete simplification of pattern.

Fibula not fused with the tibia. Digits of hindfoot reduced to four.

External form without special peculiarities; tail fully haired; some of the digits with stiff bristle-hairs present (parallel—*Petromus*, Octodontinae, Chinchillidae).

Malleus and incus fused (Tullberg).

Radiale and intermedium can be separate (fused in all other Rodents examined by Tullberg except Bathyergidae).

Family 17. CTENODACTYLIDAE

With the characters of the Superfamily.

Pectinator, *Ctenodactylus*, *Massoutiera*, *Felovia*.

Eleventh Superfamily. DIPODOIDAE

Zygomasseteric structure not essentially different from that of Anomaluroidae, the infraorbital foramen always large, sometimes extremely so, the zygomatic plate always completely beneath it. In primitive genera the infraorbital foramen is conspicuously wider below than above (compare the primitive Muroidae, *Graphiurus*, *Deomys*). Mandible with angular portion weak, sometimes perforated; occasionally strongly inflected, and usually with this formation suggested.

Skull in progressive species characterized by much broadened frontals, greatly inflated mastoids and auditory bullae, and specialized zygoma. In primitive species, the skull more or less Murine in general aspect (except the infraorbital foramen). Jugal long, usually extending to the lachrymal.

Cheekteeth $\frac{4}{3}$ or $\frac{3}{3}$, the extra premolar when present much reduced in size; the teeth rooted, cuspidate, with re-entrant folds which are fairly well open as a rule; occasionally becoming flatcrowned, in which case the re-entrant folds are narrow (specialized Zapodinae).

Fibula much reduced, fused high on the leg with the tibia. Digits of hindfoot in primitive species five; or may become reduced in progressive forms to three functional, or three only. External form much modified for bipedal saltatorial life, excepting the genus *Sicista*.

In specialized genera, the three central metatarsal bones fuse to form a cannonbone.

Malleus and incus free (Tullberg).

Family 18. DIPODIDAE

With the characters of the Superfamily.

Subfamily SICISTINAE

External form not modified for saltatorial life. Zygoma simple. Auditory bullae not inflated. Metatarsal bones normal. Cheekteeth quadritubercular, cuspidate, not tending to become flatcrowned.

Sicista.

Subfamily ZAPODINAE

External form modified for saltatorial life (as in all remaining members of the family). Cheekteeth semi-hypsodont, not quadritubercular, tending in progressive species to become flatcrowned, in which case the re-entrant folds are narrow, and usually isolate on crown surface as islands. Zygoma simple, unspecialized; auditory bullae not inflated; metatarsal bones normal.

Eozapus, *Zapus*, *Napaeozapus*.

Subfamily CARDIOCRANIINAE

Auditory bullae and mastoids abnormally inflated. Zygoma in two portions, a horizontal and a vertical, these portions connected by a curvature. Metatarsal bones normal, not fused. Cheekteeth (apparently) as in Dipodinae. Digits of hindfoot may be reduced to three.

Cardiocranius (not seen), *Salpingotus*.

Subfamily EUCHOREUTINAE

The three central metatarsal bones fused to form cannonbone. Auditory bullae much inflated. Zygoma unspecialized, simple, like that of Zapodinae. Cheekteeth cuspidate, with unusually high cusps. Rostrum much lengthened. Ear much enlarged. M.3 (evidently) vestigial. (Hindfoot with three functional digits.)

Euchoreutes.

Subfamily DIPODINAE

Three central metatarsal bones fused to form a cannonbone. Auditory bullae and mastoids considerably to excessively inflated. Zygoma in two portions, a horizontal and a vertical, these portions not connected by a curvature. Cheekteeth with moderate cusps; rostrum weak; ear less enlarged; M.3 not vestigial. (Hindfoot with three functional digits.)

Group Allactagae

Allactaga, *Alactagulus*, *Pygeretmus*.

Group Dipodes

Paradipus; *Dipus*, *Scirtopoda*, *Eremodipus* (the last not seen), *Jaculus*.

Twelfth Superfamily. MUROIDAE

Zygomasseteric structure primitively (*Graphiurus*, *Deomys*), nearly as in Sicistinae, except that the infraorbital foramen is less enlarged, and is not conspicuously wider below than above.

In two hundred other genera examined belonging to the group, the zygomatic plate is broadened and tilted upwards to a greater or lesser degree; masseter lateralis extends its line of attachment on to zygomatic plate, and masseter lateralis superficialis has its anterior head distinct, so far as known, from zygoma (see figures in Tullberg). Infraorbital foramen always transmitting muscle, never extremely enlarged, usually less so than in the preceding families of Myomorph Rodents; and sometimes (Rhizomyidae) becoming much reduced. Mandible with angular portion not distorted outwards; in Muscardinidae this portion is relatively weak, may show signs of inflection, and may be perforated.

Skull usually with constricted frontals; auditory bullae in the majority not much enlarged, but may become so (Gerbillinae); or may be much reduced, as in *Phloeomys*, *Lophiomys*, certain species of *Rattus*, and others. Jugal typically considerably shortened; but long in Muscardinidae, *Tachyoryctes*, etc.

Cheekteeth $\frac{4}{4}$ (Muscardininae, Graphiurinae), $\frac{3}{3}$ (the greater part of the superfamily), $\frac{3}{2}$ (genus *Desmodilliscus*), or $\frac{2}{2}$ (*Rhynchomys*, some Hydromyine genera); rooted except in *Myospalax*, *Rhombomys*, and the majority of the Microtinae.

Fibula so far as known reduced, and fused high on the leg. Digits of hind-foot five with one exception (*Malacothrix*). External form as a rule small, generalized; sometimes highly modified for underground life (*Spalax*, to a lesser degree *Myospalax*, *Ellobius*, *Prometheomys*, *Notiomys*, etc.); sometimes highly specialized for aquatic life, cranially as well as externally (*Ichthyomys* and allies, *Hydromys*, *Crossomys*); sometimes specialized for arboreal life, with fully opposable hallux (*Chiropodomys*, *Chiromyscus*, *Hapalomys* and others); in one case, *Notomys*, apparently fully specialized for bipedal saltatorial life. Spiny covering may be moderately developed (*Acomys*, some species of *Rattus*, *Platacanthomys*). Tail typically naked, scaly; uniformly haired in most Muscardinidae, *Crateromys*, *Lophiomys*, one species of *Neotoma*, most Gerbillinae, and others.

Malleus and incus free (Tullberg).

Caecum suppressed in Muscardinidae, so far as known, except in *Typhlomys*; becoming much reduced in *Ichthyomys* (Thomas).

Family 19. MUSCARDINIDAE

Skull without special modification; jugal usually relatively long; bullae large and to a degree inflated except in Platacanthomyinae.

Cheekteeth $\frac{4}{4}$ or $\frac{3}{3}$, primitively with basin-shaped crowns and corner cusps, becoming flatcrowned in progressive genera, in which case they become a series of relatively narrow transverse ridges (which are always traceable, even in primitive forms), the general dental effect strongly reminiscent of that of the Sciuridae.

Mandible with angular portion sometimes inflected, and sometimes with perforation.

Externally slightly specialized for arboreal life; tail fully haired except in *Myomimus* (not seen) and *Typhlomys*. Cardiac portion of stomach with horny layer absent (Tullberg). (This character not known regarding Platacanthomyinae; but present, so far as known, in all other members of the superfamily.)

Caecum suppressed, so far as known, excepting in *Typhlomys*.

Subfamily GRAPHIURINAE

Zygomatic plate remaining completely beneath infraorbital foramen; masseter lateralis not extending its line of attachment on forepart of zygomatic plate. (Cheekteeth $\frac{4}{4}$).

Graphiurus.

Subfamily MUSCARDININAE

Zygomatic plate tilted strongly upwards; masseter lateralis extending line of attachment on to forepart of zygomatic plate. Cheekteeth $\frac{4}{4}$. Bullae large, normally. Cheekteeth when flat-crowned with the depressions (between the ridges) not tending to become isolated with wear. Palate without a series of foramina (or a single large pair) situated between the toothrows.

Myomimus (not seen), *Eliomys, Dyromys, Glirulus, Glis; Muscardinus.*

Subfamily PLATACANTHOMYINAE

Like the Muscardininae except: premolars suppressed, cheekteeth (flat-crowned) with the depressions (between the ridges) tending to become isolated on crown surface with wear; bullae small; palate with a large pair of foramina, or a series of foramina, between the toothrows. (Zygomatic plate much narrowed, parallel-Hydromyinae). (A caecum is present in *Typhlomys.*)

Platacanthomys, Typhlomys.

Family 20. LOPHIOMYIDAE

Like the Muridae (below, no. 23), but more specialized; skull with temporal fossae roofed over by bony plates rising from jugal, frontal, and parietal, a structure not known elsewhere in the Order. Cheekteeth $\frac{3}{3}$; pattern as in cuspidate Cricetinae. External form modified for arboreal life. (Hallux partly opposable; bullae much reduced.)

Lophiomys.

Family 21. SPALACIDAE

Like the Muridae (below, no. 23), but more specialized; skull and external form extremely modified for underground life, the eyes suppressed. Infraorbital foramen relatively large, and zygomatic plate nearly horizontal and below it (secondarily acquired? masseter lateralis superficialis with anterior head distinct, as in Muridae, as figured by Tullberg). Cheekteeth with re-entrant folds which isolate on crown surface in adult.

Spalax.

Family 22. RHIZOMYIDAE

Like the Muridae (below), but zygomasseteric structure unusual; infraorbital foramen extremely reduced, owing to the fact that masseter lateralis rises to an abnormally high degree on zygomatic plate (which is very strongly tilted upwards), extending its line of attachment beside the infraorbital foramen on its inner side. Externally and cranially more or less modified for fossorial life; cheekteeth with re-entrant folds isolating as islands on crown surface in adult. (Infraorbital foramen not V-shaped below.)

Rhizomys, Cannomys.

(End of First Volume)

Family 23. MURIDAE

Infraorbital foramen typically specialized into a wider upper portion for muscle transmission and a narrower lower one for nerve transmission, its lower border very generally V-shaped (not nearly straight as it is in Rhizomyidae). Jugal normally strongly reduced (except *Tachyoryctes* and some genera from Madagascar). Cheekteeth laminate, cuspidate, heptamerous or prismatic, but never reminiscent of those of Sciuridae, i.e. never agreeing in pattern with those of Muscardinidae. External form various, but when subfossorial, eyes retained, and zygomatic plate not specially narrowed nor turned downwards (compare Spalacidae). Temporal fossae never roofed in by bony plates (compare Lophiomyidae). Masseter muscle, so far as known, not rising beside infraorbital foramen on its inner side (compare Rhizomyidae).

The order in which the subfamilies are listed here is provisional.

Only valid genera which have been actually examined are included in the present list.

Subfamily DEOMYINAE

Zygomatic plate remaining completely beneath the infraorbital foramen. (Pattern of cheekteeth as in Dendromyinae).

Deomys.

Subfamily MURINAE

Zygomatic plate (as in all remaining subfamilies) broadened and tilted upwards to a greater or lesser degree.

Cheekteeth laminate or cuspidate; when laminate, the laminae tightly pressed together; when cuspidate, the cusps of the upper molars arranged in three longitudinal rows.

Group Eliuri

Eliurus.

Group Anisomyes

Anisomys.

Group Mures

Hapalomys, Pogonomys, Lenomys, Chiropodomys, Vandeleuria, Micromys, Apodemus, Thamnomys, Grammomys; Carpomys, Batomys, Pithecheir, Crateromys, Hyomys, Mallomys, Conilurus, Zyzomys, Laomys, Mesembriomys; Oenomys, Dasymys, Mylomys, Arvicanthis, Lemniscomys, Rhabdomys, Pelomys, Hybomys, Hadromys, Millardia, Pyromys, Dacnomys, Eropeplus, Stenocephalemys, Aethomys, Thallomys, Rattus, Gyomys, Leporillus, Pseudomys, Apomys, Melomys, Uromys, Coelomys, Malacomys, Hacromys, Zelotomys, Chiromyscus, Leggadina, Mus, Muriculus, Hylenomys, Mycteromys, Colomys, Nesoromys, Macruromys, Crunomys; Notomys; Mastacomys; Golunda; Acomys, Uranomys; Lophuromys; Echiothrix; Bandicota, Nesokia; Beamys, Saccostomus; Cricetomys; Phloeomys.

Subfamily RHYNCHOMYINAE

Like the Murinae, but incisors and cheekteeth ($\frac{2}{2}$) so reduced as to appear almost functionless.

Rhynchomys.

Subfamily HYDROMYINAE

Like the Murinae, but cheekteeth (often $\frac{2}{2}$) with a pattern characterized by a series of basin-shaped lobes (evidently the outer row of cusps of Murinae have become suppressed).

Zygomatic plate much narrowed, though strongly tilted upwards. Infraorbital foramen may be more enlarged than is usual. M.3 when present vestigial.

Xeromys, Leptomys, Chrotomys, Celaenomys; Parahydromys, Crossomys, Hydromys.

Subfamily DENDROMYINAE

Like the Murinae, but cheekteeth with the inner row of cusps of upper molars becoming suppressed; M. $\frac{3}{3}$ vestigial.

Dendromus, Steatomys; Malacothrix; Prionomys; Petromyscus.

Subfamily OTOMYINAE

Cheekteeth with pattern of a series of transverse plates; in the upper series M.3 becoming the dominant tooth; cheekteeth hypsodont. Bullae may become much inflated.

Otomys, Parotomys.

Subfamily CRICETINAE

Cheekteeth laminate, cuspidate, prismatic or heptamerous; when cuspidate the cusps arranged in two longitudinal rows, when laminate the laminae separated by wide folds; when prismatic, cheekteeth rooted, and skull not much modified by ridges for muscle attachment (compare *Microtinae*).

Oryzomys, Neacomys, Megalomys, Nectomys, Thomasomys, Rhipidomys, Phaenomys, Chilomys, Nyctomys, Tylomys, Ototylomys, Rhagomys, Nesomys, Reithrodontomys, Peromyscus, Baiomys, Calomyscus, Onychomys, Akodon, Zygodontomys, Microxus, Lenoxus, Oxymycterus, Blarinomys, Notiomys, Scapteromys, Scotinomys, Cricetulus, Phodopus, Cricetus, Mesocricetus, Mystromys, Hesperomys, Eligmodontia, Graomys, Phyllotis, Chinchillula, Irenomys, Reithrodon, Euneomys, Chelemyscus, Neotomys, Sigmomys, Sigmodon, Holochilus, Andinomys, Neotomodon, Neotoma, Hodomys, Nelsonia; Hypogeomys; Rheomys, Ichthyomys, Anotomys.

Subfamily GYMNUROMYINAE

Cheekteeth flatcrowned, laminate, the laminae excessively tightly packed together, the pattern a series of isolated folds, these folds line-like and extremely narrowed. M.3 slightly larger than M.2, and M.2 slightly larger than M.1.

Gymnuromys.

Subfamily GERBILLINAE

Skull specialized by inflation of auditory bullae and braincase, and narrowing of rostrum ("saltatorial type"). Cheekteeth tending to become a series of transverse plates, these separated by wide folds, in progressive genera; in primitive forms, the teeth are cuspidate at birth, the cusps arranged in two longitudinal rows, in the upper molars. M.3 usually strongly reduced. (The cheekteeth are evergrowing in the genus *Rhombomys*.) External form modified for terrestrial plains or desert life, perhaps saltatorial in some cases; tail usually fully haired; limbs often lengthened to a certain degree.

Microdillus, Gerbillus, Taterillus, Tatera ; Desmodillus, Desmodilliscus, Pachyuromys ; Ammodillus ; Meriones, Brachiones, Psammomys ; Rhombomys.

Subfamily TACHYORYCTINAE

Cheekteeth moderately or strongly hypsodont, rooted, the pattern consisting of thick curved parallel ridges of enamel extending across crown surface. External form generalized or fossorial.

Group Brachyuromyes

Brachyuromys.

Group Tachyoryctae

(Infraorbital foramen V-shaped below, compare Rhizomyidae.)
Tachyoryctes.

Subfamily MYOSPALACINAE

Cheekteeth evergrowing, the pattern prismatic. Infraorbital foramen relatively large, zygomatic plate not strongly tilted upwards. Skull and external form modified for underground life, the lambdoid crest slanting forwards about to level of posterior zygomatic root (parallel-Spalacidae).

Myospalax.

Subfamily MICROTINAE

Cheekteeth prismatic in pattern, frequently but not always evergrowing. Infraorbital foramen small, narrowed; zygomatic plate strongly tilted upwards. Skull much modified by ridges for muscle attachment (tendency to develop median interorbital crest, squamosal crests, etc.). Lambdoid crest not slanted forwards to level of posterior zygomatic root.

Group Brachytarsomyes

Brachytarsomys.

Group Lemmi

Dicrostonyx ; Synaptomys, Myopus, Lemmus.

Group Microti

Clethrionomys, Aschizomys, Eothenomys, Anteliomys, Alticola, Hyperacrius ;

Dolomys; Phenacomys; Arvicola, Pitymys, Blanfordimys, Phaiomys, Neodon, Pedomys, Orthriomys, Herpetomys, Proedromys, Microtus, Lasiopodomys; Lagurus; Ondatra, Neofiber; Prometheomys, Ellobius.

The "Family Nesomyidae" or subfamily Nesomyinae of some authors in which all the Rats of Madagascar are included is here regarded as not definable. Nor can all these Rats be referred to the Cricetinae, as is often done, for it seems clear that for the most part they are not closely related to each other.

Excellent figures of zygomasseteric structure of all the leading families of Rodentia are published by Tullberg, Nova Acta Reg. Soc. Sci. Upsaliensis, 3, XVIII, 1900 (1899).

Before dealing in detail with the various families, it may be mentioned that in this work, fifty-two families and subfamilies are recognized in the Order, and that about three hundred and thirty-six genera have been examined, included in the keys, and retained as valid.

ZYGOMASSETERIC STRUCTURE

WITHOUT entering into any detailed account of the variations of the arrangement of the jaw-muscles of the Rodentia, it is necessary to note certain characters by which these muscles modify the skull, and with which it is usually possible at once to identify the "superfamily" position of any living Rodent.

There are three parts of the skull which become greatly affected in the various families, namely the infraorbital foramen, the zygomatic plate, and the formation of the mandible.

The formation of the mandible has usually been used by most authors to divide the "Hystricomorph" series from the remainder of the others; Tullberg made this his major division of the Order, and divided it into "Hystricognathi" (including Bathyergidae) for forms in which the mandible has the angular process lifted outwards by the specialized limb of masseter lateralis superficialis, and the "Sciurognathi," in which this does not take place.

The angular portion of the mandible is as just described, to a greater or lesser degree, but (with rare exceptions) strongly and clearly marked, in the families Bathyergidae, Hystricidae, Erethizontidae, Echimyidae, Dinomyidae, Cuniculidae, Dasyproctidae, and Chinchillidae. It is at its weakest in the Chinchillidae, and in this family there is some approximation towards that structure, next to be described, found in Caviidae. It is also relatively weakly developed in more primitive Hystricidae, as *Atherurus*; but in most of the genera comprising the above-mentioned families (including *Petromus* which I refer to the Echimyidae, but which has frequently been lumped with the Ctenodactylidae), it is strongly and clearly marked, and reaches its highest degree of strength in such forms as *Thryonomys*, *Myocastor*, *Capromys* and certain Echimyidae, and in the Bathyergidae.

The angular portion of the mandible is not lifted outwards by the lateralis muscle in any other family or genus of Rodent, so far as I have seen.

In the Caviidae (*Cavia*, *Galea*, *Kerodon*, *Caviella*, *Dolichotis*, *Hydrochoerus*), the mandible is not by any means typically Hystricoid, though these Rodents have universally been placed in the Hystricoid series; here it is according to Miller & Gidley the medialis portion of the masseter which influences the jaw; a very deep ridge is developed along the jaw slightly below the level of the toothrows; though this structure is suggested in Ctenodactylidae and more so in Chinchillidae, the Caviidae have as far as I have seen an entirely unique formation of the lower jaw in degree of development. Waterhouse suggested that if the lower incisors of the Caviidae were longer and continued further backwards the mandible would be typically Hystricoid, and included them in his Hystricoid series. Be that as it may, unfortunately the mandible is not so, and therefore Caviidae cannot be looked upon as typical Hystricoid Rodents to-day, whatever they may have been derived from.

In other families of Rodentia, the mandible may have the angular portion pulled inwards instead of lifted outwards, or may be comparatively without peculiarity.

The pulling inwards is developed to a most abnormal degree in the Aplodontiidae. It is also to be found in certain Sciuridae, certain Dipodidae; it is evidently nearly as in *Aplodontia* in the genus *Cynomys* (Sciuridae); and in the genus *Cardiocranius* (Dipodidae; not seen).

The mandible of the Ctenodactylidae, so often placed in the Hystricoid series, is abnormal, but not in the least like the Hystricoid type. The coronoid is suppressed; the angular process drawn backwards to a degree; and a faint medialis-ridge, reminiscent of that of the Caviidae may be traced.

I can call to mind no special peculiarities with regard to the mandible of the vast number of genera and species I have examined in the Muridae. Rarely the coronoid is suppressed. In the Muscardinidae, and in certain Dipodidae, the angular portion may be perforated. In the former family sometimes traces of the pulling inwards of the angular, so highly developed in *Aplodontia*, will be seen. The mandible may be noted as weak in the Heteromyidae.

In some genera with the "non-Hystricine" mandible, the lower incisor extends so far backwards that it forms a conspicuous process between the condylar and angular processes; examples are *Spalax*, Geomyidae, Rhizomyidae, *Nesokia*, etc. This never occurs in genera with Hystricine type of mandible. *Pedetes*, sometimes placed in the Hystricoid series (as by Thomas), has certainly not a Hystricine type of mandible, with its reduced relatively small angular process.

In mandible structure, therefore, Rodents divide very broadly speaking into three classes:

Angular process lifted up and distorted outwards by specialized limb of masseter lateralis superficialis:

Bathyergidae, Hystricidae, Erethizontidae, Echimyidae, Dinomyidae, Cuniculidae, Dasyproctidae, Chinchillidae.

Angular process never lifted up as above described.

Lower jaw deeply modified by conspicuous ridge extending below level of toothrows on outer side, for attachment of masseter medialis:

Caviidae.

Lower jaw without extreme modifications, except in certain cases by root of lower incisor; or by strong inflection of angular process (extreme only in Aplodontiidae):

Aplodontiidae, Sciuridae, Geomyidae, Heteromyidae, Castoridae, Dipodidae, Ctenodactylidae, Anomaluridae, Pedetidae, Muscardinidae, Spalacidae, Lophiomyidae, Rhizomyidae, Muridae.

The infraorbital foramen is enlarged to transmit the masseter muscle in a very large number of Rodents. Degree of enlargement, and shape and size of this foramen varies exceedingly.

Even in those forms which are regarded here as not transmitting muscle, in two families, Sciuridae and particularly Bathyergidae, is certain variation found. In *Protoxerus* and *Tamias* (Sciuridae), the infraorbital foramen is more enlarged than in the other Squirrels, and probably may transmit a small strand of the muscle. In these cases however it is not so far as I can judge anything like so enlarged and clear as in any Rodent which is regarded here as a form with muscle transmission of this foramen present. In the Bathyergidae, certain species of the genus *Cryptomys* appear to be starting to transmit muscle through the infraorbital foramen; it may rarely, as in *C. mellandi*, even be as much enlarged as in the much reduced type found in the Rhizomyidae. This is evidently a variable character, and in *Cryptomys* the foramen may even be more enlarged on one side of the skull than on the other, in individual cases. In the Aplodontiidae, most authors state that the canal does not transmit muscle; however in those examined it is on the large side for this section of the Order.

The infraorbital foramen does not transmit muscle in Geomyidae, Heteromyidae (excessively reduced in these two families), Castoridae, Sciuridae with the above noted exceptions, Aplodontiidae and Bathyergidae, with the above noted exceptions.

In all other Rodents it is clearly enlarged to do so. There are then broadly speaking two types of infraorbital foramen structure to be discussed, with the one exception of the Rhizomyidae. In Hystricidae, Erethizontidae, Echimyidae, Dinomyidae, Dasyproctidae, Chinchillidae, Caviidae, Pedetidae, Anomaluridae, Ctenodactylidae and Dipodidae, it is round, completely above the zygomatic plate, and normally extremely enlarged. This enlargement reaches its greatest development probably in the Pedetidae, and in the Idiurine subfamily of Anomaluridae; and in certain sections of the Dipodidae. In the Cuniculidae, the infraorbital foramen is secondarily reduced by the growth of the enormous cheekplates. In two genera of Rodents which are here referred to the Muroid superfamily, *Deomys* (Muridae), and *Graphiurus* (Muscardinidae), the infraorbital foramen, though not abnormally enlarged, is completely above the zygomatic plate.

In the remainder of the Order, the infraorbital foramen, though sometimes varying in actual size of enlargement, is never abnormally enlarged; in vast sections of the family Muridae, it is specialized into a wider portion above for muscle transmission, and a narrower lower one for nerve transmission. In the Subfamily Microtinae, it has become, correlated probably with the increase in general strength of jaw-muscles in this group, much reduced. It is abnormally reduced in the Rhizomyidae (*Rhizomys* and *Cannomys*); in this group, the zygomatic plate is strongly broadened and tilted upwards, and the foramen becomes reduced to a small aperture situated at the top of this plate; the masseter muscle rises up inside of it, a condition according to Tullberg not known elsewhere in the Order.

It may be noted that Winge puts forward the theory that in all Rodentia living, *Aplodontia* excepted, the infraorbital foramen has transmitted muscle, and has become secondarily closed in the Geomyidae, Sciuridae, Castoridae, Bathyergidae, Heteromyidae. Without wishing to enter into a discussion on matters such as these, it appears to me to be singularly unlikely that, having taken such a large step forward in evolution as the enlargement of this canal for muscle transmission (as it seems an unusual character among Mammalia to say the least), these families should go even further in evolution and, so to speak, develop covering over this canal so that it does not transmit again. There is not a wide difference in the arrangement of the zygomatic plate between *Aplodontia* and a primitive Sciurine such as *Belomys*; it would seem so much more likely that the Sciurine arrangement of jaw-muscles was developed from a type not widely distinct from *Aplodontia* as regards arrangement of infraorbital foramen and zygomatic plate; far more likely than that the infraorbital of *Belomys* is secondarily closed to muscle transmission.

In the Spalacidae (*Spalax* alone), the infraorbital foramen is larger than usual for a Muroid Rodent and the zygomatic plate, though to a degree broadened, appears to be nearly flattened to a horizontal position. This however may well have been brought about by the fossorial habits of this animal.

Summarizing: the infraorbital foramen does not, or scarcely transmits muscle in Sciuridae, Geomyidae, Heteromyidae, Castoridae, Bathyergidae, Aplodontiidae.

It is enlarged, and usually very much enlarged for muscle transmission in Hystricidae, Erethizontidae, Echimyidae, Dinomyidae, Cuniculidae (see note above), Dasyproctidae, Chinchillidae, Caviidae, Ctenodactylidae, Anomaluridae, Pedetidae, Dipodidae.

It is enlarged, but very rarely much enlarged for muscle transmission in Muridae, Lophiomyidae, Spalacidae, Muscardinidae, and Rhizomyidae (see note above).

The zygomatic plate is less variable in structure, broadly speaking, than either the infraorbital foramen or the mandible. Among the Rodents it is found in two conditions only. It is narrow, usually very narrow, and strictly horizontal, remaining completely beneath the infraorbital foramen, in Aplodontiidae, Bathyergidae, Dipodidae, Anomaluridae, Ctenodactylidae, Pedetidae, Hystricidae, Erethizontidae, Echimyidae, Dinomyidae, Dasyproctidae, Chinchillidae, Caviidae, and in the genus *Graphiurus* (Muscardinidae), and *Deomys* (Muridae).

In the Cuniculidae it is much distorted by the growth of the bony cheek-plates.

In other Rodentia, to a greater or lesser degree, it is broadened and tilted upwards. In these, according to Miller & Gidley, and supported by Tullberg's figures, masseter lateralis superficialis is distinct from the zygoma, "not attached to any part of zygoma except occasionally to a point at extreme base of zygomatic plate."

In the Sciuridae, Castoridae, Geomyidae and Heteromyidae, in which the infraorbital foramen does not transmit muscle, the zygomatic plate is very generally strongly broadened and tilted upwards, the only exceptions being found among the Sciuridae; such as *Tamias*, and most members of the *Pteromys* group except *Pteromys*. In these families, the lateralis muscle rises to the superior border of rostrum and excludes masseter medialis from so doing. In the Muridae, so far as known, except *Deomys*, the Muscardinidae, except *Graphiurus*, the Lophiomyidae, the Spalacidae, and the Rhizomyidae, the zygomatic plate is broadened and tilted upwards to a certain degree, but masseter medialis is transmitted through the infraorbital foramen so that it is not excluded from the superior border of the rostrum, and masseter lateralis as a rule does not extend so high on the forepart of the skull. The zygomatic plate in these families only approaches the Sciurine type of specialization as regards broadening in the Rhizomyidae. The degree of broadening, narrowing, and tilting upwards varies extremely through the Muridae, as might be expected in such a vast group. In Hydromyinae, though tilted up strongly, it is narrow. In such genera as *Oxymycterus*, and *Lophuromys*, it is very little tilted upwards; but only in *Deomys* of the vast number examined does it appear to me to be absolutely indistinguishable from the Dipodoid type as defined by Miller & Gidley.

Notwithstanding this, although Tullberg's figures show clearly that there is a wide distinction between *Glis* and *Graphiurus* in the Muscardinidae, and between *Deomys* and *Oxymycterus* in the Muridae, as regards zygomasseteric structure of the forepart of the skull, I am not persuaded of the desirability of transferring *Graphiurus* to a separate superfamily from *Glis*, as was done by Miller & Gidley, nor *Deomys* to a separate superfamily from the remainder of the Muridae, although it must be admitted that to identify the superfamily relationships of *Deomys* (here considered a Muroid), from *Sicista* (a primitive Dipodoid), is not possible on this character alone. It would seem however that the close resemblance in all other main characters between *Graphiurus* and say *Eliomys*, and between *Deomys* and say *Dendromus* indicate that the Murine type of zygomatic plate and arrangement of jaw-muscles has been derived from the Dipodoid type, or vice-versa.

The zygomatic plate therefore in the Order is narrow, and completely beneath infraorbital foramen, showing no signs of becoming broadened and tilted upwards, in Hystricidae, Erethizontidae, Echimyidae, Dinomyidae, Dasyproctidae, Caviidae, Pedetidae, Ctenodactylidae, Anomaluridae, Dipodidae, Aplodontiidae, Bathyergidae, Chinchillidae, Muscardinidae, part, subfamily Graphiurinae, and Muridae, part, subfamily Deomyinae only.

It is much modified by growth of cheekplate in Cuniculidae, but presumably possessed the above character originally as in the rest of the Hystricoidae.

It is broadened and tilted upwards to a greater or lesser degree in Sciuridae, Castoridae, Geomyidae, Heteromyidae, Lophiomyidae, Rhizomyidae, Spalacidae (see note above, p. 45), Muscardinidae, part, except Graphiurinae, and Muridae, part, all except Deomyinae.

The presumed relationship between *Deomys* and the Dendromyinae, and between *Graphiurus* and the remainder of the Muscardinidae indicate that it is not wise to base superfamily grouping on zygomasseteric structure alone, as was done by Miller & Gidley.

DISTRIBUTION

The Rodentia is the only Order of non-Marsupial land mammals inhabiting AUSTRALIA. The one family of Rodents, the Muridae, must have either got there early from South-east Asia, which is the view currently held, or evolved there, which is the view suggested in the present paper. It is curious that if the Muridae alone came from South-east Asia, some members at least of the families Tupaiidae, Soricidae, Erinaceidae, Galeopteridae, Viverridae, Mustelidae, Tarsiidae, Cercopithecidae, Tragulidae, Cervidae, Sciuridae, Hystricidae and Manidae, to quote only some of the families widely or at least comfortably distributed throughout the Indo-Malayan islands to the north-west of New Guinea, did not do so. It is remarkable to say the least if not one genus of this vast assemblage entered the Australasian region, and yet such a large number of Muridae did so. For in New Guinea and Australia, and immediately adjacent islands such as Ceram, there are two hundred and forty-five named forms of Muridae, belonging to twenty-five genera and two subfamilies. It is to my mind as likely that a large section of the Muridae evolved in Australia and came into Asia via some islands as Celebes and the Philippines which may have for a time been separated from Asia and joined Australia, but later separated from Australia and joined Asia, than that all these Australian types came from Asia unaccompanied by any other genus of non-murine mammal. (The presence of the genus *Sus* in New Guinea is usually held to be due to introduction.) This view suggests that the Muridae are among the most archaic of mammals, which appears on account of their universal distribution to be likely.

The main Australasian genera of Muridae are *Rattus* (many species totally distinct from the "ship-rats" *rattus* and *norvegicus*, and including one group, *concolor* which ranges to some of the Pacific Islands), *Uromys* (doubtfully distinguishable from *Rattus*), and the isolated and distinct genera *Zyzomys*, *Mesembriomys*, *Notomys*, *Conilurus*, *Leporillus*, and *Mastacomys* (Australian or Tasmanian), and *Mallomys*, *Hyomys*, *Pogonomys*, *Macruromys*, *Nesoromys* and *Anisomys* (New Guinea or Ceram). *Leggadina* (Australian), appears to represent a wild ally of the cosmopolitan genus *Mus*, which is I think not indigenous to the area under consideration. All these belong to the subfamily Murinae; the subfamily Hydromyinae, which is probably derived from Murinae, and closely allied to it, has half a dozen representatives in the area, as *Hydromys* (Australia and New Guinea), and the more restricted *Xeromys* (Queensland), *Crossomys*, *Parahydromys*, *Leptomys*, etc. (New Guinea), most of which are little known and rare.

The INDO-MALAYAN REGION presents few families, but great reduplication of species within the larger genera. Only Sciuridae, Hystricidae, Rhizomyidae, Muscardinidae (Malabar and South China), and Muridae have penetrated the area, and only Sciuridae, Hystricidae and Muridae to any great extent. Roughly twelve hundred forms are named from the area, about half of which are Muridae.

In this family, of the typical subfamily, the genus *Rattus* (largest genus in named forms in the Order), has its headquarters in the present region, with over three hundred and fifty named forms ranging over the whole area, and containing in the area about twenty specific groups, eight of which range through the greater part of the area except Peninsular India, and in some cases Celebes, two of which are peculiar to Peninsular India, and several of which are confined either to Celebes or the Philippines. The genera *Bandicota* and *Chiropodomys*, and to a lesser degree *Mus*, range through most of the area except that *Chiropodomys* is not known from Peninsular India nor Celebes, and *Bandicota* does not range further east than Java. Apart from these the Murine genera of the Malay Islands are rather different from those of the mainland. In the Philippines, highly specialized genera such as *Phloeomys*, *Crateromys*, *Carpomys* and *Crunomys* occur, and are not known outside the islands; they may be allied to certain Australasian types, as the New Guinea *Mallomys*, etc. The highly aberrant genus *Echiothrix* is confined to Celebes. A few other rather unimportant genera are named from Sumatra, Java, Borneo, closely allied either to *Rattus* or *Mus*, excepting *Pithecheir* (Sumatra, Malacca).

In the eastern portion of the mainland which constitutes this area (Burma, Siam, Indo-China region), a few genera as the isolated *Hapalomys*, and types such as *Dacnomys* and *Hadromys* are confined. *Vandeleuria*, wholly Indomalayan, ranges into the area from Peninsular India. In South China, the Palaearctic genera *Micromys* and *Apodemus* occur. In this area, and Siam, the genus *Mus* appears to end its natural Eastern Range (except perhaps for its presence in the Philippines).

Peninsular India appears to have types rather different from those of the eastern Indomalayan; among these may be mentioned *Golunda* and *Millardia*, which range more or less through the area, and in the north occurs a species of *Acomys* (African and Palaearctic chiefly), and *Nesokia*.

A distinctly Australasian element is seen in the Philippines in the presence of the Hydromyinae (*Chrotomys*, *Celaenomys*). From the same island comes *Rhynchomys*, which is here regarded as type of a subfamily the Rhynchomyinae.

The Muridae of the Malay Islands, other than the Philippines, all belong to the typical subfamily. In the northern part of the mainland area, a few Microtinae, as *Eothenomys* (Southern China, Burma), *Neodon* (Sikkim), and some others have their southernmost range limit in the Old World. In Peninsular India, the Gerbillinae are represented by *Tatera* which occurs throughout the area; the subfamily is not known from the remainder of the Indomalayan.

The family Rhizomyidae (*Rhizomys*, *Cannomys*) is more or less confined to the area, ranging out of it only in parts of Szechuan, the group extends through South China and from Nepal south through Siam to Malacca and Sumatra.

The Muscardinidae is represented by two rare genera which form a well-marked subfamily (Platacanthomyinae), and are confined to the Malabar coast of India (*Platacanthomys*), and to South China (*Typhlomys*). The Hystricidae very probably evolved in the present area since all the most primitive known types seem to be grouped in it. Two, *Trichys* and *Thecurus*, are confined to the islands (Sumatra, Borneo, and in the case of *Thecurus*, the Philippines) (*Trichys* reaches Malacca). The more widely ranging genera *Atherurus* and *Hystrix* occur throughout much of the area; *Hystrix* seems absent only from the Philippines and Celebes; *Atherurus* ranges from Sumatra at least, north to Assam and South China. The species of *Hystrix* in the area are with the exception of the form found in Peninsular India, which also ranges over much of Palaearctic South-west Asia, of the more primitive type, at any rate as regards development of external covering of quills and spines.

The Sciuridae present a great number of forms in the area, and a high degree of specialization. In Peninsular India, only two genera of non-flying squirrels occur, *Funambulus* (confined to the area), and *Ratufa*, which ranges over the whole region east to Borneo, but evidently not much in South China, though known from the island of Hainan. In Nepal and Burma, many more genera occur; *Callosciurus* (not very clearly distinguishable from the Holarctic genus *Sciurus*), heading the list with about three hundred named forms. *Marmota* ranges into the area from the Palaearctic, in Nepal and Yunnan. *Dremomys* and *Menetes* may be mentioned as types typical of the eastern part of the mainland; the former ranges to Malacca and Borneo. When Malacca is reached, many new forms start their ranges, some of which are highly specialized. *Lariscus* and *Rhinosciurus*, both ranging to Borneo, are among the more important. The Pygmy Squirrels of the genus *Nannosciurus* go through the whole of the larger Malay Islands, from Sumatra to the Philippines, except Celebes, where they are represented evidently by a species, *murinus*, which agrees more in characters with the allied genus *Sciurillus*. Other peculiar types are *Rheithrosciurus* and *Glyphotes*, both of Borneo. None of the above-mentioned are known outside the Indomalayan region, except that *Callosciurus* has a few forms ranging into Palaearctic China. And it seems that the further south one goes the more highly specialized or aberrant become the distinct genera, though the more normal types as *Callosciurus* and *Ratufa* go through much of the area, the former even including Celebes and the Philippines. This is one of the few regions in the world where the named forms of Sciuridae actually exceeds the number of named forms of Murinae, for in addition to the above-mentioned, the area seems to be the headquarters of the Flying-squirrels; *Petaurista*, the giant Flying-squirrels, and smaller forms as *Hylopetes* and *Petinomys*, range more or less throughout the whole area except that *Petaurista* does not occur east of Borneo, *Hylopetes* does not enter Peninsular India, and neither *Hylopetes* nor *Petinomys* appear to go very far into South China. *Belomys* is an important genus confined to the north-eastern part of the area (Sikkim, Tongking, Formosa, etc.).

To the Malay Islands, some very distinct generic types are restricted, the most noteworthy being *Iomys*. It will be seen that, as indicated above, only three families of Rodents have gained a real footing in this region, which is a very different state from that present in most of the other large areas of the World.

PALAEARCTIC RODENTS. The Palaearctic as here understood contains all land in the Old World lying north of the Yangtsekiang River, the 30° line of latitude through northern India (i.e. including Kashmir), and broadly speaking the remainder of South-west Asia and the coastal regions of Africa which lie north of this line, or just south of it (as South Persia). Arabia should probably be regarded as forming part of the African rather than the Palaearctic region.

From this area roughly eleven hundred forms are named. The Muridae is very much the dominant family here in that seven hundred and fifty forms approximately belong to it. Six other families have a wide or moderate range in the area, and two, Ctenodactylidae (coastal regions of North Africa, *Ctenodactylus*, *Massoutiera*) and Rhizomyidae (Szechuan, *Rhizomys*), just touch it.

The Microtinae is here the dominant subfamily of Muridae; the genus *Microtus*, which occurs almost throughout the whole region except most of North Africa, being the sole Rodent genus with more than a hundred forms named from the area alone. Other Microtine genera with a wide range are *Clethrionomys*, and *Arvicola*, the former like *Microtus* extending across into North America. *Ellobius* and *Prometheomys*, the two subfossorial Voles, are restricted to the area. The Lemmings, *Dicrostonyx* (Arctic regions), *Lemmus* and *Myopus* range across the northern portion. The two former also cross into North America. The most interesting of the rather numerous remaining genera in the area are *Lagurus*, *Alticola*, *Dolomys*, *Pitymys* and *Blanfordimys*. *Pitymys* has a wide range in Continental Europe, but is not met with further east of the Caucasus until it turns up again in Eastern North America, though several forms as *Neodon* occurring to the East in the Palaearctic are closely allied to it. *Lagurus* is also known from America. *Dolomys* and *Blanfordimys* are rare and local (Montenegro region, and Afghanistan region respectively).

The Murinae are well represented, but by only a very few genera, at any rate compared with the huge numbers of genera to be found in any of the tropical portions of the Old World. Indeed, only five have a real range in the area. *Apodemus* is probably naturally the most widely distributed, as well as one of the most primitive members of the group, and appears to extend its range even to Iceland. *Mus* and *Rattus* are now cosmopolitan in the Palaearctic owing to artificial human distribution, but both probably have a naturally wide range in the area, especially the former. *Micromys* ranges intermittently from England to Japan; and *Nesokia* is common in the more southern portions of the Asiatic part of the area (Syria (into Egypt), across Persia and Russian Turkestan to Kashmir and Sinkiang). Of the rest, some four genera touch the coastal part of Africa, one of which, *Acomys*, is known from Crete and Syria, and three genera range north from India into the Kashmir region, the most important of which is *Golunda*. The Subfamily Gerbillinae has a wide range in the Palaearctic east of western Europe; *Meriones* is the main genus, having more named forms from the area than any other Palaearctic Rodent except *Microtus* and *Apodemus*; *Rhombomys*, the most highly specialized member of the subfamily, is from the Palaearctic only; but apart from these no member of the group ranges as far north as Siberia, being mostly confined to the Syrian-Persian region (as *Tatera*), or North Africa (*Gerbillus*, *Psammomys*, etc., both of which range into Syria). The peculiar "Fat-tailed Gerbils" of the genus *Pachyuromys* seem more or less restricted to the Palaearctic portion of Africa.

The subfamily Cricetinae has a fairly wide range in the area, though only five genera are met with, the group being primarily American; *Calomyscus*, surely a very near relative of the American *Peromyscus*, is restricted to Persia, Russian Turkestan, and Baluchistan; the more typical Hamsters, which seem not to have very near allies in North America, have a wider range; *Cricetus* occurring from Central Europe as far west as Belgium, east to Central Siberia; *Cricetulus* covering a very large part of China, as well as Greece, South Russia, Syria, S.W. Siberia, and Kashmir; the other genera occurring in the area being *Mesocricetus* and *Phodopus*. In addition to the four great subfamilies of Muridae being well represented as indicated above, there is a very interesting subfamily confined apparently to Palaearctic China and adjacent parts of Siberia only, the Myospalacinae, with one genus, *Myospalax*. The family Spalacidae, which is here restricted to the genus *Spalax* alone, is purely Palaearctic, ranging round the eastern end of the Mediterranean Sea from Hungary and the Balkan States to Egypt, and occurring in South Russia. The family Muscardinidae, represented by the typical subfamily, is more or less western in general distribution, though represented in Japan. The four better known genera, *Eliomys*, *Dyromys*, *Glis* and *Muscardinus* all appear to meet in Central Europe, so far as their range is concerned. *Dyromys* goes east to Tianshan and Zungaria, but not west of Central Europe; *Glis* ranges to Spain and the Atlantic, also east to the Caucasus and Turkestan; *Eliomys* does not range east of European Russia, but occurs again in Sinai and North Africa, as well as the Iberian Peninsula; *Muscardinus* is not known from Spain nor east of European Russia, but ranges naturally in England and in Scandinavia, which none of the others reach except by introduction. The family Dipodidae has its headquarters in the Palaearctic. Of the more primitive groups, the Sicistinae (*Sicista*) has the widest range, occurring from Scandinavia, the Balkans, and Hungary, more or less across the area evidently, in suitable localities. The Chinese *Eozapus* represents the American subfamily Zapodinae (the only subfamily occurring in that continent). The Cardiocraniinae, containing two extremely rare types, *Cardiocranius* and *Salpingotus*, appears to be restricted to the more inaccessible parts of Chinese Central Asia, except that a species of *Salpingotus* is known from Afghanistan. Of the more specialized groups, the Euchoreutinae (*Euchoreutes*) is restricted to the deserts of Inner China; the Dipodinae have, however, a wide range outside Western Europe. *Allactaga* and *Dipus* both appear to range from South Russia across much of the Asiatic portion of the area, east more or less to the North Chinese Pacific coast; *Jaculus* ranges across North Africa from Morocco to Egypt and east as far as Persia; and generic types worthy of note confined to the Palaearctic with more restricted ranges are *Scirtopoda*, *Paradipus*, and *Pygeretmus*.

The Sciuridae have, as usual, a wide distribution in the area; only in contrast to the normal element (arboreal) in tropical areas, most of the Palaearctic genera are Ground-squirrels. *Citellus* and *Marmota* have the widest ranges, both occurring in Europe as well as much of Asia, and both occurring again in North America. *Tamias*, principally American, ranges in North Russia, Siberia and China. *Atlantoxerus*, confined to Morocco and adjacent region, represents a somewhat different type of Ground-squirrel found chiefly in

Africa, and evidently not represented in either America or the Indo-Malayan; *Spermophilopsis* from Russian Turkestan area is probably a distant ally. Another type of semi-terrestrial Squirrel is the Chinese *Sciurotamias*, which seems nearest to *Tamias* in relationships. Tree-squirrels are represented by *Sciurus*, which occurs throughout Europe, across Russia and Northern (wooded) Siberia, and parts of Eastern China, as well as in the Caucasus, but is absent from North Africa, and much of the plains regions of S.W. Siberia. The Indomalayan *Callosciurus* sends a few forms north into China. Of the Flying-squirrels, *Pteromys* has the widest range, from Scandinavia across U.S.S.R. to Japan and N.E. China. Contrary to Thomas's classification of Flying-squirrels, the genus is here held to be an isolated specialized type with no very near allies, not a near ally either of the American *Glaucomys* or the Indomalayan *Hylopetes*. *Petaurista*, from the Indomalayan, has a wide range in China, and includes Japan and the Kashmir region, but is not known west of Kashmir nor in any part of Siberia. *Eupetaurus* is confined to Kashmir, and *Trogopterus* to parts of China (though this genus touches the Indomalayan in some parts of China south of the Yangtse). *Eoglaucomys* from Afghanistan completes the Palaearctic list of Sciuridae. Two other families occur in the area, the Castoridae (with one genus, *Castor*), now restricted to various localities in parts of Europe, such as Scandinavia, and some of the larger Central European rivers, parts of Russia, and the Mongolian Altai (the genus ranging across to North America), and the Hystricidae, with one genus, *Hystrix*, specialized species of which extend from India through Persia and Turkestan to Syria, and again in Italy, Sicily (where they might have been originally introduced), and North-western Africa. This section of the genus, however, finds its widest distribution in Africa south of the Sahara.

The NEARCTIC REGION (Canada and the United States) contains roughly eleven hundred named forms of Rodents distributed among eight families. The Muridae are here in the minority as compared with all the others, only four hundred forms approximately belonging to them, while about six hundred and ninety are named for the other families. This contrasts widely with the condition found in the Palaearctic. Only two subfamilies of Muridae reach America naturally at all (apart from the House-rats, and House-mice (Murinae), *Rattus* and *Mus*, which were originally introduced accidentally by man). These two subfamilies are the Cricetinae and Microtinae. The Microtinae contain types mostly much like those of the Palaearctic, as for example *Microtus*, *Clethrionomys* (ranging over much of the area), *Dicrostonyx*, *Lemmus* (northern and Arctic), *Lagurus* and *Pitymys* (with more restricted ranges). Genera peculiar to the area are *Ondatra* (the largest member of the subfamily), *Synaptomys* (a Lemming), *Phenacomys* (one of the most primitive known Voles), and *Neofiber* (confined to Florida).

The Cricetinae of North America appear to have "come up from the south" rather than "in from the west," in that they are apparently more nearly related to South American types rather than to Palaearctic Cricetinae. Of the seven genera known north of Mexico, three only reach as far north as Canada, *Peromyscus* (which appears to cover the entire continent), *Neotoma*, and *Onychomys*.

The genera *Reithrodontomys*, *Sigmodon*, and *Oryzomys* have a fairly wide range in the warmer parts of the United States, and all the above without exception continue their ranges south into Mexico, all but *Onychomys* into Central America, and the three last-named range into South America. Outside the Muridae, three families occur which also range in the Palaearctic, and four are at the present day confined to the New World.

The Sciuridae are represented, as in the Palaearctic, mostly by Ground-squirrels, of which *Marmota*, *Citellus*, and *Tamias* (all also in the Palaearctic), each cover a great portion or most of the area. *Cynomys*, a rather isolated type of Ground-squirrel, is purely North American; Tree-squirrels are represented by *Tamiasciurus* (American only), and the more widely ranging genus *Sciurus*, which, however, covers relatively little of the area. Flying-squirrels are represented only by *Glaucomys*, which has, however, a very wide range. The Castoridae are represented by the sole genus, *Castor*, which is Holarctic in distribution. The Dipodidae are represented only by the primitive subfamily Zapodinae (*Napaeozapus*, *Zapus*), which, however, covers almost the whole area but seems not to occur south of it. We may now turn to four solely American families. The Aplodontiidae, with one genus, *Aplodontia*, represents an archaic type of Rodent confined at present to the western side of the Rocky Mountains, but known to have occurred formerly in East Asia. The Erethizontidae, a member of the Hystricoid branch, is represented by *Erethizon*, noteworthy as being the only Hystricoid adapted for a life in cold climates. Other members of the family occur in the warmer portions of the Neotropical, from Mexico southwards. The Geomyoid branch of the Order contains two families both confined at present to America, extending south to Panama and Ecuador though chiefly northern in distribution. Of these the Heteromyidae is widely distributed in the western portions of the United States, represented by the more primitive *Perognathus*, which touches western Canada, and the highly specialized saltatorial *Dipodomys* and *Microdipodops*. The Geomyidae are represented by *Thomomys*, with very many named forms from the western and central U.S.A., and ranging into western Canada, and *Geomys*, from the central and eastern United States, including Florida. So far as I have traced it this branch of the Order is not known fossil outside America.

The NEOTROPICAL AREA has more named forms than any other of the great areas, if Mexico, the West Indies, and Central America are included in it. Notwithstanding this, although South America is currently referred to as being the "headquarters" of the Rodents, once Panama is passed there is a surprising general similarity of type through the various groups found in that continent, the members being either Cricetine Muridae, or Sciuridae, or Caviidae, or members of the superfamily Hystricoidae (all of which are more or less closely allied to each other). (A genus of Heteromyidae occurs in the extreme north.) There is a lack of that wide divergence of structure which makes the study of Palaearctic, Nearctic, or African Rodents so interesting, and recalls the state of affairs present in the Indomalayan. In fact, so far as the "superfamilies" recognized in this work are reckoned, fewer of them occur in South America than in any other of the great areas except the Indo-Malayan

Even in the Muridae there is incessant repetition of a single (Cricetine) type, very different from the interesting differences to be met with in the different subfamilies that occur in all the other great areas, even including the Indomalayan. Of about fifteen hundred named forms, roughly eight hundred are Muridae, roughly seven hundred belong to other families.

In Central America (with Mexico and the West Indies), already a great increase in Cricetinae and a great decrease in the more northern Microtinae is met with. In the Cricetinae north of Panama, as well as the North American genera *Neotoma*, *Peromyscus*, *Onychomys*, *Reithrodontomys*, *Oryzomys* and *Sigmodon* being well represented, about fourteen more genera start their ranges at once. Confined to the Central America area are *Nyctomys*, *Nelsonia*, *Ototylomys*, *Scotinomys*, *Hodomys* and others; while *Tylomys*, *Nectomys*, and one of the "Fishing-rats," *Rheomys*, range north from northern South America. The Microtinae range south to Guatemala only; the chief genera in the area being *Microtus* and *Pitymys*.

The Sciuridae are very much the same, as regards genera, as in the Nearctic, except that *Marmota* and probably *Tamiasciurus* are absent. Few range south of Mexico; but the genus *Sciurus* has many named forms from this area, and extends into South America. *Glaucomys* comes into Central America; while *Microsciurus* comes up into Nicaragua from South America; but apart from *Sciurus* and *Microsciurus*, no genus which occurs north of Panama crosses south of it. The Castoridae touch extreme North Mexico. The Heteromyidae are widely distributed through Central America, the primitive genera *Heteromys* and *Liomys* occurring more or less throughout, while *Dipodomys* and *Perognathus* are represented in Mexico. The Geomyidae are likewise common in the area, and one genus, *Macrogeomys*, ranges as far south as Panama. This group (Heteromyidae + Geomyidae) is, however, not known in South America except for a few forms of *Heteromys* from the extreme northern countries.

Four families belonging to the Hystricoid branch occur in Central America; of these the Erethizontidae is represented by *Coendou* (Mexico southwards), while the Dasyproctidae (*Dasyprocta*), and the Cuniculidae (*Cuniculus*) start their range which is, as in the case of *Coendou*, from Mexico southwards over the greater part of tropical South America. The Echimyidae are represented by three subfamilies, two of which, Capromyinae (*Geocapromys*, *Capromys*), and Plagiodontiinae (*Plagiodontia*), appear to be confined to the West Indies (where surprisingly few genera of Rodents occur), except that a member of the Capromyinae has been described from Venezuela; the other, the more generalized Echimyinae, being represented by *Proechimys*, *Diplomys*, and *Hoplomys*, from Nicaragua southwards. The Caviidae are represented by *Hydrochoerus* which extends north to Panama.

South of Panama, vast quantities of Cricetine Muridae swarm, belonging to a very large number of named genera, which are in many cases not or barely distinguishable from each other. These group themselves round the following main types: *Oryzomys*, which appears to occur in all parts from Patagonia to Colombia, and has many close allies as *Nectomys*, *Rhipidomys*, *Thomasomys*, and perhaps leads to the specialized and isolated North Argentine *Scapteromys*;

Akodon, with a very wide range in the continent, and with several allies the best known of which is *Oxymycterus*; probably leading to the specialized subfossorial *Notiomys* of Patagonia; *Phyllotis*, with its allies *Hesperomys*, *Eligmodontia*, which series may lead to such dentally highly modified types as *Chinchillula* and *Irenomys*; and *Holochilus*, with its allies *Neotomys* and *Reithrodon* which seem to correspond to the Nearctic *Sigmodon* type.

By far the most interesting of the Neotropical Cricetines are the Fishing-rats, *Ichthyomys* and *Anotomys*, which must be among the most specialized of all Muridae, and in cranial characters parallel to a large degree the Australasian aquatic members of the Hydromyinae.

The Squirrels of South America are, with the exception of *Sciurillus* from the Guianas, which appears to be a type which one might consider archaic and allied to the Indomalayan *Nannosciurus*, all essentially types which agree to such a degree with the northern *Sciurus* that there appears no necessity to separate them from that genus, except for a closely allied type *Microsciurus*. The family ranges south to Jujuy (North Argentine) only. The type of Squirrel found in South America suggests that the family has "come in" recently, comparatively speaking, from the north, and has not been isolated from more or less Eocene times or before in the Continent when it was (as generally admitted) an island, as I suggest most of the Cricetines and Hystricoid types have. The Caviidae, represented by two subfamilies Hydrochoerinae (*Hydrochoerus* only; tropical portions), and the Caviinae, containing the more specialized *Dolichotis* from the southern plains, and the more primitive *Kerodon* (Brazil), and *Cavia* and its immediate allies which between them cover the continent, are confined to the area. They are in this work not regarded as typical Hystricoidae, but referred to a separate superfamily on account of the formation of the lower jaw. The Hystricoid branch of the Rodents is represented in South America as follows:

Northern tropical forest area: Family Echimyidae: two subfamilies, the Dactylomyinae, *Thrinacodus* and *Dactylomys*; the Echimyinae, several genera among which the arboreal *Echimys* and *Mesomys* and the terrestrial *Proechimys* have the widest ranges. From South Brazil are known two rather distinct types referable to the latter subfamily in *Clyomys* and *Carterodon*. Family Erethizontidae: two very distinct subfamilies, the Chaetomyinae (*Chaetomys* only, distribution evidently local), and the Erethizontinae (*Echinoprocta*: Colombia; and *Coendou*, distribution general). Family Dasyproctidae: *Dasyprocta* and *Myoprocta* (distribution general). Family Cuniculidae: *Cuniculus* (distribution general?). The Family Dinomyidae (*Dinomys*) is confined to Peru and Ecuador region. The Subfamily Octodontinae (*Echimyidae*) is represented by *Octodon* and *Ctenomys* as far north as Peru on the western side of the continent. In Peru also *Lagidium* represents the Family Chinchillidae. In the plains and mountains of the southern part of the continent the following Hystricoid types occur: Family Chinchillidae (*Chinchilla*, *Lagidium*, *Lagostomus*). Family Echimyidae: three subfamilies, Myocastorinae (*Myocastor* only). Abrocominae (*Abrocoma* only), and the Octodontinae, of which *Ctenomys*, *Spalacopus*, *Aconaemys*, *Octomys* and *Octodon* are the main genera. Besides these types, the genus *Heteromys* (Heteromyidae) occurs in Colombia, Venezuela, and Ecuador.

AFRICA is the only geographical area remaining to be discussed. This continent must surely be considered the present headquarters of the Order so far as variation in character goes, in that it contains more superfamilies than any other area, four (out of eight) of which are now confined to the continent. Roughly eleven hundred and fifty forms are named from the area; here once again the Muridae are very much the dominant feature in that about eight hundred of the above forms belong to the family. The African types, both of Squirrels and Rats and even Porcupines, have a rather different aspect from those of the Palaearctic or Indomalayan, and appear to be rather well separated from them in general.

The Murinae possess a very large number of genera, most of which appear to have a very wide range on the continent, and very few of which are at present known from any other continent. The most distinct genera are *Cricetomys* and *Saccostomus*. Other aberrant but more typically Murine types are *Lophuromys*, *Acomys*, *Uranomys*, *Mylomys*, *Thamnomys*, *Beamys*, *Dasymys*, *Arvicanthis* and its immediate allies (*Arvicanthis* ranging north to Egypt and occurring in Arabia, as does *Acomys*), *Oenomys*, *Zelotomys*, *Colomys*, etc. Besides these occur many indigenous wild species of *Mus*, and various groups of *Rattus*, some of which have received generic names which appear quite unretainable. The Dendromyinae is a group confined to the continent, very closely allied to the Murinae, and containing *Dendromus* and *Steatomys* which have a wide range, and *Prionomys* and *Malacothrix*, which are more restricted, the latter being one of the most aberrant members of the whole family. *Deomys*, here regarded as type of a distinct subfamily the Deomyinae, is confined to the Congo. The Otomyinae, with two valid genera *Otomys* and *Parotomys*, are an interesting group confined to the area. The subfamily Gerbillinae is very widely distributed through the continent in suitable areas, containing more generalized types in *Tatera*, *Gerbillus*, etc., and some more local specialized genera as *Desmodillus*, *Desmodilliscus*, *Ammodillus*, etc. The Cricetinae is represented by one genus only, *Mystromys*, from the south; but the Microtinae are not known except in the Palaearctic coastal region. Even this does not exhaust the list of subfamilies, as *Tachyoryctes*, type of the Tachyoryctinae, though not hitherto currently referred to the Muridae, is here regarded as a member of the family; this genus is known from the eastern and central portion of the continent.

The Muscardinidae are represented by the subfamily Graphiurinae, the genus *Graphiurus* ranging over most of the continent.

Eliomys, a Palaearctic type belonging to the typical subfamily, ranges south to the Rio de Oro. *Lophiomys*, here regarded as type of a family the Lophiomyidae, is confined to the eastern part (Abyssinia, Somaliland, Kenya, Sudan). The Dipodidae is represented by *Jaculus* in the Sahara and Somaliland. The family does not range south of this area.

The Ctenodactylidae is another northern African group, with very much the same range collectively as the Dipodidae; the principal genera are *Pectinator*, *Massoutiera* and *Ctenodactylus*. The group is known fossil from South Europe, and from India. The Pedetidae, with one genus, *Pedetes*, is confined to the continent, ranging in the south and east. The Anomaluridae is another family peculiar to Africa, occurring mainly in the western forests, and containing two subfamilies, the Anomalurinae (*Anomalurus*, *Anomalurops*), and the Idiurinae (*Zenkerella* and *Idiurus*), these groups sometimes being given family rank.

The African Sciuridae consist of a relatively small number of forms, one of which (*Xerus*) is terrestrial, and is represented as indicated already in parts of the Palaearctic, one of which, *Myosciurus*, is a pygmy form perhaps not distantly related to the Indomalayan *Nannosciurus*, and the remainder of which are arboreal types of which *Protoxerus*, *Heliosciurus*, *Funisciurus*, and *Paraxerus* have the widest ranges. The Hystricidae are widely distributed through the continent; the genus *Hystrix* is the dominant form of this family and here reaches its highest degree of specialization; while the genus *Atherurus* is found in the western and central forests, with species of a rather more advanced type than their Indomalayan cousins. Two other Hystricoid genera occur: *Thryonomys*, which is best referred to the family Echimyidae (otherwise American) as type of a subfamily, which ranges through most of the continent, and which is known fossil from India; and *Petromus*, which seems best referred to the same family (as type of a subfamily), and which is known only from South-west Africa. Yet another exclusively African family, the Bathyergidae, some of the most isolated living Rodents, range collectively through most of the area: *Cryptomys* has the widest range; other more highly specialized but more restricted types are *Bathyergus* and *Heterocephalus*; and *Heliophobius* which appears unique in the whole Order in dental formula has a moderate range on the eastern side.

In Madagascar Rodents are unknown save for half a dozen peculiar Muridae. It has been the custom of late years to refer these to a subfamily (or family) the Nesomyinae or to place them in the Cricetinae. I have been able to find no characters which keep them apart as a distinct subfamily, nor do they all appear to be Cricetinae. In the present classification I have had provisionally to refer them to no less than five different subfamilies. The names of these genera are *Eliurus*, *Brachyuromys*, *Nesomys*, *Gymnuromys*, *Hypogeomys* and *Brachytarsomys*. Their status will be discussed in the volume set aside for Muridae.

RODENTS OF THE PALAEARCTIC (OTHER THAN MURIDAE)

Genera, Principal Species, and Approximate Ranges

SCIURIDAE

Genus *Trogopterus*

xanthipes. China; Tibet to Chihli.

Genus *Petaurista*

alborufus. China; Tibet to Hupeh.

sulcatus. China; Chihli.

albiventer group. Kashmir; Japan, Manchuria; Szechuan.

Genus *Pteromys*

volans. Scandinavia across Siberia to Japan, Kansu.

Genus *Eoglaucomys*

fimbriatus. Afghanistan, Kashmir.

Genus *Eupetaurus*

cinereus. Kashmir.

Genus *Sciurus*

vulgaris group. All Europe; Siberia, to Manchuria, Chihli, Japan.
anomalus group. Caucasus area.

Genus *Callosciurus*

maclellandi group. Tibet; Chihli.
erythraeus. Szechuan. (Indomalayan type.)

Genus *Dremomys*

pernyi. China; Szechuan, Hupeh. (Indomalayan type.)
rufigenis. China; Szechuan. (Indomalayan type.)

Genus *Funambulus*

palmarum group. North Punjab. (Indomalayan type.)

Genus *Atlantoxerus*

getulus. Morocco.

Genus *Spermophilopsis*

leptodactylus. Afghanistan, Turkmenia.

Genus *Sciurotamias*

davidianus. China; Kansu and Szechuan to Chihli.

Genus *Tamias*

sibiricus. North Russia, Siberia, China north of Yangtze, to Japan.

Genus *Citellus*

citellus group. South-eastern Europe, Russia, Asia Minor; Shansi, Kansu, Mongolia, Transbaikalia (*dauricus*, etc.).
suslicus. East Europe, South Russia.
fulvus. East Russia, Turkestan, Persia.
pygmaeus group. South Russia, Turkestan; Mongolia (*pallidicauda*).
eversmanni. Russian Altai to East Siberia, North Mongolia.

Genus *Marmota*

marmota. Alps and Carpathians.
bobak group. Poland, Russia, Altai, North Mongolia, Kansu, Transbaikalia, Tibet.
caudata group. Kashmir, Afghanistan, Russian Turkestan, Chinese Turkestan.
caligata group. North-east Siberia.

CASTORIDAE

Genus *Castor*

fiber. Main rivers of Central Europe; Scandinavia; parts of European Russia; Mongolian Altai.

CTENODACTYLIDAE

Genus *Ctenodactylus*

gundi. North Algeria.

Genus *Massoutiera*

mzabi group. North Algeria.

DIPODIDAE

Genus *Sicista*

subtilis group. Scandinavia, Denmark, Hungary, Balkans, Russia, Siberia to Lake Baikal.

concolor group. Caucasus, Altai, Kashmir, Kansu, Manchuria, Sakhalin.

Genus *Eozapus*

setchuanus. Szechuan, Kansu.

Genus *Cardiocranius*

paradoxus. Nanshan, Sinkiang (China).

Genus *Salpingotus*

kozlovi. Mongolia; Gobi.

crassicauda group. Mongolia; Gobi, and in Afghanistan.

Genus *Euchoreutes*

naso. Chinese Turkestan, Inner Mongolia.

Genus *Allactaga*

major group. Southern Russia, Russian Turkestan.

sibirica group. Eastern Caspian region to Kansu, Mongolia, Transbaikalia, Chihli.

elater group. Caucasus to Persia, Afghanistan, Kashmir, Chinese Turkestan; also Mesopotamia (*euphratica*).

williamsi. Caucasus, Asia Minor.

tetradactyla. North Egypt.

Genus *Alactagulus*

pumilio. Caucasus, Russian Turkestan, Inner Mongolia.

Genus *Pygeretmus*

platyurus. Western Russian Turkestan.

shitkovi. Eastern Russian Turkestan.

Genus *Dipus*

sagitta. Caucasus across Russian Turkeston to Mongolia and Chihli.

Genus *Scirtopoda*

telum group. South Russia, Russian Turkestan, Mongolia.

Genus *Eremodipus*

lichtensteini. Turkmenia.

Genus *Jaculus*

orientalis. Palaearctic North Africa.

jaculus. Across Palaearctic North Africa, Syria, Persia.

Genus *Paradipus*

ctenodactylus. Turkmenia.

HYSTRICIDAE

Genus *Atherurus*

macrourus. China; Szechuan. (Indo-Malayan type.)

Genus *Hystrix*

subcristatus. China; Szechuan. (Indo-Malayan type.)

(*Hystrix*) *leucura.* Punjab, Afghanistan, Russian Turkestan, Transcaucasia, Asia Minor, Syria, Palestine.
cristata. Sicily, South Italy, North-western Africa.

MUSCARDINIDAE

Genus *Myomimus*
personatus. Transcaspia.

Genus *Eliomys*
quercinus group. Continental Europe south of Baltic; Syria, Northern Africa westwards from Tunis. Central and southern Russia.

Genus *Dyromys*
nitedula. Central Europe (Switzerland), eastwards across Russia, to N.W. Frontier (N. India), Tianshan, Zungaria. South in Europe to Greece. Asia Minor.

Genus *Glis*
glis. Continental Europe south of Baltic; Asia Minor, Caucasus, North Persia; Southern and Central Russia; South Turkmenia.

Genus *Glirulus*
japonicus. Japan.

Genus *Muscardinus*
avellanarius group. Europe, except Iberian Peninsula, including England, Sweden; parts of Russia.

SPALACIDAE

Genus *Spalax*
kirgisorum group. Kirghiz Steppes(?), Syria, Palestine, North Egypt and Libya.
monticola group. Hungary, Roumania, Balkans, Asia Minor, Caucasus.
microphthalmus group. Southern Russia, represented in Greece, Rumania, Poland.
giganteus. Eastern Russia.

RHIZOMYIDAE

Genus *Rhizomys*
vestitus. Szechuan.

RODENTS OF THE NEARCTIC (OTHER THAN MURIDAE)

Genera, Principal Species, and Approximate Ranges

APLODONTIIDAE

Genus *Aplodontia*
rufa. Western U.S.A., from California into southern British Columbia, Pacific side Rocky Mountains.

SCIURIDAE

Genus *Glaucomys*

volans. Eastern U.S.A., from New York and Minnesota southwards, including Florida.

sabrinus. Labrador; across most of Canada; Alaska; Pacific coastal States of U.S.A., east to Idaho; Virginia.

Genus *Sciurus*

carolinensis. Eastern U.S.A. and southern East Canada, west to Minnesota, Oklahoma, including Florida.

griseus. California, Oregon.

aberti. Colorado, Arizona, New Mexico.

niger group. Eastern U.S.A., from Texas and South Wisconsin eastwards, including Florida; Arizona.

Genus *Tamiasciurus*

hudsonicus group. Most of Canada; Alaska; Western U.S.A., south to California, Arizona, New Mexico; Central U.S.A. (Minnesota, South Dakota, etc.); Eastern U.S.A., south to North Carolina at least.

Genus *Tamias*

alpinus. California.

minimus group. Western U.S.A., east to Wisconsin, west to California and Pacific States; north to Yukon, Mackenzie, and to Lake Superior.

amoenus group. Western U.S.A., coastal states, east to Montana, north into Alberta and British Columbia.

quadrivittatus group. Montana, Idaho; California east to Colorado; Arizona, Texas, New Mexico.

townsendi group. Coastal states of western U.S.A., east to Utah, New Mexico.

striatus group. Eastern U.S.A., west to Oklahoma and Minnesota, south to South Carolina, north to Canada (Ontario).

Genus *Citellus*

townsendii group. Washington, Oregon, Idaho, Utah.

washingtoni group. Washington, Idaho.

richardsoni group. California, Oregon, Nevada; Wyoming; Saskatchewan.

parryii group. Oregon and Idaho north to Arctic Canada (Mackenzie and east to Hudson Bay), and Alaska.

tridecemlineatus group. Western and West Central U.S.A., from Arizona, New Mexico and Texas north to Minnesota, the Dakotas, and Montana.

spilosoma group. Arizona, New Mexico, Texas, north to (?) Nebraska.

franklinii group. Saskatchewan south to Oklahoma and Illinois.

variegatus group. Texas and Colorado west to California and Oregon.

(*Citellus*) *harrisii* group. Texas, Colorado, Arizona, California.
tereticaudus group. California, Arizona, Colorado.
lateralis group. Arizona, Colorado, Wyoming and Montana west to Pacific coastal states, north into Canada (Alberta).

Genus *Marmota*

monax group. Across Canada from Labrador to Alaska, and Eastern U.S.A., south to North Alabama, west to Kansas and Minnesota.
flaviventris group. Western U.S.A., from South Dakota, Colorado and New Mexico to Pacific states. Into British Columbia.
caligata group. Western Canada and Alaska, south to Washington and Montana, east to Alberta.

Genus *Cynomys*

ludovicianus group. The Dakotas and Montana south through West Central U.S.A. to Texas and Arizona.
gunnisoni group. Slightly to the west of the range of *ludovicianus*; Wyoming south into Arizona and New Mexico.

CASTORIDAE

Genus *Castor*

canadensis. "Most of North America from Alaska and Labrador to the Rio Grande" (Anthony).

HETEROMYIDAE

Genus *Liomys*

irroratus. Southern Texas.

Genus *Perognathus*

fasciatus group. The Dakotas, Nebraska and Texas west to Wyoming, Colorado, Arizona.
longimembris group. California to Utah and Arizona.
parvus group. California and Pacific states north into British Columbia, east to Utah and Wyoming.
formosus group. Utah, California.
baileyi group. Arizona, California.
hispidus group. Kansas, Oklahoma.
penicillatus group. Texas, Arizona, California.
intermedius group. New Mexico, Arizona, California.
californicus group. California.
spinatus group. California.

Genus *Microdipodops*

megacephalus group. California, Nevada, Oregon.

Genus *Dipodomys*

heermanni group. California, Oregon.
spectabilis group. Arizona, New Mexico.
phillipsii group. Texas.
merriami group. Texas and Utah west to California.

(*Dipodomys*) *ordii* group. Oklahoma, Texas, Wyoming west to Oregon and California.
agilis group. California.
compactus group. Texas.
microps group. Oregon, California, Arizona.
deserti group. California.

GEOMYIDAE

Genus *Thomomys*

townsendi group. California, Nevada, South Idaho.
bottae group. Oregon, Nevada, California, Colorado, Arizona, New Mexico, Texas.
alpinus group. California.
perpallidus group. New Mexico and Utah west to California.
fulvus group. Arizona, New Mexico, Texas.
umbrinus group. Arizona.
talpoides group. Colorado, Idaho and North Dakota, west to Washington, north to Canada (Saskatchewan).
fossor group. California and Oregon east to Colorado and Wyoming.
douglasii group. Washington, Oregon.
monticola group. California, Oregon.
fuscus group. Washington, Oregon, Idaho, Montana, north into Alberta.
bulbivorus group. Oregon.

Genus *Geomys*

tuza group. Eastern U.S.A. (Alabama, Georgia, Florida).
bursarius. Upper Mississippi Valley, to Kansas, Missouri, Illinois; west to Nebraska and the Dakotas.
breviceps group. Central U.S.A.; Nebraska south to New Mexico, Texas, and Louisiana.

Genus *Cratogeomys*

castanops. Colorado, New Mexico, Texas.

DIPODIDAE

Genus *Zapus*

hudsonius group. Evidently most of Canada and U.S.A., east to Labrador and North Carolina, west to Alaska, British Columbia and coastal states, including California, south to New Mexico.

Genus *Napaeozapus*

insignis. Eastern Canada and U.S.A., from Ontario and Wisconsin to North Carolina.

ERETHIZONTIDAE

Genus *Erethizon*

dorsatum group. "Most of forested North America north of 40°

(*Erethizon*) and south in the Rockies almost to Mexican boundary" (Anthony). North to Labrador and Alaska.

The more I examine North American faunal lists the more I am convinced that too many specific groups are admitted, at least in the Order Rodentia.

RODENTS OF THE INDOMALAYAN REGION (OTHER THAN MURIDAE)

Genera, Principal Species, and Approximate Ranges

SCIURIDAE

Genus *Belomys*
pearsoni. Sikkim, Assam, Tongking, Formosa.

Genus *Trogopterus*
xanthipes. Yunnan. (Palaearctic type.)

Genus *Petaurista*
petaurista group. Fukien; Formosa; Malay Peninsula, Sumatra, Java, Borneo.
alborufus group. Yunnan, Formosa.
punctatus. Malacca, Borneo.
albiventer group. Ceylon, Peninsular India, Nepal, Burma, Siam, Annam, Yunnan.

Genus *Pteromyscus*
pulverulentus. Malacca, Sumatra, Borneo.

Genus *Aeromys*
tephromelas group. Malacca, Borneo.
thomasi. Borneo.

Genus *Hylopetes*
alboniger group. Nepal, North Burma; Philippines (*nigripes*).
sagitta group. Burma, Laos, Malay Peninsula, Sumatra, Java, Borneo, Natunas.

Genus *Petinomys*
fuscocapillus group. Ceylon, South India.
hageni group. Sumatra; Philippines (*crinitus*).
genibarbis group. Java, Borneo, Malacca. Hainan (*electilis*).
setosus group. Sumatra; Tenasserim.

Genus *Petaurillus*
hosei group. Malacca, Borneo.

Genus *Iomys*
horsfieldi. Malacca, Sumatra, Borneo, Java.

Genus *Nannosciurus*
exilis group. Sumatra, Borneo, Philippines.
whiteheadi. Borneo.
melanotis group. Sumatra, Java, Borneo.

Genus *Sciurillus*
murinus. Philippines.

Genus *Callosciurus*

maclellandi group. Nepal, Assam, Burma, Yunnan, Fukien, Hainan, Formosa, Cochin-China, Siam, Annam.

erythraeus group. Hainan, Formosa, Yunnan, Kwantung, Assam, Burma, Siam, Annam, south to Pahang.

caniceps group. Chekiang; Tongking, Tenasserim, Siam south to Malacca.

pygerythrus group. Nepal, Bengal, Assam, Burma.

quinquestriatus group. Yunnan, Burma.

prevosti group. Malacca, Sumatra, Borneo, Celebes.

notatus group. Malacca, Sumatra, Java, Borneo.

hippurus group. Malacca, Sumatra, Borneo, Philippines.

tenuis group. Malacca, Sumatra, Borneo.

lowi group. Malacca, Sumatra, Borneo.

leucomus group. Celebes.

rubriventer group. Celebes.

Genus *Dremomys*

pernyi group. Burma, Yunnan to Fukien, Hainan.

owstoni. Formosa.

everetti. Borneo.

lokriah group. Nepal, Assam, Burma.

rufigenis group. Malacca, Tenasserim, Burma, Annam, Laos, Yunnan, Hainan, Hupeh.

Genus *Funambulus*

palmarum group. Peninsular India, Ceylon.

layardi. South India, Ceylon.

sublineatus. South India, Ceylon.

Genus *Ratufa*

macroura. South India, Ceylon.

indica. Peninsular India.

gigantea. Assam, Nepal, Burma, Yunnan, Hainan.

bicolor, and other species. Burma, Tenasserim, Siam, Annam, Malacca, Sumatra, Java, Borneo, Bali, Natunas.

Genus *Menetes*

berdmorei. Burma, Tenasserim, Annam, Siam.

Genus *Lariscus*

insignis group. Malay Peninsula (southern), Sumatra, Java, Borneo.

hosei. Borneo.

Genus *Glyphotes*

simus. Borneo.

Genus *Rheithrosciurus*

macrotis. Borneo.

Genus *Rhinosciurus*

laticaudatus. Malay Peninsula (southern), Sumatra, Borneo.

Genus *Hyosciurus*

heinrichi. Celebes.

Genus *Marmota*

bobak group (*himalayana*); Nepal, Yunnan. (Palaearctic type.)

Genus *Sciurotamias*

forresti. Yunnan.

HYSTRICIDAE

Genus *Trichys*

lipura group. Malacca, Sumatra, Borneo.

Genus *Atherurus*

macrourus. Hainan, Southern China, Tongking, Assam, Malacca, Tenasserim, Sumatra.

Genus *Thecurus*

pumilus group. Philippines; Sumatra (*sumatrae*).
crassispinis. Borneo.

Genus *Hystrix*

brachyurus group. Malacca, Sumatra, Java, Borneo, Sumbawa, Flores.
subcristatus group. Sikkim, Assam, Burma, Tenasserim, Yunnan, Fukien, Anhwei, Hainan, (?)Annam.
leucura group. Ceylon, Peninsular India, Nepal.

MUSCARDINIDAE

Genus *Platacanthomys*

lasiurus. South Peninsular India.

Genus *Typhlomys*

cinereus. Tongking, Fukien.

RHIZOMYIDAE

Genus *Rhizomys*

vestitus group. Burma; Fukien (*davidi*).
sinensis group. Assam, Yunnan, Kwantung; South Siam, Perak (*pannosus*).
sumatrensis group. Tenasserim to Sumatra.

Genus *Cannomys*

badius. Nepal, Burma, Siam.

RODENTS OF AFRICA (OTHER THAN MURIDAE)
(With Arabia, but not including Palaearctic North Coastal Area)

GENERA, PRINCIPAL SPECIES, AND APPROXIMATE RANGES

BATHYERGIDAE

Genus *Bathyergus*

suillus. South Africa; Cape Province.
janetta. South Africa; Namaqualand.

Genus *Georychus*

capensis. South Africa; Cape Colony.

Genus *Cryptomys*

mechowi group. Angola, Rhodesia.

hottentottus group. Cape, Rhodesia, Nyasaland, Tanganyika.

lechei section. North Nigeria, French Shari, North Congo, Kalahari, Rhodesia, Portuguese East Africa.

zechi. West Africa (Togoland).

ochraceocinereus. Sudan.

bocagei. Angola.

Genus *Heliophobius*

argenteocinereus group. Portuguese East Africa, Rhodesia, Tanganyika, South Congo, Kenya.

Genus *Heterocephalus*

glaber group. Somaliland, Abyssinia, North Kenya.

SCIURIDAE

Genus *Myosciurus*

pumilio. West Africa; Cameroons, Gaboon.

Genus *Heliosciurus*

gambianus. Gambia east to Abyssinia, south to Angola and Portuguese East Africa.

ruwenzorii. Belgian Congo, Ruwenzori.

poensis. Fernando Po, Gold Coast, Gaboon.

lucifer. Nyasaland.

Genus *Paraxerus*

cepapi group. Kenya (*ochraceus*) south to Transvaal, Portuguese East Africa, Kalahari, and Ovamboland.

palliatus group. Rhodesia, Portuguese East Africa, Zululand, to Kenya, Somaliland.

flavivittis group. Portuguese East Africa, to Tanganyika and Kenya.

boehmi group. Congo, Sudan, Ruwenzori.

Genus *Funisciurus*

lemniscatus group. Gaboon, Cameroons, Congo.

congicus group. Angola and South Congo.

pyrrhopus group. Sierra Leone east to Congo, Angola, and Ruwenzori.

Genus *Protoxerus*

stangeri. Gold Coast and Nigeria east to Kenya, south through Congo to Angola.

Genus *Myrsilus*

aubinii group. Liberia, Ashanti.

Genus *Epixerus*

wilsoni. Gaboon.

ebii. Gold Coast.

Genus *Xerus*

rutilus group. Somaliland, Eritrea, Abyssinia, Kenya.

erythropus group. Sudan, Kenya, Uganda, Sahara (Air), Lake Chad, to Sierra Leone.

capensis group. South and South-west Africa.

ANOMALURIDAE

Genus *Anomalurus*

fraseri. Gold Coast east to Uganda (?Kenya), Tanganyika, south through Congo to Angola.

peli. Guinea Coast, Ashanti.

pusillus. Congo, Gaboon.

Genus *Anomalurops*

beecrofti. Sierra Leone eastwards to Congo.

Genus *Zenkerella*

insignis. Spanish Guinea.

Genus *Idiurus*

zenkeri. Cameroons, Congo.

macrotis group. Cameroons, Congo.

PEDETIDAE

Genus *Pedetes*

cafer group. Kenya and Angola to Cape Province.

CTENODACTYLIDAE

Genus *Pectinator*

spekei. Abyssinia, Somaliland, Eritrea.

Genus *Ctenodactylus*

gundi group. Tripoli (northern Sahara, west to Morocco).

Genus *Massoutiera*

mzabi group. Sahara, south to Asben.

Genus *Felovia*

vae. Senegal.

DIPODIDAE

Genus *Jaculus*

jaculus. Sahara, south to Asben, Sudan, Somaliland; and Arabia. (The other species, *orientalis*, appears Palaearctic in distribution.)

ECHIMYIDAE

Genus *Petromus*

typicus. South-west Africa.

Genus *Thryonomys*

swinderianus group. Bahr-el-ghazal and Uganda to Nigeria, Angola, South Africa.

gregorianus group. Congo, Kenya, Nyasaland.

HYSTRICIDAE

Genus *Atherurus*

africanus group. Gambia, Sierra Leone, Nigeria, Congo, to Kenya

Genus *Hystrix*

leucura group. Arabia.

cristata group. Senegal, Asben, Somaliland, Kenya, Uganda, Tanganyika.

africaeaustralis group. South Africa, South-west Africa, Portuguese East Africa, to Tanganyika.

MUSCARDINIDAE

Genus *Graphiurus*

ocularis. Cape Province.

platyops group. South-West Africa, Rhodesia.

hueti group. Senegal, Liberia, Cameroons.

crassicaudatus. Liberia, South Nigeria.

surdus. French Congo.

monardi. Angola.

woosnami. Kalahari.

murinus group. Asben, North Nigeria, Sudan, Somaliland, Kenya, Gold Coast south to Cape Province.

Genus *Eliomys*

quercinus group. (From Palaearctic) south to Rio de Oro.

LOPHIOMYIDAE

Genus *Lophiomys*

imhausi. Somaliland, Abyssinia, Sudan (Kassala), and Kenya.

RODENTS OF THE NEOTROPICAL (OTHER THAN MURIDAE)

(According to Flower & Lydekker, Mexico should be included in this region.)

GENERA, PRINCIPAL SPECIES, AND APPROXIMATE RANGES

SCIURIDAE

Genus *Sciurillus*

pusillus. Guianas.

Genus *Syntheosciurus*

brochus. Panama

Genus *Microsciurus*

alfari group. Nicaragua south to Peru and Upper Amazon.

Genus *Sciurus*

variegatoides group. Mexico to Panama.

deppei group. Mexico, Nicaragua.

aberti group. Northern Mexico.

(*Sciurus*) *niger* group. Mexico.
hoffmani group. Nicaragua to Venezuela, Ecuador; Peru; North Argentine (Jujuy).
aestuans group. Guianas, Venezuela, Eastern Brazil to Minas Geraes.
stramineus group. Ecuador, Peru.
pucherani group. Colombia, Peru, Bolivia.
rhoadsi. Ecuador.
flammifer. Venezuela.
langsdorffi group. Venezuela, Colombia, Peru, Ecuador, Bolivia, Brazil to Matto Grosso.

Genus *Tamias*
quadrivittatus group. North Mexico. (Nearctic type.)

Genus *Citellus*
mexicanus. Mexico.
spilosoma. Mexico.
variegatus group. Mexico.
annulatus group. Mexico.
tereticaudus. North Mexico.
lateralis group. North Mexico.

Genus *Cynomys*
mexicanus. North Mexico. (Nearctic type.)

Genus *Glaucomys*
volans. Through Mexico to Honduras.

CASTORIDAE

Genus *Castor*
canadensis. Extreme North Mexico. (Nearctic type.)

HETEROMYIDAE

Genus *Heteromys*
anomalus group. Venezuela, Colombia, Ecuador.
desmarestianus group. Mexico to Panama.
gaumeri. Mexico (Yucatan).
nelsoni. Mexico (Chiapas).

Genus *Liomys*
pictus group. Mexico.
crispus group. Mexico to Panama.
irroratus group. Mexico.

Genus *Perognathus*
fasciatus group. North Mexico. (Nearctic type.)
longimembris group. North Mexico. (Nearctic type.)
baileyi group. North Mexico. (Nearctic type.)
hispidus group. Northern Mexico.
penicillatus group. North-western Mexico. (Nearctic type.)
intermedius group. Northern Mexico.

Genus *Dipodomys*

spectabilis group. Northern Mexico.
phillipsii group. Mexico.
merriami group. Northern Mexico.
ordii group. Northern Mexico.
deserti group. North Mexico (Sonora). (Nearctic type.)

GEOMYIDAE

Genus *Thomomys*

bottae group. North Mexico, Sonora. (Nearctic type.)
perpallidus group. North Mexico, Sinaloa. (Nearctic type.)
umbrinus group. Mexico.

Genus *Geomys*

breviceps group. N.E. Mexico (Tamaulipas). (Nearctic type.)

Genus *Pappogeomys*

bulleri group. Mexico; Jalisco.

Genus *Cratogeomys*

castanops group. Through Mexico.

Genus *Platygeomys*

gymnurus group. South Central Mexico.

Genus *Orthogeomys*

grandis group. South Mexico to Honduras, Salvador.

Genus *Heterogeomys*

hispidus group. Southern Mexico.

Genus *Zygogeomys*

trichopus. Mexico; Michoacan.

Genus *Macrogeomys*

heterodus group. Nicaragua, Costa Rica, Panama.

CAVIIDAE

Genus *Cavia*

aperea group. North Argentine (Tucuman, Corrientes), north to Peru, Colombia, Venezuela, British Guiana.

Genus *Galea*

spixii group. Southern Brazil, Bolivia, Argentine (to Upper Rio Negro).

Genus *Caviella*

australis. Argentine to Patagonia.
shiptoni. Argentine (Catamarca).
niata. Bolivia.

Genus *Kerodon*

rupestris. Eastern (?) Brazil.

Genus *Dolichotis*

patagona group. Argentine to Patagonia (Cordoba southwards.)
salinicola group. Argentine.

Genus *Hydrochoerus*

hydrochaeris group. Warmer portions of South America (exact range not traced), north to Panama. Known to occur in Brazil, Paraguay, British Guiana, Venezuela.

CHINCHILLIDAE

Genus *Chinchilla*

laniger. Northern Chile.

Genus *Lagidium*

viscaccia group. Peru, Bolivia, Argentine, Chile (south to 50° S.).

Genus *Lagostomus*

maximus. Argentine.

DINOMYIDAE

Genus *Dinomys*

branickii. Peru, Colombia, Ecuador, Upper Amazonia.

ECHIMYIDAE

Genus *Echimys*

dasythrix group. East Brazil; Bahia to Rio Grande do Sul.
blainvillei group. East Brazil; Bahia to Paraná.
thomasi. Island off Bahia, East Brazil.
armatus group. Guianas, Brazil (North?), Venezuela.
chrysurus group. Dutch Guiana, N.E. Brazil (Para).
saturnus. Ecuador.
grandis group. Peru, Upper Amazonia.

Genus *Isothrix*

pictus group. East Brazil (Bahia).
bistriatus group. Peru, Venezuela, Brazil south to Matto Grosso.

Genus *Diplomys*

caniceps group. Panama, Colombia.

Genus *Proechimys*

cayennensis group. Nicaragua southwards to Guianas, Peru, Bolivia, Minas Geraes.
canicollis. Colombia.
iheringi. Island off São Paulo, Brazil. (São Sebastian Island.)
setosus group. East Brazil; Bahia.

Genus *Hoplomys*

gymnurus group. Nicaragua, Panama, Ecuador.

Genus *Cercomys*

cunicularius. Paraguay, and East Brazil (Minas Geraes, Bahia, Pernambuco).

Genus *Euryzygomatomys*

spinosus. Paraguay, South-eastern Brazil.

Genus *Clyomys*

laticeps. S.E. Brazil (Santa Catharina).

Genus *Carterodon*

sulcidens. South Brazil; (? Lagoa Santa).

Genus *Mesomys*

hispidus group. Amazonia; Tocantins River to Ecuador, Peru.

Genus *Lonchothrix*

emiliae. Central Brazil; Rio Tapajoz.

Genus *Procapromys*

geayi. Venezuela.

Genus *Capromys*

pilorides. Cuba.

melanurus. Cuba.

nana. Cuba.

Genus *Geocapromys*

brownii. Jamaica.

thoracatus group. Swan Island (off Honduras), and Bahamas.

Genus *Plagiodontia*

aedium. Dominican Republic.

Genus *Thrinacodus*

albicauda group. Colombia, Venezuela.

Genus *Dactylomys*

dactylinus. Ecuador, Bolivia, Brazil (Amazonia).

peruanus. Peru.

Genus *Kannabateomys*

amblyonyx. Paraguay, S.E. Brazil (São Paulo).

Genus *Myocastor*

coypus. Chile, Patagonia, Paraguay, Argentina.

Genus *Abrocoma*

bennetti. Chile.

cinerea. Northern Argentina.

Genus *Octomys*

mimax. North Argentine (Catamarca, San Juan).

Genus *Aconaemys*

fuscus group. Southern Chile, Argentina (Andes).

Genus *Octodon*

degus group. Chile, Peru.

Genus *Octodontomys*

gliroides. Bolivia.

Genus *Spalacopus*

cyanus group. Chile.

Genus *Ctenomys*

magellanicus section. Paraguay, North Argentina to Patagonia.

torquatus section. South Brazil, Bolivia, North and Central Argentine.

leucodon. Bolivia.

opimus section. South Peru, Bolivia to Chile and Patagonia.

boliviensis section. Bolivia.

ERETHIZONTIDAE

Genus *Chaetomys*

subspinosus. Brazil; tropical? (exact locality not traced).

Genus *Echinoprocta*

rufescens. Colombia.

Genus *Coendou*

prehensilis group. Colombia, Brazil (Matto Grosso, ?Pernambuco), Bolivia.

bicolor group. Bolivia, Peru, Ecuador, Panama (*rothschildi*).

mexicanum group. Mexico, Panama.

paragayensis group. Paraguay, S.E. Brazil, Eastern Brazil?

vestitus. Colombia, Venezuela.

DASYPROCTIDAE

Genus *Myoprocta*

acouchy. Cayenne, Amazonia.

pratti. Peru, Ecuador, Colombia, east to Manaos region, Brazil.

Genus *Dasyprocta*

punctata. Mexico to Panama.

variegata. Peru, Ecuador, Colombia, Bolivia, Matto Grosso.

aguti. Guianas, Brazil. Allied forms in Lesser Antilles.

CUNICULIDAE

Genus *Cuniculus*

paca group. Mexico, Panama, Ecuador, Colombia, Brazil, Cayenne. Probably south to Paraguay.

taczanowskii group. Ecuador, Venezuela. ?Peru.

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Order RODENTIA

KEY TO SUPERFAMILIES HERE RECOGNIZED

Lower jaw much specialized, either by distortion outwards of the angular portion, by specialized limb of masseter lateralis superficialis, or by a conspicuous ridge extending along outside of jaw below level of toothrow, for attachment of masseter medialis.

Infraorbital foramen not or scarcely transmitting muscle. Fibula reduced and fully fused with tibia. (Masseter lateralis chief agent in modifying form of mandible.)

Superfamily BATHYERGOIDAE

Infraorbital foramen much enlarged for muscle transmission. Fibula rarely reduced, not fully fused with tibia.

Masseter lateralis chief agent in modifying form of mandible.

Superfamily HYSTRICOIDAE

Masseter medialis chief agent in modifying form of mandible.

Superfamily CAVIOIDAE

Lower jaw not much specialized, never with angular portion distorted outwards and never with deep ridge extending along outside of jaw for attachment of masseter medialis.

Infraorbital foramen not or scarcely transmitting muscle.

Zygomatic plate completely beneath the infraorbital foramen.

Superfamily APLODONTOIDAE

Zygomatic plate more specialized, broadened and tilted upwards to a greater or lesser degree, never completely beneath infraorbital foramen.

Jugal bone long, usually extending to lachrymal; fibula so far as known not fully fused with tibia. No externally-opening cheekpouches present. Cheekteeth normally complex.

Skull without well-marked postorbital processes; jugal much broadened; cheekteeth extremely hypsodont, not cuspidate in pattern; external form much modified for aquatic life, tail broadened, flattened, naked, the vertebrae broadened. Superfamily CASTOROIDAE

Skull with postorbital processes, well developed in the majority; jugal not specially broadened, cheekteeth usually not hypsodont, cuspidate in pattern;

external form never modified for aquatic life, tail normal, always fully haired. Superfamily SCIUROIDAE[1]

Jugal bone strongly reduced, never approaching lachrymal, the zygoma sometimes complete without it, the whole zygoma in some cases reduced, threadlike. Fibula, so far as known, fully fused with the tibia. Large externally-opening cheekpouches present. Cheekteeth with tendency to become simplified. Superfamily GEOMYOIDAE

Infraorbital foramen always enlarged for muscle transmission.

Zygomatic plate very generally tilted upwards and broadened to a greater or lesser degree (two exceptions out of approximately two hundred genera). The infraorbital foramen never much enlarged. Fibula fused with the tibia. Superfamily MUROIDAE

Zygomatic plate never tilted upwards, always narrow and completely below the greatly enlarged infraorbital foramen.

Premolars becoming suppressed, either absent, vestigial, or shed in the adult.

Fibula fused with the tibia; cheekteeth rooted, complex in pattern; angular portion of mandible weak, not drawn backwards. Superfamily DIPODOIDAE

Fibula free from tibia; cheekteeth evergrowing, simplified in pattern; angular portion of mandible strong, drawn backwards to a certain degree. Superfamily CTENODACTYLOIDAE

Premolars not suppressed, not shed in the adult, normally as large as the molars, and not reduced.

Fibula fused with the tibia; cheekteeth evergrowing, simplified in pattern; external form saltatorial; mastoids much inflated. Superfamily PEDETOIDAE

Fibula free from tibia, so far as known; cheekteeth rooted, complex in pattern; external form arboreal; mastoids not much inflated. Superfamily ANOMALUROIDAE

I would point out, before dealing with the families and genera, that sub-genera as here retained are equivalent in rank to sub-genera as understood by American authors; and are not groups which must at once be given full generic rank, as has been done so often by authors other than Americans, because they form "natural groups" or because of convenience.

Some excellent remarks on the status of genera and sub-genera are given by Osgood in his revision of the American genus *Peromyscus*, to which I would refer my readers.

[1] For the wide differences between *Castor* and the Sciuridae in external characters see Pocock, Proc. Zool. Soc. London, p. 1171, 1922.

The present author inclines to the view that systematic classification would be none the worse if sub-genera were abolished altogether.

Superfamily BATHYERGOIDAE

As here understood this contains one living family.

Family BATHYERGIDAE

1896. Thomas: Myomorpha, part; Family Bathyergidae.
1899. Tullberg: Hystricognathi; *Bathyergomorpha*, Family Bathyergidae.
1918. Miller & Gidley: Superfamily Bathyergoidae; Family Bathyergidae.
1924. Winge: Family Hystricidae, part, Bathyergini.
1928. Weber: Bathyergoidea; Family Bathyergidae.

Geographical Distribution.—Africa: from Sudan, Abyssinia and Somaliland, and from Gold Coast to the Cape.

Number of Genera.—Five.

Characters.—Zygomasseteric structure unique in the order; mandible with angular portion distorted outwards to "allow passage of a specialized and enlarged distal anterior limb of masseter lateralis superficialis" (Miller & Gidley); paralleling the Hystricoidae in this respect, but if anything even more developed than in the most specialized of these. Infraorbital foramen small, not or scarcely transmitting muscle; if so, only a small strand in certain species, the degree of enlargement of infraorbital foramen evidently in some cases variable individually.

Skull and external form much modified for fossorial life.

Number of cheekteeth varying in the different genera; cheekteeth strongly hypsodont, but not evergrowing; normally simplified to ring-pattern in adult (excepting the genus *Georychus*).

A tendency present for the upper incisors to extend into the pterygoids. Fibula reduced, fully fused with the tibia.

Remarks.—The peculiar jaw-muscle structure combined with the variability of the number of cheekteeth, and the variability of the infraorbital foramen serve to isolate the Bathyergidae completely among living rodents.

Elsewhere, there is a strong uniformity in the dental formula of any one group; in some cases, as Sciuridae (cheekteeth $\frac{5}{4}$ or $\frac{4}{4}$), Dipodidae (cheekteeth $\frac{4}{3}$ or $\frac{3}{3}$), there is a difference in the formula, it is true; but in almost all cases the extra premolar retained is vestigial and going; in a vast group like the Muridae the formula of $\frac{3}{3}$ cheekteeth is very general, only a very few Australian and Philippine genera having it reduced to $\frac{2}{2}$. But in this family, three completely different dental formulas, or possibly even four, are to be found in five genera.

These rodents certainly cannot be lumped in "Myomorpha," as was done by Thomas and earlier authors, on account of the comparatively trivial character of the fusion of the tibia and fibula; nor can they be transferred to the Hystricoidea, "Hystricidae," as was done by Winge, presumably on account of the similarity of the lower jaw in the two groups, though in Winge's Hystricidae the Ctenodactylidae are included, which do not possess the Hystricoid type of mandible. Nor does the infraorbital foramen transmit muscle here, as apparently Winge is of the opinion that it does (or did), except to a very small degree occasionally, as discussed below; nor in the Hystricoidae are the tibia and fibula fused, though this is a character which Winge has used elsewhere as a division in other families (Anomaluridae against Dipodidae, etc., page 7).

In zygomasseteric structure the Bathyergoidae differ from the Hystricoidae chiefly in that in the latter group the infraorbital foramen is always very much enlarged to transmit muscle, whereas in the present group it is usually not enlarged at all; this fact, combined with the lack of broadening of the zygomatic plate present, appears to be a primitive condition.

According to Tullberg's figures, the temporalis muscle in this family appears less reduced than is usual, taking up the whole of the hinder part of superior portion of skull, and extending forwards nearly to level of anterior zygomatic root (*Georychus capensis*).

Digits of forefoot and hindfoot five, none reduced.

According to Tullberg, the radiale and intermedium of members of this family are separate, alone of rodents (examined by him) except Ctenodactylidae. Malleus and incus fused according to Tullberg, as in Hystricoidae, Ctenodactylidae, but unlike the remainder of the order.

Thomas, Ann. Mag. Nat Hist., 8, IV, p. 111, 1909, suggested that the cheekteeth present in the various genera are probably as follows:

Heliophobius	$\frac{6}{6}$	=	p.	$\frac{2.3.4.}{2.3.4.}$	m.	$\frac{1.2.3.}{1.2.3.}$
Bathyergus and *Georychus*	$\frac{4}{4}$	=	p.	$\frac{3.4.}{3.4.}$	m.	$\frac{1.2.}{1.2.}$
Heterocephalus	$\frac{3}{3}$	=	p.	$\frac{3.4.}{3.4.}$	m.	$\frac{1.}{1.}$
"*Fornarina*" (=*Heterocephalus phillipsi*)	$\frac{2}{2}$	=	p.	$\frac{3.4.}{3.4.}$		

Miller & Gidley, with reference to *Heliophobius* which exceeds their highest formula for a rodent ($\frac{5}{4}$), state: "In the Genus *Heliophobius*, with the greatest number of teeth, there are never more than $\frac{5}{4}$ functional at one time; the apparent addition of one tooth in the upper jaw and two in the lower jaw to the maximum Rodent formula is probably due to a specialized condition of the milk-dentition."

Discussion of Genera.—The genus *Bathyergus* appears to have evolved in a rather different way from the remainder of the family in that the digging is done not so much with the incisors as with the foreclaws. This has led to great enlargement of these claws, but not to any great lengthening of the upper incisor roots, so that the upper incisors do not show any inclination to extend to the back of the palate, or the pterygoids. A parallel to this, between *Bathyergus* (a "claw-digger") and *Georychus* (a "tooth-digger"), is seen in *Spalax* against *Myospalax*; the two fossorial Microtinae *Ellobius* against *Prometheomys*; etc.

In all other Bathyergidae, the claws remain relatively small, but the upper incisors extend over the cheekteeth to the back of the palate or at extreme development into the pterygoids.

Heliophobius is remarkable in that, as indicated above, it is the only rodent known with $\frac{6}{6}$ cheekteeth, and appears to be erupting teeth more or less through life.

Cryptomys and *Georychus* are closely allied types, with a dental formula of $\frac{4}{4}$; *Georychus*, confined like *Bathyergus* to a small range in South Africa, is the only member of the family without simplified cheekteeth in the adult; *Cryptomys* with a large number of named forms extends over most of the Continent.

Heterocephalus, from Abyssinia and Somaliland, is a most extraordinary animal; alone among the rodents it has become practically naked, having lost the fur almost entirely. Various other characters such as the fact that D.3 in the manus is noticeably longer than D.4, the more strongly shortened and Murine jugal, and the reduction of the cheekteeth to $\frac{3}{3}$, or even sometimes $\frac{2}{2}$, leads me to believe that it should be separated from the rest as a "generic group."

Key to the Generic Groups of Bathyergidae

Fur reduced to a few scattered hairs. D.3 in manus markedly longer than D.4. Jugal short, supported anteriorly by the zygomatic process of the maxillary, its general form Murine. Cheekteeth becoming reduced numerically: $\frac{3}{3}$ or $\frac{2}{2}$ — *Heterocephalus* Group (HETEROCEPHALI)

Fur normal. D.3 in manus never markedly longer than D.4, usually slightly or considerably shorter. Jugal long, forming the greater part of the zygoma. Cheekteeth not becoming reduced numerically: $\frac{4}{4}$, or in one genus, at full dentition, $\frac{6}{6}$. — *Bathyergus* Group (BATHYERGI)

The *Bathyergus* Group

Fur normal; eyes and ears, as usual in the family, greatly reduced; usually D.2 in manus longer than D.3, the digits reduced in size from D.2 to D.5 evenly; pollex not vestigial, clawed. Hindfoot with D.3 remaining main digit, except in *Heliophobius*.

General cranial characters as follows: Skull with frontals moderately or rarely strongly constricted, nasals usually narrow; posterior root of zygoma noticeably broad, and zygomata widely spreading. A prominent ridge developed in all genera extending along centre of skull from posterior part of nasals to lambdoid crest. Occipital region usually prominent, outstanding and strongly ridged. Jugal long. Bullae small-moderate, not abnormal. Palate normally excessively constricted between toothrows; extending behind level of toothrows, in which position it is broader, excepting *Heliophobius*. Incisive foramina obsolete. Angle of mandible powerfully distorted outwards; usually not produced far backwards, except in *Bathyergus*. Incisors thick, pro-odont.

Key to the Genera of the Bathyergus Group

Cheekteeth $\frac{4}{4}$.

Upper incisors not extending behind toothrows, and heavily grooved. Foreclaws much enlarged. Angular portion of mandible produced considerably backwards. BATHYERGUS

Upper incisors extending behind the toothrows, in extreme development into pterygoids, not grooved. Foreclaws not specially enlarged. Angular portion of mandible not produced far backwards.

Cheekteeth simplified to ring-pattern in adult. Posterior tooth cut early in life. CRYPTOMYS

Cheekteeth retaining one inner, one outer fold to old age; posterior tooth cut late in life. GEORYCHUS

Cheekteeth at full dentition $\frac{6}{6}$.

(Upper incisor extends into pterygoids; cheekteeth ring-shaped; foreclaws not enlarged; angular portion of mandible not produced far backwards.) HELIOPHOBIUS

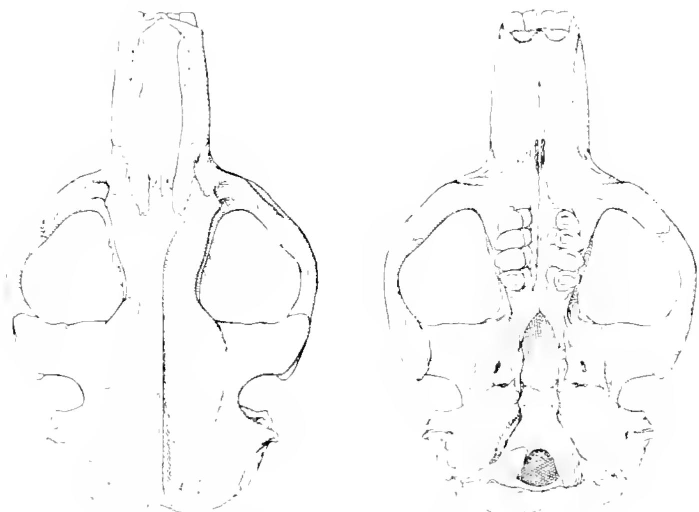


FIG. 1. BATHYERGUS SUILLUS SUILLUS, Schreber.
B.M. No. 5.8.10.10, ♂; × 1.

FIG. 2. BATHYERGUS SUILLUS SUILLUS, Schreber.
B.M. No. 5.8.10.10. ♂; × 1.

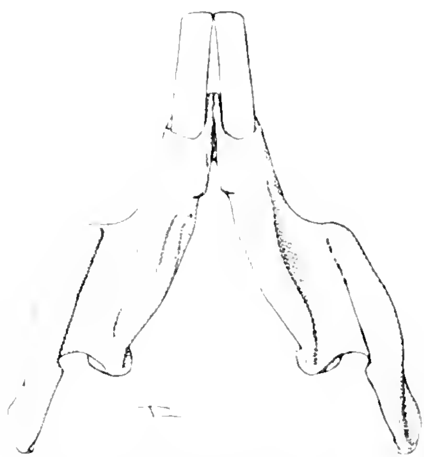


FIG. 3. BATHYERGUS SUILLUS, Schreber.
Mandible from below; × 1.

Genus 1. BATHYERGUS, Illiger

1811. BATHYERGUS, Illiger, Prodr. Syst. Mamm., p. 86.

TYPE SPECIES.—*Mus maritimus*, Gmelin.

RANGE.—South Africa: Cape Province, and Namaqualand; coastlands.

Number of Forms.—Three.

Characters.—Skull essentially as described above; frontals in the type species much constricted; occipital region extremely ridged and powerful in old age. Angular portion of mandible produced considerably backwards, the mandible being perhaps proportionately larger in relation to the upper part of the skull than in any other member of the order.

Upper incisors one-grooved, lowers plain; roots of upper incisors not extending to nor approaching posterior part of toothrow.

Cheekteeth hypsodont, wider than long, when cut, with an inner and outer fold, which quickly wear down so that the tooth is ring-shaped in adult. Infra-orbital foramen normal (small).

Size largest for the family in the type species; ear conch absent; tail as long as hindfoot, thick and flat, with long hairs growing outwards each side giving a feather-like effect. Claws immensely developed in forefoot, particularly of digits 2, 3 and 4; D.2 longer than D.3. Hindfoot with the centre digit longest, D.2 slightly longer than D.4, hallux slightly longer than D.5. Claws of hindfoot medium. Pollex with short claw, not vestigial.

Two well-marked species are known, the "giant" *suillus*, and the moderate-sized *janetta*, which appears to have a less heavily ridged skull.

Forms examined: *suillus*, *janetta*.

List of Named Forms

1 BATHYERGUS SUILLUS SUILLUS, Schreber

1782. Säugt. IV, p. 715, pl. 204B.
South Africa: Cape.
Synonym: *maritimus*, Gmelin, 1788, Linn. Syst. Nat. 1, p. 140.
africana, Lamarck, Voyages de Thunberg au Japon, etc., 4, 348, 1796.

2 BATHYERGUS SUILLUS INTERMEDIUS, Roberts

1926. Ann. Transvaal Mus. XI, p. 261.
Klaver, Cape Province.

3. BATHYERGUS JANETTA, Thomas & Schwann

1904. Abstr. Proc. Zool. Soc. London, no. 2, p. 6.
Port Nolloth, Little Namaqualand.

Genus 2. HELIOPHOBIUS, Peters

1846. Heliophobius, Peters, Monats. Ber. Akad. Berlin, p. 259.

1890. Myoscalops, Thomas, Proc. Zool. Soc. London, p. 448. New name to replace *Heliophobius* on the assumption that it was preoccupied by *Heliophobus*, Boisduval.

Type Species.—*Heliophobius argenteocinereus*, Peters.

Range.—Eastern and Central Tropical Africa: Kenya, Tanganyika, South Congo, North Rhodesia, Nyasaland.

Number of Forms.—Eight or nine are recognized.

Characters.—Cheekteeth at full dentition $\frac{6}{6}$. The teeth are very infrequently all in place together; the anterior premolars being shed before the posterior molars are cut. In fifty skulls available for examination only one No. 18.6.15.6 has all six teeth in place together (one side of the jaw only). I have not seen one with the six lower teeth in place together. The normal number in place at once appears to be either $\frac{5}{4}$ or $\frac{4}{4}$, but sometimes there may be $\frac{4}{5}$, etc. and frequently there will be 5 teeth on one side of the jaw and 4 on the other. The last tooth appears to be cut late in life. The teeth when cut are with one external and one internal fold, but soon simplify to a ring-pattern.

Upper incisor roots extending into pterygoids. Palate excessively narrow, differing from that of *Bathyergus*, *Cryptomys* and *Georychus* in that it does not extend behind the toothrows. Infraorbital foramen very small. Other essential characters of skull as already described.

Tail and ears obsolete. Claws not excessively lengthened. Hindfoot differing from that of *Bathyergus* in that D.2 is the main digit rather than D.3, as in the forefoot, though the hallux remains slightly longer than D.5.

Forms seen: *albifrons*, *angonicus*, *argenteocinereus*, *emini*, *kapiti*, *marungensis*, *robustus*, *spalax*.

List of Named Forms

Mr. R. W. Hayman has been kind enough to look through this genus for me and reports that all the named forms "cannot in my view be more than races of *argenteocinereus*, except *spalax*, which has the narrow posterior nares reaching the level of last molars, and is distinguishable on this from all the others." I fully agree with this conclusion.

1. HELIOPHOBIUS SPALAX, Thomas
1910. Ann. Mag. Nat. Hist. 8, VI, p. 315.
Taveta, near Kilimanjaro.

2. HELIOPHOBIUS ARGENTEOCINEREUS ARGENTEOCINEREUS, Peters
1852. Reise nach Mozambique, Zool. Säug. p. 140.
Tette, Lower Zambesi.

3. HELIOPHOBIUS ARGENTEOCINEREUS ANGONICUS, Thomas
1917. Ann. Mag. Nat. Hist. 8, XX, p. 314.
Bua River, Angoniland, East Rhodesia.

4. HELIOPHOBIUS ARGENTEOCINEREUS ROBUSTUS, Thomas
1906. Ann. Mag. Nat. Hist. 7, XVII, p. 179.
Mpika, N.E. Rhodesia.

5. HELIOPHOBIUS ARGENTEOCINEREUS MARUNGENSIS, Noack
1887. Zool. Jahrb. Syst. II, p. 223, pl. ix, fig. 25.
Marungu, South-east Congo.

6. HELIOPHOBIUS ARGENTEOCINEREUS EMINI, Noack
1894. Zool. Jahrb. Syst. VII, p. 559.
Simba Muenna, near Mpwapwa, Tanganyika.

7. HELIOPHOBIUS ARGENTEOCINEREUS KAPITI, Heller
1909. Smiths. Misc. Coll. LII, part 4, p. 469.
Kapiti Plains, Kenya.

8. HELIOPHOBIUS ARGENTEOCINEREUS ALBIFRONS, Gray
1864. Proc. Zool. Soc. London, p. 123.
"East Africa."
Synonym: ? *pallidus*, Gray, 1864, P.Z.S. London, 9. 124. "East Africa."

9. HELIOPHOBIUS MOTTOULEI, Schouteden. (Not seen)
1913. Rev. Zool. Afr. 2, p. 203.
Kilongwe, near Lake Kisale, Belgian Congo.

Genus 3. GEORYCHUS, Illiger

1811. Georychus, Illiger. Prodr. Syst. Mamm. p. 87.

Type Species.—*Mus capensis*, Pallas.

Range.—South Africa: Natal and Namaqualand to the Cape.

Number of Forms.—Three.

Characters.—Like *Cryptomys*, next to be described, but upper cheekteeth with one narrow inner and outer fold each, the folds persisting; lower cheekteeth with one outer fold persistent and one inner fold which tends to become weak or obsolete. Posterior cheekteeth cut late in life. Upper incisor roots extending into pterygoids. Infraorbital foramen normal (small). Externally with no special peculiarities; claws not enlarged; the digits arranged about as in *Bathyergus*.

Forms seen: *capensis*, *canescens*.

List of Named Forms

1. GEORYCHUS CAPENSIS CAPENSIS, Pallas
1779. Glires, pp. 76, 172, pl. VII.
Cape Colony.
Synonyms: *buffoni*, Cuvier, Ann. Sci. Nat. 1834, 1, p. 196.
leucops, Lichtenstein, Forsters Desc. Anim. Iter. ad. Maris Aust. Teras Suscepto, p. 364, 1844.

2. GEORYCHUS CAPENSIS CANESCENS, Thomas & Schwann
1906. Proc. Zool. Soc. London, p. 165.
Knysna, South Cape Colony.

3. GEORYCHUS CAPENSIS YATESI, Roberts
1913. Ann. Transvaal Mus. IV, p. 92.
Transvaal.

Genus 4. CRYPTOMYS, Gray

1864. Cryptomys, Gray, Proc. Zool. Soc. London, p. 124.
1864. Coetomys, Gray, Proc. Zool. Soc. London, p. 125. (Based on *coecutiens* and *damarensis*).

Type Species.—*Georychus holosericeus*, Wagner.

Range.—Africa, widely distributed: Togoland, Nigeria and Bahr-el-Ghazal to the Cape; evidently not occurring in Kenya, nor Abyssinia, nor Somaliland.

Number of Forms.—Approximately forty-nine have been named.

Characters.—Skull, excepting in some species the infraorbital foramen, without special peculiarity; about as usual in the family; frontals not much constricted; mandible with angular portion not much produced backwards. Upper incisors plain, their roots extending behind the toothrow. Cheekteeth $\frac{4}{4}$, a simple ring in adult, one inner, one outer fold when unworn.

Claws normal; length of digits as *Bathyergus*, or with considerable tendency towards D.2 and D.3 in the manus being subequal, or even in some seen D.3 is very slightly the longer. D.2 and D.3 in the hindfoot also often subequal. Mammae usually 2—1 = 6 (Thomas). Tail shorter than hindfoot.

Infraorbital foramen variable, sometimes even individually. In some cases, as in the giant species, *mellandi*, it becomes as large relatively as in some Muroid rodents, as *Rhizomys*, and surely must transmit muscle. Skull no. 20.11.3.227 at the British Museum shows a specimen in this state. In *C. coecutiens*, as figured by Tullberg, a small strand of muscle passes through the foramen.

The infraorbital foramen is normal (small), or but very slightly enlarged in *damarensis*, *lugardi*, *beirae*, *zechi* (type not seen), *molyneauxi*, *micklemi*, *foxi*, *lechei*, *kummi*, and *whytei* (slightly enlarged); in the type of *nimrodi*, the infraorbital foramen of one side of the skull is small, on the other side slightly enlarged (which proves that no specific groups may be based on this character); it is very little enlarged in *ansorgei* (one of the giant *mechowi* group); moderate in *blainei* (same group); relatively large in *bocagei*, *coecutiens* (type not seen), *darlingi*, *jorisseni*; largest in *amatus*, *hottentotus* (type not seen), *mellandi* and *mechowi* (type not seen).

The above notes, except when stated to the contrary, are based on type skulls; there may be some individual variation perhaps within some of the species.

Four forms, *mechowi*, *mellandi*, *ansorgei* and *blainei*, separate rather sharply as a group from the others on account of their relatively very large size.

Forms seen: *amatus*, *ansorgei*, *beirae*, *blainei*, *bocagei*, *coecutiens*, *damarensis*, *darlingi*, *foxi*, *holosericeus*, *hottentotus*, *jorisseni*, *kummi*, *lechei*, *lugardi*, *mechowi*, *mellandi*, *micklemi*, *molyneauxi*, *nimrodi*, *talpoides*, *whytei*, *zechi*.

List of Named Forms

Mr. R. W. Hayman has kindly looked through the large collection of the genus *Cryptomys* at the British Museum, with a view to getting it into some semblance of order, and reports as follows:

"The British Museum material of this genus seems to me to be divisible into five groups, based primarily on presence or absence of white head-spot (this is more reliable than was expected), secondarily on colour and size. Cranial characters seem to be unreliable and cannot be correlated with the groupings given here. It is obvious that many of the so-called species listed here will eventually be relegated to sub-specific rank.

1. *Without head-spot.*

(*a*) *mechowi group.* Large to very large, head and body 200 up to 260. Very pale brown in all forms.

1. *mechowi*, Peters. North Angola.
2. *mellandi*, Thomas. North Rhodesia and Angola.
3. *ansorgei*, Thomas & Wroughton. Central Angola.
4. *blainei*, Hinton. Central Angola.

(*b*) *hottentotus group.* Small to medium-sized, head and body 100–150. Drab or fawn, exceptionally blackish (*talpoides*).

5. *hottentotus*, Lesson. Cape Colony and Natal.
6. *h. talpoides*, Thomas & Schwann. Cape Colony.
7. *h. occlusus*, Allen & Loveridge. S.W. Tanganyika Terr.
8. *h. whytei*, Thomas. N.W. Nyasa, N.E. Rhodesia. (Treated as a race of *hottentotus* by Allen & Loveridge, Bull. Mus. Comp. Zool. Harv., LXXV, No. 2, p. 125.)

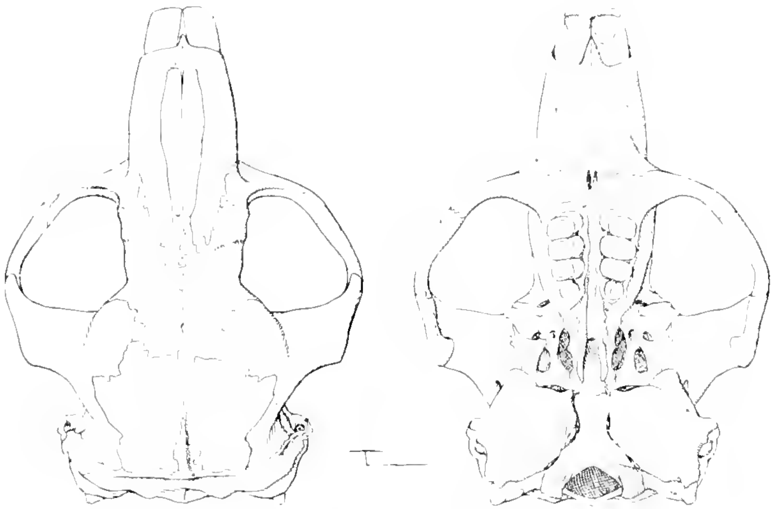


FIG. 4. CRYPTOMYS DAMARENSIS, Ogilby.
B.M. No. 25.12.4.190, ♀; × 2.

9. *coecutiens*, Lichtenstein. Cape Colony.
10. *holosericeus*, Wagner. Cape Colony, Orange Free State, Transvaal.
11. *jorisseni*, Jameson. Transvaal.
12. *nimrodi*, de Winton. S. Rhodesia.
13. *amatus*, Wroughton. N. Rhodesia and Katanga.

With head-spot.

(*a*) *lechei group.* Size medium to large, head and body about 125 to 200. Colour ranging from blackish through seal-brown to slate and silvery-fawn.

14. *lechei*, Thomas. N.E. Congo, N. Uganda. (Only 3 Uganda skins seen, all lacked spot.)
15. *kummi*, Thomas. French Shari.
16. *foxi*, Thomas. North Nigeria.

17. *lugardi*, de Winton. S.W. Africa and Kalahari.
18. *micklemi*, Chubb. N.W. Rhodesia. (St. Leger, Proc. Zool. Soc. London, 1932, p. 964, considers *micklemi* *lugardi*.)
19. *molyneauxi*, Chubb. N.W. Rhodesia.
20. *darlingi*, Thomas. S. Rhodesia.
21. *beirae*, Thomas. Portuguese East Africa.

FIG. 5. CRYPTOMYS DAMARENSIS, Ogilby.
B.M. No. 25.12.4.190, ♀; × 2.

(*b*) *damarensis group*. Size medium; head and body about 150. Pale sandy brown.

22. *damarensis*, Ogilby. S.W. Africa.
23. *ochraceocinereus*, Heuglin. Bahr-el-Ghazal, Sudan.
24. *zechi*, Matschie. Togoland, West Africa.

Authentic examples of 23 (*ochraceocinereus*) not seen. This is perhaps a more artificial group than the preceding one, but Nos. 22, 23 and 24 do not seem to fit elsewhere.

3. *With or without head-spot.*

bocagei group. Colour cinnamon to drab; size small to medium, up to 150. Head spot very variable.

25. *bocagei*, de Winton. Angola.
26. *kubangensis*, Monard. Angola."

On account of the variability of the head-spot I think it will be desirable to treat the *hottentotus*, *lechi*, *damarensis* and *bocagei* groups as sections of one specific group, particularly bearing in mind the amount of variability met with in the genus *Heliophobius* in this character. I must add that it was I who originally suggested to Mr. Hayman that the presence or absence of this spot might be used to divide *Cryptomys* into groups.

The *mechowi* group is unquestionably very distinct from the remainder.

mechowi Group

1. CRYPTOMYS MECHOWI, Peters

1881. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 133.
Malanje, North Angola.

2. CRYPTOMYS MELLANDI, Thomas

1906. Ann. Mag. Nat. Hist. 7, XVII, p. 178.
Mpika, N.-E. Rhodesia.

3. CRYPTOMYS ANSORGEI, Thomas & Wroughton

1905. Ann. Mag. Nat. Hist. 7, XVI, p. 175.
Bihé, Central Angola.

4. CRYPTOMYS BLAINEI, Hinton

1921. Ann. Mag. Nat. Hist. 9, VII, p. 372.
Loando River, Central Angola.

hottentotus Group
(typical section)

5. CRYPTOMYS HOTTENTOTUS HOTTENTOTUS, Lesson

1826. Voy. Coq. Zool. 1, p. 166, pl. ii, fig. 2.
Paarl, Cape.

6. CRYPTOMYS HOTTENTOTUS TALPOIDES, Thomas & Schwann

1906. Proc. Zool. Soc. London, p. 166.
Knysna, Cape Colony.

7. CRYPTOMYS HOTTENTOTUS OCCLUSUS, Allen & Loveridge

1933. Bull. Mus. Comp. Zool. LXXV, no. 2, p. 125.
Uzungwe Mountains, S.-W. Tanganyika.

8. CRYPTOMYS HOTTENTOTUS WHYTEI, Thomas

1897. Proc. Zool. Soc. London, p. 432.
Karonga, Lake Nyasa.

9. CRYPTOMYS COECUTIENS, Lichtenstein

1827. Brants. Muiz. p. 37.
Natal.
Synonym: *ludwigi*, Smith, 1829, Zool. Journ., p. 439. A synonym of *C. hottentotus, fide* G. M. Allen.

10. CRYPTOMYS HOLOSERICEUS, Wagner

1842. Schreb. Säugt. Suppl. III, p. 373.
Graaf Reinet, Cape Colony.

11. CRYPTOMYS NIMRODI, de Winton

1896. Proc. Zool. Soc. London, p. 808.
Bulawayo, Rhodesia.

12. CRYPTOMYS AMATUS, Wroughton

1907. Manchester Mem. 51, no. 5, p. 28.
Alala Plateau, North Rhodesia.

13. CRYPTOMYS JORISSENI, Jameson

1909. Ann. Mag. Nat. Hist. 8, IV, p. 466.
Waynek, Waterburg District, Transvaal.

(*lechei* section)

14. CRYPTOMYS LECHEI, Thomas

1895. Ann. Mag. Nat. Hist. 6, XVI, p. 241.
Bellima, Monbuttu, N.E. Congo.

15. CRYPTOMYS KUMMI, Thomas

1911. Ann. Mag. Nat. Hist. 8, VII, p. 592.
French Shari Protectorate, Ironside Plateau, about 8° N. 22° E.

16. CRYPTOMYS FOXI, Thomas

1911. Ann. Mag. Nat. Hist. 8, VII, p. 462.
Panyam, North Nigeria.

17. CRYPTOMYS LUGARDI, de Winton

1898. Ann. Mag. Nat. Hist. 7, I, p. 253.
Kalahari, between Palapye and Ngami.
Synonym: *micklemi*, Chubb, 1909, Ann. Mag. Nat. Hist. 8, III, p. 35. Upper Zambesi.

18. CRYPTOMYS MOLYNEAUXI, Chubb

1908. Ann. Mag. Nat. Hist. 8, II, p. 451.
Loano Valley, N.-W. Rhodesia.

19. CRYPTOMYS DARLINGI, Thomas

1895. Ann. Mag. Nat. Hist. 6, XVI, p. 239.
Salisbury, Rhodesia.

20. CRYPTOMYS BEIRAE, Thomas & Wroughton

1907. Proc. Zool. Soc. London, p. 780.
Beira, Portuguese East Africa.

(*damarensis* section)

21. CRYPTOMYS DAMARENSIS, Ogilby

1838. Proc. Zool. Soc. London, p. 5.
Damaraland.

22. CRYPTOMYS ZECHI, Matschie

1900. Sitz. Ber. Ges. Nat. Fr. Berlin, no. 4, p. 146.
Middle Volta, Togoland.

23. CRYPTOMYS OCHRACEOCINEREUS, Heuglin

1864. Nov. Act. Ak. Caes. Leop. Dresden, XXXI, p. 3.
Bahr-el-Ghazal, Sudan.

(*bocagei* section)

24. CRYPTOMYS BOCAGEI, de Winton

1897. Ann. Mag. Nat. Hist. 6, XX, p. 323.
Hanha, Angola.

25. CRYPTOMYS KUBANGENSIS, Monard

1933. Bull. Soc. Neuchatel. Sci. Nat. 57, p. 58.
Cubangu River, Mossamedes, Angola.

There then remain to be discussed twenty-three "species" (?) of Roberts. Some comments on some of these have already been made by Oldfield Thomas, Ann. Mag. Nat. Hist. 8, XX, p. 444, 1917.

It is useless attempting any remarks on these, as all are unrepresented; they are therefore listed alphabetically.

26. CRYPTOMYS ABERRANS, Roberts

1913. Ann. Transv. Mus. IV, p. 98.
Port St. Johns, Cape Province.

27. CRYPTOMYS ALBUS, Roberts

1913. Ann. Transv. Mus. IV, p. 100.
Wynberg, Cape Colony.

28. CRYPTOMYS ANOMALUS, Roberts

1913. Ann. Transv. Mus. IV, p. 96.
Transvaal, Pretoria.

29. CRYPTOMYS ARENARIUS, Roberts

1913. Ann. Transv. Mus. IV, p. 96.
Transvaal, Pretoria.

30. CRYPTOMYS BIGALKEI, Roberts

1924. Ann. Transv. Mus. X, p. 73.
Glen, Orange Free State.

31. CRYPTOMYS CRADOCKENSIS, Roberts

1924. Ann. Transv. Mus. X, p. 73.
Cradock, Cape Province.

32. CRYPTOMYS JAMESONI, Roberts

1913. Ann. Transv. Mus. IV, p. 95.
Transvaal, Johannesburg.

33. CRYPTOMYS JUNODI, Roberts

1926. Ann. Transv. Mus. XI, p. 260.
Masiene, Portuguese East Africa.

34. CRYPTOMYS KOMATIENSIS, Roberts

1917. Ann. Transv. Mus. V, p. 272.
Arnhemburg, Transvaal.

35. CRYPTOMYS LANGI, Roberts

1929. Ann. Transv. Mus. XIII, p. 119.
Keerkloof, Natal.

36. CRYPTOMYS MAHALI, Roberts

1913. Ann. Transv. Mus. IV, p. 108.
Transvaal.

37. CRYPTOMYS MELANOTICUS, Roberts

1926. Ann. Transv. Mus. XI, p. 260.
Makoetsi River, N.E. Transvaal.

38. CRYPTOMYS MONTANUS, Roberts

1926. Ann. Transv. Mus. XI, p. 260.
Klapperklop, Pretoria, Transvaal.

39. CRYPTOMYS NATALENSIS, Roberts

1913. Ann. Transv. Mus. IV, p. 94.
Natal, Wakkerstroom, Transvaal.

40. CRYPTOMYS ORANGIAE, Roberts

1926. Ann. Transv. Mus. XI, p. 259.
Glen, Orange Free State.

41. CRYPTOMYS PALKI, Roberts

1917. Ann. Transv. Mus. VI, p. 5.
Vaal River, Transvaal.

42. CRYPTOMYS PRETORIAE, Roberts

1913. Ann. Transv. Mus. IV, p. 99.
Transvaal, Pretoria.

43. CRYPTOMYS RUFULUS, Roberts

1917. Ann. Transv. Mus. V, p. 272.
Tzaneen, Transvaal.

44. CRYPTOMYS STELLATUS, Roberts

1917. Ann. Transv. Mus. V, p. 272.
Komatipoort, Transvaal.

45. CRYPTOMYS TRANSVAALENSIS, Roberts

1924. Ann. Transv. Mus. X, p. 73.
Pretoria district.

46. CRYPTOMYS VANDAMI, Roberts

1917. Ann. Transv. Mus. V, p. 273.
Leydsdorp, Transvaal.

47. CRYPTOMYS VETENSIS, Roberts

1926. Ann. Transv. Mus. XI, p. 259.
Vet River, Orange Free State.

48. CRYPTOMYS VRYBURGENSIS, Roberts

1917. Ann. Transv. Mus. V, p. 274.
Vryburg, British Bechuanaland.

Addendum:

CRYPTOMYS NATALENSIS NEMO, G. M. Allen.

1939. Bull. Mus. Comp. Zool. LXXXIII, p. 429.
Manetsi River, near Malala, Zoutspansberg district, Transvaal.
Synonym: *pallidus*, Roberts, 1917, Ann. Trans. Mus. V, p. 278. Not of Gray.

The *Heterocephalus* Group

Cheekteeth $\frac{3}{3}$ or $\frac{2}{2}$, simplified in adult. Size smaller than in other members of the family. Fur practically absent, the hairs occurring singly, scattered, throughout the body, most developed on the feet. Tail longer than hindfoot. Eyes and ears extremely small, no ear conch. Forefoot with five digits, the centre of which is the longest. D.5 and especially the pollex shorter than D.4 and D.2, which are subequal. Hindfoot like forefoot, but hallux about as long as D.5.

Essential cranial characters as in *Bathyergus* group, but jugal reduced; more Murine in appearance; palate not continuing behind molars, and in appearance rather less constricted normally than in other genera; upper incisors extending behind the toothrows.

Genus 5. HETEROCEPHALUS, Rüppell

1842. HETEROCEPHALUS, Rüppell, Mus. Senckenberg. Abh. 3, Heft 2, p. 99.
1903. FORNARINA, Thomas, Proc. Zool. Soc. London, p. 336. (*Heterocephalus phillipsi*, Thomas.)

TYPE SPECIES.—*Heterocephalus glaber*, Rüppell.

RANGE.—Known from Abyssinia, Somaliland, Kenya.

NUMBER OF FORMS.—Four are here listed.

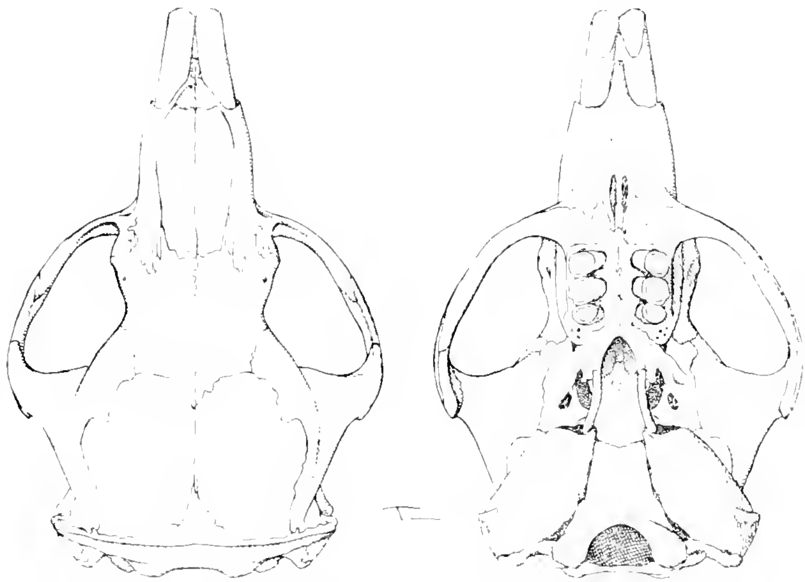


FIG. 6. HETEROCEPHALUS GLABER GLABER, Rüppell.
B.M. No. 32.2.19.9, ♀; × $3\frac{1}{2}$.

CHARACTERS.—As indicated above. Frontals little constricted; nasals appear rather broader than in other genera; palate shorter than in other genera except *Heliophobius*. Cheekteeth simple in adult, the usual folds found elsewhere in the family present when unworn; normally $\frac{3}{3}$; in *H. phillipsi*, so far as known, reduced to $\frac{2}{2}$, evidently at a certain age or stage of wear; this species is represented in the British Museum only by three skulls; two of these have two upper teeth on each side, the third has three upper cheek-teeth on one side, the posterior one minute, two on the other side, the posterior one apparently having been shed. This species was made the type of a genus "*Fornarina*" by Thomas, but much more evidence on the condition of this form is required before any generic separation can be done; I should be quite content to assume that if enough specimens could be brought to hand *phillipsi* would turn out to be no more than a race of *H. glaber*.[1]

In the few available for examination, including skulls which have been made types of two or three "species," there is much variation in the size of the cheek-teeth, M.3 being in some only slightly, and some very considerably smaller than M.2, and of the incisors, which reach their maximum size in the type of *dunni*. There is also variation in the form of the coronoid.

Hollister, 1919, East African Mammals in the U.S. National Museum, synonymizes several forms with the typical race; this classification is here followed. Provisionally I list all named forms as either synonyms or races of the type.

Forms seen: *ansorgei, glaber, dunni, phillipsi.*

FIG. 7. HETEROCEPHALUS GLABER GLABER, Rüppell.
B.M. No. 32.2.19.9, [illegible]; × 3½.

LIST OF NAMED FORMS

1. HETEROCEPHALUS GLABER GLABER, Rüppell

1842. Mus. Senckenberg, Abh. 3, Heft 2, p. 99.
Shoa, Abyssinia.
Synonym: *glaber progrediens*, Lönnberg, 1911, Kungl. Sv. Vet. Akad. Handl. Bd. 48, no. 5, p. 102. North of Guaso Nyiro, Kenya.
ansorgei, Thomas, 1903, Proc. Zool. Soc. London, p. 336. Makindu district, Kenya.
stygius, Allen, 1912, Bull. Mus. Comp. Zool. LIV, p. 444. Neumann's Boma, Nth. Guaso Nyiro, Kenya.

[1] Since the above was written, the Check List of African Mammals of G. M. Allen has been published; in this *H. phillipsi* is considered a synonym of *H. glaber*.

2. HETEROCEPHALUS GLABER SCORTECCII, de Beaux

1934. Atti. Soc. Ital, Sci. Nat. LXXIII, p. 283.
Gardo, Italian Somaliland.
(A synonym of *g. glaber*, according to G. M. Allen)

3. HETEROCEPHALUS GLABER DUNNI, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 109.
Wardairi, Central Somaliland.
(A synonym of *g. glaber*, according to G. M. Allen)

4. HETEROCEPHALUS GLABER PHILLIPSI, Thomas

1885. Proc. Zool. Soc. London, p. 612.
Somaliland.
(A synonym of *g. glaber*, according to G. M. Allen)

The references and type localities for all members of the family Bathyergidae are the work of Mr. R. W. Hayman.

The family have been described fossil from the Oligocene of Mongolia. This indicates a former wide distribution for the group, and contrasts with some of the other African families as Anomaluridae and Pedetidae which do not seem to be known outside the Continent.

BATHYERGIDAE:
SPECIAL WORKS OF REFERENCE

TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, ser. 3, no. 1, 1899.

HOLLISTER, Smiths. Inst. Bull. 99, p. 159, 1919; East African Mammals in the U.S. Nat. Mus. Note on status of some forms of *Heterocephalus*.

ST. LEGER, Key to Families and Genera of African Rodentia, Proc. Zool. Soc. London, 1931, p. 976.

THOMAS, Ann. Mag. Nat. Hist. ser. 8, vol. IV, p. 110, 1909. Note on dental formula in the family.

Superfamily HYSTRICOIDAE

This group is equal in rank to the "lateralis-series" of the superfamily Hystricoidae of Miller & Gidley; or to the "Hystricomorpha" of authors not including Caviidae (*Cavia, Galea, Caviella, Kerodon, Dolichotis, Hydrochoerus*) nor Ctenodactylidae; it is here divided into seven families.

1896. Thomas: HYSTRICOMORPHA, part, included Pedetidae, Caviidae, Ctenodactylidae.

1899. Tullberg: HYSTRICOGNATHI: *Hystricomorpha*; part, included Caviidae.

1918. Miller & Gidley: Superfamily HYSTRICOIDAE, part, lateralis series. (Included, as medialis series, the Caviidae.)

1924. Winge: Family Hystricidae, part, included Bathyergidae, Ctenodactylidae and Caviidae of this work.

1928. Weber: HYSTRICOIDAE, part; included Caviidae, Ctenodactylidae.

GEOGRAPHICAL DISTRIBUTION.—The greater part of the American Continent from Canada to Patagonia (evidently absent only from certain areas of southern U.S.A.); the greater part of the African Continent; the Indo-Malayan region, from the Himalayas to Ceylon and from Southern China to Borneo and the Philippine Islands; represented in the Palaearctic in Italy, coastal regions North-west Africa, and in South-western Asia (north into southern Siberia).

CHARACTERS.—Zygomasseteric structure differing from that of all members of the order, except Bathyergidae, in that the lower jaw, paralleling the Bathyergidae, has the angular portion of the mandible distorted outwards, to a greater or lesser degree, "to allow passage of a specialized and enlarged distal anterior limb of masseter lateralis superficialis, its general direction parallel with zygoma" (Miller & Gidley); combined with the fact that the infraorbital foramen is very much enlarged to allow passage of masseter medialis; the zygomatic plate is narrow, and remaining completely below it, the general arrangement of the forepart of the skull as regards muscle insertion (infraorbital foramen, zygomatic plate), essentially as in Anomaluridae, Ctenodactylidae, Pedetidae and Dipodidae.

Skull normally specialized, with broad frontals, which rarely show much signs of interorbital constriction, a tendency present towards complexity of zygoma (Echimyidae), and lengthening and specialization of paroccipital processes.

Dental formula: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3} = 20$.

Cheekteeth usually flatcrowned, usually hypsodont, often evergrowing, not cuspidate in adult.

A tendency present towards reduction of the digits of the hindfoot (in some forms, Dasyproctidae, *Lagostomus*, hindfoot with three digits only).

The malleus and incus are fused according to Tullberg, though in some cases apparently not completely so.

The tibia and fibula remain distinct, or are not fully fused.

REMARKS.—This group has been recognized as one of the major groups of the order by all authorities. But many forms which appear to me not to belong are currently included in it. The Hystricomorpha or Hystricoid series are always described as with the angular process distorted outwards, as indicated above; if this is a sufficiently important character on which to base superfamily grouping, and it apparently is so (Tullberg divided the whole order into two great groups, Hystricognathi and Sciurognathi, based on its presence or absence), it seems clear that forms which do not agree in mandible structure with typical Hystricoidae must be excluded from that superfamily, no matter what their ancestors may have been. This takes the Caviidae into another branch of the order, as they cannot by the longest stretch of imagination be regarded as with typically Hystricoid mandible formation. The close association of Caviidae with such forms as *Dasyprocta* and *Cuniculus* by many authors, Tullberg among them, has long struck me as extremely unnatural; *Cuniculus* is of course one of the most isolated and aberrantly specialized living rodents, and has not even the feet structure and external specialization of Caviidae and *Dasyprocta*; but the last two named, both clearly parallels in evolution, both highly modified for cursorial life, with digits of hindfoot reduced to three, are yet so clearly totally different when lower jaw structure and dental structure are looked into. Such an association appears as unnatural to me as dumping *Castor* and *Myocastor* into a family together because both swim!

Of the forty-three genera belonging to the group, thirty-six are confined to the neotropical region. One is peculiar to North America; of the remainder, two are African, two (Hystricidae) the Malay Islands, the remaining two (Hystricidae) cover a wide area in the southern palaearctic, the African and the Indo-malayan regions.

This group, together with the Cavioidae, contains all the giants of the order (except *Castor*), and exhibits some extreme types of external specialization. Taking all their characters into consideration, it appears to me that this group is without doubt, broadly speaking, the most highly specialized and progressive branch of the order, particularly such forms as *Hystrix cristata*, though in all cases such species grade down quickly to relatively low primitive allies.

The division of the group into families is not easy. As many as thirteen have been recognized by various authors. It appears to me to be both unnecessary and inconvenient to divide them into as many as this; particularly taking into account that all seem closely allied to each other, and that elsewhere vast groups like the Muridae (with Cricetinae, Microtinae, Gerbillinae, Myospalacinae, etc., etc.), are usually retained as one family. Flower & Lydekker, 1891, Mammals Living and Extinct, recognized (of Hystricoidae as here understood) only five families, the Octodontidae (=Echimyidae of this paper), Hystricidae, Chinchillidae, Dasyproctidae and Dinomyidae. Thomas in 1896 very properly separated the American "Porcupines" from the Hystricidae as a distinct family; and Miller & Gidley, Pocock and others have recognized *Cuniculus* as type of a distinct family. With these two modifications I retain the classification of Flower & Lydekker.

The Echimyidae as here understood contain a large quantity of neotropical rodents and two African genera (*Thryonomys*, *Petromus*); broadly speaking this group contains forms which have not become much modified externally (exceptions: *Myocastor*, *Thryonomys*, *Dactylomyinae*, part), but which seem to have their specialization in the skull characters (lengthened or specialized paroccipital process, some tendency to enlargement of bullae, very general tendency for complex zygoma, etc.); and in dental characters (such as the rootless simple teeth in Octodontinae). Normally the size is relatively small, though *Myocastor* and *Thryonomys* provide exceptions to this. The relationships of the various groups will be discussed below.

Apart from the evergrowing plain laminate cheekteeth, there is little to distinguish the Dinomyidae from them; and certain species of Echimyidae may attain laminate cheekteeth, though this not combined with extreme hypsodonty. But *Dinomys* is evidently rather an isolated specialized type, and is best retained as a family. The Chinchillidae are dentally like *Dinomys*, but cranially with their poorly-ridged mandible, the tendency either to lengthening of paroccipital process or extreme inflation of mastoids and bullae, they stand rather apart not only from *Dinomys* but as a group from all other Hystricoids apparently; the functional digits of the hindfoot are reduced to three. The Erethizontidae are more primitive than the Echimyidae cranially and dentally (as a rule), but very much more highly specialized externally, the feet attaining arboreal specialization not seen elsewhere in the order, and the spiny covering of the body being in a very different class from that of the few spiny members of the Echimyidae, in all but the very lowest. The Hystricidae are held not to be closely related to the Erethizontidae, but rather to Dasyproctidae; once again their lower members are less specialized than in Echimyidae, as regards cranial characters, their higher ones very much more so, with tendency to extreme inflation of nasals without parallel in living rodents. The external covering presents extreme specialization in development of spiny covering, but goes through an interesting series of grades of development, so that the lowest is much less specialized in spiny covering than the higher members. The Dasyproctidae are very similar to the Hystricidae in cranial and dental characters; externally they are very different, and not less specialized in their way, being modified for cursorial life, with three digits only to the hindfoot, and in external form calling to mind a type that primitive ancestral ungulates must have at one time passed through in their evolutionary history. Finally the Cuniculidae in the development of their vast bony cheek-plate present cranial characters very widely different from any other rodent.

Key to the Families of Hystricoidae

Entire zygomatic region abnormally modified by growth of bony cheek-plates. (Cheekteeth strongly hypsodont, the folds of the teeth isolating as islands on crown surface; form heavy; digits not numerically reduced on hindfoot, the claws thick, more or less hoof-like.) Family Cuniculidae

Zygomatic region not abnormal, always without bony cheek-plates.

- Cheekteeth evergrowing, or extremely hypsodont, the pattern one of a series of transverse plates.
  - Mandible with angular process strongly distorted outwards; incisors powerful; form heavy, limbs not lengthened; hindfoot with four well-developed digits; no tendency present for excessive enlargement of bullae and mastoids nor for lengthening of paroccipital process. Family Dinomyidae
  - Mandible with angular process rather weakly distorted outwards; incisors relatively thin or medium; form more slender, limbs to a degree lengthened; hindfoot with three well-developed digits; a marked tendency present either to excessive enlargement of bullae and mastoids, or to lengthening of paroccipital process. Family Chinchillidae
- Cheekteeth when evergrowing or extremely hypsodont never with pattern of a series of transverse plates.
  - Hindfeet excessively specialized for arboreal life, or becoming so; the hallux being replaced by a broad movable pad. (Fur conspicuously spinous, the spines short; bullae rather large, prominent; cheekteeth either with very wide re-entrant folds, or nearly laminate in structure, rooted; no lengthening of paroccipital process; zygoma simple.) Family Erethizontidae

Hindfeet never excessively modified for arboreal life, hallux never replaced by broad movable pad, and never suppressed in arboreal genera.

External form modified for cursorial life, the digits of the hindfoot reduced to three, the claws thick, more or less hooflike. (Cheekteeth semi-rooted, the re-entrant folds isolating as narrow islands on crown surface in adult; fur not developing spines.) Family DASYPROCTIDAE

External form never modified for cursorial life; digits of hindfoot never reduced to three; claws not hoof-like in structure.

Externally showing a progressive series of modification of fur into spiny covering, at extreme development highly specialized (the spines long); bullae relatively small; paroccipital process not specially lengthened nor modified; zygoma simple. (Cheekteeth semi-rooted or rooted, the re-entrant folds isolating as narrow islands on crown surface in adult; a tendency present towards extreme inflation of nasals in progressive species; form heavy, terrestrial.) Family HYSTRICIDAE

Externally without extreme modifications (in one case to a degree specialized for aquatic life); spiny covering of body when present relatively weak (as compared with Hystricidae); bullae relatively large; paroccipital process enlarged, either curving forward under the bullae or lengthened, tending to stand apart from them; zygoma very generally with upwardly directed process on posterior border, or downwardly directed process on posterior border, or both. (Cheekteeth various; sometimes evergrowing, when evergrowing most often approaching or reaching complete simplification of pattern; when with a pattern of islands isolating on crown surface in adult, usually brachyodont.) Family ECHIMYIDAE

These families it will be noticed are based chiefly on the external characters. So many fossils are known belonging to this group that care must be taken if defining the families on cranial and dental characters, as it may be that in many cases fossil forms will prove intermediate between certain groups, or break these characters down. Also the cranial characters of these Hystricoids are, generally speaking, so similar that if not known living, all except *Cuniculus* could readily be referred to one family. The extreme external specializations reached by some members of this group are in my opinion just as important as any cranial or dental character.

Family ECHIMYIDAE

1896. Thomas: Hystricomorpha, part, Family Octodontidae, part (included Ctenodactylidae); subfamilies Echimyinae (included Dactylomyinae), Capromyinae (*Capromys*, *Plagiodontia*, *Myocastor*, *Thryonomys*), Octodontinae (included *Abrocoma*), Ctenodactylinae, part (*Petromus*).
1899. Tullberg: Hystricomorpha, part, Family Echinomyidae; subfamily "Myopotamini" (= Myocastorinae); subfamily Echinomyini (groups, Echinomyes, Echimyinae and Dactylomyinae as here understood); and Octodontes (Octodontinae and Abrocominae as here understood). Family Aulacodidae (= Thryonomyidae). Family Petromyidae.
1918. Miller & Gidley. Superfamily Hystricoidae, part; Family Echimyidae, part (included *Chaetomys*); Subfamily Echimyinae ("Spiny-Rats, Hutias," etc.); subfamily Octodontinae. Family Petromyidae. Family Myocastoridae. Family Thryonomyidae. Family Abrocomidae.
1924. Winge: Family Hystricidae, part; Capromyini (*Capromys*, *Plagiodontia*, *Myocastor*, *Thryonomys*); Octodontini, groups Octodontes (Octodontinae and Abrocominae as here understood), Echinomyes (Dactylomyinae and Echimyinae as here understood); Ctenodactylini, part (*Petromus*).
1928. Weber: Hystricoidea, part. Family Capromyidae (*Capromys*, *Plagiodontia*, *Myocastor*); Family Octodontidae (*Echimys*, *Octodon*, *Ctenomys*); Family Ctenodactylidae, part (*Petromus*); Family Thryonomyidae.

Geographical Distribution.—Neotropical region, from Nicaragua southwards to Patagonia; Cuba and the West Indies; Africa widely distributed south of the Sahara.

Number of Genera.—As here understood the family contains twenty-eight genera, one of which, *Procapromys*, has not been examined and is not represented in London.

Characters.—Zygomasseteric structure typically Hystricoid in formation. Cheekteeth when evergrowing never a series of transverse plates (compare Chinchillidae, Dinomyidae); feet never abnormally modified for arboreal life (compare Erethizontidae); zygomatic region without bony cheek-plate (compare Cuniculidae); external form never modified for cursorial life, digits of hindfoot more than three (always five except four in *Thryonomys*) (compare Dasyproctidae); bullae prominent, and paroccipital process lengthened, and zygoma usually more angular, also tail never with specialized quills or bristles in spiny genera, and spiny covering when present usually not highly developed (compare Hystricidae).

As thus defined the group includes the great central mass of genera of Hystricoid rodents which have not become abnormally specialized in any external particulars. The cheekteeth may be evergrowing (Abrocominae, Octodontinae, Plagiodontinae, Capromyinae), extremely hypsodont (Myocastorinae, Petromyinae), or moderately so but rooted (the remainder). In the Octodontinae, the structure approaches complete simplification of pattern; in the Abrocominae the upper cheekteeth are simplified, but the lower series remains complex; certain simplification has taken place in Plagiodontinae, which appears unique as regards dental characters, and in Petromyinae. These subfamilies have one external fold only in the upper cheekteeth; all other subfamilies have more than one, typically three. The skull is normally remarkable for the paroccipital processes, which may be extremely lengthened, as in Myocastorinae, moderately so and standing apart from the bullae (Caprominyae, Plagiodontinae, Thryonomyinae), or curved forwards to a greater or lesser degree under the bullae (Echimyinae, Petromyinae, Abrocominae, Octodontinae). This fact has led some authors to form two families, Capromyidae and Octodontidae, but in the Dactylomyinae, as proved by British Museum material, either condition may exist; *Kannabateomys* and *Thrinacodus*, and some specimens of *Dactylomys* agree with the Echimyinae, but some large skulls of *Dactylomys* are quite indistinguishable in paroccipital structure from Capromyinae, in which group there is also some variation apparently.

The zygoma is usually rather broad, and frequently of a complex type, with a downwardly directed process on posterior lower border, and sometimes an upwardly directed one present above also.

The bullae may be much inflated, as in Abrocominae, Octodontinae, Petromyinae; they are relatively large as a general rule.

The external form varies; in Myocastorinae, which contain relatively very large forms, it is modified for aquatic life, with enlarged hindfeet, most of the digits of which are webbed; this group has also bullae, which recall the type found in Castoridae, though less specialized than in that family. Elsewhere the genera are not aquatic. Some genera of Octodontinae are remarkable as being the only Hystricoids which have taken to a subfossorial life (*Ctenomys*, *Spalacopus*, *Aconaemys*); *Spalacopus* must be about the smallest living Hystricoid genus. A tendency to develop spiny covering, most pronounced in *Mesomys*, *Lonchothrix* and *Hoplomys*, is present in some of the Echimyinae; the spiny covering is, broadly speaking, very rudimentary compared with Hystricidae (*Trichys* perhaps excepted), and even Erethizontidae.

The Dactylomyinae present a curious feature in that except in *Thrinacodus* the third and fourth digits of fore- and hindfeet are much elongated; these animals are said to be arboreal in habit. In all the genera of the family four functional digits in manus and five functional digits in pes are present excepting Thryonomyinae, in which the manus has three main digits only, D.5 being excessively shortened, though bearing a thick claw, and the hallux is entirely suppressed; this group possesses an abnormally massive and heavily ridged skull, perhaps more so than in any other living rodent, and extremely thickened three-grooved upper incisors. The form is heavy, and of terrestrial or slightly fossorial type.

I provisionally divide the group into nine subfamilies, most of which have at some time or other been regarded as distinct families. But if a vast group like the Muridae are kept together as one family, and the Hystricoid branch is divided up into about seventeen families, the classification of the Order does not appear very consistent. The simple-toothed Octodontinae are connected with the main branch by such forms as *Abrocoma* and *Plagiodontia*; the African genera appear to possess no essential characters which will keep them apart as families distinct. *Petromus* has of late been associated with the Ctenodactylidae by some authors, but the typical Hystricoid mandible of *Petromus* differs very widely from that of Ctenodactylidae, which are fully discussed elsewhere and which are here considered not related to the Hystricoid group. *Thryonomys* is undoubtedly a very distinct type, but the only character which seems valid to keep it apart as a family is the formation of the shoulder-blade, which, according to Tullberg, differs considerably from that of other Echimyidae; but unfortunately this character cannot be examined throughout the genera at the British Museum, *Petromus*, for one (one of the most important genera), being not represented so far as this character is concerned; so that until the skeleton of all the genera here included can be examined it seems more reasonable not to separate any group on this structure alone. The digits of *Thryonomys* are reduced, but this is an acquired character.

Myocastor, which is sometimes made the type of a family, is undoubtedly a highly specialized form, but aquatic specialization alone is not sufficient to base family groups on unless accompanied by some definite cranial or dental characters (compare, for instance, other families, many of which have aquatic offshoots beside normal generalized types, as Hydromyinae, Cricetinae, etc.); and the structure of the paroccipital process, though highly specialized in *Myocastor*, is too variable elsewhere in the group.

Miller & Gidley divided the Hystricoid lateralis series (=Hystricoidae as here understood) into two groups based on the lachrymal canal, which is stated to be closed in one branch, but open in the other branch on the side of the rostrum. *Abrocoma* as thus defined comes in a different group from the remainder of those here. But this character seems not too constant elsewhere, for instance both conditions are to be found in the Caviidae of Miller & Gidley, and I do not attach too great importance to this character. The family as here understood in fact is the family Octodontidae of Flower & Lydekker, and earlier authors, except that of course the Ctenodactylidae are removed.

The subfamilies must be regarded as provisional; though easily recognizable in living genera, it may be that among the large number of neotropical Hystricoid fossil rodents some forms would be found which are intermediate between some of the groups in the characters here noted.

Key to the Subfamilies of Echimyidae

Cheekteeth becoming strongly simplified, the outer side of the upper series with not more than one re-entrant fold.

The lower cheekteeth prismatic and angular in appearance; the upper series eight-shaped. Part of lachrymal canal open on side of rostrum. (Cheekteeth evergrowing; bullae much inflated; zygoma more or less simple; form terrestrial; digits of hindfoot five; skull not heavily ridged for muscle attachment.)

Subfamily Abrocominae
(*Abrocoma*)

The lower cheekteeth not essentially different in pattern from the upper series; no part of lachrymal canal open on side of rostrum.

Cheekteeth rooted, the pattern ultimately wearing out; inner side of upper and outer side of lower teeth elevated. (Bullae much inflated, the paroccipital process joining them; digits of hindfoot five; zygoma more or less simple; skull not heavily ridged for muscle attachment; form terrestrial, tail fully haired.) Subfamily PETROMYINAE (*Petromus*)

Cheekteeth evergrowing, the pattern not or scarcely changing during life. Inner side of upper and outer side of lower teeth not elevated.

Folds of cheekteeth very deep and long, set obliquely; each upper tooth with a well-marked outwardly pointing projection on external side. (Paroccipital process lengthened, standing apart from bullae, which are not extremely inflated; zygoma simple; form generalized, tail naked; skull not heavily ridged for muscle attachment.)
Subfamily PLAGIODONTINAE (*Plagiodontia*)

Folds of cheekteeth not specially deep and long, set less obliquely, or not so. Upper cheekteeth either eight-shaped, or "kidney-shaped." (Bullae normally much inflated, the paroccipital process curved forwards under them to a greater or lesser degree, and joining them; zygoma complex, always with an upwardly pointing process on posterior border; skull normally not heavily ridged for muscle attachment (sagittal crest if present weak); external form terrestrial, or modified for subfossorial life; digits of hindfoot five.)
Subfamily OCTODONTINAE (*Octomys*, *Octodontomys*, *Octodon*, *Aconaemys*; *Spalacopus*; *Ctenomys*)

Cheekteeth less simplified, the outer side of the upper molars with at least two, typically three, re-entrant folds.

Externally considerably modified for aquatic life (bodily size largest of family); paroccipital process much elongated; cheekteeth extremely hypsodont, but not evergrowing, with well-marked re-entrant folds which are long retained, the teeth decreasing in size markedly from M.3 forwards; skull considerably ridged for muscle attachment (palate constricted anteriorly; digits of hindfoot five; zygoma complex).
Subfamily MYOCASTORINAE (*Myocastor*)

External form never modified for aquatic life; paroccipital process less or not elongated; cheekteeth less or not decreasing in size from M.3 forwards.

Skull massive, abnormally heavily ridged for muscle attachment; incisors thick, the upper ones heavily three-grooved; forefoot with three functional digits (D.5 clawed but extremely shortened); hindfoot with four digits only; cheekteeth rooted; external form heavy, terrestrial-fossorial (bullae not much inflated, paroccipital process lengthened to a degree, and standing apart from bullae; zygoma much broadened, jugal nearly reaching lachrymal). (Shoulder-blade differing from American genera (Tullberg).) Subfamily THRYONOMYINAE (*Thryonomys*)

Skull much less heavily ridged for muscle attachment; incisors not three-grooved (plain except in *Carterodon*); forefoot always with four and hindfoot always with five functional digits; jugal usually complex, with upwardly or downwardly projecting process present on posterior border, and normally not approaching lachrymal.

Cheekteeth extremely broadened, the re-entrant folds deep and persistent, the teeth rooted; palate with a tendency towards anterior constriction; paroccipital processes tending to stand apart from bullae in larger species, or curved forwards under them in smaller forms; tendency present towards considerable elongation of middle digits of forefoot and hindfoot; (fur not spiny). Subfamily DACTYLOMYINAE (*Thrinacodus*, *Dactylomys*, *Kannabateomys*)

Cheekteeth not specially broadened; no tendency present towards any lengthening of the digits.

Cheekteeth evergrowing, the folds filled up with cement, the teeth flatcrowned; fur not developing spines; paroccipital processes usually standing apart from the bullae (not always); palate slightly constricted anteriorly; form usually not rat-like (modified for arboreal or terrestrial life). Subfamily CAPROMYINAE (*Procapromys* (not seen), *Capromys*, *Geocapromys*)

Cheekteeth rooted, the folds normally isolating as narrow islands in adult, or rarely (*Echimys* and allies) more persistent, the dental pattern more complex, or in extreme development becoming a series of transverse plates. External form usually rat-like; modified for arboreal, terrestrial, or slightly for fossorial life; a tendency present for the fur to be spiny; paroccipital processes curved forwards under the bullae, which are large but not abnormally so, excepting *Clyomys*; palate not constricted anteriorly.

Subfamily ECHIMYINAE

(*Echimys*, *Isothrix*, *Diplomys*; *Proechimys*, *Hoplomys*, *Euryzygomatomys*, *Clyomys*, *Carterodon*, *Cercomys*, *Mesomys*, *Lonchothrix*)

Subfamily ECHIMYINAE

GEOGRAPHICAL DISTRIBUTION.—Neotropical region from Nicaragua south to Paraguay and South Brazil.

NUMBER OF GENERA.—Eleven.

CHARACTERS.—Cheekteeth rooted, not specially broadened, flatcrowned with inner and outer re-entrant folds which become isolated on crown surface with wear; or with a heavier dentition, more complex, and tending to become a series of transverse plates (*Echimys*, *Isothrix*, *Diplomys*). Bullae prominent; paroccipital processes curved forward under the bullae. Skull with broad frontals, little or not constricted. Externally more or less rat-like; a tendency present for development of spiny covering, which is in rare cases strongly developed.

Compared with the Capromyinae, the cheekteeth are brachyodont and rooted, and of a less simple general appearance, the pattern changing during the animal's life; compared with the Dactylomyinae, there is no broadening of the cheekteeth, which never show traces of the almost prismatic pattern peculiar to Dactylomyinae; and no digit elongation takes place; compared with the Myocastorinae, cheekteeth more brachyodont, and pattern not long maintained; also externally not modified for aquatic life; skull much less heavily ridged, size smaller, form much less heavy, and paroccipital processes not lengthened; compared with Thryonomyinae, skull much less heavily ridged; forefoot with four and hindfoot with five clearly developed digits.

In the remainder of the subfamilies the cheekteeth are more simplified.

There seems in this group a tendency for the tail to be lost during life, paralleled by the Old World porcupine *Trichys*; in the case of *Trichys* it is suggested that the males may bite off the tail of the female when courting; but whether this might apply to this group is not known.

The subfamily contains two sections, in one of which the teeth are much heavier, more complex, the folds usually not isolating as islands; in extreme development the teeth become a series of transverse plates. The genera contained in this section have the feet modified for arboreal life.

ECHIMYS is the main genus, with five or more rather well-defined specific groups, and a wide range in South America; a species, *E. armatus*, is said to occur in the Lesser Antilles (Martinique). The fur may be strongly spinous, or weakly so; ISOTHRIX appears to be indistinguishable cranially or dentally from *Echimys*, but has soft fur, and a bushy tail; DIPLOMYS is a (chiefly) Central American genus in which both lower and upper molars are a series of transverse plates, though in a section of *Echimys* the upper molars are already so, so that *Diplomys* is not widely separated from *Echimys*.

The simpler-toothed branch of the subfamily, in which the dentition is lighter, and the folds isolate as islands in the adult, contains eight genera; PROECHIMYS is much the most widely distributed, having a range coincident with with that of the subfamily, and very many named forms; this genus has spiny fur in adult, though not highly developed, and is terrestrial; HOPLOMYS stands near *Proechimys*, but the spiny covering is very much more developed, and the cheekteeth are more complex; the genus ranges from Nicaragua to Ecuador. EURYZYGOMATOMYS is like *Proechimys*, but is more modified for fossorial life (though not highly so); the tail is strongly reduced; the cheekteeth are more simplified than in normal *Proechimys*, and the skull is less ridged posteriorly, but the zygoma is greatly broadened. CLYOMYS is near *Euryzygomatomys*, but alone in the group has abnormally inflated bullae. CARTERODON is not unlike the last two named in cranial characters, but has deeply grooved incisors (unique in the subfamily), and softer fur. These three genera are rare and have a restricted range in Brazil, the last two being very little known. CERCOMYS agrees with the last named in essential cranial and dental characters, but is not in any way modified for fossorial life; the tail is long and fully haired, the fur soft. MESOMYS is an arboreal type ranging across the tropical portions of northern South America; the fur is densely spiny, the teeth are of the *Proechimys* type. Finally LONCHOTHRIX, rare and little known, is much like *Mesomys* externally except for the heavily tufted tail, but dentally differs from all in the considerable width of the re-entrant folds of the molars.

KEY TO THE GENERA OF ECHIMYINAE

Cheekteeth lighter, with narrow folds, which typically become isolated as islands in adult; the teeth never tending to become a series of transverse plates.

- The hindfeet broadened, noticeably modified for arboreal life. (Fur densely spiny; D.5 hindfoot relatively long; tail long, usually longer than head and body.)
  - Cheekteeth with strong wide folds; tail conspicuously tufted terminally. LONCHOTHRIX
  - Cheekteeth with weaker narrower folds; tail not or scarcely tufted terminally. MESOMYS
- The hindfeet narrow, long, terrestrial in type. (D.5 hindfoot relatively short; tail in general shorter than head and body.)
  - Jugal thickened anteriorly; zygomatic region noticeably broadened, Tail strongly reduced.
    - Upper incisors grooved; fur soft; foreclaws less enlarged. CARTERODON
    - Upper incisors plain; fur bristly; foreclaws to a greater or lesser degree enlarged.

Bullae abnormally inflated. CLYOMYS

Bullae moderate. EURYZYGOMATOMYS

Jugal not or rarely thickened anteriorly, zygomatic region narrower. Tail not strongly reduced. (Upper incisors plain; bullae never abnormally inflated.)

Fur soft; tail well haired; palatal foramina broadened; folds of cheekteeth tend less to isolate. CERCOMYS

Fur spiny; tail poorly haired; palatal foramina not noticeably broadened; folds of cheekteeth tend to isolate to a greater degree.

Modification of hair into spines at highest development; cheekteeth more complex, outer side of upper cheekteeth with clear traces of four folds. HOPLOMYS

Modification of hair into spines much less developed; cheekteeth relatively simpler, outer side of upper cheekteeth with clear trace of three folds or less. PROECHIMYS

Cheekteeth heavier, with more persistent folds, the general effect complex; the folds isolating late, or not isolating; or cheekteeth tending to become a series of transverse plates. (Feet adapted for arboreal life.)

The lower molars a series of transverse plates, as well as the upper series. DIPLOMYS

The lower molars not becoming specialized into a series of transverse plates; (the upper cheekteeth may or may not be so).

Fur bristly or spiny; tail not bushy. ECHIMYS

Fur soft; tail bushy. ISOTHRIX

Genus 1. ECHIMYS, Cuvier

1809. ECHIMYS, Cuvier, Bull. Soc. Philom. XXIV, p. 394.
1811. LONCHERES, Illiger, Prodr. Syst. Mamm. et Avium, p. 90. (*Myoxus chrysurus*, Zimmermann).
1837. NELOMYS, Cuvier, Ann. Sci. Nat. Paris, 2, VIII, p. 370. (*Nelomys blainvillei*, Cuvier).
1841. PHYLLOMYS, Lund, Afh. K. Danske Vid. Selsk, 4, VIII, p. 243. (*Phyllomys braziliensis*, Waterhouse.)
1840. ECHINOMYS, Wagner, Abh. Bayer. Akad. 3, p. 203. (Emendation of *Echimys*.)

TYPE SPECIES.—*Myoxus chrysurus*, Zimmermann.

RANGE.—Neotropical; Colombia, Ecuador, Peru, Southern Brazil, Eastern Brazil, Amazon region, the Guianas, Venezuela. *E. armatus* is recorded from Martinique, Lesser Antilles.

NUMBER OF FORMS.—Twenty-two are named.

CHARACTERS.—Skull with broad frontals, and as a rule well marked supraorbital ridges; in larger species the parietals are well ridged. Infraorbital foramen with no canal for transmission of nerve. Bullae prominent, the paroccipitals curved forward under them. Palate varying in width in different species, but tends to be narrow. Palatal foramina normally short. Zygoma relatively broad, the jugal usually with process both above and below on posterior border. Mandible well twisted and ridged.

Cheekteeth complex; apparently usually there are two outer and two inner folds in the upper series, and there is a strong tendency for these teeth to be divided into a series of transverse plates. They are completely so in some Southern Brazilian types as *medius*, *thomasi*, *lamarum*, *dasythrix*, etc., for which Thomas revived the generic name *Nelomys*. Tate synonymizes this with *Echimys*; some of the northern species come so near this formation that I do not think the name can be used. The lower cheekteeth are characterized by one outer and two inner folds, except the premolar, a complex tooth with three or sometimes four inner folds; the folds of the lower teeth are usually rather well open.

Externally, the feet are broad and modified for arboreal life, with D.5 relatively long, and claws prominent; the fur is always spiny, though the spines vary in their development in different groups, being in some very strong, in others relatively weak. The length of the tail is little shorter than head and body to longer than this measurement; it may be well haired or nearly naked.

Not very much material of this interesting genus is available for examination, but the forms seen seem to divide sharply and easily into five main groups. These groups should be regarded, however, as provisional, as it may be with more material that some of the characters would not be constant.

The *blainvillei* group as here understood is equivalent to part of the genus *Nelomys* of Thomas; containing species in which the upper molars are apparently completely specialized into transverse plates; the tail is longer than the head and body, and is more or less completely haired; *blainvillei* has the spines strongly developed in the one skin seen; *medius* has the spines weakly developed; *thomasi* is like *medius* but much larger (hindfoot 45 as against about 38 or less in allies). *E. braziliensis* is listed as "hairy-tailed" by Tate, and is provisionally included here, as it was based on the genus "*Phyllomys*" which is considered by Thomas synonymous with *Nelomys*.

The *dasythrix* group contains the rest of the genus *Nelomys* of Thomas; it is closely allied to the last, and from the same area (Southern Brazil), but the tail appears to be not longer than the head and body, and is naked. The spines are strong. It may be that *blainvillei* might be considered an intermediate form between these two groups.

The *armatus* groups contains forms in which the upper teeth are normally not separated into transverse plates; the tail is naked, or in *punctatus* rather intermediate between the "hairy-tailed" and "naked-tailed" types. The spines are strong, well developed. *E. carrikeri*, not seen, appears to stand near *punctatus* from the description; *longirostris* is stated to be near *armatus*, as is *obscura*, according to Tate. I can see no specific difference between *armatus* and *occasius*, and treat the latter as a subspecies. *E. flavidus* is described as an insular form of *punctatus*.

The *chrysurus* group contains two striking forms; the tail is longer than the head and body, coloured white from about half its length or more to the end; a white headspot present; spiny covering strong to extreme (at maximum for the genus). The tail is well haired; the dentition agrees with *armatus*.

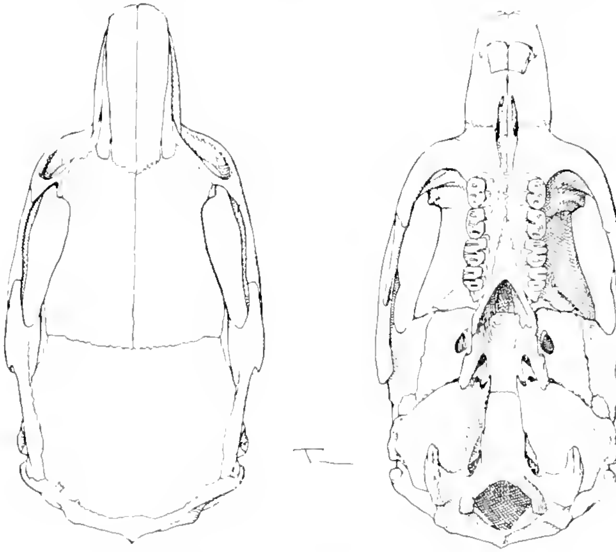


Fig. 8. Echimys armatus armatus, Geoffroy.
B.M. No. 3.4.5.40, ♀; × $1\frac{1}{2}$.

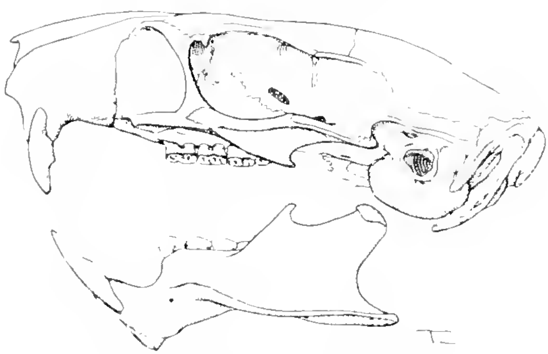
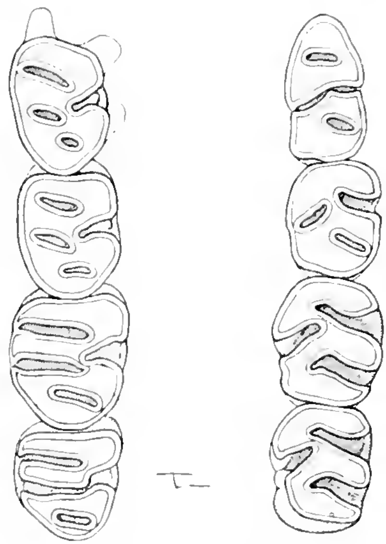


Fig. 9. Echimys armatus armatus, Geoffroy.
B.M. No. 3.4.5.40, ♀; × $1\frac{1}{2}$.

E. saturnus, a giant species (hindfoot 51), was thought by Thomas to be near the above group; it is evidently known by one skin only. I am inclined for now to refer it to the *grandis* group (below), on account of the much less development of the spiny covering, which is relatively weak. There is no white headspot. The tail is only white at the extreme tip. With a larger series it may be that *saturnus* could be shown to belong to the *chrysurus* group, but with the limited material at present at hand there is no doubt that it is very different from that group. (The tail is long and fully haired.)

The *grandis* group contains western forms with tail sub-equal to or shorter than head and body, not white terminally, and well haired. Spiny covering weak or weak-medium. *E. grandis* is a very large form (hindfoot 53); dentition usually as in *armatus* group.



a *b*

FIG. 10. ECHIMYS ARMATUS ARMATUS, Geoffroy.
Cheekteeth: *a*, upper; *b*, lower. B.M. No. 3.4.5.40, ♀; × 7.

The spines may vary through the animal's life, and be an age character throughout this family, within closely related species; but I do not think there is any question of such a difference between groups listed here as "strong-spined" or "weak-spined." In adult *grandis*, for instance, the spines are very weak; in adult *chrysurus* abnormally strong.

Other species not represented at the British Museum I am unable to allocate to groups.

Forms seen; *armatus*, *blainvillei*, *braziliensis*, *chrysurus*, *dasythrix*, "*guianae*," *grandis*, *lamarum*, *medius*, *occasius*, *paleacea*, *punctatus*, *rhipidurus*, *saturnus*, *thomasi*.

LIST OF NAMED FORMS

(The references and type localities for all members of the family Echimyidae have been collected for me by Mr. G. W. C. Holt.)

Not seen and not allocated to groups

1. ECHIMYS SEMIVILLOSUS, Geoffroy

1838. Revue Zool. 1, p. 101.
New Grenada, Colombia.

2. ECHIMYS MACRURA, Wagner

1842. Archiv. für. Naturg. 1, p. 360.
Borba, Rio Madeira, Brazil.

3. ECHIMYS UNICOLOR, Wagner

1842. Archiv. für. Naturg. 1, p. 361.
Brazil.

4. ECHIMYS NIGRISPINA, Wagner

1842. Archiv. für. Naturg. 1, p. 361.
Ypanema, São Paulo, Brazil.

dasythrix Group

5. ECHIMYS DASYTHRIX, Hensel

1872. Abh. Akad. Berlin, p. 49.
Rio Grande do Sul, Brazil.

6. ECHIMYS LAMARUM, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVIII, p. 297.
Lamarão, Bahia, Brazil.

blainvillei Group

7. ECHIMYS BLAINVILLEI, Cuvier

1837. Ann. Sci. Nat. Paris, 2, VIII, p. 371.
Small Island near Bahia, Brazil.

8. ECHIMYS MEDIUS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 239.
Roca Nova, Parana, Brazil.

9. ECHIMYS THOMASI, Ihering

1897. Revista Paulista, ii, p. 171.
Island of São Sebastiao, near Bahia, Brazil.

10. ECHIMYS BRAZILIENSIS, Waterhouse

1848. Nat. Hist. Mamm. ii, p. 330.
Lagoa Santa, Minas Geraes, Brazil.

armatus Group

11. ECHIMYS ARMATUS ARMATUS, Geoffroy

1838. Revue Zoologique, 1, p. 101.
Cayenne, French Guiana.
Synonym: *guianae*, Thomas, 1888, Ann. Mag. Nat. Hist. 6, II, p. 326.
British Guiana.
castaneus, Allen & Chapman, 1893, Bull. Amer. Mus. N. H. V, p. 222. Princetown, Trinidad.

12. ECHIMYS ARMATUS OCCASIUS, Thomas

1921. Ann. Mag. Nat. Hist. 9, VII, p. 450.
Gualea, Mt. Pichincha, Ecuador. (This locality is queried by Tate, 1935.)

13. ECHIMYS LONGIROSTRIS, Anthony

1921. Amer. Mus. Nov. no. 19, p. 5.
Kartabo, British Guiana.

14. ECHIMYS OBSCURA, Wagner

1840. Abh. Akad. Wiss. Münch. iii, p. 196.
Brazil.

15. ECHIMYS PUNCTATUS, Thomas

1899. Ann. Mag. Nat. Hist. 7, III, p. 153.
Caicara, Rio Orinoco, Venezuela.

16. ECHIMYS FLAVIDUS, Hollister

1914. Proc. Biol. Soc. Washington, XXVII, p. 143.
El Valle, Margarita Island, Venezuela.

17. ECHIMYS CARRIKERI Allen

1911. Bull. Amer. Mus. Nat. Hist. XXX, p. 251.
San Esteban, near Venezuela.

chrysurus Group

18. ECHIMYS CHRYSURUS, Zimmermann

1780. Geogr. Gesch. ii, p. 352.
Surinam (Dutch Guiana).
Synonym: *cristatus*, Desmarest, 1817, Nouv. Dict. d'Hist. Nat. 2nd ed., X, p. 55.

19. ECHIMYS PALEACEA, Illiger

1811. Prodr. Syst. Mamm. et Avium, nom. nud. 1820, Lichtenstein, Abh. Ak. Wis. Berlin, p. 187.
Province of Pará, Brazil.

grandis Group

(*saturnus* section)

20. ECHIMYS SATURNUS, Thomas

1928. Ann. Mag. Nat. Hist. 10, II, p. 409.
Ecuador, Rio Napo, Prov. del Oriente.

(typical section)

21. ECHIMYS GRANDIS, Wagner

1845. Archiv. für Naturg. 1, p. 146.
Managueri, Upper Amazon, Brazil.

22. ECHIMYS RHIPIDURUS, Thomas

1928. Ann. Mag. Nat. Hist. 10, II, p. 291.
Pebas, Rio Marañon, Peru.

Genus 2. ISOTHRIX, Wagner

1845. ISOTHRIX, Wagner, Archiv. für. Naturg. 1, p. 145.
1852. LASIUROMYS, Deville, Rev. Mag. Zool. 2, IV, p. 353. (*Lasiuromys villosus*, Deville.)

TYPE SPECIES.—*Isothrix bistriatus*, Wagner.

RANGE.—Venezuela, Brazil and Peru. (South evidently to Matto Grosso.)

NUMBER OF FORMS.—Eight are named.

Characters.—Like *Echimys* cranially and dentally; (parietals ridged; upper cheekteeth not tending to become separated into transverse plates).

Fur soft, showing no tendency to develop bristles or spines. Tail long, bushy, almost Sciurine. Feet of arboreal type.

Remarks.—In a group of this description where considerable specialization is sometimes present towards modification of fur into spines, I think the difference in the coat between *Echimys* and *Isothrix* is sufficient for their generic separation.

Forms seen: *molliae*, *negrensis*, *orinoci*, *pagurus*, *pictus*, *villosus*.

Two groups may be recognized among the material examined, *pictus*, with its highly specialized black (or dark brown) and white colour pattern, and the rest which are much more sober in coloration.

Mr. Tate stated that *pictus* is an *Echimys*; but it definitely belongs here according to our specimens; some months ago when he was in London we looked at the species together, and he was in agreement with me on this point.

List of Named Forms

pictus Group

1. ISOTHRIX PICTUS, Pictet

1841. Notice An. Nouv. Mus. Genève, p. 29.
Bahia, Brazil.

bistriatus Group

2. ISOTHRIX BISTRIATUS BISTRIATUS, Wagner

1845. Arch. Naturg. 1, p. 146.
Rio Guapore, Brazil.

3. ISOTHRIX BISTRIATUS ORINOCI, Thomas

1899. Ann. Mag. Nat. Hist. 7, IV, p. 382.
Maipures, Upper Orinoco, Venezuela.

4. ISOTHRIX BISTRIATUS NEGRENSIS, Thomas

1920. Ann. Mag. Nat. Hist. 9, VI, p. 277.
Acajutuba, Lower Rio Negro, Brazil.

5. ISOTHRIX PACHYURA, Wagner

1845. Archiv. für Naturg. 1, p. 146.
Cuyaba, Matto Grosso, Brazil.
Synonym: *crassicaudus*, Wagner, Abh. Akad. Münch., p. 291, 1847.
Brazil.

6. ISOTHRIX PAGURUS, Wagner

1845. Archiv. für Naturg. 1, p. 146.
Borba, Rio Madeira, Brazil.

7. ISOTHRIX VILLOSUS VILLOSUS, Deville

1852. Rev. Mag. Zool. 2, IV, p. 560.
Mission de Sarayacu, Rio Urubamba, Peru.

8. ISOTHRIX VILLOSUS MOLLIAE, Thomas

1924. Ann. Mag. Nat. Hist. 9, XIII, p. 534.
Tushemo, Masisea, Rio Ucayali, Peru.

The "*hirsutus*" of Burmeister which has been confused with this genus is a *Sigmodon* (Cricetinae).

Genus 3. DIPLOMYS, Thomas

1916. Diplomys, Thomas, Ann. Mag. Nat. Hist. 8, XVIII, p. 240.

Type Species.—*Loncheres caniceps*, Günther.

Range.—Panama and Colombia.

Number of Forms.—Four.

Characters.—In general like *Echimys*, but the lower cheekteeth in a series of transverse plates as well as the upper teeth. There are four laminae in each of the upper teeth; in the lower series there are four in P.4, three in the molars.

Externally, the fur is harsh but not spiny; tail moderately haired, but with the scales visible; feet of arboreal type.

Remarks.—The genus is not well represented in London; I assume the dental characters to be constant.

Forms seen: *caniceps, labilis.*

List of Named Forms

1. DIPLOMYS CANICEPS, Günther

1876. Proc. Zool. Soc. London, p. 745.
Medellin, Colombia.

2. DIPLOMYS LABILIS, Bangs

1901. Amer. Naturalist, XXXV, p. 638.
San Miguel Island, Panama.

3. DIPLOMYS DARLINGI, Goldman

1912. Smiths. Misc. Coll. LX, no. 2, p. 12.
Marraganti, Rio Tuyra, East Panama.

4. DIPLOMYS RUFODORSALIS, Allen

1899. Bull. Amer. Mus. Nat. Hist. XII, p. 197.
Onaca, Santa Marta district, Colombia.

Genus 4. PROECHIMYS, Allen

1899. Proechimys, Allen, Bull. Amer. Mus. Nat. Hist., XII, p. 257.
1921. Trinomys, Thomas, Ann. Mag. Nat. Hist. 9, VIII, p. 140. *Proechimys albispinus*, Geoffroy. Valid as a subgenus.

Type Species.—*Echimys trinitatis*, Allen & Chapman.

Range.—From Nicaragua, Costa Rica and Panama to Colombia, Ecuador, Peru, Bolivia, Southern Brazil, East Brazil, the Amazon region, the Guianas, Venezuela, Trinidad.

Number of Forms.—Approximately fifty are named.

Characters.—Rostrum relatively narrow and pointed; incisors typically opisthodont; supraorbital ridges present and usually well developed; parietals usually ridged. Canal for transmission of nerve in infraorbital foramen present, weak or absent, never strongly developed. Palatal foramina well open, but not excessive; palate relatively broader as a rule than in *Echimys*; toothrow rather short, far forward in skull, the pterygoid fossae long. Jugal normally thin, but ridged posteriorly and tending to have a weak process on posterior lower border; thickened only, so far as seen, in *iheringi* (considerably, but not as extremely as in *Euryzygomatomys*), to a degree in the subgenus *Trinomys*, and to a degree in *dimidiatus*. Bullae largish; paroccipital

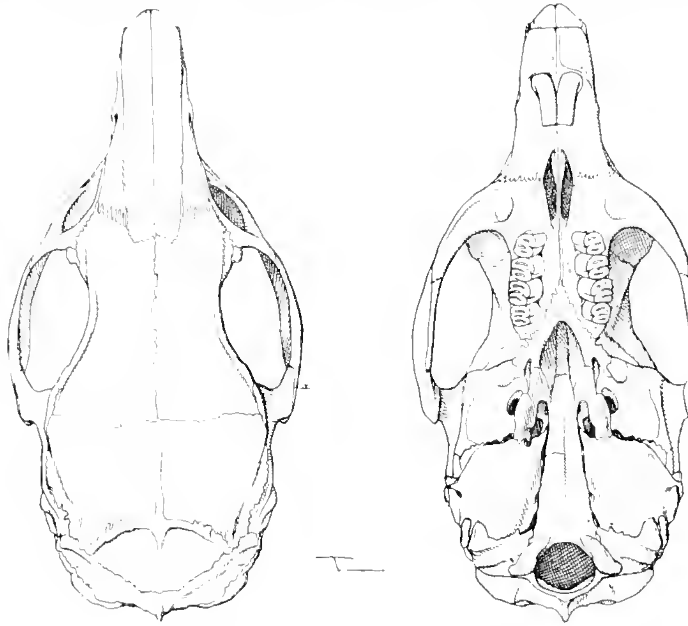


FIG. 11. PROECHIMYS CAYENNENSIS, Desmarest.
B.M. No. 3.4.5.44, ♀; × 1½.

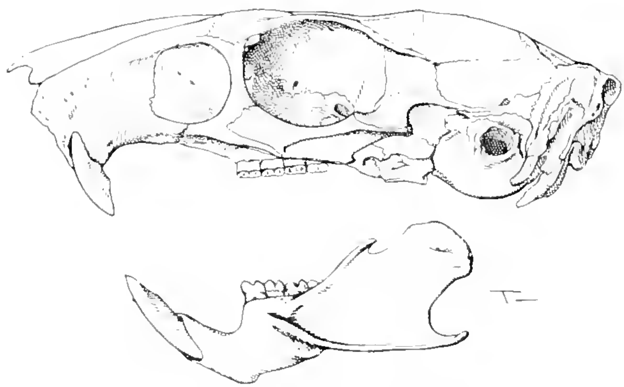
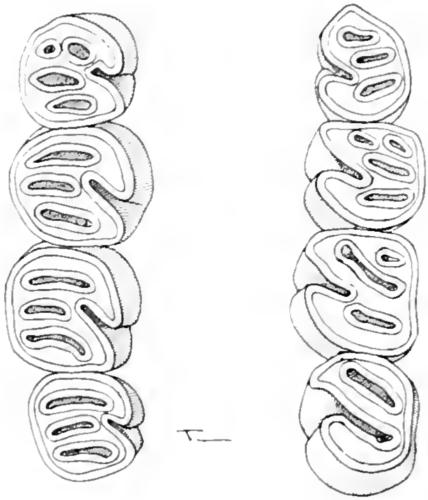


FIG. 12. PROECHIMYS CAYENNENSIS, Desmarest.
B.M. No. 3.4.5.44, ♀; × 1½.

processes curved forwards under them, as is usual in the subfamily. Mandible strongly ridged, the angular process clearly lifted outwards, its lower border broad; coronoid process low; angular portion slightly drawn backwards at lower border.

Upper cheekteeth normally with three outer and one inner folds each, these soon becoming isolated as islands. A few species, which will be discussed below, vary slightly in pattern. Lower cheekteeth normally reverse the pattern of the



a. b.

FIG. 13. PROECHIMYS CAYENNENSIS, Desmarest.
Cheekteeth: *a*, upper; *b*, lower. B.M. No. 3.4.5.44, ♀; × 8.

upper series. P.4 sometimes with extra island anteriorly. Spines always present in adult, but not highly developed, at any rate as compared with such genera as *Mesomys* and *Hoplomys*. Tail rather shorter than head and body, naked or moderately haired. Hindfeet long and narrow, the outer digits shorter than the central three, hallux shorter than D.5; forefoot not abnormal, pollex rudimentary.

TRINOMYS was erected as a subgenus for the species *albispinus* and *setosus*, on the ground mainly that the folds of the cheekteeth are in these species reduced from three (external) to two. (One skull seen in which the teeth are cutting has a normal P.4, however). The cheekteeth may vary slightly elsewhere in the genus; *P. vacillator* has it appears M.2 and M.3 as *Trinomys*; the type of *P. dimidiatus* appears to be going the same way, though rather worn. One skull seen of *P. canicollis* seems also to be transitionary towards the *Trinomys* type. It should also be noted that *P. iheringi* seems not quite normal dentally; the teeth in this case appearing a little more complex than usual.

Other characters of *Trinomys* are cranial, "shorter muzzle, less developed supraorbital ridges, and orthodont or slightly pro-odont incisors." Also the spiny covering seems to be much more developed than in the other species.

Forms seen: *albispinus*, *bolivianus*, *brevicauda*, *calidior*, *cayennensis*, *canicollis*, *centralis*, *cherriei*, *chiriquinus*, *chrysaeolus*, *colombianus*, *decumanus*, *dimidiatus*, *goeldii*, *gorgonae*, *guiarae*, *gularis*, *hendeei*, *hilda*, *iheringi*, *longicaudatus*, *mincae*, *oris*, *pachita*, *panamensis*, *rattinus*, *roberti*, *rosa*, *securus*, *semispinosus*, *setosus*, *sertonius*, *simonsi*, *trinitatis*, *urichi*, *vacillator*, *warreni*.

Of the fifty named forms of this genus, twelve have not been seen.

Most of the remainder are standing at the present day as "distinct species." A very large number, however, seem to conform to one essential type, so that neither in external nor cranial characters, so far as I can see, are they more than racially distinct.

P. cayennensis, Desmarest, 1817, is the oldest name for this type of Spiny-Rat. It is true that Tomes has pointed out characters by which his *semispinosus* may be distinguished from *cayenennsis*; but these seem to me to be relatively unimportant subspecific characters. All forms occurring north of Panama are at present regarded as races of *semispinosus*.

The type and a large or moderate series of skins have been examined in *chrysaeolus*, *decumanus*, *rosa*, *warreni*, *cherriei*, *gularis*, *brevicauda*, *simonsi*, *pachita*, *hilda*, *bolivianus*, *securus*, *oris* and *roberti*, and a moderate or large series of skins of *mincae*, *guiarae*, *trinitatis*, *urichi*, *gorgonae*, *longicaudatus*, and *goeldii*. Not one of the above names seem to me to be retainable as full species.

There are slight colour variations present; there are quite noticeable size variations (but the smallest connected with the largest by intermediate forms); there are variations in the length of the tail, though in animals of this kind, which frequently lose the tail during life, this seems to be a character to which too much attention should not be paid.

I propose provisionally to treat all the above-mentioned forms, and *semispinosus* and its races, as subspecies of *cayennensis*. Should this prove in any case incorrect, it may be noted that numbers 14 to 20 are regarded now as *semispinosus* and its races, and numbers 21 to 40 as "distinct species."

P. vacillator is kept separate on account of the dental characters noticed above, though it must be admitted that on external characters alone it would certainly be regarded as a race of *cayennensis*. *P. canicollis* differs in colour from the above; *hendeei* and *rattinus* are darker than usual, and with rather weak spines; Thomas regarded these as forming a section of the genus; they are accordingly kept apart as species. *P. iheringi* is kept apart as a group on account of the characters of the zygoma. *P. dimidiatus*, of which one skull only has been seen, might belong to that group, or to the typical one; until more specimens come to hand the question must remain open. *P. albispinus* differs from the only other species referred to the subgenus *Trinomys* in colour, so far as seen.

The forms here referred as races to *cayennensis* are mostly supposed by Thomas to be "species" on trifling skull characters, such as the absence of the parietal ridges (age character?), the length of palatal foramina, "narrow muzzle," etc.

List of Named Forms

Subgenus *Proechimys*, Allen

Not seen, and not allocated to group.

1. PROECHIMYS OCHRACEUS, Osgood
1912. Field Mus. Pub. Zool. Ser. X, p. 56.
El Panorama, Rio Aurare, Zulia, Venezuela.

2. PROECHIMYS MACROURUS, Jentink
1879. Notes Leyden Mus. 1, note 23, p. 97.
Surinam.

3. PROECHIMYS O'CONNELLI, Allen
1913. Bull. Amer. Mus. Nat. Hist. XXXII, p. 479.
Villavicencio, Colombia.

4. PROECHIMYS POLIOPUS, Osgood
1914. Field Mus. Nat. Hist. Zool. ser. X, p. 141.
San Juan de Colon, Tachira, Venezuela.

5. PROECHIMYS STEEREI, Goldman
1911. Proc. Biol. Soc. Washington, XXIV, p. 238.
Hyutanaham, Rio Purus, Brazil.

6. PROECHIMYS KERMITI, Allen
1915. Bull. Amer. Mus. Nat. Hist. XXXIV, p. 629.
Lower Solimões, Brazil.

7. PROECHIMYS BOIMENSIS, Allen
1916. Bull. Amer. Mus. Nat. Hist. XXXV, p. 523.
Boim, Rio Tapajoz, Brazil.

8. PROECHIMYS ELEGANS, Lund
1841. Afh. K. Danske Vid. Selsk, 4, VIII, p. 245.
Lagoa Santa, Minas Geraes, Brazil.

9. PROECHIMYS LEUCOMYSTAX, Ribeiro
1914. Comm. Linhas. Telegr. Annex. 5, p. 43.
Utiarity, Rio Papagaio, Matto Grosso, Brazil.

10. PROECHIMYS MYOSUROS, Lichtenstein
1820. Abh. Akad. Wiss. Berlin (1818–1819), p. 192.
Bahia, Brazil.

11. PROECHIMYS LEPTOSOMA, Brants
1827. Muizen, p. 150.
Bahia and São Paulo, Brazil.
Synonym: *cinnamomeus*, Lichtenstein, 1830, Darstellung, pl. 36, fig. 2.

12. PROECHIMYS FULIGINOSUS, Wagner
1842. Schreber Säug. Suppl. III, p. 343.
Brazil.

From the descriptions, *ochraceus* (no. 1), *o'connelli* (no. 3), *steerei* (no. 5), *kermiti* (no. 6), appear near *cayennensis* or perhaps races; *poliopus* (no. 4) is probably distinct, *boimensis* (no. 7), is clearly distinct from others, and *macrourus* (no. 2), is described as a form with an unusually long tail (head and body 221, tail 320).

cayennensis Group

13. PROECHIMYS CAYENNENSIS CAYENNENSIS, Desmarest

1817. Nouv. Dict. d'Hist. Nat. 2d Ed. X, p. 59.
Guiana.

14. PROECHIMYS CAYENNENSIS SEMISPINOSUS, Tomes

1860. Proc. Zool. Soc. London, p. 265.
Gualaquiza, Eastern Ecuador.

15. PROECHIMYS CAYENNENSIS BURRUS, Bangs

1901. Amer. Naturalist, XXXV, p. 640.
San Miguel Island, Panama.

16. PROECHIMYS CAYENNENSIS CENTRALIS, Thomas

1896. Ann. Mag. Nat. Hist. 6, XVIII, p. 312.
San Emilio, Lake Nicaragua, Nicaragua.

17. PROECHIMYS CAYENNENSIS PANAMENSIS, Thomas

1900. Ann. Mag. Nat. Hist. 7, V, p. 220.
City of Panama, Panama.
Synonym: *centralis chiriquinus*, Thomas, 1900, Ann. Mag. Nat. Hist. 7, V, p. 220. Bogava, Chiriqui, Panama.

18. PROECHIMYS CAYENNENSIS RUBELLUS, Hollister

1914. Proc. Biol. Soc. Washington, XXVII, p. 57.
Angostura Valley, Costa Rica.

19. PROECHIMYS CAYENNENSIS COLOMBIANUS, Thomas

1914. Ann. Mag. Nat. Hist, 8, XIV, p. 60.
Condoto, Choco, Western Colombia.

20. PROECHIMYS CAYENNENSIS CALIDIOR, Thomas

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 254.
San Javier, Lower Rio Cachavi, Ecuador.

21. PROECHIMYS CAYENNENSIS CHRYSAEOLUS, Thomas

1898. Ann. Mag. Nat. Hist. 7, I, p. 244.
Muzo, north of Bogota, Colombia.

22. PROECHIMYS CAYENNENSIS MINCAE, Allen

1899. Bull. Amer. Mus. Nat. Hist. XII, p. 198.
Minca, Santa Marta district, Colombia.

23. PROECHIMYS CAYENNENSIS GORGONAE, Bangs

1905. Bull. Mus. Comp. Zool. Harvard, 46, p. 89.
Gorgona Island, Colombia.

24. PROECHIMYS CAYENNENSIS DECUMANUS, Thomas

1899. Ann. Mag. Nat Hist. 7, IV, p. 282.
Chongon, Prov. Guayas, Ecuador.

25. PROECHIMYS CAYENNENSIS ROSA, Thomas

1900. Ann. Mag. Nat. Hist. 7, V, p. 219.
Santa Rosa, South-west Ecuador.

26 PROECHIMYS CAYENNENSIS GULARIS, Thomas

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 253.
Canelos, Rio Bobonaza, Ecuador.

27. PROECHIMYS CAYENNENSIS BREVICAUDA, Gunther

1876. Proc. Zool. Soc. London, p. 748.
Chamicuros, Huallaga River. Peru.

28. PROECHIMYS CAYENNENSIS SIMONSI, Thomas
1900. Ann. Mag. Nat. Hist. 7, VI, p. 300.
Perene River, Prov. Junin, Peru.

29. PROECHIMYS CAYENNENSIS PACHITA, Thomas
1923. Ann. Mag. Nat. Hist. 9, XII, p. 694.
Puerto Leguia, Rio Pachita, Peru.

30. PROECHIMYS CAYENNENSIS HILDA, Thomas
1924. Ann. Mag. Nat. Hist. 9, XIII, p. 534.
San Lorenzo, Rio Marañon, Peru.

31. PROECHIMYS CAYENNENSIS BOLIVIANUS, Thomas
1901. Ann. Mag. Nat. Hist. 7, VIII, p. 537.
Mapiri, Upper Rio Beni, Bolivia.

32. PROECHIMYS CAYENNENSIS SECURUS, Thomas
1902. Ann. Mag. Nat. Hist. 7, IX, p. 140.
Charuplaya, Securé River, Bolivia.

33. PROECHIMYS CAYENNENSIS WARRENI, Thomas
1905. Ann. Mag. Nat. Hist. 7, XVI, p. 312.
Comaccka, Demerara River, British Guiana.

34. PROECHIMYS CAYENNENSIS GUAIRAE, Thomas
1901. Proc. Biol. Soc. Washington, XIV, p. 27.
La Guaira, Venezuela.

35. PROECHIMYS CAYENNENSIS URICHI, Allen
1899. Bull. Amer. Mus. Nat. Hist. XII, p. 199.
Quebrada Seca, Prov. Sucre, Venezuela.

36. PROECHIMYS CAYENNENSIS CHERRIEI, Thomas
1899. Ann. Mag. Nat. Hist. 7, IV, p. 381.
Munduapo, Upper River Orinoco, Venezuela.

37. PROECHIMYS CAYENNENSIS TRINITATIS, Allen & Chapman
1893. Bull, Amer. Mus. Nat. Hist. V, p. 223.
Princestown, Trinidad.

38. PROECHIMYS CAYENNENSIS GOELDII, Thomas
1905. Ann. Mag. Nat. Hist. 7, XV, p. 587.
Santarem, Rio Tapajoz, Brazil.

39. PROECHIMYS CAYENNENSIS ORIS, Thomas
1904. Ann. Mag. Nat. Hist. 7, XIV, p. 195.
Igarapé-Assu, near Pará, Brazil.

40. PROECHIMYS CAYENNENSIS ROBERTI, Thomas
1901. Ann. Mag. Nat. Hist. 7, VIII, p. 531.
Rio Jordão, Araguary district, Minas Geraes, Brazil.

41. PROECHIMYS CAYENNENSIS LONGICAUDATUS, Rengger
1830. Naturg. Säug. Paraguay, p. 236.
North of Paraguay, Matto Grosso, Brazil.

42. PROECHIMYS VACILLATOR, Thomas
1903. Ann. Mag. Nat. Hist. 7, XI, p. 490.
Kanuku Mountains, British Guiana.

43. PROECHIMYS HENDEEI, Thomas
1926. Ann. Mag. Nat. Hist, 9, XVIII, p. 162.
Puco Tambo, 50 miles east of Chachapoyas, Peru.

44. PROECHIMYS RATTINUS, Thomas

1926. Ann. Mag. Nat. Hist. 9, XVIII, p. 164.
Tushemo, Masisea, Rio Ucayali, Peru.

45. PROECHIMYS CANICOLLIS, Allen

1899. Bull. Amer. Mus. Nat. Hist. XII, p. 200.
Bonda, Santa Marta district, Colombia.

46. PROECHIMYS DIMIDIATUS, Gunther

1876. Proc. Zool. Soc. London, p. 747.
South Brazil.

iheringi Group

47. PROECHIMYS IHERINGI, Thomas

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 252.
Island of São Sebastiao, São Paulo, Brazil.

Subgenus *Trinomys*, Thomas

48. PROECHIMYS ALBISPINUS ALBISPINUS, Geoffroy

1838. Ann. Sci. Nat. X, p. 125.
Ilha de Deos, near Bahia, Brazil.

49. PROECHIMYS ALBISPINUS SERTONIUS, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 142.
Lamarão, Bahia, Brazil.

50. PROECHIMYS SETOSUS, Geoffroy

1817. Desmarest, Nouv. Dict. d'Hist. Nat. X, p. 59.
Brazil.

The *anomalus* of Kuhl, 1820, Beitr. Zool., p. 17, is, according to Tate, based on *Heteromys anomalus*, Thompson.

Genus 5. HOPLOMYS, Allen

1908. Hoplomys, Allen, Bull. Amer. Mus. Nat. Hist. XXIV, p. 649.

Type Species.—*Hoplomys truei*, Allen.

Range.—Known from Nicaragua, Panama and Ecuador.

Number of Forms.—Three.

Characters.—Skull much like *Proechimys*; bullae appear a little smaller. Cheekteeth with four (at least) outer folds in the upper series, longer than *Proechimys*, placed more obliquely, but isolating in the same way, the folds stretching further across the tooth, and sometimes tending to divide up more when isolated. Lower molars reversing the pattern of the upper series. Frontals and parietals strongly ridged.

Feet as *Proechimys*; spines much more developed, at maximum for the family, more or less concealing the fur, coarse and strong. Tail shorter than head and body, scaly, naked. Size about largest of subfamily (*truei*: head and body 380 mm.).

Forms seen: *gymnurus*.

According to Goldman (Smiths. Misc. Coll., LXIX, no. 5, p. 124, 1920) all forms may be regarded as races of the oldest name, *gymnurus*.

List of Named Forms

1. HOPLOMYS GYMNURUS GYMNURUS, Thomas

1897. Ann. Mag. Nat. Hist. 6, XX, p. 550.
Cachavi, North Ecuador.

2. HOPLOMYS GYMNURUS GOETHALSI, Goldman

1912. Smiths. Misc. Coll. LVI, no. 36, p. 10.
Rio Indio, near Gatun, Canal Zone, Panama.

3. HOPLOMYS GYMNURUS TRUEI, Allen

1908. Bull. Amer. Mus. Nat. Hist. XXIV, p. 650.
Lavala, Matagalpa, Nicaragua.

Genus 6. CERCOMYS, Cuvier

1829. Cercomys, Cuvier, Hist. Nat. Mammalia, iii, pl. 60.
1881. Thrichomys, Trouessart, Cat. Mamm. Bull. Soc. Études Sci. Angers, p. 179. (*Nelomys antricola*, Lund).

Type Species.—*Cercomys cunicularius*, Cuvier.

Range.—East Brazil (Pernambuco) southwards(?); known also from Bahia, Lagoa Santa and Paraguay.

Number of Forms.—Four.

Characters.—Skull broad, rather less heavily ridged than *Proechimys* and *Hoplomys*, braincase appearing rather broader, and parietals not or scarcely ridged. Jugal not thickened anteriorly, zygoma narrow, and usually with weak process on lower posterior border. Infraorbital foramen with separate canal for nerve transmission. Bullae large. Upper cheekteeth with two outer folds and one inner one, the folds usually clear and straight, not tending to isolate so completely as in *Hoplomys* and *Proechimys*. Lower cheekteeth reversing the pattern of the upper series; P.4 often with a small extra inner fold.

Palatal foramina usually abnormally broadened.

Externally with soft fur, showing no signs of developing bristles; tail slightly shorter than head and body, thickly haired. Feet essentially as *Proechimys*.

Remarks.—This genus has in the past been compared with *Dactylomys* and *Myocastor*; but from the dental characters and the characters of the feet I am convinced that it has nothing to do with these genera, but seems to bear very nearly the same relationship to *Proechimys* that *Isothrix* does to *Echimys*, namely a hairy-tailed soft-furred representative. A paper has been published (Boker, 1929, Verh. Anat. Ges. Jena, XXXVIII, p. 19) on the bipedal leaping adaptations of a captivity specimen of this genus.

Forms seen: *laurentius*, *fosteri*, *apereoides*.

I am convinced that all the three forms seen are not more than racially distinct from each other, though the first two were described as species.

Thomas states (Proc. Biol. Soc. Washington, 1912, XXV, p. 115) that *apereoides* is synonymous with the earlier described *cunicularius*.

According to Thomas there are four mammae (*laurentius*).

List of Named Forms

1. CERCOMYS CUNICULARIUS CUNICULARIUS, Cuvier

1829. Hist. Nat. Mamm. iii, fig. 276.
"Capitanerie des Mines," Brazil.
Synonym: *apereoides*, Lund, 1841, Afh. K. Danske Vidensk Selsk 4, VIII, p. 98. Lagoa Santa, Minas Geraes, Brazil.
antricola, Lund, 1841, Afh. K. Danske Vidensk Selsk 4, VIII, p. 242. Brazil.

2. CERCOMYS CUNICULARIUS LAURENTIUS, Thomas

1904. Ann. Mag. Nat. Hist. 7, XII, p. 254.
São Lourenço, near Pernambuco, Brazil.

3. CERCOMYS CUNICULARIUS FOSTERI, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 227.
Sapucay, Paraguay.

4. CERCOMYS INERMIS, Pictet. (Not seen)

1841. Notice An. Nouv. Mus. Genève, ii, p. 33.
Bahia, Brazil.

Genus 7. EURYZYGOMATOMYS, Goeldi

1901. Euryzygomatomys, Goeldi, Bol. Mus. Paraense, III, p. 179.

Type Species.—*Echimys spinosus*, Rengger. (See Tate, 1935, Taxonomy of Neotropical Hystricoid Rodents).

Range.—"Probably throughout the pampas country of Paraguay, northern Corrientes, Paraná, Santa Catharina and Rio Grande do Sol" (Tate).

Number of Forms.—Three are named.

Characters.—Skull broad, with poorly marked supraorbital ridges, relatively broad rostrum, prominent bullae (these not excessively inflated). Palate narrow and rather short; palatal foramina short and broad. Infraorbital foramen with a separate canal for nerve transmission. Jugal long, greatly thickened anteriorly, but with posterior projecting process not well marked; the zygoma more robust than in the genera dealt with above. Mandible heavily ridged and twisted; coronoid higher than in *Proechimys*. Upper cheek-teeth with two outer, one inner folds, becoming isolated as islands with wear; general effect nearer *Cercomys* than *Proechimys*. Lower teeth with this pattern reversed.

Fur bristly, spines about as well developed as in the less spiny members of *Proechimys*, or perhaps less so. Feet narrow, essentially of *Proechimys* type;

claws of forefoot slightly elongated. Tail strongly reduced, not much longer than hindfoot, well haired.

Forms seen: *spinosus*, *catellus*.

I do not think that the above two forms are more than racially distinct from each other.

List of Named Forms

1. EURYZYGOMATOMYS SPINOSUS SPINOSUS, Desmarest

1817. Nouv. Dict. D'Hist. Nat. 2d Ed. X, p. 57.
Atira, 8 leagues east of Asuncion, Paraguay.
Synonym: *brachyurus*, Wagner, 1843, Schreber Säug. Suppl. iii, p. 346. Brazil.
rufa, Lichtenstein, 1818, Abh. Akad. Berlin, p. 192. Brazil.

2. EURYZYGOMATOMYS SPINOSUS CATELLUS, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVIII, p. 301.
Joinville, Santa Catharina, Brazil.

3. EURYZYGOMATOMYS GUIARA, Brandt (Not seen)

1835. Mem. Acad. St. Petersb. 6, III, p. 432.
Ypaneme, São Paulo, Brazil.

The status of this form appears doubtful (Tate, Bull. Amer. Mus. Nat. Hist. LXVIII, p. 405).

Genus 8. CLYOMYS, Thomas

1916. Clyomys, Thomas, Ann. Mag. Nat. Hist. 8, XVIII, p. 300.

Type Species.—*Echimys laticeps*, Thomas.

Range.—Described from Joinville, Santa Catharina, Brazil.

Number of Forms.—One.

Characters.—Essentially like *Euryzygomatomys* in cranial characters except that the bullae are abnormally inflated, very much more so than in other members of this subfamily, a great part visible external to the paroccipitals when viewed from behind. Dental characters of the one skull seen too worn for notes.

Externally like *Euryzygomatomys*, but foreclaws noticeably more developed.

Forms seen: *laticeps*.

List of Named Forms

1. CLYOMYS LATICEPS, Lund, 1841, nom. nud., Thomas

1909. Thomas, Ann. Mag. Nat. Hist. 8, IV, p. 240.
Joinville, Santa Catharina, Brazil.
(1841, Lund, nom. nud., Afh. K. Danske Vid. Selsk. 4, VIII, p. 99)

Genus 9. CARTERODON, Waterhouse

1848. Carterodon, Waterhouse, Nat. Hist. Mammalia, ii, p. 351.

Type Species.—*Echimys sulcidens*, Lund.

RANGE.—Brazil (? Lagoa Santa).

NUMBER OF FORMS.—One.

CHARACTERS.—Jugal thickened anteriorly, as in *Euryzygomatomys* and *Clyomys*; supraorbital ridges developed, and slight interorbital constriction present in the one skull examined. Nasals broad. Bullae prominent, but not extreme. No canal for nerve transmission in the infraorbital foramen. Mandible heavily twisted. Zygoma with moderate process on posterior lower border. Upper incisors one-grooved. The outer side of these teeth yellow, the inner side white, as remarked by Waterhouse. Lower incisors plain. Upper cheekteeth with two outer, one inner folds, the enamel surrounding them thick; lower teeth reversing the pattern.

Size relatively small; fur soft, at any rate compared with most of the genera of this group; tail shortened, well haired, evidently not so reduced as in *Euryzygomatomys*; feet narrow and long, as in *Proechimys*; claws moderate.

Forms seen: *sulcidens*.

List of Named Forms

1. CARTERODON SULCIDENS, Lund

1841. Afh. K. Danske Vid. Selsk, 4, VIII, p. 99.
(Originally described fossil from Lagoa Santa, Brazil.)

This genus was originally described from fossil remains, but subsequently found living.

Genus 10. MESOMYS, Wagner

1845. MESOMYS, Wagner, Arch. für Naturg. 1, p. 145.

TYPE SPECIES.—*Mesomys ecaudatus*, Wagner.

RANGE.—Amazonia; "From the Tocantins River to eastern Peru and Ecuador" (Tate).

NUMBER OF FORMS.—Approximately seven.

CHARACTERS.—This genus was described by Thomas as having the skull, ears and feet of *Echimys*, but the teeth of *Proechimys*. Skull with short and narrow rostrum, and well marked supraorbital ridges. Frontals tending to be very broad, parietals not or scarcely ridged. No canal for transmission of nerve in infraorbital foramen. Bullae relatively large; jugal not specially broadened, with weak process on posterior border both below and sometimes above. Palatal foramina short; toothrow far forward in skull.

Upper cheekteeth of *Proechimys* type, with narrow folds, usually traces of four external in the upper series, the lower teeth reversing the pattern.

Size small, usually or always under 200 mm. head and body, fur heavily spiny, comparable to that of *Hoplomys*; hindfeet very broad, of arboreal type, D.5 long; claws prominent. Tail usually slightly longer than head and body, scaly, poorly haired except terminally.

Forms seen: *ferrugineus*, *hispidus*, *leniceps*, *spicatus*, *stimulax*.

The few species admitted are all very closely allied to each other.

List of Named Forms

1. MESOMYS HISPIDUS, Desmarest

1817. Nouv. Dict. D'Hist. Nat. 2d. Ed. X, p. 58.
"South America."
Synonym: *ecaudatus*, Wagner, 1845, Arch. für. Naturg. 1, p. 145. Borba, Rio Madeira, Brazil. (For status see Thomas, Ann. Mag. Nat. Hist. 8, XVIII, p. 298, 1916.)

2. MESOMYS FERRUGINEUS FERRUGINEUS, Günther

1876. Proc. Zool. Soc. London, p. 750.
Chamicuros, Rio Huallaga, Peru.

3. MESOMYS FERRUGINEUS SPICATUS, Thomas

1924. Ann. Mag. Nat. Hist. 9, XIII, p. 535.
Tushemo, near Masisea, Rio Ucayali, Peru.

4. MESOMYS LENICEPS, Thomas

1926. Ann. Mag. Nat. Hist. 9, XVIII, p. 348.
Yambrasbamba, Amazonas, Peru.

5. MESOMYS STIMULAX, Thomas

1911. Ann. Mag. Nat. Hist. 8, VII, p. 607.
Cameta, Lower Tocantins, Brazil.

6. MESOMYS DIDELPHOIDES, Desmarest. (Not seen)

1817. Nouv. Dict. d'Hist, Nat. 2nd Ed. X, p. 58.
Probably from Brazil.

7. MESOMYS OBSCURUS, Wagner. (Not seen)

1840. Abh. Akad. Wiss. Münch. iii, p. 196.
Brazil.

Genus 11. LONCHOTHRIX, Thomas

1920. Lonchothrix, Thomas, Ann. Mag. Nat. Hist. 9, VI, p. 113.

Type Species.—*Lonchothrix emiliae*, Thomas.

Range.—Described from Villa Braga, Rio Tapajoz, Brazil.

Number of Forms.—One.

Characters.—Skull closely similar to that of *Mesomys*. Cheekteeth compared by Thomas to those of a small *Erethizon*; upper molars with three outer, one inner folds, these noticeably wide and deep; lower cheekteeth evidently with only two inner folds, one outer in all molars; P.4 with traces of four folds (three main, one vestigial); the folds wide in the lower series.

Externally the form is striking owing to the heavily tufted tail, which is considerably longer than the head and body, but hairy at the end only, the upper part scaly and covered with short spines. Fore and hindfeet broad, of arboreal type, as in *Mesomys*. Spines of body very highly developed comparatively, even the belly being semi-spinous.

Little appears to be known of this genus; the teeth do not appear very typical of this section; I include it here on account of the resemblance to *Mesomys* in cranial and external characters.

Forms seen: *emiliae*.

LIST OF NAMED FORMS

1. LONCHOTHRIX EMILIAE, Thomas
1920. Ann. Mag. Nat. Hist, 9, VI, p. 114.
Villa Braga, Rio Tapajoz, Brazil.

Subfamily CAPROMYINAE

GEOGRAPHICAL DISTRIBUTION.—Cuba, Jamaica, Bahama Islands, Swan Island (Gulf of Honduras), and one form named from Venezuela.

NUMBER OF GENERA.—As here understood the group contains three genera, of which one is not represented in the British Museum.

CHARACTERS.—Not essentially different from the Echimyinae, but cheek-teeth evergrowing, characterized by two outer, one inner folds in the upper series, the folds in adult completely filled with cement, the teeth flatcrowned and changing little or not at all during the animal's life.

Paroccipital processes usually, not always, tending to stand apart from the bullae. Form usually robust, not Rat-like; tail haired, long and prehensile or strongly reduced; habits terrestrial or arboreal.

KEY TO THE GENERA OF CAPROMYINAE, not including the genus *Procapromys* (not seen)

Tail considerably longer than hindfoot; claws more prominent; (habits arboreal). (Tail prehensile, constant?). CAPROMYS

Tail scarcely longer than hindfoot; claws less prominent; (habits terrestrial). GEOCAPROMYS

Genus 1. CAPROMYS, Desmarest

1822. CAPROMYS, Desmarest, Bull. Soc. Philom. Paris, p. 185.

TYPE SPECIES.—*Capromys fournieri*, Desmarest = *Isodon pilorides*, Say.

RANGE.—Cuba, including the Isle of Pines.

NUMBER OF FORMS.—Six.

CHARACTERS.—Skull long and rather flat, a postorbital-like ridge can be present; parietals may be well ridged; jugal with well marked and strong backwardly directed process. Bullae prominent. Paroccipital processes usually slightly lengthened, and standing apart; in the one skull seen of *C. nana* (adult female), the paroccipital processes join the bullae, about as in Echimyinae.

Infraorbital foramen with no canal for nerve transmission. Palate slightly constricted anteriorly, but less so than in *Myocastor* or *Dactylomys*; palatal foramina medium. Mandible with angular process drawn backwards, and strongly lifted outwards; condyle high; coronoid process low. Incisors narrow.

Upper cheekteeth as already described; the lower series reverse the pattern of the upper series, the premolar has also a vestigial extra inner fold.

Externally rather large as a rule; fur harsh; feet broad, of arboreal type, or more or less; claws prominent, D.5 relatively long, hallux medium. A tendency in the few skins examined for D.4 to be a little longer than D.3. Forefoot with four digits well developed, pollex small. Tail long, haired, said to be prehensile in at least one species, and may be so throughout the genus.

The species of *Capromys* were revised by Chapman, 1901, Bull. Amer. Mus. Nat. Hist., vol. XIV, p. 313.

Forms seen: *prehensilis*, *pilorides*, *melanurus*, *nana*.

C. nana, of which one skull alone is available, seems considerably smaller than the remainder; it was originally described as fossil, but subsequently found living. *C. melanurus*, of which one specimen only has been seen, has a much more heavily haired tail than the remainder. *C. prehensilis* and *C. pilorides* are distinguishable from each other on length of tail, and the latter is stated to have a much heavier skull. The genus is not very well represented in London.

List of Named Forms

(The references and type localities of all Capromyinae are the work of Mr. G. W. C. Holt.)

1. CAPROMYS PILORIDES PILORIDES, Say

1822. Journ. Acad. Philadelphia, ii, p. 333.
Cuba.
Synonym: *fournieri*, Desmarest, 1822, Mém. Soc. Hist. Nat. 1, p. 43. Cuba.
? *quemi*, Fischer, Add. ad Synops. Mamm. 1830, p. 389.

2. CAPROMYS PILORIDES RELICTUS, Allen

1911. Bull. Mus. Comp. Zool. Harvard Univ. 54, p. 207.
Casas Mountains, Nueva Gerona, Isle of Pines, Cuba.

3. CAPROMYS PREHENSILIS PREHENSILIS, Poeppig

1824. Journ. Acad. Philadelphia, 4, p. 11.
Wooded parts of Southern Cuba.
Synonym: *poeyi*, Guerin, 1834, Mag. Zool. IV, Pl. XV, 5 pp., and *poeppingi*, Lesson, 1842, Nouv. Tabl. Règn. Anim. p. 124.

4. CAPROMYS PREHENSILIS GUNDLACHI, Chapman

1901. Bull. Amer. Mus. Nat. Hist. XIV, p. 317.
Nueva Gerona, Isle of Pines.

5. CAPROMYS MELANURUS, Peters

1864. Mon. Ber. Akad. Wiss. Berlin, p. 384.
Manzanillo, Cuba.
Synonym: *pallidus*, Peters, 1864, Mon. Ber. Akad. Wiss. Berlin, p. 384. Cuba.

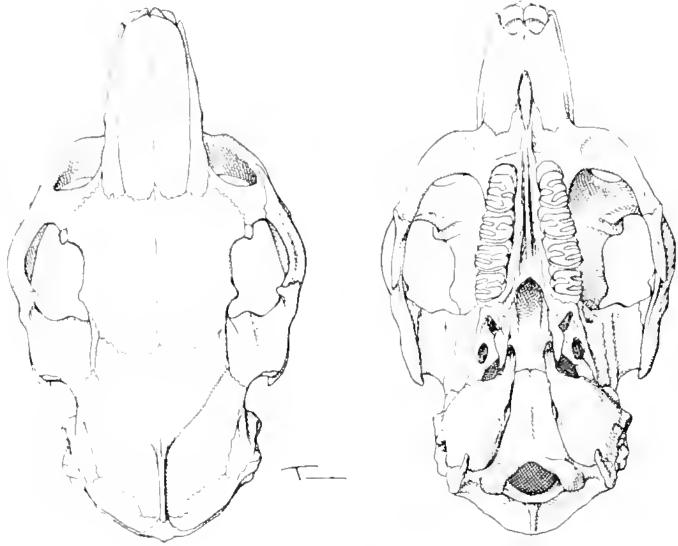


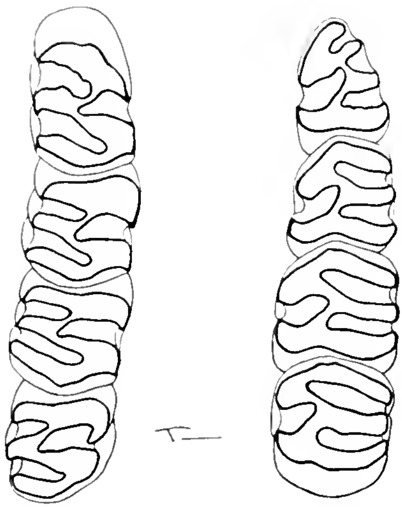
FIG. 14. GEOCAPROMYS BROWNII, Fischer.
B.M. No 1334 C.; × 1.

FIG. 15. GEOCAPROMYS BROWNII, Fischer.
B.M. No. 1334 C.; × 1.

6. CAPROMYS NANA, G. M. Allen

1917. Proc. New England Zool. Club, VI, p. 54.
Sierra de Hato Nuevo, Province of Matanzas, Cuba.

The "*Capromys*" *elegans* of Cabrera, 1901, is a member of the Murine genus *Phloeomys*.



a *b*

FIG. 16. GEOCAPROMYS BROWNII, Fischer.
Cheekteeth: B.M. No. 1334C.; ×7.

Genus 2. GEOCAPROMYS, Chapman

1901. GEOCAPROMYS, Chapman, Bull. Amer. Mus. Nat. Hist. XIV, p. 313.

TYPE SPECIES.—*Capromys browni*, Fischer.

RANGE.—Jamaica, Swan Island, and the Bahamas.

NUMBER OF FORMS.—Three.

CHARACTERS.—Like *Capromys*, but tail strongly shortened, scarcely longer than hindfoot; feet with less prominent claws, and pollex more reduced (the feet, however, do not seem very different in formation from those of *Capromys*); habits terrestrial. "Dentition and cranium as *Capromys*, but ascending portion of maxillary arch of zygoma wider, superior margin of squamosal narrower, and without process, and occipital region lower" (Chapman). I am inclined to doubt the constancy of these cranial characters between the two groups, particularly when *C. nana*, not known in Chapman's day, is compared. The skull may have a sagittal ridge in adult; it may be that this is present also in *Capromys*, but not in our small series; the paroccipitals in *Geocapromys* appear relatively short. The dentition is as in *Capromys*; in the cutting teeth of a newly born animal, the folds are quite open and well marked, but even as early in life as that the dentition is relatively simple. In M.1 lower, the vestigial inner extra front fold of *Capromys* is more clearly marked.

The group was proposed as a subgenus, but has since been given generic rank; the differences in habit and tail characters between the two groups seem, I think, to warrant their separation. The broader ascending portion of the maxillary seems very well marked in all our series of *Geocapromys* with one exception, which might be wrongly identified; other than this it seems a clear distinction between *Geocapromys* and *Capromys*.

The species were revised by Chapman, 1901, Bull. Amer. Mus. Nat. Hist., vol. XIV, pp. 313–323. *browni* seems rather larger, and with a rather heavier skull than *thoracatus* and *ingrahami*, which appear very doubtfully distinct from each other. Certain cranial characters are said to distinguish *brownii* from *thoracatus*, and the form of the ear.

Forms seen: *brownii*, *thoracatus*, *ingrahami*.

List of Named Forms

1. GEOCAPROMYS BROWNII, Fischer

1829. Syn. Mamm. Addenda, page 389 (= p. 589).
Jamaica.
Synonym: *brachyurus*, Hill, 1851, in Gosse, Nat. Sojourn in Jamaica, p. 471. Jamaica.

2. GEOCAPROMYS THORACATUS, True

1888. Proc. U.S. Nat. Mus. XI, p. 469.
Little Swan Island, Gulf of Honduras.

3. GEOCAPROMYS INGRAHAMI, Allen

1891. Bull. Amer. Mus. Nat. Hist. III, p. 329.
Plana Keys, between Acklin Island and Mariguana, Bahama Islands.

Genus 3. PROCAPROMYS, Chapman

1901. Procapromys, Chapman, Bull. Amer. Mus. Nat. Hist. XIV, p. 322.

Type Species.—*Capromys geayi*, Pousargues.

Range.—Described from Venezuela, central coastal region.

Number of Forms.—One.

Remarks.—Not represented in the British Museum; differing in dental details from *Capromys* and *Geocapromys*.

"Size smaller than the smallest known species of *Capromys*, tail half as long as head and body—enamel outline in the first three upper molars continuous, with two external and one internal folds; the fourth, last molar with three distinct and disconnected transverse enamel ellipses, the posterior one about half the size of either of the anterior two; enamel outline in the four lower molars continuous, the first molar with three internal and one external folds, the first and second interior folds being more extended than in the corresponding tooth of *Capromys*; the remaining three lower molars each with two internal and one external folds, the enamel enclosed space on the posterior margin of the last molar being scarcely wider than the enamel itself" (Chapman).

Chapman suggests that this represents the ancestral mainland type from which *Capromys* and *Geocapromys* descended.

List of Named Forms

1. PROCAPROMYS GEAYI, Pousargues

1899. Bull. Mus. Paris, p. 150.

Mountainous coastal region on the slopes of the range which separates the town of Caracas from the port of La Guaira, Venezuela.

Subfamily PLAGIODONTINAE

Geographical Distribution.—Dominican Republic.

Number of Genera.—One.

Characters.—Not unlike the Capromyinae, but cheekteeth differing markedly from any Hystricoid Rodent examined; the upper molars with only one fold each side, these folds very long and deep, penetrating far into tooth, running parallel to each other and set obliquely; folds well filled with cement, as in Capromyinae; each upper tooth with (in the one examined) a strong outwardly-pointing external projection on the outer side, adjacent to the external border of the outer fold. Cheekteeth evergrowing. Lower cheekteeth with two long, deep inner and one shallow outer folds. Paroccipital processes much lengthened. Jugal simpler than in Capromyinae, without processes on upper or lower border. Tail naked.

Remarks.—The status of this genus must remain provisional; it does not appear to agree with Capromyinae sufficiently to be included in the same subfamily, in dental characters; but only one skull is available for examination.

Genus 1. PLAGIODONTIA, Cuvier

1836. Plagiodontia, Cuvier, Ann. Sci. Nat. Paris, 2, VI, p. 347.

Type Species.—*Plagiodontia aedium*, Cuvier.

Range.—As in the subfamily.

Number of Forms.—Two.

Characters.—Miller compared his *P. hylaeum* with *Geocapromys brownii*; the most noteworthy differences quoted were (in *Plagiodontia*) the less breadth between the lachrymals, the more anterior positions of the swellings caused by the frontal sinuses, the zygoma much more slender, the upper part not bearing an orbital process, the jugal slender, without posterior concavity and posteroinferior process, the excessively long paroccipital processes, the smaller incisive foramina, the greater width of the mandibular masseteric ridge. Some interorbital constriction is apparent. There is no canal in the infraorbital foramen for nerve transmission. The skull appears depressed, or slanting downwards, posteriorly; the palate is slightly constricted anteriorly.

The cheekteeth are as described above.

The feet are heavy, the tail naked, of moderate length, the ears small. Claws well developed; D.5 hindfoot relatively long.

Miller suggested that the animal is more nearly related to *Adelphomys*, a Patagonian fossil, than to living Hutias, with which it is currently associated.

Forms seen: *hylaeum*.

List of Named Forms

1. PLAGIODONTIA AEDIUM, Cuvier

1836. Ann. Sci. Nat. Paris, 2, VI, p. 347.
Dominican Republic.

2. PLAGIODONTIA HYLAEUM, Miller

1927. Proc. U.S. Nat. Mus. LXXVII, no. 16, p. 4.
Guarabo, 10 miles east of Jovero, Samana Province, Dominican Republic.

The type species does not appear to be known at present as a living animal. Originally described in 1836, little more was heard of the genus until Miller described *hylaeum* ninety years later. In 1916 Miller described some bones taken in the Dominican Republic; the impression at that time was that the animal was extinct.

Subfamily DACTYLOMYINAE

Geographical Distribution.—South America: Venezuela, Colombia, Amazonia, Ecuador, Peru, Bolivia, Paraguay, S.E. Brazil, etc.

Number of Genera.—Three.

Characters.—Cheekteeth brachyodont, excessively broad and heavy, the pattern essentially consisting of a deep re-entrant fold in the middle of each upper molar more or less completely dividing each tooth into two lobes, each of which is subdivided by a broad external fold. The pattern varies slightly within the genera, but the general somewhat prismatic effect is unmistakable. There is a strong tendency towards anterior constriction of the palate, as in *Myocastor*; the paroccipital processes are usually as in *Echimys*, i.e. curved forward under the bullae, but in some specimens of *Dactylomys dactylinus*, they stand apart from the bullae and cannot be distinguished from those of *Geocapromys*, which makes the former separation of this section of Rodents into forms with large paroccipitals (family "Capromyidae") and forms with paroccipitals curved under the bullae (family Echimyidae, hitherto including *Dactylomys*) unretainable. Skull number 22.5.4.4. in the British Museum appears just as *Geocapromys*, in paroccipital structure. The palatal foramina are small or nearly obsolete; the palate is very narrow and extends to a level with hinder part of M.3 or slightly behind it.

The fur is soft, not developing spines. A feature of the group is the extreme elongation of certain digits in the manus and pes of all except *Thrinacodus*, a character very unusual or unique within the Order. I am told that these are climbing animals, and that they grasp the branches between their third and fourth digits. The tail is usually much longer than the head and body, and may be heavily haired, or naked and reptilian in appearance.

If the families Capromyidae, Myocastoridae and Thryonomyidae are to be retained as distinct from the Echimyidae, I suggest the present group should also form a special family, Dactylomyidae. For the purposes of the present work, however, all these groups are kept within one family, as already noted.

Key to the Genera of Dactylomyinae

Digits three and four of both fore and hindfeet not specially elongated, and not broadened. THRINACODUS

Digits three and four of both fore and hindfeet much elongated, and considerably broadened.

Palate much constricted anteriorly; main lobes of upper cheekteeth not united by enamel bridges. DACTYLOMYS

Palate scarcely constricted anteriorly; main lobes of upper cheekteeth united by narrow enamel bridges. KANNABATEOMYS

Genus 1. THRINACODUS, Günther

1879. THRINACODUS, Günther, Proc. Zool. Soc. London, p. 144.

TYPE SPECIES.—*Thrinacodus albicauda*, Günther.

RANGE.—Colombia and Venezuela.

NUMBER OF FORMS.—Three.

CHARACTERS.—Essential cranial and dental characters as *Dactylomys*, next to be described. Palate as *Dactylomys*. Digit elongation at minimum for the subfamily; the foreclaws sharper than in related genera; pollex as usual in the group scarcely traceable. Digits narrow; D.3 and D.4 longer than the outer digits in forefoot; D.2 longer than D.5. Hindfoot with digits not abnormal, essentially like those of forefoot except that a short hallux is present. Fur thick and soft; tail longer than head and body, moderately to poorly haired.

(The paroccipital processes agree with those of the Echimyinae.)

Forms seen: *edax*, *albicauda*.

The three forms are at present regarded as species; I am not very convinced as to their distinctness from each other, and they should perhaps be regarded as races.

List of Named Forms

1. THRINACODUS ALBICAUDA, Gunther

1879. Proc. Zool. Soc. London, p. 144.
Near Medellin, Colombia.

2. THRINACODUS APOLINARI, Allen

1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 387.
Tomeque, Bogota district, Colombia.

3. THRINACODUS EDAX, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVIII, p. 299.
Sierra de Mérida, Venezuela.

Genus 2. DACTYLOMYS, Geoffroy

1838. DACTYLOMYS, Geoffroy, Ann. Sci. Nat. Paris, 2, X, p. 126.
1916. LACHNOMYS, Thomas, Ann. Mag. Nat. Hist. 8, XVIII, p. 298. (*Dactylomys peruanus*, Allen). Valid as a subgenus.

TYPE SPECIES.—*Dactylomys typus*, Geoffroy = *Echimys dactylinus*, Desmarest.

RANGE.—Known from Ecuador, Peru, Amazonia, and Bolivia.

NUMBER OF FORMS.—Five.

CHARACTERS.—Skull typically with weak postorbital-like ridges, and a sagittal crest developed in adult; paroccipital processes, as noted above, in the type species tending to stand apart from the bullae (age character?), or in smaller forms about as in *Echimys*. Jugal not thickened anteriorly, but relatively broad, with small process on upper and lower border posteriorly. Bullae moderately large. Infraorbital foramen with no canal for nerve transmission. Palate constricted anteriorly so that the premolars almost touch each other. Upper cheekteeth as described above, the inner side of the lobes narrow and contracted; lower molars with two inner folds, the hinder one completely dividing the tooth; lower premolar with a small extra lobe anteriorly, behind which it is not so completely divided into lobes as are the molars.

Size rather large; fur soft; tail longer than head and body, typically almost completely naked except the portion joining the body, which is well haired. Forefoot with the two central digits greatly lengthened, broadened to a degree; D.2 also considerably lengthened; D.5 short; pollex untraceable normally. Claws weak, nail-like. Hindfoot not very different from forefoot except that the hallux is moderately developed, and the claws are more prominent.

LACHNOMYS, proposed as a subgenus by Thomas for *D. peruanus*, is given generic rank by Tate, though it scarcely seems even a valid subgenus. The fur is much thicker, and the tail is fully haired throughout. The dental details given by Thomas to divide the two subgenera are not clear to me in our series.

Forms seen: *dactylinus*, *canescens*, *peruanus*.

The species *boliviensis* appears from description to be very closely allied to the type species.

LIST OF NAMED FORMS

Subgenus *Dactylomys*, Geoffroy

1. DACTYLOMYS DACTYLINUS DACTYLINUS, Desmarest

1817. Nouv. Dict. d'Hist. Nat. 2nd Ed. X, p. 57.
No locality in original description.
Synonym: *typus*, Geoffroy, 1838, Ann. Sci. Nat. Paris, 2, X, p. 127.
Brazil (?)

2. DACTYLOMYS DACTYLINUS CANESCENS, Thomas

1912. Ann. Mag. Nat. Hist. 8, XI, p. 87.
Itacoatiara, Middle Amazons, Brazil (below Manaos).

3. DACTYLOMYS DACTYLINUS MODESTUS, Lönnberg

1921. Archiv. für Zool. XIV, no. 4, p. 38.
Banks of Rio Curaray, Ecuador (Prov. del Oriente).

4. DACTYLOMYS BOLIVIENSIS, Anthony

1920. Journ. Mamm. Baltimore, I, p. 82.
Mission San Antonio, Cochabamba, Bolivia.

Subgenus *Lachnomys*, Thomas

5. DACTYLOMYS PERUANUS, Allen

1900. Bull. Amer. Mus. Nat. Hist. XIII, p. 220.
Juliaca, Peru.

Genus 3. KANNABATEOMYS, Jentink

1891. KANNABATEOMYS, Jentink, Notes Leyden Mus. XIII, p. 109.

TYPE SPECIES.—*Dactylomys amblyonyx*, Wagner.

RANGE.—Paraguay and South-eastern Brazil.

NUMBER OF FORMS.—Two.

CHARACTERS.—The palate very slightly constricted anteriorly; the cheek-teeth not completely divided into lobes, the lobes being connected by a small bridge; the enamel folds more nearly perpendicular to the molar series than in *Dactylomys*. The lower cheekteeth with an anterior V-shaped fold, and a posterior elongated one, as in *Dactylomys*, but the lobes thus formed united by a small bridge. Lower premolar like that of *Dactylomys*, but anterior lobe larger.

Skull much like that of *Dactylomys*; apparently a sagittal ridge is not formed; the paroccipital processes curve under the bullae.

Externally rather smaller than typical *Dactylomys*; the fur thick, soft. Forefeet much as in *Dactylomys*; hindfoot relatively broad, essential digit arrangement as in *Dactylomys*. Tail very long, relatively well haired.

REMARKS.—Very closely allied to *Dactylomys*. The character of the palate is perhaps the most important in keeping the two genera separate.

Forms seen: *amblyonyx*, *pallidior*.

LIST OF NAMED FORMS

1. KANNABATEOMYS AMBLYONYX AMBLYONYX, Wagner

1845. Archiv. für Naturg. 1, p. 146.
Ypanema, Province of São Paulo, Brazil.

2. KANNABATEOMYS AMBLYONYX PALLIDIOR, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 489.
Sapucay, Paraguay.

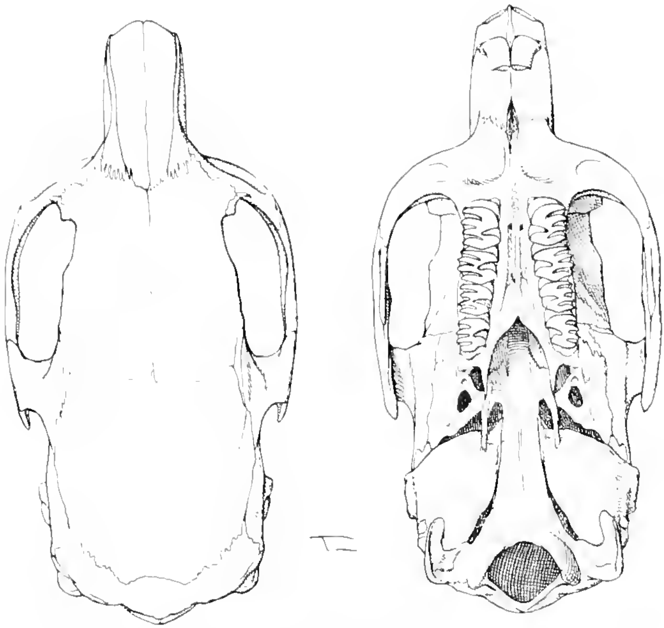


Fig. 17. Kannabateomys amblyonyx amblyonyx, Wagner.
B.M. No. 1.6.6.67, ♀; × 1½.

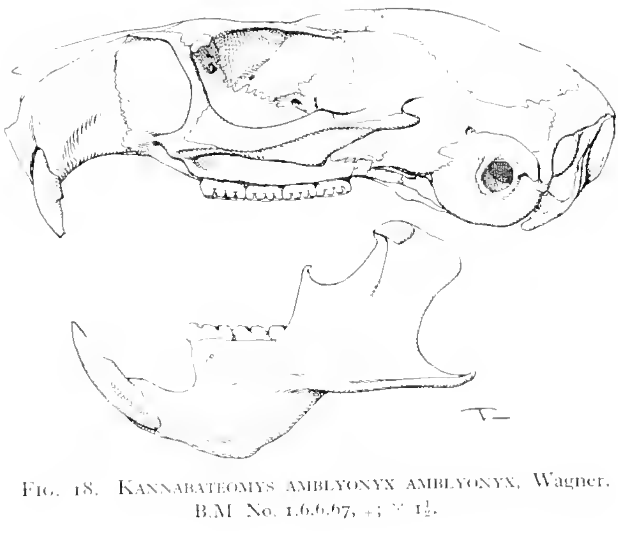
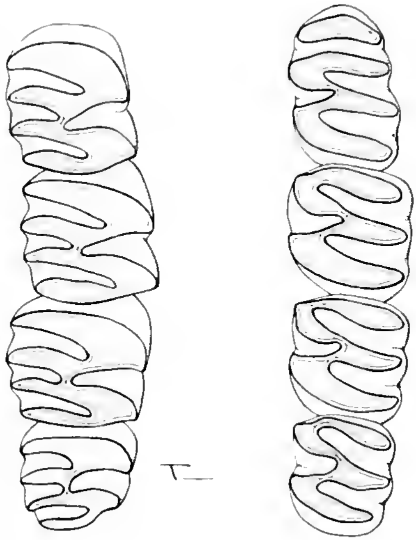


Fig. 18. Kannabateomys amblyonyx amblyonyx, Wagner.
B.M No. 1.6.6.67, ♀; × 1½.



a *b*

FIG. 19. KANNABATEOMYS AMBLYONYX AMBLYONYX, Wagner.
Cheekteeth: B.M. No. 1.6.6.67, ♂; ×5.

Subfamily MYOCASTORINAE

GEOGRAPHICAL DISTRIBUTION.—Southern South America.

NUMBER OF GENERA.—One.

CHARACTERS.—The external form robust and heavy, the size larger than in other members of the family; the genus is quite one of the giants of the Order. The external characters show strong specialization towards aquatic life; the hindfeet have four of the toes webbed; D.5 is free, and perhaps used for combing the fur. The hindfeet are much larger than the forefeet, which bear a rather rudimentary pollex, and four well-developed main digits; all the digits are armed with sharp large claws.

The skull is more heavily ridged for attachment of muscles than in other Neotropical Echimyidae, and is the only member of the family which tends in this character to approach the African *Thryonomys*. The paroccipital processes are greatly elongated; the lateral process of each stands well apart from the main downwardly pointing bone.

The cheekteeth decrease markedly in size from M.3 forwards; they are semi-rooted, and broadened, with strong inner and outer re-entrant folds, which are long retained; the palate is strongly constricted anteriorly.

Genus 1. MYOCASTOR, Kerr.

1792. MYOCASTOR, Kerr, Anim. Kingd., p. 225.
1805. MYOPOTAMUS, Geoffroy, Ann. Mus. d'Hist. Nat. VI, p. 82. (*Myopotamus bonariensis*, Geoffroy.)

TYPE SPECIES.—*Mus coypus*, Molina.

RANGE.—Southern South America; Hollister in a review of races represented in the American Museum quotes as localities: Chile, the Straits of Magellan, Buenos Ayres, Santa Fé and Paraguay, Parana River; Rio Negro and Rio Salados, Patagonia. Whether the genus ranges farther north than any of these has not been ascertained; quoted by Waterhouse from Peru.

NUMBER OF FORMS.—Three.

CHARACTERS.—The nasals are somewhat arched, the frontals broad and flat, the parietals deeply depressed, and in adults a very strong sagittal ridge is present. There is a sharply pointed but short squamosal process and a small postorbital process to the frontals. The anterior zygomatic root is placed farther back than normal, over the middle of the toothrow. The occipital region is high and prominent. The bullae tend to spread sideways, with the neck pointing outwards and upwards, approaching the type found in *Castor*, though much less developed than in that genus. The hamular processes are thick, the palate very narrow anteriorly, broad posteriorly. Jugal thick, broader posteriorly, with an upwardly projecting process on posterior border. There is no special canal for nerve transmission in the infraorbital foramen.

The mandible is immensely heavily ridged and distorted outwards, the angular process sharply drawn backwards. The coronoid process is obsolete.

The cheekteeth are extremely hypsodont; the fundamental pattern of the upper series, judging by a young specimen, appears to be two external re-entrant folds, the front one placed far forwards, the second one about in the middle of the tooth, and two internal folds, the first almost meeting the second outer one, the second placed posteriorly, rapidly extending across the tooth and cutting off the posterior part altogether. The enamel surrounding the folds is wide, the general effect of the dental pattern rather complex, probably not changing much during the animal's life. In the lower series, there are three inner and one outer re-entrant folds; P.4 has one small extra inner fold. M.3 is in both jaws considerably the largest tooth, in the adult; M.2 is markedly larger than the anterior two teeth, which tend to wear down in old age. In these front teeth, the folds tend to isolate, but the effect is considerably different from such types as *Euryzygomatomys* in which as the folds isolate the pattern tends to become simpler.

The general effect of the teeth is reminiscent to a degree of that of *Castor*, perhaps owing to the similar life which these two unrelated animals lead.

The incisors are broad and powerful.

The essential external characters are described above; the fur is soft and thick, and of some commercial value ("Nutria"). The tail is moderate in length, scaly and poorly haired.

The largest of a small series of skins at the British Museum is 586 mm. head and body; whether this would represent about the extreme development for the genus I do not know.

Forms seen: *coypus*.

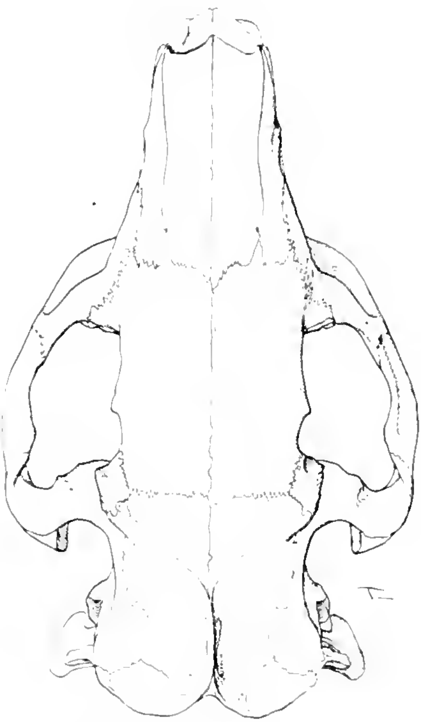


FIG. 20. MYOCASTOR COYPUS SANTAECRUZAE, Hollister. B.M. No. 16.10.3.85; ½.

LIST OF NAMED FORMS

(References and type localities by Mr. G. W. C. Holt.)

1 MYOCASTOR COYPUS COYPUS, Molina

1782. Sagg. Stor. Natur. Chile, p. 287.
Chile.
Synonym: *popelairi*, Wesmael, 1841, Bull. Ac. Roy. Brux. VIII, 2. p. 61.
chilensis, Lesson, 1842, Nouv. Tabl. Règn. Anim. p. 126.

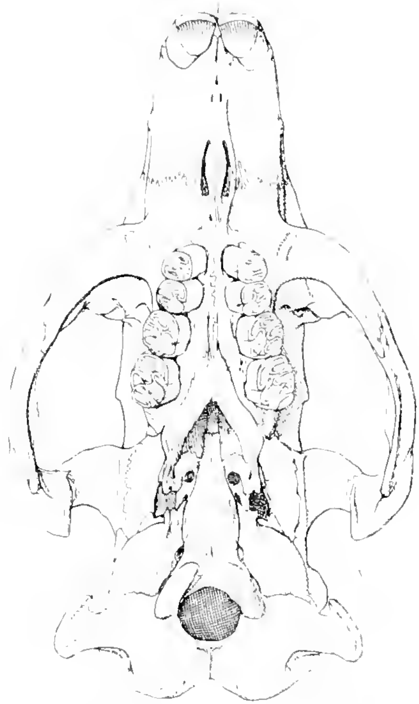


FIG. 21. MYOCASTOR COYPUS SANTAECRUZAE, Hollister.
B.M. No. 16.10.3.85; × $\frac{4}{5}$.

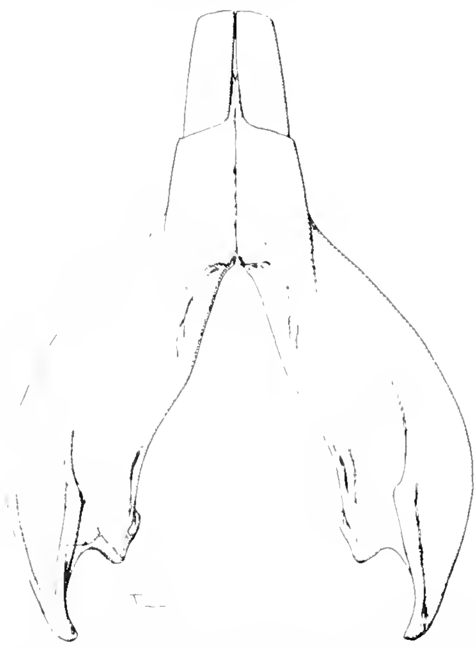


FIG. 22. MYOCASTOR COYPUS SANTAECRUZAE, Hollister.
Mandible from below: B.M. No. 16.10.3.85; × $\frac{4}{5}$.

FIG. 23. MYOCASTOR COYPUS SANTAECRUZAE, Hollister.
B.M. No. 16.10.3.85; $\frac{4}{5}$.

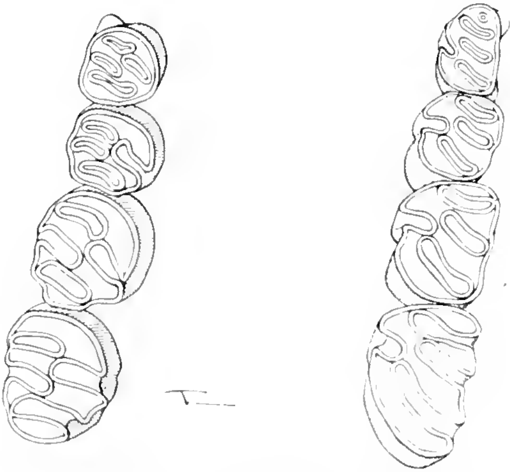


FIG. 24. MYOCASTOR COYPUS SANTAECRUZAE, Hollister.
Cheekteeth: B.M. No. 16.10.3.85; × 2.

2. MYOCASTOR COYPUS BONARIENSIS, Geoffroy

1806 (1805). Ann. Mus. d'Hist. Nat. VI, p. 82.
Paraguay.
Synonym: *castorides*, Barrow, 1815, Trans. Linn. Soc. London, XI, p. 167. Brazil (?)

3. MYOCASTOR COYPUS SANTAECRUZAE, Hollister

1914. Proc. Biol. Soc. Washington XXVII, p. 57.
Rio Salado, near Los Palmaros, Santa Cruz, Argentina.

Subfamily THRYONOMYINAE

Geographical Distribution.—Africa, widely distributed south of the Sahara. "Central and East Africa from Bahr-el-Ghazal and Uganda to Eastern Cape Province" (St. Leger); Nigeria; Angola; *T. swinderianus* group; Kenya, Uganda, North Congo and Nyasaland, *T. gregorianus* group.

Number of Genera.—One.

Characters.—Skull massive, excessively prominently ridged; cheekteeth rooted, similar in pattern to some of the genera of Echimyinae; incisors powerful, the upper ones heavily three-grooved; paroccipital processes elongated; occipital region of skull extremely powerfully developed. Arrangement of digits of fore and hindfoot perissodactyle; hallux entirely suppressed; D.5 of manus vestigial; claws thick and heavy, more or less fossorial. The shoulder-blade as described by Tullberg is apparently peculiar, and not like that of the other Echimyidae examined by him.

Remarks.—As indicated above, without comparing the shoulder-blade of this animal with all other genera included here, it is not wise to base a separate family on this alone. The digit reduction, unique in the present family, is too uncertain a character in other groups to base family characters on. Nevertheless I am not sure that this animal is rightly referred to the present family, or if it is an entirely distinct offshoot; it seems to stand alone rather in the Hystricoid group, though having no very striking characters to separate it off from the remainder of the more normal genera.

Genus 1. THRYONOMYS, Fitzinger

1827. Aulacodus, Temminck, Mon. Mam. Tab. Méth., p. xxvi. (Not of Eschscholtz.) (*Aulacodus swinderianus*, Temminck.)

1867. Thryonomys, Fitzinger, Sitz.-B. K. Akad. Wiss. Wien, Math. Nat. Cl., 56, p. 141.

1922. Choeromys, Thomas, Ann. Mag. Nat. Hist. 9, IX, p. 390. (*Thryonomys gregorianus*, Thomas.)

Type Species.—*Aulacodus semipalmatus*, Heuglin.

Range.—As in the subfamily Thryonomyinae.

Number of Forms.—Ten.

Characters.—Skull very prominently ridged; rostrum high, broad, rather reminiscent of *Pedetes* except that the nasals are less arched and the zygomatic plate is not specially projected forwards; jugal and zygoma thick, not markedly angular, the jugal nearly in contact with the lachrymal, the zygomatic region bearing some resemblance to that of *Pedetes*. Frontals broad, with sharp angular depression immediately in front of the suture formed by the frontals and parietals each side, in adult. Infraorbital foramen very large, with well marked canal for nerve transmission. Parietals converging into an excessively high sagittal ridge; occipital region high and prominent; bullae moderate in size; paroccipital processes considerably lengthened (less so than *Myocastor*, probably more so than other Echimyidae). Bony palate extending slightly behind M.3; the palate straight, broad; palatal foramina very broad and large. Mandible with moderate coronoid process, angular portion low, drawn backwards to a degree, the mandible very heavily ridged and distorted outwards.

Cheekteeth semi-hypsodont, broad and heavy; the enamel surrounding the folds thick, the folds broad originally, tending to become narrower with wear, evidently not isolating on crown surface to any degree. Upper cheekteeth with two outer, one inner folds; lower teeth reversing the pattern, P.4 with small extra inner fold. In old age, the pattern wears out.

Incisors very broad and powerful, probably more so than in any other Rodent, the upper ones three-grooved, the main groove normally placed centrally, the second and third placed between this and the inner edge of the teeth.

Externally, size rather large (perhaps approaching 600 mm. head and body); form heavy; fur harsh and bristly. Tail not long, comparatively well haired. Forefoot with three main digits, the centre one longest, a minute pollex, and D.5 so reduced that it must be almost functionless, though the claw is about as well developed as those of digits 2, 3 and 4. Hindfoot lacking hallux; the digits otherwise like those of forefoot, but longer; D.5 greatly reduced. I am told that a specimen kept at the London Zoological Gardens "shed its tail" when picked up, thus recalling a feature which is common in the Echimyinae.

In the *swinderianus* group, the skull is much arched anteriorly; the *gregorianus* group was given the generic name "*Choeromys*" by Thomas on account of the "almost complete absence of the large frontal sinuses present in *Thryonomys*, and so developed as to produce a totally different shape of the opening that leads from the cerebral to the olfactory fossa of the skull. The opening is narrow below, broad above in *Choeromys*, broad below, narrow above in *Thryonomys*, where its upper corners have been compressed by the large frontal sinuses; owing to this absence of sinuses the frontal area is flat instead of convex."

(The tail was also stated to be more reduced in "*Choeromys*," but in this character *T. sclateri* is intermediate, having the tail nearly as long as in the typical group. But in any case the tail is strongly reduced comparatively in the whole genus.)

A cranial character such as this, though clearly marked, does not seem of generic importance when one takes into account the differences to be found in the skull of other Hystricoid genera, for instance, *Coendou*, in which closely related forms (as *laenatum* and *mexicanum*) may have the skull in the one case arched, in the other flat; or *Hystrix*, in which the nasals vary extremely, even in

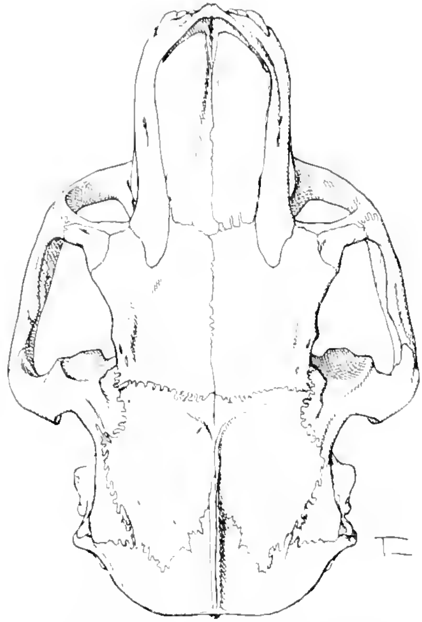


FIG. 25. THRYONOMYS GREGORIANUS GREGORIANUS, Thomas.
B.M. No. 34.6.2.68, ♀; × 1.

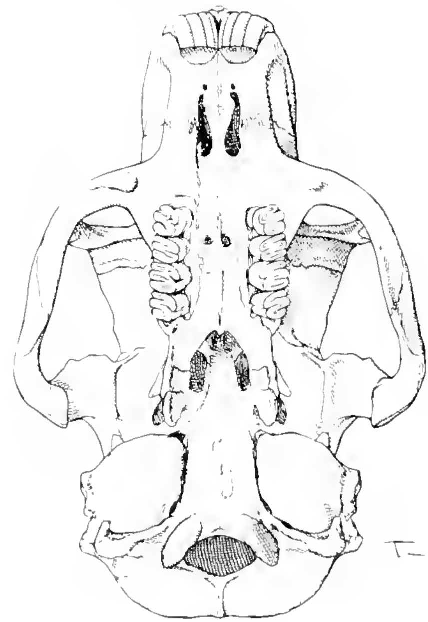


FIG. 26. THRYONOMYS GREGORIANUS GREGORIANUS, Thomas.
B.M. No 34.6.2.68, ♀; × 1.

FIG. 27. THRYONOMYS GREGORIANUS GREGORIANUS, Thomas.
B.M. No. 34.6.2.68, ♀; × 1.

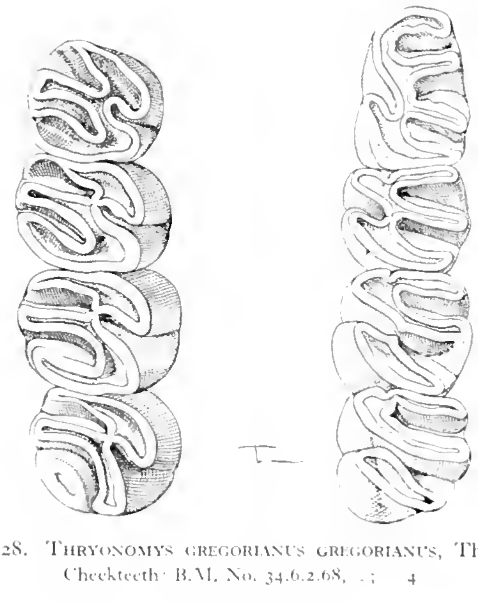


FIG. 28. THRYONOMYS GREGORIANUS GREGORIANUS, Thomas.
Cheekteeth: B.M. No. 34.6.2.68, ♀; × 4

the closely allied African Crested Porcupines (*cristata* compared with *africae-australis*); these two groups of *Thryonomys* are so essentially similar in all other characters that I do not think *Choeromys* is worth retaining even as a subgenus.

Forms seen: *angolae*, *congicus*, *gregorianus*, *harrisoni*, *raptorum*, *sclateri*, *swinderianus*, *variegatus*.

List of Named Forms

(References and type localities by Mr. G. W. C. Holt.)

swinderianus Group

1. THRYONOMYS SWINDERIANUS SWINDERIANUS, Temminck

1827. Monogr. Mamm. 1, p. 248.
Sierra Leone. (For full range of specific group see "Subfamily Thryonomyinae," page 144.)

2. THRYONOMYS SWINDERIANUS VARIEGATUS, Peters

1852. Reise nach Mozambique, Zool. Säug, p. 138.
Africa. Was first mentioned in Manuscript, Peters, 1845, and recorded from Tette, Macanga, Sena and Boror.
Synonym: *calamophagus*, de Beerst, 1897, Pousargues. Bull. Mus. Paris, p. 160. Nyasa, Central Africa.
semipalmatus, Heuglin, 1864, Nov. Act. Acad. Leop. Dresden, XXXI, p. 6. Central Africa.

3. THRYONOMYS SWINDERIANUS RAPTORUM, Thomas

1922. Ann. Mag. Nat. Hist. 9, IX, p. 392.
Nigeria, Lagos.

4. THRYONOMYS SWINDERIANUS ANGOLAE, Thomas

1922. Ann. Mag. Nat. Hist. 9, IX, p. 392.
Angola, junction of Luandu and Cuje Rivers.

gregorianus Group

5. THRYONOMYS RUTSHURICUS, Lonnberg

1918. Stockholm. Vet, Ak. Handl. 58, no. 2, p. 78.
Central Africa, Rutshuru, east of Rutshuru River, half-way between Lake Albert Edward and Lake Kivu.

6. THRYONOMYS GREGORIANUS GREGORIANUS, Thomas

1894. Ann. Mag. Nat. Hist. 6, XIII, p. 202.
Luiji Reru River, Kiroyo, Kenya.

7. THRYONOMYS GREGORIANUS PUSILLUS, Heller

1912. Smiths. Misc. Coll. LIX, no. 16, p. 17.
Ndi, Taita Hills, Kenya.

8. THRYONOMYS HARRISONI HARRISONI, Thomas & Wroughton

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 384.
Lado (Anglo-Egyptian Sudan), Loka, 60 miles S.-W. of Fort Berkeley.

9. THRYONOMYS HARRISONI CONGICUS, Thomas

1922. Ann. Mag. Nat. Hist. 9, IX, p. 390.
Uele River, Belgian Congo.

10. THRYONOMYS SCLATERI, Thomas

1897. Proc. Zool. Soc. London, p. 432.
Nyika Plateau, Nyasaland.

Addenda (*gregorianus* group):

THRYONOMYS LOGONENSIS, Jeannin.

1936. Mamm. Sauvages du Cameroun, Encycl. Biol. 16, p. 178.
Borders of Logone, Chad district, French Equatorial Africa.

T. rutshuricus, not seen, is described as a very short-tailed form, probably nearest the *gregorianus* group. *T. harrisoni* has a narrower skull than in allies.

Subfamily PETROMYINAE

Geographical Distribution.—South-west Africa.

Number of Genera.—One.

Characters.—Cheekteeth rooted, but showing considerable simplification of pattern; only one fold on each side in the upper series; the internal side of the upper series and the external side of the lower series marked by two elevations, the teeth strongly hypsodont. External form small, generalized except for the bushy tail. Bullae much inflated; skull flattened; mandible typically Hystricoid in formation.

Genus 1. PETROMUS, Smith

1831. Petromus, Smith, South Afr. Quart. Journ. 1, no. 5, p. 10.

Type Species.—*Petromus typicus*, Smith.

Range.—As in the subfamily.

Number of Forms.—Four.

Characters.—Skull broad and flat, without any constriction in the interorbital region; infraorbital foramen with canal for nerve transmission; bullae considerably inflated, the paroccipital processes joining them; palatal foramina deep and long, well open, extending to toothrow; palate extending slightly behind the toothrows, relatively narrow. Angular portion of mandible slanting downwards posteriorly. Incisors opisthodont.

Cheekteeth as described above, the elevations clear and well marked, the teeth set obliquely, the folds broad. Lower teeth with one fold on each side in adult, as in the upper series. Pattern ultimately obliterated with wear.

External form more or less Rat-like except for the tail, which is bushy, and not very much shorter than the head and body. Feet narrow, with short claws; four main digits well developed on both fore and hindfeet, D.5 nearly as long as the others; pollex vestigial, hallux short. Some stiff bristle hairs present on hindtoes, as in Octodontinae.

The zygoma is relatively broad, sometimes with weak process on the lower border. The mandible is clearly distorted outwards in the angular process, like typical Hystricoids, but unlike Ctenodactylidae, with which this genus has been associated; the coronoid is low, the angular portion drawn backwards.

Forms seen: *typicus*, *tropicalis*, *cunealis*.

cunealis was described as a species, but is probably best regarded as a race as there seems very little essential difference between it and *typicus*.

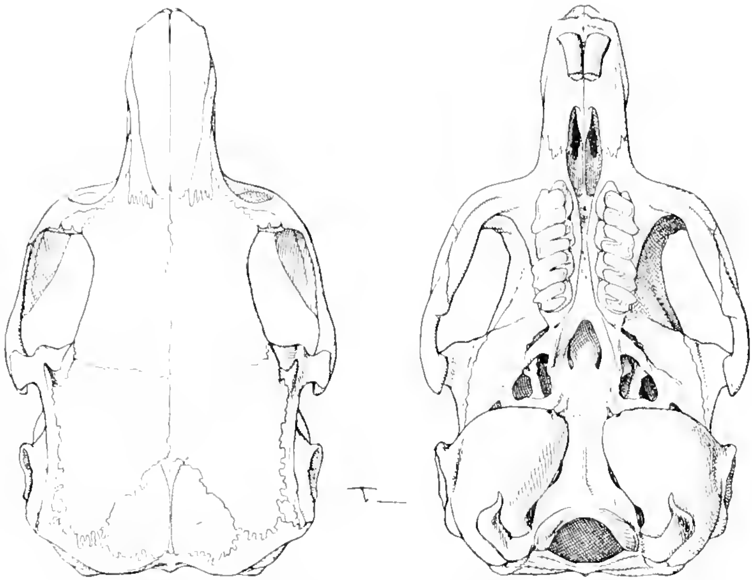


Fig. 29. Petromus typicus typicus, Smith.
B.M. No. 12.4.25.12 ♂; 2.

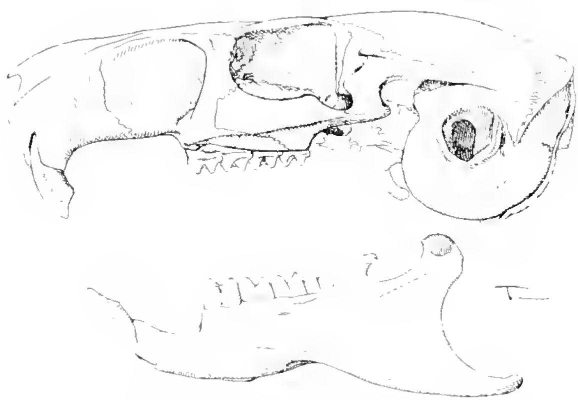


Fig. 30. Petromus typicus typicus, Smith.
B.M. No. 12.4.25.12 ♂; 2.

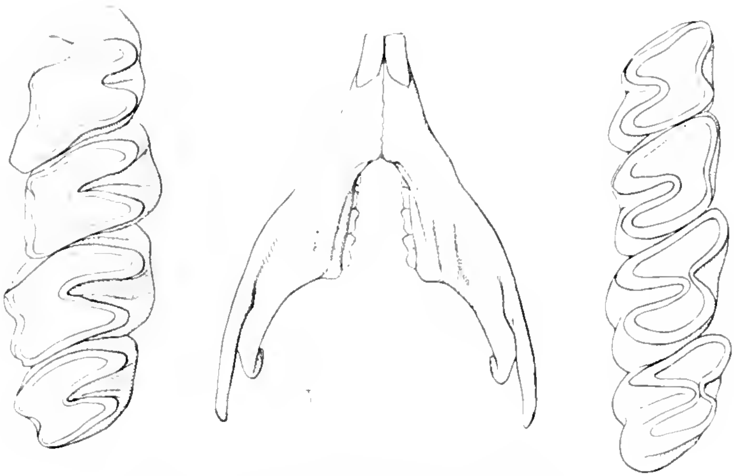


FIG. 31. PETROMUS TYPICUS TYPICUS, Smith.
Mandible from below × 2; cheekteeth × 7; B.M. No. 12.4.25.12, ♂.

LIST OF NAMED FORMS

(References and type localities by Mr. G. W. C. Holt.)

1. PETROMUS TYPICUS TYPICUS, Smith

1831. South Afr. Quart. Journ. 1, no. 5, p. 11.
Mouth of Orange River, South Africa.

2. PETROMUS TYPICUS TROPICALIS, Thomas & Hinton

1925. Proc. Zool. Soc. London, p. 241.
Karibib, S.-W. Africa.

3. PETROMUS TYPICUS MARJORIAE, Bradfield

1935. Descr. new races of Kalahari Birds and Mammals, 2 pp. 1935.
Khan River, S.-W. Africa.

4. PETROMUS TYPICUS CUNEALIS, Thomas

1926. Proc. Zool. Soc. London, p. 307.
Cunene River Falls, S.-W. Ovamboland, S.-W. Africa.

Subfamily ABROCOMINAE

GEOGRAPHICAL DISTRIBUTION.—Northern Chile and Argentina.

NUMBER OF GENERA.—One.

CHARACTERS.—Cheekteeth evergrowing, the upper teeth simplified, each tooth cut into two lobes by one wide re-entrant fold on each side; lower teeth complex, with one outer, two inner deep folds, the spaces caused by these folds sharply angular. Part of lachrymal canal open on side of rostrum in front of orbit. Bullae greatly inflated. External form not highly modified; tail haired, relatively short.

REMARKS.—Miller & Gidley refer this form to a distinct family; for discussion of the retention of the genus in the Echimyidae see page 103.

Genus 1. ABROCOMA, Waterhouse

1837. ABROCOMA, Waterhouse, Proc. Zool. Soc. London, p. 30.

TYPE SPECIES.—*Abrocoma bennetti*, Waterhouse.

RANGE.—As in the subfamily Abrocominae.

NUMBER OF FORMS.—Seven.

CHARACTERS.—Rostrum long and narrow, braincase round, not ridged, frontals considerably constricted (for a member of this group). No canal for transmission of nerve in the infraorbital foramen. Palate straight, short and relatively narrow; palatal foramina very long and narrow, totally different from that of Octodontinae, but reminiscent of the Chinchillidae. Zygoma simple. Anterior ascending maxillary portion of zygoma extremely narrow; jugal widely separated from the lachrymal. Bullae very large indeed,

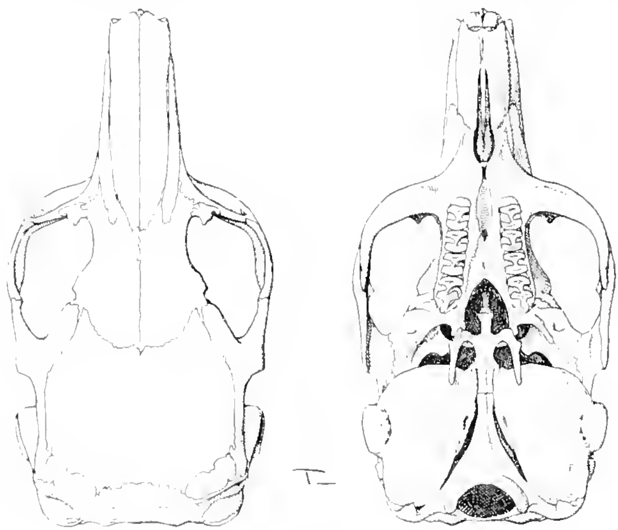


FIG. 32. ABROCOMA BENNETTI BENNETTI, Waterhouse.
B.M. No. 4.1.7.7. ♂; × 1½.

FIG. 33. ABROCOMA BENNETTI BENNETTI, Waterhouse.
B.M. No. 4.1.7.7., ♂; 1½.

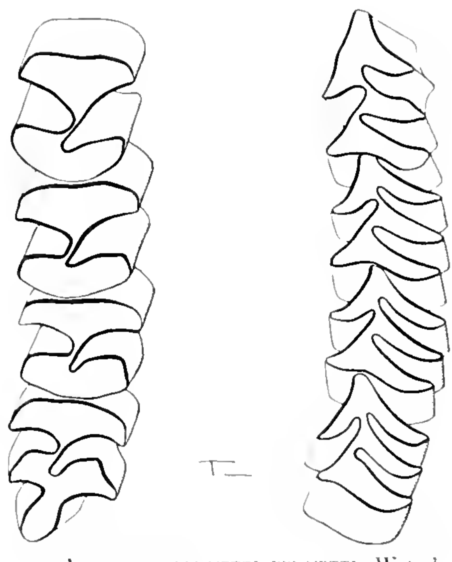


FIG. 34. ABROCOMA BENNETTI BENNETTI, Waterhouse.
Cheekteeth: B.M. No. 4.1.7.7., ♂; 7.

the mastoids appearing to a degree in superior aspect of skull. Incisors narrow. Mandible with very narrow angular process drawn sharply backwards, a wide curved space separating the condyle from the angular process; coronoid low.

Lobes of upper cheekteeth united by a narrow bridge; M.3 with backwardly projecting heel caused by a small extra outer fold. The folds are strong, and rather wide. Lower teeth quite different in appearance from the upper series (a rare feature in the Order); two inner, one outer folds; general pattern not far removed from that present in *Capromys*, but effect very different, folds widely open, not filled.

Externally, fur very soft as a rule; tail usually short, but well haired, ear relatively large. Forefoot short, with four digits, the claws small; hindfoot with a reduced hallux, D.5 shorter than the three central digits. Claws weak. Some stiff bristle-hairs present on the central digits of the hindfoot, as in Chinchillidae and Octodontinae.

According to Waterhouse the skeleton of *A. bennetti* bears a greater number of ribs than is usual; the number quoted is seventeen pairs, which he compares with *Capromys* and *Coendou*, in which genera sixteen are said to be present.

Two specific groups may be recognized, according to London material, the members of which do not seem to me to be more than racially distinct from each other.

The *bennetti* group contains relatively larger forms (hindfoot 31–38), colour more brown, posterior palatal foramina fused and conspicuous between toothrows.

The *cinerea* group contains relatively smaller forms (hindfoot 31 or usually less), colour grey, posterior palatal foramina not conspicuous between toothrows, vestigial.

Forms seen: *bennetti*, *budini*, *cinerea*, *famatina*, *murrayi*, *schistacea*, *vaccarum*.

List of Named Forms

(References and type localities by Mr. G. W. C. Holt.)

bennetti Group

1. ABROCOMA BENNETTI BENNETTI, Waterhouse

1837. Proc. Zool. Soc. London, p. 31.
Flanks of Cordillera, Aconcagua, Chile.
Synonym: *cuvieri*, Waterhouse, 1837, Proc. Zool. Soc. London, p. 32. Valparaiso, Chile.
helvina, Wagner, 1842, Arch. Naturg. 1, p. 7. Chile.

2. ABROCOMA BENNETTI MURRAYI, Wolffsohn

1916. Rev. Chilena, p. 6.
Vallenar, Province Atacama, Chile.

cinerea Group

3. ABROCOMA CINEREA CINEREA, Thomas

1919. Ann. Mag. Nat. Hist. 9, IV, p. 132.
Casabindo Volcano, Jujuy, North Argentina.

4. ABROCOMA CINEREA BUDINI, Thomas

1920. Ann. Mag. Nat. Hist. 9, V, p. 475.
Otro Cerro, 18 kilometres north-west of Chumbicha, Catamarca, Argentina.

5. ABROCOMA CINEREA FAMATINA, Thomas

1920. Ann. Mag. Nat. Hist. 9, VI, p. 419.
La Invernada, Rioja, Argentina (18 kilometres north-west of Nevada de Famatina).

6. ABROCOMA CINEREA SCHISTACEA, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 216.
Los Sombreros, Sierra Tontal, San Juan, Argentina.

7. ABROCOMA CINEREA VACCARUM, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 217.
Punta de Vacas, Mendoza, Argentina.

Subfamily OCTODONTINAE

Geographical Distribution.—Neotropical: Peru, Bolivia and Matto Grosso southwards to Southern Patagonia.

Number of Genera.—Six.

Characters.—Cheekteeth, both upper and lower, completely simplified, with, in the upper series, one fold each side in less simplified forms, general effect eight-shaped or "kidney-shaped." Bullae normally much inflated. No part of lachrymal canal open on side of rostrum. Externally generalized, or modified for subfossorial life. Some stiff bristle-hairs present on toes of hindfeet.

The generalized forms include *Octomys* (tail thickly bushy, bullae largest in subfamily, cheekteeth eight-shaped); *Octodontomys* (similar externally, but bullae slightly smaller, and cheekteeth completely simple); and *Octodon* (tail less bushy, bullae smaller than the above genera, and cheekteeth more or less kidney-shaped in adult). The subfossorial types include *Aconaemys* (cheekteeth like *Octomys*, upper incisors not abnormal, bullae moderate in size); *Spalacopus* (small forms with the upper incisor extending backwards and almost overlapping the toothrows, bullae relatively small); and *Ctenomys* (differing from the above two genera in the much larger foreclaws, more heavily ridged skull, particularly the zygoma, kidney-shaped cheekteeth, with vestigial M.3; the bullae are relatively large; the incisors are not so extreme as in *Spalacopus*).

In this group, there is always an upwardly pointing process on the posterior border of the jugal, which, however, varies in development, being most extreme usually in *Ctenomys*.

Key to the Genera of Octodontinae

External form considerably modified for subfossorial life. Tail strongly reduced, not much longer than hindfoot.

Cheekteeth simpler, kidney-shaped; skull more heavily ridged for muscle attachment; foreclaws strongly lengthened. (Incisor root in upper series not tending to overlap toothrow; bullae relatively large.) CTENOMYS

Cheekteeth more complex, more or less eight-shaped, or completely so; skull less heavily ridged for muscle attachment; foreclaws less lengthened.

Re-entrant folds of upper molars not meeting in middle of the teeth; upper incisors strongly pro-odont, their roots extending backwards, forming a projection by the side of and almost overlapping the upper toothrow; bullae small (for the subfamily). SPALACOPUS

Re-entrant folds of upper molars meeting in middle of the teeth; upper incisors less pro-odont, not abnormal. Bullae larger. ACONAEMYS

External form not modified for subfossorial life. Tail not much reduced, little shorter than head and body (or may be longer than this measurement). (Bullae strongly inflated.)

Re-entrant folds of upper molars meeting in middle of the teeth; general dental effect clearly eight-shaped. (Tail bushy; bullae at maximum for subfamily.) OCTOMYS

Re-entrant folds of upper molars not meeting in middle of the teeth; general dental effect not eight-shaped.

Cheekteeth completely simple, the folds obsolete. (Tail bushy; bullae relatively larger.) OCTODONTOMYS

Cheekteeth not completely simple, the effect becoming kidney-shaped, the folds not obsolete. (Tail less bushy; bullae relatively smaller.) OCTODON

Genus 1. OCTOMYS, Thomas

1920. OCTOMYS, Thomas, Ann. Mag. Nat. Hist. 9, VI, p. 117.

TYPE SPECIES.—*Octomys mimax*, Thomas.

RANGE.—Argentina (Catamarca, San Juan).

NUMBER OF FORMS.—Two.

CHARACTERS.—Skull without constriction in interorbital region, and not prominently ridged for muscle attachment. Occipital region relatively weak. Bullae large and much inflated, largest of subfamily, mastoids visible in superior aspect of skull; palate nearly straight, narrow, V-shaped posteriorly, relatively short. Palatal foramina short, broad, with broad median septum. Rostrum pointed, not shortened. Infraorbital foramen with a canal for nerve transmission. A capsule on mandible at root of M.2. Coronoid process low.

Cheekteeth complex for the group; clearly eight-shaped, the folds meeting in the middle of the tooth; M.3 the smallest tooth.

External form not modified for fossorial life; fur very soft; tail about as long as head and body or slightly longer, heavily haired. Claws small; forefoot with four well developed digits and rudimentary pollex; hindfoot with hallux short, D.5 shorter than the three central digits.

Forms seen: *mimax*, *joannius*.

I am listing "*joannius*" provisionally as a race, though I think it is very probable that the two forms are based on the same animal.

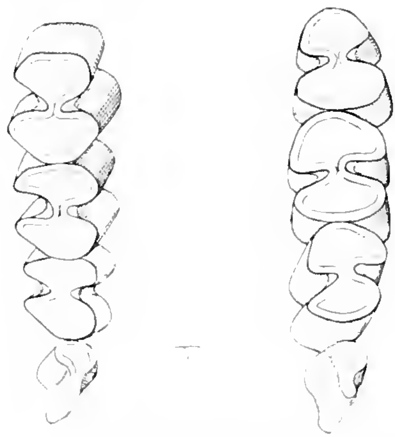


FIG. 35. OCTOMYS MIMAX MIMAX, Thomas.
B.M. No. 20.5.11.32, ♂; × 8.

LIST OF NAMED FORMS

(References and type localities for all species of Octodontinae have been collected by Mr. G. W. C. Holt.)

1. OCTOMYS MIMAX MIMAX, Thomas
1920. Ann. Mag. Nat. Hist. 9, VI, p. 118.
La Puntilla, Tinogasta, Catamarca, Argentina.

2. OCTOMYS MIMAX JOANNIUS, Thomas
1921. Ann. Mag. Nat. Hist. 9, VIII, p. 217.
Pedernal, San Juan, Argentina.

Genus 2. ACONAEMYS, Ameghino

1891. ACONAEMYS, Ameghino, Revista Argent. de Hist. Nat. 1, p. 245.
1841. SCHIZODON, Waterhouse, Proc. Zool. Soc. London, p. 89. (Not of Agassiz.)

TYPE SPECIES.—*Schizodon fuscus*, Waterhouse.

RANGE.—Southern Chile and Argentina.

NUMBER OF FORMS.—Two.

CHARACTERS.—Essentially like *Octomys* dentally; cranially differing in the rather shortened rostrum; the palatal foramina short, small (infraorbital foramen with canal for nerve transmission); the bullae much smaller, of medium size. Coronoid process moderate. Incisors rather broad. M.3 tends to have the posterior lobe reduced, both above and below.

Externally modified for fossorial life; arrangement of digits about as in *Octomys*; claws enlarged to a degree; ear moderate-sized, not strongly reduced; tail haired, not much longer than hindfoot.

REMARKS.—This genus is very much the most generalized of the three fossorial Octodontinae, both in external and dental characters.

The two species are closely allied, and differ chiefly in the quality of the fur.

Forms seen: *fuscus*, *porteri*.

LIST OF NAMED FORMS

1. ACONAEMYS FUSCUS, Waterhouse

1841. Proc. Zool. Soc. London, p. 91.
Valle de las Cuevas, eastern slope of Andes, Argentina.

2. ACONAEMYS PORTERI, Thomas

1917. Ann. Mag. Nat. Hist. 8, XIX, p. 281.
Osorno, Southern Chile.

Genus 3. OCTODON, Bennett

1832. OCTODON, Bennett, Proc. Zool. Soc. London, p. 46.

TYPE SPECIES.—*Octodon cumingii*, Bennett.

RANGE.—Chile and Peru.

NUMBER OF FORMS.—Six.

CHARACTERS.—Skull essentially like that of *Octomys*; the weak parietal ridges may come together in old age; bullae relatively smaller than in either *Octomys* or *Octodontomys*; infraorbital foramen with canal for nerve transmission.

Cheekteeth becoming modified and transitionary towards those of *Ctenomys*; anterior part in upper series projecting outwards; lower teeth with posterior part pointing inwards. The upper teeth have a small inner fold retained; the lower teeth are more eight-shaped than in *Ctenomys*, but much less so than in *Octomys* and *Aconaemys*. When cut, though simple, they are nearer the *Octomys* type; the folds of the upper series nearly meet, though the adult pattern is suggested already.

External form somewhat Rat-like; fur typically much less soft than in *Octodontomys* and *Octomys*. Ear large; tail rather shorter than head and body, less well haired than in *Octomys*, scales traceable; moderately haired except at end, which is slightly bushy. *O. bridgesii* is a softer-furred form.

Forms seen: *bridgesii, clivorum, degus.*

Waterhouse synonymized *pallidus* and *cumingii* with *degus*; they are provisionally listed here as subspecies, though I have seen neither, and they may prove either synonymous or valid.

List of Named Forms

1. OCTODON DEGUS DEGUS, Molina
1782. Sagg. Storr. Nat. Chili, 1st Ed., p. 303.
Chile.

2. OCTODON DEGUS CLIVORUM, Thomas
1927. Ann. Mag. Nat. Hist. 9, XIX, p. 556.
Puente Alto, Santiago, Chile.

3. OCTODON DEGUS PERUANA, Waterhouse
1848. Nat. Hist. Mammalia, ii, p. 257.
San Juan de Matucana, Lima, Peru.

4. OCTODON DEGUS CUMINGII, Bennett
1832. Proc. Zool. Soc. London, p. 47.
Between Valparaiso and Santiago, Chile.

5. OCTODON DEGUS PALLIDUS, Wagner
1845. Arch. Naturg. 2, p. 33.
Chile.

6. OCTODON BRIDGESII, Waterhouse
1844. Proc. Zool. Soc. London, p. 155.
Chile.

The name *franziusi* listed by Trouessart in this genus (Cat. Mamm. viv. foss. 1904, Suppl., p. 500), is according to Tate a Geomyid.

Genus 4. OCTODONTOMYS, Palmer

1902. Neoctodon, Thomas, Proc. Zool. Soc. London, i, p. 114 (pre-occupied).
1903. Octodontomys, Palmer, Science, 2, XVII, p. 873.

Type Species.—*Neoctodon simonsi*, Thomas = *Octodon gliroides*, Gervais & D'Orbigny.

Range.—Bolivia.

Number of Forms.—One.

Characters.—Cheekteeth simpler than in *Octodon*, the folds obsolete, a slight concavity on outer side of upper molars; lower molars with slight median constriction each side. Skull essentially as in *Octomys* except the relatively smaller bullae, which, however, are larger than those of *Octodon*. Infraorbital foramen with canal for nerve transmission.

Essential external characters as *Octomys*; tail thickly bushy, fur very soft.

Forms seen: *gliroides.*

List of Named Forms

1. OCTODONTOMYS GLIROIDES, Gervais & D'Orbigny

1844. Bull. Soc. Philom. p. 22.
Bolivian Andes, near La Paz.
Synonym: *simonsi*, Thomas, 1902, Proc. Zool. Soc. London, i, p. 115.
Potosi, Bolivia.

Genus 5. SPALACOPUS, Wagler

1832. Spalacopus, Wagler, Isis, XXV, p. 1219.

Type Species.—*Spalacopus poeppigi*, Wagler.

Range.—Chile.

Number of Forms.—Two.

Characters.—Skull with the same essential characters as *Octomys*, but frontals appear narrower, and upper incisors strongly pro-odont, and much lengthened, extending backwards to a level of about M.1 and forming a projection by the side of and almost overlapping the toothrow.

Fig. 36. Spalacopus cyanus, Molina.
B.M. No. 1.3.21.14, ♂; × 2½.

Bullae smaller than in all other Octodontinae, not much inflated. Palatal foramina small. Infraorbital foramen with no separate canal for nerve transmission. Coronoid process prominent.

Cheekteeth eight-shaped, but the folds not meeting in the middle of the tooth, the general effect rather simpler than *Octomys*; M.3 above and below smaller, simpler.

Externally typically smaller than other genera, about the smallest living Hystricoid Rodent. Colour very dark. Considerably modified for fossorial life; tail short, hairy, little longer than hindfoot; claws not greatly enlarged. Arrangement of digits about as *Octomys*. Ear small.

REMARKS.—The broad abnormally lengthened upper incisors differentiate this genus clearly from all allies, and notwithstanding its small size it may be considered one of the most specialized of the group. The teeth too are more simplified than in *Octomys* and *Aconaemys*, but the smaller bullae suggest a more generalized character.

S. tabanus appears to represent a larger form than the type, but is not well known.

Forms seen: *cyanus*, *tabanus*.

LIST OF NAMED FORMS

1. SPALACOPUS CYANUS, Molina

1782. Sagg. Stor. Nat. Chili, 1st Ed. p. 300.
Chile.
Synonym: *poeppigi*, Wagler, 1832, Isis, XXV, p. 1219. Quintero, Rio Aconcagua, Chile.
ater, Cuvier, 1834, Ann. Sci. Nat. 1, p. 323. Coquimbo.
noctivagus, Poeppig, 1835, Arch. Naturg. 1, p. 252. Quintero, Rio Aconcagua, Chile.

2. SPALACOPUS TABANUS, Thomas

1925. Ann. Mag. Nat. Hist. 9, XV, p. 585.
South Chile.

Genus 6. CTENOMYS, Blainville

1826. CTENOMYS, Blainville, Bull. Soc. Philom. p. 62.
1916. HAPTOMYS, Thomas, Ann. Mag. Nat. Hist. 8, XVIII, p. 305; subgenus for *C. leucodon*, Waterhouse.

TYPE SPECIES.—*Ctenomys brasiliensis*, Blainville.

RANGE.—South Brazil (Matto Grosso), Bolivia, Paraguay, Argentina (Buenos Ayres region, Jujuy, Salta, Tucuman, Catamarca, San Juan, Cordoba, Mendoza, etc.), Patagonia south to Tierra del Fuego; Chile.

NUMBER OF FORMS.—Approximately sixty-one are named.

CHARACTERS.—Skull with broad rostrum, postorbital process usually present to frontals, their development variable; parietals well ridged, though evidently most often a sagittal crest is not formed; lambdoid crest prominent; bullae large, pear-shaped, spread sideways; paroccipital processes large, curved under them (the bullae show prominently on each side when skull is viewed from behind). Palate essentially as in other Octodontinae; palatal foramina usually short; jugal with extremely prominent upwardly projecting process in larger forms; this process always present, usually well developed.

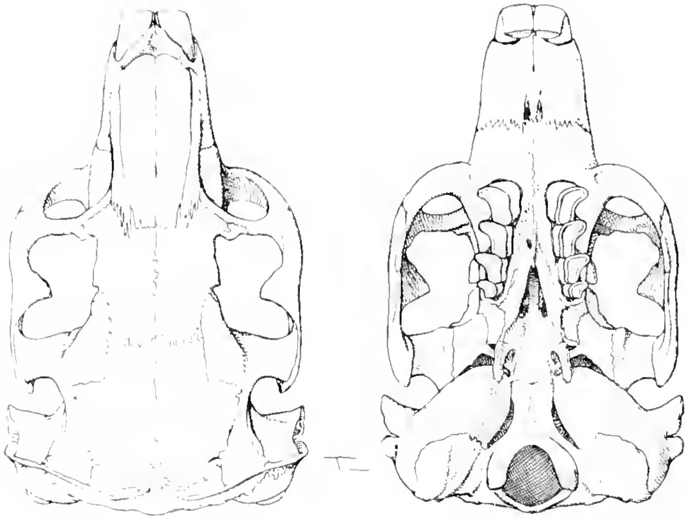


FIG. 37. CTENOMYS TUCONAX, Thomas.
B.M. No. 25.3.1.19, ♀; × 1½.

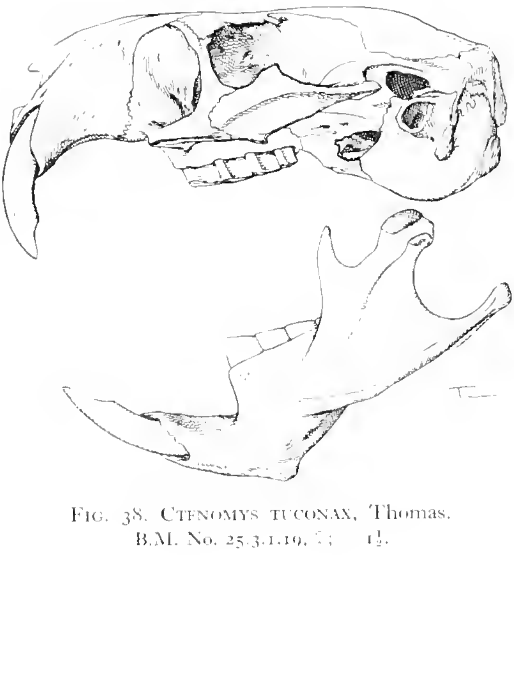
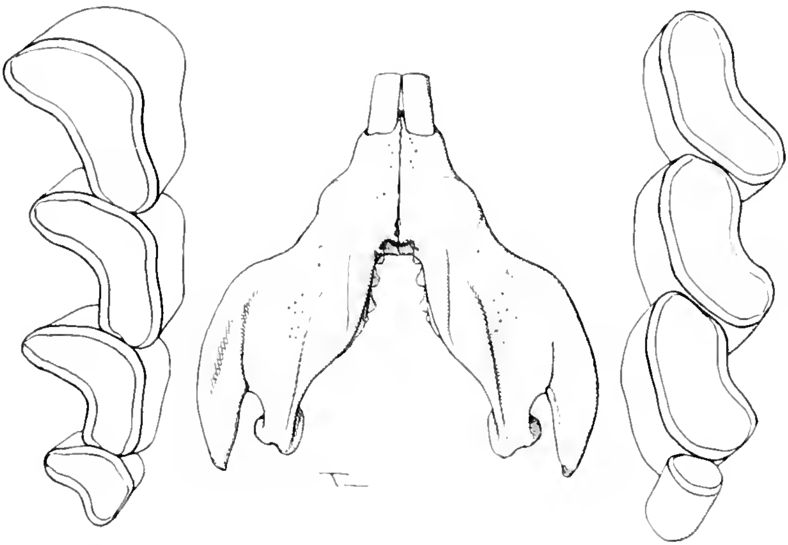


FIG. 38. CTENOMYS TUCONAX, Thomas.
B.M. No. 25.3.1.19, ♀; × 1½.

Infraorbital foramen with no canal for nerve transmission. Upper incisor root extending far backwards, and showing on inner border of infraorbital foramen, though not so extremely as in *Spalacopus*. Mandible with angular processes widely spreading, sharply distorted outwards; coronoid process moderate.

Incisors much thickened, usually not pro-odont, except in *leucodon* and *lewisi*. Cheekteeth like *Octodon*, but simpler, the small inner fold obsolete in the upper molars. M. $\frac{3}{3}$ vestigial.



a. *b.*

FIG. 39. CTENOMYS TUCONAX, Thomas.
Mandible from below, × 1½; Cheekteeth, × 6: B.M. No. 25.3.1.19, ♀.

Externally much modified for subfossorial life; eyes and ears reduced; forefoot with extremely large claws (pollex less reduced than is normal); hindfoot with moderate claws; hallux rather less reduced than in other Octodontinae, otherwise general arrangement of digits like allied genera; tail strongly shortened though not vestigial, moderately or poorly haired.

Forms seen: *antonii*, *azarae*, *barbarus*, *bergi*, *boliviensis*, *budini*, *coludo*, *dorsalis*, *emilianus*, *fochi*, *fodax*, *frater*, *fueginus*, *fumosus*, *fulvus*, *goodfellowi*, *haigi*, *johannis*, *juris*, *knighti*, *latro*, *lentulus*, *leucodon*, *lewisi*, *luteolus*, *magellanicus*, *mendocina*, *mordosus*, *nigriceps*, *occultus*, *opimus*, *perrensi*, *pontifex*, *porteousi*, *recessus*, *saltarius*, *sericeus*, *steinbachi*, *sylvanus*, *talarum*, *torquatus*, *tuconax*, *tucumanus*, *tulduco*, *utibilis*, *viperinus*.

This genus is undoubtedly in great need of revision. The forms seem extremely closely allied to each other, generally speaking, though most of them are standing at present as distinct "species." There is great difference in size between some of the forms, *emilianus*, *tuconax*, and *nigriceps* having a hindfoot measurement of 38 mm. and forms like *recessus* and *occultus* only 26 mm. But intermediate forms exist between both extremes, so that all hindfoot measurement figures exist within the genus between the figures 38 mm. and 26 mm. *leucodon* and *lewisi*, the latter described as semi-aquatic, have more pro-odont upper incisors than the others. Three large Bolivian types, *boliviensis*, *goodfellowi* and *steinbachi*, appear to have a skull which is broader than normal, particularly in the region of the muzzle.

The genus has been reviewed by Rusconi, 1928 (Anal. Soc. Arg. Geogr. "Gaea," III, p. 235), who shows the subgenus "*Haptomys*" to be no longer retainable.

I propose for the purposes of the present work to divide the genus into sections. No attempt is made to reduce forms to subspecies, the genus being far too big for a revision to be attempted in the present work; undoubtedly very many "species" now standing will ultimately be regarded as races. There are many forms not represented in the British Museum, though in the case of those that have been seen, except in very few cases, a large and representative series of skins have been examined.

So far as Patagonia is concerned, on British Museum material, there are two well-marked groups, very small types like *magellanicus*, and very large types like *fodax* present only. But elsewhere, there are the "small," "medium," and "large" sections living apparently more or less side by side, the measurements of which grade into each other.

The sections here recognized are as follows, though it must be borne in mind that the plan followed here is no more than provisional, and an attempt to get some order out of considerable chaos.

1. *magellanicus* section: small forms, smallest of genus; hindfoot usually under 30, rarely exceeding this measurement, never more than 32; often 24, 25, 26.
2. *torquatus* section: moderate-sized forms, not becoming very large; hindfoot rarely under 30, never less than 28, usually measurement 31–35; never more than 37.
3. *opimus* section: like the last, but becoming large, approaching maximum for the genus; hindfoot usually over 36, not under 35 excepting one race of *opimus* (*luteolus*), which agrees with the larger members of section 2. At maximum, hindfoot up to 48 (*fodax*); in others as a rule not more than 39.
4. *boliviensis* section: agreeing in measurement with the last, but skull unusually broadened, particularly in the muzzle region. (Bolivia: *boliviensis*, *goodfellowi*, *steinbachi*.)
5. *leucodon* section: incisors strongly pro-odont; hindfoot measurement about 30 (not many seen).
6. *lewisi* section: incisors also pro-odont, hindfoot measurement 32–37; water-side dwelling type. Thomas suggested that this was not a near ally of *leucodon*.

List of Named Forms

magellanicus section

1. CTENOMYS HAIGI HAIGI, Thomas
1919. Ann. Mag. Nat. Hist. 9, III, p. 210.
Maiten, Western Chubut, Argentina.

2. CTENOMYS HAIGI LENTULUS, Thomas
1919. Ann. Mag. Nat. Hist. 9, III, p. 211.
Pilcañeu, Upper Rio Negro, Argentina.

3. CTENOMYS SERICEUS, Allen
1903. Bull. Amer. Mus. XIX, p. 187.
Cordilleras, upper Rio Chico de Santa Cruz, Patagonia.

4. CTENOMYS MAGELLANICUS, Bennett
1835. Proc. Zool. Soc. London, p. 190.
Port Gregory, Straits of Magellan.
Synonym: *neglectus*, Nehring, 1900, Zool. Anz. XXIII, p. 535. Patagonia.

5. CTENOMYS TALARUM TALARUM, Thomas
1898. Ann. Mag. Nat. Hist. 7, I, p. 285.
Los Talas, Ensenada, La Plata, Argentina.

6. CTENOMYS TALARUM ANTONII, Thomas
1910. Ann. Mag. Nat. Hist. 8, V, p. 242.
Los Yngleses ranch, Ajo, eastern Buenos Ayres, Argentina.

7. CTENOMYS TALARUM RECESSUS, Thomas
1912. Ann. Mag. Nat. Hist. 8, IX, p. 241.
Bahia Blanca, Argentina.

8. CTENOMYS MENDOCINA, Philippi
1869. Arch. für Naturg. p. 38.
Mendoza, Argentina.

9. CTENOMYS PONTIFEX, Thomas
1918. Ann. Mag. Nat. Hist. 9, I, p. 39.
East side of Andes, Province of Mendoza, Argentina (near Fort San Rafael).

10. CTENOMYS BERGI, Thomas
1902. Ann. Mag. Nat. Hist. 7, IX, p. 241.
Cruz de Eje, Cordova, Argentina.

11. CTENOMYS FOCHI, Thomas
1919. Ann. Mag. Nat. Hist. 9, III, p. 117.
Chumbicha, Catamarca, Argentina.

12. CTENOMYS TUCUMANUS, Thomas
1900. Ann. Mag. Nat. Hist. 7, VI, p. 301.
Tucuman, Argentina.

13. CTENOMYS LATRO, Thomas
1918. Ann. Mag. Nat. Hist. 9, I, p. 38.
Tapia, Tucuman, Argentina.

14. CTENOMYS OCCULTUS, Thomas

1920. Ann. Mag. Nat. Hist. 9, VI, p. 243.
Monteagudo, 80 kilometres south-east of Tucuman City, Argentina.

15. CTENOMYS SALTARIUS, Thomas

1912. Ann. Mag. Nat. Hist. 8, X, p. 639.
Salta, Northern Argentina.

16. CTENOMYS JURIS, Thomas

1920. Ann. Mag. Nat. Hist. 9, V, p. 194.
El Chaguaral, Jujuy, Argentina, 20 kilometres east of San Pedro de Jujuy, between San Pedro and Villa Carolina.

17. CTENOMYS DORSALIS, Thomas

1900. Ann. Mag. Nat. Hist. 7, VI, p. 385.
Northern Chaco, Paraguay.

torquatus section

18. CTENOMYS PERRENSI, Thomas

1896. Ann. Mag. Nat. Hist. 6, XVIII, p. 311.
Goya, Corrientes, Argentina.

19. CTENOMYS AZARAE, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 228.
37° 45′ S., 65° W., 780 kilometres south-west of Buenos Ayres, Buenos Ayres Province, Argentina.

20. CTENOMYS PORTEOUSI PORTEOUSI, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVIII, p. 304.
Bonifacio, South-west Buenos Ayres, Argentina.

21. CTENOMYS PORTEOUSI AUSTRALIS, Rusconi

1934. Rev. Chili. Nat. Hist. 38, p. 108.
Province Buenos Ayres, Argentina.

22. CTENOMYS TULDUCO, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 218.
Los Sombreros, Sierra Tontal, San Juan, Argentina.

23. CTENOMYS FAMOSUS, Thomas

1920. Ann. Mag. Nat. Hist. 9, VI, p. 420.
Potrerillo, Rioja, Argentina.

24. CTENOMYS COLUDO COLUDO, Thomas

1920. Ann. Mag. Nat. Hist. 9, VI, p. 119.
La Puntilla, Tinogasta, Catamarca, Argentina.

25. CTENOMYS COLUDO JOHANNIS, Thomas

1921. Ann. Mag. Nat. Hist. 9, VII, p. 523.
Cañada Honda, San Juan, Argentina.

26. CTENOMYS VIPERINUS, Thomas

1926. Ann. Mag. Nat. Hist. 9, XVII, p. 605.
Tablelands above Norco, Vipos, Dept. of Trancas, Tucuman, Argentina.

27. CTENOMYS SYLVANUS SYLVANUS, Thomas

1919. Ann. Mag. Nat. Hist. 9, IV, p. 155.
Tartagal, Province Salta, Argentina.

28. CTENOMYS SYLVANUS UTIBILIS, Thomas
1920. Ann. Mag. Nat. Hist. 9, V, p. 193.
Yuto, Rio San Francisco, Argentina, 20 kilometres east of San Pedro de Jujuy.

29. CTENOMYS SYLVANUS MORDOSUS, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 325.
Tambo, 75 kilometres east of Tarija, Bolivia.

30. CTENOMYS BUDINI BUDINI, Thomas
1913. Ann. Mag. Nat. Hist. 8, XI, p. 141.
Cerro de Lagunita, Jujuy, Argentina.

31. CTENOMYS BUDINI BARBARUS, Thomas
1921. Ann. Mag. Nat. Hist. 9, VII, p. 185.
Sunchal, Jujuy, Argentina.

32. CTENOMYS FRATER, Thomas
1902. Ann. Mag. Nat. Hist. 7, IX, p. 228.
Potosi, Bolivia.

33 CTENOMYS TORQUATUS, Lichtenstein
1830. Darstell. Säugethiere, text of Pl. XXXI.
Southern Provinces of Brazil and banks of Uruguay River.

leucodon section

34. CTENOMYS LEUCODON, Waterhouse
1848. Nat. Hist. Mammalia, II, p. 281.
San Andres de Machaca, Bolivia (Dept. of La Paz).

lewisi section

35. CTENOMYS LEWISI, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 323.
Sama, 50 kilometres west of Tarija, Bolivia.

opimus section

36. CTENOMYS EMILIANUS, Thomas & St. Leger
1926. Ann. Mag. Nat. Hist. 9, XVIII, p. 637.
Chos Malal, Neuquen, Argentina.

37. CTENOMYS FODAX, Thomas
1910. Ann. Mag. Nat. Hist. 8, V, p. 243.
Valle de Lago Blanco, Chubut, Patagonia.

38. CTENOMYS FUEGINUS, Philippi
1880. Arch. für Naturg. p. 276.
Eastern Island of Tierra Del Fuego.

39. CTENOMYS FULVUS, Philippi
1860. Reise. Atacama Halle, p. 157.
Desert of Atacama, Chile.

40. CTENOMYS KNIGHTI, Thomas
1919. Ann. Mag. Nat. Hist. 9, III, p. 498.
Otro Cerro, 45 kilometres west of Chumbicha, Catamarca, Argentina.

41. CTENOMYS TUCONAX, Thomas

1925. Ann. Mag. Nat. Hist. 9, XV, p. 583.
Concepcion, Tucuman, Argentina.

42. CTENOMYS OPIMUS OPIMUS, Wagner

1848. Archiv. für Naturg. 1, p. 75.
Bolivia.

43. CTENOMYS OPIMUS NIGRICEPS, Thomas

1900. Ann. Mag. Nat. Hist. 7, VI, p. 383.
Tetiri, Puno Moquegua Road, South Peru.

44. CTENOMYS OPIMUS LUTEOLUS, Thomas

1900. Ann. Mag. Nat. Hist. 7, VI, p. 384.
Cordilleras of Jujuy, Argentina.

boliviensis section

45. CTENOMYS BOLIVIENSIS, Waterhouse

1848. Nat. Hist. Mammalia, ii, p. 278.
Plains of Santa Cruz de la Sierra, Bolivia.

46. CTENOMYS STEINBACHI, Thomas

1907. Ann. Mag. Nat. Hist. 7, XX, p. 164.
Campo of Province Sara, Bolivia.

47. CTENOMYS GOODFELLOWI, Thomas

1921. Ann. Mag. Nat. Hist. 9, VII, p. 136.
Esperanza, Concepcion, Eastern Bolivia.

Not seen, and not allocated to section

48. CTENOMYS BRASILIENSIS, Blainville

1826. Bull. Soc. Philom. p. 62.
Minas Geraes, Brazil. (Waterhouse treats *torquatus*, number 33, as a synonym of this species.)

49. CTENOMYS OSGOODI, Allen

1905. Report Princetown Univ. Exped. to Patagonia, p. 191.
Rio Chico de Santa Cruz, Patagonia.
Synonym: *robustus*, Allen, not of Philippi, 1903, Bull. Mus. Nat. Hist. XIX, p. 185. Patagonia. (According to measurements from description, this species will belong in the *magellanicus* section.)

50. CTENOMYS COLBURNI, Allen

1903. Bull. Amer. Mus. Nat. Hist. XIX, p. 188.
Arroyo Aike, 50 miles south-east of Lake Buenos Ayres, Patagonia. (According to measurements from description this species probably belongs in *magellanicus* section.)

51. CTENOMYS MINUTUS, Nehring

1887. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 47.
"Campos," East of Mundo Novo, Rio Grande do Sul, Brazil.

52. CTENOMYS RONDONI, Ribeiro

1914. Comm. Linhas. Tel. Annexo, 5, p. 39.
Juruena, Matto Grosso, Brazil.

53. CTENOMYS BICOLOR, Ribeiro
1914. Comm. Linhas. Tel. Annexo, 5, p. 41.
Matto Grosso, Brazil.

54. CTENOMYS NATTERERI, Wagner
1848. Archiv. für. Naturg. 1, p. 72.
Caissora, Matto Grosso, Brazil.

55. CTENOMYS PUNDTI, Nehring
1900. Zool. Anz. XXIII, p. 420.
Alejo Ledensa, Cordova, Argentina.

56. CTENOMYS ATACAMENSIS, Philippi
1860. Reise. Atacama Halle, p. 157.
Desert of Atacama, Chile.

57. CTENOMYS ROBUSTUS, Philippi
1896. An. Mus. Nac. Chile, no. 13, p. 11.
Canchones, near Pica, Tarapaca, Chile.

58. CTENOMYS PALLIDUS, Philippi
1896. An. Mus. Nac. Chile, no. 13, p. 13.
Breas, desert of Atacama, Chile.

59. CTENOMYS PERNIX, Philippi
1896. An. Mus. Nac. Chile, 13, p. 15.
Near Aguas Calientes, Chile.

60. CTENOMYS CHILENSIS, Philippi
1896. An. Mus. Nac. Chile, 13, p. 16.
Linares, Chile.

61. CTENOMYS MAULINUS, Philippi
1872. Zeitschr. f. ges. Naturw. XL, p. 442.
High Andes of Province of Maule, Chile.

Tate lists also a "*cinerea*," Thomas, which is evidently a mistake for *Abrocoma cinerea*, Thomas.

The family Echimyidae contains according to Miller & Gidley very many Neotropical fossil genera. The Octodontinae are quoted from the Oligocene; one of the genera, *Cephalomys*, had a deciduous P.4 (Gregory, Orders of Mammals, 1910), a character not known in living Hystricoids; the Echimyinae (with which Miller & Gidley include Capromyinae and Dactylomyinae) are quoted from the Miocene; some of the genera, as *Isobolodon* (Porto Rico), *Brotomys* (Dominican Republic), and *Boromys* (Cuba), are thought to have existed recently. The Thryonomyinae have been described from the Miocene of India.

ECHIMYIDAE:
GENERAL WORKS OF REFERENCE

WATERHOUSE, 1848, Natural History of Mammalia: Rodentia. General review of all forms then known.

TATE, 1935, Taxonomy of Neotropical Hystricoid Rodents, Bull. Amer. Mus. Nat. Hist. LXVIII, p. 295.

POCOCK, Proc. Zool. Soc. London, 1922, p. 365; external characters of Hystricomorph Rodents (notes on *Octodon*, *Capromys*, *Myocastor*, *Dactylomys*, *Ctenomys*, *Thryonomys*).

Tullberg, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, ser. 3, no. 1, 1899.
Chapman, 1901, Bull. Amer. Mus. Nat. Hist. vol. XIV, p. 313. Revision of Hutias (Capromyinae).
Rusconi, Review of Ctenomys, 1928, An. Soc. Arg. Geogr. "Gaea," III, p. 235.
Thomas, races of *Thryonomys swinderianus*, Ann. Mag. Nat. Hist., 9, IX, p. 392, 1922.
Miller, Proc. U.S. Nat. Mus, LXXII, no. 16, p. 4, 1927 (*Plagiodontia hylaeum*).
Jentink, Notes Leyden Museum, XIII, 1891, p. 105. On *Dactylomys dactylinus* and *Kannabateomys amblyonyx*.
And numerous papers by Oldfield Thomas (Echimyinae, Octodontinae).

Family DINOMYIDAE

1896. Thomas: Hystricomorpha; Family Dinomyidae.
1899. Tullberg: Hystricomorpha; (?) Family Dinomyidae.
1918. Miller & Gidley: Hystricoidae; Family Dinomyidae.
1924. Winge: Family Hystricidae; Dasyproctini, part, group Dinomyes.
1928. Weber: Hystricoidea; Family Caviidae, part, subfamily Dinomyinae.

Geographical Distribution. South America; Peru, Colombia, Ecuador and Western Amazonia.

Number of Genera.—One.

Characters.—Cheekteeth extremely hypsodont, or probably evergrowing, a series of transverse plates. External form heavy, terrestrial; forefeet and hindfeet with four digits, the feet broad, the claws long and powerful. Limbs not lengthened. Palate constricted anteriorly. Zygomasseteric structure typically Hystricoid, as regards the formation of the lower jaw.

Remarks.—Except by those authors who merge *Cuniculus* and *Dasyprocta* with the Caviidae and who have regarded this genus also as a member of that family, *Dinomys* has usually been regarded as an isolated type among Hystricoidae. There is not the slightest reason to suppose that the animal is near the Caviidae, the lower jaw being typically Hystricoid in formation, and therefore differing from that family; nor does the genus seem closely connected either with *Cuniculus* or *Dasyprocta*, differing from both in tooth formation as well as the feet and digits. The palate and cheekteeth are similar to those of the Chinchillidae, but from these *Dinomys* differs by its typically ridged and distorted angular portion of the mandible, the general external form, the absence of part of the lachrymal canal open on the side of the rostrum, as well as by no tendency to great inflation of bullae.

Goeldi in a paper on some captivity specimens states that the animals are slow-moving, unlike *Dasyprocta* and the Chinchillidae. He mentions the fact that like *Dasyprocta* but unlike *Cuniculus* they will sit up on their haunches and use the front paws when feeding. The claws on dried skins of *Dinomys* appear to be fossorial in type, but Goeldi states that he has not seen the captivity specimens use the claws for digging.

The breadth of the manubrium has been used as a character to distinguish this genus as a family or subfamily from Dasyproctidae or Caviidae (Winge and others); it should be noted that this character, according to Tullberg's notes, may vary within some of the other families.

Long and Narrow	Broad
Lagostomus (Chinchillidae)	*Chinchilla* (Chinchillidae)
Dolichotis (Caviidae)	*Cavia* (Caviidae)

It is stated to be long and narrow in *Dasyprocta* and *Cuniculus*, broad in *Dinomys*.

The clavicles in *Dinomys* are stated to be complete.

Genus 1. DINOMYS, Peters

1873. Dinomys, Peters, Mon. Ber. Ak. Wiss. Berlin, p. 551.

Type Species.—*Dinomys branickii*, Peters.

Range.—As in the family Dinomyidae.

Number of Forms.—One only is now recognized; revised by Sanborn, 1931, Field. Mus. N.H., zool. ser. XVIII, p. 149.

Characters.—Skull heavy and broad, with long broad frontals; the parietals are depressed for muscular attachment, but a sagittal crest is not formed in any of the few skulls examined. No separate canal in infra-orbital foramen for nerve transmission. Bullae medium sized; paroccipital processes not lengthened. Jugal long, broad, but evidently simple. Palate of a similar type to that found in Chinchillidae, but mesopterygoid fossa much broader; the palate is continued farther backwards, to slightly behind the tooth-rows. Palatal foramina small. Lachrymal large.

Incisors broad and heavy; cheekteeth a series of transverse plates; four of these in each upper tooth; four evidently in the lower teeth, but the anterior one vestigial.

Externally large, heavy, bearing a superficial resemblance to *Cuniculus*; but tail longer than hindfoot (fully haired). Hindlimbs not lengthened; the feet broad, the claws long and heavy; no great discrepancy between the lengths of the (four) digits; forefoot with four digits, the claws large and powerful, though apparently narrower than in *Cuniculus*.

The genus is not well represented at the British Museum.

Forms seen: *branickii*, "*occidentalis*."

List of Named Forms

(The references and type localities are the work of Mr. G. W. C. Holt.)

1. DINOMYS BRANICKII, Peters

1873. Mon. Ber. Akad. Berlin, p. 552.
Central Peru; Montaña de Vitoc, Colonia Amable Maria.
Synonym: *branickii occidentalis*, Lönnberg, 1921, Ark. Zool. XIV, no. 4, p. 49. Hambo, near Gualea, Ecuador.
gigas, Anthony, 1921, Amer. Mus. Nov. no. 19, p. 6. Colombia.
pacarana, Ribeiro, 1919, Arch. Escola Sup. Agric. Med. Vet. 2, p. 13. Amazon, Brazil.

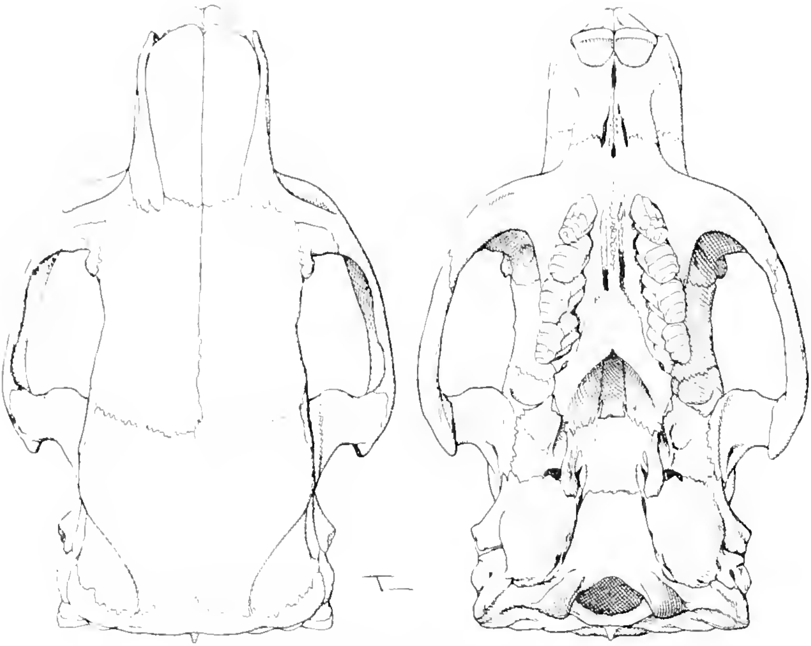


Fig. 40. Dinomys branickii, Peters.
B.M. No. 34 9.10.191, ♂; $\frac{3}{4}$.

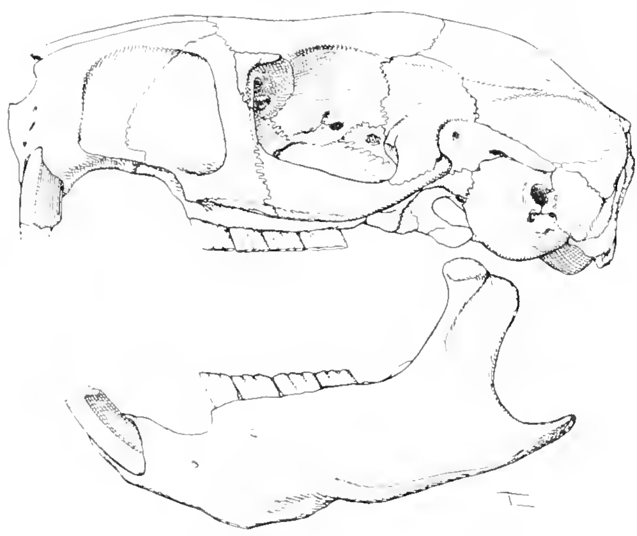


Fig. 41. Dinomys branickii, Peters.
B.M. No. 34 9.10.191, ♂; $\frac{3}{4}$.

The family Dinomyidae as defined by Miller & Gidley (Lachrymal canal closed in front of orbit; like the Echimyidae, but cheekteeth combining a multilaminar structure with excessive hypsodonty), is known fossil from the Miocene of South America and the Greater Antilles; many extinct genera are quoted by these authors.

Family ERETHIZONTIDAE

1896. Thomas: HYSTRICOMORPHA, part; Family Erethizontidae, with subfamilies Erethizontinae and Chaetomyinae.
1899. Tullberg: HYSTRICOMORPHA, part; Family Erethizontidae.
1918. Miller & Gidley: Superfamily HYSTRICOIDAE; Family Erethizontidae. Family Echimyidae, subfamily Echimyinae, part (*Chaetomys*).
1924. Winge: Family Hystricidae; Hystricini, part; "Sphinguri."
1928. Weber: HYSTRICOIDEA, part; Family Erethizontidae.

GEOGRAPHICAL DISTRIBUTION.—America; Canada, Western United States; Mexico, Central America, and the greater part of Tropical South America.

NUMBER OF GENERA.—Four.

CHARACTERS.—Not essentially different from the Echimyidae, but externally more highly specialized; feet becoming abnormally modified for arboreal life; function of hallux being taken over in specialized forms by a broad movable pad, the sole becoming abnormally wide; body hair modified partly or completely into short sharp spines. Bullae prominent, but paroccipital processes not lengthened. Cheekteeth rooted, typically with the re-entrant folds extremely wide; external form thickset, heavy.

REMARKS.—Presumably because these animals are also known as "Porcupines," or because their fur is spiny, most earlier authors placed them in the family Hystricidae. Thomas very properly formed a distinct family for them, and most subsequent authors have retained the distinction. Tullberg states that there is hardly a single common feature between the Old World and New World Porcupines except the spines, and even these are of a considerably different structure. The two families differ entirely in the structure of the feet, the structure of the cheekteeth, the formation of the bullae, the structure of the tail; even in the essential arrangement of spiny covering. They agree in zygomasseteric structure, which proclaims them both members of the Hystricoidea, but this seems about all they have in common. In fact, it would seem from cranial and dental characters, at least, that the American representatives of the Hystricidae (if that family has American representatives, and the resemblance is not due to convergence) are the Dasyproctidae; certainly not the present group.

In Erethizontidae the paroccipital processes are less lengthened and evidently of a more generalized structure than in Echimyidae. The zygoma is simpler than in that family. The cheekteeth of the typical subfamily, which contains *Erethizon*, *Echinoprocta*, and *Coendou*, and which has been incorrectly split into two subfamilies by some authors (see notes on *Echinoprocta* below), are remarkable for the width of their reentrant folds, paralleling in this formation certain Squirrels as *Funisciurus*, also the Anomaluridae, and to a degree reminiscent of some of the more complex-toothed Neotropical Cricetinae.

Chaetomys, on the other hand, has teeth more like those of *Echimys*. This is an isolated type, the relationships of which are by no means clear, so that it might be quite correct to refer it to a distinct family Chaetomyidae. Agreeing with most specialized Erethizontinae in the structure of the feet, it differs to a very wide degree from them in cranial and dental characters. The orbit is almost completely surrounded by bone, a very rare feature in the Order; and in no member of the Order which I have seen is this specialization so nearly complete. Moreover, the teeth are not in the least like those of *Erethizon* and *Coendou*. It is a rare genus, the exact locality of which I have so far been unable to trace, and evidently little is known about it. The spiny covering of the body is very poorly developed compared with other members of the family. Miller & Gidley transferred it to the Echimyidae, but it seems not to belong there in cranial characters, and the feet are as highly specialized as in *Coendou*, and evidently in exactly the same manner.

Thomas expressed the opinion that mainly on this account it might be retained in this family, and formed a subfamily for its reception. This view is here adopted.

Key to the Subfamilies of Erethizontidae

Orbit almost surrounded by extremely thickened jugal and short postorbital process of frontals. Cheekteeth with narrow re-entrant folds, the structure of the upper series not far removed from laminate. Subfamily CHAETOMYINAE
Chaetomys

Orbit large; frontal without postorbital process; jugal not specially thickened. Cheekteeth with wide re-entrant folds.
Subfamily ERETHIZONTINAE
Erethizon, *Echinoprocta*, *Coendou*

The mandible in this family is characterized by the length of the symphysis; the angular process is not so conspicuously distorted as in the Echimyidae, and a weak ridge below the condyle similar to that sometimes found in Chinchillidae, and presumably for the attachment of masseter medialis, foreshadowing that which is so much lengthened and such an important feature of the jaw in Caviidae, can be present. In *Erethizon* the lower border of the angular process is conspicuously broadened.

Subfamily CHAETOMYINAE

Geographical Distribution.—? Brazil.

Number of Genera.—One.

Characters.—As indicated in the above key.

Genus 1. CHAETOMYS, Gray

1843. Chaetomys, Gray, List Specimens Mamm. in Coll. Brit. Mus. p. 123.

Type Species.—*Hystrix subspinosa*, Kuhl.

Range.—Brazil; exact locality apparently not known.

Number of Forms.—One.

Characters.—Frontals extremely broad, but some narrowing present in front of the well-marked postorbital process. Parietals strongly ridged, but the posterior part of the skull broad, and parietal ridges showing no signs of coming together. Palate relatively narrow; short. Palatal foramina very short, far in front of toothrows.

Bullae relatively large, the meatus produced sharply sideways, forming sharp angle. Paroccipital processes short. Nasal chamber appears less open than is usual in Erethizontinae. Jugal with anterior part immensely broadened, nearly in contact with the postorbital process; the jugal nearly extending to the lachrymal. No canal for nerve transmission in infraorbital foramen. Mandible with low coronoid; angular process relatively small, the lower border not specially widened, but this part of the jaw clearly distorted outwards.

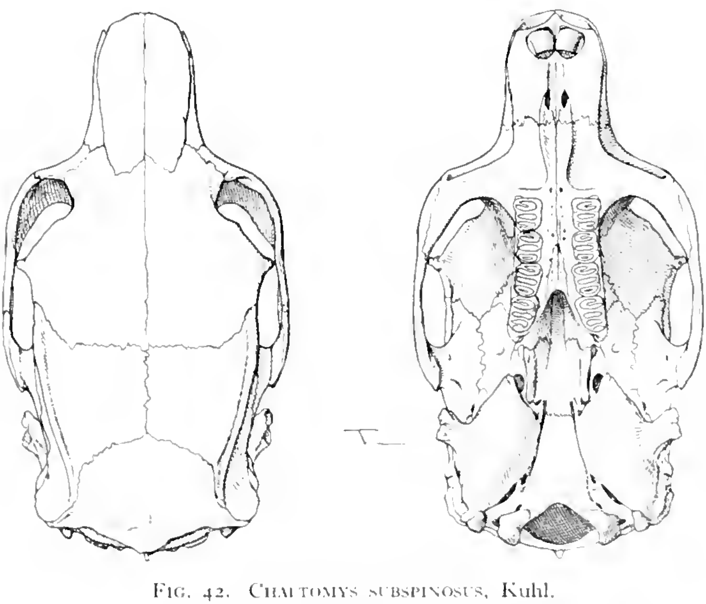


Fig. 42. Chaetomys subspinosus, Kuhl.
B.M. No. 3.9.4.86, . ; 1.

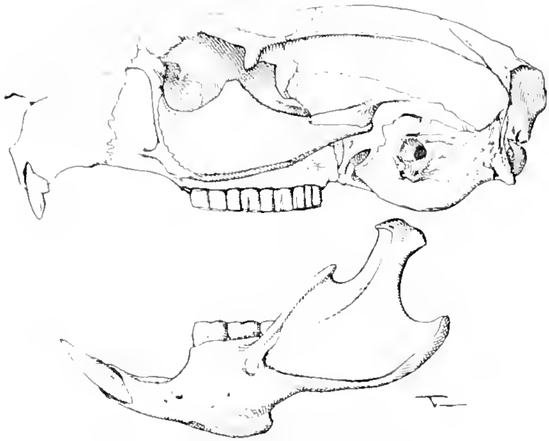
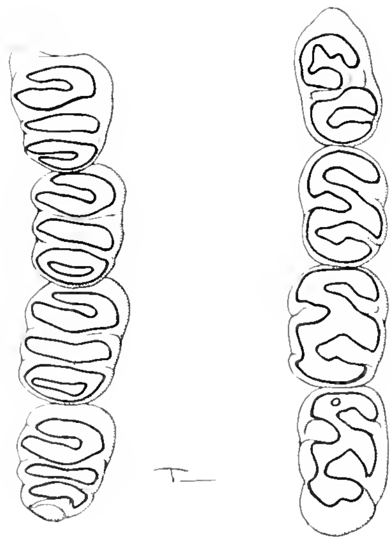


FIG. 43. CHAETOMYS SUBSPINOSUS, Kuhl.
B.M. No. 3.9.4.86, ×; × 1.



a. *b.*

FIG. 44. CHAETOMYS SUBSPINOSUS, Kuhl.
Checkteeth: B. M. No. 3.9.4.86, ×; × 3.

Upper cheekteeth are divided into three lobes, the middle one being simple, straight, separated from the front and the hind ones, which are each subdivided by a well-marked outer re-entrant fold. The lower cheekteeth are not unlike those of *Echimys*; there are one outer and two inner folds present. Incisors narrow.

The spiny covering of the back is rudimentary, consisting of long wavy bristles only; the head is densely covered with sharp spines, which extend over the neck and forelimb. Feet as specialized as in any member of the family; four digits present on fore and hindfeet, these bearing long curved claws, the pollex and hallux minute, replaced by a broad pad. Tail relatively long, scaly, and moderately haired, the underside, near the body, clothed with stiff bristles, as in *Coendou*.

Forms seen: *subspinosus*.

List of Named Forms

(The references and type localities of all Erethizontidae are the work of Mr. G. W. C. Holt.)

1. CHAETOMYS SUBSPINOSUS, Kuhl.

1820. Beitr. Zool. Mamm. p. 71.
Brazil (?).
Synonym: *tortilis*, Olfers, 1820, Neue Bibl. Reis. XV, p. 211. Brazil.
moricandi, Pictet, 1843, Rev. Zool. p. 227. Brazil.

Subfamily ERETHIZONTINAE

Geographical Distribution.—As in the subfamily.

Number of Genera.—Three.

Characters.—Differing from the Chaetomyinae in the large orbit, the lack of postorbital process, the lack of extreme thickening of the jugal, the pattern of the cheekteeth, which are with wide inner and outer re-entrant folds (three outer, one inner in the upper series), and the greater development of spiny covering of the back. The feet may be highly specialized, or in *Erethizon* less so. The tail may be short (*Erethizon*, *Echinoprocta*), or long and prehensile (*Coendou*).

Remarks.—Pocock in 1922 proposed to divide this group into two subfamilies, Erethizontinae and Coendinae; he does not include in his key the genus *Echinoprocta* which is precisely intermediate in the main character (the tail), between Pocock's two "subfamilies."

Key to the Genera of Erethizontinae

Hallux well developed, and no well-marked pad taking its place on the hindfoot; inner side of forefoot not or less expanded; tail short, non-prehensile. Erethizon

Hallux vestigial or absent, its function taken over by a broad movable pad; inner side of forefoot more expanded.

Tail short, non-prehensile, little longer than hindfoot. ECHINOPROCTA

Tail long, prehensile (as far as known), much longer than hindfoot. COENDOU

Genus 1. ERETHIZON, Cuvier

1822. ERETHIZON, Cuvier, Mem. Mus. Hist. Nat. IX, p. 425.

TYPE SPECIES.—*Hystrix dorsata*, Linnaeus.

RANGE.—North America; "Most of forested North America north of 40° and south in the Rocky Mountains almost to Mexican boundary" (Anthony). Forms named from Labrador, Nebraska, California, Arizona, British Columbia, Alaska.

NUMBER OF FORMS.—Seven.

CHARACTERS.—Nasals wide, widely open anteriorly; frontals broad, strongly ridged, these ridges extending backwards to form a sharp sagittal crest. Palate narrow anteriorly, very broad behind, and short. Zygoma simple, jugal broader anteriorly. Bullae large, the external meatus produced slightly sideways. Palatal foramina medium in size. Incisors relatively thin.

Mandible with low coronoid, relatively low condylar process, this thickened; the area beside the condyle with noticeable ridge presumably for attachment of masseter medialis; this short, not so pronounced as in some Chinchillidae. Angular portion distorted outwards fairly strongly, the lower border abnormally thickened.

Upper cheekteeth with one external and one internal main persistent folds, the other two outer folds (anterior and posterior) tending to isolate, and to take up most of the lobes formed by the central folds. Usually a trace of a small posterior fold in the back of each tooth.

The lower teeth reverse the pattern of the upper series.

The infraorbital foramen has no separate canal for transmission of nerve, in this respect agreeing with all other members of the subfamily.

Entire body, limbs, head, tail, and sides of feet covered with thick hair which completely conceals the highly effective spiny covering below it. The spines are short, with barbed tip, and detach very easily; once sticking in an object they are sometimes quite difficult to take out (this feature common to all Erethizontinae).

Tail short and bushy, covered with spines more or less throughout. Hindfoot lacking the inner pad characteristic of *Coendou*, and with a well-developed hallux, which is, however, shorter than the remaining four digits; claws curved, powerful. Forefoot broad, with four functional digits. Mammae 4 (Anthony). Size relatively large; up to about 34 inches head and body.

The genus is noteworthy as being the only Hystricoid adapted for life in cold climates.

Two closely allied species are admitted.

Forms seen: *dorsatum*, *epixanthum*, *myops*.

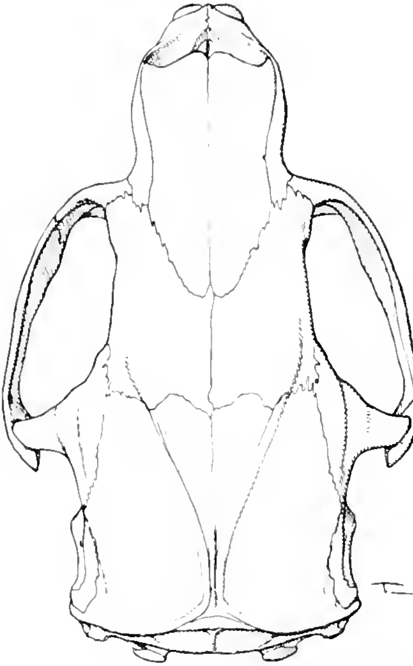


Fig. 45. Erethizon epixanthum myops, Merriam.
B.M. No. 4.11.30.1; × 1.

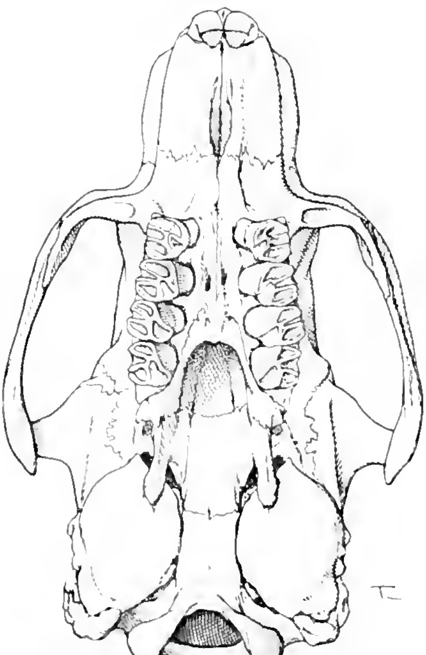


Fig. 46. Erethizon epixanthum myops, Merriam.
B.M. No. 4.11.30.1; × 1.

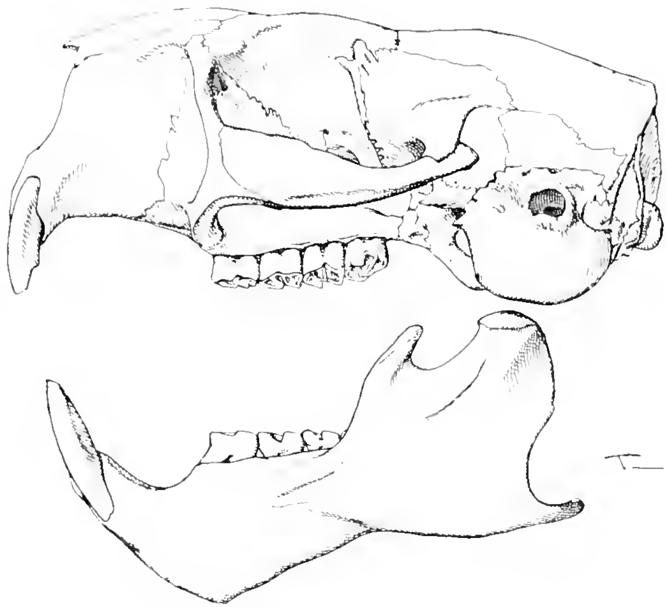


FIG. 47. ERETHIZON EPIXANTHUM MYOPS, Merriam.
B.M. No. 4.11.30.1; 1.

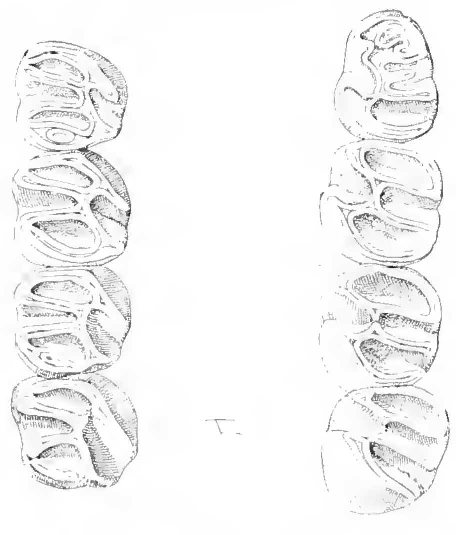


FIG. 48. ERETHIZON EPIXANTHUM MYOPS, Merriam.
Cheekteeth: 4.11.30.1; 2½.

List of Named Forms

1. ERETHIZON DORSATUM DORSATUM, Linnaeus

1758. Syst. Nat. 1, p. 57.
Eastern Canada.
Synonym: *hudsonis*, Brisson, 1756, Regn. Anim. Quadr. p. 128. America.
Trouessart quotes as synonym: *pilosus americanus*, Catesby, 1731, Nat. Hist. Carolina, 1, xxx.

2. ERETHIZON DORSATUM PICINUM, Bangs

1900. Proc. New Engl. Zool. Club, II, p. 37.
L'Anse au Loup, Strait of Belle Isle, Labrador.

3. ERETHIZON EPIXANTHUM EPIXANTHUM, Brandt

1835. Mem. Acad. St. Petersb. pl. 1, p. 390.
California.

4. ERETHIZON EPIXANTHUM BRUNERI, Swenk

1916. Univ. Studies Lincoln Nebr. vol. XVI, p. 3.
3 miles east of Mitchell, Scotsbluff County, Nebraska.

5. ERETHIZON EPIXANTHUM COUESI, Mearns

1897. Proc. U.S. Nat. Mus. XIX, p. 723.
Fort Whipple, Yavapai County, Arizona.

6. ERETHIZON EPIXANTHUM NIGRESCENS, Allen

1903. Bull. Amer. Mus. Nat. Hist. XIX, p. 558.
Shesley River, British Columbia, Canada.

7. ERETHIZON EPIXANTHUM MYOPS, Merriam

1900. Proc. Washington Acad. Sci. II, p. 27.
Portage Bay, Alaska Peninsula, Alaska.

Genus 2. ECHINOPROCTA, Gray

1865. Echinoprocta, Gray, Proc. Zool. Soc. London, p. 321.

Type Species.—*Erethizon rufescens*, Gray.

Range.—Colombia.

Number of Forms.—One.

Characters.—Cranially and dentally not essentially different from small species of *Coendou* (next to be described); a sagittal crest evidently formed; frontals not specially inflated; zygoma simple; a little constriction noticeable in interorbital region.

Size smaller than is normal in *Coendou*; the spines of the back long and bristly, gradually becoming thicker and stronger as they approach the rump, on which they are as strong as in *Coendou*. Head covered with sharp spines.

Feet, including the bone formation of the specialized pad of the hindfoot (as figured by Trouessart), similar to *Coendou*; hallux suppressed. Tail short, little longer than hindfoot, hairy, non-prehensile.

Forms seen: *rufescens*.

List of Named Forms

1. ECHINOPROCTA RUFESCENS, Gray

1865. Proc. Zool. Soc. London, p. 322.
Colombia.

Genus 3. COENDOU, Lacepède

1799. COENDOU, Lacepède, Tabl. des Divisions des Mamm. p. 11.
1825. SPHIGGURUS, Cuvier, Dents. Mamm., p. 256. (*Sphiggure*, 1822, Mem. Mus. Nat. Hist. Paris, IX, p. 427.) (*Sphiggurus spinosus*, Cuvier.) VALID AS A SUBGENUS.
1825. SINOETHERUS, Cuvier, Dents Mamm. p. 256. (*Hystrix prehensilis*, Linnaeus.)
1835. CERCOLABES, Brandt. Mem. Acad. St. Petersburg, 6, iii, p. 391. New name for Coendou, Lacepède.

TYPE SPECIES.—*Hystrix prehensilis*, Linnaeus.

RANGE.—Mexico (through Central America?), to Panama; Venezuela, Colombia, Ecuador, Peru, Bolivia, Brazil south to Paraná and Rio Grande do Sul. One form named from Chile, and one "said to be from the West Indies"; there seems reason to doubt both these localities.

NUMBER OF FORMS.—Twenty-nine.

CHARACTERS.—Skull broad, sometimes characterized by somewhat extreme inflation of frontals (this most developed in *prehensilis* group, also to a certain degree in *bicolor* and *mexicanum*); the skull in these species sloping sharply downwards in front, and more gradually so behind; in smaller species as *paragayensis*, the portion of the skull over the posterior zygomatic root is the highest part; between these extremes exist intermediate forms. Nasals well open anteriorly, usually short. Parietals ridged, and a sagittal crest may be formed (this evidently a variable character). Palate wide, especially posteriorly; hamulars thick, usually joining the bullae, which are prominent. Palatal foramina usually relatively short. Paroccipital processes not lengthened. Jugal rather long; zygoma simple. Mandible like *Erethizon* except that the lower border is usually less extremely broadened; there is a tendency in this group for the degree of distortion outwards of the angular process to be weak. Cheekteeth essentially as *Erethizon*.

Externally the body is covered in short thick spines, which probably do not much exceed four inches in length at highest development. Tail prehensile, so far as known; its length variable in the different species; sometimes slightly longer than the head and body, but usually rather shorter. The lower part at the end is naked, curling upwards when grasping an object. The underside near the body is covered with stiff sharp bristles, which it has been suggested perform a similar function to the caudal scales of the Anomaluridae, to assist the animal's balance when resting on a branch.

The upper part of the tail near the body is spiny. The feet are very highly specialized, the pad on the hindfoot at its highest development; the claws are long and curved; both fore and hindfeet with four functional digits only; there is no very marked discrepancy in their lengths. The pads of the hindfoot are supported by a bony structure, which is well described and figured by Waterhouse, 1848, Nat. Hist. Mamm., p. 405, and pl. 18, fig. 4.

Some forms have the spiny covering of the back mixed with or covered by long thick fur; the hair of the chest and belly is usually in these forms less bristly, or soft. For these the subgeneric name *Sphiggurus* is used by Tate; it is here retained.

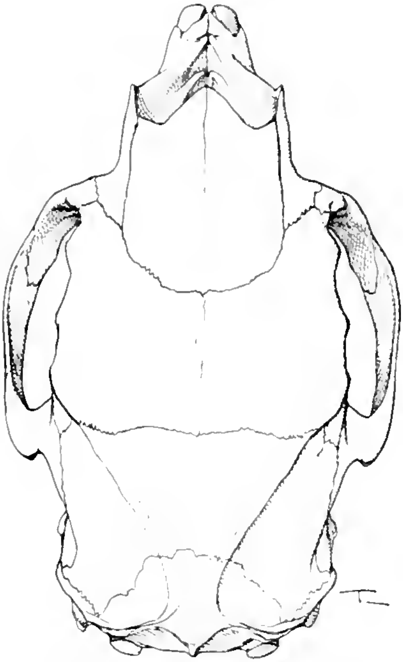


FIG. 49. COENDOU PREHENSILIS BOLIVIENSIS, Gray.
B.M. No. 50.6.5.2; × 1.

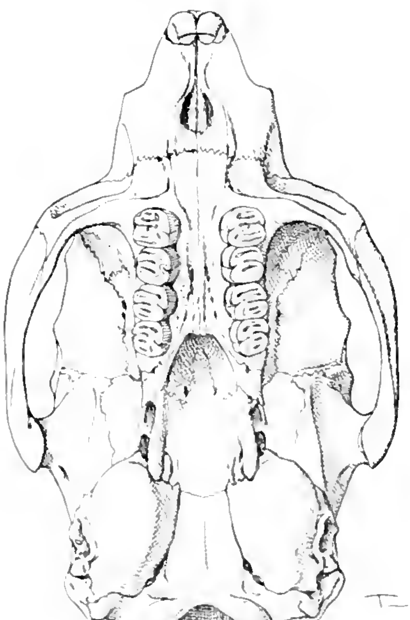


FIG. 50. COENDOU PREHENSILIS BOLIVIENSIS, Gray.
B.M. No. 50.6.5.2; × 1.

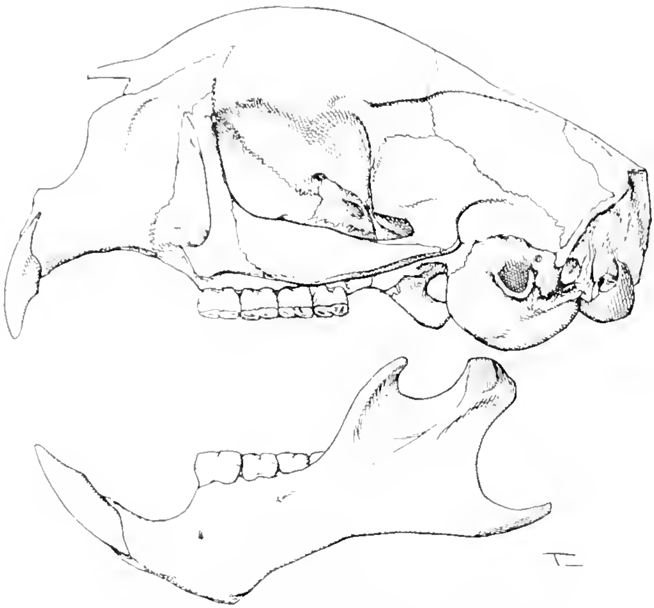


FIG. 51. COENDOU PREHENSILIS BOLIVIENSIS, Gray.
B.M. No. 50.6.5.2; × 1.

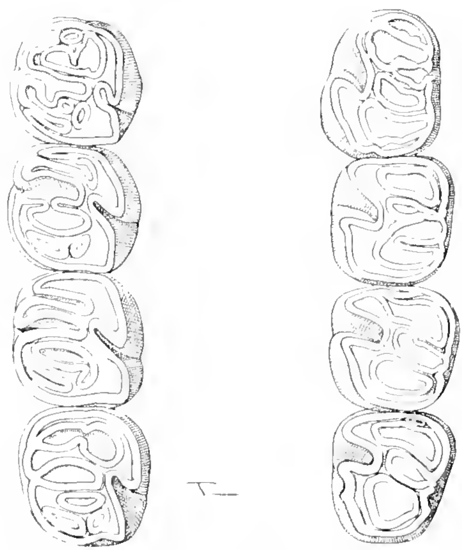


FIG. 52. COENDOU PREHENSILIS BOLIVIENSIS, Gray.
Cheekteeth: B.M. No. 50.6.5.2; × $3\frac{1}{2}$.

Forms seen: *bicolor*, *boliviensis*, *centralis*, "*couiy*" (=*paragayensis*), *insidiosus*, *laenatum*, *melanurus*, *mexicanum*, *pallidus*, *prehensilis*, *pruinosus*, *quichua*, *roberti*, *rothschildi*, *simonsi*, *tricolor*, *vestitus*, *villosus*, *yucataniae*.

The genus is in need of revision; it appears to be in a more chaotic state even than is usual among these Neotropical Rodents, many "species" being apparently based on only one skin, with exact locality unknown.

It appears to me to divide, broadly speaking, into four or possibly five groups.

Subgenus *Coendou* (the spines not mixed with hairy covering):

prehensilis group: large animals (largest of genus), with frontals normally at maximum inflation for the genus; general effect silvery as regards colour, the spines white terminally (evidently main spines black terminally in all others). Long-tailed types.

With *prehensilis*, *boliviensis*, which is probably a synonym, or at most a race of *prehensilis*, *centralis*, described as near *brandti*; *brandti*, which seems very near *prehensilis*; and *tricolor*, the status of which is doubtful, the type skull (broken) appears to be less arched in the region of the frontals than in allies, and the colour of the one skin seen, on the identification of which there is some doubt, rather different. Perhaps this species should be placed *incertae sedis*. *C. sanctaemartae*, not seen, is described as a member of the group.

bicolor group: presenting typically the following features: spines black terminally, general effect of animal dark; head and shoulders covered by a profuse mantle of moderately long thick bristle-like spines (not sharp, nor effective as weapons of defence). Relatively large; frontals markedly inflated, but less extremely than in *prehensilis* group. *C. simonsi* is evidently not more than a subspecies of *bicolor*. *C. quichua*, a smaller form, with less developed mantle on head and shoulders; the mantle-spines white-tipped in the type skin. Skull not arched in frontal region. *C. rothschildi*, near *quichua*, differing in colour.

Incertae sedis species: *platycentrotus*, near *prehensilis* according to Waterhouse, but placed in neighbourhood of *bicolor* group by Tate; and *nycthemera*, stated by Waterhouse to be synonymous with *bicolor*, but this identification questioned by Thomas; and listed by Tate as a member of subgenus *Sphiggurus*.

Subgenus *Sphiggurus* (the spines mixed with and typically covered by long woolly hair).

mexicanum group. Larger, very dark types, from Central America. Typically the skull considerably inflated in the frontal region (about as in *bicolor*). Includes *laenatum*, in which the frontals are flat, with no trace of inflation. Goldman (Mammals Panama, Smiths. Misc. Coll. 69, 5, p. 133, 1920) states that intergradation may take place here, and refers *laenatum* to *mexicanum* as a subspecies; this indicates that too much attention should not be paid to cranial characters in this group, as the skulls of *laenatum* and the *mexicanum* (with *yucataniae*) examined are very distinct from each other.

paragayensis group: normally smaller lighter types. (It is not easy to give exact measurements of these species, as comparatively few of the skins examined bear measurements.) So far as seen the frontals never inflated.

paragayensis (or the skins bearing the name "*couiy*," which according to Tate must be regarded as a synonym of *paragayensis*), if identified rightly, are remarkable for the fact that the spines of the head and shoulders are exceptionally strong, and not covered by any hair, which is present, however, on the lower part of the back. The type skin of *roberti* is similar, but even less hairy on head and shoulders.

insidiosus (or skins bearing this name) have the head and back normally hairy; the skulls of these three last-mentioned species are very similar. Tate suggests that *spinosus* of Cuvier is probably a synonym of *paragayensis*. *C. villosus* is probably a synonym of *insidiosus* according to Waterhouse; it appears to be treated as such at the British Museum. *C. nigricans*, not seen, is considered near *villosus* by Waterhouse. *C. melanurus* is a type much like the above-mentioned, but with a jet-black tail; the skull is flat. *C. pallidus*, based on a young animal "said to be from the West Indies," is a similar type of animal, but much lighter coloured (albinistic?); rather short-tailed.

A rather distinct section is seen in *vestitus* and *pruinosus*, which differ from each other in colour; both have no inflation of the frontals; the spines are of two kinds, the normal mixed with longer "bristle-spines"; covered as usual in the subgenus with thick hair. In *vestitus* the tail appears shorter than in any other; it is still, however, considerably longer than *Echinoprocta*, and partly naked, as in *Coendou*.

Finally *chilensis*, *affinis*, and *sericeus* are not represented in London; the first-named was said to come from Chile, but Tate, p. 299, states: "It seems improbable that any Porcupine exists in the wild state in Chile."

List of Named Forms

Subgenus *Coendou*, Lacepède

prehensilis Group

1. COENDOU PREHENSILIS PREHENSILIS, Linnaeus

1758. Syst. Nat. 10th Ed. p. 57.
Brazil. (Probably near Pernambuco.)
Synonym: *cuandu*, Desmarest, 1822, Ency. Meth. (Mamm.), 2, p. 346. Brazil.
longicaudatus, Lacepède, 1799, Tabl. des Div. des Mamm. p. 1. Cayenne.

2. COENDOU PREHENSILIS BOLIVIENSIS, Gray

1850. Ann. Nat. Hist. V, p. 380.
Bolivia.

3. COENDOU CENTRALIS, Thomas

1903. Proc. Zool. Soc. London, p. 240.
Chapada, Matto Grosso, Brazil.

4. COENDOU BRANDTII, Jentink
1879. Notes Leyden Mus. 1, p. 96.
Matto Grosso, Brazil (?).

5. COENDOU SANCTAEMARTAE, Allen
1904. Bull. Amer. Mus. Nat. Hist. XX, p. 441.
Bonda, Santa Marta district, Colombia.

6. COENDOU TRICOLOR, Gray
1850. Ann. Nat. Hist. V, p. 381.
Bolivia (?).

bicolor Group

7. COENDOU BICOLOR BICOLOR, Tschudi
1845. Fauna Peruana, p. 186.
Woods between Rivers Tullamayo and Chanchamayo, Peru.

8. COENDOU BICOLOR SIMONSI, Thomas
1902. Ann. Mag. Nat. Hist. 7, IX, p. 141.
Charuplaya, Securé River, Yungas, Bolivia.

9. COENDOU QUICHUA QUICHUA, Thomas
1899. Ann. Mag. Nat. Hist. 7, IV, p. 283.
Puembo, Pichincha, Ecuador.

10. COENDOU QUICHUA RICHARDSONI, Allen
1913. Bull. Amer. Mus. Nat. Hist. XXXII, p. 478.
Esmeraldas, Ecuador.

11 COENDOU ROTHSCHILDI, Thomas
1902. Ann. Mag. Nat. Hist. 7, X, p. 169.
Sevilla Island, off Chiriqui, Panama.

incertae sedis

12. COENDOU PLATYCENTROTUS, Brandt
1835. Mém. Acad. St. Petersb. p. 399.
"America australis."

13. COENDOU NYCTHEMERA, Kuhl
1820. Beitr. Zool. Mamm. p. 71.
No locality. Brazil (?).

Subgenus *Sphiggurus*, Cuvier

mexicanum Group

14. COENDOU MEXICANUM MEXICANUM, Kerr
1792. Anim. Kingd. p. 214.
Mountains of Mexico.
Synonym: *novaehispaniae*, Brisson, 1756, Reg. Anim. p. 127. Mexico. (For status of Brisson's specific names see Tate, Bull. Amer. Mus. N.H. LXVIII, 1935, p. 297.)
liebmanni, Reinhart, 1844, Arch. Naturg. p. 241. Mexico.

15. COENDOU MEXICANUM YUCATANIAE, Thomas
1902. Ann. Mag. Nat. Hist. 7, X, p. 249.
Yucatan, Mexico (probably near Izamal).

16. COENDOU LAENATUM, Thomas
1903. Ann. Mag. Nat. Hist. 7, XI, p. 381.
Boquete, Chiriqui, Panama.

paragayensis Group

(Typical Section)

17. COENDOU PARAGAYENSIS, Oken

1816. Lehrbuch der Zoologie, p. 870.
Paraguay.
Synonym: *couiy*, Desmarest, 1822, Mammalogie, ii, p. 345. Brazil.

18. COENDOU SPINOSUS, Cuvier

1822. Mém. Mus. Hist. Nat., IX, p. 433.
No locality (? Brazil) (? Based on *paragayensis*, Oken).

19. COENDOU ROBERTI, Thomas

1902. Ann. Mag. Nat. Hist. 7, IX, p. 63.
Roça Nova, Parana, Brazil.

20. COENDOU INSIDIOSUS, Kuhl

1820. Beitr. Zool. Mamm. p. 71.
No locality (? Brazil).

21. COENDOU VILLOSUS Cuvier

1822. Mém. Mus. Hist. Nat. IX, p. 434.
Brazil.

22. COENDOU NIGRICANS, Brandt

1835. Mém. Acad. St. Petersb. p. 403.
Brazil.

23. COENDOU MELANURUS, Wagner

1842. Archiv. für Naturg. 1, p. 360.
Barra, Rio Negro, Brazil.

24. COENDOU PALLIDUM, Waterhouse

1848. Nat. Hist. Mamm. ii, p. 434.
"Said to be —— the West Indies."

(*vestitus* section)

25. COENDOU VESTITUS, Thomas

1899. Ann. Mag. Nat. Hist. 7, IV, p. 284.
Colombia.

26. COENDOU PRUINOSUS, Thomas

1905. Ann. Mag. Nat. Hist. 7, XVI, p. 310.
Montañas de la Pedregosa, Merida, Venezuela.

Not allocated to group; not seen

27. COENDOU AFFINIS, Brandt

1835. Mém. Acad. St. Petersb. p. 412.
Brazil.

28. COENDOU SERICEUS, Cope

1889. Amer. Naturalist, XXIII, p. 136.
São João do Monte Negro, Rio Grande do Sul, Brazil.

29. COENDOU CHILENSIS, Molina

1809. Geogr. Nat. and Civil Hist. of Chile, p. 242.
Chile.

Numbers 27, 28, 29 have not been seen; they are listed by Tate as members of the subgenus *Sphiggurus*.

ERETHIZONTIDAE: *SPECIAL WORKS OF REFERENCE*

WATERHOUSE, 1848, Natural History Mammalia, Rodentia.
TATE, 1935, Taxonomy of Neotropical Hystricoid Rodents, Bull. Amer. Mus. Nat. Hist. LXVIII, p. 295.
POCOCK, Proc. Zool. Soc. London, 1922, p. 365. External Characters of some Hystricomorph Rodents (*Coendou*, *Erethizon*).
TROUESSART, *Echinoprocta*, Bull. Mus. Hist. Nat. 1920, no. 6, p. 448.
ALLEN, North American Rodentia, p. 385, 1876. "Hystricidae" (*Erethizon*).
TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, 1, 1899.

The family is known fossil from the Oligocene from America.

Family DASYPROCTIDAE

1896. Thomas: HYSTRICOMORPHA: Family Dasyproctidae, part, included *Cuniculus* ("*Coelogenys*").
1899. Tullberg: HYSTRICOMORPHA: Family Caviidae, part.
1918. Miller & Gidley: HYSTRICOIDAE: Family Dasyproctidae.
1924. Winge: Family Hystricidae, part, Dasyproctini, part, Dasyproctae, part (included *Cuniculus*).
1928. Weber: HYSTRICOIDEA: Family Caviidae, part, subfamily Dasyproctinae, part (included *Cuniculus*).

GEOGRAPHICAL DISTRIBUTION.—Tropical America, from Mexico through Central America to Bolivia and Paraguay, Ecuador and Peru. Trinidad. Lesser Antilles.

NUMBER OF GENERA.—Two.

CHARACTERS.—External form much modified for cursorial life; hindlimbs lengthened; hindfeet with three digits, forefoot with four functional digits, the claws hooflike. Cheekteeth semi-rooted, extremely hypsodont, closely paralleling the structure present in the Hystricidae. Clavicles undeveloped.

REMARKS.—This family has (together with *Cuniculus*) often been united with the Caviidae. This association appears most unnatural. The lower jaw is totally distinct in the two groups, *Dasyprocta* being typically Hystricoid in this formation; the cheekteeth show an entirely different pattern in the two groups.

The similarities between such genera as *Dasyprocta* and *Dolichotis* in the arrangement of digits and parts of the skeleton for swift running appear to be parallel evolution brought about by a similar mode of life, comparable to the similarities between such types as *Bathyergus* and, say, *Geomys*, which resemble each other externally to a large degree and yet in which the zygomasseteric structure and the cheekteeth are totally different. One of the reasons which has been advocated for classing *Dasyprocta* with the Caviidae is the formation of the penis, which is said to be armed with a pair of horny spikes in these genera; it is therefore interesting to note that according to Pocock the penis of *Dolichotis* and of *Hydrochoerus*, both members of Caviidae, lack these spikes, disagreeing in this character from *Cavia* and other members of the Caviidae, as well as from

Dasyprocta and *Cuniculus*. But in any case the penis does not furnish a sufficiently reliable character on which to base family distinctions.

Key to the Genera of Dasyproctidae

Tail not obsolete, approaching half length of hindleg; toothrow reduced, "teeth smaller both relatively and absolutely than in any species of *Dasyprocta*" (Thomas). Myoprocta

Tail obsolete; teeth relatively larger, and toothrow less reduced. Dasyprocta

These two genera are not well marked, and might be regarded as subgenera of one genus. *Myoprocta* contains much smaller forms than is normal in *Dasyprocta*.

Genus 1. DASYPROCTA, Illiger

1811. Dasyprocta, Illiger, Prodr. Syst. Mamm. et Avium, p. 93.

Type Species.—*Mus aguti*, Linnaeus.

Range.—As in the family Dasyproctidae; south to South Brazil.

Number of Forms.—About forty-six are named.

Characters.—The skull is less ridged than in other Hystricoids of a similar size; the nasals shorter than the frontals, which are broad, flat, and with a well-marked though short postorbital process at suture of frontals and parietals. A weak short sagittal crest is developed in the adult. The bullae are moderately large; the paroccipital processes prominent, though not so lengthened as in *Cuniculus*. The palate is straight, and extends back to level of M.3; the hinder part being formed much as in the Hystricidae. Palatal foramina short, far in front of toothrow. Lachrymal much enlarged, forming most of upper zygomatic root, and part of the lachrymal canal is open on the side of the rostrum, immediately in front of the anterior part of toothrow. There is no canal for nerve transmission in the infraorbital foramen, which is of medium size. Zygoma generally simple. Mandible with angular portion powerfully distorted outwards, and its lower border slightly drawn backwards; coronoid process low; condylar process rather broad.

Cheekteeth strongly hypsodont; like those of the Hystricidae in essential pattern; one more or less persistent narrow inner fold in the upper series; the outer folds soon isolate as islands, and there is a tendency for the islands to divide on the surface of the tooth, so that there may be seven or eight or more minute islands in a worn tooth. Lower cheekteeth like the upper series, but with the pattern reversed. Incisors relatively thin, compressed.

Externally the form is slender, cursorial, the hindlimbs lengthened, the hindfoot very long and narrow, with three digits which bear sharp hoof-like claws; the central digit is the longest, D.4 is a little shorter than D.2; the sole is naked; in the skeleton of the foot the metatarsal bones for the outer digits are absent or vestigial. The forefoot is less elongated than the hindfoot; the digits are four, but the appearance of the foot is perissodactyle owing to D.5 being considerably reduced; the pollex is represented by a knob. The fur on the hinder part of the body is very long and thick. The ears are of medium size. The tail is obsolete. The head and body measurement may approach 580 mm.

Forms seen: *aguti*, *azarae*, *boliviae*, *catrinae*, *cayennae*, *coibae*, *cristata*, *croconota*, *flavescens*, *fuliginosa*, *isthmica*, *lucifer*, *lunaris*, *maraxica*, *nigra*, *paraguayensis*, *pandora*, *prymnolopha*, *punctata*, *ruatanica*, *rubrata*, *variegata*, *yungarum*.

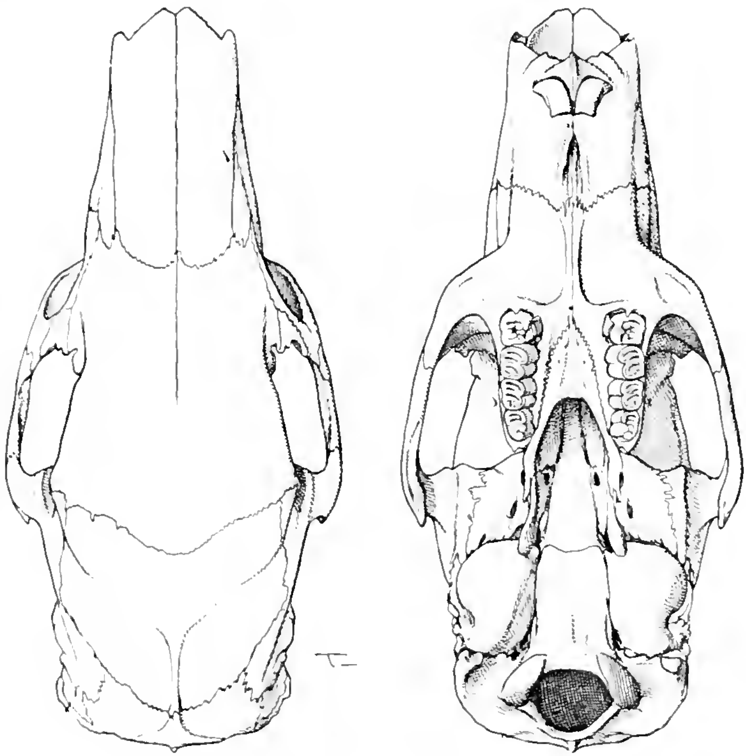


FIG. 53. DASYPROCTA PUNCTATA ISTHMICA, Alston.
B.M. No. 98.11.6.10; × 1.

LIST OF NAMED FORMS

(References and type localities for all forms of Dasyproctidae are the work of Mr. G. W. C. Holt.)

Tate divides the genus into three sections: "Eastern or red-rumped Agoutis," "Central American Agoutis," and "Dark-grey Agoutis." The material examined does not support these divisions; moreover, I have been quite unable to

Fig. 54. Dasyprocta punctata isthmica, Alston.
B.M. No. 98.11.6.10; × 1.

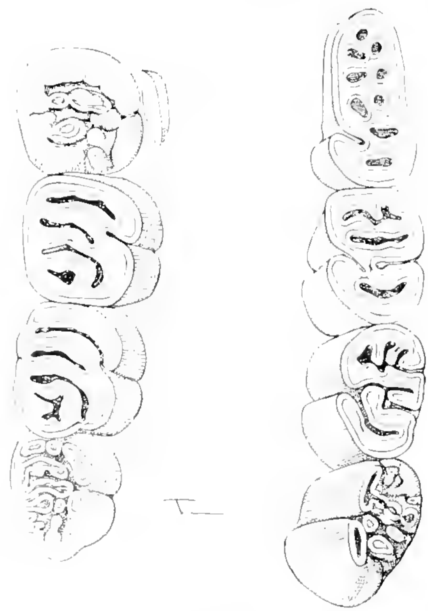


Fig. 55. Dasyprocta punctata isthmica, Alston.
Cheekteeth: B.M. No. 98.11.6.10; × 4.

(In the lower jaw the anterior tooth is the much worn milk molar—seen in profile in fig. 54; in the upper jaw the anterior tooth is the newly cut premolar, and the large inner root of the shed milk molar is seen to the right or inner side of this tooth.)

get this large and unwieldy genus into any definite order, and therefore list geographically.

The real dark-grey types like *colombiana* or *fuliginosa* grade quickly into dark unicolorous types, which in turn grade into reddish-rumped types, which seem to grade into the red types like *aguti*. Sometimes a blackish middorsal area may be present, as in *prymnolopha*.

How many species should be recognized I am not prepared to say, but it seems clear that far too many are at present standing, and many could be reduced to the rank of subspecies. It is to be hoped that someone will attempt a revision of this genus, which is much needed.

1. DASYPROCTA NOBLEI, Allen
1914. Proc. New. Engl. Zool. Club. V. p. 69.
Goyave, Guadeloupe, Lesser Antilles.

2. DASYPROCTA ALBIDA, Gray
1842. Ann. Mag. Nat. Hist. 1, X, p. 264.
St. Vincent, Lesser Antilles.

3. DASYPROCTA ANTILLENSIS, Sclater
1874. Proc. Zool. Soc. London, p. 666.
St. Lucia, Lesser Antilles.

4. DASYPROCTA RUBRATA RUBRATA, Thomas
1898. Ann. Mag. Nat. Hist. 7, II, p. 272.
Savannah Grande, Trinidad.

5. DASYPROCTA RUBRATA FLAVESCENS, Thomas
1898. Ann. Mag. Nat. Hist. 7, II, p. 273.
Caripe, Cumana, Venezuela.

6. DASYPROCTA LUCIFER LUCIFER, Thomas
1903. Ann. Mag. Nat. Hist. 7, XI, p. 491.
Caicara, Rio Orinoco, Venezuela.

7. DASYPROCTA LUCIFER CAYENNAE, Thomas
1903. Ann. Mag. Nat. Hist. 7, XI, p. 492.
Approvague, Cayenne.

8. DASYPROCTA CAYANUS, Lacepède
1802. Tabl. des Div. des Mamm. p. 78.
Cayenne.

9. DASYPROCTA PRYMNOLOPHA, Wagler
1831. Isis, XXIV, p. 619.
Guiana.

10. DASYPROCTA NIGRICLUNIS, Osgood
1915. Field. Mus. Nat. Hist. Publ. Zool. ser. X, p. 192.
São Marcello, upper Rio Preto, Bahia, Brazil.

11. DASYPROCTA CROCONOTA, Wagler
1831. Isis, XXIV, p. 618.
Amazon River, Brazil (mouth of Rio Madeira).

12. DASYPROCTA AGUTI AGUTI, Linnaeus
1766. Syst. Nat. 12th. ed. p. 80.
Brazil.

(D. aguti aguti) Synonym: (?) *leporina*, Linnaeus, 1758, Syst. Nat. 10th. ed. p. 59.
Unknown (probably unidentifiable, according to Tate.)
bicolor, Boddaert, 1785, Elenchus Anim. p. 103.

13. DASYPROCTA AGUTI MARAXICA, Thomas
1923. Ann. Mag. Nat. Hist. 9, XII, p. 341.
Marajo Island, Amazon River, Brazil.

14. DASYPROCTA AGUTI LUNARIS, Thomas
1917. Ann. Mag. Nat. Hist. 8, XX, p. 259.
Moon Mountains, British Guiana.

15. DASYPROCTA AZARAE AZARAE, Lichtenstein
1823. Doubl. Zool. Mus. Berlin, p. 3.
São Paulo, Brazil.

16. DASYPROCTA AZARAE CATRINAE, Thomas
1917. Ann. Mag. Nat. Hist. 8, XX, p. 311.
Santa Catharina, Southern Brazil.

17. DASYPROCTA AUREA, Cope
1889. Amer. Naturalist, p. 138.
Chapada, Matto Grosso, Brazil.

18. DASYPROCTA CAUDATA, Lund
1841. Afh. K. Danske. Vid. Selsk. 4, viii, p. 286.
Rio das Velhas, Minas Geraes, Brazil.

19. DASYPROCTA PARAGUAYENSIS, Liais
1872. Climats, Géologie, Faune et Géographie Botanique du Bresil, p. 536.
Paraguay.
Synonym: *felicia*, Thomas, 1917, Ann. Mag. Nat. Hist. 8, XX, p. 310.
Near Concepcion, Paraguay.

20. DASYPROCTA MEXICANA, Saussure
1860. Rev. Mag. Zool. 2, XII, p. 53.
"Hot zone of Mexico," probably in State of Vera Cruz.

21 DASYPROCTA PUNCTATA PUNCTATA, Gray
1842. Ann. Mag. Nat. Hist. 1, X, p. 264.
Realejo, west coast of Nicaragua.

22. DASYPROCTA PUNCTATA RICHMONDI, Goldman
1917. Proc. Biol. Soc. Washington XXX, p. 114.
Escondido River, 50 miles above Bluefields, Nicaragua.

23. DASYPROCTA PUNCTATA CHIAPENSIS, Goldman
1913. Smiths. Misc. Coll. LX, no. 22, p. 13.
Huehuetan, Chiapas, Mexico.

24. DASYPROCTA PUNCTATA YUCATANICA, Goldman
1913. Smiths. Misc. Coll. LX, no. 22, p. 12.
Apazote, Campeche, Mexico.

25. DASYPROCTA PUNCTATA UNDERWOODI, Goldman
1931. Journ. Washington Acad. Sci. XXI, p. 481.
San Geronimo, district of Pirris, West Costa Rica.

26. DASYPROCTA PUNCTATA DARIENSIS, Goldman
1913. Smiths. Misc. Coll. LX, no. 22, p. 11.
Near head of Rio Limon, Mt. Pirri, Eastern Panama.

27. DASYPROCTA PUNCTATA NUCHALIS, Goldman
1917. Proc. Biol. Soc. Washington XXX, p. 113.
Divala, Chiriqui, Panama.

28. DASYPROCTA PUNCTATA ISTHMICA, Alston
1876. Proc. Zool. Soc. London, p. 347.
Colon, Panama.

29. DASYPROCTA RUATANICA, Thomas
1901. Ann. Mag. Nat. Hist. 7, VIII, p. 272.
Ruatan Island, Bay of Honduras.

30. DASYPROCTA CALLIDA, Bangs
1901. Amer. Naturalist, XXXV, p. 635.
San Miguel Island, Panama.

31. DASYPROCTA COIBAE, Thomas
1902. Nov. Zool. IX, p. 136.
Coiba Island, Panama.

32. DASYPROCTA PANDORA, Thomas
1917. Ann. Mag. Nat. Hist. 8, XX, p. 313.
Gorgona Island, off Colombia.

33. DASYPROCTA VARIEGATA VARIEGATA, Tschudi
1845. Fauna Peruana, p. 190.
Chanchamayo region, Eastern Peru.

34. DASYPROCTA VARIEGATA ZAMORAE, Allen
1915. Bull. Amer. Mus. Nat. Hist., XXXIV, p. 627.
Zamora, Eastern Eucador.

35. DASYPROCTA VARIEGATA CHOCOENSIS, Allen
1915. Bull. Amer. Mus. Nat. Hist. XXXIV, p. 627.
Los Cisneros, Choco district, Colombia.

36. DASYPROCTA VARIEGATA COLOMBIANA, Bangs
1898. Proc. Biol. Soc. Washington XII, p. 163.
Santa Marta, Colombia.

37. DASYPROCTA VARIEGATA YUNGARUM, Thomas
1910. Ann. Mag. Nat. Hist. 8, VI, p. 505.
Chimosi, Yungas, Bolivia.

38. DASYPROCTA VARIEGATA BOLIVIAE, Thomas
1917. Ann. Mag. Nat. Hist. 8, XX, p. 312.
Charuplaya, Bolivia.

39. DASYPROCTA VARIEGATA URUCUMA, Allen
1915. Bull. Amer. Mus. Nat. Hist. XXXIV, p. 634.
Urucum, near Curumba, Matto Grosso, Brazil.

40. DASYPROCTA FULIGINOSA FULIGINOSA, Wagler
1832. Isis, XXV, p. 1220.
Near Amazon River, Brazil. (Borba, Rio Madeira.)
Synonym: *nigra*, Gray, Ann. Mag. Nat. Hist. 1, X, p. 264, 1842.
nigricans, Wagner, 1842, Archiv. für Naturg. 1, p. 362.
Borba, R. Madeira, Brazil.
caroliniensis, Cuvier, Gervais, Mamm. 1, 1854, p. 329.

41. DASYPROCTA FULIGINOSA CANDELENSIS, Allen
1915. Bull. Amer. Mus. Nat. Hist. XXXIV, p. 625.
La Candela, Huila, Colombia.

42. DASYPROCTA FULIGINOSA MESATIA, Cabrera
1917. Madrid Trab. Mus. Nac. Ci. Nat. 31, p. 53.
Tarapote, Ecuador.

43. DASYPROCTA CRISTATA, Desmarest
1816. Nouv. Dict. d'Hist. Nat. 2d. Ed. 1, p. 213.
Surinam, Dutch Guiana.

44. DASYPROCTA KALINOWSKII, Thomas
1897. Ann. Mag. Nat. Hist. 6, XX, p. 219.
Idma, valley of Santa Ana, Cuzco, Peru.

Genus 2. MYOPROCTA, Thomas

1903. Myoprocta, Thomas, Ann. Mag. Nat. Hist. 7, XII, p. 464.

Type Species.—*Cavia acouchy*, Erxleben.

Range.—Guianas, Brazil, Colombia, Ecuador, Peru.

Number of Forms.—Ten.

Characters.—Like *Dasyprocta*, but smaller (about 380 or less, head and body); the tail less reduced, approaching about half the length of the hindleg, slender, hairy. Essential cranial and dental characters as in *Dasyprocta*, but toothrow reduced, the teeth "smaller both relatively and absolutely than in any species of *Dasyprocta*" (Thomas); the sagittal crest appears to be in old individuals rather longer than in *Dasyprocta*. There may be a small backwardly directed process on anterior portion of jugal, just behind its point of junction with zygomatic process of maxillary.

Forms seen: *acouchy*, *caymanum*, *leptura*, *limanus*, *milleri*, *pratti*, *puralis*.

There appears some doubt on the status of *exilis*. Apart from this the forms divide into two groups, the type species, reddish above, and the *pratti* group, duller greenish types.

List of Named Forms

(*acouchy* Section)

1. MYOPROCTA ACOUCHY, Erxleben
1777. Syst. Regn. Anim. p. 354.
Cayenne.

2. MYOPROCTA LEPTURA, Wagner
1844. Schreber Säug. Suppl. IV, p. 49.
Rio Negro, Brazil.

(*pratti* Section)

3. MYOPROCTA PRATTI PRATTI, Pocock
1913. Ann. Mag. Nat. Hist. 8, XII, p. 110.
Pongo de Rentema, Rio Marañon, Peru.

4. MYOPROCTA PRATTI ARCHIDONAE, Lonnberg
1925. Journ. Mamm. Baltimore, VI, p. 274.
Archidona, Province Oriente, Ecuador.

5. MYOPROCTA PRATTI PURALIS, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 639.
Ayapua, about 300 kilometres south-west of Manaos, Brazil.

6. MYOPROCTA PRATTI CAYMANUM, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 638.
Canabouca, Parana de Jacare, 120 kilometres south-west of Manaos, Brazil.

7. MYOPROCTA PRATTI LIMANUS, Thomas
1920. Ann. Mag. Nat. Hist. 9, VI, p. 279.
Acajutuba, Rio Negro, Brazil.

8. MYOPROCTA MILLERI, Allen
1913. Bull. Amer. Mus. Nat. Hist. XXXII, p. 477.
La Murelia, Caqueta, Colombia.

Not allocated to section; not seen

9. MYOPROCTA EXILIS EXILIS, Wagler
1831. Isis, XXIV, p. 621.
Amazon, Brazil.

10. MYOPROCTA EXILIS PARVA, Lönnberg
1921. Ark. Zool. XIV, no. 4, p. 41.
Rio Curaray, Prov. Oriente, Ecuador.

DASYPROCTIDAE: *SPECIAL WORKS OF REFERENCE*

Waterhouse, 1848, Natural History Mammalia, vol. II, Rodentia.
Tate, 1935, Bull. Amer. Mus. Nat. Hist. LXVIII, p. 295. Taxonomy of Neotropical Hystricoid Rodents.
Pocock, Proc. Zool. Soc. London, p. 365, 1922. External Characters of some Hystricomorph Rodents.

The Dasyproctidae are known fossil from the Miocene, from the Neotropical region only.

Family HYSTRICIDAE

1896. Thomas: Hystricomorpha: Family Hystricidae.
1899. Tullberg: Hystricomorpha: Family Hystricidae.
1918. Miller & Gidley: Superfamily Hystricoidae: Family Hystricidae, with subfamilies Hystricinae and Atherurinae.
1924. Winge: Family Hystricidae, part, Hystricini, part, Hystrices.
1928. Weber: Hystricoidea: Family Hystricidae.

Geographical Distribution.—Tropical parts of the Old World; the greater part of the African Continent; Italy and Sicily; Transcaucasia; Southern Palaearctic Asia (Arabia, Syria, Persia, Mesopotamia, Afghanistan, Russian Turkestan); Peninsular India and Ceylon;

South China (south of the Yangtsekiang), Hainan, Assam, Burma southwards to Malacca, Sumatra, Java and islands to the east of it (Sumbawa, Flores); Borneo; represented in the Philippine Islands.

NUMBER OF GENERA.—Four.

CHARACTERS.—External form heavy, terrestrial-fossorial; modification of hair into spiny covering always well developed, at extreme development reaching a grade of specialization not seen elsewhere in the Order; tail always bearing a group of modified quills or bristles; digits of hindfoot five. Cheekteeth moderately to extremely hypsodont, semi-rooted in progressive genera, the re-entrant folds isolating early on crown surface as narrow enamel islands; bullae relatively small, and paroccipital processes not lengthened. Occipital region of skull strongly ridged, prominent; zygoma simple; a tendency present towards extreme inflation and lengthening of nasals; clavicles imperfect; habits entirely terrestrial.

According to Tullberg, the carpus has no free centrale (*Atherurus*, *Hystrix*), unique in the Order among those examined by him except in Cuniculidae. According also to this author, the lungs are abnormal, being divided into a number of small lobes.

REMARKS.—Lyon in 1907 proposed to divide the family into two subfamilies, the Hystricinae and the Atherurinae, on account of the differences of the length and structure of the tail between the two groups, the fact that there are only three sacral vertebrae present in Atherurinae as against four in the Hystricinae (at the same time remarking that there is apparently some variation in the number of the vertebrae, especially lumbar, sacral, and caudal).

But although the *Atherurus* group is much less specialized than the *Hystrix* group both in spiny covering, reduction of tail, and in the more brachyodont cheekteeth, there appear to be too many essential characters common to both groups for this division to be maintained; the pattern of the cheekteeth and the structure of the feet, for example, are essentially similar in both groups; and the cranial characters of *Thecurus*, the lowest member of the *Hystrix* group, are very similar to those of *Atherurus*, including the rather important character of length of nasals.

CHEEKTEETH.—The cheekteeth vary individually, but the essential pattern throughout the family is, in the upper series, one inner and three outer folds, the folds isolating as islands almost immediately on the flat crown surface; like the Dasyproctidae, there is a strong tendency for the isolated folds to divide, particularly the posterior one, so that on the outer side of the tooth there are usually at least four isolated islands in the adult. The lower cheekteeth reverse the pattern of the upper series. The milk premolars are shed comparatively late in life.

GENERAL EXTERNAL CHARACTERS of principal species, as regards the development of spiny covering.

For note on details of formation of hollow "rattling-quills" (caudal quills) of *Hystrix* group, see p. 208.

Trichys lipura is the most primitive species in development of spiny covering, in all respects. No true quills are developed; the body is covered with relatively short flattened weakly developed spines; the tail is more or less naked, and bearing a brush of unmodified bristles at the end; the head is hairy.

Atherurus macrourus presents the next stage of development; the body is covered with spines of a similar nature, but sharper, longer, and evidently more effective as weapons of defence; the head is similar to *Trichys*; the tail long, less naked, covered with spiny short hairs, and the end bears a cluster of much more specialized bristles, these being alternatively expanded and contracted; but, as far as seen, no quills are as yet developed.

Atherurus africanus and related African forms present a higher stage of development in that among the spines of the back there are present a few thick circular quills, of the type found in all higher Porcupines; these vary in their development; they may be quite strong or, in some skins I have seen, very weak, so that perhaps if a really large series of skins came to hand from Africa it might be that some "quill-less" ones would be among them. Otherwise the external characters are as in the Asiatic *Atherurus*.

It is interesting that, judging by a specimen of *Atherurus* at the London Zoological Gardens, very much the same noise can be made by the rattling of the tail bristles as that produced by the smaller species of *Hystrix*.

Thecurus pumilis, from the Philippines, to which *T. sumatrae* evidently bears a close resemblance in general spine characters, appears to be the lowest true Porcupine; in this species, as in all the *Hystrix* group, the tail has become strongly reduced and its end bears a cluster of small and very poorly developed hollow "rattling-quills" which reach such a high stage of specialization in the higher Porcupines; some of these tend to be closed at the tip. A certain number of short thick true quills are developed; the spines of the body extend to the rump from the upper part of the back; the head is hairy, much as in the Brush-tailed Porcupines.

Hystrix (*Acanthion*) *javanicum* represents the next stage; the caudal quills are very weakly developed, essentially as in *Thecurus pumilis*; the head remains hairy; the quills of the back are perhaps slightly more developed than in *Thecurus pumilis*; judging by the few skins seen they appear, as in *Thecurus*, to be tightly wedged in the body, so that I should imagine they are very infrequently shed, but I have not seen this animal in captivity; on dried skins they do not give to the touch as do the quills of most higher Porcupines.

Thecurus crassispinis from Borneo stands rather alone in development of spines, and presents a mixture of generalization mixed with extremely high specialization. The quills of the back are enormously thick, relatively as thick as those even of the most highly developed forms of *Hystrix*, or so it seems to me. But no long thin quills are developed to cover them, as they are in *Hystrix cristata* and *leucura* groups; the head remains hairy, with no trace of a crest; and the caudal quills remain at their lowest development.

Hystrix (*Acanthion*) *hodgsoni* represents a stage of development typically not very much higher than in *javanicum*; the quills, though not as well developed as in *Thecurus crassispinis*, are profuse and well developed, less tightly wedged in the body apparently than in *javanicum*; there is a certain growth of long hair-like quills on the back, not met with in those described heretofore; a vestigial crest may be present (or suggested) on the head; but the caudal quills remain very poorly developed. Whether certain intergradation takes place between this and such forms as *klossi* from the same area I do not know; there seems to be a rather distinct difference as a rule between skins seen of *hodgsoni*, as compared with *klossi*, as regards crest, caudal quills, etc.; comparable to the difference seen between *javanicum* and *brachyurus*.

Hystrix (*Acanthion*) *brachyurus* (with *longicauda*, *mülleri*) reaches a rather higher state of specialization; the caudal quills are as a rule larger than in *hodgsoni*, more open, and apparently less primitive; the quills of the body are powerful and profuse, though not attaining any great length.

Hyxtrix (*Acanthion*) *klossi* is very similar in external characters to *brachyurus*, though on cranial characters belonging to a different group; there are a few long hair-like quills present, as in *hodgsoni*; the crest tends to become less abortive, and quite well marked; this type, I believe, leads on to the Chinese Porcupine *subcristatus*, in which the crest is said to be quite well developed, but skins of which I have not seen unless a very small juvenile labelled "*yunnanensis*," from Annam, which has for its size surprisingly developed caudal quills and quite conspicuous crest, represents this species, as from these characters I suspect it may do.

Hystrix leucura (with *hirsutirostris*) marks the highest development to be attained in a Porcupine; a long crest of hairs is present on the head; the quills are exceedingly profuse on the back; the short ones found in the preceding species being more or less covered by an outgrowth of long thin quills, each with several rings instead of only one as in the above species. The caudal quills are large, well open, and at their highest development; there are many short white (ordinary) quills in the neighbourhood of the tail. Sometimes the long quills tend to be narrower than in *cristata* and other African Porcupines. The bodily size is usually larger than in other Asiatic Porcupines.

Hystrix cristata, *H. galeata*, *H. africaeaustralis* are indistinguishable from one another externally; the quills may tend to be thicker, perhaps longer and more powerful than in *leucura*, otherwise the external covering is essentially similar, including the long crest and powerful tail-quills; the size, in *galeata*, becomes the largest in the genus.

For the last thirteen years these animals have been a special hobby of the author, in the London Zoological Gardens, and a few words on their captivity habits may not be amiss.

The temperament of *H. cristata* compared with the smaller *H. brachyurus* type of animal is as different as that of a dog from a cat. The smaller Porcupines never display, so far as I have observed them, the slightest nervousness, and generally seem to tame down and come to hand almost on arrival, and to be the most friendly of animals, though occasionally exhibiting an unpleasant streak in their character which I have only once observed in *cristata* (an old specimen newly imported from abroad which might have been ill-treated).

On the other hand all *cristata* Porcupines I have ever seen are most abnormally nervy animals, extremely hard to tame; it is nothing, for instance, for a specimen of this kind to take sixteen weeks before ever feeding from hand. But once they get over their first nerves, and brace their courage sufficiently to come to hand, they are most engaging animals, with an excellent temperament, and, I think, with a good memory for people; although it has been my experience that they never completely lose their distrust, so that the least thing outside routine, such, for instance, as a sudden movement, or a sneeze, will send them scurrying for shelter in a panic, and if it is an animal which does not know one well, it will be some time before the animal can be coaxed back. One *cristata* only I have known who allowed himself to be stroked. This was an individual who seemed to delight in being scratched and rubbed all over; on this animal, the belly, shoulders, and limbs are covered with bristles which are not harsh to the touch; the skin of the back when reached through the mass of quills is completely naked, flesh-coloured, soft and velvety. This nakedness is probably not a constant character; I have noticed a certain growth of hair under the quills of the back on other Crested Porcupines, which is also present in *H. hodgsoni*. *H. cristata* definitely sheds the quills much more freely and frequently than the *hodgsoni-brachyurus* type of animal; and on occasion can do very much more damage with them; but any Porcupine will draw blood immediately (even accidentally), or if touched or handled when not in the mood, and speaking from personal experience it can be agonizingly painful.

Moreover, they can attack with their spiny covering by running sideways or backwards into their enemy, usually leaving some of the quills in anything they run into. The quills in *cristata* may reach extreme length; I once had one in my possession measuring twenty-one inches. But it is not these, but the short thick quills which do the damage. The young have sharp little bristles at birth; and these will develop into sufficiently sharp spines within ten days to make handling impossible. In captivity there are one or at most two young in a litter, so far as my experience goes. *H. hodgsoni*, which has the caudal rattling quills poorly developed, does not use them except in moments of great excitement, and even then the noise produced is feeble; but in *cristata*, in which these hollow quills are at maximum development, they are normally used constantly, though I have known more than one specimen which appeared quite unable to make any sound with them at all. The sound produced by *cristata* is entirely different from that produced by *hodgsoni*, and in moments of anger or excitement it can be terrific; a noisy motor-bicycle is the only thing to which I can compare it; but I have never been able to ascertain whether all this noise is caused by the quills, or whether the animal roars at the same time. It must be stated, not for the first time, that the belief that these animals shoot their quills *is* a myth. But the origin of that story may be explained as follows: a Porcupine will normally be carrying a few loose quills on the body (sometimes these may even be picked out in very tame specimens, as in "Joe," a famous *hodgsoni* (or *javanicum*?) which lived in the London Zoo for about twelve years or more). When the animal wakes up suddenly, he shakes himself, and on rare occasions one of these loose quills is shot out and hurtles across the cage, giving the effect that the animal has shot it.

The captivity life is good; best of all Rodents, according to Flower's valuable paper on the subject; in this paper a specimen is mentioned which attained the great age of twenty years; but normally I suppose twelve or fifteen would be the absolute limit. It may be added that their gnawing powers are prodigious and that they use extreme ingenuity on certain occasions; for instance, I once saw one trying to shake open a door; after some ineffective pawing attempts, he ran backwards and then took a run at the door, just as a human being might do, which I thought showed high reasoning power.

Key to Generic Groups

Tail relatively long, its end bearing a tuft of bristles; cheekteeth rooted, more brachyodont; spiny covering not highly developed (thick circular quills on back most often absent); anterior zygomatic root over P.4. ATHERURUS Group. ATHERURI
Trichys; Atherurus

Tail short, bearing a cluster of highly modified hollow quills; cheekteeth usually strongly hypsodont, semi-rooted; spiny covering highly developed, always with thick circular quills present on back; anterior zygomatic root over middle of toothrow.
HYSTRIX Group. HYSTRICES
Thecurus, Hystrix

The *Atherurus* Group

CHARACTERS.—As indicated in the above key. The size is relatively smaller usually than in the *Hystrix* group; the spiny covering less specialized. Skull with no inflation of nasals, and usually no inflation of frontals. The thick quills on the back, characteristic of true Porcupines, are not developed in *Trichys* nor in the Asiatic section of *Atherurus*; in the African section of the latter genus they are usually present. This indicates a higher grade of specialization for the African forms of this genus, which is paralleled by the *Hystrix* group, which are at their lowest in the Indo-Malayan region, and at their highest in Africa.

Key to the Genera of the *Atherurus* Group

Skull with well-marked postorbital process, and strong interorbital constriction; lower incisors more compressed; tail long, scaly, its tip bearing a cluster of parallel-sided bristles; body clothed with flexible spines; a prominent horizontal groove on surface of jugal.
TRICHYS

Skull with scarcely marked postorbital process (or this absent), and little interorbital constriction; lower incisors not compressed; tail long, less naked, its tip bearing a cluster of bristles which are alternately expanded and contracted; body clothed with sharper bristles, sometimes mixed with quills; no groove on surface of jugal. ATHERURUS

Genus 1. TRICHYS, Günther

1876. TRICHYS, Günther, Proc. Zool. Soc. London, p. 739.

TYPE SPECIES.—*Trichys lipura*, Günther.

RANGE.—Sumatra, Borneo, and southern Malay Peninsula (Malacca, Perak, etc.).

NUMBER OF FORMS.—Two.

CHARACTERS.—Skull rather long and narrow; a prominent sagittal ridge present in adult; well-marked postorbital processes present, behind which skull is considerably constricted; nasals short, narrow, shorter than the frontals, extending back to anterior zygomatic root. Rostrum slender. Occipital region high, strong; paroccipital processes not lengthened; bullae relatively small. Palate straight, moderately wide; hamular process long; palatal foramina very short, situated far in front of toothrow.

Infraorbital foramen relatively small for a Hystricoid Rodent; no canal for nerve transmission. Zygoma simple; jugal long, though not extending to lachrymal, a prominent groove running along it, on exterior border, throughout most of its length. Mandible with angular portion well distorted outwards; the hinder part of the jaw flattened, as in all Hystricidae (i.e. no backward prolongation of angular process). Coronoid high, nearly as high as condyle in type skull.

Cheekteeth as already described, rooted; toothrow short.

Externally covered with flat grooved spines scarcely more developed than in some Neotropical Echimyidae; head and underparts hairy. Tail moderately long, poorly haired, scaly, its end bearing a cluster of straight bristles. There is a tendency present for this animal to lose the tail during life. Forefoot rather broad, with four well-developed digits bearing thick claws, the two central digits slightly longer than the outer ones. Pollex rudimentary. Hindfeet similar to the forefeet, but longer, and the hallux more developed than the pollex; otherwise digits like those of forefoot.

Size smaller than is usual in the family.

Forms seen: *lipura*, *macrotis*.

The two species are very closely allied, and might be considered as not more than races; their chief difference lies in the size of the ear.

List of Named Forms

(References and type localities of all Hystricidae are the work of Mr. G. W. C. Holt.)

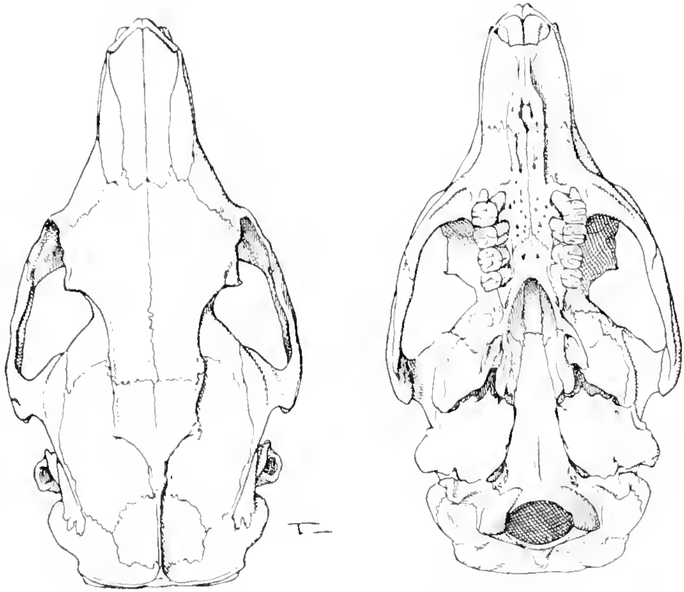


FIG. 56. TRICHYS MACROTIS, Miller.
B.M. No. 16.11.16.2; × 1.

FIG. 57. TRICHYS MACROTIS, Miller.
B.M. No. 16.11.16.2; × 1.

1. TRICHYS LIPURA, Gunther

1876. Proc. Zool. Soc. London, p. 739.

Borneo.

Synonym: *guentheri*, Thomas, 1889, Proc. Zool. Soc. London, p. 235. Kina Balu, Borneo.

2. TRICHYS MACROTIS, Miller

1903. Proc. U.S. Nat. Mus. XXVI, p. 469.

N.-W. Sumatra, Tapanuli Bay.

Genus 2. ATHERURUS, Cuvier

1829. Atherurus, Cuvier, Dict. Sci. Nat. LIX, p. 483.

Type Species.—*Hystrix macrourus*, Linnaeus. (See Lyon, Proc. U.S. Nat. Mus. XXII, 1907, p. 584).

Range.—Indo-Malayan: Southern China, Tongking, Hainan, Assam, Tenasserim, Malay Peninsula, Sumatra. (Other Malay Islands?) Africa: Nigeria, Fernando Po, Sierra Leone, Senegambia, Congo, Uganda, Kenya. (In China occurring as far north as Szechuan.)

Number of Forms.—Thirteen.

Characters.—Skull with short nasals, extending back about to anterior margin of infraorbital foramen; frontals long, becoming arched and slightly inflated in *africanus*; usually no postorbital process, but this can be slightly marked, and usually very little interorbital constriction. Sagittal crest formed in adult. Zygoma simple, but jugal broader anteriorly, and tending to be longer in African species than in Malayan ones; in many cases it reaches the lachrymal in African group. Bullae relatively small. Palate essentially as *Trichys*. Occipital region of skull as in *Trichys*. Mandible with low coronoid, rather low condyle; angular process moderately to weakly distorted outwards; traces of a ridge beside the condyle, as found in Erethizontidae and Chinchillidae, may be present. Infraorbital foramen without canal for nerve transmission; relatively small for a Hystricoid Rodent, particularly in *africanus*, in which the frontal inflation is present. Palatal foramina much reduced. Cheekteeth as described above; rooted.

Externally covered with spines, stronger and more powerful than in *Trichys*; head hairy. Tail moderately long, with short spiny hairs on the scales, and a thick tuft of bristles at the end, the bristles alternately expanded and contracted (up to about five times or more); in the African species these expansions tend to be nearer to each other and rather more numerous than in the Indo-Malayan type. Feet essentially as in *Trichys*. Head and body length up to 525 mm. or perhaps more.

These may be described as much faster-moving animals than members of the genus *Hystrix*, judging by specimens observed in the London Zoological Gardens.

In the African species the thick round quills, characteristic of all the members of the *Hystrix* group, are present; these vary in their development from scarcely traceable to rather strong; it may be that with a large series, African types might come to hand which lack them. They are always absent in the Indo-Malayan forms so far as I have examined.

Forms seen: *africanus*, *assamensis*, *burrowsi*, *centralis*, *macrourus*, *stevensi*, *tionis*, *turneri*, *zygomaticus*.

The forms are here provisionally treated as two distinct groups, based on the presence (African species) or absence (Malayan types) of true quills.

Of the Indo-Malayan forms, from descriptions and from those I have examined I cannot credit that there is more than one species; trivial skull characters have for the most part been used to separate the various forms, and probably all are best regarded as races.

The African types divide sharply into two on skull characters, though the form *turneri* seems to me to be intermediate between the two types to a certain degree; it must also be noted as a form in which apparently the quills are weak.

In *africanus*, the frontals are arched, the skull is broader, the infraorbital foramen, due no doubt to the inflation of the frontals, seems smaller, and the jugal appears consistently to extend up to the lachrymal.

In *centralis*, the frontals are not or less arched, the skull is narrower, and more like the Asiatic types, and the jugal may or may not extend so far anteriorly. *A. burrowsi*, based on a skull without a skin, is best regarded as a race of *centralis*.

List of Named Forms

macrourus Group

1. ATHERURUS MACROURUS MACROURUS, Linnaeus

1758. Syst. Nat. 10th Ed. no. 4, p. 57.
No exact locality.
Synonym: (?) *fasciculata*, Shaw, 1801, Gen. Zool. ii, 1, p. 11, pl. 124. (This name used by Lyon, 1907, for the Malaccan *Trichys*.)
orientalis, Brisson, 1756, Regn. Anim. p. 131. East Indies.

2. ATHERURUS MACROURUS PEMANGILIS, Robinson

1912. Ann. Mag. Nat. Hist. 8, X, p. 590.
Johore Archipelago (Malaya); Pulau Pemanggil, between Pulau Aor and Pulao Tioman, S. China Sea.

3. ATHERURUS MACROURUS STEVENSI, Thomas

1925. Proc. Zool. Soc. London, p. 505.
Ngai-Tio, Tongking.

4. ATHERURUS MACROURUS ASSAMENSIS, Thomas

1921. Journ. Bombay Nat. Hist. Soc. XXVII, p. 598.
Cherrapunji, Assam.

5. ATHERURUS MACROURUS HAINANUS, Allen

1906. Bull. Amer. Mus. Nat. Hist. XXII, p. 470.
Hainan.

6. ATHERURUS MACROURUS TERUTAUS, Lyon

1907. Proc. U.S. Nat. Mus. XXXII, p. 587.
Pulou Terutau (Malay Peninsula).

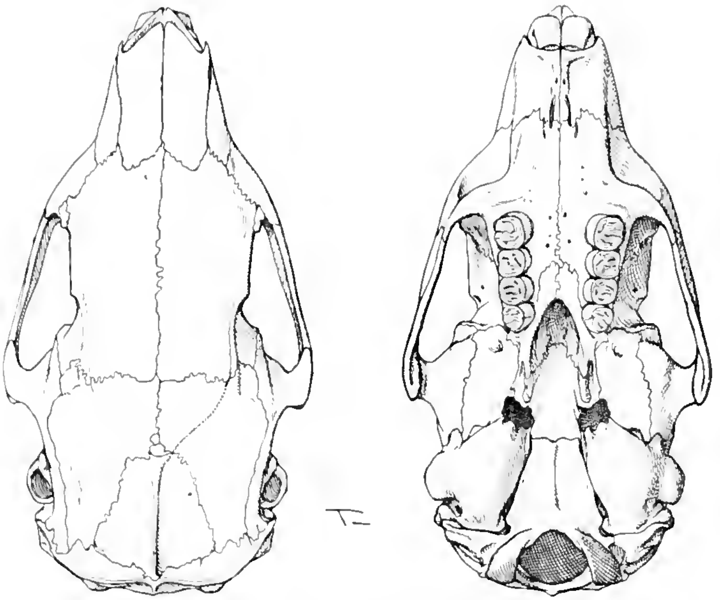


Fig. 58. Atherurus turneri, St. Leger.
B.M. No. 34.6.2.77, ♂; × 1.

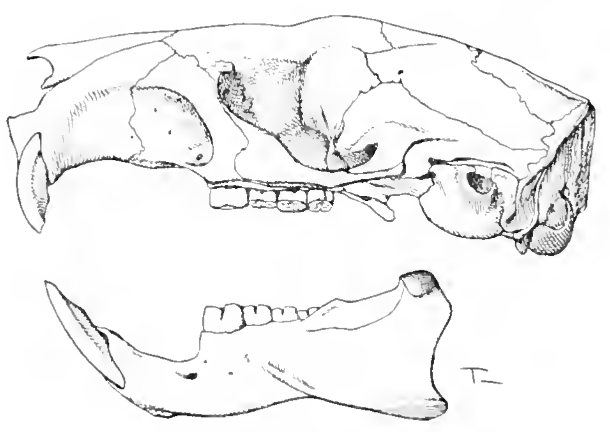


Fig. 59. Atherurus turneri, St. Leger.
B.M. No. 34.6.2.77, ♂; × 1.

7. ATHERURUS MACROURUS TIONIS, Thomas

1908. Journ. Fed. Malay States Mus. Vol. II, no. 3, p. 105.
Juara Bay, Tioman Island (Malay Peninsula).

8. ATHERURUS MACROURUS ZYGOMATICUS, Miller

1903. Smiths. Misc. Coll. no. 1420, 45, p. 42.
Pulau Aor, Johore, Malay Peninsula.

africanus Group

9. ATHERURUS CENTRALIS CENTRALIS, Thomas

1895. Ann. Mag. Nat. Hist. 6, XV, p. 89.
Monbuttu, Congo, Central Africa.

10. ATHERURUS CENTRALIS BURROWSI, Thomas

1902. Ann. Mag. Nat. Hist. 7, IX, p. 271.
Lower Aruwimi River, Congo.

11. ATHERURUS TURNERI, St. Leger

1932. Ann. Mag. Nat. Hist. 10, X, p. 231.
West Kenya Colony; Kakamega Forest, near Kaimosi, North Kavirondo.

12. ATHERURUS AFRICANUS, Gray

1842. Ann. Mag. Nat. Hist. X, p. 261.
Sierra Leone.

incertae sedis

13. ATHERURUS ARMATUS, Gervais. (Not seen.)

1854. Nat. Hist. Mamm. 1, p. 334.
Senegambia.
(Description evidently based on external characters only.)

The genus *Atherurus* provides a good example of discontinuous distribution, no form being known living between Assam and Kenya. It is interesting to note that the genus lives side by side with *Hystrix* throughout much of its range; and that the primitive member of the *Atherurus* group (*Trichys*) is restricted to the Malay Islands area, exactly as is the primitive member of the *Hystrix* group (*Thecurus*).

The *Hystrix* Group

The *Hystrix* group differs from the *Atherurus* group primarily in the reduction of the tail, which is short, and as indicated above bears a cluster of hollow "rattling-quills," developed to a greater or lesser degree. These quills have a flower-like effect, being secured to the tail by a stalk, above which they open out into the hollow terminal part. When the animal is nervous, the tail is apparently shaken, and the quills, being lightly attached, are rattled together to produce the warning signal. I have written at some length above on this fact, and the habits of certain species of the genus concerning it. There are always on the back some thick circular quills, the extremities of which are very sharp.

The cheekteeth in this section are extremely hypsodont, usually semi-rooted.

Key to the Genera of the *Hystrix* Group

Nasals narrower, shorter, confined to rostrum (essentially *Atherurus*-like in appearance), extending back to about anterior margin of infraorbital foramen, shorter than the frontals. Thecurus

Nasals broader, longer, not confined to rostrum, extending back about to the level of the lachrymal in primitive species, or in progressive species tending to reach level of posterior zygomatic root; frontals shorter than the nasals. Hystrix

The nasals of all *Hystrix* seen are considerably broadened, even in primitive forms like *javanicum*. So far as I can trace, and from our skulls, the percentage of the nasal length against the occipitonasal length does not exceed 33 per cent in *Thecurus*, and averages 31 in our series, 32 in a series of *sumatrae* the measurements (taken against the "total length" of skull) published by Lyon. In *Hystrix*, its lowest adult appears to be a specimen from Flores with the percentage 39·4; two specimens from Java, juvenile or subadult have the percentage 39·6 and 39·8; others measured are over 40 per cent. Some measurements included below.

Genus 3. THECURUS, Lyon

1907. Thecurus, Lyon, Proc. U.S. Nat. Mus. XXXII, p. 582.

Type Species.—*Thecurus sumatrae*, Lyon.

Range.—Sumatra, Borneo, and Paragua, Philippine Islands.

Number of Forms.—Three.

Characters.—Like smaller species of *Hystrix* (next to be described), but skull transitionary towards the *Atherurus* type, the nasals narrow, extending back only to about the level of anterior margin of infraorbital foramen. Rostrum narrower; skull appearing flatter than in any *Hystrix* seen. Frontals longer than nasals; interorbital constriction may be suggested. Palate not narrowed in front of toothrows; palatal foramina as usual very small; infraorbital foramen, as in *Hystrix*, with no canal for nerve transmission. Bullae relatively small. Cheekteeth strongly hypsodont; pattern as already described (ultimately the pattern of the teeth appears to become obliterated).

Remarks.—On account of the *Atherurus*-like skull (regarding the area of the nasals) this group may, I think, stand as a genus, though it is not very well separated from smaller species of *Hystrix* like *javanicum*. There is, however, an undoubted and clear difference in the skulls of these two types. Lyon in his original genus description compared *Thecurus* to "*Acanthion*" and remarked that the caudal rattling-quills are much smaller; but, as indicated above, they are essentially in formation as those of *H. javanicum* (which Lyon evidently did not see), and *H. hodgsoni* from Nepal, which Lyon did not use in his notes for comparing the two types.

He also mentioned a number of skeletal characters in which the two groups

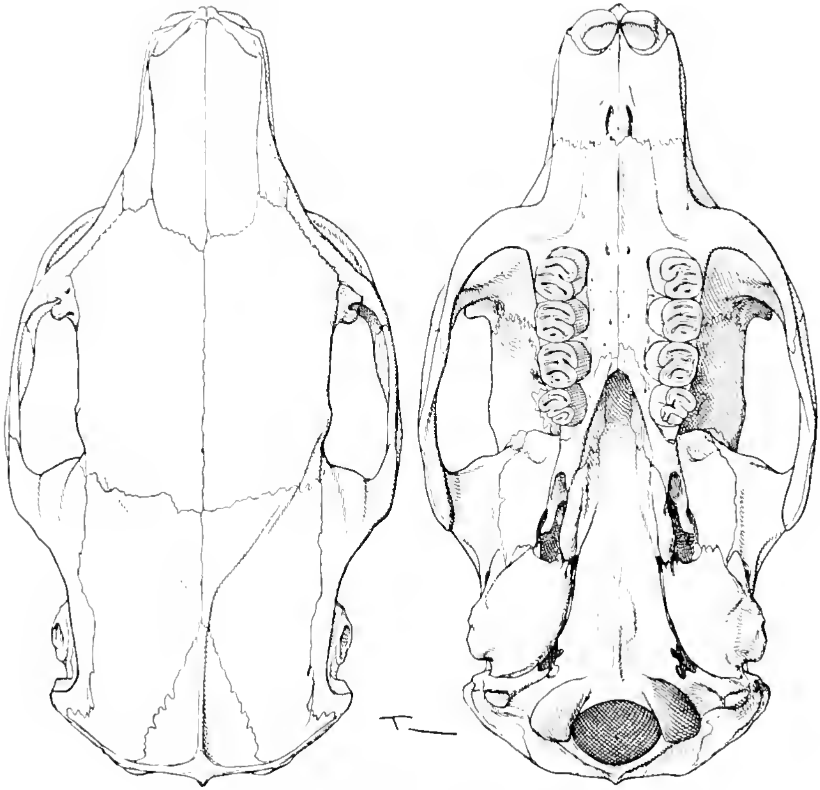


FIG. 60. THECURUS CRASSISPINIS, Günther.
B.M. No. 92.9.6.17; × 1.

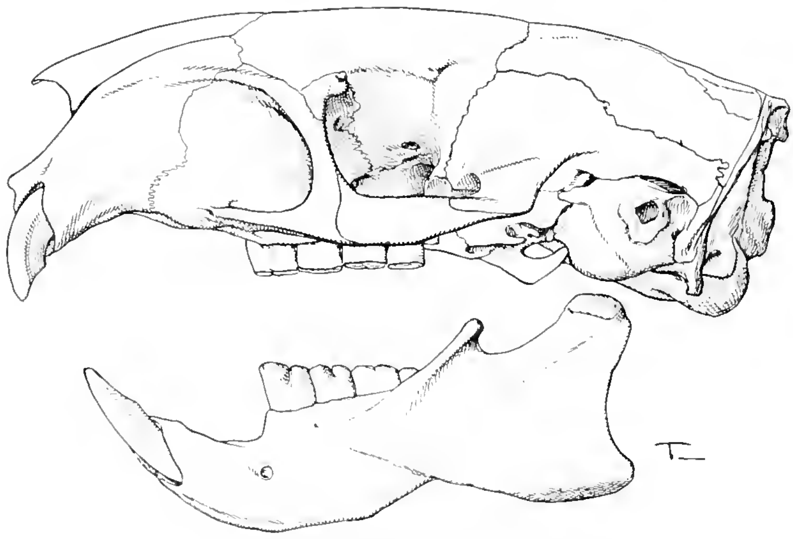


FIG. 61. THECURUS CRASSISPINIS, Günther.
B.M. No. 92.9.6.17; × 1.

differed; such as, for instance (compared with *Acanthion*), "instead of having a large laterally compressed neural spine on the axis, that vertebra bears a relatively short triprismatic spine, not compressed laterally any more than it is anteroposteriorly," etc. But before accepting such characters as these for generic purposes it is surely necessary to examine skeletons of all known *Hystrix*-group Porcupines.

As indicated above in my notes on external characters of main species in the family, two very well-marked groups may be recognized: the *pumilis* group, in which the covering is at its lowest development among true Porcupines, and the *crassispinis* group, containing a larger animal in which the quills of the back reach a surprising degree of thickness for a relatively generalized Porcupine of this type.

Forms seen: *crassispinis*, *pumilis*, and a recently acquired specimen from Sumatra which I take to represent *sumatrae*.

List of Named Forms

pumilis Group

1. THECURUS PUMILIS, Günther

1879. Ann. Mag. Nat. Hist. 5, IV, p. 106.
Paragua, Philippine Islands.

2. THECURUS SUMATRAE, Lyon

1907. Proc. U.S. Nat. Mus. XXXII, p. 583.
Aru Bay, east coast of Sumatra.

crassispinis Group

3. THECURUS CRASSISPINIS, Günther

1876. Proc. Zool. Soc. London, p. 736.
Mainland of Borneo, opposite Labuan.

Nasal, Frontal and Occipitonasal Measurements (in mm.) of British Museum Series of Skulls (other than broken ones)

Species	Number	Nasal length	Frontal length	Occipitonasal length
T. pumilis	79.5.3.17	25	c. 34	87
,,	94.2.1.15	27	32	91
T. crassispinis	76.9.20.15 (the type)	33	38	c. 110
,,	92.9.6.17	37	40	114
,,	92.10.1.5	34	39	111
,,	95.5.7.7	35	37	107
,,	84.5.19.7	35	36	106

Measurements for comparison, of *brachyurus* Group of *Hystrix* in British Museum (small species with nasal percentage of occipitonasal length less than 50 per cent)

H. javanicum, juvenile	50.12.2.16	43·5	29	109
H. brachyurus	5.9.27.1	51	36	122

SPECIES	NUMBER	NASAL LENGTH	FRONTAL LENGTH	OCCIPITONASAL LENGTH
H. brachyurus	3.2.6.74	63	34	130
H. mülleri (?), from Borneo	93.3.4.8	62·5	34	128
FROST COLLECTION, 1938. Not yet registered.				
Flores, adult female *javanicum*		43	31	109
Flores, adult male *javanicum*		45	31	109
East Java, adult male *javanicum*		51·5 left 48 right	31·5	114
East Java, old female *javanicum*		44	31·5	104
East Java, sub-adult *javanicum*		42	32	106

All other *Hystrix*, so far as traced, have the percentage of nasals against occipitonasal length more than 50 per cent except sometimes *H. leucura* (47, *fide* Lönnberg).

Genus 4. HYSTRIX, Linnaeus

1758. HYSTRIX, Linnaeus. Syst. Nat. 10th. Ed. 1, p. 56.
1822. ACANTHION, Cuvier, Mem. Mus. Hist. Nat. IX, p. 425. (*Acanthion javanicum*, Cuvier.) Valid as a subgenus.

TYPE SPECIES.—*Hystrix cristata*, Linnaeus.

RANGE.—The greater part of the African Continent (Morocco, Asben (Sahara), Upper Egypt, Senegal, Gambia; Uganda, Kenya, Somaliland, Tanganyika, Portuguese East Africa, South-west Africa, South Africa); Italy and Sicily; Palestine, Syria, Asia Minor, Mesopotamia, South Arabia (specimens in B.M.), Afghanistan, probably Persia; Transcaucasia (Talysh); South-western Siberia (Turkmenia, Semirechia, Kopet-Dag mountains, Karakum), (Vinogradov); Baluchistan; Peninsular India (Punjab, Rajputana, Central Provinces, Palanpur, Cutch, Kathiawar, Deccan, Mysore, Coorg, Nilgiris, Malabar); Ceylon; Nepal, Sikkim, Bhutan, Assam; Burma, Tenasserim, South China (Szechuan, Yunnan, Fukien, Anhwei); Hainan; Malay Peninsula, Sumatra, Java, Borneo, Sumbawa, Flores.

NUMBER OF FORMS.—Approximately thirty-five.

CHARACTERS.—Nasals, even in the most primitive forms, longer and broader than in *Thecurus*, extending about to lachrymal level in *brachyurus* group, progressively lengthened in most other species; broader to a degree and much longer in *subcristatus* group; relatively short in *leucura* group, and not wider behind than in front; relatively short in *africaeaustralis* group but enormously broadened, much wider behind than in front; considerably broader behind, and also much lengthened in *cristata* group, ultimately approaching the level of the posterior zygomatic root. In these larger African species the skull becomes much arched. A prominent sagittal crest normally present in adult. Occiput thick, strongly ridged, prominent. Bullae relatively small; paroccipital processes not much lengthened. Palate broad, extending about to end of toothrows behind, and straight; not depressed in front of toothrows;

palatal foramina short, far in front of toothrow. Infraorbital foramen of moderate size for a Hystricoid Rodent, relatively small in some in which the nasals reach their maximum inflation; no canal for nerve transmission. Zygoma broad but simple; jugal not approaching lachrymal as a rule; zygomatic plate projected forwards, appearing as an anterior prolongation of zygoma; lachrymal moderately large. Incisors broad. Mandible with hinder part flattened, the angular portion powerfully ridged and distorted outwards. Coronoid process low.

Externally becoming very large in progressive species ("38 inches" and 810 mm. the largest (measured) skins seen, *galeata* type). Forefeet broad, with four well-developed digits bearing thick claws; hindfeet longer but essentially similar except that the hallux is quite well developed, the two central digits slightly longer than the outer ones.

I have already written at length on the external characters as regards arrangement of head-crest, body quills and spines, and caudal rattling-quills, of the various species, on pp. 199, 200.

The cheekteeth are essentially as already described under the heading "Family Hystricidae" (p. 198). They are strongly hypsodont, the pattern is long preserved though ultimately obliterated, and the premolar is shed late in life.

Remarks.—The genus is frequently divided into two, *Hystrix* and *Acanthion*. Great as are the differences between the highly specialized *H. cristata* (type of *Hystrix*), and the relatively primitive *H. javanicum* (type of *Acanthion*), it becomes clear that so many intermediate forms exist that this classification cannot be retained. This is made very clear in a paper by Lönnberg, 1923 (on the Chinese Porcupine *H. subcristatus*, Swinhoe with remarks on other members of the genus, Arkiv. för Zoologi, Band 15, No. 18, pp. 1–10), and in other papers by this author.

In 1912 Miller restricted the genus *Hystrix* to the European and African species only, on account of the "inflation of facial regions of skull at maximum for the family; nasal bones extending to glenoid level." But this appears to include in *Hystrix* the Chinese *subcristatus*, currently referred to *Acanthion*, and to exclude the African crested species *africaeaustralis*, which is naturally a *Hystrix*. It is quite clear that on nasal structure alone this genus will not divide into two.

In my opinion, in an animal of this description, the external characters (development of quills, etc.) must be regarded as being just as important as any cranial character. There is a definite break in the species between *cristata*, *africaeaustralis*, *leucura* groups (Crested Porcupines) on the one hand, and *subcristatus*(?) (skin not seen, but description fits in with *Acanthion* as here suggested), *klossi*, *brachyurus*, *javanicum* types on the other. For the present I suggest that *Acanthion* may be used subgenerically for the latter group (with crest poorly developed, vestigial or absent; caudal-quills moderately to poorly developed; body quills thick but without the profuse mantle of many-ringed longer quills present and covering them). If on the other hand *subcristatus* proves to be an intermediate between the two groups, the name *Acanthion* will have to be placed in synonymy.

Subgenus ACANTHION

(With characters as just indicated; quills with one ring only.)

There are two groups here recognized, a "short-nasal" group containing *brachyurus*, of the Malay Peninsula and Islands (with *longicauda* and *mülleri* as races or synonyms), and *javanicum*, and a "long-nasal" group. *H. brachyurus* group (nasals in percentage of occipitonasal length averaging 45·3 in our specimens; 49 in five measured by Lyon (nasals against "total length" of skull). *H. javanicum* has an average percentage of 40·9 in the few adult skulls represented in London; *sumbawae*, Schwarz, from Sumbawa has a slightly lower measurement, 36·2, in the figures published. This might or might not be a race of *javanicum*; specimens received from Flores (which is beyond Sumbawa eastwards from Java), appear quite indistinguishable from typical *javanicum*. I divide this group into two sections, the typical, and the *javanicum* section (several skins of which have been seen), these sections differing from each other in the external characters indicated on pp. 199, 200. Although between these two sections there is quite a clear difference in the material examined, perhaps if enough material was collected, the two types would intergrade.

H. subcristatus group (with long nasals) contains *subcristatus*, *klossi* (with *millsi*, based on skulls the external characters of which are unknown, provisionally treated as a race), and *hodgsoni*. Nasals in percentage of occipitonasal length in *subcristatus* 56·6–57·7 (Lönnberg), (and mesopterygoid space unusually wide in our skulls); the percentage in *hodgsoni* averages 55·6 in four measured; the same in *klossi* (four measured), is 53·6. This group is divided into two sections, in precisely the same way as the *brachyurus* group; in *hodgsoni* the external characters are more primitive than in *klossi*; but probably intergradation would take place in these external characters, if enough specimens came to hand. These characters have been noted on p. 200.

The measurements of the skulls just quoted are:

SPECIES	NUMBER	NASAL LENGTH	FRONTAL LENGTH	OCCIPITONASAL LENGTH
H. klossi	14.12.8.224	80	31	139
,, ,, (type)	14.12.8.223	75	34	145
,, ,,	15.11.4.220	71	30	136
,, ,, (*millsi*; type)	21.7.16.4	68	33	128
H. hodgsoni	53.8.16.11	64	24	115
,, ,,	45.1.8.8	65	20	116
,, ,,	21.10.4.35	66	23	115
,, ,,	79.11.21.637	61	24	114

Two of the main difficulties of dealing with animals of this description are (1) the rarity, and (2) the frequently bad condition, in which they come to hand.

But even if these notes are based on insufficient material, they do at least give a preliminary survey of all the main species of the whole genus, and not sections of it (for instance, Lönnberg's paper compares only *subcristatus* with the larger crested types; Lyon's paper compares only the Indo-Malayan ones. I have seen no paper which compares *klossi*, *hodgsoni*, etc., with either of these, or either of these groups with each other).

Subgenus HYSTRIX

(With more highly specialized development of external characters; crest long, fully developed; caudal rattling-quills at maximum development; a profuse

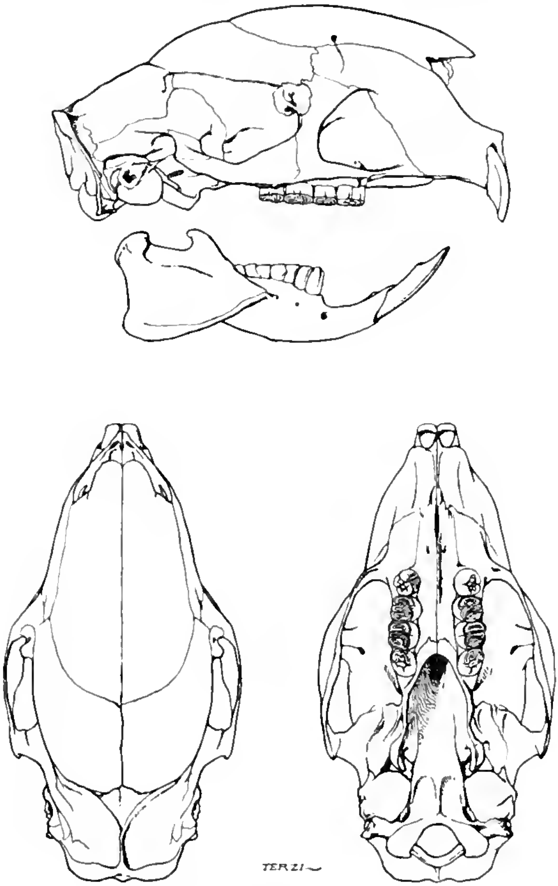


FIG. 62. HYSTRIX CRISTATA, Linnaeus.
(From Miller's *Catalogue of the Mammals of Western Europe.*)
× ½.

growth of very long many-ringed quills covering the short thick ones of *Acanthion*. For detail notes see p. 213.)

Lönnberg states that these Porcupines (with *subcristatus*) should divide into three groups, as follows:

"Nasal cavity widened chiefly by means of prolongation backwards of nasals. Proc. nasales of premaxillaries truncate behind, only little widened. *subcristatus*."

"Nasal cavity much enlarged by extremely broad proc. nasales of premaxillaries——. *leucura, galeata*."

(He suggests this group might divide into two, one for *leucura* (Indian, Asiatic types), the other for the African *galeata*.)

"Nasal cavity enlarged by expansion of nasals, proc. nasales of premaxillaries wedge-shaped behind, not or only moderately enlarged. *africaeaustralis, cristata*."

(He suggests that this group might also divide into two, one for *cristata* and *senegalica* type, one for *africaeaustralis*.)

But there is a very profound difference between *leucura* and *galeata*. Skulls referred to *galeata* in London seem to vary individually in the shape of the nasals. I believe that all species of African Porcupines excepting *africaeaustralis* would prove to be referable to one species *cristata* if enough of them came to hand, and that the shape of the nasals would be found to vary individually so that *galeata* would become merged into *cristata*. *H. leucura* with *hirsutirostris* seems to me to be a perfectly natural group, sharply differentiated on nasal structure from all African Porcupines. The nasals are not or scarcely broader posteriorly than anteriorly; the whole skull lacks that broadening characteristic of African Crested Porcupines. Further, the nasals in percentage of occipitonasal length are short; (47–49 *leucura*, 48·2–49·6 *hirsutirostris*) (*fide* Lönnberg); a *leucura* measured for comparison with these figures has the percentage 51·7. This is markedly shorter even than in *africaeaustralis*.

Russian authors give *hirsutirostris* full specific rank, but there seems no reason to believe that it is distinct from the Indian *leucura*. I am therefore treating all named forms of this group as subspecies of the earlier name *leucura*.

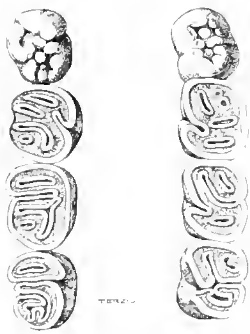


FIG. 63. HYSTRIX CRISTATA, Linnaeus. Cheekteeth; 1½.

The *africaeaustralis* group, from South and Southern Africa, appears on the material examined to be clearly separable from the *cristata* group as here understood. Compared with *leucura*, the nasals are much broadened, always as far as seen considerably broader posteriorly than anteriorly; compared with the *cristata* group, they are short (percentage of occipitonasal-nasal length 54–55·2, *fide* Lönnberg; this percentage slightly exceeded (55·9), in British Museum material). *H. stegmanni*, not seen, appears from Lönnberg's percentage figures and remarks to belong in this group.

The *cristata* group contains all other African Porcupines, as here understood. The nasal length is maximum for the genus, and is combined with great broadening, but the shape is very variable both individually and between some of the species (*cristata*, percentage 58·9–65, *senegalica*, 69; *galeata*, 61·1–66·8; *galeata ambigua*, 60·7, *fide* Lönnberg). The nasals extend much farther back than in the *africae-australis* group. *H. aerula*, from Asben, is a small form allied to *senegalica*. In my opinion probably all North African Porcupines are no more than races of *cristata*, including *occidanea*, not seen, as figured by Cabrera.

Forms seen: *aerula*, *africaeaustralis*, "*bengalensis*," *brachyurus*, *cristata*, *cuneiceps*, "*cuvieri*," *galeata*, *hirsutirostris*, *hodgsoni*, *javanicum*, *klossi*, *leucura*, *millsi*, *mülleri*, *senegalica*, *schmidti*, *somaliensis*, *subcristatus*.

List of Named Forms

Subgenus *Acanthion*, Cuvier

brachyurus Group

(*javanicum* section)

1. HYSTRIX JAVANICUM, Cuvier

1822. Mem. Mus. Nat. Hist. IX, p. 431.
Java. (Occurs also in Flores.)
Synonym: *torquata*, van der Hoev, 1836, Tijdschr. iii, p. 110. Java.
brevispinosa, Wagner, 1844, Schreber, Säug. Suppl. IV, p. 20. Java.
ecaudata, van der Hoev, 1836, Tijdschr. iii, p. 110. Java.

2. HYSTRIX SUMBAWAE, Schwarz

1911. Ann. Mag. Nat. Hist. 8, VII, p. 639.
Dompu, Sumbawa, East Indian Archipelago.

(typical section)

3. HYSTRIX BRACHYURUS BRACHYURUS, Linnaeus

1758. Syst. Nat. 10th Ed. p. 57, no. 5.
Malacca.
Synonym: *grotei*, Gray, 1866, Proc. Zool. Soc. London, pl. 31, p. 310.
flemingi, Gray, 1847, Proc. Zool. Soc. London, p. 103.

4. HYSTRIX BRACHYURUS LONGICAUDA, Marsden

1811. Hist. Nat. Sumatra, 3rd Ed. p. 118.
Sumatra.

5. HYSTRIX BRACHYURUS MÜLLERI, Marshall

1871. Proc. Zool. Soc. London, p. 235. (See Lyon, Proc. U.S. Nat. Mus. XXXII, 1907, p. 580.)
Padang, Sumatra.
(An animal of this type occurs in Borneo.)

subcristatus Group

(*hodgsoni* section)

6. HYSTRIX HODGSONI, Gray

1847. Proc. Zool. Soc. London, p. 101.
Nepal, Himalayas.
Synonym: *bengalensis*, Blyth, 1851, Journ. As. Soc. Bengal, XX, p. 170.
alophus, Hodgson, 1847, Journ. As. Soc. Bengal, XVI, p. 771. Himalayas.

(typical section)

7. HYSTRIX KLOSSI KLOSSI, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVII, p. 139.
Tenasserim Town.

8. HYSTRIX KLOSSI MILLSI, Thomas

1922. Journ. Bombay Nat. Hist. Soc. XXVIII, no. 2, p. 431.
Sangrachu, Assam.

9. HYSTRIX SUBCRISTATUS SUBCRISTATUS, Swinhoe

1870. Proc. Zool. Soc. London, p. 638.
South China; Fokien Province.

10. HYSTRIX SUBCRISTATUS PAPAE, Allen

1927. Amer. Mus. Nov. no. 290, p. 3.
Hainan.

Not allocated to Group

11. HYSTRIX YUNNANENSIS, Anderson

1878. Anat. and. Zool. Res. Yunnan, p. 332.
West Yunnan.
(According to Thomas based on a short-nosed species allied to *javanicum*.)

Subgenus *Hystrix*, Linnaeus

leucura Group

12. HYSTRIX LEUCURA LEUCURA, Sykes

1831. Proc. Zool. Soc. London, p. 103.
India; Sayul of Mahrattas.
Synonym: *zeylonensis*, Blyth, 1851, Journ. As. Soc. Bengal, XX, p. 171.
Ceylon.
malabarica, Sclater, 1865, Proc. Zool. Soc. London, p. 353.
Cochin, India.
indica, Gray & Hardwicke, 1833–34, Ill. Indian Zool. ii, pl. 14.

13. HYSTRIX LEUCURA CUNEICEPS, Wroughton

1912. Journ. Bombay Nat. Hist. Soc. XXI, p. 771.
Nokania, Cutch, India.

14. HYSTRIX LEUCURA HIRSUTIROSTRIS, Brandt

1835. Mamm. Exot. Nov. p. 39.
Afghanistan.

15. HYSTRIX LEUCURA BLANFORDI, Muller

1911. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 121.
Jalk, Baluchistan.

16. HYSTRIX LEUCURA SATUNINI, Muller

1911. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 117.
Transcaspia, Geok Tepe, east of Caspian Sea, 75½° E., 38° N.

17. HYSTRIX LEUCURA MERSINAE, Müller

1911. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 122.
Mersina, south-east of Taurus, Asia Minor.

18. HYSTRIX LEUCURA AHARONII, Muller
1911. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 123.
Palestine; Emmaus, west of Jerusalem.

19. HYSTRIX LEUCURA SCHMITZI, Müller
1911. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 126.
Palestine; Ain Dcheier, N.-W. of Dead Sea, Jordan valley.

20. HYSTRIX LEUCURA NARYNENSIS, Muller
1919. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 67.
Naryn, Turkestan.

21. HYSTRIX LEUCURA MESOPOTAMICA, Müller
1920. Zool. Anzeiger, 51, p. 198.
Jebel Abdul Azir, N.-E. Syria; 40° 20′ E., 36° 20′ N.

africaeaustralis Group

22. HYSTRIX AFRICAEAUSTRALIS AFRICAEAUSTRALIS, Peters
1852. Reise nach Mossambique, Säugeth. p. 170.
South-East Africa; Querimba, Tette; 11° to 17° south.
Synonym: *capensis*, Grill, 1858, Zool. Anteckningar af. J. F. Victorin, p. 19.

23. HYSTRIX AFRICAEAUSTRALIS PRITTWITZI, Müller
1910. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 311.
Tabora, Tanganyika Territory.

24. HYSTRIX AFRICAEAUSTRALIS ZULUENSIS, Roberts
1936. Ann. Trans. Mus. XVIII, p. 240.
Zululand, White Umfolosi River.

25. HYSTRIX STEGMANNI, Müller
1910. Arch. f. Naturgesch. Jahrg. 76, Band 1. p. 186.
Kissenji, north-east of Lake Kivu, Tanganyika.

cristata Group

26. HYSTRIX CRISTATA CRISTATA, Linnaeus
1758. Syst. Nat. 1, 10th Ed. p. 56.
Near Rome, Italy. (See Miller, Cat. Mamm. W. Europe, 1912, p. 543.)
Synonym: *cuvieri*, Gray, 1847, Proc. Zool. Soc. London, p. 102. Locality not known.
(?) *daubentoni*, Cuvier, 1822, Mém. Mus. Nat. Hist. IX, p. 431. Locality unknown; perhaps best regarded as unidentifiable.
alba, de Selys-Longchamps, 1839, Études de Micromamm. p. 152, nom, nud.
europaea, Kerr, 1792, Anim. Kingd. p. 213.
(Some specimens in B.M. labelled "*moroccana*"; the reference to this name has not been traced.)

27. HYSTRIX CRISTATA OCCIDANEA, Cabrera
1924. Bol. Soc. Esp. Hist. Nat. XXIV, p. 220.
Mogador, West Morocco.

28. HYSTRIX CRISTATA SENEGALICA, Cuvier
1822. Mem. Mus. Hist. Nat. IX, p. 430.
Senegal, West Africa.

29. HYSTRIX CRISTATA AERULA, Thomas

1925. Ann. Mag. Nat. Hist. 9, XVI, p. 196.
Aouderas, Asben, Sahara.

30. HYSTRIX GALEATA GALEATA, Thomas

1893. Ann. Mag. Nat. Hist. 6, XI, p. 230.
Lamu, Kenya.

31. HYSTRIX GALEATA SOMALENSIS, Lonnberg

1912. Kungl. Sv. Vet. Akad. Handl. Band. 48, no. 5, p. 109.
Njoro, Guaso Nyiro, North Kenya.

32. HYSTRIX GALEATA AMBIGUA, Lonnberg

1908. Sjost. Kilimanj. Meru. Exp. p. 29.
Kibonoto, Kilimanjaro, East Africa.

33. HYSTRIX GALEATA LADEMANNI, Muller

1910. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 314.
Kondoa-Irangi, Tanganyika.

34. HYSTRIX GALEATA CONRADSI, Muller

1910. Sitz. Ber. Ges. Nat. Freunde Berlin, p. 314.
Ukerewe Island, Lake Victoria.

35. HYSTRIX GALEATA LÖNNBERGI, Muller

1910. Sitz. Ber. Ges. Nat Freunde Berlin, p. 315.
Kilimanjaro, East Africa.

The family Hystricidae is known fossil from the Upper Miocene, from the Old World only.

HYSTRICIDAE:
SPECIAL WORKS OF REFERENCE

WATERHOUSE, 1848, Natural History Mammalia; Rodentia (Vol. II).

POCOCK, 1922, Proc. Zool. Soc. London, 1922, p. 365. External Characters of some Hystricomorph Rodents.

TULLBERG, 1899, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, 1.

LYON, Porcupines of the Malay Peninsula; Proc. U.S. Nat. Mus. XXXII, 1907, pp. 575–594.

LÖNNBERG, On the Chinese Porcupine *Hystrix subcristatus*, Swinhoe, Arkiv. for Zoologi, Bd. 15, no. 18, p. 1, 1923.

MILLER, Catalogue of Mammals of Western Europe, 1912, p. 542. Hystricidae. (*Hystrix cristata*).

Family CUNICULIDAE

1896. Thomas: HYSTRICOMORPHA: Dasyproctidae, part.
1899. Tullberg: HYSTRICOMORPHA: Caviidae, part.
1918. Miller & Gidley: HYSTRICOIDAE: Family Cuniculidae.
1924. Winge: Family Hystricidae; Dasyproctini, part, Dasyproctae, part.
1928. Weber: HYSTRICOIDEA: Caviidae, part; subfamily Dasyproctinae, part.

GEOGRAPHICAL DISTRIBUTION.—Tropical America, from Mexico to South Brazil.

NUMBER OF GENERA.—One.

CHARACTERS.—Skull highly abnormal, the greater part of the maxillary and jugal expanded to form large bony cheek-plates, the surface of which tends to become rugose. Cheekteeth hypsodont, semi-rooted, characterized by deep re-entrant folds which isolate as long islands on crown surface. External form heavy, terrestrial, the limbs not lengthened; feet with digits of sub-ungulate type, the claws extremely thick; hindfoot perissodactyle, with three main digits, but both D.5 and hallux present though strongly reduced; forefoot artiodactyle, with four main digits.

Clavicles not suppressed, but (said to be) incomplete. According to Tullberg, the carpus lacks a free centrale, alone of all Rodents examined by him excepting the Hystricidae.

Remarks.—The differences between this genus and the Dasyproctidae with which it has often been associated have been discussed at length by Pocock (Proc. Zool. Soc. London, 1922, p. 424), who, following Miller & Gidley, refers the animal to a distinct family. I am entirely in agreement with this classification. The unique skull structure in the family indicates evolutionary development along a very different line not only from that of Dasyproctidae but from all other Rodents; the feet do not agree with those of the Dasyproctidae, nor are the limbs lengthened; the cheekteeth do not agree exactly with those of the Dasyproctidae. (The relationships of Dasyproctidae as compared with Caviidae, with the latter of which *Cuniculus* has also been associated, have been fully discussed when dealing with the family Dasyproctidae.)

As indicated already, the cranial characters of this genus differ entirely from those of any other Rodent; in this particular it must be looked upon as the most aberrantly specialized member of the whole Order.

Genus 1. CUNICULUS, Brisson

1762. Cuniculus, Brisson, Regn. Anim. ed. 2, p. 13.

1799. Agouti, Lacepède, Ordres et Genres Mamm. 9. *Agouti paca* (=*Mus paca*, Linnaeus).

1807. Coelogenus, Cuvier, Ann. Mus. Hist. Nat. Paris, X, p. 203. (*Mus paca*, Linnaeus.)

1924. Stictomys, Thomas, Ann. Mag. Nat. Hist. 9, XIII, p. 238. (*Coelogenys taczanowskii*, Stolzmann.)

Type Species.—*Mus paca*, Linnaeus.

Range.—Forms are named from Mexico, Panama, Cayenne, Ecuador, Colombia, Brazil, Venezuela. Specimens in British Museum from Paraguay, Peru; according to Thomas ranging to South Brazil.

Number of Forms.—Ten approximately.

Characters.—Skull with zygomatic region abnormally modified by outgrowth from maxillary and jugal, of bone forming a cheek-plate which extends downwards and conceals a large part of the mandible, the maxillary part of this plate being deeply hollowed internally. The infraorbital foramen is smaller than in other Hystricoidae, in adults becoming strongly reduced, being dwarfed by the cheek-plate. Infraorbital foramen with a separate

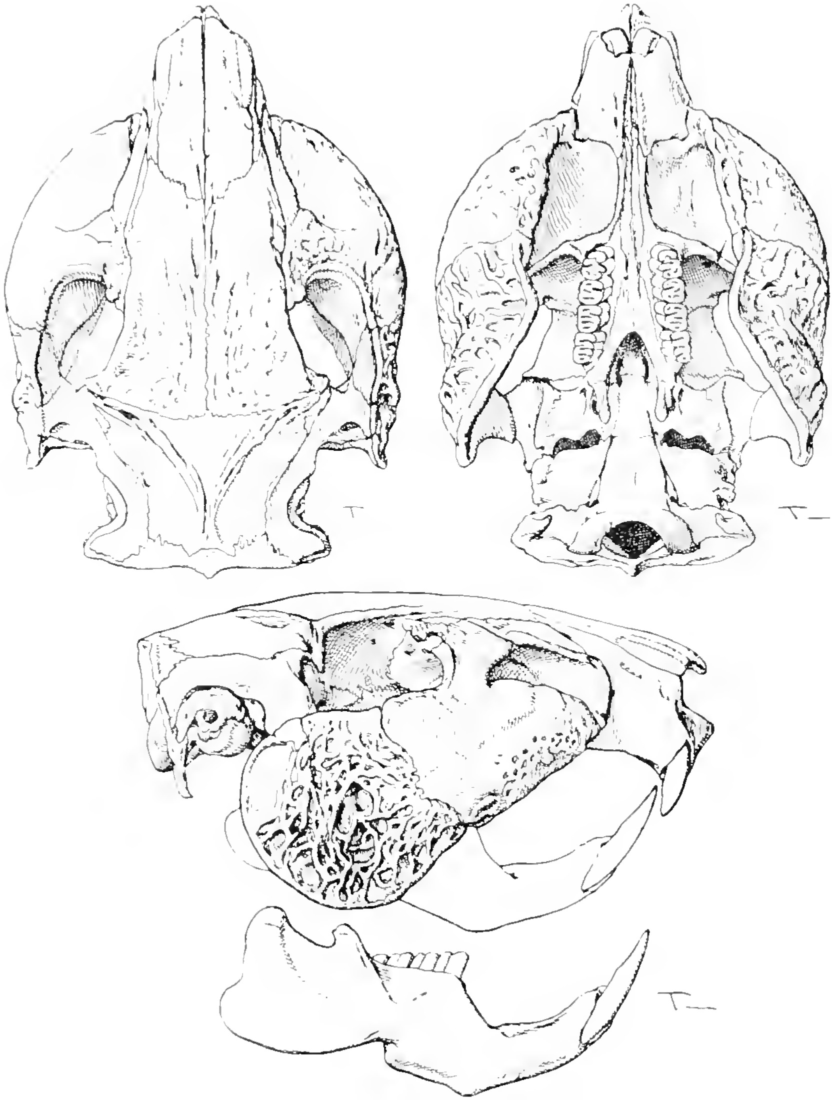


Fig. 64. Cuniculus paca, Linnaeus.
B.M. No. 13.10.24.61, ♂; × slightly more than ½.

canal for nerve transmission. Nasals broad, relatively short; frontals broad, very long; parietals depressed, and a sagittal ridge formed in adult; well marked postorbital processes occur at the suture of the frontals and parietals. Paroccipital processes thick and rather long; bullae relatively small. Palate broad, not constricted anteriorly, the anterior part extending beyond the toothrow as a

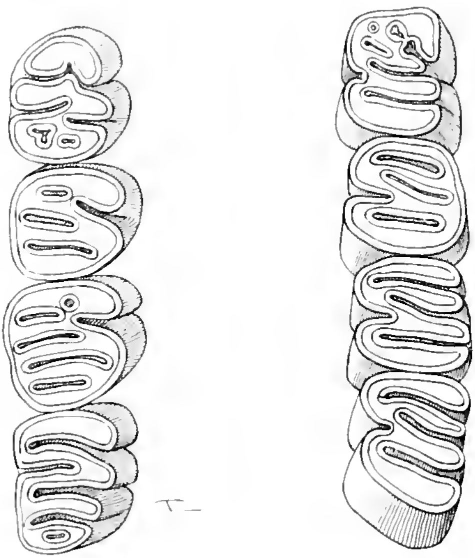


Fig. 65. Cuniculus paca, Linnaeus.

Cheekteeth: B. M. No. 13.10.24.61, ♂: × 2½.

narrow shelf bordered by two high longitudinal ridges which extend nearly to the incisors, and on either side of which lie the enormous cavities caused by the cheekplates. Palatal foramina obsolete. On account of the cheek-plate, the skull of the typical species appears nearly as broad as long. There is a marked tendency for the cheek-plate in old specimens to become rugose, and for the frontals to assume a similar character, this being apparently especially marked in males. The hinder part of the mandible is more or less flattened, as in Hystricidae; coronoid process relatively low; degree of distortion outwards of angular process moderate. Cheekteeth rather complex; upper series apparently with two inner and three outer re-entrant folds, except M.3, which is the largest tooth of the series, and in which the number of folds appears to be reversed. Sometimes there is a tendency for M.1 to become reduced in size and elements, with wear. Most of the folds isolate as long persistent islands almost immediately; the unworn tooth shows, as usual in this Order, an extremely complex pattern. Some of the isolated folds become suppressed with wear. Lower teeth with one outer, three inner folds each; the premolar may have an extra inner fold.

Incisors thin, compressed.

Externally typically the fur is harsh, the sides of the body with longitudinal rows of spots. Hindfoot with D.5 much reduced, but with moderate claw (though less strong than those of D.2, 3, 4); hallux rudimentary; three main digits long, bearing very sharp somewhat hoof-like claws. Forefoot with four main digits; D.2 is longer than D.5, but shorter than the central pair; pollex represented by a knob. Tail obsolete. Form heavy, and size large, one of the largest members of the Order. (The largest skin examined is 685 mm. head and body, but this measurement probably may be exceeded.)

It is probable that the habits of these animals are not cursorial (compared with Dasyproctidae); Pacas are said to take to the water when alarmed.

In the *taczanowskii* group (Mountain Pacas), the fur is thicker, less harsh. This group was referred to a distinct genus by Thomas, on account of "the narrow compressed claws and much more profusely granulated soles; cranially by the proportionately longer nasals, much smaller orbits, more anteriorly situated postorbitals—the zygomata narrower, generally much less rugose, though as usual there is much variation in this respect—finally the incisors are orthodont." Mammae 1—1 = 4 (*sierrae*), (Thomas).

But there are far too many essential characters shared by the two groups for there to be any question of even subgeneric separation, in my opinion. These characters indicate that the plains Pacas and mountain Pacas belong to distinct species. It may be stated that in a skin of *sierrae*, the claws seem even thicker than a specimen of *paca* with which it was compared; there is certainly no generic difference so far as claws are concerned; (compare, for instance, *Chinchilla* with *Lagostomus*; *Cavia* with *Kerodon*); when two groups have gone so far together in specialization (cranial characters), it not only seems unnecessary but bad classification to give them generic names on small cranial differences such as the above.

An interesting account of the formation of the cheek-pouches of the genus is given by Mr. R. I. Pocock (under the name of *Coelogenys*), Proc. Zool. Soc. London, 1922, p. 376.

Forms seen: *paca*, *guanta*, *taczanowskii*, *sierrae*.

I can see no specific difference between the last two forms, the latter being described as a distinct species.

List of Named Forms

(References and type localities collected by Mr. G. W. C. Holt.)

paca Group

1. CUNICULUS PACA PACA, Linnaeus

1766. Syst. Nat. 1, p. 81.
Cayenne.
Synonym: *fulvus*, Cuvier, 1807, Ann. Mus. X, p. 207.
subniger, Cuvier, 1807, Ann. Mus. X, p. 206. Tobago.

2. CUNICULUS PACA NELSONI, Goldman

1913. Smiths. Misc. Coll. LX, no. 22, p. 9.
Catemaco, Southern Vera Cruz, Mexico.

3. CUNICULUS PACA VIRGATUS, Bangs

1902. Bull. Mus. Comp. Zool. Harvard Univ. XXXIX, p. 47.
Divala, Chiriqui, Panama.

4. CUNICULUS PACA ALBA, Kerr

1792. Anim. Kingd. p. 217.
St. Francis River, Brazil.

5. CUNICULUS PACA MEXIANAE, Hagmann

1908. Arch. Rassenbiol. 5, p. 25.
Mexiana Island, Amazonian estuary, Brazil.

6. CUNICULUS PACA GUANTA, Lönnberg

1921. Ark. f. Zool. Band XIV, no. 4, p. 45.
Pacto, below Gualea, Ecuador.

7. CUNICULUS PACA SUBLAEVIS, Gervais

1854. Gervais Mamm. 1, p. 326.
Colombia.

taczanowskii Group

8. CUNICULUS TACZANOWSKII TACZANOWSKII, Stolzmann

1885. Proc. Zool. Soc. London, p. 161.
Ecuador; forests on either slope of the Andes, between 6,000 and 10,000 ft.

9. CUNICULUS TACZANOWSKII ANDINA, Lönnberg

1913. Ark. f. Zool. Band VIII, no. 16, p. 28.
Mount Pichincha, Ecuador.

10. CUNICULUS TACZANOWSKII SIERRAE, Thomas

1905. Ann. Mag. Nat. Hist. ser. 7, XV, p. 589.
Pedregosa Mountains, Sierra de Merida, Venezuela.

Tate quotes "*thomasi*," nom. nud. (?) ex Thomas, Bull. Amer. Mus. Nat. Hist., LXVIII, 2, p. 314, 1935.

CUNICULIDAE:
SPECIAL WORKS OF REFERENCE

Pocock, 1922, Proc. Zool. Soc. London, 1922, p. 365. External Characters of some Hystricomorph Rodents; p. 376, account of the mechanics of the cheek-pouches.

WATERHOUSE, 1848, Natural History Mammalia, Rodentia.
TATE, 1935, Taxonomy Neotropical Hystricoid Rodents, Bull. Amer. Mus. Nat. Hist. LXVIII, p. 295.
TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, 1, 1899.

Family CHINCHILLIDAE

1896. Thomas: HYSTRICOMORPHA: Family Chinchillidae.
1899. Tullberg: HYSTRICOMORPHA: Family Chinchillidae.
1918. Miller & Gidley: HYSTRICOIDAE: Family Chinchillidae.
1924. Winge: Family Hystricidae, part; "Eriomyini" (= Chinchillini).
1928. Weber: HYSTRICOIDEA: Family Chinchillidae.

GEOGRAPHICAL DISTRIBUTION.—Western and Southern South America, from Peru, Bolivia and North Argentina southwards.

NUMBER OF GENERA.—Three.

CHARACTERS.—Cheekteeth evergrowing, the pattern one of transverse plates. Mandible with no sharply defined ridge for attachment of masseter lateralis; the angular portion less strongly distorted outwards than is usual in Hystricoidae; a weak ridge below condylar process presumably for attachment for masseter medialis may be present, foreshadowing the structure present in Cavioidae, but much shorter and less developed than in that group. Jugal usually in contact with lachrymal; zygoma simple, but normally thickened anteriorly. A tendency present towards great inflation of mastoids and bullae; paroccipital processes relatively long. Palate much constricted anteriorly; palatal foramina usually very long, narrow. Incisors relatively narrow. External form slender, the hindfeet lengthened (semi-saltatorial or cursorial Rabbit-like types); digits of hindfoot three or four, D.5 when present extremely reduced, perhaps functionless.

The lachrymal is large; part of the lachrymal canal is open on side of rostrum in front of orbit.

A skeleton has been examined in each of the three genera, and each presents the feature that the fibula, though not fused with the tibia, is excessively reduced, a structure rather different from that of other Hystricoid Rodents examined for this character.

The Chinchillidae fall into two well-marked groups, one containing *Lagostomus* only, the other *Chinchilla* and *Lagidium*.

The differences between the skulls and the digits of these groups are rather extreme, and they have been regarded as subfamilies (Pocock, 1922). But these differences seem rather adaptive; and I have seen it stated that *Chinchilla* has bred with "the much larger but related Vizcacha" (Jennison, 1929). They are therefore here treated as groups only.

KEY TO THE GROUPS OF CHINCHILLIDAE

Paroccipital processes long, standing apart from bullae, which are not specially inflated; occipital region of skull strong, prominent; skull

more prominently ridged for muscle attachment; digits of hindfoot three, the claws heavy, prominent, excessively sharp; palatal foramina shorter; cheekteeth, excepting M.3, upper series, bilaminate. LAGOSTOMUS Group. LAGOSTOMI
Lagostomus

Paroccipital processes closely applied to bullae, not or less elongated; bullae considerably to extremely inflated; occipital region of skull weak; skull not prominently ridged for muscle attachment; digits of hindfoot four; the claws blunt and weak; palatal foramina long and narrow; cheekteeth trilaminate. CHINCHILLA Group. CHINCHILLAE
Chinchilla, Lagidium

The *Chinchilla* Group

CHARACTERS.—As indicated in the above key.

KEY TO THE GENERA OF THE CHINCHILLA GROUP

Bullae abnormally inflated, the mastoids showing prominently in superior aspect of skull. Jugal usually not in contact with lachrymal. Laminae of cheekteeth straight. CHINCHILLA

Bullae less abnormally inflated, the mastoids scarcely showing in superior aspect of skull. Jugal in contact with lachrymal. Laminae of cheekteeth curved. LAGIDIUM

Genus 1. CHINCHILLA, Bennett

1829. CHINCHILLA, Bennett, Gard. and Menagerie Zool. Soc. 1, p. 1.
1830. ERIOMYS Lichtenstein, Darstell. Säug. VI, pl. 28. (*Eriomys chinchilla*, Lichtenstein).

TYPE SPECIES.—*Mus laniger*, Molina.

RANGE.—Chile. ? Bolivia.

NUMBER OF FORMS.—One is recognized.

CHARACTERS.—Mastoids and bullae abnormally inflated, the mastoids showing prominently each side and at back of skull. Considerable interorbital constriction evident. No canal for nerve transmission in infraorbital foramen. Palatal foramina very long; palate narrow, considerably so anteriorly. Jugal usually not extending to lachrymal, broad. Paroccipital processes moderate, closely applied to and dwarfed by the bullae. Mandible with narrow angular process, which is sharply drawn backwards; the ridge outside the condylar process weak.

Cheekteeth like *Lagidium* (next to be described), but the laminae straighter; three lobes per tooth, the hinder one in M.3 pointing backwards, as a heel. The anterior lobe of the lower teeth short, reduced.

Externally, with very soft fur; the tail long, though not as long as head and body, heavily haired throughout. Hindfeet long and narrow; stiff bristle hairs

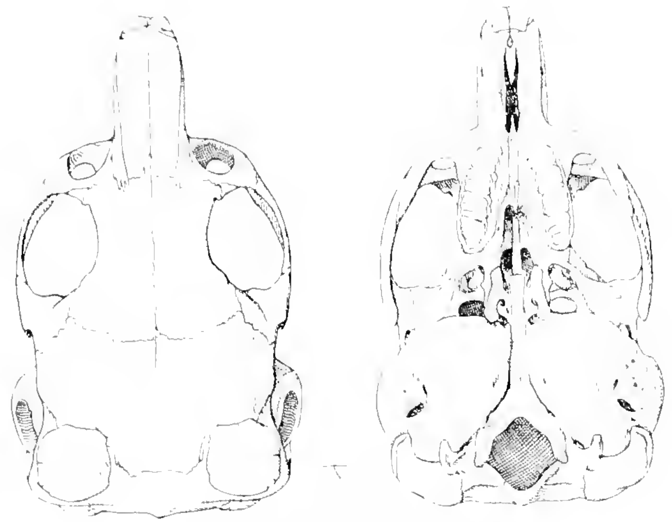


FIG. 66. CHINCHILLA LANIGER, Molina.
B.M. No. 1.8.24.1, ♂; × 1½.

FIG. 67. CHINCHILLA LANIGER, Molina.
B.M. No. 1.8.24.1, ♂; × 1½.

present on inner digit; three main digits; D.5 placed high on foot, and not nearly reaching base of D.4; extremely short. Ear large. Forefoot short; four main digits; pollex represented by a tubercle. Rudimentary cheek-pouches present (Pocock).

Forms seen: *laniger*.

LIST OF NAMED FORMS

(References and type localities of all Chinchillidae are the work of Mr. G. W. C. Holt.)

1. CHINCHILLA LANIGER, Molina

1782. Sagg. Stor. Nat. Chile, p. 301.

Northern Provinces of Chile.

Synonym: *chinchilla*, Meyen, 1833, Nova Acta, XVI, 2, p. 586. Chile.
brevicaudata, Waterhouse, 1848, Mamm. II, p. 241. Bolivia.
velligera, Prell, 1934, Zool. Anzeig. Leipzig, Bd. 108, p. 100. Chile.

As is well known, these animals were nearly exterminated on account of the value of their fur; now it appears they are being farmed, and it is hoped they will be saved from extinction.

Genus 2. LAGIDIUM, Meyen

1833. LAGIDIUM, Meyen, Nova Acta Ak. Caes. Leop. Car. XVI, 2, p. 576.

1816. VISCACCIA, Oken, Lehrb. Nat. iii, 2, p. 835.

"The rulings of the International Zoological Nomenclature have reduced *Viscaccia*, Oken to a synonym of the later described *Lagidium*" (Tate).

1833. LAGOTIS, Bennett, Proc. Zool. Soc. London, V, p. 58. (*Lagotis cuvieri*, Bennett).

TYPE SPECIES.—*Lagidium peruanum*, Meyen.

RANGE.—Peru, Bolivia, Argentina, Chile; south in Argentine to 50° S., or nearly to Magellan.

NUMBER OF FORMS.—Twenty-one are named.

CHARACTERS.—Skull narrow, with long rostrum; a tendency present for the frontals to be depressed between the orbits; the braincase flat, round; no sagittal ridge formed. Bullae very large, but not distorting the occipital region of the skull as they do in *Chinchilla*, and not appearing much in superior aspect of the skull. Paroccipital processes straight, joining the bullae. Palatal foramina long and narrow; palate much constricted anteriorly. Jugal very broad, in contact with lachrymal anteriorly, and with small upwardly directed process on hinder upper border. Infraorbital foramen with no canal for nerve transmission. Mandible near that of *Chinchilla*; the angular process narrow, drawn backwards to a degree, the angular process not much distorted outwards (older specimens seem more developed in this respect), the short ridge beside the condyle very weak as a rule.

Cheekteeth each with three laminae, the laminae curved; the upper series with the third plate of each tooth shorter than the other ones; M.3 with a backwardly pointing heel. In the lower series the front lobe of each tooth is reduced (three laminae per tooth).

Externally larger than *Chinchilla*; fur thick and soft; usually a black mid-dorsal stripe present. Ear large. Hindfeet narrow, with four digits; D.5 much as in *Chinchilla*, extremely short. Claws weak and blunt. Forefeet with four digits. Tail shorter than head and body, but of considerable length, and heavily hairy.

Forms seen: *arequipae*, *boxi*, *cuscus*, *famatinae*, *inca*, *luteum*, *lockwoodi*, *moreni*, *pallipes*, *peruanum*, *perluteum*, *punensis*, *sarae*, *saturatus*, *subrosea*, *tontalis*, *tucumanum*, *viscaccia*, *vulcani*, *viatorum*, *wolffsohni*.

Mr. R. W. Hayman has looked through the considerable British Museum material with a view to getting the twenty-one "distinct species" in this genus into some sort of revision. He reports as follows:

"There appear to be four species in this genus, two of them containing eighteen of the twenty-one named forms recognized here.

"In Peru, extending southwards as far as the Bolivian and Chilian borders is a group of small forms having the following features in common: smallish size, dorsal stripe mostly absent or indefinite, rostrum short and teeth small. *Peruanum* is the earliest name for this group.

"Southwards from North Bolivia to Chubut in the Argentine Andes is a second group having the following in common: larger size, dorsal stripe usually well marked and contrasting sharply with the usually greyish pelage, long rostrum and large teeth.

"*Viscaccia* is the earliest name in this group. Both this and the preceding group have the hindfeet usually conspicuously paler than the body colour, and in both the proportionate ear to head and body length may range from 17 per cent to 21 per cent.

"In the southern Argentine Andes another group occurs, closely related in skull characters to the *viscaccia* group, but characterized externally by very short ears in proportion to large overall size, the percentage being from 13 to 15, and by the hindfeet being uniformly coloured with the body. *Boxi*, *sarae* and *wolffsohni* belong here, the latter being the most southerly species of the genus.

"Except for the three last-named, all are here listed as subspecies of *viscaccia* and *peruanum*. Although small skulls of *vulcani*, one of the northern races of *viscaccia*, closely approach in proportions large skulls of *inca*, the most removed geographically of the *peruanum* group, the skins are quite distinct.

"Actually where the two species approach each other geographically they are most distinct (compare *punensis* and *arequipae* of South Peru with *lutea*, *cuscus* and *perlutea* of North Bolivia).

1. *v. viscaccia.*
2. *v. lutea.*
3. *v. cuscus.*
4. *v. perlutea.*
5. *v. vulcani.*
6. *v. tucumana.*
7. *v. lockwoodi.*
8. *v. famatinae.*

9. *v. tontalis.*
10. *v. viatorum.*
11. *v. moreni.* (5–11 inclusive doubtfully separable).
12. *p. peruanum.*
13. *p. pallipes.* Possibly a synonym of 12.
14. *p. inca.*
15. *p. subrosea.*
16. *p. saturata.*
17. *p. punensis.*
18. *p. arequipae.* 17 and 18 doubtfully distinct.
19. *b. boxi.*
20. *b. sarae.*
21. *wolffsohni.*"

Note.—*L. wolffsohni* differs clearly in colour pattern from all the remainder.

List of Named Forms

1. LAGIDIUM VISCACCIA VISCACCIA, Molina

1782. Storr. Nat. Chile, p. 307.
Chile.
Synonym: *lutescens*, Philippi, 1896, Ann. Mus. Chile, 13, p. 8. Tacapuca, Northern Chile.
cuvieri, Bennett, 1833, Proc. Zool. Soc. London, p. 58. Peru.
aureus, Geoffroy & D'Orbigny, 1830, Ann. Sci. Nat. XXI, p. 291. Corrientes, Buenos Ayres.
criniger, Gay, 1847, Fauna Chile, 1, p. 49. Chile.
crassidens, Philippi, 1896, Ann. Mus. Nac. Chile, 13, p. 10.
chilensis, Oken, 1816, Lehrbuch Naturgesch. ii, p. 836, Chile.
crinigerum, Philippi, 1896, Ann. Mus. Nac. Chile, 13, p. 10. Chile.
viscaccica, Brandis, 1786, Versuch einer Naturgesch. von Chile, p. 272.

2. LAGIDIUM VISCACCIA LUTEA, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 443.
Esperanza, Mount Sajama, Bolivia.

3. LAGIDIUM VISCACCIA CUSCUS, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 443.
Paratani, Bolivia.

4. LAGIDIUM VISCACCIA PERLUTEA, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 443.
Pampa Aulliaga, Bolivia.

5. LAGIDIUM VISCACCIA VULCANI, Thomas

1919. Ann. Mag. Nat. Hist. 9, IV, p. 133.
Cerro Casabindo, Jujuy, Argentina.

6. LAGIDIUM VISCACCIA TUCUMANA, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 444.
Cumbre de Mala-Mala, Sierra de Tucuman, Argentina.

7. LAGIDIUM VISCACCIA LOCKWOODI, Thomas

1919. Ann. Mag. Nat. Hist. 9, III, p. 499.
Otro Cerro, Rioja, Argentina.

8. LAGIDIUM VISCACCIA FAMATINAE, Thomas

1920. Ann. Mag. Nat. Hist. 9, VI, p. 421.
La Invernada, Rioja, Argentina.

9. LAGIDIUM VISCACCIA TONTALIS, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 219.
Los Sombreros, Sierra Tontal, west of San Juan, Argentina.

10. LAGIDIUM VISCACCIA VIATORUM, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 220.
Punta de Vacas, Mendoza, Argentina.

11. LAGIDIUM VISCACCIA MORENI, Thomas

1897. Ann. Mag. Nat. Hist. 6, XIX, p. 467.
Hills near Chubut, Argentina.

12. LAGIDIUM PERUANUM PERUANUM, Meyen

1833. Nova Acta Ac. Nat. Cur. XVI, p. 578.
Southern Peru.

13. LAGIDIUM PERUANUM PALLIPES, Bennett

1835. Proc. Zool. Soc. London, p. 67.
(Believed to be) Chilian Andes.

14. LAGIDIUM PERUANUM INCA, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 442.
Incapirca, Zezioro, Junin, Peru.

15. LAGIDIUM PERUANUM SUBROSEA, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 442.
Galera, west of Oroya, Dept. Lima, Peru.

16. LAGIDIUM PERUANUM SATURATA, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 442.
Limbane, Inambari, Dept. of Puno, Peru.

17. LAGIDIUM PERUANUM PUNENSIS, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 443.
Puno, Lake Titicaca, Peru.

18. LAGIDIUM PERUANUM AREQUIPAE, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 442.
Sumbay, near Arequipa, Peru.

19. LAGIDIUM BOXI BOXI, Thomas

1921. Ann. Mag. Nat. Hist. 9, VII, p. 179.
Pilcaneu, Rio Negro, Argentina.

20. LAGIDIUM BOXI SARAE, Thomas & St. Leger

1926. Ann. Mag. Nat. Hist. 9, XVIII, p. 639.
Pino Hachado, Neuquen, Argentina.

21. LAGIDIUM WOLFFSOHNI, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 440.
Sierra de los Baguales y de las Vizcachas, 50° 50′ S., 72° 20′ W., on boundary between Chile and Argentina.

The *Lagostomus* Group

Differing chiefly from the *Chinchilla* group in the bullae, which are not greatly inflated, the paroccipital processes, which are lengthened and stand apart from the bullae, the extremely sharp claws of the feet, the complete suppression of D.5 on the hindfoot, the skull more heavily ridged for muscle attachment.

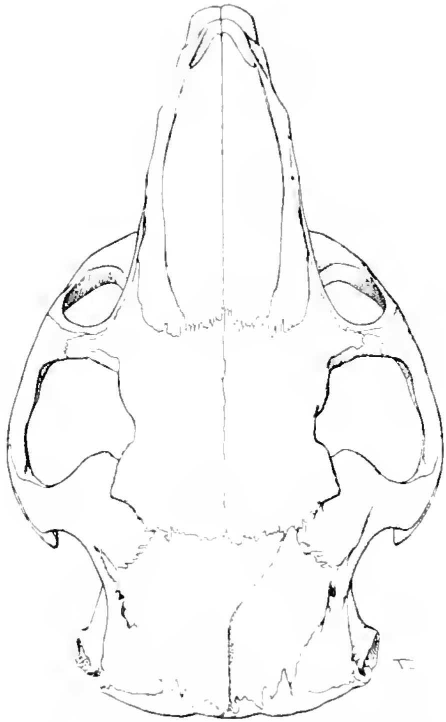


Fig. 68. Lagostomus maximus maximus, Desmarest.
B.M. No. 17.5.2.18; × $\frac{4}{5}$.

Genus 3. LAGOSTOMUS, Brooks

1828. Lagostomus, Brooks, Trans. Linn. Soc. XVI, p. 96.
1824. Vizcacia, Schinz. Naturg. und Abbild. Säugeth. p. 243. (This name is not to be used as it is a homonym of *Viscaccia*, Oken, (Tate).)

Type Species.—*Lagostomus trichodactylus*, Brooks = *Dipus maximus*, Desmarest.

Range.—Argentina. One form, from Peru, is probably extinct.

Number of Forms.—Four.

Characters.—Skull flat, with broad frontals, which bear quite well-marked postorbital processes. Nasals relatively long and narrow.

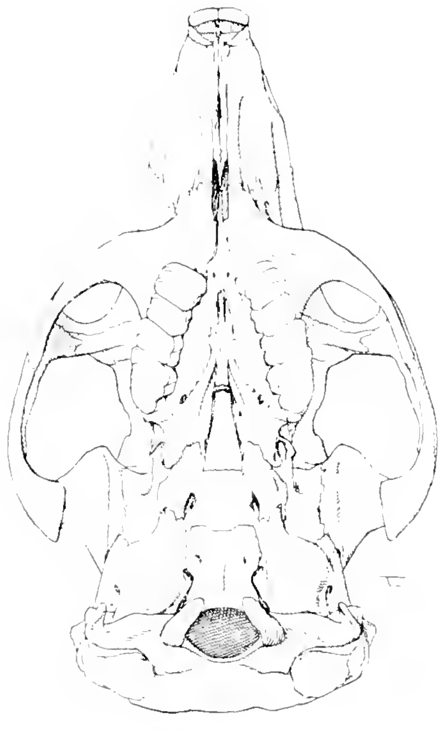


Fig. 69. Lagostomus maximus maximus, Desmarest.
B.M. No. 17.5.2.18; ½.

A well-marked sagittal crest present. Paroccipital processes lengthened (probably about as much as in *Thryonomys*); bullae not much inflated compared with the *Chinchilla* group, though appearing to a certain degree behind, each side of occipital region. A prominent canal present in infraorbital foramen for nerve

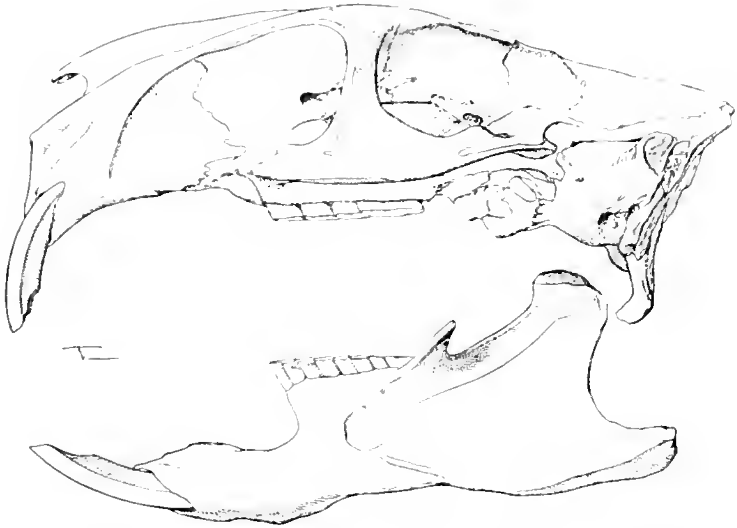


FIG. 70. LAGOSTOMUS MAXIMUS MAXIMUS, Desmarest.
B.M. No. 17.5.2.18; × $\frac{4}{5}$.

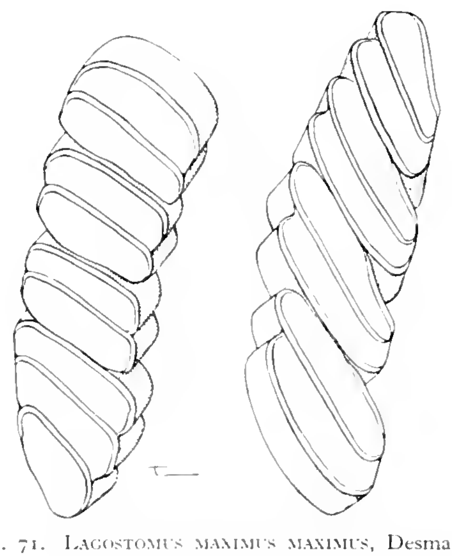


FIG. 71. LAGOSTOMUS MAXIMUS MAXIMUS, Desmarest.
Cheekteeth: B.M. No. 17.5.2.18; × $2\frac{1}{2}$.

transmission. Palate strongly constricted anteriorly. Jugal slanting sharply upwards anteriorly, and in contact with lachrymal. As in other members of the family, the upper zygomatic root is placed far backwards, over the middle of hinder part of the toothrow. Mandible with rather strong ridge beside condyle for attachment of masseter medialis; this, however, much shorter than in Caviidae. Coronoid low; condylar process relatively low; angular process distorted outwards rather weakly.

Cheekteeth set at an angle, the upper series with their outer edge pointing forwards; all upper and lower teeth with two laminae only except M.3 upper series, which is the largest tooth in the series and has three laminae. Incisors medium in width, their surfaces covered with faint longitudinal grooves. According to Pocock the penis differs considerably from that of other Hystricoid genera examined by him, including *Chinchilla*; see also note on breadth of manubrium on p. 171, which indicates yet another wide distinction from the Chinchillae.

Externally relatively large (up to 470 mm. head and body in London collection); fur less soft than in *Chinchilla* group; tail not long, fully haired; forefoot with four digits armed with stout claws; hindfoot rather long, with three digits only, the claws in their development comparable to those of *Cuniculus*, excessively thick and sharp. Stiff bristle-hairs present on D.3, which is the longest digit; D.2 is shorter than D.4.

Forms seen: *crassus*, *immollis*, *maximus*.

List of Named Forms

1. LAGOSTOMUS MAXIMUS MAXIMUS, Desmarest

1817. Nouv. Dict. d'Hist. Nat. xiii, p. 117.
Argentina (?). (Locality unknown.)
Synonym: *trichodactylus*, Brooks, Trans. Linn. Soc. XVI, p. 96, 1828. Argentina.
diana, Griffith in Cuvier, 1827, Anim. Kingd. III, p. 170.
viscaccia, Geoffroy & D'Orbigny, 1830, Ann. Sci. Nat. xxi, p. 291.
criniger, Lesson, 1842, Nouv. Tabl. Règne. Anim. p. 105.
pamparum, Schinz, 1825 (1824) Naturg. und Abbild. Säugeth. p. 244.
americana, Schinz, 1825, Cuviers Thierreich, IV, p. 429.

2. LAGOSTOMUS MAXIMUS IMMOLLIS, Thomas

1910. Ann. Mag. Nat. Hist. ser. 8, V, p. 245.
Tapia, Tucuman, Argentina.

3. LAGOSTOMUS MAXIMUS PETILIDENS, Hollister

1914. Proc. Biol. Soc. Washington XXVII, p. 58.
8 miles south of Carmen de Patagones, Southern Argentina.

4. LAGOSTOMUS CRASSUS, Thomas. (Extinct?)

1910. Ann. Mag. Nat. Hist. ser. 8, V, p. 246.
Santa Ana, Cuzco, Peru. (Known from cranial characters only.)

CHINCHILLIDAE:
SPECIAL WORKS OF REFERENCE

WATERHOUSE, 1848, Natural History Mammalia, Rodentia.
TATE, 1935, Taxonomy of Neotropical Hystricoid Rodents, Bull. Amer. Mus. Nat. Hist. LXVIII, p. 295.
POCOCK, Proc. Zool. Soc. London, 1922, p. 365. External Characters of some Hystricomorph Rodents.
TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, no. 1, 1899.

The family is known fossil from the Miocene, from the Neotropical region only. Miller & Gidley quoted several extinct genera.

Superfamily CAVIOIDAE

1896. Thomas: HYSTRICOMORPHA, part.
1899. Tullberg: HYSTRICOGNATHI, *Hystricomorpha*, part.
1918 Miller & Gidley: Superfamily HYSTRICOIDAE, part, medialis series.
1924. Winge: Family Hystricidae, part.
1928. Weber: HYSTRICOIDEA, part.

This Superfamily is equal to the medialis series of the Hystricoidae of Miller & Gidley, and contains one family, the Caviidae, containing the genera and subgenera *Cavia*, *Galea*, *Caviella*, *Monticavia*, *Nanocavia*, *Kerodon*, *Dolichotis*, *Paradolichotis* and *Hydrochoerus* only.

I have elsewhere, when dealing with the Hystricoidae (Hystricoidae, p. 97) remarked on the desirability of removing the Caviidae from the typical Hystricoid series, on account of the different formation of the lower jaw. Apart from this structure and the formation of the cheekteeth they appear to agree in essential characteristics with the Hystricoidae; but although Chinchillidae may show a certain resemblance in mandible formation to Caviidae, I am unable to regard the Caviidae as typical Hystricoidae now, whatever their ancestors may have been.

Family CAVIIDAE

1896. Thomas: HYSTRICOMORPHA: Family Caviidae.
1899. Tullberg: HYSTRICOMORPHA: Family Caviidae, part, included *Dasyprocta* and *Cuniculus* ("*Coelogenys*").
1918. Miller & Gidley: HYSTRICOIDAE (Medialis series). Family Caviidae; and Family Hydrochoeridae (*Hydrochoerus* and fossil allies).
1924. Winge: Family Hystricidae, Dasyproctini, part, group Caviae.
1928. Weber: HYSTRICOIDEA: Family Caviidae, part, subfamilies Caviinae (*Cavia*), and *Hydrochoerinae* (*Hydrochoerus*, *Dolichotis*).

GEOGRAPHICAL DISTRIBUTION.—The greater part or the whole of South America; extending north to Panama.

NUMBER OF GENERA.—Six.

CHARACTERS.—Zygomasseteric structure differing from that of the Hystricoidae in the formation of the lower jaw, which has the angular process drawn backwards but not distorted outwards, and possesses a deep horizontal ridge, for the insertion of masseter medialis (according to

Miller & Gidley) present on side of mandible slightly below alveolar level and extending from the level of the condylar process to about as far as the hinder part of M.1. Infraorbital foramen very large, as in Hystricoidae, and zygomatic plate narrow, remaining completely beneath it.

Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$ = 20. Cheekteeth evergrowing, unilaterally hypsodont, normally comparatively simplified in structure, but with sharp folds and angular projections, the general effect more or less prismatic.

Tibia and fibula not fully fused.

Clavicles suppressed. External form ambulatory or cursorial; digits of hindfoot reduced to three. Tail obsolete. Lachrymal large; part of lachrymal canal open on side of the rostrum, except in the genus *Dolichotis*.

Two well-marked subfamilies may be recognized, which are sometimes considered as families; but which, notwithstanding the high specializations of the Hydrochoerinae, appear to agree in very many essential features.

Key to the Subfamilies of the Caviidae

M.3 not greatly enlarged; pattern of cheekteeth comparatively simple; palate short to extremely short (from before backwards); paroccipital processes not abnormally elongated. Subfamily Caviinae
(*Cavia, Galea, Caviella, Kerodon ; Dolichotis*)

M.3 extremely enlarged (upper series); pattern of cheekteeth comparatively complex; palate not short (from before backwards); paroccipital processes abnormally lengthened. Subfamily Hydrochoerinae
(*Hydrochoerus*)

Subfamily CAVIINAE

Geographical Distribution.—As in the family, except not known from Panama.

Number of Genera.—Five.

Remarks.—The Caviinae fall into two well-marked groups, the *Cavia* group, smaller genera with short limbs, shorter ears, and moderate claws (or in *Kerodon* blunt nails), and the *Dolichotis* group, containing a single genus, with larger size, long limbs, long ears, sharp hoof-like claws, the external form more modified for cursorial life.

Dolichotis seems to be too nearly allied to the Caviae for these groups to be regarded as subfamilies, as has been done (Pocock, Tate).

The *Cavia* group was revised by Osgood in 1915 (Field. Mus. Nat. Hist. Publ. Zool. ser. X, no. 13, pp. 194, 195), who rightly restricted the genus *Kerodon* to the species *rupestris*, and proposed the subgenera *Galea* and *Caviella* for those species of *Cavia* with more simple cheekteeth. Thomas in 1916 treated *Galea* and *Caviella* as full genera, and erected *Monticavia* for the species *niata* (referred by Osgood to *Caviella*). Later Thomas erected *Nanocavia* for a new species *shiptoni*, allied to *Caviella* and *Monticavia*.

The Caviinae have recently been revised at some length by Kraglievitch, 1931, Ann. Mus. Nac. Buenos Aires, XXXVI, p. 77. He divides the subfamily

Caviinae into the two groups here recognized. The genera *Cavia*, *Galea*, *Caviella*, *Monticavia*, and *Kerodon* are retained in the *Cavia* group; *Nanocavia* he reduced to a subgenus of *Monticavia*.

On this account I retain *Galea* and *Caviella* as full genera, though I am bound to say that I feel convinced that it would be wiser to retain Osgood's original classification, in which these two groups are regarded as of subgeneric value only, as the characters which separate them from each other are of very doubtful value.

But *Monticavia* is so closely allied to *Caviella* that I cannot treat it as more than a subgenus. The main differences between *Monticavia* and *Caviella* are that the heel in M.3 of *Monticavia* is less sharply defined, and that the incisors are in *Monticavia* more pro-odont. But Kraglievitch gives the measurement of the angle of the incisors of *Caviella* as between 88° and 110°, and that of *Monticavia* (*Nanocavia*) *shiptoni* as 111°, so that the difference in this respect appears to amount to one degree between the two "genera," which is hardly sufficient to base a generic name on!

Kerodon is a distinct genus, which cannot be confused with any of the other members of the *Cavia* group, whatever their status may be.

Key to the Groups of the Caviinae

The limbs shorter; ears short; claws not hooflike, less broadened, or may be blunt; nasals not narrowed and pointed anteriorly; interorbital region narrower; paroccipital processes less lengthened.
Cavia Group (Caviae)
(*Cavia*, *Galea*, *Caviella*; *Kerodon*)

The limbs longer; ears long; claws powerful and hooflike; nasals markedly narrowed and pointed anteriorly; interorbital region very broad; paroccipital processes more lengthened.
Dolichotis Group (Dolichotides)
(*Dolichotis*)

The *Cavia* Group

Characters as indicated in the above key. Size medium or small, not becoming large.

In all the genera, the jugal is broad but rather short, and zygoma not angular; incisors relatively short, narrow; palate extremely constricted anteriorly, the premolars almost touching; upper cheekteeth much higher on inner side than outer side, the lower cheekteeth much higher on outer side than inner side.

Mandible with coronoid process obsolete; condylar process of medium height; angular process drawn far backwards, but not distorted outwards. Beside and below the condylar process and extending forwards about to level of hinder part of M.1 is an extremely deep and prominent ridge for insertion of masseter medialis.

Key to the Genera of the *Cavia* Group

Claws blunt. Sternum narrow and rounded (Osgood). Kerodon

Claws sharp. Sternum broad and flat (Osgood).

Posterior lobe of upper cheekteeth with a clear and deep outer re-entrant fold; dental pattern less simplified. CAVIA

Posterior lobe of upper cheekteeth with no re-entrant fold; dental pattern more simplified.

Orbital branch of maxillae completely interrupted by the lachrymal; incisors pigmented; skull not bowed. GALEA

Orbital branch of maxillae not completely interrupted by the lachrymal; incisors not pigmented; skull bowed to a greater or lesser degree. CAVIELLA

The differences between *Galea* and *Caviella* are based on characters which are in other groups very variable; for instance, in *Dolichotis* the interruption of the orbital branch of the maxillae by the lachrymal may be present or absent. The incisors may or may not be pigmented within many genera elsewhere in the Order, for instance, *Ctenomys*, *Xerus* (*Geosciurus*), and others. The orbit is more circular in *Caviella* than in *Galea*.

Genus 1. CAVIA, Pallas

1766. CAVIA, Pallas, Misc. Zool. p. 30.

TYPE SPECIES.—*Cavia cobaya*, Pallas = *Mus porcellus*, Linnaeus.

RANGE.—South America; Brazil, the Guianas, Venezuela, Colombia, Peru, Bolivia south to Northern Argentina.

NUMBER OF FORMS.—Approximately seventeen.

CHARACTERS.—Skull with some interorbital constriction apparent, and a sagittal crest developed in the adult. Infraorbital foramen broader below than above; a canal present for transmission of nerve. Bullae relatively large. Paroccipital processes noticeably elongated. Palate short, extending about to front of M.3. Palatal foramina short, narrow. Jugal medium, not approaching the lachrymal. Incisors not pigmented.

Upper cheekteeth divided into two lobes by inner re-entrant fold in the upper series, the hinder lobe larger than the anterior one, and with a deeply indenting fold in its outer border. M.3 with posterior projection. Lower cheekteeth with one deep outer fold dividing tooth into two lobes and with an inner fold in tbe posterior lobe. Mandible as already described.

Externally the limbs not specially elongated, the hindfeet long, with three digits, the central digit the longest; the claws sharp. Forefeet with four digits, D.3 the longest, D.5 the shortest; D.4 rather longer than D.2. Ears relatively short.

This genus is quite well differentiated from *Galea* and *Caviella* by the more complex cheekteeth.

Forms seen: *anolaimae*, *aperea*, *azarae*, *festina*, *fulgida*, *guianae*, *nana*, *pamparum*, *pallida*, *porcellus*, *rosida*, *stolida*, *tschudii*, *umbrata*.

For notes on the species of *Cavia* see Thomas, Ann. Mag. Nat. Hist. 8, XIX, p. 152, 1917.

List of Named Forms

(References and type localities of all named forms for the Caviidae are the work of Mr. G. W. C. Holt.)

1. CAVIA GUIANAE, Thomas
1901. Ann. Mag. Nat. Hist. 7, VIII, p. 152.
Kanuku Mountains, British Guiana.

2. CAVIA VENEZUELAE, Allen
1911. Bull. Amer. Mus. Nat. Hist. XXX, p. 250.
Altagracia, Immataca district, Venezuela.
Considered by Thomas as doubtfully distinguishable from *guianae*.

3. CAVIA APEREA APEREA, Erxleben
1777. Syst. Regn. Anim. 1, p. 348.
Brazil.
Synonym: *leucopyga*, Brandt, 1835, Mém. Acad. St. Petersb. 6, iii, p. 436. Brazil.

4. CAVIA APEREA AZARAE, Lichtenstein
1823. Doublet. Zool. Mus. Berlin, p. 3.
Ypamena, Province São Paulo, Brazil.

5. CAVIA ROSIDA, Thomas
1917. Ann. Mag. Nat. Hist. 8, XIX, p. 154.
Roca Nova, East Paraná, Brazil.

6. CAVIA PAMPARUM, Thomas
1901. Ann. Mag. Nat. Hist. 7, VIII, p. 539.
Goya, Corrientes, Argentina.

7. CAVIA TSCHUDII TSCHUDII, Fitzinger
1867. Sitz.-Ber. K. Akad. Wien (Math. Nat.), LVI, p. 154.
City of Yca, 70 miles east of Pisco, Western Peru.

8. CAVIA TSCHUDII UMBRATA, Thomas
1917. Ann. Mag. Nat. Hist. 8, XIX, p. 157.
Incapirca, Zezioro, Central Peru.

9. CAVIA TSCHUDII AREQUIPAE, Osgood
1919. Journ. Mamm. Baltimore, p. 34.
Arequipa, Peru.
Synonym: *tschudii pallidior*, Thomas, 1917, Ann. Mag. Nat. Hist, 8, XIX, p. 158. Not (*niata*) *pallidior*, Thomas. The name *arequipae* was proposed in case *Monticavia* was regarded as not distinguishable generically from *Cavia*. Perhaps *pallidior* should stand in the present work, as *niata pallidior* is regarded as a *Caviella*.

10. CAVIA TSCHUDII STOLIDA, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVIII, p. 166.
Rio Utcubamba, 15 miles south of Chachapoyas, Peru.

11. CAVIA TSCHUDII FESTINA, Thomas
1927. Ann. Mag. Nat. Hist. 9, XX, p. 604.
Huariaca, Junin, Peru.

12. CAVIA TSCHUDII SODALIS, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 607.
Norco, 20 kilometres north-west of Vipos, Prov. Tucuman, Argentina.

13. CAVIA TSCHUDII ATAHUALPAE, Osgood

1913. Field Mus. Nat. Hist. Publ. Zool. ser. X, no. 13, p. 98.
Cajamarca, Peru.

14. CAVIA NANA, Thomas

1917. Ann. Mag. Nat. Hist. 8, XIX, p. 158.
Bolivian Highlands (Chulumani, Yungas).

15. CAVIA FULGIDA, Wagler

1831. Isis, XXIV, p. 512.
Amazonia.
Synonym: *rufescens*, Lund, 1841, Afh. K. Danske. Vid. Selsk. 4, VIII, p. 284. Lagoa Santa, Brazil.
nigricans, Wagner, 1841, Schreber, Säug. Suppl. IV, p. 64. Brazil.

16. CAVIA ANOLAIMAE, Allen

1916. Bull. Amer. Mus. Nat. Hist. XXXV, p. 85.
Anolaima, west of Bogota, Colombia; on a branch of River Bogota.

17. CAVIA PORCELLUS, Linnaeus. (Domestic)

1758. Syst. Nat. 10th ed., 1, p. 59.
Brazil.
Synonym: *aperoides*, Lund, Blik. Dyr. pl. 25. Brazil.
robusta, Lund, 1841, Blik. Dyr. pl. 25, fig. 16.
brasiliensis, Linnaeus, 1754, Mus. Adolphi. Friederici, p. 9.
gracilis, Lund, 1841, Blik. Dyr. pl. 25.
cutleri, Bennett, 1835, Proc. Zool. Soc. London p. 191. Lima, Peru.
cobaya, Marcgrave, 1648, Hist. Nat. Bras. p. 224. Peru.
longipilis, Fitzinger, 1879, Sitz.-Ber. K. Akad. Wien (Math. Nat.), LXXX, Ab. 1, p. 431. Japan.

Genus 2. GALEA, Meyen

1833. GALEA, Meyen, Nova Acta Ak. Caes. Leop. XVI, 2, p. 597.

TYPE SPECIES.—*Galea musteloides*, Meyen.

RANGE.—Bolivia, North Argentina, Chile and Brazil.

NUMBER OF FORMS.—Ten.

CHARACTERS.—Like *Cavia* but cheekteeth simpler, each upper tooth cut into two lobes by one inner fold; M.3 with weak backwardly projecting heel. Lower teeth two-lobed; P.4 with short anterior prolongation.

Orbital branch of maxillary completely interrupted by lachrymal. Incisors pigmented.

Forms seen: *auceps*, *boliviensis*, *comes*, *demissa*, *flavidus*, *littoralis*, *negrensis*, *palustris*, *spixii*.

List of Named Forms

1. GALEA MUSTELOIDES MUSTELOIDES, Meyen

1833. Nova Acta Ak. Caes. Leop. XVI, 2, p. 598.
Pass of Tacara and Tajori, Andes, North-west Bolivia.
Synonym: *boliviensis*, Waterhouse, 1848, Nat. Hist. Mamm. 11, p. 175. Bolivia, highlands between Cochabamba and La Paz.
comes, Thomas, 1919, Ann. Mag. Nat. Hist. 9, IV, p. 134. Maimara, Jujuy, Argentina.

2. GALEA MUSTELOIDES LEUCOBLEPHARA, Burmeister

1861. Reise durch La Plata, II, p. 425.
Mendoza to Tucuman, Argentina.

3. GALEA MUSTELOIDES LITTORALIS, Thomas

1901. Ann. Mag. Nat. Hist. 7, VII, p. 195.
Bahia Blanca, Argentina.
Synonym: *musteloides negrensis*, Thomas, 1919, Ann. Mag. Nat. Hist. 9, III, p. 211. Pilcaneu, Upper Rio Negro, Argentina.

4. GALEA MUSTELOIDES DEMISSA, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 623.
San Antonio, Parapiti, Bolivia.

5. GALEA MUSTELOIDES AUCEPS, Thomas

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 255.
Guarina, Lake Titicaca, Bolivia.

6. GALEA MINIMUS, Molina

1782. Sagg. Stor. Nat. Chili, 1st ed., p. 306.
Chile.
Considered a subspecies of *musteloides* by Tate; if this is so, the name antedates *musteloides*, and all races must be regarded as races of *minimus*.

7. GALEA SPIXII, Wagler

1831. Isis, XXIV, p. 512.
Brazil.
Synonym: *saxatilis*, Lund, 1841, Afh. K. Danske Vid. Selsk. 4, VIII, p. 286. Lagoa Santa, Brazil.

8. GALEA WELLSI, Osgood

1915. Field Mus. Nat. Hist. Publ. Zool. ser. X, no. 13, p. 196.
São Marcello, Bahia, Brazil.

9. GALEA PALUSTRIS, Thomas

1911. Ann. Mag. Nat. Hist. 8, VII, p. 608.
Cameta, lower Rio Tocantins, Brazil.

10. GALEA FLAVIDENS, Brandt

1835. Mém. Acad. St. Petersb. p. 439.
Brazil.
Synonym: *obscurus*, Lichtenstein, 1823, Doublet. Z. Mus. Berlin, p. 3. Brazil.
bilobidens, Lund, 1841, Afh. K. Danske Vid. Selsk. 4, VIII, p. 286. Brazil.

Genus 3. CAVIELLA, Osgood

1915. CAVIELLA, Osgood, Field. Mus. Nat. Hist. Publ. Zool. ser. X, no. 13, p. 194. Regarded by Kraglievitch as indistinguishable from *Microcavia*, Gervais and Ameghino, 1880, Mamm. Foss. Amer. Sud. p. 50, a fossil genus.

1916. MONTICAVIA, Thomas, Ann. Mag. Nat. Hist. 8, XVIII, p. 303. *Cavia niata*, Thomas. Valid as a subgenus.

1925. NANOCAVIA, Thomas, Ann. Mag. Nat. Hist. 9, XV, p. 418. *Nanocavia shiptoni*, Thomas. Valid as a subgenus.

TYPE SPECIES.—*Cavia australis*, Geoffroy & D'Orbigny.

RANGE.—Bolivia and Argentina, south to Patagonia.

NUMBER OF FORMS.—Eight.

CHARACTERS.—Skull with rostrum slanting downwards anteriorly, more bowed than in allies, the highest part of the skull usually about over posterior zygomatic root. Palatal foramina larger than in preceding

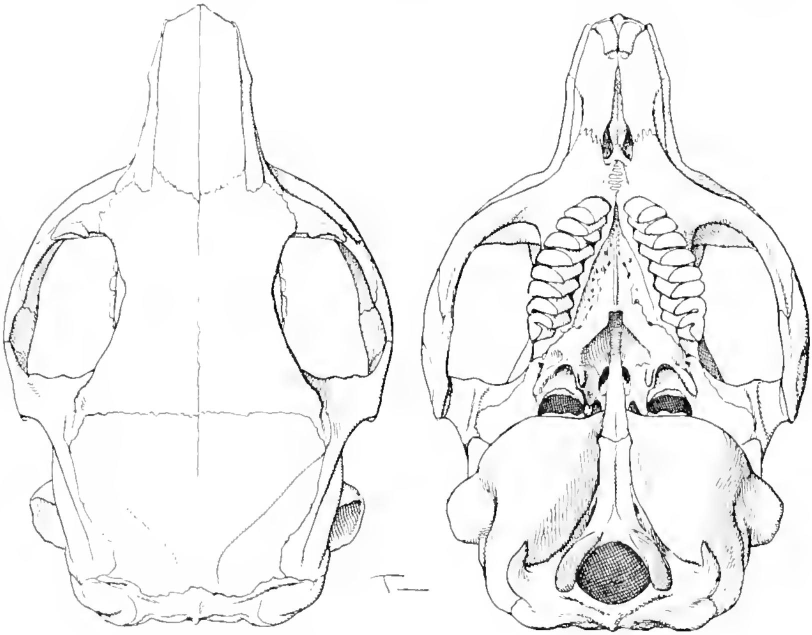


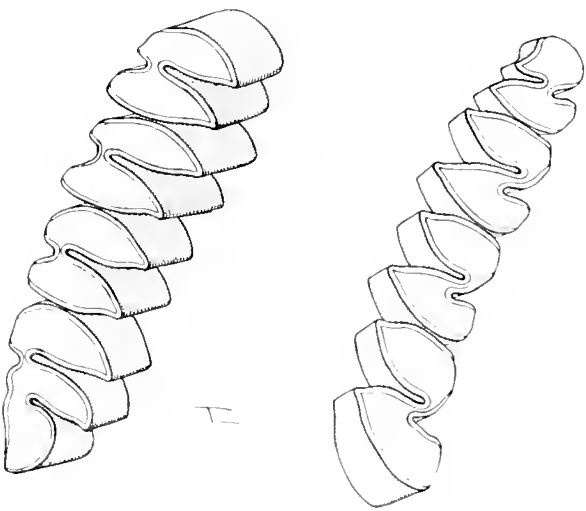
FIG. 72. CAVIELLA AUSTRALIS JOANNIA, Thomas.
B.M. No. 71.12.29.12, ♀; × 2.

genera, triangular, placed more closely to toothrows. Sagittal crest present in old age. Bullae relatively larger, and orbit more circular than in *Cavia* and *Galea*. Incisors without pigment. Cheekteeth like *Galea*, but usually M.3 with deeper posterior fold.

Monticavia, here regarded as a subgenus of *Caviella*, has more pro-odont incisors, the angle with the line of toothrow about 115°. M.3 is less complicated, the heel a short projection, without internal notch. Skull more bowed anteriorly.

Nanocavia, as remarked above, is intermediate between typical *Caviella* and *Monticavia* in the angle of the incisors; the bullae are considerably smaller than in either, the portion appearing on occipital surface of skull practically uninflated.

FIG. 73. CAVIELLA AUSTRALIS JOANNIA, Thomas.
B.M. No. 71.12.29.12, ♀; × 2.



a. *b.*

FIG. 74. CAVIELLA AUSTRALIS JOANNIA, Thomas.
Cheekteeth: B.M. No. 71.12.29.12, ♀; × 6.

Forms seen: *australis*, *joannia*, *maenas*, *niata*, "*nigriana*," *pallidior*, *salinia*, *shiptoni*.

List of Named Forms

Subgenus *Caviella*, Osgood

1. CAVIELLA AUSTRALIS AUSTRALIS, Geoffroy & D'Orbigny

1833. Mag. Zool. 1, pl. 12.
Rio Negro, Patagonia.
Synonym: *australis nigriana*, Thomas, 1921, Ann. Mag. Nat. Hist. 9, VII, p. 446. Neuquen, Rio Negro, Argentina.

2. CAVIELLA AUSTRALIS KINGII, Bennett

1835. Proc. Zool. Soc. London, p. 190.
Port Desire, Patagonia.

3. CAVIELLA AUSTRALIS JOANNIA, Thomas

1921. Ann. Mag. Nat. Hist. 9, VII, p. 446.
Cañada Honda, San Juan, Argentina.

4. CAVIELLA AUSTRALIS MAENAS, Thomas

1898. Ann. Mag. Nat. Hist. 7, I, p. 284.
Chilecito, Rioja, Argentina.

5. CAVIELLA AUSTRALIS SALINIA, Thomas

1921. Ann. Mag. Nat. Hist. 9, VII, p. 447.
South-east Catamarca, Argentina.

Subgenus *Nanocavia*, Thomas

6. CAVIELLA SHIPTONI, Thomas

1925. Ann. Mag. Nat. Hist. 9, XV, p. 419.
Laguna Blanca, Catamarca, Argentina.

Subgenus *Monticavia*, Thomas

7. CAVIELLA NIATA NIATA, Thomas

1898. Ann. Mag. Nat. Hist. 7, I, p. 282.
Esperanza, 50 km. from Mt. Sahama, Bolivia.

8. CAVIELLA NIATA PALLIDIOR, Thomas

1902. Ann. Mag. Nat. Hist. 7, IX, p. 229.
Pampa Aullaga, Lake Poopo, Bolivia.

Genus 4. KERODON, F. Cuvier

1825. Kerodon, F. Cuvier, Dents. des Mamm. p. 151.

Type Species.—*Cavia rupestris*, Wied.

Range.—Brazil. (British Museum specimens from Bahia.)

Number of Forms.—One.

Characters.—Much like *Cavia* cranially. Sagittal ridge feeble or absent. Infraorbital foramen with no canal for nerve transmission.

Palatal foramina excessively narrowed. Rostrum relatively narrow. Bullae moderate; paroccipital processes rather long. Upper cheekteeth two-lobed; M.3 with a weak backwardly projecting heel. P.4 lower with a well-marked extra anterior projection; heel of M.3 (lower) poorly defined. Differing, according to Osgood, in several details of the skeleton from *Cavia* and allies, the chief of which is that the sternum in this genus is narrow and rounded instead of broad and flat, the spinous processes of the lumbar vertebrae are thick, heavy, and depressed, and the large neural spine of the axis fully overlaps the first cervical.

Externally differing markedly from all allies in the fact that the digits are armed only with blunt nails.

Remarks.—Whatever the status of *Galea* and *Caviella* compared with *Cavia*, there is no doubt that on account even of the nails alone, this genus is distinct from that group.

Forms seen: *rupestris.*

List of Named Forms

1. KERODON RUPESTRIS, Wied

1820. Isis, VI, p. 43.
Rio Grande de Belmont, Rio Pardo, etc., Brazil.
Synonym: *moco,* F. Cuvier, Dents. des Mamm. 1825, p. 151. Brazil.
sciureus, Geoffroy, 1826, Dict. Class. IX, p. 120. Brazil.

The *Dolichotis* Group

Becoming larger than the *Cavia* group; to very large (head and body 690, or more?); hindlimbs lengthened, general form modified for cursorial life. Hindfoot very long, with three digits bearing hooflike claws; arrangement of digits perissodactyle. A rudimentary tail present. Forefoot artiodactyle, the four digits armed with sharp claws. Frontals much broadened, and nasals considerably specialized.

Genus 5. DOLICHOTIS, Desmarest

1819. Dolichotis, Desmarest, Journ. Phys. Paris, LXXXVIII, p. 211. (*Cavia patachonicha,* Shaw.)

1927. Weyenberghia, Kraglievitch, Physis, VIII, p. 579. Subgenus for *Dolichotis salinicola,* Burmeister. Name preoccupied.

1927. Paradolichotis, Kraglievitch, Physis, VIII, p. 594. *Dolichotis salinicola,* Burmeister. Valid as a subgenus.

1927. Pediolagus, Marelli, Mem. Jardin Zool. la Plata, vol. III, p. 5. *Dolichotis salinicola,* Burmeister.

1928. Lagospedius, Marelli, Physis, IX, p. 103. *Dolichotis salinicola,* Burmeister.

Type Species.—*Cavia patachonica,* Shaw.

Range.—Patagonia and Argentina.

Number of Forms.—About five have been named. There appear to be only two species.

Characters.—Nasals large, much pointed anteriorly, considerably excised at the side on joining the maxillae in the typical subgenus.

Nasals not extending as far forwards as the premaxillae. Frontals very broad, the orbits roofed in by expansion of the frontal bone, which is deeply notched anteriorly. Occiput relatively weak, sloping forwards; paroccipital processes considerably elongated, much more than is normal, but not comparable to the structure found in *Hydrochoerus*. Bullae moderately large. Palate very short, extending only to about level of M.2; toothrows nearly meeting anteriorly. Palatal foramina long and narrow. Jugal broad, short; often a small upwardly directed process on posterior border. Mandible as normally in Caviidae, the masseteric ridge sometimes less deep than in the *Cavia* group. Lachrymal very large, but apparently the canal is practically or completely closed in front of the orbit. Cheekteeth evergrowing, unilaterally hypsodont as in *Cavia* group. Upper cheekteeth each two-lobed, except M.3, which is cut into three lobes by two re-entrant folds. Lower cheekteeth with one outer fold cutting the teeth into two lobes; P.4 with an extra anterior prolongation.

No separate canal for nerve transmission in the infraorbital foramen.

Ears long; essential external characters as described above.

Paradolichotis is proposed as a subgenus for the smaller species *salinicola* (head and body to about 460 in few skins seen), differing in the lower anterior prolongation of the nasals being rudimentary or absent, and in several parts of the skeleton (there are no skeletons of this species in London). For further details see Kraglievitch, 1931, Anales Museo Nac. Buenos Ayres, xxxvi, p. 77.

According to Pocock the penis of *Dolichotis* differs considerably from that of members of the *Cavia* group.

Forms seen: *magellanica*, *centricola*, *salinicola*.

It appears that *magellanica* and *patachonicha* may be regarded as synonyms of the oldest name *patagonum*; I have never seen any notes in which these forms have been compared or regarded as distinct.

List of Named Forms

Subgenus *Dolichotis*, Desmarest

1. DOLICHOTIS PATAGONA PATAGONA, Zimmermann

1780. Geogr. Gesch. II, p. 328.
Patagonia.
Synonym: (?) *patachonica*, Shaw, 1801, Genl. Zoology, 2, 1, p. 226.
(?) *magellanica*, Kerr, 1792, Anim. Kingd. p. 220. Magellan.

2. DOLICHOTIS PATAGONA CENTRICOLA, Thomas

1902. Ann. Mag. Nat. Hist. 7, IX, p. 242.
Cruz del Eje, Central Cordova, Argentina.

Subgenus *Paradolichotis*, Kraglievitch

3. DOLICHOTIS SALINICOLA, Burmeister

1875. Proc. Zool. Soc. London, p. 635.
Stations Totoralejo and Recreo, Central Argentine Railway. 29° S., 65° W.
Synonym: (?) *centralis*, Weyenbergh, 1877, Versk. Ak. Amsterdam, XI, p. 247. Cordova, Argentina. Status *fide* Thomas, Trouessart.

Subfamily HYDROCHOERINAE

GEOGRAPHICAL DISTRIBUTION.—The warmer parts of South America, north to Panama.

NUMBER OF GENERA.—One.

CHARACTERS.—Cheekteeth more complex than in the Caviinae; M.3 enormously enlarged, exceeding the combined length of the three anterior teeth in size; paroccipital processes extremely elongated, very much more so than in any other Rodent; bodily size largest in the Order; (habits semi-aquatic).

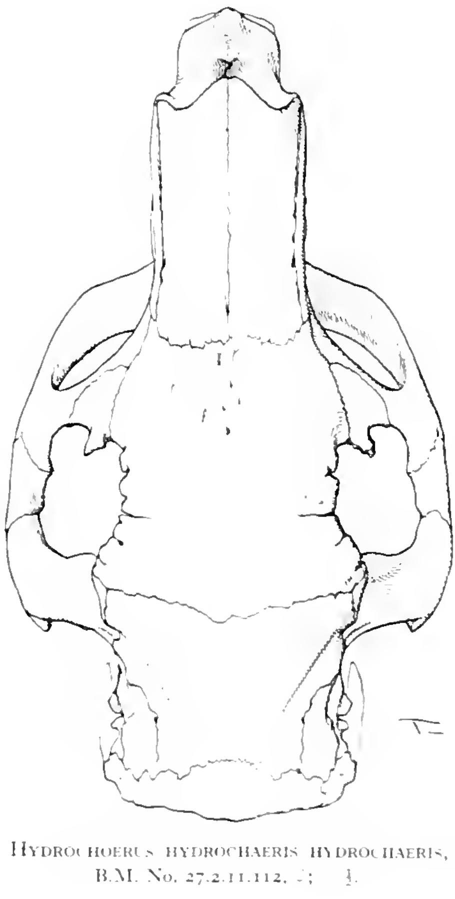


FIG. 75. HYDROCHOERUS HYDROCHAERIS HYDROCHAERIS, Linnaeus. B.M. No. 27.2.11.112, ♂; ½.

Genus 1. HYDROCHOERUS, Brisson

1762. Hydrochoerus, Brisson, Regn. Anim. 2d Ed. p. 12.

Type Species.—*Sus hydrochaeris*, Linnaeus.

Range.—As in the subfamily. Forms named from Brazil, Paraguay, and Panama. Specimens in British Museum from British Guiana. Said to occur in Venezuela, and also to extend to Peru and Bolivia; but the exact range of this genus has not been traced.

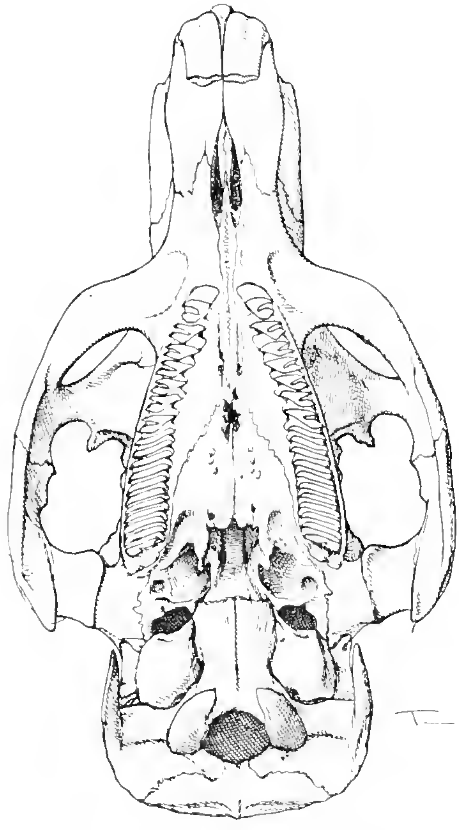


Fig. 76. Hydrochoerus hydrochaeris hydrochaeris, Linnaeus.
B.M. No. 27.2.11.112, ♀; ½.

Number of Forms.—Three.

CHARACTERS.—Skull heavy, rather flat; nasals broad; frontals broad and long; occiput relatively narrow, and evidently a sagittal ridge is not formed. Lachrymal large, with part of lachrymal canal open on side of rostrum. Bullae proportionately smaller than in Caviidae; palate much longer, extending back to hinder part of M.3; palatal foramina large; palate constricted anteriorly; pterygoid fossae very deep; infraorbital foramen without canal for nerve transmission. Paroccipital processes abnormally elongated. Mandible

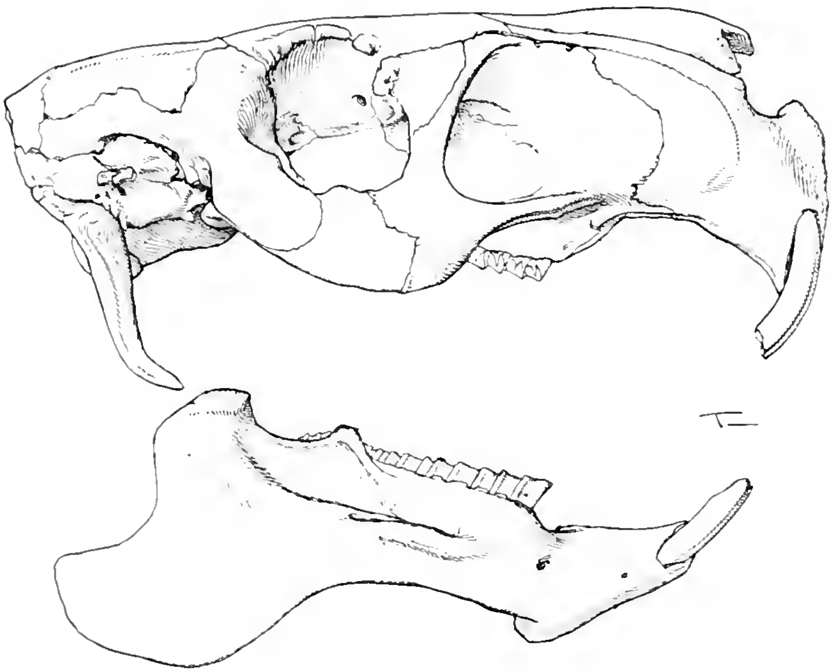


FIG. 77. HYDROCHOERUS HYDROCHAERIS HYDROCHAERIS, Linnaeus.
B.M. No. 27.2.11.112, [illegible]; × ½.

typically Cavioid in formation, the masseter medialis ridge moderately to strongly developed. Jugal broad, zygoma heavy.

Incisors broad, faintly one-grooved. Cheekteeth remarkable for the amount of cement present. In the upper series, P.4, M.1, and M.2 are each divided into two lobes, the lobes united by cement, and each lobe with a further deep outer fold; the lobes narrowed internally and pointing forwards. M.3 with nine or ten narrow transverse plates joined to each other, and to an anterior and a posterior lobe, the anterior lobe like those of the other molars, the posterior lobe consisting of two transverse plates joined externally. In the lower teeth, P.4 and M.1 are each divided into three lobes; in the premolar each lobe has an inner fold; in M.1 the two anterior lobes are with one inner fold, the posterior lobe with an outer fold. M.2 and M.3 have each four lobes, the central two of which are simple transverse plates, the anterior with an inner fold, the posterior

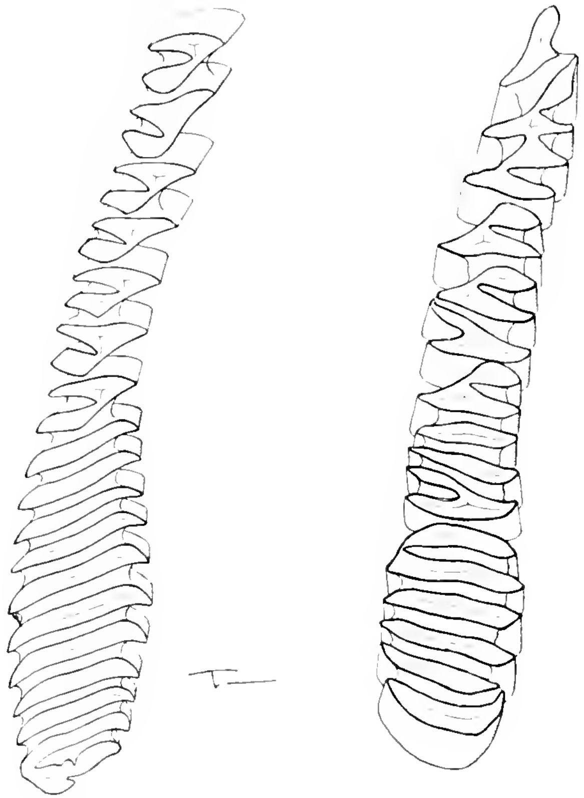


FIG. 78. HYDROCHOERUS HYDROCHAERIS HYDROCHAERIS, Linnaeus.
Cheekteeth: B.M.No. 27.2.11.112, ♀; × $1\frac{1}{2}$.

with an outer fold. M.3 is the dominant tooth of the series, but is very much less enlarged than M.3 in the upper series.

External form very large, easily the largest member of the Order, though not of course comparing with "very large" forms of other Orders. Head broad, ears short; fur harsh; limbs not greatly lengthened. Forefoot perissodactyle; D.3 the longest digit; D.5 considerably shorter than the others.

Hindfoot perissodactyle, with three digits only, the digits webbed, but the webbing poorly developed. Claws heavy, thick. Tail rudimentary.

The largest specimen seen is 1175 mm. head and body, but I should imagine that this does not represent the extreme development for the genus.

Contrary to the opinion of some I have discussed the subject with, my very limited experience with these animals in captivity, at the London Zoological Gardens, indicates that they possess considerable intelligence; more so indeed than in any Rodent I have ever tried to establish contact with.

Forms seen: *hydrochaeris*.

List of Named Forms

1. HYDROCHOERUS HYDROCHAERIS HYDROCHAERIS, Linnaeus

1766. Syst. Nat. 12th Ed. p. 103.

Brazil.

Synonym: *capybara*, Erxleben, 1777, Syst. Regn. Anim. p. 193.

2. HYDROCHOERUS HYDROCHAERIS NOTIALIS, Hollister

1914. Proc. Biol. Soc. Washington XXVII, p. 58.

Paraguay.

3. HYDROCHOERUS ISTHMIUS, Goldman

1912. Smiths. Misc. Coll. LX, no. 2, p. 11.

Marraganti, Rio Tuyra, Eastern Panama.

Remarks.—Notwithstanding the extreme specializations of this genus, such as the lengthened paroccipital processes, lengthening of M.3, and enormous bodily size, I think that there are far too many essential characteristics shared between it and the Caviidae for *Hydrochoerus* to be referred to a separate family, as has recently been advocated (Pocock, Miller & Gidley).

The Caviinae and Hydrochoerinae are both known from the Miocene from South America. The Hydrochoerinae are also known from the Pleistocene of the South-eastern United States.

CAVIIDAE:
SPECIAL WORKS OF REFERENCE

Pocock, 1922, P.Z.S. p. 365. External characters of some Hystricomorph Rodents.
Waterhouse, 1848, Natural History Mammalia, vol. II (Rodentia).
Tate, 1935, Taxonomy of Neotropical Hystricoid Rodents, Bull. Amer. Mus. Nat. Hist. LXVIII, 2, p. 295.
Tullberg, 1899, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, 1.
Osgood, 1915, Field. Mus. Nat. Hist. Publ. Zool. ser. X, no. 13, p. 195.
Kraglievitch, An. Mus. Nac. Buenos Aires, XXXVI, 1931, page 59.

Superfamily APLODONTOIDAE

As here understood this contains one living family.

Family APLODONTIIDAE

1896. Thomas: Aplodontiae: Family Aplodontiidae.
1899. Tullberg: Sciuromorpha: *Sciuroidei*, part; Family Aplodontiidae.

1918. Miller & Gidley: Superfamily DIPODOIDAE, part; Family Aplodontiidae.
1924. Winge: HAPLODONTIDAE, part: Haplodontini.
1928. Weber: HAPLODONTOIDEA: Family Haplodontidae.

GEOGRAPHICAL DISTRIBUTION.—Nearctic; Western North America; the Pacific side of the Rocky Mountains, from California to extreme Southern British Columbia.

NUMBER OF GENERA.—One.

CHARACTERS.—Zygomasseteric structure of a type differing from any found elsewhere in the Order. Masseter lateralis superficialis attached anteriorly to zygoma; but infraorbital foramen not transmitting muscle; zygomatic plate very narrow, completely below the infraorbital foramen; mandible with angular portion not distorted outwards by specialized portion of lateralis muscle, but with its outer border sharply pulled inwards.

Skull flattened, greatly widened posteriorly. Bullae with neck directed horizontally outwards. Cheekteeth evergrowing, simplified in pattern, the dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}=22$. Fibula not reduced nor fully fused with the tibia, at any rate as compared with Murine or Dipodoid genera. External form more or less modified for fossorial life.

REMARKS.—The Aplodontiidae were included by Miller & Gidley in their Superfamily Dipodoidae; but the genus is evidently very far removed from other members of that group as understood by these authors. The main difference as regards jaw-muscles is that in this case the infraorbital foramen does not transmit muscle, or scarcely does so; (according to Taylor it definitely does not do so; Coues states that it does transmit a small strand, and from skulls examined it appears that it could do so; as figured by Tullberg, and as stated by Winge, it does not; but the difference between this type of jaw-muscle structure, even if it does transmit a small strand, is very widely different from that present in such specialized families as Dipodidae, Pedetidae, and Anomaluridae, with which this family is associated by Miller & Gidley). It should be noted that the main difference between the Hystricoidae and the Bathyergoidae of Miller & Gidley is that in the latter the infraorbital foramen does not transmit muscle, and in the former it does so; so that it would appear that if the classification of Miller & Gidley were retained, this family should be separated from "Dipodoidae" if only on the grounds of consistency.

Coues, Tullberg, and other writers have come to the conclusion that *Aplodontia* is a Sciuroid; Tullberg places the genus as a family together with the Sciuridae in his section Sciuroidei, a section of Sciuromorpha equal in importance to his Castoroidei, and Geomyoidei. But once again it appears that the zygomasseteric structure of *Aplodontia* is widely different from either Sciuridae, Castoridae, or Geomyidae, all of which have evolved a more specialized arrangement of the forepart of the skull for attachment of masseter muscles in that the zygomatic plate is broadened, to a highly specialized degree in all but a few genera of the Pteromys group, and even in these the difference between *Aplodontia* and such primitive forms as *Belomys* is already quite well established. In these families, masseter lateralis rises up the broadened zygomatic plate to the superior border of the rostrum, and masseter lateralis superficialis has become distinct from the zygoma; but in *Aplodontia* this is not the case; so that as far as zygomasseteric structure is concerned it appears that *Aplodontia* is not to be considered a near ally of either Sciuridae, Castoridae, or Geomyidae.

The extraordinary inflection of the angular portion of the mandible is so far as I have seen without parallel in the Order, though certain Sciuridae, as *Cynomys*, and certain Dipodidae, as I believe *Cardiocranius*, and certainly to a degree *Zapus*, approach it.

Apart from this, it would seem that *Aplodontia* stands nearest what one might consider the primitive or ancestral type of zygomasseteric structure of Rodentia; this apparently is the theory of Winge, who derives directly or indirectly all families of Rodentia as here understood from his family "Haplodontidae."

The jaw muscles, though arranged in a different manner from most members of the Order, are according to Tullberg very strongly developed. The temporalis muscles are strong and extensive.

The family contains one living genus.

Genus 1. APLODONTIA, Richardson

1829. Aplodontia, Richardson, Zool. Journ., vol. 4, p. 334.

Type Species.—*Aplodontia leporina*, Richardson = *Anisonyx rufa*, Rafinesque.

Range.—As in the family. A good map of the range is published in Anthony, Field Book of North American Mammals, 1928, p. 455.

Number of Forms.—Nine.

Characters.—As in the superfamily. The skull is abnormally broadened posteriorly, and considerably so anteriorly; behind the anterior zygomatic root the frontals are abruptly and considerably narrowed. The parietal ridges are well marked, but not fused in the few skulls examined. The zygomata are widely spreading. The skull is much flattened. The width of the occipital region is about equal to two-thirds of the length of the skull. The auditory bullae are flask-shaped, with the neck directed horizontally outwards. The posterior zygomatic root is noticeably at right angles to the supraoccipital. Incisive foramina not large, situated far in front of the palate, which is broad, and extends behind the toothrows.

Mandible with the outer side of the angular process pulled inwards to an abnormal degree; to such an extent that the posterior border is horizontal, and the two edges of this process form the base of a triangle which has for its apex the condylar process. This is perhaps best expressed by noting that if the two halves of the mandible are separated each half may be made to stand up on a table resting on the angular portion. Coronoid process very high and curved backwards.

As noted above, the infraorbital foramen appears sufficiently enlarged to transmit a very small strand of muscle; in appearance it is round; but it is very small compared with any Rodent in which the infraorbital may be said definitely to transmit muscle, and according to all authors I have read on the point with the exception of Coues it does not do so.

Incisors powerful.

Cheekteeth evergrowing, $\frac{5}{4}$; P.3 minute, probably functionless, the pattern of the other teeth in the adult nearly simplified to a ring, the inner side of those of the upper series circular, the outer side of each tooth with an externally pointing projection on either side of which is a slight depression.

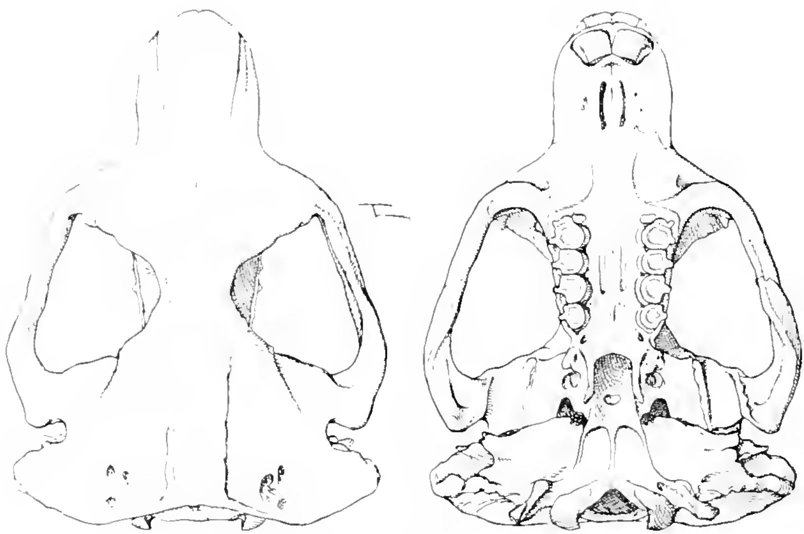


FIG. 79. APLODONTIA RUFA RUFA, Rafinesque.
B.M. No. 98.9.28.1, [illegible]; × 1.

Lower teeth like those of the upper series, but with the pattern reversed, and with tendency for a small re-entrant external angle to be present, this wearing out with age.

Form thickset, heavy; fur thick and soft; limbs short; eyes and ears small; tail more or less vestigial, much shorter than hindfoot. Claws, particularly those of the forefoot, enlarged and powerful. Forefoot with all digits present, but pollex very short. D.3 the longest digit, then D.4, next D.2, last D.5. Hindfoot with the three centre digits roughly equal, the hallux and D.5 shorter than these. Mammae 6 (Taylor).

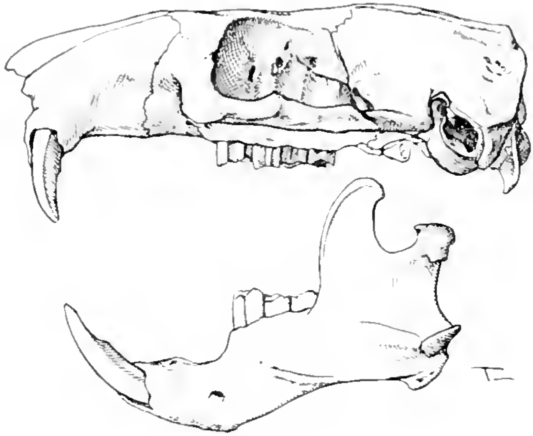


FIG. 80. APLODONTIA RUFA RUFA, Rafinesque.
B.M. No. 98.9.28.1, ♀; × 1.

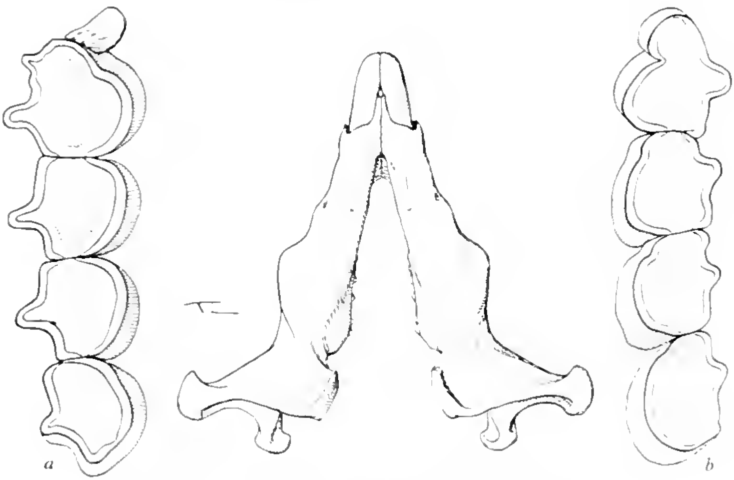


FIG. 81. APLODONTIA RUFA RUFA, Rafinesque.
Mandible from below, × 1; Cheekteeth × 4; B.M. No. 98.9.28.1, ♀.

The species of *Aplodontia* are described as burrowing, mainly nocturnal animals, living in colonies in dense wet forests, in which they construct numerous tunnels, and feed on bark, leaves, and twigs. They are said not to hibernate.

The family Aplodontiidae is known from the Miocene of Western North America. A closely related genus is described fossil from Eastern Asia.

Though this work is concerned with living Rodents, mention may be made of an interesting fossil family from North America which appear to have had a similar zygomasseteric structure to the Aplodontiidae, and are referred to that family by Winge, namely the Mylagaulidae. They appear to have developed along lines noticeably different from any living group of Rodents, and I feel that no general work on Rodentia would be complete without reference to them.

"Family MYLAGAULIDAE

"Skull excessively fossorial, occipital region obliquely truncate, with lambdoid crest moved forward nearly to level of zygomatic root; frontal with short post-orbital processes; bony horn-cores on rostrum in two genera, absent in a third; cheekteeth highly modified from normal heptamerous structure, the grinding function of toothrow in adult almost completely taken over by the greatly enlarged fourth premolar. General structure of skull much as in the Aplodontiidae; cheekteeth $\frac{4}{4}$ or $\frac{3}{3}$, a reduced heptamerous pattern evident in slightly worn crowns, but this giving place with wear to a system of narrow longitudinal and oblique lakes. Molars relatively small, soon crowded out by the premolar, an excessively hypsodont laterally compressed tooth closed at base and rapidly increasing in crown length from the unworn surface downwards. Skeleton highly modified for underground life.

"*Mylagaulus*, *Ceratogaulus*, and *Epigaulus*, North American Miocene and Pliocene" (Miller & Gidley).

APLODONTIIDAE:

SPECIAL WORKS OF REFERENCE

TAYLOR, Univ. Calif. Publ. Zool., XVII, pp. 435–504, 1918. A full revision of the genus.
COUES, Monograph of North American Rodents, p. 549, 1877. Monograph of genus.
TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3rd ser., no. 1, 1899.

Forms examined: *rufa*, *pacifica*, *olympica*, "*major*."

LIST OF NAMED FORMS

Nine forms are now recognized, all regarded as races of the type species.

Revised by Taylor, 1918, Univ. Calif. Publ. Zool., XVII, p. 435. The references and type localities are the work of Mr. R. W. Hayman.

1. APLODONTIA RUFA RUFA, Rafinesque

1817. Amer. Monthly Mag. 2, p. 45.
Columbia River, Oregon.
Synonyms: *leporina*, Richardson, 1829, Zool. Journ. 4, p. 335.
grisea, Taylor, 1916, Univ. Calif. Pub. Zool. XII, p. 497. (Near Seattle, Washington.)
chryseola, Kellogg, 1914. Univ. Calif. Publ. Zool. XII, p. 295. (Jackson Lake, California.)

2. APLODONTIA RUFA OLYMPICA, Merriam

1899. Proc. Biol. Soc. Washington, XIII, p. 20.
Quinault Lake, Chehalis County, Washington.

3. APLODONTIA RUFA COLUMBIANA, Taylor
1916. Univ. Calif. Publ. Zool. XII, p. 499.
Vicinity of Hope, British Columbia.

4. APLODONTIA RUFA RAINIERI, Merriam
1899. Proc. Biol. Soc. Washington XIII, p. 21.
Paradise Creek, south side Mount Rainier, Washington.

5. APLODONTIA RUFA PACIFICA, Merriam
1899. Proc. Biol. Soc. Washington, XIII, p. 19.
Newport, Yaquina Bay, Lincoln County, Oregon.

6. APLODONTIA RUFA HUMBOLDTIANA, Taylor
1916. Proc. Biol. Soc. Washington XXIX, p. 21.
Carlotta, Humboldt County, California.

7. APLODONTIA RUFA CALIFORNICA, Peters
1864. Monatsber. k. Preuss. Akad. Wiss. Berlin, p. 179.
(Assumed to be) Sierra Nevada, California.
Synonym: *major*, Merriam, 1886, Science, 7, p. 219, Ann. New York Ac. Sci., III, pp. 312, 316. (California, Sierra Nevada Mountains.)

8. APLODONTIA RUFA NIGRA, Taylor
1914. Univ. Calif. Publ. Zool. XII, p. 297.
Point Arena, Mendocino County, California.

9. APLODONTIA RUFA PHAEA, Merriam
1899. Proc. Biol. Soc. Washington, XIII, p. 20.
Point Reyes, Marin County, California.

Superfamily SCIUROIDAE

This as here understood contains one family only.

Family SCIURIDAE

1896. Thomas: SCIUROMORPHA: Family Sciuridae (with subfamilies Sciurinae and Nannosciurinae).
1899. Tullberg: SCIUROMORPHA: *Sciuroidei* (part, included Aplodontiidae): Family Sciuridae.
1918. Miller & Gidley: Superfamily SCIUROIDAE, part: Family Sciuridae, with subfamilies Sciurinae, Nannosciurinae and Pteromyinae.
1924. Winge: Family Sciuridae, part; Sciurini.
1928. Weber: SCIUROIDEA: Families Sciuridae, Pteromyidae, Xeridae, Tamiidae, Marmotidae.

GEOGRAPHICAL DISTRIBUTION.—Practically cosmopolitan; absent only from the Australasian region, Madagascar, and Southern South America (Patagonia, Chile, most of Argentina). Also absent from certain desert regions, as Arabia, and Egypt, etc.

NUMBER OF GENERA.—I have retained forty-four genera.

CHARACTERS.—Zygomasseteric structure as follows: infraorbital foramen not transmitting muscle, or scarcely so; masseter lateralis superficialis with anterior head distinct from zygoma; zygomatic plate broadened, tilted upwards, forming base for masseter lateralis to rise obliquely to superior border of rostrum, which it does to the exclusion of masseter medialis. Mandible never highly modified; usually with the angular portion pulled inward to a degree, as in Muscardinidae, Dipodidae, Aplodontiidae, etc.

Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$ or $\frac{1}{1}$, m. $\frac{3}{3} = 20$ or 22.

Cheekteeth rooted, brachyodont or hypsodont, their pattern usually characterized by prominent cusps and ridges, the lower series most often basin-shaped, the pattern as a rule complex. Tibia and fibula not fully fused. Jugal long, usually in contact with the lachrymal. Skull with well-marked postorbital processes, which may in rare cases be poorly developed (for instance *Myosciurus*). Tail always fully haired, usually thick and bushy. External form suited to arboreal or terrestrial life. Digits of hindfoot five.

This is one of the largest and most widely distributed groups of living Rodents, and possesses about thirteen hundred named forms.

CRANIAL CHARACTERS.—The following cranial characters are general in the group.

There are, as indicated above, always postorbital processes present. There is very rarely any strongly marked interorbital constriction present, though this becomes noticeable in some members of the *Pteromys* group. The jugal is long, usually in contact with the lachrymal. The bullae are rarely excessively inflated, but as a rule evenly rounded and of relatively large size. The palate is broad as a rule, and usually terminates slightly behind the toothrows, or about on a level with the hinder molars. In the *Xerus* section it is much produced backwards. The incisive foramina are always situated considerably in front of the toothrows, and are as a rule very short. The incisors are usually laterally compressed in the arboreal genera (with some exceptions), and less or not so in the terrestrial forms.

DENTAL CHARACTERS.—The cheekteeth of all the genera seem referable to a single original pattern, though varying considerably in the various genera. In *Lariscus* and *Rheithrosciurus* they are almost simplified. The original plan appears to be, in the upper series, that of four transverse ridges, a more or less marked cusp marking the outer border of each of these; the ridges run across to the inner border of the tooth, which is normally formed by one large inner cusp, except in some primitive Flying-squirrels, in which the three inner cusps are retained; each of these transverse ridges has between them a depression; the second and third ridges are the highest; the first and fourth mark respectively the anterior and posterior terminations of the tooth. The lower cheekteeth are normally with a large central basin-shaped depression, often tending to take up most of the tooth, and surrounded by cusps, of which there is usually a main one at each corner, though sometimes the posterointernal cusp may be hardly developed. The anterointernal cusp is in almost every case the highest one.

If Winge's theory, that the infraorbital foramen of this family once transmitted muscle and has become secondarily closed to muscle transmission, is correct, we have in this family and others which share its zygomasseteric structure (Castoridae, Heteromyidae, Geomyidae), one of the most highly specialized arrangement of jaw muscles known in the Order. But primitive genera like *Belomys* appear to be so (comparatively) near the Aplodontiidae in zygomatic plate and infraorbital foramen formation that I very much doubt whether this is so, and think it more probable that the arrangement has been derived from something like the Aplodontoid type of zygomasseteric structure.

All forms belonging to this family, including the Flying-squirrels, which have often been referred to a distinct family, appear to me to be so obviously closely related, and so obviously offshoots of one essential stem, that I can recognize no subfamilies. I have provisionally divided the family into two groups, the Flying-squirrels and the Non-flying-squirrels, though when dealing with the Anomaluridae I have endeavoured to point out that a flying-membrane is not a structure on which subfamilies should be based; this membrane may have been developed independently in the present group on more than one occasion, and I must admit that this division into groups is largely for convenience owing to the very large size of the family.

Key to the Groups of Sciuridae

A flying-membrane present attached to sides. Cheekteeth often but not always with tendency towards abnormal complexity. Zygomatic plate often but not always low, weak, and little tilted upwards.
Pteromys Group (Pteromyes)
(*Belomys*, *Trogopterus*, *Pteromyscus*, *Petaurista*, *Aeromys*, *Pteromys*, *Glaucomys*, *Eoglaucomys*, *Hylopetes*, *Petinomys*, *Petaurillus*, *Iomys*, *Eupetaurus*.)

No flying-membrane present. Cheekteeth never with tendency towards abnormal complexity. Zygomatic plate often but not always strongly tilted upwards. Sciurus Group (Sciuri)
(*Myosciurus*, *Nannosciurus*, *Sciurillus*, *Microsciurus*, *Syntheosciurus*, *Sciurus*, *Tamiasciurus*, *Callosciurus*, *Funambulus*, *Dremomys*, *Ratufa*, *Menetes*, *Lariscus*, *Glyphotes*, *Rheithrosciurus*, *Rhinosciurus*, *Hyosciurus*, *Heliosciurus*, *Paraxerus*, *Funisciurus*, *Protoxerus*, *Myrsilus*, *Epixerus*, *Xerus*, *Atlantoxerus*, *Spermophilopsis*, *Sciurotamias*, *Tamias*, *Citellus*, *Marmota*, *Cynomys*.)

Outline of Previous Classification of Family Sciuridae

1891. Flower & Lydekker, Mammals Living and Extinct.

Ten living genera were recognized in the Family Sciuridae, which was divided into the subfamilies Sciurinae and Arctomyinae (=Marmotinae), the latter "so intimately connected with the preceding subfamily that the division into two groups is purely a matter of convenience."

The genera were:

1. *Sciurus*. (All Tree-squirrels except number 2.)

2. *Rheithrosciurus.*
3. *Xerus.*
4. *Tamias.*
5. *Pteromys* (=*Petaurista*).
6. *Sciuropterus* (=*Pteromys*).
7. *Eupetaurus.*
8. *Arctomys* (=*Marmota*).
9. *Cynomys.*
10. *Spermophilus* (=*Citellus*).

Two years later Forsyth Major, published his paper on the dentition of the Sciuridae (1893, Proc. Zool. Soc. London, p. 179) which has formed the basis of most modern classifications of the family. He recognized three subfamilies, the Sciurinae (including Marmotinae of Flower & Lydekker), the Pteromyinae, (Flying-squirrels), and the Nannosciurinae containing the Old World Pygmy-squirrels. He recognized ten genera as in Flower & Lydekker except that *Nannosciurus* was raised to generic rank, and that *Tamias* was suppressed and regarded as a subgenus of *Sciurus*. Several of the species, forming the genus *Sciurus* of former classifications, were referred, on account of dental characters, to the genus *Xerus*. His arrangement was as follows:

SCIURINAE

1. *Rheithrosciurus*
2. *Xerus*
   - Subgenus *Protoxerus* (=the modern *Protoxerus*, *Epixerus* and *Myrsilus*)
   - Subgenus *Xerus*
   - Subgenus *Atlantoxerus*
   - Subgenus *Paraxerus* (=the modern *Paraxerus* and *Funisciurus*)
   - Subgenus "*Eoxerus*" (=the modern *Funambulus*, *Menetes*, *Lariscus*, and *Rhinosciurus*)
3. *Sciurus*
   - Subgenus "*Eosciurus*" (=*Ratufa*)
   - Subgenus *Sciurus*. American, Palaearctic, and African forms currently referred to *Sciurus*, *Callosciurus*, *Heliosciurus*.
   - Subgenus *Tamias*
4. *Spermophilus* (=*Citellus*)
5. *Arctomys* (=*Marmota*)
6. *Cynomys*

PTEROMYINAE

7. *Sciuropterus* (=the modern *Pteromys* and related genera)
8. *Pteromys* (=*Petaurista*)
9. *Eupetaurus*

NANNOSCIURINAE

10. *Nannosciurus* (=the modern *Nannosciurus* and *Myosciurus*)

This arrangement was followed by Thomas in 1896 in his classification of the whole Order except that the Pteromyinae were not regarded as forming a distinct subfamily, being referred to the Sciurinae, and *Tamias* was again given generic rank.

In 1897 (Proc. Zool. Soc. London, p. 933) Thomas proposed that all subgenera of Major's classification except *Atlantoxerus* should be given generic rank, substituting the name *Funambulus* for *Eoxerus*, and *Ratufa* for *Eosciurus*.

In 1908 (Journ. Bombay N. H. Soc., XVIII, 2, p. 244) Thomas gave a revised list of Asiatic genera of non-flying Squirrels, recognizing altogether twelve.

1. *Sciurus*. (The group subsequently referred to *Callosciurus* and "*Tomeutes*.")
2. *Zetis*, which had formerly been referred to *Funambulus*, but was separated in the paper now under discussion; the name is antedated by *Dremomys*, Heude.
3. *Glyphotes* (erected by Thomas, 1898).
4. *Ratufa*.
5. *Tamiops*, which had been erected by Allen for *Sciurus maclellandi*.
6. *Rhinosciurus*, which had been separated from *Funambulus* by Miller.
7. *Menetes*, which was separated from *Funambulus* by Thomas in the paper now under discussion.
8. *Funambulus*. (Restricted to the forms now referred to it.)
9. *Lariscus*. ("*Laria*," Gray, preoccupied.) (Formerly had been referred to *Funambulus*.)
10. *Rheithrosciurus*.
11. *Sciurotamias*, which had been erected by Miller for *Sciurus davidianus*.
12. *Nannosciurus*.

This classification is retained in the present work except that I am unable to regard *Tamiops* as a genus distinct from *Callosciurus*.

In the same year (Ann. Mag. Nat. Hist., 8, I, p. 1) Thomas revised the Flying-squirrels, recognizing eight genera:

1. *Petaurista*.
2. *Eupetaurus*.
3. *Trogopterus*, which had been previously erected by Heude.
4. *Iomys*.
5. *Belomys*.
6. *Pteromyscus*.
7. *Petaurillus*.
8. "*Sciuropterus*" (=*Pteromys*), with subgenera *Glaucomys*, *Hylopetes*, and *Petinomys*; all these subgenera have subsequently been given generic rank and appear to me to be clearly distinct from *Pteromys* as now restricted (Scandinavian, Russian, Siberian, and Japanese small Flying-squirrels), but more doubtfully so from each other.

The following year (Ann. Mag. Nat. Hist., 8, III, p. 467) Thomas revised the African genera of Sciuridae, recognizing twelve genera:

1. *Sciurus.* (The group subsequently referred by Thomas to *Aethosciurus*, and shown by Hollister, Bull. U.S. Nat. Mus., 99, p. 9, 1919, to be not distinguishable as a full genus from *Heliosciurus*.)
2. *Heliosciurus.*
3. *Myrsilus.* (Separated from *Protoxerus*.)
4. *Paraxerus.*
5. *Funisciurus.* (Separated from *Paraxerus*.)
6. *Protoxerus.*
7. *Epixerus.* (Separated from *Protoxerus*.)
8. *Atlantoxerus.*
9. *Xerus.*
10. *Euxerus.* } (Both separated from *Xerus*.)
11. *Geosciurus.* }
12. *Myosciurus.*

This classification is followed in the present work except that *Euxerus* and *Geosciurus* are regarded as subgenera of *Xerus* only; *Aethosciurus*, following Hollister, is referred to *Heliosciurus*; and I think that with representative material it is likely that both *Myrsilus* and *Epixerus* (here retained) would be better referred to *Protoxerus*.

In 1912, Miller (Catalogue of Mammals of Western Europe) regarded the Flying-squirrels as forming a distinct family, the Petauristidae (the sole character being the presence of the flying-membrane, p. 940). In 1918 in Miller & Gidley (Classification of Rodentia) he very properly reduced the group to the rank of subfamily.

In 1915, J. A. Allen (Bull. Amer. Mus. Nat. Hist., XXXIV, p. 147) restricted the genus *Sciurus* to the Palaearctic, and divided the Squirrels occurring in America into no less than seventeen genera. These names, based mostly on mammary formula (4 or 6) and the relative length of the rostrum, have for the most part been disregarded, and appear to be based for the most part on specific groups. His "genera," with remarks on subsequent treatment, are listed below:

1. *Tamiasciurus.* Retained by Miller, 1923 (List of North American Recent Mammals) as a subgenus of *Sciurus*. Given generic rank by Pocock (Proc. Zool. Soc. London, p. 237, 1923) on account of the suppression of the baculum. Retained as a full genus by Howell 1938 (North. Amer. Fauna, 56, p. 1) in his classification of genera of North American Sciuridae.
2. *Neosciurus.* Regarded as a synonym of *Sciurus*, subgenus *Sciurus* by Miller, 1923. Revived as a subgenus of *Sciurus* by Howell, 1938 (including "*Baiosciurus*" and "*Echinosciurus*").
3. *Otosciurus.* Regarded as a synonym of *Sciurus*, subgenus *Sciurus* by Miller, 1923. Revived as a subgenus of *Sciurus* by Howell, 1938.
4. *Hesperosciurus.* Regarded as a synonym of *Sciurus*, subgenus *Sciurus* by Miller, 1923. Revived as a subgenus of *Sciurus* by Howell, 1938.

5. *Echinosciurus.* Regarded as a synonym of *Sciurus*, subgenus *Sciurus* by Miller, 1923. Regarded as a synonym of *Sciurus*, subgenus *Neosciurus* by Howell, 1938.
6. *Baiosciurus.* Regarded as a valid subgenus of *Sciurus* by Miller, 1923. Regarded as a synonym of *Sciurus*, subgenus *Neosciurus* by Howell, 1938.
7. *Parasciurus.* Regarded as a synonym of *Sciurus*, subgenus *Guerlinguetus* by Miller, 1923. Revived as a valid subgenus by Howell, 1938.
8. *Syntheosciurus.* Currently retained as a full genus.
9. *Microsciurus.* Currently retained as a full genus.
10. *Sciurillus* (Thomas). Currently retained as a full genus. Transferred to the subfamily Nannosciurinae by Thomas, and by Miller & Gidley, 1918. (In the present paper it has been thought desirable to include in this genus certain Squirrels from Celebes (*murinus* group), which as far as examined agree in cranial characters with this genus.)
11. *Leptosciurus.* Regarded as a subgenus of *Sciurus* by Thomas (Ann. Mag. Nat. Hist. 10, II, p. 290, 1928) (as all Neotropical "genera" of Allen).
12. *Notosciurus.* Remarks as *Leptosciurus.*
13. *Mesosciurus.* Regarded as a synonym of *Sciurus*, subgenus *Guerlinguetus* by Miller, 1923, and by Howell, 1938.
14. *Guerlinguetus.* Regarded as a valid subgenus of *Sciurus* by Miller, 1923, and by Howell, 1938. (But in a wider sense than accepted by Allen.)
15. *Hadrosciurus.* Remarks as *Leptosciurus.*
16. *Urosciurus.* Regarded as indistinguishable from *Sciurus*, subgenus *Hadrosciurus* by Thomas, 1928 (Ann. Mag. Nat. Hist. 10, II, p. 290, 1928). Shown by Lönnberg, 1921, to be not retainable on cranial characters suggested by Allen.
17. *Simosciurus.* Regarded as not distinguishable on cranial characters from either *Hadrosciurus* or *Urosciurus* by Lönnberg, 1921. (Author's note: but dentition normal, noticeably different from *Hadrosciurus* and *Urosciurus*. Here regarded as a synonym of *Sciurus*, subgenus *Guerlinguetus.*)

Miller and Gidley, 1918, in their classification of the Order Rodentia divided the family into three subfamilies, the Sciurinae, Pteromyinae and Nannosciurinae, the latter based solely on cranial characters (but originally proposed by Forsyth Major on dental characters).

Miller (List of North American Recent Mammals, U.S. Nat. Mus. Bull. 128), 1923, listed twelve genera occurring north of Panama:

1. *Marmota.*
2. *Otospermophilus.* (Had been separated since earlier classifications of Thomas and Forysth Major, from *Citellus.*)

3. *Callospermophilus.* (Had been separated since earlier classifications from *Tamias.*)
4. *Citellus.*
5. *Ammospermophilus.* (Remarks as *Callospermophilus.*)
6. *Cynomys*, with subgenus *Leucocrossuromys.*
7. *Eutamias.* (Had been given generic rank by Merriam, separated from *Tamias.*)
8. *Tamias.*
9. *Sciurus*, with subgenera *Tamiasciurus*, *Sciurus*, *Baiosciurus*, and *Guerlinguetus.*
10. *Microsciurus.*
11. *Syntheosciurus.*
12. *Glaucomys.*

Howell, 1938, has made some modifications in this arrangement. *Callospermophilus*, *Ammospermophilus*, and *Otospermophilus* are referred to *Citellus* as subgenera. In the present work, *Eutamias* is shown to be not a valid genus.

In 1915, Thomas introduced the system of dividing generically on the structure of the penis-bone or baculum, and a few genera have since been erected, based on this character, alone. These genera are not retained in the present work, for the following reasons. Out of numerous named forms, very few appear to have been examined as regards this structure; those that have, have been shown in some cases to vary in this character from subspecies to subspecies (Osman Hill, 1936, *Funambulus*). In other families of Rodents, no generic names have been given to forms which vary in baculum characters; or at most subgeneric names only (for instance, Dipodidae (Vinogradov), Cricetinae (Argyropulo)). If these mammals are given subgenera only on this structure, which seems to me to be scarcely necessary (or at most of subgeneric value except in cases of total suppression of the baculum), I fail to see why such names as *Tomeutes* in the present family must be given full generic rank. It may also be argued that the baculum refers to the male animal only. Pocock has suggested that there may be corresponding modifications in the reproductive parts of the female, and suggests that these might be worked out later. But the work on this whole problem is so far from being finished that it seems absurd to recognize names based on the shape of the baculum alone.

On the other hand, it is admitted that the genera, all currently accepted, *Callosciurus*, *Funambulus*, *Heliosciurus*, and *Sciurus* are not in all cases distinguishable from each other on cranial and dental characters. In cases like these there are wide differences between the *few forms* heretofore examined in penial characters; *Heliosciurus* is said to have the baculum suppressed; while the other three are referred to as many distinct subfamilies by Pocock. These genera are here provisionally retained, partly on this character, partly on average differences in cranial and dental characters, partly on account of the great convenience of so doing, though some doubt is felt on the advisability of their retention.

Pocock (Proc. Zool. Soc. London, 1923, pp. 209–246) classified the whole family on characters of the baculum alone, with ears and feet used if the baculum had not been examined, but leaving cranial and dental characters out altogether. But if this character is given such importance, I fail to see how fossil forms are to be considered; and it seems that if cranial and dental characters have been used primarily for classification since the days of Linnaeus one cannot be blamed for wishing to continue to give more importance to these characters than to an external character which has only been definitely verified in a very small percentage of named species and races, and found to be subspecifically variable in at least one case.

Pocock classified the family (not including the Flying-squirrels) as follows:

Subfamily Sciurinae

Sciurus, with subgenus *Tenes* for *persicus*; all the American genera or subgenera, *Neosciurus*, *Parasciurus*, *Echinosciurus*, etc., except *Tamiasciurus*, (?) *Rheithrosciurus*.

Subfamily Tamiasciurinae

Tamiasciurus. ("Penis . . . flexible throughout owing to the suppression of the baculum" (compare *Heliosciurus*).)

Subfamily Funambulinae

("A highly diversified group of genera, with glans penis exceedingly variable in size and structure, and baculum either relatively very large (*Funambulus*, *Tamiodes*), relatively small (*Protoxerus*, *Ratufa*), minute (*Funisciurus*, *Paraxerus*, *Aethosciurus*), or absent (*Heliosciurus*).")

Funambulus, *Tamiodes*, *Ratufa*, *Protoxerus*, *Aethosciurus*, *Funisciurus*, *Paraxerus*, *Heliosciurus*, and probably other African genera admitted by Thomas, including possibly even *Myosciurus*.

Subfamily Callosciurinae

Callosciurus, *Menetes*, *Tomeutes*, *Rhinosciurus*, *Lariscus*, *Dremomys*, *Tamiops*, *Nannosciurus*, probably others.

Subfamily Xerinae

Atlantoxerus, *Xerus*, *Euxerus*, *Geosciurus*.

Subfamily Marmotinae

Marmota, *Marmotops*, *Cynomys*, *Citellus*, with many subgenera. (?) *Tamias*, *Eutamias*.

The subfamily Nannosciurinae was done away with by Thomas and Pocock because, as might be expected, the baculum of *Myosciurus* differs from that of *Nannosciurus*. The dental characters of the group diagnosed by Forsyth Major appear to be not strictly constant in all cases; and the cranial characters diagnosed by Miller & Gidley appear to be not so distinct in all cases as was at first supposed; for instance, the genus *Microsciurus* (Sciurinae) appears to be rather transitionary towards *Sciurillus* (Nannosciurinae) which, in turn, connects with *Nannosciurus*.

Winge, 1924 (Pattedyr Slaegter, II, p. 84), recognized nine genera only of Sciuridae as here understood, but referred the Castoridae to the family.

Group Sciuri
1. *Tamias*.
2. *Otospermophilus*.
3. *Sciurus*.
4. *Pteromys* (with *Petaurista*).
5. *Eupetaurus*.
6. *Xerus*.

Group "Arctomyes"
7. *Arctomys* (= *Marmota*).
8. *Spermophilus* (= *Citellus*).
9. *Cynomys*.

Howell, 1938, has revised the genera and subgenera occurring in North America north of Panama, and recognizes:

1. *Tamias*.
2. *Eutamias* (subgenus *Neotamias*).
3. *Marmota* (subgenus *Marmotops*).
4. *Cynomys*, with subgenus *Leucocrossuromys*.
5. *Citellus*, with subgenera *Citellus* (*townsendii*, *washingtoni*, *richardsonii*, and *parryi* groups); *Ictidomys* (*tridecemlineatus* and *spilosoma* groups); *Otospermophilus*; *Notocitellus* (subgenus n. for *annulatus*); *Ammospermophilus*; *Callospermophilus*; *Xerospermophilus* (*tereticaudus* group); *Poliocitellus* (subgenus n. for *franklinii*).
6. *Glaucomys*.
7. *Syntheosciurus*.
8. *Microsciurus*.
9. *Sciurus* (typical subgenus restricted to Palaearctic). Subgenera *Neosciurus* (with synonyms *Baiosciurus* and *Echinosciurus*); *Hesperosciurus* (*griseus*); *Otosciurus* (*aberti*); *Parasciurus* (with synonym *Aracosciurus*); *Guerlinguetus* (with synonym *Mesosciurus*).
10. *Tamiasciurus*.

This arrangement is followed in the present paper except that *Eutamias* is not considered a valid genus, and that *Marmotops* (based on the presence of a functionless digit) is regarded as a synonym of *Marmota*.

In forming the key to the genera, I do not include the following three characters which have frequently been used for generic purposes, but in my opinion certainly should not be so.

(1) Presence or absence of functionless upper premolar (P.3). This feature has been pointed out to be a character of little importance already by

Hollister and Pocock. The tooth in question is either present or absent in the genus *Tamiasciurus*, and may occasionally appear in typical *Heliosciurus*, which was originally given generic rank on the sole character "cheekteeth $\frac{4}{4}$" instead of $\frac{5}{4}$. In any case except in certain Marmots the tooth appears to have ceased to be of much functional importance.

(2) Colour pattern. Nearly all Squirrels with a *Tamias*-like series of longitudinal stripes on the back have received generic names. I do not think that genera can be retained on this ground alone, unless coupled with definite characters elsewhere. Examples are "*Tamiscus*" and "*Tamiops*." *Citellus tridecemlineatus*, for instance, has the most specialized colour pattern known in the family, but many other species of *Citellus* are uniformly coloured. Also a striped colour pattern occurs in *Funisciurus* (*lemniscatus* group) side by side with species without it.

(3) Geographical distribution. I am not persuaded that because a Squirrel comes from Africa it is of necessity distinct generically from one that comes from the Malay region, or even from America.

Classification Here Adopted

Thirteen genera of Flying-squirrels are here retained, and thirty-one genera of non-flying Squirrels. In this family above all others generic names have been bestowed freely, and for no apparent reason, again and again. It is not an easy group, and it may be that the key I have endeavoured to get together will not hold in all cases; also some of the genera are at the moment only separable on average characters, or on characters of the baculum which may break down at a later date when more forms have been examined. I can see no necessity of retaining more than thirty-one genera of non-flying Squirrels, and would be quite content personally to regard even several of those that have been retained as of not more than subgeneric value.

I have divided the non-flying Squirrels into seven sections which may in some cases be of doubtful value. These will be discussed later.

The *Pteromys* Group

I have made no changes in this group, the thirteen named genera being all retained.

The *Sciurus* Group

A. *Nannosciurus* section (Pygmy Squirrels with abnormal cranial characters).

Genus 1. *Myosciurus*, Thomas.

Sole species: *M. pumilio*.

Genus 2. *Nannosciurus*, Trouessart.

Principal species: *N. exilis* group; *N. whiteheadi* group; *N. melanotis* group.

Genus 3. *Sciurillus*, Thomas.

Principal species: *S. pusillus* group; *S. murinus* group (Celebes).

B. Sciurus section. (Typical Tree-squirrels; all genera except *Ratufa* and possibly *Microsciurus* are not easily distinguishable from the genus *Sciurus*.)

Genus 4. *Microsciurus*, Allen.
Principal species: *M. alfari* group.

Genus 5. *Syntheosciurus*, Bangs.
Sole species: *S. brochus*.

Genus 6. *Sciurus*, Linnaeus.

Subgenus *a*. *Sciurus*, Linnaeus.
Principal species: *S. vulgaris* group (with *lis*).

Subgenus *b*. *Tenes*, Thomas.
Principal species: *S. anomalus* group.

Subgenus *c*. *Neosciurus*, Trouessart. (Considered valid by Howell, 1938.)
Principal species: *S. carolinensis* group; *S. deppei* group; *S. aureogaster* group, with *poliopus*, *colliaei*, *socialis*, *griseoflavus*, *yucatanensis*, *variegatoides*, etc.

Subgenus *d*. *Otosciurus*, Nelson. (Considered valid by Howell, 1938.)
Principal species: *S. aberti* group.

Subgenus *e*. *Hesperosciurus*, Nelson. (Considered valid by Howell, 1938.)
Sole species: *S. griseus*.

Subgenus *f*. *Parasciurus*, Trouessart. (Considered valid by Howell, 1938.)
Principal species: *S. niger* group (*oculatus*, *arizonensis*, etc.)

Subgenus *g*. *Guerlinguetus*, Gray.
Principal species: *S. hoffmani* group (with *gerrardi*, etc.); *S. aestuans* group; *S. pucherani* group (*ignitus*, *boliviensis*); *S. stramineus* group.

Subgenus *h*. *Notosciurus*, Allen.
Sole species: *S. rhoadsi*.

Subgenus *i*. *Hadrosciurus*, Allen.
Principal species: *S. flammifer*; *S. langsdorffi* group ("*Urosciurus*" as understood by Allen).

Genus 7. *Tamiasciurus*, Trouessart.
Principal species: *T. hudsonicus* group.

Genus 8. *Callosciurus*, Gray.

Subgenus *a*. *Tamiops*, Allen.
Principal species: *C. maclellandi* group.

Subgenus *b*. *Callosciurus*, Gray.
Principal species: *C. tenuis* group, with *jentinki*; *C. lowi* group; *C. erythraeus* group (with *sladeni*, *ferrugineus*, *finlaysoni*, *flavimanus*, *bocourti*, *germaini*, *griseimanus*, *atrodorsalis*); *C. caniceps* group; *C. prevosti* group; *C. notatus*

group (with *vittatus*, *nigrovittatus*); *C. pygerythrus* group (with *lokroides*, *phayrei*); *C. quinquestriatus* group; *C. hippurus* group (with *pryeri*, *brooki*, *melanogaster*, *philippinensis* and other species from Philippines); *C. leucomus* group; *C. rubriventer* group.

Genus 9. *Funambulus*, Lesson.

Principal species: *F. palmarum* group, with *pennanti*, *tristriatus*, *wroughtoni; F. layardi* group; *F. sublineatus* group.

Genus 10. *Dremomys*, Heude.

Principal species: *D. lokriah* group; *D. rufigenis* group; *D. pernyi* group, with (?)*owstoni*, (?)*everetti*.

Genus 11. *Ratufa*, Gray.

Principal species: *R. macroura*; *R. indica*; *R. bicolor*; *R. gigantea*; *R. melanopepla*; *R. affinis*; *R. ephippium*.

C. Lariscus section. (Not a natural group, but containing genera from the Indo-Malayan region, all of which are much specialized and clearly distinct from *Sciurus* generically.)

Genus 12. *Menetes*, Thomas.

Principal species: *M. berdmorei* and races.

Genus 13. *Lariscus*, Thomas & Wroughton.

Principal species: *L. insignis* group; *L. hosei*.

Genus 14. *Glyphotes*, Thomas.

Sole species: *G. simus*.

Genus 15. *Rheithrosciurus*, Gray.

Sole species: *R. macrotis*.

Genus 16. *Rhinosciurus*, Gray.

Sole species: *R. laticaudatus*.

Genus 17. *Hyosciurus*, Tate & Archbold.

Sole species: *H. heinrichi*.

D. African arboreal genera. (All but *Heliosciurus* are clearly distinct generically from *Sciurus*. *Heliosciurus* appears to lead into *Paraxerus* in cranial and dental characters.)

Genus 18. *Heliosciurus*, Trouessart.

Subgenus *a*. *Heliosciurus*, Trouessart.

Principal species: *H. gambianus* group.

Subgenus *b*. *Aethosciurus*, Thomas.

Principal species: *H. poensis* group; *H. ruwenzorii*; *H. lucifer*.

Genus 19. *Paraxerus*, Forsyth Major. (Synonym: *Tamiscus*, Thomas.)

Principal species: *P. cepapi* group (with *ochraceus*); *P. palliatus* group; *P. flavivittis* group; *P. boehmi* group, with *emini*, etc.

Genus 20. *Funisciurus*, Trouessart.

Principal species: *F. lemniscatus* group; *F. congicus* group; *F. pyrrhopus* group, with *auriculatus*, *mystax*, *carruthersi*, etc.

Genus 21. *Protoxerus*, Forsyth Major.

Principal species: *P. stangeri* and races.

Genus 22. *Myrsilus*, Thomas.

Principal species: *M. aubinii*.

Genus 23. *Epixerus*, Thomas.

Sole species: *E. wilsoni*; *E. ebii*.

E. Xerus section. (African and some Palaearctic Ground-squirrels with peculiar cranial characters.)

Genus 24. *Atlantoxerus*, Forsyth Major.

Sole species: *A. getulus*.

Genus 25. *Xerus*, Hemprich & Ehrenberg.

Subgenus *a*. *Xerus*, Hemprich & Ehrenberg.

Principal species: *X. rutilus* group.

Subgenus *b*. *Euxerus*, Thomas.

Principal species: *X. erythropus* group.

Subgenus *c*. *Geosciurus*, Thomas.

Sole species: *X. capensis*, *X. princeps*.

Genus 26. *Spermophilopsis*, Blasius.

Principal species: *S. leptodactylus*.

F. Tamias section. (Chipmunks; semi-terrestrial types, in some ways connecting *Citellus-Marmota* section with *Sciurus* section.)

Genus 27. *Sciurotamias*, Miller

Subgenus *a*. *Sciurotamias*, Miller.

Principal species: *S. davidianus*.

Subgenus *b*. *Rupestes*, Thomas.

Sole species: *S. forresti*.

Genus 28. *Tamias*, Illiger.

Subgenus *a*. *Tamias*, Illiger.

Sole species: *T. striatus* and races.

Subgenus *b*. *Eutamias*, Trouessart.

Sole species: *T. sibiricus* and races.

Subgenus *c*. *Neotamias*, Howell.

Principal species: *T. alpinus* group; *T. minimus* group; *T. amoenus* group; *T. quadrivittatus* group; *T. townsendii* group. (As revised by Howell, 1931.)

G. Marmota section. (Ground-squirrels without the peculiarities of the palate and lachrymal of the *Xerus* section, without the peculiarities of the infraorbital foramen of the *Tamias* section, and usually, not always, with abnormal dental characters.)

Genus 29. *Citellus*, Oken.

Subgenus *a*. *Citellus*, Oken.

Principal species: Palaearctic—*C. fulvus* group;

C. *pygmaeus* group (with *erythrogenys* and others); *C. citellus* group (with *xanthoprymnus*, *alaschanicus*, *dauricus*); *C. suslicus* group; *C. eversmanni* group. Nearctic (arrangement of Howell, 1938, followed)—*C. townsendii* group; *C. washingtoni* group; *C. richardsonii* group; *C. parryii* group (with *columbianus*).

Subgenus *b*. *Ictidomys*, Allen.
Principal species: *C. tridecemlineatus* group (with *mexicanus*); *C. spilosoma* group.

Subgenus *c*. *Poliocitellus*, Howell.
Sole species: *C. franklinii*.

Subgenus *d*. *Otospermophilus*, Brandt.
Principal species: *C. variegatus*, *C. beecheyi*.

Subgenus *e*. *Notocitellus*, Howell.
Sole species: *C. annulatus*, *C. adocetus*.

Subgenus *f*. *Ammospermophilus*, Merriam.
Principal species: *C. leucurus*.

Subgenus *g*. *Xerospermophilus*, Merriam.
Principal species: *C. mohavensis*, *C. tereticaudus*.

Subgenus *h*. *Callospermophilus*, Merriam.
Principal species: *C. lateralis*.

Genus 30. *Marmota*, Blumenbach.
Principal species: *M. monax* group; *M. flaviventris* group; *M. caligata* group (with *camtschatica*); *M. caudata* group (with *aurea*, *dichrous*, etc.); *M. bobak* group (with *sibirica*, *baibacina*, *himalayana*); *M. marmota* group.

Genus 31. *Cynomys*, Rafinesque.

Subgenus *a*. *Cynomys*, Rafinesque.
Sole species: *C. ludovicianus*, *C. mexicanus*.

Subgenus *b*. *Leucocrossuromys*, Hollister.
Principal species: *C. gunnisoni* group.

All specific groups recognized here, except in cases of genera which have been definitely revised, must be regarded as provisional.

The *Pteromys* Group

Geographical Distribution.—Indo-Malayan region from Himalayas to Ceylon, and to Sumatra, Java, Borneo and the Philippines (not Celebes); Palaearctic, from North Scandinavia across the northern portion of the region to Japan; Afghanistan, Kashmir, Tibet; much of China north of the Yangtsekiang. Nearctic; from northern Canada south to Guatemala.

Characters.—This group differs from the *Sciurus* group in the presence of a flying-membrane attached along the sides of the body, rising from the wrist, and from the ankles.

The cheekteeth are usually, not always, with a tendency towards excessive complexity of pattern, which reaches its extreme development in the genera *Belomys* and *Trogopterus*, in which the cheekteeth are more complex in pattern than in any other genera in the entire Order so far as my observations go. Further, as a general rule, the zygomatic plate is low, very little tilted upwards, and weak in general appearance; though this is not the case in the genus *Pteromys* and perhaps some others. Bullae always prominent. Cheekteeth $\frac{5}{4}$, except in the genus *Iomys*.

The characters of the zygomatic plate and cheekteeth tend to show, in my opinion, that this group should be regarded as more primitive than the *Sciurus* group.

External Characters.—The genera referred to this group agree in all essential characters rather closely. In all genera the flying-membrane is, as indicated above, attached to the wrist and supported by a cartilaginous outgrowth. Posteriorly it is attached just above the ankle. In *Petaurista* and *Aeromys*, the tail is more or less narrow and round, and there is a well-developed interfemoral membrane present; in the remainder, so far as seen, there is no well-developed interfemoral membrane, and the tail is wider, flatter, having an appearance very much like a large feather.

In the forefoot there are four well-developed digits, the two centre being the longest, D.4 slightly or considerably longer than D.3, the two outer digits subequal and a little shorter; the pollex, as usual in the group, is more or less untraceable. In the hindfoot, the hallux, though well developed, is the shortest digit; D.5 is usually slightly shorter than the central three, but may sometimes tend to be as long as them; D.4 is usually slightly the longest. Claws usually heavy, curved and powerful. The size is extremely variable; *Petaurillus* must be one of the smallest of all Squirrels, while certain species of *Petaurista* are as large as any other member of the family excepting certain giant forms of *Marmota*. So far as known, the habits of these animals are nocturnal, thereby differing from the non-flying Squirrels.

Thirteen groups have in this branch of the family been given generic rank in recent years. The animals are not as common in Museums as the non-flying Squirrels, and many of the forms are very little known. I think it is reasonable at the moment to retain all these genera; indeed it may be that even more will be needed as the Indo-Malayan forms become better known.

Key to the Genera of the Pteromys Group

Cheekteeth strongly hypsodont; (fur excessively thick and heavy). Eupetaurus

Cheekteeth not strongly hypsodont; (in the majority, fur not excessively thick and heavy).

Cheekteeth always in the lower series and usually in the upper series characterized by signs of extreme complication due to wrinkling; the essential pattern of the cheekteeth usually more or less masked.

P.4 conspicuously enlarged. (Bullae not specially inflated.)

Cheekteeth semi-hypsodont; P.4 extremely enlarged. TROGOPTERUS

Cheekteeth brachyodont; P.4 more moderately enlarged. BELOMYS

P.4 not specially enlarged.

Bullae much inflated; the basi-occipital narrowed. PTEROMYSCUS

Bullae not specially inflated, the basi-occipital noticeably wide. (Usually the tail is narrowed.) PETAURISTA

Cheekteeth with a more normal pattern, the wrinkling though sometimes traceable never excessive, and never masking the essential pattern.

Cusps and ridges of cheekteeth poorly marked; P.4 noticeably smaller than M.1. PETAURILLUS

Cusps and ridges of cheekteeth well marked; P.4 not smaller than M.1.

Inner side of upper cheekteeth formed by two well-marked approximately equal-sized cusps, the formation of the teeth square. Lower cheekteeth with the central depression considerably narrowed. (General dental pattern somewhat simplified in appearance.) IOMYS

Inner side of upper cheekteeth never formed by two well-marked approximately equal-sized cusps, the formation of the teeth not obviously square. Lower cheekteeth with the central depression not becoming narrowed, excepting the genus *Pteromys* in which the general dental pattern is extremely complex in appearance.

Tail rounded and narrowed. AEROMYS

Tail broad, flat, feather-shaped.

Bullae low and flattened, scarcely rising above general level of the base of the skull. PETINOMYS

Bullae without special peculiarities.

M.3 with two clear ridges between the anterior and posterior margins of tooth; second main ridge of P.4, M.1 and M.2 with re-entrant folds cutting off central supplementary cusp; central depression of lower molars, particularly M.3, tending to become narrow and reduced; M.3 lower with four ridges and three depressions; inner side of upper cheekteeth usually with three cusps present or traceable; zygomatic plate strongly heightened and tilted upwards; incisive foramina long. PTEROMYS

M.3 with only one ridge between anterior and posterior margins of tooth; second main ridge of P.4, M.1 and M.2 with no re-entrant folds cutting off central supplementary cusp; central depression of lower cheekteeth not tending to become reduced; M.3 lower never with four ridges and three depressions; inner side of upper cheekteeth as a rule with only one long cusp present (as in normal Sciuridae); zygomatic plate low, little tilted upwards (except *Eoglaucomys*); incisive foramina short.

Cheekteeth relatively simpler, with small extra ridges and depressions not or barely traceable.

Zygomatic plate low, little tilted upwards; hindfoot with no metatarsal pad. GLAUCOMYS

Zygomatic plate high, well tilted upwards; hindfoot with metatarsal pad present. EOGLAUCOMYS

Cheekteeth relatively more complex, with small extra ridges and depressions normally present. HYLOPETES

The last three genera it must be admitted are not very clearly distinguishable from one another.

The character of the tail, which I have used for retaining the genus *Aeromys*, is I think of sufficient importance to be used in a generic sense, in that the tail seems to be a definite organ used by these animals for their "flying." Very much the same state occurs in the Dipodidae, the genera *Scirtopoda* and *Pygeretmus* being based chiefly on the tail formation, which in these cases is used for jumping. (Certainly if the tail in these externally specialized forms is not considered a generic character the genus *Pygeretmus* will be indistinguishable from the genus *Alactagulus*.)

Genus 1. BELOMYS, Thomas

1908. BELOMYS, Thomas, Ann. Mag. Nat. Hist. 8, I, p. 2.

TYPE SPECIES.—*Sciuropterus pearsoni*, Gray.

RANGE.—Indo-Malayan; Sikkim, Assam, Manipur, Tongking; Formosa.

Number of Forms.—Five.

Characters.—Skull with depressed frontals, and moderately developed postorbital processes. Bullae large. Zygomatic plate very primitive, little tilted upwards, only a little more specialized than the type found in Aplodontiidae; zygoma, as in most other members of the group, long and horizontal, being somewhat reminiscent of the zygoma of the Anomaluridae. The ridge of the superior portion of the zygomatic plate does not extend further forward than the level of the upper part of the infraorbital foramen.

Cheekteeth $\frac{5}{4}$, excessively wrinkled and complicated. P.3 is small, P.4 much enlarged in the upper series, its anterior portion extending beyond the small premolar in front of it, which is closely applied to the inner side of P.4. The inner side of the upper teeth differ from most Sciuridae in that instead of being formed by one large elongate cusp, there are three cusps present which evidently do not join, the front one being the smallest. The teeth are extremely complex; what might become a normal Sciurine pattern can be vaguely traced among the mountain-like elevations and deep depressions covering the whole surface of the teeth; the elevations are arranged in three primary longitudinal rows. A well-marked external projecting angle is present on each upper tooth, the centre of which is divided by a deep re-entrant fold; this appears to correspond to the space between the two main ridges in normal Sciuridae. M.3, even in these teeth, appears more simplified than the other molars, this being a very common feature throughout the family.

Lower teeth exceptionally complicated; M.3 the longest tooth. Four main cusps present, or may be traced, the anterointernal one as usual the highest. In M.3 there appear to be at least five transverse ridges extending across the central part of the tooth, but each is much broken up.

Essential external characters as already described; ear rather large, with a tuft of long bristles or hairs at base.

Forms seen: *pearsoni*, *kaleensis*, *trichotis*, *blandus*.

I am not convinced that there is more than one species of this rather exceptional genus, and accordingly treat all named forms provisionally as races of the type.

List of Named Forms

(The references and type localities to all forms belonging to this group are the work of Mr. R. W. Hayman.)

1. BELOMYS PEARSONI PEARSONI, Gray
1842. Ann. Mag. Nat. Hist., X, p. 263.
Darjiling, Sikkim.

2. BELOMYS PEARSONI BLANDUS, Osgood
1932. Field Mus. Nat. Hist. Zool., XVIII, no. 2, p. 269.
Muong Moun, south of Lai Chau, Tongking.

3. BELOMYS PEARSONI VILLOSUS, Blyth
1847. Journ. Asiat. Soc. Bengal, XVI, p. 866.
Upper Assam.

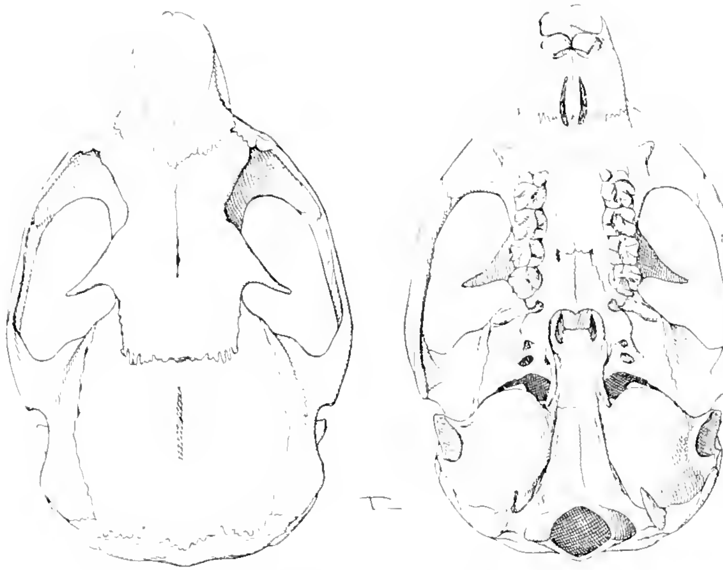


FIG. 82. BELOMYS PEARSONI TRICHOTIS, Thomas.
B.M. No. 15.5.5.43, ♂; × 2.

FIG. 83. BFLOMYS PEARSONI TRICHOTIS, Thomas.
B.M. No. 15.5.5.43, ♂; × 2.

4. BELOMYS PEARSONI TRICHOTIS, Thomas

1908. Ann. Mag. Nat. Hist. 8, I, p. 7.
Machi, Manipur.

5. BELOMYS PEARSONI KALEENSIS, Swinhoe

1862. Proc. Zool. Soc. London, p. 359.
North Formosa.

Genus 2. TROGOPTERUS, Heude

1898. TROGOPTERUS, Heude, Mém. Hist. Nat. Chinois, IV, pt. 1, pp. 46–47.

TYPE SPECIES.—*Pteromys xanthipes*, Milne-Edwards.

RANGE.—China; known from Tibet, Szechuan, Ichang, Shensi, Yunnan, Chihli, etc.

NUMBER OF FORMS.—Five.

CHARACTERS.—Like *Belomys*, but P.4 even more enlarged in the upper toothrow, and cheekteeth semi-hypsodont (brachyodont in *Belomys*). Zygomatic plate like *Belomys*, but with a prominent knob under the infraorbital foramen for muscle attachment; this knob, often present in Sciuridae, I shall refer to as the "masseter-knob." The upper part of the zygomatic plate is more ridged than in *Belomys*. Bullae large. Upper cheek-teeth excessively wrinkled, the elevations arranged in three primary rows. The external projection in the main upper teeth present, though usually smaller than in *Belomys*. P.3 present, closely applied to the inner side of P.4, which projects anteriorly considerably beyond it, and is extremely large. Teeth large and heavy; the general effect complex in the extreme. Lower teeth with four main cusps, one at each corner, but the pattern as complexly wrinkled and folded as in the upper series. M.3 relatively less enlarged than in *Belomys*. Mandible with angular portion rather sharply pulled inwards; coronoid high, recurved.

Essential external characters as in *Belomys*; sole may be partly haired.

Forms seen: *xanthipes*, *mordax*, *minax*, *himalaicus*, *edithae*.

Thomas has divided the limited British Museum material into five separate species. I do not think that there is more than a racial difference between any of the named forms. Until more material comes to hand it seems to be more correct to regard all named forms as subspecies of *xanthipes*.

LIST OF NAMED FORMS

1. TROGOPTERUS XANTHIPES XANTHIPES, Milne-Edwards

1867. Ann. Sci. Nat. Zool., VIII, p. 376.
Chihli, North China.

2. TROGOPTERUS XANTHIPES MORDAX, Thomas

1914. Journ. Bombay Nat. Hist. Soc., XXIII, 2, p. 230.
Ichang, Yangtze-kiang, China.

3. TROGOPTERUS XANTHIPES HIMALAICUS, Thomas

1914. Journ. Bombay Nat. Hist. Soc., XXIII, 2, p. 231.
Gyantse, Chumbi Valley, Tibet.

4. TROGOPTERUS XANTHIPES EDITHAE, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 658.
North-west flank of Likiang Range, Yunnan.

5. TROGOPTERUS XANTHIPES MINAX, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 660.
Won Cauen, Upper Min River, Szechuan, China.

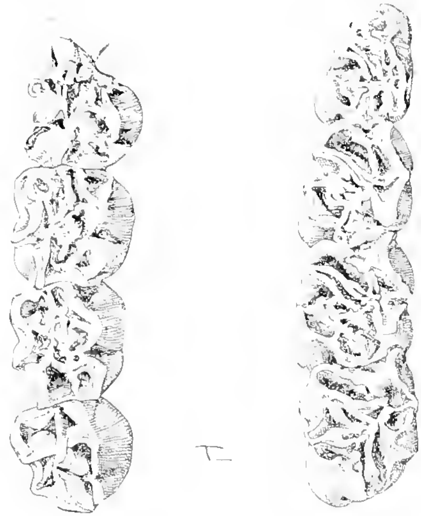


FIG. 84. TROGOPTERUS XANTHIPES MORDAX, Thomas.
B.M. No. 22.9.1.46, ♀; × 5.

Genus 3. PTEROMYSCUS, Thomas

1908. PTEROMYSCUS, Thomas, Ann. Mag. Nat. Hist. 8, I, p. 3.

TYPE SPECIES.—*Sciuropterus pulverulentus*, Günther.

RANGE.—Penang, Sumatra, Borneo.

NUMBER OF FORMS.—Two.

CHARACTERS.—Much like *Belomys*, but with P.3 vestigial, and P.4 not conspicuously larger than M.1; also differing in details of the pattern of the upper teeth, and with the bullae relatively very much enlarged.

The teeth when worn appear to present a rather more normal, less wrinkled appearance, but in younger skulls the complexity of the molars is great. The external projection in the upper molars is less marked than in *Belomys*, and apparently there are only two inner cusps present, the small anterior one being barely traceable. The lower teeth are more or less as in *Belomys*; M.3 considerably elongated.

Externally like *Belomys*, but ear smaller and without tufts.
Forms seen: *pulverulentus*, *borneanus*.

List of Named Forms

1. PTEROMYSCUS PULVERULENTUS PULVERULENTUS, Günther

1873. Proc. Zool. Soc. London, p. 413, pl. xxxviii.
Penang, Malay Peninsula.

2. PTEROMYSCUS PULVERULENTUS BORNEANUS, Thomas

1908. Ann. Mag. Nat. Hist. 8, I, p. 7.
Baram, Sarawak, Borneo.

Genus 4. PETAURISTA, Link

1795. Petaurista, Link, Zool. Beytr., 1, pt. ii, pp. 52, 78.

Type Species.—*Sciurus petaurista*, Pallas.

Range.—Palaearctic and Indo-Malayan; Ceylon, Peninsular India (southern portion, Surat, Orissa); Punjab, Kashmir; Kumaon, Nepal, Sikkim; Burma (Chindwin, Chin Hills, Arakan, Shan States), Tenasserim; Yunnan, Fukien, Hainan, Formosa. Tongking, Siam, Annam, Malay Peninsula; Sumatra, Java, Borneo, Natunas. Also in Szechuan, Hupeh, and China north of the Yangtsekiang; South Kansu; Tibet; Chihli, South Manchuria, Korea, and Japan.

Number of Forms.—About sixty-one.

Characters.—Skull characterized by very large postorbital processes standing nearly at right angles to the braincase; frontals deeply depressed; parietal ridges well marked but showing no signs of joining or even approaching each other in any seen. Jugal with superior process pointing upwards below postorbital process, a structure often to be seen in the present group. Bullae usually large but not extremely so; palate broad. Zygomatic plate similar in general type to that of *Belomys*, but more prominently ridged. Cheekteeth somewhat intermediate between the wrinkled type of *Belomys* and *Trogopterus* and the more normal type found in *Hylopetes* and others. In the upper toothrow each main upper tooth has three inner main cusps originally, but in worn teeth these tend to come together; but a well-marked posterior re-entrant fold (originally between cusps 2 and 3) appears always to be retained; sometimes three inner folds are present. The fold which is retained sometimes appears as a pit; it is present in M.3, which is normally as complex as the other molars, not simplified as is usual in Sciuridae. The normal Sciurine pattern of four ridges and three depressions is traceable, but there is often a tendency towards wrinkling, though less marked than in *Trogopterus* and *Belomys*. P.4 is sometimes rather larger than M.1. P.3 well developed. The lower cheekteeth agree with those of *Trogopterus* and *Belomys*, and are excessively complex; M.3 is not elongated. The central depression is barely traceable as a rule, and the crown surface when worn usually presents four or more broken up isolated depressions, and with many small ridges running across the surfaces of the teeth. A well-marked depression in front of the anteroexternal main cusp present, and usually one between the two outer main cusps present. Teeth semi-hypsodont.

In *P. sulcatus*, not represented in London, the upper incisors are described as broad, and grooved. The describer states that *fulvinus* may have faintly grooved incisors, and does not consider the character generic; but it makes the retention of such genera as *Syntheosciurus* more than doubtful. The upper incisors are normally plain in this genus.

Size large; up to 464 mm. head and body or perhaps more. Interfemoral

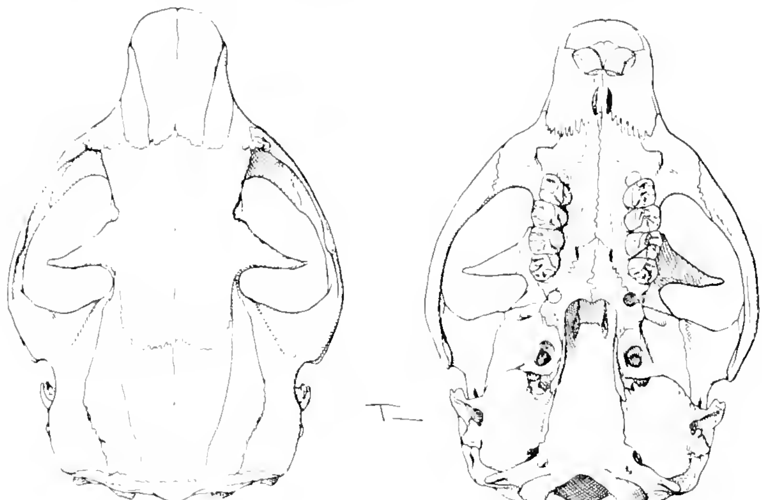


Fig. 85. Petaurista philippensis philippensis, Elliot.
B.M. No. 13.8.22.35, ♂; × 1.

membrane usually more developed than in other genera; tail usually longer than head and body, as a rule narrowed and rounded though fully haired; but in some forms, as *leucogenys*, perhaps on account of the cold climate in which they live, the tail appears in adult to be much broader, and approaching the formation found in the smaller Flying-squirrels, though a young *leucogenys* seen has a narrow tail, as in normal *Petaurista*. D.4 considerably longer than D.3 in manus, as a rule.

Forms seen: *albiventer*, *alborufus*, *annamensis*, *badiatus*, *barroni*, *batuana*, *birrelli*, *candidulus*, *caniceps*, *castaneus*, *cinderella*, *cineraceus*, *clarki*, *elegans*, *fulvinus*, *gorkhali*, *grandis*, *hintoni*, *inornatus*, *lanka*, *lena*, *leucogenys*, *lylei*, *magnificus*, *marchio*, *marica*, *melanotis*, *mergulus*, *nigricaudatus*, *nikkonis*, *nitidula*, *nobilis*, *ochraspis*, *oral*, *oreas*, *petaurista*, *philippensis*, *primrosei*, *punctata*, *rajah*, *reguli*, *senex*, *sibylla*, *taylori*, *tosae*, *venningi*, *xanthotis*, *yunnanensis*.

FIG. 86. PETAURISTA PHILIPPENSIS PHILIPPENSIS, Elliot.
B.M. No. 13.8.22.35, ♂; × 1.

FIG. 87. PETAURISTA PHILIPPENSIS PHILIPPENSIS, Elliot.
Cheekteeth: B.M. No. 13.8.22.35, ♂; × 4½.

This genus contains very many standing distinct species, which are most difficult to arrange in any natural order. Many of the species are known only by very few specimens; some are based on one skin without a skull.

Wroughton (1911, Journ. Bombay Nat. Hist. Soc. XX, 4, p. 1012) has keyed the majority of the Indo-Malayan species, but does not include the Palaearctic ones; Robinson & Kloss, with the exception of the Malay Island forms, did not attempt any revision as regards the reducing of the more doubtful species to races.

I am inclined provisionally to recognize four groups, one of which contains the majority of the genus and is divisible into several sections.

The ALBORUFUS group contains forms with a striking and highly specialized red and white colour-pattern (the head white, the back mostly deep red, with or without a white or brownish dorsal patch). Large thick-furred forms, with bushy tail. China, south to Yunnan, east to Tibet; and Formosa (*lena*).

The remaining groups have no well-marked specialized colour-pattern as indicated above.

The PETAURISTA group contains forms which are mostly unicolorous; most often deep red in general coloration, or in one race blackish; rather short-furred types; back not grizzled. Chiefly Malay Islands, though a race is named from South China.

All other groups examined have a certain amount of grizzling apparent, sometimes strongly marked, on dorsal surface.

The ALBIVENTER group contains the remaining forms in the genus which are represented in London, and divides apparently into the following sections:

punctatus section: back with conspicuons white spots present. Malacca, Borneo, and *marica* from Yunnan. These are very distinct types, but do not appear to be well known, and it has been snggested that the peculiar coloration is in these skins due to disease. Rather small forms.

philippensis section: brownish grizzled white, the white always conspicuous. Rather thick-fnrred species. Tail usually longer than head and body. Containing *philippensis* and the other species from Ceylon and Peninsnlar India, also *lylei* and *cineraceus* from Siam. This section rather grades into the

albiventer section: upper portion usually without conspicuous white grizzling, less frosted in general appearance; frequently more or less reddish in coloration. Tail not specially broadened, or less densely bushy than in *leucogenys* section; fur thick to extremely thick. The most important species referred to this section are *inornatus*, *caniceps*, *albiventer* (all very thick-furred), and *magnificus*, from the Himalayas; and apparently *mergulus* from islands of the Mergui Archipelago. "*Pteromys*" *gorkhali* is a *Petaurista* very closely allied to or perhaps a subspecies of *caniceps*. The group appears to be represented in Burma by *candidulus*, which has white grizzling present, but is much redder in general coloration than any member of the *philippensis* section.

leucogenys section: this is closely allied to the last, but appears to differ in the very general broad appearance of the tail (more so than in other *Petaurista*); the immensely thick fur, and rather *Eupetaurus*-like general appearance; and contains the Japanese and Manchurian *leucogenys*, and *xanthotis* from Tibet. *P. melanopterus*, not seen, is usually considered as allied to this branch.

The SULCATUS group contains one species (not seen) differing apparently from the others in the grooved incisors, though it must be borne in mind that the incisors can be grooved in individual cases elsewhere in the genus.

This arrangement must be regarded as provisional.

List of Named Forms

petaurista Group

1. PETAURISTA ELEGANS, Temminck

1839–44. Müller & Schlegel, Verhandl. Nat. Gesch., pp. 107, 112, pl. xvi, figs. 1–3.
Island south of Nusa Kumbang, South Java.

2. PETAURISTA PETAURISTA PETAURISTA, Pallas

1766. Misc. Zool., p. 54.
West Java.
Synonym: *nitida*, Desmarest, 1818, Nouv. Dict. Hist. Nat., XXVII, p. 403. Java.
taguan, Link, 1795, Zool. Beytr. 1 (2), p. 78.

3. PETAURISTA PETAURISTA NIGRICAUDATUS, Robinson & Kloss

1918. Journ. Fed. Malay States Mus., VII, p. 223.
Ongop Ongop, Banjoewangi, East Java.

4. PETAURISTA PETAURISTA MELANOTUS, Gray

1837. Charlesworth's Mag. Nat. Hist., I, p. 584.
"Nepal" (error), Malay Peninsula substituted.

5. PETAURISTA PETAURISTA CICUR, Robinson & Kloss

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 223.
Bandon, Siamese Malaya.

6. PETAURISTA PETAURISTA RAJAH, Thomas

1908. Ann. Mag. Nat. Hist. 8, I, p. 251.
Mount Dulit, Baram, Borneo.

7. PETAURISTA PETAURISTA NITIDULUS, Thomas

1900. Nov. Zool., VII, p. 592.
Bunguran, North Natuna Islands.

8. PETAURISTA PETAURISTA BATUANA, Miller

1903. Smiths. Misc. Coll., XLV, p. 27.
Tana Bala, Batu Islands, W. Sumatra.
Synonym: *marchio*, Thomas, 1908, Ann. Mag. Nat. Hist. 8, I, p. 251. Si Ramba, Sumatra.

9. PETAURISTA PETAURISTA TERUTAUS, Lyon

1907. Proc. Biol. Soc. Washington, XX, p. 17.
Terutau Island, northern Straits of Malacca.

10. PETAURISTA PETAURISTA MIMICUS, Miller

1913. Smiths. Misc. Coll., LXI, no. 21, p. 27.
Pulau Rupat, East Sumatra.

11. PETAURISTA PETAURISTA LUMHOLTZI, Gyldenstolpe

1919. Stockholm Vet. Akad. Handl. 60, 6, p. 28.
Poeroek Tjahoe, Central Borneo.

12. PETAURISTA PETAURISTA RUFIPES, G. Allen

1925. Amer. Mus. Nov. 163, p. 13.
Yungan, Fukien Province, China.

13. PETAURISTA GRANDIS, Swinhoe

1862. Proc. Zool. Soc. London, p. 358, pl. xlv.
Formosa.

alborufus Group

14. PETAURISTA ALBORUFUS ALBORUFUS, Milne-Edwards

1870. Compt. Rend., LXX, p. 342.
Moupin, Szechuan.

15. PETAURISTA ALBORUFUS LEUCOCEPHALUS, Hilzheimer

1906. Zool. Anz., XXIX, p. 298.
Tibet.

16. PETAURISTA ALBORUFUS CASTANEUS, Thomas

1923. Ann. Mag. Nat. Hist. 9. XII, p. 172.
Ichang, Middle Yangtsekiang, China.

17. PETAURISTA ALBORUFUS OCHRASPIS, Thomas

1923. Ann. Mag. Nat. Hist. 9. XII, p. 172.
Likiang Range, N.-W. Yunnan.

18. PETAURISTA LENA, Thomas

1907. Ann. Mag. Nat. Hist. 7, XX, p. 522.
Tapposha, Central Formosa.

albiventer Group

(*punctatus* Section)

19. PETAURISTA PUNCTATUS PUNCTATUS, Gray

1846. Ann. Mag. Nat. Hist., XVIII, p. 211.
Malacca.

20. PETAURISTA PUNCTATUS BANKSI, Chasen

1934. Bull. Raffles Mus. 8, p. 104.
Mount Kina Balu, Borneo.

21. PETAURISTA PUNCTATUS MARICA, Thomas

1912. Ann. Mag. Nat. Hist. 8, IX, p. 687.
Yunnan; probably near Mongtze.

22. PETAURISTA PUNCTATUS SYBILLA, Thomas

1916. Journ. Bombay Nat. Hist. Soc., XXIV, 3, p. 423.
Chin Hills, near Kindat, Upper Burma.

(*philippensis* Section)

23. PETAURISTA PHILIPPENSIS PHILIPPENSIS, Elliot

1839. Madras Journ. Lit. and Sc., X, p. 217.
Near Madras, India.
Synonym: (?) *grisciventer*, Gray, 1843, List Mamm., p. 133.

24. PETAURISTA PHILIPPENSIS ORAL, Tickell
1842. Calcutta Journ. Nat. Hist., II, p. 401, pl. XI.
Singhbum district, Bengal.

25. PETAURISTA PHILIPPENSIS CINDERELLA, Wroughton
1911. Journ. Bombay Nat. Hist. Soc., XX, 4, pp. 1014, 1018.
Surat district, Bombay.

26. PETAURISTA PHILIPPENSIS LANKA, Wroughton
1911. Journ. Bombay Nat. Hist. Soc., XX, 4, pp. 1014, 1017.
Ceylon.

27. PETAURISTA CINERACEUS CINERACEUS, Blyth
1847. Journ. Asiat. Soc. Bengal, XVI, p. 865.
Arakan.

28. PETAURISTA CINERACEUS STOCKLEYI, Carter
1933. Amer. Mus. Nov., 674, p. 1.
Melamoong, N.-W. Siam.

29. PETAURISTA LYLEI LYLEI, Bonhote
1900. Proc. Zool. Soc. London, p. 192.
Doi Sritepe, Chiengmai, N. Siam.

30. PETAURISTA LYLEI VENNINGI, Thomas
1914. Journ. Bombay Nat. Hist. Soc., XXIII, 1, p. 27.
Kalaw, Southern Shan States, Burma.

31. PETAURISTA LYLEI BADIATUS, Thomas
1925. Proc. Zool. Soc., London, p. 501.
Ngai-Tio, Central Tonkin.

(*albiventer* Section)

32. PETAURISTA MERGULUS MERGULUS, Thomas
1922. Journ. Bombay Nat. Hist. Soc., XXVIII, p. 1067.
Ross Island, Mergui Archipelago.

33. PETAURISTA MERGULUS REGULI, Thomas
1926. Journ. Bombay Nat. Hist. Soc., XXXI, p. 22.
King Island, Mergui Archipelago.

34. PETAURISTA MERGULUS PRIMROSEI, Thomas
1926. Journ. Bombay Nat. Hist. Soc., XXXI, p. 22.
Sullivan Island, Mergui Archipelago.

35. PETAURISTA ANNAMENSIS ANNAMENSIS, Thomas
1914. Journ. Bombay Nat. Hist. Soc., XXIII, 2, p. 204.
Bali, Nha-Trang, South Annam.

36. PETAURISTA ANNAMENSIS BARRONI, Kloss
1916. Journ. Nat. Hist. Soc. Siam, II, p. 33.
Hup Bon, Sriracha, S.-E. Siam.

37. PETAURISTA YUNNANENSIS, Anderson
1875. Ann. Mag. Nat. Hist. 4, XVI, p. 282.
Momein, Yunnan.

38. PETAURISTA CANDIDULUS, Wroughton
1911. Journ. Bombay Nat. Hist. Soc., XX, 4, pp. 1014, 1022.
Kindat, Upper Chindwin, Burma.

39. PETAURISTA TAYLORI, Thomas

1914. Journ. Bombay Nat. Hist. Soc., XXIII, p. 205.
Bankason, South Tenasserim.

40. PETAURISTA FULVINUS, Wroughton

1911. Journ. Nat. Hist. Soc. Bombay, XX, 4, pp. 1014, 1021.
Simla, West Himalayas.

41. PETAURISTA ALBIVENTER, Gray

1834. Ill. Ind. Zool., pl. xviii.
No locality. (Occurs Nepal, Kumaon (Wroughton).)

42. PETAURISTA MAGNIFICUS, Hodgson

1836. Journ. Asiat. Soc. Bengal, V, p. 231.
Nepal.
Synonym: *nobilis*, Gray, 1842, Ann. Mag. Nat. Hist., X, p. 263. Darjiling.
chrysothrix, Hodgson, 1844, Journ. Asiat. Soc. Bengal, XIII, p. 67.

43. PETAURISTA INORNATUS, Geoffroy

1844. In Jacquemont's Voyage, IV, Mamm., p. 62, Atlas ii, pl. iv.
North India.

44. PETAURISTA BIRRELLI, Wroughton

1911. Journ. Bombay Nat. Hist. Soc., XX, 4, pp. 1014, 1019.
Murree, Hazara, Punjab.

45. PETAURISTA CANICEPS, Gray

1842. Ann. Mag. Nat. Hist., X, p. 262.
Sikkim.
Synonym: *senex*, Hodgson, 1844, Journ. Asiat. Soc. Bengal, XIII, p. 68. Nepal.

46. PETAURISTA GORKHALI, Lindsay

1929. Journ. Bombay Nat. Hist. Soc., XXXIII, 3, p. 566.
Gorkha, Nepal (12,000 ft.).

47. PETAURISTA CLARKEI, Thomas

1922. Ann. Mag. Nat. Hist. 9, X, p. 396.
Mekong Valley, Yunnan.

(*leucogenys* Section)

48. PETAURISTA XANTHOTIS, Milne-Edwards

1872. Ann. Sci. Nat. Zool., p. 301.
"Tibet" (probably Moupin, Szechuan).

49. PETAURISTA LEUCOGENYS LEUCOGENYS, Temminck

1827. Mon. Mamm. 1, Tab. Méthod. p. xxvii.
Japan.

50. PETAURISTA LEUCOGENYS NIKKONIS, Thomas

1905. Ann. Mag. Nat. Hist., 7, XV, p. 488.
Nikko, Central Hondo, Japan.

51. PETAURISTA LEUCOGENYS OREAS, Thomas

1905. Ann. Mag. Nat. Hist., 7, XV, p. 488.
Wakayama, South Hondo, Japan.

52. PETAURISTA LEUCOGENYS TOSAE, Thomas

1905. Ann. Mag. Nat. Hist., 7, XV, p. 488.
Tosa, Sikoku Island, Japan.

53. PETAURISTA LEUCOGENYS HINTONI, Mori

1923. Journ. Mamm. Baltimore, 4, p. 191.
Seoul, Korea.
Synonym: *thomasi*, Kuroda & Mori, 1923, Journ. Mamm. Baltimore, 4, p. 27. Seoul, Korea.

54. PETAURISTA WATASEI, Mori

1927. Annot. Zool. Jap., 11, ii, p. 107.
Mukden, S. Manchuria.

55. PETAURISTA MELANOPTERUS, Milne-Edwards

1867. Ann. Sci. Nat. Zool., VIII, p. 375.
Tcheli, China.

sulcatus Group

56. PETAURISTA SULCATUS, Howell

1927. Journ. Washington Acad. Sci. XVII, p. 82.
Hsinlungshan, 65 miles north-east of Peking, Chih-li, E. China.

Not seen and not allocated to group

57. PETAURISTA RUBICUNDUS, Howell

1927. Journ. Washington Acad. Sci. XVII, p. 82.
Mapientung, Szechuan, China.

58. PETAURISTA HAINANA, G. M. Allen

1925. Amer. Mus. Nov. 163, p. 14.
Nam Fong, Hainan.

59. PETAURISTA PECTORALIS, Swinhoe

1870. Proc. Zool. Soc. London, p. 634.
Takow, S.W. Formosa.

60. PETAURISTA FILCHNERINAE, Matschie

1908. Exp. Filchner China & Tibet, Zool. Bot. Ergebn., p. 208.
Si-ning-Fu, China (Upper Hwang-Ho, Kansu).
Probably = *xanthotis*, according to Howell.

Addenda:

PETAURISTA PETAURISTA PENANGENSIS, Kloss

1918. Journ. Fed. Malay States Mus. VII, p. 224.
Telok Bahang, Penang Island.

PETAURISTA, PUNCTATA SUMATRANA, Kloss

1921. Journ. Fed. Malay States Mus. X, p. 230.
Padang Highlands, W. Sumatra.

For references purposes I include Wroughton's key to the species of *Petaurista* occurring in India (1919, Journ. Bombay Nat. Hist. Soc. XXVI, No. 2, p. 354). All these forms are regarded as belonging to the *albiventer* group.

"General colour blackish or greyish, never rufous or fulvous.
Smaller, hindfoot 70–77.
Smaller, hindfoot 72. *oral*
Larger, hindfoot 77. *cinderella*

Larger, hindfoot 80–85.
Back of ears and forearm bay; tail drab-grey. *cineraceus*
No bay marking; tail black.
Limbs and parachute dark maroon, under surface salmon buff. *lylei (lylei venningi)*
Limbs and parachute like the back, at most with a rufous tinge; under-surface white.
Limbs and parachute with a rufous tinge. *philippensis*
Limbs and parachute like the back. *lanka*
General colouring rufous or fulvous.
Size larger, hindfoot over 80 mm.
Colour darker; black tufts behind the ears. *taylori*
Colour paler, dark bay tufts behind the ears. *candidulus*
Size smaller, hindfoot 65–77.
Larger, hindfoot 70–77.
A well-marked dark saddle-patch extending forward to the crown; hindfoot 73. *nobilis*
No saddle patch.
Back of ears black.
Colour darker, grizzled bay and buff. *birrelli*
Colour paler, grizzled brown and white. *inornatus*
Back of ears coloured like head.
Face grey. *caniceps*
Face like head and back.
Darker (bay); no pale area on shoulders; hindfeet black. *albiventer*
Paler (ferruginous); shoulders slightly paler than back; feet coloured like back. *fulvinus*
Smaller, hindfoot 60–65. *sibylla*"

The forms *oral*, *cinderella* and *lanka* are regarded as subspecies of *philippensis* by Robinson & Kloss in their list of Oriental Sciuridae; *sibylla* is regarded as a race of *punctatus* in this paper (as is also *marica* from Yunnan); these authors use the name *magnificus* instead of *nobilis*.

Genus 5. AEROMYS, Robinson & Kloss

1915. AEROMYS, Robinson & Kloss, Journ. Fed. Malay States Mus. VI, p. 23.

TYPE SPECIES.—*Pteromys tephromelas*, Günther.

RANGE.—Penang, Borneo and Sumatra.

NUMBER OF FORMS.—Three.

CHARACTERS.—External characters, including the interfemoral and the narrow round tail (which is much narrowed and very long) essentially as in *Petaurista*. Skull near *Petaurista*. But cheekteeth with in the adult no wrinkling, relatively simple, and of similar pattern to *Hylopetes* (below), with which group Thomas in 1908 associated the genus. Forsyth Major pointed out that this group agrees in dental characters with the smaller Flying-squirrels, rather than with the *Petaurista* type. But in a skull in which the teeth are just being cut, the wrinkling is extreme.

For remarks on the desirability of retaining this genus see p. 276.

Forms seen: *bartelsi*, *phaeomelas*, *tephromelas*, *thomasi*.

Two groups may be recognized here provisionally, *tephromelas* and *phaeomelas*, very dark blackish forms, and *thomasi* which has a very attractive deep red colour.

List of Named Forms

tephromelas Group

1. AEROMYS TEPHROMELAS, Günther

1873. Proc. Zool. Soc. London, p. 413, pl. xxxvii.
Penang, Malay Peninsula.

2. AEROMYS PHAEOMELAS, Gunther

1873. Proc. Zool. Soc. London, p. 413.
Borneo. (Should be regarded as a race of *tephromelas*?)

3. AEROMYS BARTELSI, Sody

1936. Natuurk. Tijschr. Ned. Ind. 96, p. 146.
Pagar Djawa, Pematang Siantar, Deli, N. Sumatra.
(Described doubtfully as *Petaurista*; now seen to be *Aeromys*.)

thomasi Group

4. AEROMYS THOMASI, Hose

1900. Ann. Mag. Nat. Hist. 7, V, p. 215.
Baram, Sarawak, Borneo.

Genus 6. PTEROMYS, Cuvier

1800. Pteromys, Cuvier, Tabl. Elem. Hist. Nat. Anim. p. 135.

1825. Sciuropterus, F. Cuvier, Dents. des Mamm. 161–162, pl. 56, p. 255. *Sciurus volans*, Linnaeus.

Type Species.—*Sciurus volans*, Linnaeus.

Range.—Palaearctic; Northern Scandinavia, Finland, Lithuania, Latvia, Estonia; European Russia, south to former Minsk, Smolensk, Riazan, Vladimir, Kasan and Orenberg governments (Vinogradov); across wooded Siberia; quoted by Vinogradov from Pavlodar district, North Kazakstan; Anadyr region; Transbaikalia. Manchuria, Korea, Japan; Sakhalin; Kansu.

Number of Forms.—Thirteen.

Characters.—Zygomatic plate much more specialized than in other members of the group, being considerably heightened, powerfully ridged on its superior border, the ridge extending beyond the general line of the zygomatic plate, which is hollowed to a certain degree. Masseter knob

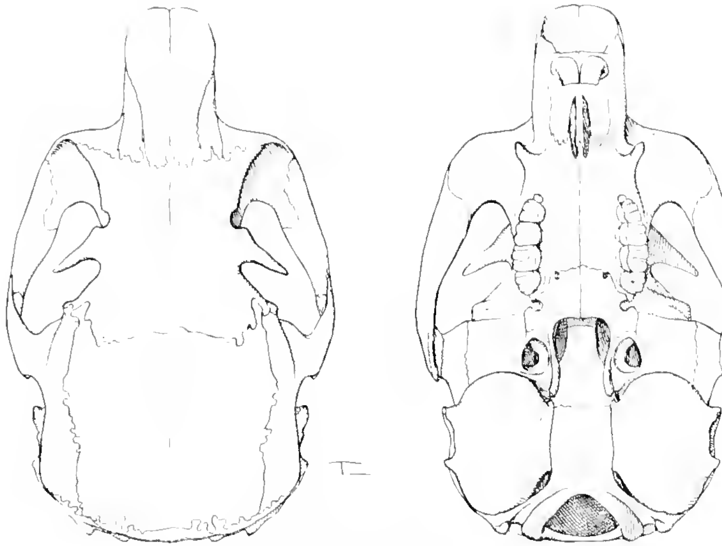


Fig. 88. Pteromys volans volans, Linnaeus.
B.M. No. 1.6.9.1, ♂; × 2.

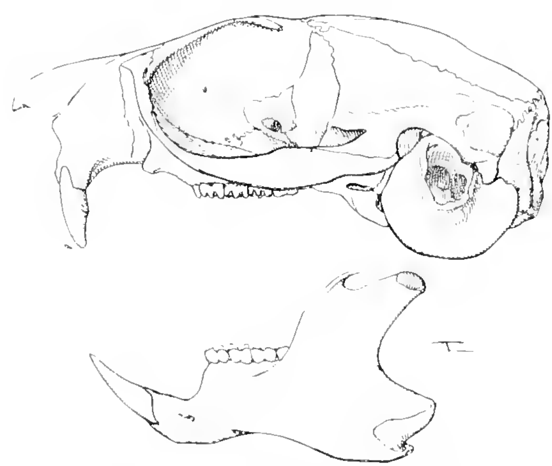


Fig. 89. Pteromys volans volans, Linnaeus.
B.M. No. 1.6.9.1, ♂; × 2.

of infraorbital foramen prominent. Frontals depressed, braincase smooth and strongly depressed posteriorly. Bullae large. Incisive foramina larger (longer) than in most other Flying-squirrels. Mandible with angular portion strongly pulled inwards. Cheekteeth without the excessive wrinkling characteristic of *Belomys* and allies, but much more complex in general appearance than in *Glaucomys* and allies. P.3 small. Upper series with the inner side of the tooth composed of three more or less distinct cusps; general pattern otherwise not far removed from that of *Sciurus*, but the second main ridge of P.4, M.1 and M.2 is cut by a deep re-entrant fold which together with another depression next to the raised inner border of the tooth isolates the intermediate portion of the ridge as a high and distinct cusp, traces of this to be seen apparently at all times; a further peculiarity is that M.3 is not simplified, but retains two high main transverse ridges between the anterior and posterior margins of the tooth, a very rare feature in this family. In the lower teeth, M.3 is greatly elongated; the cusps and ridges of the teeth are very prominent; the cusp between the two outer main cusps usually takes the form of a ridge; the posterointernal cusp is high and broad, and the central depression characteristic of most Sciuridae is rather reduced. A high ridge rounds off the posterior portion of M.3; in this tooth, usually there are traceable three depressions between four transverse ridges, the second and third of which are rather low.

Fig. 90.
Pteromys volans.
Cheekteeth; × 5.

External characters as usual in the group; sole densely haired in all examined; size not large.

The genus *Pteromys*, "*Sciuropterus*," as arranged by Thomas in 1908, contained *Glaucomys*, *Hylopetes* and *Petinomys* as subgenera. Whatever may be the fate of these, there is no doubt in my mind that by the unique dental characters combined with the strongly specialized zygomatic plate the genus *Pteromys* must be restricted to the northern Palaearctic small Flying-squirrels, and is very distinct from all others. It is regrettable that the name "*Pteromys*," which has in the past been used for the large Flying-squirrels of the genus *Petaurista* cannot be dropped in favour of the much more widely known *Sciuropterus*.

Forms seen: "*russicus*" (=*volans*), *aluco*, *athene*, *amygdalei*, *momonga*.

It is not clear whether there is more than one valid species belonging to this genus.

List of Named Forms

1. PTEROMYS VOLANS VOLANS, Linnaeus

1758. Syst. Nat., 10th Ed., vol. 1, p. 64.
Sweden.
Synonym: *russicus*, Tiedemann, 1808, Zoologie, vol. 1, p. 154. Finland.
sibiricus, Desmarest, Mammologie, II, p. 342, 1822.
vulgaris, Wagner, Schreber, Säugt. Suppl. III, p. 228, 1843.

2. PTEROMYS VOLANS OGNEVI, Stroganov

1936. Zool. J. Moscow, 15, p. 530, 559.
Lake Peno, Kalininschen Region, in estuary of the Volga, Gouv. Twer, Russia.

3. PTEROMYS VOLANS GUBARI, Ognev

1935. Bull. Soc. Nat. Moscow, 43, 1934, pp. 304, 311.
West Siberia, district of Troitzk, formerly Bijsk.

4. PTEROMYS VOLANS TUROVI, Ognev

1929. Bull. Pac. Sci. Fishery Res. Sta., II, pp. 14, 41.
Peninsula Koty, Baikal, Siberia.

5. PTEROMYS VOLANS BETULINUS, Serebrennikov

1930. Zeitschr. für Säugetierk. 4, Heft 3, p. 142.
Pavlodar, Semipalatinsk, Siberia.

6. PTEROMYS VOLANS INCANUS, Miller

1918. Proc. Biol. Soc. Washington, XXXI, p. 3.
East Siberia; Verkhne Kolymssk.

7. PTEROMYS VOLANS ATHENE, Thomas

1907. Proc. Zool. Soc. London, p. 409.
Korsakoff, Saghalien.

8. PTEROMYS VOLANS ALUCO, Thomas

1907. Proc. Zool. Soc. London, p. 464.
Kaloguai, 55 miles north-east of Seoul, Korea.

9. PTEROMYS VOLANS ARSENJEVI, Ognev

1935. Bull. Soc. Nat. Moscow, 43 (1934), pp. 309, 314.
Ussuri.

10. PTEROMYS BUECHNERI, Satunin

1903. Ann. Mus. St. Petersb., VII, p. 549.
Kansu, China.

11. PTEROMYS ORII, Kuroda

1921. Journ. Mamm. Baltimore, 2, p. 208.
Uyenai, Iburi Province, Hokkaido, Japan.

12. PTEROMYS MOMONGA MOMONGA, Temminck

1847. Faun. Japon, p. 47, pl. 14.
Interior of Japan.

13. PTEROMYS MOMONGA AMYGDALEI, Thomas

1906. Proc. Zool. Soc. London, p. 344.
Washikaguchi, Nara Ken, South Central Hondo, Japan.

Genus 7. GLAUCOMYS, Thomas

1908. GLAUCOMYS, Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. I, p. 5.

TYPE SPECIES.—*Mus volans*, Linnaeus.

RANGE.—North America: Alaska, Keewatin, Labrador, Manitoba, Alberta, British Columbia, Washington, Oregon, Idaho, California, Utah, Texas, Alabama, Florida, Virginia, New York (good distribution maps published by Anthony (after Howell), Field Book North. Amer. Mamm. 1928, for all forms occurring north of Mexico); South Mexico, Honduras.

Number of Forms.—Thirty.

Characters.—Cheekteeth relatively simple, not essentially different in general arrangement from *Sciurus*, and with no traces of the extra complications seen in the Malayan *Hylopetes* and *Petinomys*. In the lower teeth, M.3 is less enlarged than in *Pteromys*, and the central depression is not reduced, so far as seen.

In the upper cheekteeth, M.3 is simple, as usual in the family, lacking the third (second main) transverse ridge of *Pteromys*. Bullae large. Incisive foramina very short. Frontals not depressed. Zygomatic plate low and primitive, not comparing with *Pteromys*, and much lower than in *Eoglaucomys* in all seen. Postorbital process relatively small.

Size rather small. Soles, at any rate in winter, densely haired, the metatarsal pad characteristic of most members of the group being absent. Mammae 8.

Not many specimens of this genus have been available for examination, but the genus has been fully revised by Howell (North Amer. Fauna, No. 44, 1918). In this paper very many skulls are figured, and the genus is fully compared with *Pteromys*. Two groups are recognized, the *volans* group, evidently rather smaller forms from eastern U.S.A. and Mexico, with the ventral surface lighter; and the *sabrinus* group, from Labrador, across much of Canada, to Alaska, and in the western U.S.A.; usually larger, and with ventral surface darker.

Forms seen: *volans*, *sabrinus*, *alpinus*.

List of Named Forms

volans Group

1. GLAUCOMYS VOLANS VOLANS, Linnaeus

1758. Syst. Nat., 10th Ed., vol. 1, p. 64.
Virginia.
Synonym: *volucella*, True, 1885, Proc. U.S. Nat. Mus. VII, p. 596.
silus, Bangs, 1896, Proc. Biol. Soc. Washington, X, p. 163.
Katis Mountain, Greenbrier County, West Virginia.
nebrascensis, Swenk, 1915, Univ. Nebraska Studies, p. 15, pl. 151.

2. GLAUCOMYS VOLANS SATURATUS, Howell

1915. Proc. Biol. Soc. Washington, XXVIII, p. 110.
Dothan, Henry County, Alabama.

3. GLAUCOMYS VOLANS QUERCETI, Bangs

1896. Proc. Biol. Soc. Washington, X, p. 166.
Citronelle, Citrus County, Florida.

4. GLAUCOMYS VOLANS TEXENSIS, Howell

1915. Proc. Biol. Soc. Washington, XXVIII, p. 110.
Sour Lake, Hardin County, Texas.

5. GLAUCOMYS VOLANS GOLDMANI, Nelson

1904. Proc. Biol. Soc. Washington, X, p. 148.
Twenty miles south-east of Teopisca, Chiapas, Mexico.

6. GLAUCOMYS VOLANS HERRERANUS, Goldman

1936. Journ. Washington Acad. Sci., XXVI, p. 463.
Mountains of Vera Cruz, Mexico.

7. GLAUCOMYS VOLANS MADRENSIS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 463.
Sierra Madre, Chihuahua, Mexico.

8. GLAUCOMYS VOLANS UNDERWOODI, Goodwin

1936. Amer. Mus. Nov., no. 898, p. 1.
Zambrano, Tegucigalpa, Honduras (a village half-way between Tegucigalpa and Comayagua).

sabrinus Group

9. GLAUCOMYS SABRINUS SABRINUS, Shaw

1801. Gen. Zool. 2, p. 157.
Severn River, Keewatin, Canada.
Synonym: *hudsonius*, True, Proc. U.S. Nat. Mus. VII, 1885, p. 596.

10. GLAUCOMYS SABRINUS MAKKOVIKENSIS, Sornborger

1900. Ottawa Naturalist, XIV, p. 48.
Makkovik, Labrador.

11. GLAUCOMYS SABRINUS MACROTIS, Mearns

1899. Proc. U.S. Nat. Mus. XXI, p. 353.
Catskill Mountains, Green County, New York (Hunter Mountain).

12. GLAUCOMYS SABRINUS CANESCENS, Howell

1915. Proc. Biol. Soc. Washington, XXVIII, p. 111.
Portage la Prairie, Manitoba, Canada.

13. GLAUCOMYS SABRINUS BANGSI, Rhoads

1897. Proc. Acad. Nat. Sci. Philadelphia, p. 321 (footnote).
Idaho County, Idaho.

14. GLAUCOMYS SABRINUS ALPINUS, Richardson

1828. Zool. Journ. 3, p. 519.
Jasper House, Alberta, Canada.

15. GLAUCOMYS SABRINUS YUKONENSIS, Osgood

1900. North Amer. Fauna, no. 19, p. 25.
Camp Davidson, Yukon River, near Alaska-Canada boundary, Yukon, Canada.

16. GLAUCOMYS SABRINUS ZAPHAEUS, Osgood

1905. Proc. Biol. Soc. Washington, XVIII, p. 133.
Cleveland Peninsula (Helm Bay), S.-E. Alaska.

17. GLAUCOMYS SABRINUS OREGONENSIS, Bachman

1839. Journ. Acad. Nat. Sci. Philadelphia, VIII, p. 101.
Columbia County, Oregon (probably near St. Helen).

18. GLAUCOMYS SABRINUS COLUMBIENSIS, Howell

1915. Proc. Biol. Soc. Washington, XXVIII, p. 111.
Okanagan, British Columbia

19. GLAUCOMYS SABRINUS FULIGINOSUS, Rhoads

1897. Proc. Acad. Nat. Sci. Philadelphia, p. 321.
Cascade Mountains, near Martin Station, Kittitas County, Washington.

20. GLAUCOMYS SABRINUS LATIPES, Howell

1915. Proc. Biol. Soc. Washington, XXVIII, p. 112.
Glacier, British Columbia.

21. GLAUCOMYS SABRINUS OLYMPICUS, Elliot

1899. Field Columb. Mus. Publ. 30, zool. ser., vol. 1, p. 225.
Happy Lake, Challam County, Washington.

22. GLAUCOMYS SABRINUS BULLATUS, Howell

1915. Proc. Biol. Soc. Washington, XXVIII, p. 113.
Sawtooth Lake, east base of Sawtooth Mountains, Idaho.

23. GLAUCOMYS SABRINUS KLAMATHENSIS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 225.
Fort Klamath, Klamath County, Oregon.

24. GLAUCOMYS SABRINUS FLAVIVENTRIS, Howell

1915. Proc. Biol. Soc. Washington, XXVIII, p. 112.
Bear Creek, Trinity County, California.

25. GLAUCOMYS SABRINUS LASCIVUS, Bangs

1899. Proc. New England Zool. Club, I, p. 69.
Tallac, El Dorado County, California.

26. GLAUCOMYS SABRINUS CALIFORNICUS, Rhoads

1897. Proc. Acad. Nat. Sci. Philadelphia, p. 323.
San Bernardino Mountains, San Bernardino Co., California.

27. GLAUCOMYS SABRINUS STEPHENSI, Merriam

1900. Proc. Biol. Soc. Washington, XIII, p. 151.
Sherwood, Mendocino County, California.

28. GLAUCOMYS SABRINUS GRISEIFRONS, Howell

1934. Journ. Mamm. Baltimore, 15, p. 64.
Lake Bay, Prince of Wales Island, Alaska.

29. GLAUCOMYS SABRINUS LUCIFUGUS, Hall

1934. Occ. Papers Mus. Zool. Univ. Michigan, 296, p. 1.
Summit County, Utah; 12 miles east of Kamas.

30. GLAUCOMYS SABRINUS FUSCUS, Miller

1936. Proc. Biol. Soc. Washington, XLIX, p. 143.
Cranberry Glades, Pocahontas County, West Virginia.

Genus 8. EOGLAUCOMYS, Howell

1915. Eoglaucomys, Howell, Proc. Biol. Soc. Washington, XXVIII, p. 109.

Type Species.—*Sciuropterus fimbriatus*, Gray.

Range.—Palaearctic; Afghanistan and Kashmir, Punjab.

Number of Forms.—Two.

Characters.—This species was originally included in *Glaucomys* by Thomas. It differs from *Glaucomys*, as well as by the characters such as the depressed frontals and much larger postorbital processes due to the greater size of the animal, in that P.3 is divided into two cusps and that the metatarsal pad is present on the hindfoot. The zygomatic plate is much more strongly tilted upwards, and tends to approach *Pteromys* in this respect. The upper and lower cheekteeth are much like *Glaucomys*, differing from *Hylopetes* in being relatively simpler. Ears longer and more pointed than *Glaucomys*. Mammae 8.

It differs from *Pteromys* in the fact that the inner sides of the upper molars have only the one main cusp; the second main ridge of P.4, M.1, M.2 has no portion of it isolated as a cusp in adult; M.3 has, as is usual, only one main ridge; there is no tendency for the central depression in the lower molars, particularly M.3, to become reduced; M.3 lower is not specially lengthened; the zygomatic plate is less extreme; and the palatal foramina are short (normal for the group).

Forms seen: *fimbriatus*, *baberi*.

List of Named Forms

1. EOGLAUCOMYS FIMBRIATUS FIMBRIATUS, Gray

1837. Ann. Mag. Nat. Hist. I, p. 584.
Himalayas: Simla.

2. EOGLAUCOMYS FIMBRIATUS BABERI, Blyth

1847. Journ. Asiat. Soc. Bengal, XVI, p. 866.
Mountain district of Nijrow, Kohistan, Afghanistan.

Genus 9. HYLOPETES, Thomas

1908. Hylopetes, Thomas, Ann. Mag. Nat. Hist. 8, I, p. 6.

Type Species.—*Sciuropterus everetti*, Thomas.

Range.—Indo-Malayan; Sikkim, Nepal, Yunnan; Burma, Tenasserim, Laos; Malay Peninsula, Sumatra, Java, Borneo, and adjacent islands; Philippine Islands.

Number of Forms.—Seventeen.

Characters.—Not essentially different from *Eoglaucomys* but cheekteeth with traces in both upper and lower series of a more complex pattern, and characterized by the usual presence of several small pits and depressions in addition to the usual Sciurine ridges. The zygomatic plate is primitive, of *Belomys* type, not high. In large forms, as *alboniger*, the post-orbital process stands out well, the frontals are depressed; in small species, as *spadiceus*, the frontals are flatter, the postorbital process short. The infraorbital foramen may be rather well open; in *aurantiacus*, the portion of the zygomatic plate behind it is much narrowed. Upper cheekteeth with the essential pattern of *Eoglaucomys*, but with the ridges often with small depressions traceable in them, and the joins of the three original inner cusps are sometimes traceable in the inner side of the teeth. The difference between this genus and *Eoglaucomys* in dental characters is comparable to that between *Sciurus* and *Callosciurus*. Lower cheekteeth with M.3 elongated, and P.4 rather the smallest tooth; more complicated as a rule than in *Eoglaucomys*, and with a short well-marked fold present in front of the anteroexternal cusp except in much worn teeth, and with many small faint pits and lines present, these more clearly marked in the larger species. Mammae 6. Tail broad, feather-shaped. The bullae are normal.

This genus was originally proposed as a subgenus of *Pteromys*, from which it is unquestionably distinct. It might be more correct to refer this genus, with *Eoglaucomys*, to the genus *Glaucomys*; but for the present I retain all named genera in this group.

Forms seen: *alboniger, aurantiacus, belone, everetti, harrisoni, leonardi, laotum, nigripes, platyurus, probus, phayrei, sagitta, spadiceus.*

This genus divides into two well-marked groups on size characters, the much larger *alboniger* group (head and body length over 200), containing *alboniger* from Nepal, Yunnan, Burma, and *nigripes* from the Philippines; and the smaller *sagitta* group, containing all other forms. The size in the second group is rather variable, but seems to grade down from the largest to the smallest; approximate head and body measurements of the main species are: *phayrei*, about 170; *sagitta*, about 150; *aurantiacus*, about 140; *belone*, about 135; *spadiceus*, about 126; and *platyurus* about 100. *H. amoenus*, not seen, is 165. *H. everetti* is about the same size as *phayrei*, and rather more brightly coloured than the majority of the remainder.

List of Named Forms

sagitta Group

1. HYLOPETES PLATYURUS, Jentink

1890. Notes Leyden Mus., XII, p. 147, pl. vii, figs. 7, 8.
Deli, N.-E. Sumatra.

2. HYLOPETES SPADICEUS, Blyth

1847. Journ. Asiat. Soc. Bengal, XVI, p. 867.
Arakan.

3. HYLOPETES BELONE, Thomas

1908. Ann. Mag. Nat. Hist. 8, XI, p. 305.
Pulau Terutau, Malacca.

4. HYLOPETES SAGITTA, Linnaeus

1766. Syst. Nat. 12th ed. 1, p. 88.
Java.

5. HYLOPETES LEPIDUS, Horsfield

1824. Zool. Res. Java, p. 173, pl.
Java.
(A synonym of *sagitta* according to Thomas & Wroughton, 1909, Proc. Zool. Soc. London, p. 387.)

6. HYLOPETES HARRISONI HARRISONI, Stone

1900. Proc. Acad. Nat. Sci. Philadelphia, XLII, p. 462.
Menbuang River, Sarawak, Borneo.

7. HYLOPETES HARRISONI CAROLI, Gyldenstolpe

1919. Stockholm Vet. Akad. Handl. 60, no. 6, p. 29.
East Borneo.

8. HYLOPETES AURANTIACUS, Wagner

1841. Münch. Gel. Anz., XII, p. 438.
Banka Island, off Sumatra.

9. HYLOPETES AMOENUS, Miller

1907. Proc. U.S. Nat. Mus., XXXI, p. 264.
Kundur Island, Rhio Archipelago, Malaya.

10\. HYLOPETES PHAYREI PHAYREI, Blyth
1859. Journ. Asiat. Soc. Bengal, XXVIII, p. 278.
Rangoon, Burma.

11\. HYLOPETES PHAYREI PROBUS, Thomas
1914. Journ. Bombay Nat. Hist. Soc., XXIII, 1, p. 28.
Mount Popa, Burma.

12\. HYLOPETES PHAYREI LAOTUM, Thomas
1914. Journ. Bombay Nat. Hist. Soc., XXIII, 1, p. 28.
Laos Mountains.

13\. HYLOPETES EVERETTI, Thomas
1895. Nov. Zool. II, p. 27.
Bunguran Island, Natunas.

alboniger Group

14\. HYLOPETES ALBONIGER, Hodgson
1836. Journ. Asiat. Soc. Bengal, V, p. 231.
Nepal.
Synonym: *turnbulli*, Gray, 1837, Proc. Zool. Soc. London, p. 68.

15\. HYLOPETES LEONARDI, Thomas
1921. Journ. Bombay Nat. Hist. Soc., XXVII, 3, p. 501.
Kachin Province, North Burma.

16\. HYLOPETES NIGRIPES NIGRIPES, Thomas
1893. Ann. Mag. Nat. Hist. 6, XII, p. 30.
Puerta Princesa, Palawan, Philippine Islands.

17\. HYLOPETES NIGRIPES ELASSODONTUS, Osgood
1918. Proc. Biol. Soc. Washington, XXXI, p. 1.
Bancalan Island, Philippine Islands.

Genus 10. PETINOMYS, Thomas

1908. PETINOMYS, Thomas, Ann. Mag. Nat. Hist. 8, I, p. 6.

TYPE SPECIES.—*Sciuropterus lugens*, Thomas.

RANGE.—Indo-Malayan; Ceylon and South India; Hainan; Tenasserim; Malacca, Sumatra, Java, Borneo; Basilan Island (Philippines).

NUMBER OF FORMS.—Thirteen.

CHARACTERS.—Like *Hylopetes*, but the bullae, although large, are flattened, described by Thomas as "fairly large horizontally, but peculiarly low and flattened, scarcely rising above the general level of the base of the skull, their substance unusually thick and opaque." As in *Hylopetes*, this genus includes some large forms, as *fuscocapillus*, with depressed frontals and more powerful postorbital processes, and some very small forms, as *setosus*, with less modified skulls. In the larger species the parietal ridges are quite well developed.

Cheekteeth like *Hylopetes*, sometimes tending to be a little more complex. Zygomatic plate generally low and primitive, a little less so than is usual in the *fuscocapillus* group. Mammae 4 or 6.

Though the peculiar flattening of the bullae is less strongly marked in *fuscocapillus* than the others, it seems reasonable to regard this group as a genus. Four well marked groups have been examined:

the FUSCOCAPILLUS group of South India, large, head and body length about 296 mm., bullae not quite typical of the genus (hindfoot about 52);
the HAGENI group, about as large; bullae typical of the genus; including *hageni* and *lugens*, from Sumatra and adjacent islands, and (?) *crinitus* (head and body 310, not seen), of the Philippines. The head and body measurement of *lugens* is 230, of *hageni*, 313 mm. (Jentink);
the GENIBARBIS group: moderate-sized forms, hindfoot about 30; Borneo, Java, Malacca; the Hainan species (not seen), head and body 172 mm. is provisionally included here;
the SETOSUS group: pygmy forms; hindfoot 20–24, head and body 120 in *phipsoni*, probably 100 or less in *setosus*; includes *phipsoni* of Tenasserim, *setosus* of Sumatra, and *vordermanni* of Billiton (head and body 100).

Forms seen: *borneoensis*, *fuscocapillus*, *genibarbis*, *hageni*, *layardi*, *lugens*, *malaccanus*, *phipsoni*, *setosus*.

List of Named Forms

setosus Group

1. PETINOMYS SETOSUS, Temminck & Schlegel
1847. Fauna Japon, Mamm., p. 49.
Padang, Sumatra.

2. PETINOMYS PHIPSONI, Thomas
1916. Journ. Bombay Nat. Hist. Soc., XXIV, 3, p. 421.
Tenasserim Town, Tenasserim.

3. PETINOMYS VORDERMANNI, Jentink
1890. Notes Leyden Mus., XII, p. 150, pl. vii, figs. 13, 14.
Billiton Island, off Sumatra.

genibarbis Group

4. PETINOMYS GENIBARBIS GENIBARBIS, Horsfield
1824. Zool. Res. Java (description and plate).
Eastern Java.

5. PETINOMYS GENIBARBIS BORNEOENSIS, Thomas
1908. Ann. Mag. Nat. Hist. 8, II, p. 304.
Bakong River, East Sarawak, Borneo.

6. PETINOMYS GENIBARBIS MALACCANUS, Thomas
1908. Ann. Mag. Nat. Hist. 8, II, p. 304.
Malacca.

7. PETINOMYS ELECTILIS, G. M. Allen
1925. Amer. Mus. Nov. 163, p. 16.
Nam Fong, Hainan.

hageni Group

8. PETINOMYS LUGENS, Thomas
1894. Ann. Mus. Stor. Nat. Genova, XIV, p. 666.
Si Oban, Sipora Island, W. Sumatra.

9. PETINOMYS MAERENS, Miller
1903. Smiths. Misc. Coll., XLV, p. 26.
North Pagi Island, west of Sumatra.

10. PETINOMYS HAGENI, Jentink
1888. Notes Leyden Mus., XI, p. 26.
Deli, Sumatra.

11. PETINOMYS CRINITUS, Hollister
1911. Proc. Biol. Soc. Washington, XXIV, p. 185.
Basilan Island, Philippines.

fuscocapillus Group

12. PETINOMYS FUSCOCAPILLUS, Jerdon (in Blyth)
1847. Journ. Asiat. Soc. Bengal, XVI, p. 867.
South India.

13. PETINOMYS LAYARDI, Kelaart
1850. Journ. Roy. Asiat. Soc. Ceylon, XI, p. 328.
Ceylon.

Genus 11. PETAURILLUS, Thomas

1908. PETAURILLUS, Thomas, Ann. Mag. Nat. Hist. 8, I, p. 3.

TYPE SPECIES.—*Sciuropterus hosei*, Thomas.

RANGE.—Known from Selangor and Borneo.

NUMBER OF FORMS.—Three.

CHARACTERS.—Pygmy Flying-squirrels, rather sharply differentiated from the other genera by the simpler cheekteeth and the relative size of the upper teeth. P.4 is noticeably smaller than M.1; but P.3 is quite well developed, so that the three anterior teeth decrease evenly in size from M.1 forwards. The cheekteeth with low ridges, the pattern not distinct, though evidently much as in normal Sciuridae. P.4 lower noticeably reduced; cusps of lower teeth low. Zygomatic plate a little higher and broader than is usual. Bullae large. Size very small.

The forms of this genus are not well known.

Forms seen: *hosei*, *emiliae*, *kinlochi*.

LIST OF NAMED FORMS

1. PETAURILLUS HOSEI, Thomas
1900. Ann. Mag. Nat. Hist. 7, V, p. 275.
Toyul River, Baram, Sarawak, Borneo.

2. PETAURILLUS EMILIAE, Thomas

1908. Ann. Mag. Nat. Hist. 8, I, p. 8.
Baram, Sarawak, Borneo.

3. PETAURILLUS KINLOCHI, Robinson & Kloss

1911. Journ. Fed. Malay States Mus., IV, p. 171.
Kapar, Selangor, Malay Peninsula.

Genus 12. IOMYS, Thomas

1908. IOMYS, Thomas, Ann. Mag. Nat. Hist. 8, I, p. 1.

TYPE SPECIES.—*Pteromys horsfieldi*, Waterhouse.

RANGE.—Malacca, Sumatra, Borneo, Java.

NUMBER OF FORMS.—Five.

CHARACTERS.—Skull, including the low zygomatic plate, essentially as *Belomys*. Cheekteeth $\frac{4}{4}$, in appearance square, and differing noticeably from all other members of the group. The two main ridges of the upper cheekteeth rise inwardly as well as outwardly into two cusps, so that each tooth has a well-marked cusp at each corner. The depressions in front of the two main ridges are well marked, but the posterior depression is obsolete. No marked discrepancy in size between any of the upper cheekteeth. P.3 absent. M.3 with only one main ridge, but the two inner cusps are present. P.4 with its small foremost cusp placed in front of the tooth, nearly centrally. Lower cheekteeth with four well-marked cusps on each tooth, the anterointernal not or little higher than the others, which is a very rare feature in the family. The central depression is much narrowed, and appears as a re-entrant fold; opposite to it is a narrow external fold which is separated from it by a narrow ridge joining the two outer cusps. This tooth formation rather suggests the specialized lower molars of *Funisciurus* among the *Sciurus* group.

Externally with no special features. Ear rather large.

Forms seen: *thomsoni*, *horsfieldi*, *davisoni*.

The named forms are all regarded as races of the type by Robinson & Kloss, 1918.

LIST OF NAMED FORMS

1. IOMYS HORSFIELDI HORSFIELDI, Waterhouse

1837. Proc. Zool. Soc. London, p. 87.
Java (or Sumatra).

2. IOMYS HORSFIELDI DAVISONI, Thomas

1886. Proc. Zool. Soc. London, p. 74, pl. vi.
Malacca.

3. IOMYS HORSFIELDI THOMSONI, Thomas

1900. Ann. Mag. Nat. Hist. 7, V, p. 275.
Bakong River, Baram, Sarawak, Borneo.

4. IOMYS HORSFIELDI LEPIDUS, Lyon

1911. Proc. U.S. Nat. Mus., XL, p. 78.
Kendawangan River, S.-W. Borneo.

5. IOMYS HORSFIELDI SIPORA, Chasen & Kloss

1928. Proc. Zool. Soc. London, 1927, p. 819.
Sipora Island, Sumatra.

Genus 13. EUPETAURUS, Thomas

1888. EUPETAURUS, Thomas, Journ. Asiat. Soc. Bengal, LVII, p. 256.

TYPE SPECIES.—*Eupetaurus cinereus*, Thomas.

RANGE.—Kashmir.

NUMBER OF FORMS.—One.

CHARACTERS.—"Skull distinct from that of '*Pteromys*' (= *Petaurista*) by its longer trumpet-shaped muzzle, more marked supraorbital notches, longer anterior palatine foramina, and shorter bony palate. Teeth strikingly contrasted with those of any of the other Sciuridae by being hypsodont instead of brachyodont, while their essential pattern remains unchanged. Thus, while the crown of each tooth is enormously lengthened vertically, the grooves ordinarily present on the grinding surface of the molars of '*Pteromys*' are reproduced as deep vertical foldings of the enamel, which when seen in the natural section produced by wear give the teeth very much the general appearance of those of many of the Hystricomorpha . . . the teeth also apart from their hypsodont structure, are distinguishable by their very large proportional size, by being set more obliquely than is the case in other Squirrels, and by presenting . . . a sharp posterointernal angle, markedly different from the evenly convex internal border of the teeth of '*Pteromys*.' The implantation of the large upper premolar is also peculiar, in that of the three distinct roots it has in the allied forms, the anteroexternal and the internal have coalesced into a single broad flat root. . . ." (Thomas). As figured by Thomas, P.4 is rather longer than M.1 in the upper series.

This genus is represented at the British Museum by a few skins, but as yet by no skull. Tail very thickly haired throughout; it appears to be of the *Pteromys* rather than the *Petaurista* type, and there is evidently no well-marked interfemoral membrane. Ear low. Whole body covered in excessively thick soft woolly fur, that of the ventral surface being lighter than that of the dorsal. Even the hindfoot is, except for the pads, heavily haired. Size large.

Forms seen: *cinereus* (skins).

LIST OF NAMED FORMS

1. EUPETAURUS CINEREUS, Thomas

1888. Journ. Asiat. Soc. Bengal, LVII, p. 258, pls. xxii, xxiii.
Gilgit Valley, Himalayas, Kashmir.

The *Sciurus* Group

GEOGRAPHICAL DISTRIBUTION.—As in the family Sciuridae.

CHARACTERS.—This group differs from the *Pteromys* group in the invariable absence of flying-membrane. The cheekteeth are never so excessively complex as in certain Flying-squirrels as *Belomys*, *Trogopterus*, etc.;

but on the other hand some Flying-squirrels as *Glaucomys* are quite as simplified dentally as any of the present group; in the *Sciurus* group, usually the zygomatic plate is higher and more tilted upwards than in the more primitive members of the *Pteromys* group.

Key to Genera of Sciurus Group

The rostrum extremely elongated.

Upper incisors much reduced; cheekteeth tending to wear down to the roots in adult; infraorbital foramen barely forming a canal; claws not enlarged. RHINOSCIURUS

Upper incisors strong, not reduced; cheekteeth evidently without peculiarities; infraorbital foramen forming a long canal; claws much enlarged. HYOSCIURUS

The rostrum not extremely elongated. (Upper incisors not abnormally reduced; the cheekteeth never tending to wear down to the roots during life.)

The upper incisors greatly strengthened, either much thickened anteroposteriorly, their surfaces with many parallel grooves, or much broadened.

Upper and lower incisors much thickened anteroposteriorly, with many parallel grooves on their surfaces. Premolars considerably reduced; toothrows reduced, and cheekteeth simplified in pattern. Rostrum lengthened. RHEITHROSCIURUS

Upper and lower incisors much broadened, the lower part of the upper teeth and the upper part of the lower teeth diverging from each other, their anterior surfaces without grooves. Cheekteeth (so far as ascertainable) normal. Rostrum short. GLYPHOTES

The upper incisors without extreme abnormalities; (in genera in which these teeth are becoming thickened, their anterior surfaces are without grooves).

Skull abnormal, the orbit circular, placed far backwards; postorbital process much reduced or vestigial, situated above level of posterior zygomatic root. Lachrymal over middle or hinder part of toothrow. Zygomatic plate appearing nearly vertical.

Infraorbital foramen forming no canal, the portion of the zygomatic plate behind it exceedingly reduced, situated in front of tooth-row. Ectopterygoid absent. P.4 (upper series) much reduced. (Cranial characters as indicated above carried to extreme degree; size smallest of family.) MYOSCIURUS

Infraorbital foramen forming a canal, the portion of the zygomatic plate behind it normal, situated over hinder part of toothrow. Ectopterygoid present. P.4 (upper series) not specially reduced.

Cranial characters as indicated above carried to extreme degree; postorbital process vestigial. M.3 more reduced than is normal in the family. Palate usually narrowed. NANNOSCIURUS

Cranial characters as indicated above not or less extremely developed. Postorbital process less vestigial. M.3 not reduced. Palate not narrowed. SCIURILLUS

Skull less abnormal; orbit not circular, not placed unusually far backwards; postorbital process usually situated considerably in front of posterior zygomatic root (excepting the genus *Microsciurus*); lachrymal usually over or in front of part of toothrow; zygomatic plate strongly oblique.[1]

Cheekteeth simplified, losing all traces of normal pattern practically from birth. LARISCUS

Cheekteeth not simplified, not losing all traces of normal pattern till adult or usually late in life.

Externally modified for terrestrial life; D.3 in the manus always (so far as seen, possibly excepting *Atlantoxerus*) longer than D.4. (Cheekteeth in progressive species becoming strongly hypsodont; tail shorter than head and body, often considerably reduced; infraorbital foramen forming a canal.)

Lachrymal considerably enlarged. Palate extending conspicuously behind toothrows. Bullae enlarged, well inflated.

Tail short, little longer than hindfoot; claws of fore- and hindfeet excessively thickened and developed; bullae not evenly rounded. SPERMOPHILOPSIS

Tail relatively long, sometimes approaching head and body length; claws of fore- and hindfeet not excessively thickened, less developed; bullae evenly rounded. (Fur always bristly, compare *Atlantoxerus*.) XERUS

Lachrymal not specially enlarged.

Palate extending conspicuously behind toothrows.

[1] Possible exceptions to some of these characters may be shown in the Celebes *Callosciurus leucomus*, very few skulls of which have been examined.

(Bullae large, evenly rounded; fur not bristly, compare *Xerus*.) ATLANTOXERUS

Palate not extending conspicuously behind toothrows. (Usually, upper cheekteeth with tendency towards constriction on inner side, so that they become roughly three-sided instead of more or less rounded or four-sided, as is normal; this constant in *Cynomys* (strongly developed), *Marmota* (moderately developed), and a large portion of *Citellus* (strongly developed).

Toothrows markedly convergent posteriorly. Dentition extremely heavy. Skull with prominent ridges for muscle attachment. Mandible with angular portion strongly inflected. Pollex not vestigial. CYNOMYS

Toothrows not or scarcely convergent posteriorly. Dentition rarely or not extremely heavy. Pollex vestigial.

Skull massive, with heavy prominent postorbital processes, a strong sagittal crest normally present. Ridges for muscle attachment on skull prominent. Mandible with angular portion normally less inflected. MARMOTA

Skull lighter, with moderate or weak postorbital processes, a sagittal crest most often not developed. Ridges on skull for muscular attachment never excessive. Mandible with angular portion normally strongly inflected. CITELLUS

Externally semi-terrestrial or arboreal in external characters; D.3 in manus never constantly longer than D.4 (except in the genera *Tamias* and *Sciurotamias* there is a very general tendency for D.4 to be longer than D.3). (Palate never produced conspicuously behind toothrows; upper cheekteeth with no tendency towards constriction on inner side.)

Infraorbital foramen forming no canal, and normally relatively large, round and well open, usually at maximum for the subfamily. (The position of the genus *Epixerus* must be regarded as provisional.)

D.3 and D.4 in manus normally approximately equal in length. Skull more or less flat, and with reduced postorbital processes. (Ventral surface of body normally furred; cheek-pouches present; tail not conspicuously bushy.) Incisors not specially thickened. TAMIAS

D.4 in the manus longer than D.3. Skull not flattened, the postorbital processes not reduced. (Tail conspicuously bushy.) Incisors considerably thickened.

Ventral surface of body normally haired. Cheekteeth (of all specimens examined) with clear and well-marked ridges and depressions (compare *Protoxerus*). Infraorbital foramen well open (compare *Epixerus*.) MYRSILUS

Ventral surface of body poorly haired, often almost naked.

Toothrows considerably reduced. Infraorbital foramen narrower, less well open. EPIXERUS

Toothrows not specially reduced. Infraorbital foramen large, well open. (Cheekteeth usually without clearly marked ridges and depressions (compare *Myrsilus*).) PROTOXERUS[1]

Infraorbital foramen less open, always forming at least a short canal.

The lower cheekteeth specialized, becoming transversely ridged, as in the upper series, the central depression characteristic of normal genera much reduced and appearing as a re-entrant fold.

Zygomatic plate normal, the ridge on its upper border extending beyond level of the infraorbital foramen. Upper cheekteeth simplifying early in life, in the adult usually with only one clear re-entrant fold retained; the central depression of the lower molars often becoming isolated. MENETES

[1] With representative material it may be that *Protoxerus*, *Epixerus*, and *Myrsilus* would be better considered as all of the one genus *Protoxerus* only.

Zygomatic plate shortened, the ridge on its upper border stopping abruptly above the infraorbital foramen. Upper cheekteeth not simplifying early in life, usually in adult with three clear re-entrant folds present. Lower teeth with the central depression normally not isolated.

Lower cheekteeth with cusps obsolete, and crowns almost completely flat. FUNISCIURUS

Lower cheekteeth with cusps strongly marked, the crowns not becoming flat. PARAXERUS

The lower cheekteeth much less specialized, or not so; not tending to become transversely ridged as in the upper series.

Skull flattened, little depressed posteriorly, narrow in general appearance, and with strongly reduced postorbital process. Zygomatic plate not strongly tilted upwards. D.3 and D.4 in manus usually approximately equal in length. (Infraorbital foramen barely forming a canal, only a little less open than in *Tamias*.) SCIUROTAMIAS

Skull not specially flattened, usually strongly depressed posteriorly, and with postorbital process never much reduced except in very small species. Zygomatic plate well tilted upwards. (Infraorbital foramen clearly forming a canal.)

Postorbital process extremely thick and prominent; cheekteeth with very low cusps, the pattern almost always indistinct; feet much specialized for arboreal life, the inner side of forefoot with conspicuous expansion (evidently taking the functional place of pollex). RATUFA

Postorbital process usually not extremely prominent; cheekteeth with moderate or high cusps, the pattern almost always clear and definite at least at some stage of life; feet less conspicuously specialized for arboreal life, the expansion on the inner side of forefoot absent or less conspicuous.

Postorbital process tending to be situated nearly or exactly over the posterior zygomatic root. (Upper incisors pro-odont.) MICROSCIURUS

Postorbital process situated clearly in front of posterior zygomatic root.

(The remainder of the genera are not at all times distinguishable from each other on cranial and dental characters alone.)

Baculum, so far as known, suppressed or vestigial.

Zygomatic plate either slanting upwards or forwards, with strong ridge on superior border, and with prominent masseter knob present under the infraorbital foramen; or with the ridge not approaching the superior border of rostrum, and stopping abruptly above the infraorbital foramen. Lower cheekteeth with a narrow transverse valley extending from first outer main cusp to the anterointernal cusp. HELIOSCIURUS

Zygomatic plate without abnormalities. Lower cheekteeth without well-marked narrow transverse valley extending from first outer main cusp to anterointernal cusp (so far as seen). TAMIASCIURUS

Baculum, so far as known, retained. (The characters of the genus *Syntheosciurus* in this respect are not known.)

Rostrum progressively elongated throughout every species of the genus, at its extreme development becoming abnormal. DREMOMYS

Rostrum never consistently elongated throughout every species of a genus, at extreme development never abnormal.

Coronoid process relatively low; cusps of cheekteeth noticeably high, and central depression of lower cheekteeth often tending to be relatively smaller; zygomatic plate usually slanting upwards far forwards, and rather prominently ridged (M.3 lower series not specially elongated). FUNAMBULUS

Coronoid process in the majority high, well developed; cusps of cheekteeth usually less noticeably high, and central depression of lower cheekteeth not reduced normally; zygomatic plate most often not slanting upwards far forwards, and not conspicuously ridged.

Upper cheekteeth with small outer (third) cusp usually, not always, absent or obsolete; pattern of cheekteeth usually definite, clear, and rather more complex; M.3 lower series normally tending to be noticeably elongated. CALLOSCIURUS

Upper cheekteeth with small outer (third) cusp retained or traceable; pattern of cheekteeth usually comparatively indistinct; M.3 lower series rarely or not elongated.

Upper incisors not pro-odont, plain. SCIURUS

Upper incisors pro-odont, one-grooved. SYNTHEOSCIURUS

The genera *Callosciurus* and *Funambulus* are retained, it must be admitted, more for convenience than because of the conviction that they are of necessity distinct generically from *Sciurus*, though Pocock transferred them on baculum structure to three different subfamilies. Apart from this structure, they are separable only on average characters; the same applies to *Dremomys*, which possesses intermediate species grading into *Callosciurus* to which it evidently stands nearest. Comparing *Funambulus* with *Sciurus* and *Callosciurus*, Pocock writes, regarding the baculum of his "Funambulinae": "It is when present always a simple bone, without the spatulate expansion at the apex seen in the Sciurinae and without the accessory blade of the Callosciurinae."

SECTION A. NANNOSCIURUS SECTION: Pygmy Squirrels with highly abnormal cranial characters; the Nannosciurinae of Miller & Gidley, and Forsyth Major.

Genus 1. MYOSCIURUS, Thomas

1909. MYOSCIURUS, Thomas, Ann. Mag. Nat. Hist., 8, III, pp. 469, 474

TYPE SPECIES.—*Sciurus pumilio*, Le Conte.

RANGE.—West Africa; Cameroons, Gaboon.

NUMBER OF FORMS.—One.

CHARACTERS.—Skull with extremely broad frontals; postorbital process vestigial, situated over posterior zygomatic root. Zygomatic plate almost vertical, slanting upwards over or behind toothrow. Infraorbital foramen immediately in front of toothrow, the portion of the zygomatic plate behind it abnormally narrowed, also placed in front of toothrow. No ectopterygoid. Palate straight, considerably narrowed. Jugal broad, as in allied genera. Incisors pro-odont. Cheekteeth $\frac{4}{4}$. According to Forsyth Major, writing of this genus and *Nannosciurus*, "The pattern of the crown differs from that found in the Sciuromorpha generally in presenting only three complete transverse crests in the upper molars instead of four, and three in the lower molars. The third crest . . . is very reduced in these pygmy squirrels, sometimes not more than a minute cusp. A further peculiarity of these molars is the large development of the anterior transverse valley both of the superior and inferior molars . . . sometimes almost equalling that of the posterior valley. This last, owing to the partial suppression of the third crest, occupies the area of the median as well as that of the posterior transverse valley in the teeth of Sciuromorpha." On this account he referred these genera to a separate subfamily; but sometimes, as in skull No. 9.10.2.36 at the British Museum, the ordinary Sciurine ridges (four) and depressions (three) may be traced in the main teeth. The toothrow is reduced. Another peculiarity is that in this genus M.3 is turned over, and faces outwards. Upper and lower premolars very reduced in size.

Size very small indeed, head and body about 75 mm. Tail much narrowed, shorter than head and body (about three-quarters this length or slightly more). Digits as in normal Tree-squirrels.

This genus is undoubtedly the most aberrant of the section, as shown chiefly by the abnormal infraorbital foramen, and also the lack of ectopterygoid and the extremely small size.

Forms seen: *pumilio.*

LIST OF NAMED FORMS

(References and type localities of all members of *Sciurus* group by Mr. R. W. Hayman.)

1. MYOSCIURUS PUMILIO, Le Conte

1857. Proc. Ac. Nat. Sci. Philadelphia, p. 11.
Gaboon.
Synonym: *minutus*, du Chaillu, 1861, Proc. Boston Soc. Nat. Hist., VII, p. 366. Gaboon.
minutulus, Hollister, 1921, Proc. Biol. Soc. Washington, XXXIV, p. 135.

Genus 2. NANNOSCIURUS, Trouessart

1880. NANNOSCIURUS, Trouessart, le Naturaliste, p. 292.

TYPE SPECIES.—*Sciurus melanotis*, Müller & Schlegel.

RANGE.—Indo-Malayan; Sumatra, Borneo, Java, and the Philippine Islands.

NUMBER OF FORMS.—Fourteen.

CHARACTERS.—Like *Myosciurus* but with the ectopterygoid present, and infraorbital foramen forming a short canal, the portion of the zygomatic plate behind it less reduced, normal. Coronoid process, as in *Myosciurus*, much reduced. The cheekteeth are similar to those of *Myosciurus*, though the elements of the usual Sciurine pattern may be sometimes traced, as in skulls No. 92.11.8.6 and 10.4.5.113 at the British Museum. M.3 not facing outwards, relatively small, more reduced than is usual in Sciurinae; P.3 present; P.4 as a rule not specially reduced. P.4 lower smaller than the other lower molars;

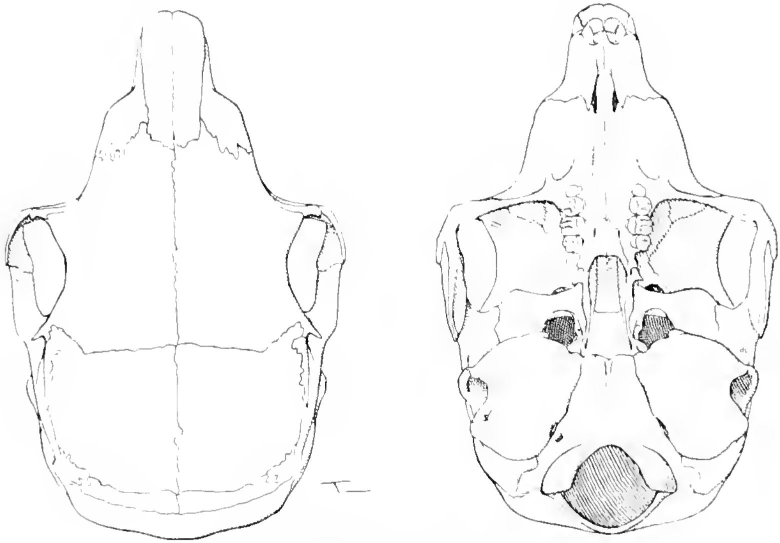


FIG. 91. MYOSCIURUS PUMILIO, Le Conte.
B.M. No. 5.5.23.5, ♂; × 3½.

FIG. 92. MYOSCIURUS PUMILIO, Le Conte.
B.M. No. 5.5.23.5, ♂; × 3½.

cusps in lower teeth nearly obsolete, and the main central depression appears to give way to a transverse ridge. Palate usually narrow.

Externally slightly larger than *Myosciurus*, or becoming so. Tail tending to be narrow, shorter than head and body length. Arrangement of digits not abnormal.

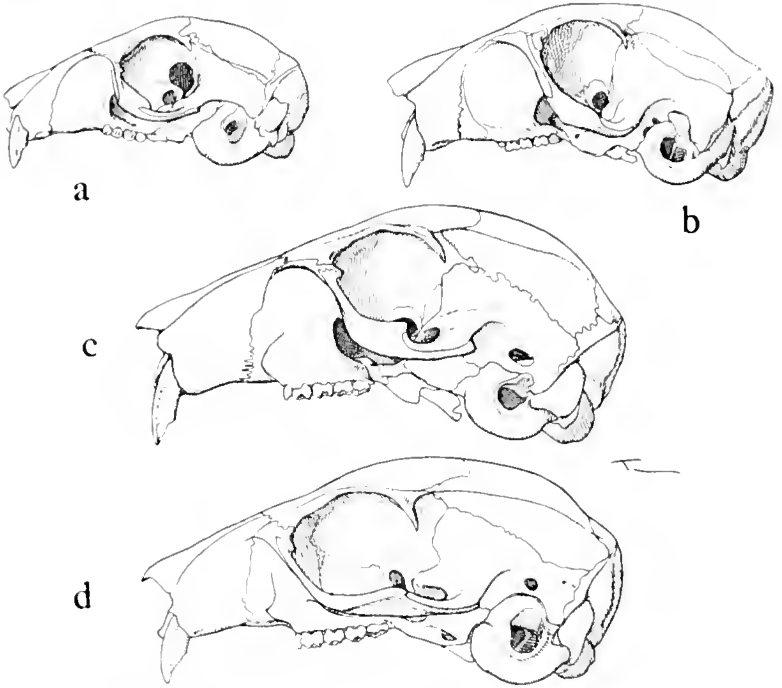


FIG. 93. (*a*) MYOSCIURUS PUMILIO, Le Conte. ×2.
(*b*) SCIURILLUS PUSILLUS PUSILLUS, Desmarest. ×2.
(*c*) SCIURILLUS MURINUS MURINUS, Müller & Schlegel. ×2.
(*d*) CALLOSCIURUS TENUIS SURDUS, Miller. ×2.

Three groups are recognizable in this genus: *melanotis* group, paler, with black ears and white face markings; *exilis* group, darker, without face markings; and *whiteheadi* group, like the last but with ear-tufts present and conspicuous, in some cases extremely long. (These absent in *exilis* group.)

Forms seen: *borneanus*, *concinnus*, *exilis*, *melanotis*, *pulcher*, *retectus*, *samaricus*, *whiteheadi*.

List of Named Forms

exilis Group

1. NANNOSCIURUS EXILIS EXILIS, Muller & Schlegel

1838. Tijds. Natur. Ges., p. 148.
Batang Singalur, Sumatra.

2. NANNOSCIURUS EXILIS RETECTUS, Thomas

1910. Ann. Mag. Nat. Hist. 8, V, p. 387.
Banguey Island, North Borneo.

3. NANNOSCIURUS EXILIS SORDIDUS, Chasen & Kloss

1928. Journ. Malay Branch Roy. As. Soc., VI, pt. 1, p. 44.
Long Temelan, Middle East Borneo.

4. NANNOSCIURUS CONCINNUS, Thomas

1888. Ann. Mag. Nat. Hist. 6, XI, p. 407.
Isabella, Basilan Island, Sulu group, Philippines. Considered a subspecies of *exilis* by Robinson & Kloss, 1918.

5. NANNOSCIURUS SAMARICUS, Thomas

1897. Minutes Zool. Soc. London, 15th June, p. 1. 1898. Trans. Zool. Soc. London, XIV, p. 389, pl. 30, fig. 2.
Samar, Philippine Islands.

6. NANNOSCIURUS SURRUTILUS, Hollister

1913. Proc. U.S. Nat. Mus. XLVI, p. 313.
Mount Bliss, Mindanao, Philippine Islands.

7. NANNOSCIURUS LUNCEFORDI, Taylor

1934. Philippine Land Mammals, p. 373.
Saub, Cotabato, Mindanao, Philippine Islands.

whiteheadi Group

8. NANNOSCIURUS WHITEHEADI, Thomas

1887. Ann. Mag. Nat. Hist. 5, XX, p. 127.
Mount Kina Balu, North Borneo.

melanotis Group

9. NANNOSCIURUS MELANOTIS MELANOTIS, Müller & Schlege

1844. Temminck's Verhandelinger, Zoologie, pp. 87, 88, pl. xiv, fig. 4.
Java.
Synonym: *soricinus*, Waterbouse, 1838, Cat. Mamm., p. 46.

10. NANNOSCIURUS MELANOTIS SUMATRANUS, Lyon

1906. Proc. Biol. Soc. Washington, XIX, p. 53.
Tarussan Bay, West Sumatra.

11. NANNOSCIURUS MELANOTIS PULCHER, Miller

1902. Proc. Acad. Nat Sci. Philadelphia, p. 153.
Sinkep Island, near Sumatra.

12. NANNOSCIURUS MELANOTIS BANCANUS, Lyon

1906. Proc. Biol. Soc. Washington, XIX, p. 55.
Klabat Bay, Bangka Island, East Sumatra.

13. NANNOSCIURUS MELANOTIS BORNEANUS, Lyon

1906. Proc. Biol. Soc. Washington, XIX, p. 54.
Sanggan, West Borneo.

14 NANNOSCIURUS MELANOTIS PALLIDUS, Chasen & Kloss

1928. Journ. Malay Branch. Roy. As. Soc., VI, pt. 1, p. 43.
Long Pochoes, Middle East Borneo.

Genus 3. SCIURILLUS, Thomas

1914. Sciurillus, Thomas, Abstr. Proc. Zool. Soc. London, May 12th, p. 36; id., Proc. Zool. Soc. London, 1914, p. 416.

Type Species.—*Sciurus pusillus*, Desmarest.

Range.—Neotropical; Guianas, extending south to the Amazon. Indo-Malayan; Celebes (*murinus* group provisionally included here).

Number of Forms.—Five.

Characters.—In cranial characters clearly a member of the *Nannosciurus* section. Ectopterygoid present. Skull much like that of *Nannosciurus* except that the palate is broad and normal, and the whole cranial effect is a little less extreme owing presumably to the fact that the animals are rather larger. Jugal in both specific groups included here very broad. Post-orbital process less vestigial than in *Nannosciurus*. In the type species the opening of the infraorbital foramen is carried upwards on front part of zygomatic plate as a curved groove. P.3 present. M.3 not reduced. Only much worn teeth examined in the type species; the ridges not clear, obsolete, the cusps low. P.4 lower, somewhat reduced.

Externally (type species) rather larger than *Nannosciurus*, head and body reaching 107 mm. Tail more normal, longer, about as long as head and body, bushy. Digits not abnormal, arboreal type.

There are also at the British Museum three specimens from Celebes labelled "*Sciurus murinus*." Whether these represent true *murinus* or not I have been unable to find out, as I have not seen any description or reference to this species which mentions cranial characters. But all cranial characters of the Nannosciurinae as diagnosed by Miller & Gidley, except the fact that the middle of orbit (like typical *Sciurillus*) is not behind the middle of the skull, are clearly present in these skulls from Celebes. The species is evidently a transitionary type between *Nannosciurus* section and *Sciurus* section, and is evidently the Celebes representative of the former; "giant" representatives, if one can call a Squirrel a giant, which must measure less than six inches in head and body length. The dentition is about as in normal Squirrels apparently, but much worn in the three examined; the proportions of the teeth agree with those of *Sciurillus* rather than *Nannosciurus*, as do the main cranial characters. It is not my intention to burden this Order with more generic names than can be avoided, so I transfer this group provisionally to *Sciurillus*, though it may be that later the group will need a generic name. Should true *murinus* prove to belong to *Callosciurus* in cranial characters, these skulls must represent a new and undescribed species, but one which I should not feel justified in leaving in *Callosciurus* on cranial characters. It is interesting to note that *Nannosciurus* is not known from Celebes. It is to be hoped that further material will come to hand. The form *evidens*, which is described as near *murinus*, I provisionally list here, though I have not seen it.

Forms seen: *pusillus*, *glaucinus*, *murinus*.

List of Named Forms

pusillus Group

1. SCIURILLUS PUSILLUS PUSILLUS, Desmarest

1822. Mammalogie, pt. 2, p. 337, pl. 77, fig. 2.
South America; Cayenne.

2. SCIURILLUS PUSILLUS GLAUCINUS, Thomas

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 575.
Great Falls of Demerara River, British Guiana.

murinus Group

3. SCIURILLUS MURINUS MURINUS, Muller & Schlegel

1844. Verhandl. Zool., p. 87.
Celebes.

4. SCIURILLUS MURINUS NECOPINUS, Miller & Hollister

1921. Proc. Biol. Soc. Washington, XXXIV, p. 98.
Goenoeng Lehio, Middle Celebes.

5. SCIURILLUS (?) EVIDENS, Miller & Hollister

1921. Proc. Biol. Soc. Washington, XXXIV, p. 99.
Puloh Lembeh, N.-E. Celebes.

The infraorbital foramen of the *murinus* group is normal, without the above-noted peculiarity of the *pusillus* group.

Since the above was written, we have been fortunate enough to obtain three more of these Celebes Pygmy Squirrels, through Mr. W. Frost. Their cranial characters are precisely as in the skulls at present in the British Museum and mentioned above. This indicates that at any rate these skulls did come from Celebes, and also apparently that a small Squirrel of this type is common there, as Mr. Frost writes that Squirrels have not been easy to obtain, and these were the first that came to hand; and it strengthens my supposition that they probably are true *murinus*, and that the species should certainly not remain in the genus *Callosciurus*. The dentition of the new skulls indicates that the pattern is probably as in normal Squirrels; P.3 is relatively well developed.

The head and body length is 130 mm.; the tail is shorter than this measurement (average 70).

Note.—Since the above was written I have seen an important paper on the genus *Sciurillus* (South American section) by Tate & Anthony, Amer. Mus. Nov. 780, Feb. 14, 1935, notes on South American Mammalia, no. 1, *Sciurillus*. These authors state that the form *kuhlii*, Gray, 1867, Ann. Mag. Nat. Hist. 3, XX, p. 433, Pebas, Peru (see the above-mentioned paper, p. 10), is a race of *Sciurillus pusillus*, and not a synonym of *Sciurus aestuans*, as listed here. I have not seen *kuhlii*.

Section B. Sciurus Section: typical Tree-squirrels. In this section are placed very many forms belonging to about eight genera, from the Holarctic, South America, and the Indo-Malayan.

Except for *Microsciurus* and *Ratufa*, the genera are not clearly distinguishable from one another on cranial and dental characters. On characters of the baculum, some of them have been arranged in three different subfamilies (Pocock); but other than the two genera noted above all might quite easily be referred to a single genus *Sciurus*. The African genus *Heliosciurus*, which I have placed in section D, is another genus which is separable only on baculum characters from *Sciurus* or its allies.

Genus 4. MICROSCIURUS, Allen

1895. MICROSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., VII, p. 332.

TYPE SPECIES.—*Sciurus alfari*, Allen.

RANGE.—Neotropical: Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru, and Rio Negro (Amazon).

NUMBER OF FORMS.—About twenty-one.

CHARACTERS.—Skull strongly depressed posteriorly, and postorbital process situated nearly or exactly over posterior zygomatic root, as in *Nannosciurus* and *Sciurillus*; but zygomatic plate slanting gradually upwards as in normal Squirrels, and orbit less circular than in these genera. Frontals very broad, nasals short. Jugal broad. Upper incisors pro-odont, usually extending beyond plane of tip of nasals. Palate normal. Bullae rather small. Cheekteeth as in *Sciurus*, though the small outer (third) cusp of the upper molars is often barely traceable. P.3 present, and rather well developed, except in the type of *manarius*, in which there seem to be no traces of this tooth.

Externally: size small; tail rather narrow or occasionally much narrowed, rather shorter than head and body as a rule; digits as in normal Tree-squirrels.

This genus suggests the *Sciurillus* type of skull, but is in all respects a little nearer to *Sciurus* in cranial characters. The lachrymal is usually situated rather further back in relation to the toothrow than in members of the present section.

Forms seen: *alfari*, *avunculus*, *boquetensis*, *browni*, *flaviventer*, *isthmius*, *manarius*, *mimulus*, *napi*, *otinus*, *palmeri*, *rubrirostris*, *similis*, *simonsi*.

The species were revised by Allen (Bull. Amer. Mus. Nat. Hist., XXXIII, p. 145, 1914). All seem very closely related to each other, except perhaps *manarius*, as noted above.

LIST OF NAMED FORMS

1. MICROSCIURUS ALFARI ALFARI, Allen

1895. Bull. Amer. Mus. Nat. Hist., VII, p. 333.
Volcan de Turrialba, near Jimenez, Costa Rica.

2. MICROSCIURUS ALFARI VENUSTULUS, Goldman

1912. Smiths. Misc. Coll., LVI, 36, p. 4.
Gatun, Panama.

3. MICROSCIURUS ALFARI BROWNI, Bangs

1902. Bull. Mus. Comp. Zool. Harvard Univ., XXXIX, 2, p. 24.
Bogava, Chiriqui, Panama.

4. MICROSCIURUS BOQUETENSIS, Nelson

1903. Proc. Biol. Soc. Washington, XVI, p. 121.
Boquete, Chiriqui, Panama.

5. MICROSCIURUS SIMILIS SIMILIS, Nelson

1899. Bull. Amer. Mus. Nat. Hist., XII, p. 78.
Cali, Cauca Valley, Colombia.

6. MICROSCIURUS SIMILIS FUSCULUS, Thomas

1910. Ann. Mag. Nat. Hist. 8, VI, p. 503.
Juntas, Rio San Juan, Choco District, Colombia.

7. MICROSCIURUS OTINUS, Thomas

1901. Ann. Mag. Nat. Hist. 7, VII, p. 193.
Medellin, Colombia.

8. MICROSCIURUS ISTHMIUS ISTHMIUS, Nelson

1899. Bull. Amer. Mus. Nat. Hist., XII, p. 77.
Truando River, Isthmus of Darien, Colombia.

9. MICROSCIURUS ISTHMIUS VIVATUS, Goldman

1912. Smiths. Misc. Coll., LX, no. 2, p. 4.
Cana, Pirri Range, Eastern Panama.

10. MICROSCIURUS MIMULUS, Thomas

1898. Ann. Mag. Nat. Hist. 7, II, p. 266.
Cachavi, Esmeraldes, Ecuador.

11. MICROSCIURUS PALMERI, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 234.
Sipi, Rio Sipi, Rio San Juan, Choco district, Colombia.

12. MICROSCIURUS SIMONSI, Thomas

1900. Ann. Mag. Nat. Hist. 7, VI, p. 294.
Porvenir, near Zaparal, Bolivar Province, Ecuador.

13. MICROSCIURUS PERUANUS, Allen

1897. Bull. Amer. Mus. Nat. Hist., IX, p. 115.
Guayabamba, N.-W. Peru.

14. MICROSCIURUS NAPI, Thomas

1900. Ann. Mag. Nat. Hist., 7, VI, p. 295.
Rio Coca, Upper Rio Napo, Ecuador-Colombia boundary.

15. MICROSCIURUS RUBRIROSTRIS, Allen

1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 163.
Chanchamayo, Central Peru.

16. MICROSCIURUS FLORENCIAE, Allen

1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 164.
Florencia, Caqueta District, S.-W. Colombia.

17. MICROSCIURUS AVUNCULUS, Thomas

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 574.
Gualaquiza, Eastern Ecuador.

18. MICROSCIURUS SEPTENTRIONALIS, Anthony

1920. Journ. Mamm. Baltimore, 1, p. 81.
Sabalos, on Rio San Juan, at junction of Rio Sabalos, Nicaragua.

19. MICROSCIURUS SABANILLAE, Anthony

1922. Amer. Mus. Nov. 32, p. 2.
South Ecuador, Sabanilla, Prov. de Loja; 5,700 ft.

20. MICROSCIURUS MANARIUS, Thomas

1920. Ann. Mag. Nat. Hist. 9, VI, p. 275.
Acajutuba, Rio Negro, Amazonas.

21. MICROSCIURUS FLAVIVENTER, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 432.
Brazil.

Genus 5. SYNTHEOSCIURUS, Bangs

1902. SYNTHEOSCIURUS, Bangs, Bull. Mus. Comp. Zool. Harvard Univ., XXXIX, no. 2, p. 25.

TYPE SPECIES.—*Syntheosciurus brochus*, Bangs.

RANGE.—Panama.

NUMBER OF FORMS.—One.

CHARACTERS.—Skull with no special peculiarities; rostrum rather long, bullae relatively small, postorbital process moderate. Cheek-teeth $\frac{5}{4}$, evidently like *Sciurus* (only two skulls with much worn teeth seen). Upper incisors pro-odont, extending beyond plane of tip of nasals, and one-grooved.

Fur very thick and soft; tail rather shorter than head and body; digits normal arboreal type; ear strongly reduced.

REMARKS.—This genus is retained by North American authors, including Howell in his recent key to genera occurring north of South America. But the sole character, pro-odont grooved incisors, appears to me to be questionable. Elsewhere the incisors may be pro-odont, as in *Callosciurus prevosti*; and grooves may appear from time to time, as in, for instance, *Heliosciurus*, in other genera. The present species is a little known form. It is probably not more than subgenerically separable from *Sciurus*.

Forms seen: *brochus*.

LIST OF NAMED FORMS

1. SYNTHEOSCIURUS BROCHUS, Bangs

1902. Bull. Mus. Comp. Zool., Harvard Univ., XXXIX, no. 2, p. 25.
Boquete, Chiriqui, Panama. Altitude, 7,000 ft.

Genus 6. SCIURUS, Linnaeus

1758. SCIURUS, Linnaeus, Syst. Nat., 10th Ed., vol. 1, p. 63.

1899. BAIOSCIURUS, Nelson, Proc. Acad. Sci. Washington, 1, p. 31. *Sciurus deppei*, Peters.

1880. ECHINOSCIURUS, Trouessart, le Naturaliste, 2, p. 292. *Sciurus hypopyrrhus*, Wagner.

1880. NEOSCIURUS, Trouessart, le Naturaliste, 2, p. 292. *Sciurus carolinensis*, Gmelin. Valid as a subgenus: see Howell, 1938, N.A. Fauna, 56, p. 1.

1899. HESPEROSCIURUS, Nelson, Proc. Acad. Sci. Washington, 1, p. 27. *Sciurus griseus*, Ord. Valid as a subgenus: see Howell, 1938.

SCIURUS (*continued*)

1899. OTOSCIURUS, Nelson, Proc. Acad. Sci. Washington, 1, p. 28. *Sciurus aberti*, Woodhouse. Valid as a subgenus: see Howell, 1938.

1909. TENES, Thomas, Ann. Mag. Nat. Hist. 8, III, p. 468, footnote. *Sciurus persicus*, Erxleben (= *anomalus*, Guldenstaedt). Valid as a subgenus.

1935. OREOSCIURUS, Ognev, Abstr. Works. Zool. Inst. Moscow, 2, p. 50. *Sciurus anomalus*, Guldenstaedt.

1821. GUERLINGUETUS, Gray, London Med. Repos., XV, p. 304. *Sciurus guerlinguetus*, Gray (= *Sciurus aestuans*, Linnaeus). Valid as a subgenus.

1823. MACROXUS, F. Cuvier, Dents des Mamm., p. 161. Le Guerlinguet (*Sciurus aestuans*, Linnaeus).

1880. PARASCIURUS, Trouessart, le Naturaliste, II, p. 292. *Sciurus niger*, Linnaeus. Valid as a subgenus: see Howell, 1938.

1899. ARAEOSCIURUS, Nelson, Proc. Washington Acad. Sci., I, p. 29. *Sciurus oculatus*, Peters.

1915. MESOSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., XXXIV, p 212. *Sciurus aestuans hoffmani*, Peters.

1915. HISTRIOSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 213. *Sciurus gerrardi*, Gray.

1915. SIMOSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 280. *Sciurus stramineus*, Eydoux & Souleyet.

1915. HADROSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 265. *Sciurus flammifer*, Thomas. Valid as a subgenus.

1915. UROSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 267. *Sciurus tricolor*, Poeppig.

1915. LEPTOSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 199. *Sciurus pucherani*, Fitzinger.

1914. NOTOSCIURUS, Allen, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 585. *Notosciurus rhoadsi*, Allen. Valid as a subgenus.

The arrangement of these names subgenerically is as follows:

Subgenus 1. SCIURUS, Linnaeus (restricted by Howell, 1938, to Palaearctic *vulgaris* group).

Subgenus 2. TENES, Thomas.
Synonym: *Oreosciurus*, Ognev.

Subgenus 3. NEOSCIURUS, Trouessart.
Synonym: *Echinosciurus*, Trouessart } (see Howell,
Baiosciurus, Nelson } 1938).

Subgenus 4. HESPEROSCIURUS, Nelson.

Subgenus 5. OTOSCIURUS, Nelson.

Subgenus 6. PARASCIURUS, Trouessart.
Synonym: *Araeosciurus*, Nelson.

Subgenus 7. GUERLINGUETUS, Gray.
Synonym: *Macroxus*, Cuvier.
Mesosciurus, Allen.
Histriosciurus, Allen.
Simosciurus, Allen.
Leptosciurus, Allen.

Subgenus 8. NOTOSCIURUS, Allen.

Subgenus 9. HADROSCIURUS, Allen.
Synonym: *Urosciurus*, Allen.

TYPE SPECIES.—*Sciurus vulgaris*, Linnaeus.

RANGE.—Europe, from Ireland eastwards and from North Scandinavia to the Mediterranean; the greater part of European Russia; south to Crimea; Caucasus, Asia Minor, parts of Syria and Persia; Siberia, east to Anadyr region, and south to Altai, Transbaikalia, Amur, Ussuri; North Mongolia; Manchuria, Chihli, Korea, Saghalien, Japan. South-eastern Canada (Ontario); U.S.A.: Oregon, Minnesota, California, Arizona, Colorado, New Mexico, Texas, Louisiana, Florida, eastern States generally; Mexico south through Central America to Colombia, Ecuador, Peru, Bolivia, Jujuy (North Argentina), Brazil generally, the Guianas, Venezuela, Trinidad, Tobago.

NUMBER OF FORMS.—About a hundred and ninety.

CHARACTERS.—The skull, typically, is with moderately developed postorbital process; the braincase is strongly depressed posteriorly; there are no prominent ridges present for muscle attachment; except in the South American subgenus *Hadrosciurus*, the parietal ridges very rarely show signs of joining together. The frontals tend to be slightly depressed. The palate is broad, rather square posteriorly, and terminating just behind the toothrows. The incisive foramina are small, far in front of toothrows. The bullae are usually relatively large. The zygomatic plate slants gradually upwards, its ridge moderately or weakly developed; the zygomatic plate not tending to become narrowed in the upper border, the front face usually appearing broad and flat. The infraorbital foramen always forms a canal; the masseter knob is weak. The length of the rostrum is in the genus variable, but never tends to become extreme. Mandible with no special peculiarities.

In the upper cheekteeth there are on the main teeth four transverse ridges, the second and third of which are higher than the first and fourth which respectively form the anterior and posterior margins of the tooth. The two centre ridges are nearly parallel and extend across to the inner side of the tooth, which is rounded and formed as usual in the family by one large inner cusp. The outer sides of the second and third ridges are formed by well-marked cusps, which are usually originally fairly high; between these is placed a small outer cusp, which may become very low but is usually traceable. M.3 has only one prominent transverse ridge, the second; the third ridge of the other teeth is obsolete in this tooth, which has a corresponding wide depression behind the second ridge. P.3 present or absent; when present, vestigial as a general rule.

In the lower teeth, the premolar is usually noticeably smaller than the other teeth, and M.3 is not much elongated as it often is, for instance, in *Callosciurus*; each tooth has a more or less well-marked cusp at each corner, and with the exception of certain forms of the subgenus *Hadrosciurus*, the main central depression is always well marked. The anterointernal cusp is the highest, the posterointernal the lowest. Between these two, and between the two outer main cusps, is placed a small extra cusp each side.

Externally, size moderately large or moderately small; the tail always thickly bushy, very rarely showing signs of becoming narrow; it may be longer than the head and body, as in some forms of *stramineus*, or subequal in length to this measurement, or considerably shorter, as in *anomalus*. In the type species, the sole of the hindfoot is densely hairy in winter. The digits are arranged as characteristic of all arboreal Squirrels; D.4 the longest digit in the hindfoot, D.3 and D.2 successively each a little shorter; D.5 well developed, nearly as long as D.2; hallux moderate. In the forefoot, D.4 is longer than D.3 (slightly); the two other main digits are subequal, and a little shorter than the central two digits. The ear is usually prominent; in *vulgaris* and *aberti*, conspicuous ear-tufts are present, the development of which in *vulgaris* varies seasonally.

Subgenus Sciurus (Palaearctic range of the genus except the Caucasus, Syria, Persia, and Asia Minor); this has once again been restricted to the Palaearctic, by Howell, 1938, though formerly Miller, 1923, regarded the majority of the North American species as belonging to it. Plantar pads 4; ear tufted; sole densely haired in winter. Cheekteeth $\frac{5}{4}$. Mammae 8 (Miller). Includes *vulgaris*, with numerous races, and the Japanese *lis*, which in the absence of knowledge of detail characters such as the baculum appears to me to be doubtfully specifically distinct from *vulgaris*.

Subgenus Tenes (Caucasus, Syria, Persia, Asia Minor); *anomalus* and races (synonym "*Oreosciurus*," Ognev). Plantar pads 6; mammae 10; baculum said to differ from *vulgaris* (Ognev); ears not tufted; cheekteeth normally $\frac{4}{4}$. (Fur less thickened than is usual in *vulgaris*.) Tail rather short, averaging about 70 per cent of head and body length in a comparatively small series of specimens examined.

Subgenus Neosciurus (Eastern U.S.A., Eastern Canada, Mexico, Honduras, Guatemala, Nicaragua, Costa Rica). (Synonym "*Echinosciurus*," "*Baiosciurus*").

"The skull of *S. carolinensis* (type of subgenus *Neosciurus*) does not differ widely in general shape from that of *S. vulgaris*, but is relatively longer, with braincase shallower and more elongated, . . . and rostrum longer and relatively narrower; postorbital process shorter and stouter. . .

"In *S. deppei* (type of *Baiosciurus*, Nelson), P.4 averages slightly more quadrate than the same tooth in *Neosciurus*, but examination of a large series of *deppei* and *carolinensis* shows that the character is too slight and inconstant to serve as a basis for subgeneric distinction.

"*S. a. hypopyrrhus* and the large group of Mexican forms associated with it by Nelson in the subgenus *Echinosciurus* differ in general from *carolinensis* in having a shorter and relatively broader rostrum, and a more or less prominent depression in the frontals; these differences, however, are considered too slight to warrant the recognition of the group" (Howell, 1938).

The baculum of *carolinensis* is said to be essentially as in *vulgaris*; according to Howell, this character is in *deppei* and *adolphei dorsalis* (one of the *aureogaster* group (="*Echinosciurus*")) essentially as in *carolinensis*. There are 6 mammae in *deppei*, which species appears to have a rather lower coronoid process than is usual, though this character may be present also in some of the South American forms. Cheekteeth, in this subgenus, $\frac{5}{4}$.

Subgenus HESPEROSCIURUS (California, Oregon; "Western Gray Squirrels"). "The skull of S. *griseus* resembles that of *carolinensis* very closely except that it is larger . . . the jugal relatively lighter (shallower). Baculum widely different from *Neosciurus*, resembling more closely that of *S. aberti*" (Howell, 1938). P.3 in our small series relatively well developed.

Subgenus OTOSCIURUS (Arizona, Colorado, New Mexico, and Northern Mexico; *aberti* group). "In general shape the skull of *S. aberti* closely resembles that of *S. vulgaris*. P.3 relatively larger and more strongly developed, the crown being subject to wear with the rest of the molars. . . . Compared with *Neosciurus*, this subgenus differs in having braincase and interorbital region relatively broader, postorbital breadth less than interorbital breadth, postorbital process larger and longer, postorbital notch deeper, P.3 more strongly developed" (Howell, 1938). The baculum differs widely from *Neosciurus*, and is nearer *griseus*. The baculum of each of the four subgenera occurring in the United States is figured by Howell, 1938, N.A. Fauna, no. 56, p. 35.

Subgenus PARASCIURUS. (Synonym "*Araeosciurus*.") (Eastern United States including Florida; Texas, Arizona, Mexico) (*niger* group). "Compared with *Neosciurus*, the skull of very similar shape, . . . the frontals slightly elevated on posterior half; a distinct interorbital notch; the baculum closely similar to that of *S. carolinensis*. Cheekteeth reduced to $\frac{4}{4}$. The parietal ridges are in the few skulls examined tending to be prominent, and probably would join, though actually no skull has been seen with this feature. Relatively large Squirrels.

Subgenus GUERLINGUETUS. (Synonym "*Mesosciurus*," "*Histriosciurus*," "*Simosciurus*," "*Leptosciurus*.") "Skull differs from *Parasciurus* in having a shorter rostrum, more swollen braincase, and position of notch in maxillary plate of zygoma . . . there is one upper premolar, which is subcircular or quadrate in shape, differing thus from *Parasciurus* in which this tooth is subtriangular" (Howell). This group ranges from Nicaragua southwards over most of South America, south to Jujuy.

In 1915 Allen divided the South American Squirrels into many "genera." These names were based simply on mammary formula (6 or 8), the bodily size, the relative length of the rostrum (shown subsequently in some cases to be incorrect), the geographical distribution. He keyed these genera as follows:

"Mammae 6.
  Premolars $\frac{1}{1}$
    Size small, total length 320–380. Tail shorter than head and body.
      Soles naked, plantar pads normal. *Leptosciurus*
      Soles heavily furred nearly the whole length; plantar pads all near base of toes. *Notosciurus*

Size medium, total length 375–450. Tail subequal to or shorter than head and body. *Mesosciurus*

Mammae 8.

Premolars $\frac{2}{1}$; tail as long as or longer than head and body.

Size small, tail narrow. *Guerlinguetus*

Size large, total length 490–580, tail broad and bushy.

Skull broad and heavy, rostrum short. *Hadrosciurus*

Skull long and narrow, rostrum slender. *Urosciurus*

Size large, tail very long and narrow, rostrum very broad and short. *Simosciurus*"

It will be seen that "*Mesosciurus*" differs from *Guerlinguetus* in having mammae 6 instead of 8, and "*Simosciurus*" differs in being larger.

The majority of these names, based on characters such as these, have naturally been currently disregarded. *Hadrosciurus*, *Urosciurus* and *Simosciurus* have been shown by Lönnberg to be quite indistinguishable from each other on the cranial characters proposed by Allen.

Thomas stated that *Urosciurus* was not distinguishable from *Hadrosciurus*. Those forms occurring in South America have not been revised like the forms occurring north of Panama (Howell, Miller, etc.). I think there is no doubt that, pending a full revision of all the forms all will have to stand as synonyms of the oldest name *Guerlinguetus* except perhaps *Notosciurus* (not seen), and certainly *Hadrosciurus*, which as I shall endeavour to show is so distinct dentally that it might almost form a genus.

In addition therefore to the *aestuans* group (typical *Guerlinguetus*), the subgenus will include the *hoffmani* group, "*Mesosciurus*," regarded as a synonym by both Miller and Howell; the *stramineus* group, "*Simosciurus*," large attractive long-tailed Squirrels from Peru and Ecuador with, however, absolutely no distinctive features cranially and dentally; and the *pucherani* group, "*Leptosciurus*"; this subgenus was described as "Skull similar in general form and proportions to *S. aestuans*; differing from *Guerlinguetus* in the structure of the upper molars, the outer border of the crowns having only two prominent cusps instead of three, the intervening cusplets usually prominent in *Guerlinguetus* and most other American Tree-squirrels are practically obsolete or entirely absent." But I have seen some specimens belonging to this group with this character not clearly developed; and I have seen specimens of *aestuans* which appear to me to be indistinguishable from *Leptosciurus*; I think it is highly improbable that this is a constant feature dividing the two groups into subgenera.

Subgenus NOTOSCIURUS (*rhoadsi*, Ecuador. Not seen).

"Size small, tail of medium length—naked portion of plantar surface of hindfeet restricted to distal half, the rest heavily furred; the posterior pad large, nearly square, occupying the whole breath of the sole, close to the toe pads" (Allen). This is evidently based on one young individual, the milk premolar being retained, according to Allen, in the one skull, so that it is not known whether the permanent dentition would include

P.3. Originally proposed as a genus; but hairiness of sole is certainly not a valid character; compare winter specimens of *Sciurus vulgaris*.

Subgenus HADROSCIURUS. (Synonym; "*Urosciurus*.") (Venezuela, Peru, Brazil, Colombia, Ecuador, Bolivia).

This is a very distinct group of Squirrels, which may ultimately have to be regarded as a genus, which seem to be paralleling to a certain degree such forms as *Epixerus* and *Rheithrosciurus*, in that the incisors are becoming thickened, and the toothrows rather strongly reduced. The muzzle is pointed, the palate relatively narrow. In the upper teeth, the cusps are evidently low, at all times, but the normal cusps and ridges are traceable. In the lower teeth, a rather different appearance from normal *Sciurus* is frequently present. There is often a well-developed transverse ridge extending across the middle of the tooth and connecting the small intermediate cusps; this ridge may isolate as an island. The small anterior transverse ridge in the lower teeth regarded by Hollister as characteristic of the African *Heliosciurus* is in this subgenus usually well developed. It would be interesting to examine a large series of lower molars of this group, and ascertain how far this general pattern is constant, or if it is present in some races, and not in others, as the material examined appears to vary somewhat in development. The central depression in those forms with the pattern fully developed becomes reduced, which as far as I have seen does not happen elsewhere in the genus. A short sagittal crest is often present.

Some figures have been obtained in order to see if the group would stand as a genus on the reduction of the toothrow, but the results are disappointing as some of the other groups overlap. The percentages of toothrow compared with total length of skull are given below, throughout the genus, in a small number of skulls measured.

	PERCENTAGE OF TOOTHROW AGAINST TOTAL LENGTH OF SKULL	
	AVERAGE	EXTREMES
Subgenus *Hadrosciurus*	15·3	14·2–16·1
Guerlinguetus aestuans group.	15·8	14·9–17·8
"*Leptosciurus*" *pucherani* group.	16·1	14·6–16·7
Guerlinguetus hoffmani group.	16·8	15–17·2
Guerlinguetus gerrardi and allies.	16·8	16·4–17·2
Guerlinguetus stramineus group ("*Simosciurus*").	17·6	17·2–18
Subgenus *Parasciurus*.	17·7	17·1–18·6
Sciurus anomalus.	17·8	17·1–18·6
Sciurus carolinensis.	17·8	17·5–18·7
Sciurus vulgaris.	18·1	17·9–18·4
Sciurus deppei.	18·3	17·3–18·9
Sciurus aberti.	18·4	18–19·1
Sciurus aureogaster group.	18·6	17·4–20·6
Sciurus griseus.	18·7	18·3 19·6

The species referred to *Hadrosciurus* are relatively large forms.

The species of *Sciurus* occurring in Western Europe are revised by Miller, Cat. Mamm. Western Europe, 1912, p. 897.

Species occurring in Mexico and Central America by Nelson, 1899, Proc. Washington Acad. Sci., I, pp. 15–106 (under a number of subgeneric names).

Species occurring in South America by Allen, 1915, Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 147–288 (under a number of generic names).

The North American subgenera are, as indicated above, revised by Howell, 1938, N.A. Fauna, no. 56, which together with a revision of Nearctic *Citellus*

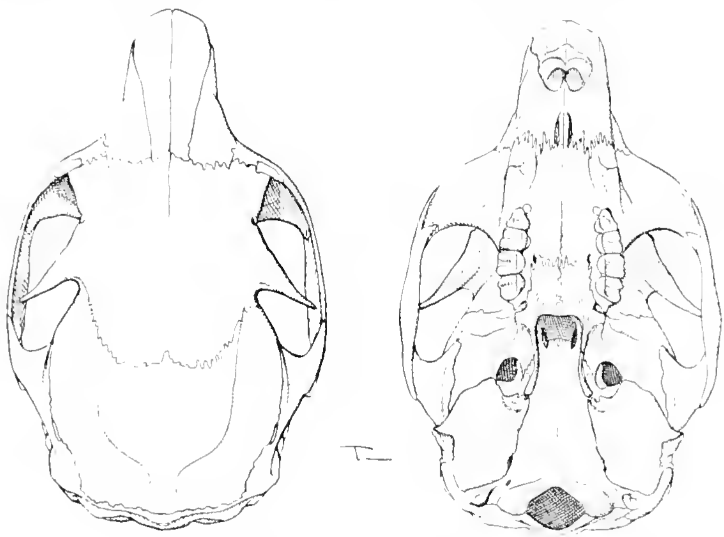


FIG. 94. SCIURUS VULGARIS VULGARIS, Linnaeus.
B.M. No. 97.4.11.1, ♂; × 1½.

clears up much misunderstanding as regards the status of genera and subgenera of Squirrels occurring in North America, and has made my task very much more simple, as the North American collection of Sciuridae at the British Museum is not representative.

Forms seen: *aberti*, *aestuans*, *alleni*, *alphonsei*, *anomalus*, *annalium*, *anthonyi*, *argenteus*, *argentinus*, *aureogaster*, *boliviensis*, *bondae*, *boothiae*, "*brunneoniger*," *carolinensis*, *castus*, *chapmani*, *chiriquensis*, "*cinereus*," *cocalis*, *cocos*, *colliaei*, *coreae*, *croaticus*, "*cuscinus*," *deppei*, *dorsalis*, *durangi*, *flammifer*, "*fraseri*," *frumentor*, *fulminatus*, *fuscoater*, *fusconigricans*, *fuscorubens*, *goldmani*, *griseoflavus*, *griseogena*, *griseus*, *guayanus*, *hyporrhodus*, *igniventris*, *infuscatus*, *ingrami*, *irroratus*, *italicus*, *juralis*, "*klagesi*," *langsdorffi*, *leucotis*, *leucourus*, *lilaeus*, *lis*, *macconnelli*, *mantchuricus*, *martensi*, *medellinensis*, *melania*, *melanotis*, *meridensis*, "*milleri*" (=*leonis*), *nadymensis*, *nayaritensis*, *nebouxi*, *nelsoni*, *nemoralis*, *nesaeus*, *niger*, "*nigrescens*," *nigripes*, *numantius*, *oculatus*, "*ochrescens*," *orientis*, *pallescens*, *paraensis*, *pucherani*, *pyrrhinus*, *pyrrhonotus*, *quelchi*, "*quercinus*" (=*hernandezi*), *quindianus*, *rigidus*, *rufiventer*, *rupestris*, *russus*, *segurae*, *sinaloensis*, *steinbachi*, *stramineus*, *taedifer*, *teparius*, *tobagensis*, *tricolor*, "*variabilis*" (=*gerrardi*), *variegatoides*, *varius*, "*versicolor*" (=*inconstans*), *vulgaris*, *yucatanensis*.

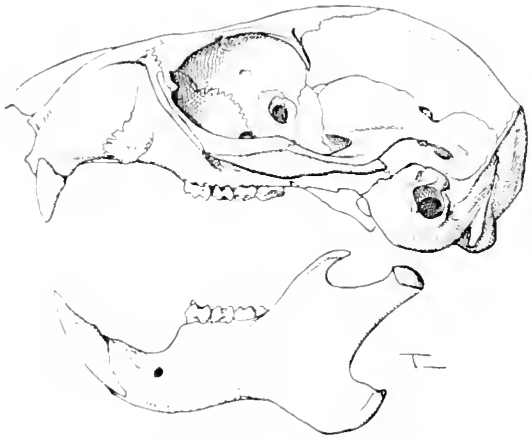


Fig. 95. Sciurus vulgaris vulgaris, Linnaeus.
B.M. No. 97.4.11.1, ♂; × 1½.

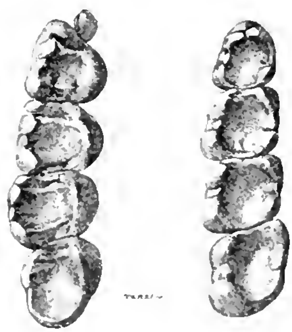


Fig. 96. Sciurus vulgaris vulgaris, Linnaeus.
Cheekteeth; × 5.

List of Named Forms

"Natios," "morphs" and other sub-sub-species of Russian authors are not accepted.

Subgenus *Sciurus*, Linnaeus

1. SCIURUS VULGARIS VULGARIS, Linnaeus

1758. Syst. Nat., Ed. 10, I, p. 63.
Upsala. Sweden.
Synonym: *europaeus*, Gray, 1843, List. Mamm., p. 139.
rufus, Kerr, 1792, Anim. Kingd., p. 255.
albonotatus, Billberg, Synopsis Faunae, Scandinaviae, p. 2 Southern Sweden. 1827.
albus, Billberg, same reference. Skane, Sweden.
niger, Billberg, same reference. Skane, Sweden.
typicus, Barrett-Hamilton, Proc. Zool. Soc. London, p. 6 1899.

2. SCIURUS VULGARIS VARIUS, Brisson

1762. Regn. Anim, p. 106.
Northern Europe.
Synonym: *cinereus*, Fischer, 1829, Synops. Mamm., p. 353.

3. SCIURUS VULGARIS LEUCOURUS, Kerr

1792. Anim. Kingd., p. 256.
England.

4. SCIURUS VULGARIS RUSSUS, Miller

1907. Ann. Mag. Nat. Hist. 7, XX, p. 427.
Dinan, France.

5. SCIURUS VULGARIS FUSCOATER, Altum

1876. Forstzoologie, 2nd ed., I, p. 75.
Harz Mountains, Germany.
Synonym: *nigrescens*, Altum, same reference.
brunnea, Altum, same reference.
graeca, Altum, same reference.
gothardi, Fatio, Arch. Sci. Phys. Nat. Genève, 4th ser., xix, p. 512, 1905. South slope of Mt. St. Gothard, Switzerland.
rutilans, Miller, Ann. Mag. Nat. Hist., 7, XX, p. 426, 1907. Rudolstadt, Thüringen, Germany.

6. SCIURUS VULGARIS ITALICUS, Bonaparte

1838. Iconog. Faun. Ital., i, fasc. 23.
Italy.
Synonym: *meridionalis*, Lucifero, Revista Ital. Sci. Nat. Siena, XXVII, p. 45, 1907. Sila, Calahria, Italy.

7. SCIURUS VULGARIS LILAEUS, Miller

1907. Ann. Mag. Nat. Hist. 7, XX, p. 429.
Agoriani, Greece. (North side of Lyakura (Parnassus) mountains.)

8. SCIURUS VULGARIS ALPINUS, Desmarest

1822. Mamm., II, p. 543.
Pyrenees.

9. SCIURUS VULGARIS NUMANTIUS, Miller

1907. Ann. Mag. Nat. Hist. 7, XX, p. 428.
Pinares de Quintanar de la Sierra, Burgos, Spain.

10. SCIURUS VULGARIS INFUSCATUS, Cabrera

1905. Bol. Real. Soc. Españ. Hist. Nat. Madrid, V, p. 227.
Las Navas, Avila, Spain.

11. SCIURUS VULGARIS SEGURAE, Miller
1909. Ann. Mag. Nat. Hist. 8, III, p. 418.
Molinicos, Sierra de Segura, Albacete, Spain.

12. SCIURUS VULGARIS BAETICUS, Cabrera
1905. Bol. Real. Soc. Españ. Hist. Nat. Madrid, V, p. 228.
Alanis, Seville, Spain.

13. SCIURUS VULGARIS SILANUS, Hecht
1931. Zeitschr. für Säugetierk. Berlin, 6, p. 238.
Silania, Italy.

14. SCIURUS VULGARIS AMELIAE, Cabrera
1924. Bol. Real Soc. Españ. Hist. Nat. Madrid, XXIV, p. 420.
Greece, Kontinoplo, Mt. Olympus.

15. SCIURUS VULGARIS CROATICUS, Wettstein
1927. Anz. Akad. Wien, I, p. 1.
Croatia, Apatisanska Duliba Forest, south-east of Krasno.

16. SCIURUS VULGARIS BALCANICUS, Heinrich
1936. Bull. Inst. R. Hist. Nat. Sophia, 9, p. 41.
Walder am Unterlauf der Kamtschija, Ostauslaufer des Balkan, Bulgaria.

17. SCIURUS VULGARIS ISTRANDJAE, Heinrich
1936. Bull. Inst. R. Hist. Nat. Sophia, 9, p. 41.
Dorf. Karamlek, Strandjabalkan, Bulgaria.

18. SCIURUS VULGARIS RHODOPENSIS, Heinrich
1936. Bull. Inst. R. Hist. Nat. Sophia, 9, p. 41.
Dorf Tschepelare, Central Rhodopen, Bulgaria.

19. SCIURUS VULGARIS NADYMENSIS, Serebrennikov
1928. C.R. Acad. Sci. U.S.S.R., p. 422.
Nadym River, West Siberia.

20. SCIURUS VULGARIS MARTENSI, Matschie
1901. Archiv. für. Naturgesch. Berlin, p. 313.
Lower Yenesei River, Siberia.

21. SCIURUS VULGARIS ALTAICUS, Serebrennikov
1928. C.R. Acad. Sci. U.S.S.R., p. 422.
Kok-Su River, mouth of Yamanush River, Altai Mountains. (Listed as a valid race by Vinogradov, 1933.)

22. SCIURUS VULGARIS FUSCONIGRICANS, Dwigubski
1804. Prodromus Faunae Rossicae, p. 85.
Bargusin, Transbaikalia.

23. SCIURUS VULGARIS FUSCORUBENS, Dwigubski
1804. Prodromus Faunae Rossicae, p. 85.
East Siberia.

24. SCIURUS VULGARIS DULKEITI, Ognev
1929. Zool. Anz., 83, p. 76.
Amuka River, Great Shantar Islands, east coast of Siberia.

25. SCIURUS VULGARIS MANTCHURICUS, Thomas
1909. Ann. Mag. Nat. Hist. 8, IV, p. 501.
Khingan, Manchuria.

26. SCIURUS VULGARIS RUPESTRIS, Thomas

1907. Proc. Zool. Soc. London, p. 410.
Darmé, 25 miles N.W. of Korsakoff, Saghalien.

27. SCIURUS VULGARIS EXALBIDUS, Pallas

1778. Nov. Sp. Quadr. Glir. Ord., p. 374.
Locality not known. (Distribution: Western Siberia.)

28. SCIURUS VULGARIS JACUTENSIS, Ognev

1930. Bull. Pacif. Sta. Vladivostock, 2, no. 5, pp. 18, 41.
Yakutsk, Siberia.

29. SCIURUS VULGARIS FEDJUSHINI, Ognev

1935. Abstr. Works. Zool. Inst. Moscow, 2, p. 43.
Minsk, West Russia.

30. SCIURUS VULGARIS FORMOSOVI, Ognev

1935. Abstr. Works. Zool. Inst. Moscow, 2, p. 44.
Nijni-Novgorod, Russia.

31. SCIURUS VULGARIS BASHKIRICUS, Ognev

1935. Abstr. Works. Zool. Inst. Moscow, 2, p. 45.
Samara, Russia.
Synonym: *vulgaris baskiricus* natio *uralensis*, Ognev, same reference, p. 46. Ural.

32. SCIURUS VULGARIS JENISSEJENSIS, Ognev

1935. Abstr. Works. Zool. Inst. Moscow, 2, p. 47.
Lower Tunguska, Turuchansk, East Siberia.

33. SCIURUS VULGARIS COREAE, Sowerby

1921. Ann. Mag. Nat. Hist. 9, VII, p. 252.
Kaldguai, 55 miles N.E. of Seoul, Korea.

34. SCIURUS VULGARIS CHILIENSIS, Sowerby

1921. Ann. Mag. Nat. Hist. 9, VII, p. 253.
Tung-ling, 75 miles north-east of Peking, China.

35. SCIURUS VULGARIS KESSLERI, Migulin

1928. Prot. Plant Ukraine, no. 3–4, p. 83.
Zhitomir and Shepetovka, West Ukraine, European Russia.

36. SCIURUS VULGARIS UKRAINICUS, Migulin

1928. Prot. Plant Ukraine, no. 3–4, p. 82.
Sumsk district, Kharkov, Russia.

37. SCIURUS VULGARIS OGNEVI, Migulin

1928. Prot. Plant Ukraine, no. 3–4, p. 84.
Rynski village, Bororski district, Kharkov govt., Russia.

38. SCIURUS VULGARIS ARCTICUS, Trouessart

1906. Bull. Mus. Hist. Nat. 6, p. 365.
Lena River, North Siberia.

39. SCIURUS VULGARIS ORIENTIS, Thomas

1906. Proc. Zool. Soc. London, 1905, ii, p. 345.
Aoyama, Hokkaido, Japan.

40. SCIURUS VULGARIS KALBINENSIS, Selewin

1935. Bull. Univ. Tachkent, 19, pp. 75–77.
Altai, west of Irtish.

41. SCIURUS VULGARIS ARGENTEUS, Kerr

1792. Anim. Kingd., p. 256.
Altai.
Sciurus vulgaris calotus, Hodgson, 1842, Calcutta Journ. Nat. Hist., ii, p. 221, "high regions of Central Asia," is currently regarded as unidentifiable.

42. SCIURUS LIS, Temminck

1842. Fauna Japonica, p. 45, pl. xii, figs. 1–4.
Central Japan.

Subgenus *Tenes*, Thomas

(Synonym: *Oreosciurus*, Ognev)

43. SCIURUS ANOMALUS ANOMALUS, Guldenstaedt

1785. Schreber Säugth., IV, p. 781.
Sabeka, 25 kms. south-west of Kutais, Georgia, Caucasus.
Synonym: *caucasicus*, Pallas, 1811, Zoogeogr., I, p. 186.
russatus, Wagner, 1842, Schreber's Säugth. Suppl., III, p. 155.
historicus, Gray, 1867, Ann. Mag. Nat. Hist., 3, XX, p. 273.

44. SCIURUS ANOMALUS PALLESCENS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 285.
Asia Minor.

45. SCIURUS ANOMALUS FULVUS, Blanford

1875. Ann. Mag. Nat. Hist. 4, XVI, p. 311.
Shiraz, Persia.

46. SCIURUS ANOMALUS SYRIACUS, Ehrenberg

1829. Symp. Phys., I, pl. 8.
Lebanon.
Ognev has also listed *persicus* (Erxleben, Syst. Regn. Anim. 1, p. 417, 1777) as a valid form, but there is reason to believe that this name was based on a Dormouse, *Glis glis*.

Subgenus *Neosciurus*, Trouessart

(Synonym: *Baiosciurus*, Nelson.
Echinosciurus, Trouessart.)

carolinensis Group

(Revised by Bangs, Proc. Biol. Soc. Washington, X, pp. 153–159, 1896.)

47. SCIURUS CAROLINENSIS CAROLINENSIS, Gmelin

1788. Syst. Nat., 1, p. 148.
"Carolina."
Synonym: *migratorius*, Audubon & Bachman, 1854, Quad. I, p. 265.
cinereus, Schreber, Säugth., IV, p. 766, 1792.
hiemalis, Ord, 1815, Guth. Geog., II, p. 292.

48. SCIURUS CAROLINENSIS EXTIMUS, Bangs

1896. Proc. Biol. Soc. Washington, X, p. 158.
Miami, Florida. (Dade County.)

49. SCIURUS CAROLINENSIS FULIGINOSUS, Bachman

1838. Proc. Zool. Soc. London, p. 97.
Near New Orleans, Louisiana.

50. SCIURUS CAROLINENSIS HYPOPHAEUS, Merriam

1886. Science, VII, p. 351.
Elk River, Sherburne County, Minnesota.

51. SCIURUS CAROLINENSIS LEUCOTIS, Gapper

1830. Zool. Journ., V, p. 206.
Between York and Lake Simcoe, Ontario, Canada.

aureogaster Group

52. SCIURUS AUREOGASTER AUREOGASTER, F. Cuvier

1829. Hist. Nat. Mamm. 6, livr. 59, pl. with text (Binomial published at end of work only, vol. 7, tabl. gén. et. méth., p. 4, 1842).
"California," really Eastern Mexico.
Synonym: *rufiventer*, Lichtenstein, 1830, (1827) Ab. K. Akad. Wiss. Berlin, 116.
leucogaster, Cuvier, Suppl. H.N. Buffon, 1, p. 300, 1831.
mustelinus, Audubon & Bachman, 1841, Proc. Acad. Nat. Sci. Philadelphia, p. 100.
ferrugineiventris, Audubon & Bachman, same reference, p. 101.
chrysogaster, Giebel, Säugeth., p. 650, 1855.
hypoxanthus, Geoffroy, Voy. de la Venus, Zool., p. 158, 1855.

53. SCIURUS AUREOGASTER HYPOPYRRHUS, Wagler

1831. Isis, p. 510.
Mexico, probably in Vera Cruz.
Synonym: *morio*, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 424, 1867.
maurus, Gray, same reference, p. 425.
nigrescens, Bennett, Proc. Zool. Soc., London, p. 41, 1833.

54. SCIURUS AUREOGASTER FRUMENTOR, Nelson

1898. Proc. Biol. Soc. Washington, XII, p. 154.
Las Vegas, Vera Cruz, Mexico.

55. SCIURUS POLIOPUS POLIOPUS, Fitzinger

1867. Sitz-Ber. Akad. Wiss. Wien. Math. Nat. Cl., LV, Abth. 1, p. 478.
Cerro San Felipe, Oaxaca, Mexico.
Synonym: *wagneri*, Allen, 1898, Bull. Amer. Mus. Nat. Hist., X, p. 453.
albipes, Wagner, 1837, Abh. math.-phys. Cl. k. bayer. Akad. Wiss. München, II, p. 501, not of Kerr.
leucops, Gray, Ann. Mag. Nat. Hist., 3, XX, p. 427, 1867.

56. SCIURUS POLIOPUS HERNANDEZI, Nelson

1898. Science, N.S., VIII, p. 783.
Mountains 15 miles west of Oaxaca, Mexico.
Synonym: *quercinus*, Nelson, 1898, Proc. Biol. Soc. Washington, XII, p. 150, not of Erxleben.

57. SCIURUS POLIOPUS PEREGRINATOR, Nelson

1904. Proc. Biol. Soc. Washington, XVII, p. 149.
Piaxtla, Puebla, Mexico.

58. SCIURUS POLIOPUS NEMORALIS, Nelson

1898. Proc. Biol. Soc. Washington, XII, p. 151.
Patzcuaro, Michoacan, Mexico.

59. SCIURUS POLIOPUS SENEX, Nelson

1904. Proc. Biol. Soc. Washington, XVII, p. 148.
La Salada, S.-E. Michoacan, 40 miles south of Uruapan, Mexico.

60. SCIURUS POLIOPUS CERVICALIS, Allen
1890. Bull. Amer. Mus. Nat. Hist., III, p. 183.
Hacienda San Marcos, Jalisco, Mexico.

61. SCIURUS POLIOPUS COLIMENSIS, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 152.
Hacienda Magdalena, Colima, Mexico.

62. SCIURUS POLIOPUS EFFUGIUS, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 152.
Mountains west of Chilpancingo, Guerrero, Mexico.

63. SCIURUS POLIOPUS TEPICANUS, Allen
1906. Bull. Amer. Mus. Nat. Hist. XXII, p. 243.
Rancho Palo Amarillo, Nayarit, Mexico.

64. SCIURUS NELSONI NELSONI, Merriam
1893. Proc. Biol. Soc. Washington, VIII, p. 144.
Huitzilac, Morelos, Mexico.

65. SCIURUS NELSONI HIRTUS, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 153.
Tochimilco, Puebla, Mexico.

66. SCIURUS COLLIAEI COLLIAEI, Richardson
1839. Voyage H.M.S. Blossom, Zool., p. 8.
San Blas, Nayarit, Mexico.
Synonym: *griseocaudatus*, Gray, 1844, Zool. Sulphur, 1, p. 34.

67. SCIURUS COLLIAEI NUCHALIS, Nelson
1899. Proc. Washington Acad. Sci. I, p. 59.
Manzanillo, Colima, Mexico.

68. SCIURUS SINALOENSIS, Nelson
1899. Proc. Washington Acad. Sci. I, p. 60.
Mazatlan, Sinaloa, Mexico.

69. SCIURUS TRUEI, Nelson
1899. Proc. Washington Acad. Sci. I, p. 61.
Camoa, Rio Mayo, Sonora, Mexico.

70. SCIURUS SOCIALIS SOCIALIS, Wagner
1837. Abh. math.-phys. Cl. k. bayer. Akad. Wiss. München, II, p. 504.
Near Tehuantepec City, Oaxaca, Mexico.

71. SCIURUS SOCIALIS COCOS, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 155.
Acapulco, Guerrero, Mexico.

72. SCIURUS SOCIALIS LITTORALIS, Nelson
1907. Proc. Biol. Soc. Washington, XX, p. 87.
Puerta Angel, Oaxaca, Mexico.

73. SCIURUS GRISEOFLAVUS GRISEOFLAVUS, Gray
1867. Ann. Mag. Nat. Hist. 3, XX, p. 427.
Guatemala.

74. SCIURUS GRISEOFLAVUS CHIAPENSIS, Nelson
1899. Proc. Washington Acad. Sci., I, p. 69.
San Cristobal, Chiapas, Mexico.

75. SCIURUS YUCATANENSIS YUCATANENSIS, Allen
1877. Monogr. N. Amer. Rodents, p. 705.
Merida, Yucatan, Mexico.

76. SCIURUS YUCATANENSIS BALIOLUS, Nelson
1901. Proc. Biol. Soc. Washington, XIV, p. 131.
Apazote, Campeche, Mexico.

77. SCIURUS YUCATANENSIS PHAEOPUS, Goodwin
1932. Amer. Mus. Nov. 574, p. 1.
Guatemala, Secanquim, district of Alta Verapaz.

78. SCIURUS VARIEGATOIDES VARIEGATOIDES, Ogilby
1839. Proc. Zool. Soc. London, p. 117.
San Salvador, Central America.
Synonym: *pyladei*, Lesson, 1842, Rev. Zool. Paris, V, p. 130.
(For a revision of *S. variegatoides* and its subspecies see Harris, 1937, Misc. Publ. 38, Univ. Michigan.)

79. SCIURUS VARIEGATOIDES UNDERWOODI, Goldman
1932. Journ. Washington, Acad. Sci. XXII, p. 275.
Honduras; Monte Redondo, 30 miles north-west of Tegucigalpa.

80. SCIURUS VARIEGATOIDES GOLDMANI, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 149.
Huehuetan, Chiapas, Mexico.

81. SCIURUS VARIEGATOIDES BANGSI, Dickey
1928. Proc. Biol. Soc. Washington, XLI, p. 7.
Barra de Santiago, Dept. Ahuachapan, San Salvador.

82. SCIURUS VARIEGATOIDES BOOTHIAE, Gray
1843. List. Spec. Mamm. Brit. Mus., p. 139.
Honduras.
Synonym: *fuscovariegatus*, Schinz, 1845, Syn. Mamm. 11, p. 15.
(?) *boothiae annalium*, Thomas, 1905, Ann. Mag. Nat. Hist., 7, XVI, p. 309. Honduras.

83. SCIURUS VARIEGATOIDES BELTI, Nelson
1899. Proc. Washington, Acad. Sci. I, p. 78.
Escondido River, 50 miles above Bluefields, Nicaragua.

84. SCIURUS VARIEGATOIDES ADOLPHEI, Lesson
1842. Nouv. Tabl. Regn. Anim. Mamm., p. 112.
Realejo, Nicaragua.

85. SCIURUS VARIEGATOIDES MANAGUENSIS, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 150.
Managua River, Guatemala.

86. SCIURUS VARIEGATOIDES AUSTINI, Harris
1933. Occ. Pap. Mus. Zool. Univ. Michigan, 266, p. 1.
Costa Rica: Las Agujas, Prov. of Puntarenas.

87. SCIURUS VARIEGATOIDES ATRIRUFUS, Harris
1930. Occ. Pap. Mus. Zool. Univ. Michigan, 219, p. 2.
Costa Rica: Tambor, Nicoya Peninsula.

88. SCIURUS VARIEGATOIDES DORSALIS, Gray
1848. Proc. Zool. Soc. London, p. 138.
"Caracas, Venezuela" (erroneous); Liberia, Costa Rica.
Synonym: *intermedius*, Gray, 1867, Ann. Mag. Nat. Hist. 3, XX, p. 421, and *nicoyana*, Gray, same reference, p. 423.

89. SCIURUS VARIEGATOIDES RIGIDUS, Peters
1863. Monatsber. k. preuss. Akad. Berlin, p. 652.
San José, Costa Rica.

90. SCIURUS VARIEGATOIDES THOMASI, Nelson
1899. Proc. Washington Acad. Sci. I, p. 71.
Talamanca, Costa Rica.

91. SCIURUS VARIEGATOIDES MELANIA, Gray
1867. Ann. Mag. Nat. Hist. 3, XX, p. 425.
Point Berica, Costa Rica.

92. SCIURUS VARIEGATOIDES HELVEOLUS, Goldman
1912. Smiths. Misc. Coll. LVI, no. 36, p. 3.
Corozal, Canal zone, Panama.

deppei Group

93. SCIURUS DEPPEI DEPPEI, Peters
1863. Monatsber. k. preuss Akad. Wiss. Berlin, p. 654.
Bapantla, Vera Cruz, Mexico.
Synonym: *tephrogaster*, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 431, 1867.
taeniurus, Gray, same reference.

94. SCIURUS DEPPEI MATAGALPAE, Allen
1908. Bull. Amer. Mus. Nat. Hist. XXIV, p. 660.
San Rafael del Norte, Nicaragua.

95. SCIURUS DEPPEI VIVAX, Nelson
1901. Proc. Biol. Soc. Washington, XIV, p. 131.
Apazote, Campeche, Mexico.

96. SCIURUS NEGLIGENS, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 147.
Alta Mira, Tamaulipas, Mexico.

Subgenus *Hesperosciurus*, Nelson

97. SCIURUS GRISEUS GRISEUS, Ord
1818. Journ. de Phys., LXXXVII, p. 152.
The Dalles, Wasco County, Oregon.
Synonym: *fossor*, Peale, 1848, Mamm. Birds. U.S. Explor. Exp., p. 55.
heermanni, Leconte, Proc. Acad. Nat. Sci. Philadelphia, p. 149, 1852.
leporinus, Henshaw, Ann. Rep. Engin., 1876, p. 310.

98. SCIURUS GRISEUS ANTHONYI, Mearns
1897. Proc. U.S. Nat. Mus. XX, p. 501, 1898.
Campbell's Ranch, Laguna Mountains, San Diego County, California.

99. SCIURUS GRISEUS NIGRIPES, Bryant
1889. Proc. Calif. Acad. Sci. 2, II, p. 25.
Coast region of San Mateo County, California.

Subgenus *Otosciurus*, Nelson

100. SCIURUS ABERTI ABERTI, Woodhouse
1853. Proc. Acad. Nat. Sci. Philadelphia, VI, 1852, p. 220.
San Francisco Mountain, Coconino County, Arizona.
Synonym: *castanotus*, Baird, 1855, Proc. Acad. Nat. Sci. Philadelphia, VII, p. 332. Copper mines, New Mexico.

101 SCIURUS ABERTI BARBERI, Allen

1904. Bull. Amer. Mus. Nat. Hist. XX, p. 207.
Colonia Garcia, Chihuahua, Mexico.

102. SCIURUS ABERTI FERREUS, True

1900. Proc. Biol. Soc. Washington, XIII, p. 183.
Loveland, Larimer County, Colorado.
Synonym: *concolor*, True, 1894, Diagnoses of new N. Amer. Mamm. p. 1. Reprinted Proc. U.S. Nat. Mus. XVII, p. 241. (Preoccupied.)

103. SCIURUS ABERTI MIMUS, Merriam

1904. Proc. Biol. Soc. Washington, XVII, p. 130.
Hall Peak, Cimarron Mountains, Mora County, New Mexico.

104. SCIURUS ABERTI PHAEURUS, Allen

1904. Bull. Amer. Mus. Nat. Hist., XX, p. 205.
La Cienega, N.-W. Durango, Mexico.

105. SCIURUS ABERTI CHUSCENSIS, Goldman

1931. Proc. Biol. Soc. Washington, XLIV, p. 133.
N.-W. New Mexico: Chusca Mountains.

106. SCIURUS KAIBABENSIS, Merriam

1904. Proc. Biol. Soc. Washington, XVII, p. 129.
Bright Angel Creek, Kaibab Plateau, north side of Grand Canyon of Colorado, Coconino Co., Arizona.

107. SCIURUS DURANGI, Thomas

1893. Ann. Mag. Nat. Hist. 6, XI, p. 50.
Ciudad Ranch, 100 miles west of Durango City, Durango, Mexico.

Subgenus *Parasciurus*, Trouessart

(Synonym: *Araeosciurus*, Nelson.)

108. SCIURUS NIGER NIGER, Linnaeus

1758. Syst. Nat., Ed. 10, I, p. 64.
South Carolina.
Synonym: *vulpinus*, Gmelin, 1788, Gm. Syst. Nat. 1, p. 147

109. SCIURUS NIGER AVICENNIA, Howell

1919. Journ. Mamm. Baltimore, 1, p. 37.
Everglade, Lee County, Florida.

110. SCIURUS NIGER TEXIANUS, Bachman

1838. Proc. Zool. Soc. London, p. 86.
Coast of Louisiana or Mississippi.

111. SCIURUS NIGER NEGLECTUS, Gray

1867 Ann. Mag. Nat. Hist. 3, XX, p. 425.
Wilmington, Delaware (Newcastle County).
Synonym: *cinereus*, True, Proc. U.S. Nat. Mus. VII, p. 595. (1884).
vicinus, Bangs, 1896, Proc. Biol. Soc. Washington, X, p. 150. (West Virginia.)

112. SCIURUS NIGER BRYANTI, Bailey

1920. Bailey Mus. & Libr. Nat. Hist. Newport News, Va. Bull. 1, p. 1.
Dorchester County, Maryland.

113. SCIURUS NIGER RUFIVENTER, Geoffroy

1803. Cat. Mamm. Mus. Nat. Hist. Paris, p. 176.
Mississippi Valley.
Synonym: *ludovicianus*, Custis, 1806, Burtons Med. & Phys. Journ. 2, pt. 2, p. 47.
ruber, Rafinesque, 1820, Ann. of Nat. p. 4.
macroura, Say, Longs Exp. Rocky Mtns. 1, p. 115, 1823.
magnicaudatus, Harlan, Faun. Amer. p. 178, 1825.
(?) *subauratus*, Bachman, Proc. Zool. Soc. London, 1838, p. 87.
(?) *audubonii*, Bachman, Proc. Zool. Soc, London, 1838, p. 97.
rubicaudatus, Aud. & Bach. Quadr. N. America II, p. 30, 1851.
sayii, Aud. & Bach. Quadr. N. America II, p. 274, 1851.
atroventris, Engelmann, Trans. Ac. Sci. St. Louis, I, p. 329, 1859.

114. SCIURUS NIGER LIMITIS, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 331.
Devil's River, Valverde County, Texas.

115. SCIURUS OCULATUS OCULATUS, Peters

1863. Monatsber. k. Akad. Wiss. Berlin, p. 653.
Mexico, probably near Las Vegas, Vera Cruz.
Synonym: *niger melanotus*, Thomas, 1890, Proc. Zool. Soc. London, p. 73. Las Vegas, Vera Cruz, Mexico.
capistratus, Lichtenstein, Ab. Akad. k. Wiss. Berlin, 116, 1830 (1827). (Preoccupied.)

116. SCIURUS OCULATUS TOLUCAE, Nelson

1898. Proc. Biol. Soc. Washington, XII, p. 148.
North slope of Volcano of Toluca, State of Mexico, Mexico.

117. SCIURUS ALLENI, Nelson

1898. Proc. Biol. Soc. Washington, XII, p. 147.
Monterey, Nuevo Leon, Mexico.

118. SCIURUS NAYARITENSIS, Allen

1890. Bull. Amer. Mus. Nat. Hist., II, p. vii, footnote.
Sierra Valparaiso, Zacatecas, Mexico.
Synonym: *alstoni*, Allen, 1889, Bull. Amer. Mus. Nat. Hist. II, p. 167. (Not of Anderson, 1878.)

119. SCIURUS APACHE, Allen

1893. Bull. Amer. Mus. Nat. Hist. V, p. 29.
N.-W. Chihuahua, Mexico.

120. SCIURUS CHIRICAHUAE, Goldman

1933. Proc. Biol. Soc. Washington, XLVI, p. 71.
Chiricahua Mountains, Cochise County, Arizona.

121. SCIURUS ARIZONENSIS ARIZONENSIS, Coues

1867. Amer. Nat. I, p. 357.
Fort Whipple, Yavapai County, Arizona.

122. SCIURUS ARIZONENSIS HUACHUCA, Allen

1894. Bull. Amer. Mus. Nat. Hist. VI, p. 349.
Huachuca Mountains, Southern Arizona.

123. SCIURUS ARIZONENSIS CATALINAE, Doutt
1931. Ann. Carn. Mus. 20. p. 271.
Santa Catalina Mountains, Arizona.

Subgenus *Guerlinguetus*, Gray

(Synonym: *Mesosciurus*, Allen.
Histriosciurus, Allen.
Macroxus, Cuvier.
Simosciurus, Allen.
Leptosciurus, Allen.)

hoffmani Group

124. SCIURUS HOFFMANI HOFFMANI, Peters
1863. Monatsber. k. Akad. Wiss. Berlin, p. 654.
Costa Rica.
Synonym: *xanthotis*, Gray, 1867, Ann. Mag. Nat. Hist. 3, XX, p. 429.
rufoniger, True, Proc. U.S. Nat. Mus, 1884, VII, p. 595.

125. SCIURUS HOFFMANI CHIRIQUENSIS, Bangs
1902. Bull. Comp. Zool. XXXIX, no. 2, p. 22.
Divala, Chiriqui, Panama.

126. SCIURUS HOFFMANI MANAVI, Allen
1914. Bull. Amer. Mus. Nat. Hist. XXXIII, p. 589.
Manavi, Rio de Oro, Ecuador.

127. SCIURUS HOFFMANI QUINDIANUS, Allen
1914. Bull. Amer. Mus. Nat. Hist. XXXIII, p. 587.
Rio Frio, Central Andes, Colombia.

128. SCIURUS HOFFMANI HYPORRHODUS, Gray
1867. Ann. Mag. Nat. Hist. 3, XX, p. 419.
Bogota, Colombia.

129. SCIURUS HOFFMANI SODERSTROMI, Stone
1914. Proc. Acad. Sci. Philadelphia, LXVI, p. 14.
Ecuador.

130. SCIURUS MIRAVALLENSIS, Harris
1931. Occ. Pap. Zool. Mus. Univ. Michigan, 227, p. 1.
Volcan de Miravalles, Costa Rica.

131. SCIURUS RICHMONDI, Nelson
1898. Proc. Biol. Soc. Washington, XII, p. 146.
Escondido River, 50 miles above Bluefields, Nicaragua.

132. SCIURUS GRISEOGENA GRISEOGENA, Gray
1867. Ann. Mag. Nat. Hist. 3, XX, p. 429.
Venezuela.
Synonym: *klagesi*, Thomas, 1914, Ann. Mag. Nat. Hist. 8, XIV, p. 240.
Near Caracas, Venezuela.

133. SCIURUS GRISEOGENA MERIDENSIS, Thomas
1901. Ann. Mag. Nat. Hist. 7, VII, p. 192.
Escorial, Sierra de Merida, Venezuela.
Synonym: *tamae*, Osgood, 1912, Field Mus. Nat. Hist. Zool. Ser. X, no. 5, p. 48. Paramo de Tama, Colombia-Venezuela boundary.

134. SCIURUS CHAPMANI CHAPMANI, Allen
1899. Bull. Amer. Mus. Nat. Hist. XII, p. 16.
Caparo, Trinidad.
Synonym: *aestuans quebradensis*, Allen, 1899, Bull. Amer. Mus. Nat. Hist. XII, p. 217. Quebrada Secca, Venezuela.

135. SCIURUS CHAPMANI TOBAGENSIS, Osgood
1910. Field Mus. Nat. Hist. Zool. Ser. X, no. 4, p. 27.
Tobago, West Indies.

136. SCIURUS NESAEUS, G. Allen
1902. Proc. Biol. Soc. Washington, XV, p. 93.
Margarita Island, Venezuela.

137. SCIURUS GRISEIMEMBRA, Allen
1914. Bull. Amer. Mus. Nat. Hist. XXXIII, p. 589.
Buenavista, Eastern Andes, Colombia.

138. SCIURUS CANDELENSIS CANDELENSIS, Allen
1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 590.
Huila, Colombia.

139. SCIURUS CANDELENSIS SUMACO, Cabrera
1917. Trab. Mus. Nac. Ci. Nat. 31, p. 51.
San José, East Ecuador.

140. SCIURUS ARGENTINUS, Thomas
1921. Ann. Mag. Nat. Hist. 9, VIII, p. 609.
Jujuy, North Argentina.

141. SCIURUS FERMINAE, Cabrera
1917. Trab. Mus. Nac. Ci. Nat. Madrid, 31, p. 49.
Bueza, East Ecuador.

142. SCIURUS GERRARDI GERRARDI, Gray
1861. Proc. Zool. Soc. London, p. 92, pl. XVI.
"New Grenada," probably Medellin, Colombia.
Synonym: *variabilis*, Alston, 1878, Proc. Zool. Soc. London, p. 665, not of Geoffroy.

143. SCIURUS GERRARDI LEONIS, Lawrence
1933. Journ. Mamm. Baltimore, 14, p. 369.
Colombia.
Synonym: *milleri*, Allen, 1912, Bull. Amer. Mus. Nat. Hist. XXXI, p. 91. (Preoccupied.) Cocal, W. Colombia.

144. SCIURUS GERRARDI INCONSTANS, Osgood
1921. Journ. Mamm. Baltimore, 2, p. 40.
Ecuador.
Synonym: *versicolor*, Thomas, 1900, Ann. Mag. Nat. Hist. 7, VI, p. 385. (Preoccupied.) Cachabi, Prov. Esmeraldas, N. Ecuador.

145. SCIURUS GERRARDI MORULUS, Bangs
1900. Proc. New England Zool. Club, II, p. 43.
Loma del Leon, Panama.

146. SCIURUS GERRARDI CHOCO, Goldman
1913. Smiths. Misc. Coll. LX, no. 22, p. 4.
Cana, Pirri Mountains, Eastern Panama.

147. SCIURUS GERRARDI SALAQUENSIS, Allen
1914. Bull. Amer. Mus. Nat. Hist. XXXIII, p. 592.
Rio Salaqui, N.-W. Colombia.

148. SCIURUS GERRARDI ZULIAE, Osgood
1910. Field Mus. Nat. Hist. Zool. Ser. X, 4, p. 26.
Zulia, Venezuela.

149. SCIURUS GERRARDI CUCUTAE, Allen
1914. Bull. Amer. Mus. Nat. Hist. XXXIII, p. 592.
El Guayabal, Colombia.

150. SCIURUS GERRARDI BAUDENSIS, Allen
1915. Bull. Amer. Mus. Nat. Hist. XXXIV, p. 308.
Baudo, West Colombia.

151. SCIURUS GERRARDI VALDIVIAE, Allen
1915. Bull. Amer. Mus. Nat. Hist., XXXIV, p. 309.
Puerto Valdivia, Colombia.

152. SCIURUS SPLENDIDUS SPLENDIDUS, Gray
1842. Ann. Mag. Nat. Hist. 1, X, p. 263.
Santa Marta, Colombia.
Synonym: *saltuensis magdalenae*, Allen, 1914, Bull. Amer. Mus. Nat. Hist. XXXIII, p. 593. Rio Magdalena, Colombia.

153. SCIURUS SPLENDIDUS SALTUENSIS, Bangs
1898. Proc. Biol. Soc. Washington, XII, p. 185.
Santa Marta, Colombia.

154. SCIURUS SPLENDIDUS BONDAE, Allen
1899. Bull. Amer. Mus. Nat. Hist. XII, p. 213.
Bonda, Santa Marta, Colombia.

155. SCIURUS PYRRHINUS, Thomas
1898. Ann. Mag. Nat. Hist. 7, II, p. 265.
Vitoc, Peru.

aestuans Group

156. SCIURUS AESTUANS AESTUANS, Linnaeus
1766. Syst. Nat. Ed. 12, 1, p. 88.
Surinam.
Synonym: *kuhlii*, Gray,[1] 1867, Ann. Mag. Nat. Hist. 3, XX, p. 433.
guianensis, Peters, 1863, Monatsber. Akad. Wiss. Berlin, p. 655.

157. SCIURUS AESTUANS GILVIGULARIS, Wagner
1843. Archiv. f. Naturg. II, p. 43.
Borba, Brazil, near mouth of Rio Madeira.

158. SCIURUS AESTUANS MACCONNELLI, Thomas
1901. Ann. Mag. Nat. Hist. 7, VIII, p. 148, footnote.
Mt. Roraima, British Guiana.

159. SCIURUS AESTUANS QUELCHI, Thomas
1901. Ann. Mag. Nat. Hist. 7, VIII, p. 147.
Kanuku Mountains, British Guiana.

160. SCIURUS AESTUANS VENUSTUS, Allen
1915. Bull. Amer. Mus. Nat. Hist., XXXIV, p. 260.
Rio Cunacunuma, near Mt. Duida, Venezuela.

[1] See note on p. 318.

161. SCIURUS AESTUANS GARBEI, Pinto
1931. Rev. Mus. Paulista, XVII, p. 294.
Esperito Santo, Bahia, Brazil.

162. SCIURUS ALPHONSEI ALPHONSEI, Thomas
1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 442.
Pernambuco, Brazil.
Synonym: *roberti*, Thomas, 1903, Ann. Mag. Nat. Hist. 7, XII, p. 463. (Not of Bonhote). S. Lourenço, near Pernambuco.

163. SCIURUS ALPHONSEI PARAENSIS, Goeldi
1904. Bol. Mus. Goeldi, IV, p. 70.
Para, Brazil.

164. SCIURUS INGRAMI, Thomas
1901. Ann. Mag. Nat. Hist. 7, VII, p. 368.
Tunnel, Southern Minas Geraes, Brazil.

stramineus Group

165. SCIURUS STRAMINEUS STRAMINEUS, Eydoux & Souleyet
1841. Voy. Bonite, Zool. I, p. 38, pl. IX.
Omatope, Peru.
Synonym: *fraseri*, Gray, 1867, Ann. Mag. Nat. Hist. 3, XX, p. 430. Ecuador.

166. SCIURUS STRAMINEUS NEBOUXI, Geoffroy
1855. Voy. de la Venus, Zool. p. 163, pl. xii.
Near Payta, Peru.

167. SCIURUS STRAMINEUS GUAYANUS, Thomas
1900. Ann. Mag. Nat. Hist. 7, V, p. 150.
Balzar Mountains, West Ecuador.

168. SCIURUS STRAMINEUS ZARUMAE, Allen
1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 597.
Zaruma, S.-W. Ecuador.

pucherani Group

169. SCIURUS PUCHERANI PUCHERANI, Fitzinger
1867. Sitz.-Ber. Akad. Wiss. Wien Math. Nat. Cl. LV, Abth. 1, p. 487.
Vicinity of Bogota, Colombia.
Synonym: *rufoniger*, Pucheran, 1845, Rev. Zool. VIII, p. 336.
chrysuros, Pucheran, same reference, p. 337.

170. SCIURUS PUCHERANI MEDELLINENSIS, Gray
1872. Ann. Mag. Nat. Hist. 4, X, p. 408.
Medellin, Colombia.

171. SCIURUS PUCHERANI CAUCENSIS, Nelson
1899. Bull. Amer. Mus. Nat. Hist. XII, p. 79.
San Antonio, Western Andes, Colombia.

172. SCIURUS PUCHERANI SALENTENSIS, Allen
1914. Bull. Amer. Mus. Nat. Hist. XXXIII, p. 587.
Near Salento, Central Andes, Colombia.

173. SCIURUS IGNITUS IGNITUS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 429.
Yungas, upper Rio Beni, Bolivia.
Synonym: *ochrescens*, Thomas, 1914, Ann Mag. Nat. Hist. 8, XIII, p. 362. Upper Beni River, Bolivia.
cuscinus, Thomas, 1899, Ann. Mag. Nat. Hist.7, III, p. 40. Ocabamba, Cuzco, Peru.

174. SCIURUS IGNITUS IRRORATUS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 431.
Upper Rio Ucayali, Peru.

175. SCIURUS BOLIVIENSIS, Osgood

1921. Journ. Mamm. Baltimore, 2, p. 39.
Santa Cruz de la Sierra, Bolivia.
Synonym: *leucogaster*, Gray, 1867, Ann. Mag. Nat. Hist. 3, XX, p. 430. (Preoccupied.)

Subgenus *Notosciurus*, Allen

176. SCIURUS RHOADSI, Allen

1914. Bull. Amer. Mus. Nat. Hist. XXXIII, p. 585.
Pagma Forest, Chunchi, Ecuador.

Subgenus *Hadrosciurus*, Allen

(Synonym: *Urosciurus*, Allen)

177. SCIURUS FLAMMIFER, Thomas

1904. Ann. Mag. Nat. Hist. 7, XIV, p. 33.
Caura district, Middle Orinoco, Venezuela.

178. SCIURUS TRICOLOR, Poeppig

1844. Tschudi Fauna Peruana, I, Therologie, p. 156, pl. xi.
North-east Peru.
Synonym: (?) *fumigatus*, Gray, 1867, Ann. Mag. Nat. Hist., 3, XX, p. 428.
brunneoniger, Gray, same reference. p. 429.

179. SCIURUS NIGRATUS, Pinto

1931. Rev. Mus. Paulisto, XVII, p. 309.
Rio Jurua, Amazon.

180. SCIURUS DUIDA, Allen

1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 594.
Rio Cunucunuma, south of Mt. Duida, Venezuela.

181. SCIURUS IGNIVENTRIS IGNIVENTRIS, Wagner

1842. Wiegmanns Arch. f. Naturgesch. I, p. 360.
Upper Rio Negro, Brazil.
Synonym: *morio*, Wagner, Abh. Math. Phys. Cl. K. B. Akad. Wiss. München, V, 1850, p. 275.

182. SCIURUS IGNIVENTRIS TAEDIFER, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 487.
50 miles south-east of Bogota, Colombia.

183. SCIURUS IGNIVENTRIS COCALIS, Thomas
1900. Ann. Mag. Nat. Hist. 7, VI, p. 138.
Upper Rio Napo, Ecuador.

184. SCIURUS IGNIVENTRIS ZAMORAE, Allen
1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 594.
Zamora, Ecuador.

185. SCIURUS IGNIVENTRIS FULMINATUS, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 637.
Manacapuru, Lower Rio Negro, Brazil.

186. SCIURUS PYRRHONOTUS PYRRHONOTUS, Wagner
1842. Wiegmanns Archiv. f. Naturgesch. 1, p. 360.
Borba, near mouth of Rio Madeira, Brazil.

187. SCIURUS PYRRHONOTUS TAPARIUS, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 635.
Santarem, Lower Amazons.

188. SCIURUS PYRRHONOTUS CASTUS, Thomas
1903. Ann. Mag. Nat. Hist. 7, XI, p. 488.
Chimate, Upper Rio Beni, Bolivia.

189. SCIURUS PYRRHONOTUS JURALIS, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 636.
Jurua River, Upper Amazons.

190. SCIURUS LANGSDORFFI LANGSDORFFI, Brandt
1835. Mem. Acad. Sci. St. Petersb. 6, Math. Phys. Nat. III, 2, p. 425, pl. xi.
Cuyaba, Matto Grosso, Brazil.

191. SCIURUS LANGSDORFFI URUCUMUS, Allen
1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 595.
Urucum, Rio Paraguay, Matto Grosso.

192. SCIURUS LANGSDORFFI STEINBACHI, Allen
1914. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 596.
Santa Cruz de la Sierra, Bolivia.

Genus 7. TAMIASCIURUS, Trouessart

1880. TAMIASCIURUS, Trouessart, le Naturaliste, 2, no. 37, p. 292.

TYPE SPECIES.—*Sciurus hudsonicus*, Erxleben.

RANGE.—North America: Canada and U.S.A.; forms named from Alaska, Hudson Bay, British Columbia, Mackenzie, Washington, Oregon, Idaho, Wyoming, South Dakota, Minnesota, California, Lower California, Arizona, New Mexico, North Carolina, Maine, Connecticut.

NUMBER OF FORMS.—Twenty-seven.

CHARACTERS.—The generic difference between this and *Sciurus* is the complete suppression of the baculum (Pocock, Tullberg, Howell), though whether all the forms have been examined in this respect I do not know.

It appears, from Tullberg's notes on genera throughout the whole Order, to be a sufficiently rare character in Rodents on which to warrant the retention of generic names.

Skull characters much like normal *Sciurus*; the parietal ridges may join; bullae relatively more enlarged than is usual in *Sciurus*; braincase not strongly deflected posteriorly; palate extending slightly behind toothrows. Cheekteeth near *Sciurus vulgaris* in type; P.3 may be present or absent; in all skulls but two examined in the British Museum (a very small series) it is absent; Allen in his revision of the genus, 1898, remarks that it is absent in about 30 per cent of those examined.

External characters rather reminiscent of *Sciurus vulgaris*; tail relatively short (40 per cent total length, Allen); ears tufted seasonally; sole hairy in most skins seen, also evidently a seasonal character. Digits normal (arboreal type).

The complete or almost complete suppression of the baculum is also found in the African genus *Heliosciurus*.

Forms seen: *albolimbatus*, *douglasi*, *fremonti*, *hudsonicus*, *loquax*, *richardsoni*, *vancouverensis*.

The species and races were revised by Allen, Bull. Amer. Mus. Nat. Hist. XX, pp. 249–298, 1898.

List of Named Forms

1. TAMIASCIURUS HUDSONICUS HUDSONICUS, Erxleben

1777. Syst. Regn. Anim. 1, p. 416.
Hudson Strait.
Synonym: *rubrolineatus*, Desmarest, Mamm. II, p. 333, 1822.

2. TAMIASCIURUS HUDSONICUS GYMNICUS, Bangs

1899. Proc. New England Zool. Club, 1, p. 28.
Greenville, near Moosehead Lake, Maine. (Piscataquis County.)

3. TAMIASCIURUS HUDSONICUS LOQUAX, Bangs

1896. Proc. Biol. Soc. Washington, X, p. 161.
Liberty Hill, New London County, Connecticut.

4. TAMIASCIURUS HUDSONICUS MINNESOTA, Allen

1899. Amer. Nat. XXXIII, p. 640.
Fort Snelling, Hennepin County, Minnesota.

5. TAMIASCIURUS HUDSONICUS DAKOTENSIS, Allen

1894. Bull. Amer. Mus. Nat. Hist. VI, p. 325.
Squaw Creek, Black Hills, Custer County, South Dakota.

6. TAMIASCIURUS HUDSONICUS BAILEYI, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 261.
Bighorn Mountains, Washakie County, Wyoming.

7. TAMIASCIURUS HUDSONICUS VENTORUM, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 263.
South Pass City, Wind River Mountains, Fremont County, Wyoming.

8. TAMIASCIURUS HUDSONICUS RICHARDSONI, Bachman

1838. Proc. Zool. Soc. London, p. 100.
Head of Big Lost River, Fremont County, Idaho.

9. TAMIASCIURUS HUDSONICUS STREATORI, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 267.
Ducks, British Columbia, Canada.

10. TAMIASCIURUS HUDSONICUS VANCOUVERENSIS, Allen

1890. Bull. Amer. Mus. Nat. Hist. III, p. 165.
Duncan Station, Vancouver Island, British Columbia.

11. TAMIASCIURUS HUDSONICUS PICATUS, Swarth

1921. Journ. Mamm. Baltimore, 2, p. 92.
Kupreanof Island, S.-E. Alaska, 25 miles south of Kake Village, southern end of Keku Straits.

12. TAMIASCIURUS HUDSONICUS PETULANS, Osgood

1900. North Amer. Fauna, No. 19, p. 27.
Glacier, White Pass, Southern Alaska.

13. TAMIASCIURUS HUDSONICUS ABIETICOLA, Howell

1929. Journ. Mamm. Baltimore, 10, p. 75.
Highlands, N. Carolina.

14. TAMIASCIURUS HUDSONICUS COLUMBIENSIS, Howell

1936. Proc. Biol. Soc. Washington, XLIX, p. 135.
Raspberry Creek, about 30 miles south-east of Telegraph Creek, Northern British Columbia.

15. TAMIASCIURUS HUDSONICUS KENAIENSIS, Howell

1936. Proc. Biol. Soc. Washington, XLIX, p. 136.
Hope, Cook Inlet, Alaska.

16. TAMIASCIURUS HUDSONICUS PREBLIEI, Howell

1936. Proc. Biol. Soc. Washington, XLIX, p. 133.
Fort Simpson, Mackenzie, Canada.

17. TAMIASCIURUS REGALIS, Howell

1936. Occ. Pap. Mus. Univ. Mich. no. 338, p. 1.
Belle Isle, Isle Royale, Michigan.

18. TAMIASCIURUS DOUGLASII DOUGLASII, Bachman

1838. Proc. Zool. Soc. London, p. 99.
Near mouth of Columbia River.
Synonym: *belcheri*, Gray, Ann. Mag. Nat. Hist. 1842, p. 263.
suckleyi, Baird, Pr. A. Phil. 1855, p. 333.

19. TAMIASCIURUS DOUGLASII MOLLIPILOSUS, Audubon & Bachman

1841. Proc. Acad. Nat. Sci. Philadelphia, 1, p. 102.
Coast of Northern California.
Synonym: *orarius*, Bangs, 1897, Proc. Biol. Soc. Washington, XI, p. 281. Philo, Mendocino Co., California.

20. TAMIASCIURUS DOUGLASII CASCADENSIS, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 277.
Mount Hood, Oregon.
(According to Osgood, 1907, this will probably stand as *lanuginosus*, Bachman, 1838, Proc. Zool. Soc. London, p. 101. Hunter Island, British Columbia.)

21. TAMIASCIURUS DOUGLASII ALBOLIMBATUS, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 453.
Blue Canyon, Placer County, California.
Synonym: *californicus*, Allen, 1890, Bull. Amer. Mus. Nat. Hist. III, p. 165. (Not of Lesson.)

22. TAMIASCIURUS DOUGLASII MEARNSI, Townsend

1897. Proc. Biol. Soc. Washington, XI, p. 146.
San Pedro Martir Mountains, Lower California.

23. TAMIASCIURUS FREMONTI FREMONTI, Audubon & Bachman

1854. Quadr. N. Amer. 3, p. 237.
"Rocky Mountains," probably in Park region of Central Colorado.

24. TAMIASCIURUS FREMONTI NEOMEXICANUS, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 291.
Rayado Canyon, Colfax Co., New Mexico.

25. TAMIASCIURUS FREMONTI LYCHNUCHUS, Stone & Rehn

1903. Proc. Acad. Nat. Sci. Philadelphia, p. 18.
Forks of Ruidoso, Lincoln County, New Mexico.

26. TAMIASCIURUS FREMONTI MOGOLLONENSIS, Mearns

1890. Auk, vol. 7, p. 49. Bull. Amer. Mus. Nat. Hist. II, p. 277.
Quaking Asp Settlement, summit of Mogollon Mtns., Yavapai County, Arizona.

27. TAMIASCIURUS FREMONTI GRAHAMENSIS, Allen

1894. Bull. Amer. Mus. Nat. Hist. VI, p. 350.
Graham Mountains, Graham Co., Arizona.

Genus 8. CALLOSCIURUS, Gray

1867. CALLOSCIURUS, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 277.
1880. HETEROSCIURUS, Trouessart, le Naturaliste, 1, p. 290. (*Sciurus erythraeus*, Pallas.)
1915. TOMEUTES, Thomas, Ann. Mag. Nat. Hist. 8, XV, p. 385. (*Sciurus lokroides*, Hodgson.)
1906. TAMIOPS, Allen, Bull. Amer. Mus. Nat. Hist., XXII, p. 475. (*Sciurus maclellandi*, Horsfield.) Valid as a subgenus.

TYPE SPECIES.—*Sciurus rafflesii*, Vigors & Horsfield.

RANGE.—From Tibet (subgenus *Tamiops*), Chihli (subgenus *Tamiops*), Szechuan, China south of the Yangtsekiang; Hainan, Formosa; Bengal, Nepal, Sikkim, Assam, Burma, Siam, south through Malay region to Sumatra, Java, Borneo, Celebes and the Philippine Islands.

NUMBER OF FORMS.—Approximately three hundred and twenty. This genus is second in number of named forms to *Rattus* only in the Order.

CHARACTERS.—This genus was originally divided from *Sciurus* by Thomas on the structure of the baculum. I have already remarked that this seems usually a very questionable character on which to base generic names, particularly on account of the relatively few forms in which this character has been definitely verified. Thomas wrote: "All Indian and Malay species hitherto referred to *Sciurus* have bacula totally different from true *Sciurus*, and themselves are divisible into two types, with an essential community between the two." Exactly how many forms have been examined on this character I do not know, though some months ago I endeavoured to make a list of those I had come across which had been; there seems to be a constant wide distinction, as far as one reads, between those Squirrels currently included in this group and those currently referred to *Sciurus* which have been examined, in this character. Also there is a certain difference in the teeth, not altogether constant, yet noticeable in most of the leading species referred to this genus. M.3 in the lower jaw is very often noticeably elongated, particularly on the inner side; the anterointernal cusp in the lower teeth is as a rule very high; the subsidiary small cusps on the outer side of the upper molars are very frequently almost obsolete; the ridges of the upper molars are often higher and more definite in this group; there is often a tendency towards complexity due to the presence of extra small ridges and depressions on the crown; and the anterior extra ridge cutting off a depression in the lower teeth and running from the anteroexternal to the anterointernal cusp, characteristic of the genus *Heliosciurus*, is usually present and well marked; further, P.3 is strong as a rule, whereas in most members of *Sciurus* it is vestigial. Also often, but not always, in the present genus the upper incisors tend to become proödont.

The group is probably a natural one, though it is largely for convenience that it is here regarded as a full genus distinct from *Sciurus*. According to Thomas and Pocock, *Tamiops* which I refer to this genus as a subgenus, and the closely allied *Dremomys* both agree in bacular characters with the "*Tomeutes*" section of this genus. *Tomeutes* was erected as a genus by Thomas based solely on the formation of the baculum. I have already commented on the inadvisability on p. 266 of retaining it. In the present state of our knowledge I do not think it advisable to retain it even as a subgenus. Pocock, 1923, writing of *Callosciurus* and *Tomeutes*, states that "distinct as the bacula of these two kinds are, there are indications of intergradation between them," and "in *Tomeutes*, the variation is so great that it is impossible to affirm any character by which the baculum of *Tomeutes* can be distinguished from the bacula of *Dremomys*, *Rhinosciurus*, *Tamiops* and *Lariscus*." This author states that the species *vittatus* is a "*Tomeutes*." This species appears to me to be indistinguishable from *notatus*, or very questionably so, on cranial and external characters. To refer it to a distinct subgenus seems absurd (*notatus* is a "*Callosciurus*" on penial characters, so far as known). Furthermore there are forty-six named subspecies of *vittatus*. It would be interesting to examine the baculum in all of them. Probably it might be found that there is a complete intergradation in the species alone, though this is sheer surmise. Therefore until very much more work is done on this character in these Malay Squirrels, and bearing in mind that the baculum evidently varies from local race to local race in *Funambulus*, and in different species of *Ratufa*, all these Indo-Malayan Squirrels should be referred to a single genus only.

The skull is in the group not essentially different from *Sciurus*; in some species there is a tendency for the rostrum to be slightly elongated; the parietal ridges often do not join, but in others quite a sharp crest is formed by them (further notes on this character below). The cheekteeth are as described above; the large internal cusp of the upper molars may be seen in some specimens to be composed of three separate elements when cut. In *C. prevosti* and others the frontals appear unusually broad, and the postorbital processes are strongly developed. The zygomatic plate is usually much as in *Sciurus*, but in some species there is a tendency for it to be more prominently ridged, a little inclined to be narrowed above, and slanting upwards far forwards.

C. rubriventer, from Celebes, is the most distinct species seen; it appears to be larger than all others; the cheekteeth are (in the two skulls seen) rather worn, but simpler than is usual; the parietal ridges are very prominent, and unite to form a sagittal ridge more or less close behind the postorbital process, this ridge being much longer than in any other species seen. This form might perhaps form a distinct subgenus.

C. leucomus, from Celebes, appears in two skulls seen to be almost transitionary to the *Nannosciurus-Sciurillus* type of skull, with postorbital process situated unusually far backwards, and lachrymal situated farther back than is usual. Whether these characters are constant I do not know. A large collection of Celebes Squirrels would be most welcome, as it is curious that out of only about ten skulls examined from this island, every form seems aberrant and different from the more normal Indo-Malayan Squirrels; the species *murinus* I have had to refer to the genus *Sciurillus*, a member of the *Nannosciurus* section.

External characters as in normal Tree-squirrels; D.4 normally longer than D.3 in manus. The colour, as might be expected, varies enormously throughout the genus. In *S. tenuis*, and *S. jentinki* (small species), the tail is usually much narrowed. Prominent ear tufts are present in *leucomus*, *rubriventer* and *rosenbergi*.

TAMIOPS was proposed as a genus by Allen and has usually been accepted. The upper cheekteeth are, as often in *Callosciurus*, with the third outer cusp (which is present in *Sciurus*) absent or vestigial. This, though the genus was established mainly on this character, can hardly be regarded as of generic rank. P.3 is relatively large, as in *Callosciurus*. The lower cheekteeth resemble *Callosciurus*; M.3 is elongated to a degree, and the cusps are well marked. The skull is not abnormal. The size is small. Back with conspicuous black stripes (usually five in number, though these vary in development). Digits as in normal Tree-squirrels, with D.4 in the manus normally slightly longer than D.3. Tail usually much narrowed.

The group was compared with *Sciurus* only by Allen; but unfortunately in differentiating between this group and *Sciurus* on dental characters he has merely repeated the condition usually found in *Callosciurus*. The narrow tail turns up again in *Callosciurus tenuis*. The colour pattern alone remains of Allen's characters, which in my opinion is not a valid generic character (see p. 269).

A skeleton has been compared with *Callosciurus* skeleton, but does not show any essential difference in general formation. The only difference appears to be that in "*Tamiops*" there are 26 tail vertebrae, whereas in *Callosciurus tenuis* there are only 23. But this is hardly a generic character; for instance, in *Ratufa indica*, as quoted by Flower (Osteology, p. 85, 1885), there may be either 24 or 25. Under these circumstances I have no alternative to reducing *Tamiops* to a subgenus of the present genus.

Forms seen: *alacris*, *albescens*, *albivexilli*, *andrewsi*, *annellatus*, *aoris*, *aquilo*, *atratus, atrodorsalis, balstoni, baluensis, bangueyae, barbei, bartoni, bellona, besuki, bhutanensis, bilimitatus, "bilineatus," blanfordi, blythi, bocki, bocourti, bonhotei, borneanus, brookei, caniceps, careyi, carimonensis, caroli, castaneoventris, centralis, chinensis, cinnamomeus, clarkei, cockerelli, concolor, condurensis, contumax, crotalius, crumpi, dactylinus, davisoni, dextralis, domelicus, dulitensis, erebus* (=*piceus*), *erythraeus, epomophorus, erythrogaster, famulus, ferrugineus, finlaysoni, flavimanus, floweri, "fluminalis," folletti, formosanus, forresti, frandseni, fraterculus, fryanus, germaini, gloveri, gordoni, grayi, griseicauda, griseimanus, griseipectus, gunong, harmandi, harringtoni, hastilis, hendeei, hippurellus, hippurosus, hippurus, humei, ictericus, imarius, imitator, inconstans, inquinatus, janetta, jentinki, juvencus, kinneari, kongensis, kuchingensis, lancavensis, laotum, leucomus, leucopus, leucotis, lokroides, lowi, lylei* (race of *bocourti*), *lylei* (*Tamiops*, here renamed *holti*), *maclellandi, madurae, manipurensis, mapravis, maritimis, mearsi, melanogaster, menamicus, mentawi, "meticulosus," michianus, maporensis, microrhynchus, midas, millardi, milleri, mindanensis, miniatus, moheius, mohillus, moi, monticolus, nagarum, nakanus, natunensis, navigator, nesiotes, nigrovittatus, ningpoensis, notatus, nox, olivaceus, orestes, owensi, panjioli, panjius, pemangilensis, peninsularis, perhentiani, phanrangis, phayrei, philippinensis, pierrei, pipidonus, pirata, plasticus, pluto, "portus," prevosti, proteus, pryeri, punctatissimus, pygerythrus, quantulus, quinquestriatus, rafflesi, roberti, robinsoni, rodolphei, rosenbergi, rubex, rubriventer, rufoniger, rupatius, sylvester, samarensis, sarawakensis, scotti, seimundi, shanicus, shortridgei, "siamensis," similis, singapurensis, sinistralis, sladeni, sordidus, "splendidus," steerei, stevensi, styani, subluteus, suffusus, sullivanus, surdus, swinhoei, tabaudius, tachardi, tacopius, tahan, tamansari, tapanulius, telibius, tenuirostris, tenuis, terutavensis, thaiwanensis, tiomanicus, vanakeni, virgo, vittatus, watsoni, wellsi, williamsoni, wrayi, youngi, zimmeensis.*

So far as subspecies are concerned, the classification of Robinson & Kloss, 1918 (Rec. Indian Mus. XV, pt. IV, pp. 171–250), is followed.

The forms in which the baculum structure is definitely verified, so far as at present traced, are: *maclellandi, prevosti, notatus, castaneoventris, atrodorsalis, vittatus, lokroides, hippurus, miniatus, robinsoni, tahan, caniceps, erythraeus, pluto, sladeni, similis, phayrei, blanfordi, pygerythrus, janetta, pryeri, philippinensis, melanogaster, tenuis, brooki, lowi, stevensi, blythi.*

This list is probably incomplete.

The division of this genus is very difficult; but provisionally I think it is reasonable to divide the genus into twelve groups.

It must, however, be borne in mind that this arrangement is very provisional, and how many of the groups would stand in a detailed revision of the whole genus I do not know.

1. *tenuis* group. Small Squirrels, hindfoot usually under 36 mm., and upper incisors less proödont. Malay Peninsula, Sumatra, Borneo. The tail is normally much narrowed.

   tenuis, jentinki, probably *fraterculus.*

2. *lowi* group. Size as in group 1, but as far as seen upper incisors strongly proödont. Tail not much narrowed, but often relatively short. Malay

Peninsula, Sumatra, Borneo. Both these groups have the baculum of the "*Tomeutes*" type so far as known.

All other forms of the typical subgenus are larger animals, with hindfoot measurement usually more than 36 mm.

3. *erythraeus* group. This contains the majority of the Squirrels belonging to the genus from the northern part of the range, i.e. South China to Siam, with the baculum, so far as known, of "*Callosciurus*" type as diagnosed by Thomas. Usually, but not always, the upper incisors do not tend to be proödont. The colour is extremely various, but there appear to be intermediate forms between all the extremes. As examples may be quoted some races of *ferrugineus* (unicolorous red); *cockerelli*, mostly red above, white below; *finlaysoni*, typically unicolorous white; *bocourti*, typically black above, white below; *germaini* subspecies, unicolorous black. *C. erythraeus* is typically greenish above, red below, but some races are whitish below. There are no flank stripes except in a race of *sladeni*, which has black ones. The colour is never black above, red below, as in *prevosti*. *C. atrodorsalis* has usually a black mid-dorsal region.
erythraeus, *sladeni*, *ferrugineus*, *finlaysoni*, *bocourti*, *germaini*, *flavimanus*, *atrodorsalis*, *cockerelli*, *griseimanus*.

4. *caniceps* group. Doubtfully distinct from *erythraeus* group, but upper incisors very generally tending to be proödont. *C. caniceps* is typically orange above, and with black tailtip, but as usual there is much variation in colour in races (as arranged by Robinson & Kloss). Tenasserim and Siam to Malacca.

5. *prevosti* group. Related to the above two groups so far as known in bacular characters; black above, red below, always as far as seen, with or without white flank stripe which may in some forms be broadened so that it takes up most of the back; shades extremely variable; in some cases these appear to be the most beautifully marked of all Squirrels. Malacca, Sumatra, Borneo, Celebes. The upper incisors are very generally proödont.

6. *notatus* group. Closely allied to the above; bacular characters so far as known like the "*Callosciurus*" type of Thomas, except apparently *vittatus* (but one? out of forty-six races examined; see remarks on p. 349). Very generally with a white stripe over a black stripe on the flanks (one race only in all forms examined with white flank-stripe only). Body usually green above; red or in *nigrovittatus* greyish below. Upper incisors very generally proödont. *notatus*, *vittatus*, *nigrovittatus*. Malay Peninsula and islands to Borneo. In the last four groups, the parietal ridges of the skull, so far as seen, very rarely tend to come together, and the zygomatic plate is rarely heavily ridged.

7. *pygerythrus* group. Squirrels from Burma, Assam, and Nepal, with so far as known the baculum of the "*Tomeutes*" type of Thomas. The parietal

ridges may come together, though this is not a usual feature of the skull. There is a tendency for the zygomatic plate to be rather more powerfully ridged, and it may extend upwards farther forwards than is usual. The colour is typically duller than in the *erythraeus* group, though this varies; no flank stripes except in *phayrei*, in which they are black. The incisors most often do not tend to be projected forwards.

pygerythrus, *lokroides*, *blythi*, *stevensi*, *phayrei*.

8. *quinquestriatus* group. Very similar to group 7, but with the belly typically longitudinally banded black and white, and with a well-developed black mid-ventral stripe, so far as seen. This feature seems sufficiently rare to warrant the formation of a group for this species. Yunnan, Burma.

9. *hippurus* group. This contains several squirrels agreeing, so far as at present known, with the *pygerythrus* group in the structure of the baculum, from the southern portion of the range of the genus (Malacca, Sumatra, Borneo, Philippines). Most often the general colour is somewhat darker than in the *pygerythrus* group; frequently more or less unicolor, as in *brookei*, *philippinensis*, etc. *melanogaster* is a dark form with a black belly, and differs from the other species, included here, so far as seen, in the more proödont upper incisors. The colours are more strongly contrasted in *hippurus*, *pryeri*, and *steerei*. The tail in *hippurus* is extremely bushy; this species tends to become largest of the genus except *rubriventer*. A short sagittal crest is a normal feature of the skull, so far as seen, in *hippurus*, *melanogaster*, and all species examined from the Philippine Islands, but is not so in *brookei*.

hippurus, *pryeri*, *brookei*, *philippinensis*, *steerei*, *juvencus*, *mindanensis*, *samarensis* (? other Philippine species), *melanogaster*.

10. *leucomus* group. I have not seen enough material to be able to frame a definition of this group. About seven species are described as members of the group (or near *leucomus* or *rosenbergi*), which are not represented in London. The skull of *leucomus* seems aberrant, as noted above, though how far this is a constant feature I do not know. Conspicuous ear tufts are present in both species seen which are allotted to the group (in this respect differing from all other groups except the *rubriventer* group and the subgenus *Tamiops*); but this is not a constant character in some other described forms. *C. leucomus* has well-marked white spots behind the ears, not seen in other members of the genus, but these are absent in *rosenbergi* and others. Celebes. (*leucomus*, *rosenbergi* the sole species examined.)

11. *rubriventer* group. Very large; ears tufted; upper incisors strongly proödont; a long sagittal crest present in both skulls seen. Celebes.

12. *maclellandi* group (subgenus *Tamiops*). Usually smaller than the other species of the genus Tail usually much narrowed. A *Tamias*-like colour pattern of parallel black stripes on the back. Ear usually tufted. Burma, South China, Siam, Hainan, Formosa, to Tibet, Chihli.

This arrangement is, as remarked above, very provisional, and it may be that many of these groups will break down when the whole genus is carefully revised; for such a revision there is much need. It seems to me to be a more natural arrangement at any rate than lumping the species into two "genera" based on a single external character that cannot yet have been verified in a third of the named forms.

List of Named Forms

Subgenus *Tamiops*, Allen[1]

1. CALLOSCIURUS MACLELLANDI MACLELLANDI, Horsfield

1839. Proc. Zool. Soc. London, p. 152.
Assam.
Synonym: *pembertoni*, Blyth, 1842, J. A. S. Bengal, XI, p. 887. Bhutan.
leucotis, Temminck, 1853, Esq. Zool. Côte de Guiné, p. 252. Malacca.

2. CALLOSCIURUS MACLELLANDI MANIPURENSIS, Bonhote

1900. Ann. Mag. Nat. Hist. 7, V, p. 51.
Aimole, Manipur.

3. CALLOSCIURUS MACLELLANDI MARITIMUS, Bonhote

1900. Ann. Mag. Nat. Hist. 7, V, p. 51.
Foochow, China.

4. CALLOSCIURUS MACLELLANDI MONTICOLUS, Bonhote

1900. Ann. Mag. Nat. Hist. 7, V, p. 52.
Ching Fen Ling, Fokien, China.

5. CALLOSCIURUS MACLELLANDI FORMOSANUS, Bonhote

1900. Ann. Mag. Nat. Hist. 7, V, p. 52.
North Formosa.

6. CALLOSCIURUS MACLELLANDI BARBEI, Blyth

1847. Journ. Asiat. Soc. Bengal, XVI, p. 875.
Yé, Tenasserim.

7. CALLOSCIURUS MACLELLANDI KONGENSIS, Bonhote

1901. Proc. Zool. Soc. London, 1, p. 55.
Raheng, Siam.

8. CALLOSCIURUS MACLELLANDI NOVEMLINEATUS, Miller

1903. Proc. Biol. Soc. Washington, XVI, p. 147.
Trang, Siamese Malaya.

9. CALLOSCIURUS MACLELLANDI RODOLPHEI, Milne-Edwards

1867. Rev. Mag. Zool. XIX, p. 227.
Cochin-China.

10. CALLOSCIURUS MACLELLANDI HAINANUS, Allen

1906. Bull. Amer. Mus. Nat. Hist. XXII, p. 476.
Lei-Mui Mon, Hainan (mountains).

11. CALLOSCIURUS MACLELLANDI SAUTERI, Allen

1911. Bull. Amer. Mus. Nat. Hist. XXX, p. 339.
Chip Chip, Northern Formosa.

12. CALLOSCIURUS MACLELLANDI RIUDONI, Allen

1906. Bull. Amer. Mus. Nat. Hist. XXII, p. 477.
Riudon, Hainan (plains).

[1] For further notes on these forms, see p. 653.

13. CALLOSCIURUS MACLELLANDI LIANTIS, Kloss

1919. Journ. Nat. Hist. Soc. Siam, III, no. 4, p. 370.
Cape Liant, S.-E. Siam.

14. CALLOSCIURUS MACLELLANDI LAOTUM, Robinson & Kloss

1922. Ann. Mag. Nat. Hist. 9, IX, p. 92.
Pak Hin Bung, Mekong River, Laos.

15. CALLOSCIURUS MACLELLANDI MOI, Robinson & Kloss

1922. Ann. Mag. Nat. Hist. 9, IX, p. 92.
Langbian Plateau, S. Annam.

16. CALLOSCIURUS MACLELLANDI RUSSEOLUS, Jacobi

1923. Ahh. Mus. Dresden, 16, no. 1, p. 11.
Tibet.

17. CALLOSCIURUS MACLELLANDI FORRESTI, Thomas

1920. Ann. Mag. Nat. Hist. 9, V, p. 305.
Lichiang Range, Yunnan.

18. CALLOSCIURUS MACLELLANDI OLIVACEUS, Osgood

1932. Field Mus. Nat. Hist. Publ. Zool. Ser. XVIII, p. 292.
Mt. Fan Si Pan, near Chapa, Tongking.

19. CALLOSCIURUS SWINHOEI, Milne-Edwards

1874. Rech. des Mamm. p. 308.
Moupin, Tibet.
(Listed as a distinct species by Robinson & Kloss, 1918.)

20. CALLOSCIURUS INCONSTANS, Thomas

1920. Ann. Mag. Nat. Hist. 9, V, p. 306.
Mongtze (?), Yunnan.

21. CALLOSCIURUS CLARKEI, Thomas

1920. Ann. Mag. Nat. Hist. 9, V, p. 304.
Yantze Valley, Yunnan (North).

22. CALLOSCIURUS SPENCEI, Thomas

1921. Journ. Bombay Nat. Hist. Soc. XXVII, p. 503.
North Kachin Province, N. Burma.

23. CALLOSCIURUS HOLTI, New Name
(To replace *Tamiops* (*Callosciurus*) *lylei*, Thomas)

1920. Ann. Mag. Nat. Hist. 9, V, p. 307.
Coast 50 miles south of Bangkok, S.-E. Siam. Not *Callosciurus lylei*, Bonhote.

24. CALLOSCIURUS VESTITUS, Miller

1913. Proc. Biol. Soc. Washington, XXVIII, p. 115.
Hsin-Lung-Shan, 65 miles north-east of Peking, China.

Subgenus *Callosciurus*, Gray

tenuis Group

25. CALLOSCIURUS TENUIS TENUIS, Horsfield

1824. Zool. Res. Java, p. 153.
Singapore Island.
Synonym: *affinis*, Horsfield, 1824, Zool. Res. Java, p. 153. Singapore.

26. CALLOSCIURUS TENUIS SURDUS, Miller
1900. Proc. Acad. Sci. Washington, XI, p. 80.
Trang, Siamese Malaya.

27. CALLOSCIURUS TENUIS SORDIDUS, Kloss
1911. Ann. Mag. Nat. Hist. 8, VII, p. 119.
Great Redang Island, off Trengganu, East Malay Peninsula.

28. CALLOSCIURUS TENUIS TIOMANICUS, Robinson
1917. Journ. Fed. Malay States Mus. VII, p. 103.
Tioman Island, east coast of Malay Peninsula

29. CALLOSCIURUS TENUIS TAHAN, Bonhote
1908. Journ. Fed. Malay States Mus. III, p. 6.
Mt. Tahan, Pahang, Malay Peninsula.

30. CALLOSCIURUS TENUIS GUNONG, Robinson & Kloss
1914. Journ. Fed. Malay States Mus. V, p. 119.
Kao Nong, Bandon, Siamese Malaya.

31. CALLOSCIURUS TENUIS MODESTUS, Müller
1839. Temmincks Verhandelinger Zoologie, Inleidung, p. 55.
Mt. Singgalang, Sumatra.

32. CALLOSCIURUS TENUIS ALTITUDINIS, Robinson & Kloss
1916. Journ. Straits Branch Roy. Asiat. Soc. 73, p. 269.
Korinchi Peak, Sumatra, 7,300 ft.

33. CALLOSCIURUS TENUIS MANSALARIS, Miller
1903. Proc. U. S. Nat. Mus. XXVI, p. 451.
Mansalar Island, W. Sumatra.

34. CALLOSCIURUS TENUIS BATUS, Lyon
1916. Proc. U. S. Nat. Mus. LII, p. 443.
Tana Bala, Batu Islands, W. Sumatra.

35. CALLOSCIURUS TENUIS BANCARUS, Miller
1903. Proc. U. S. Nat. Mus. XXVI, p. 451.
Bangkaru Island, Banjak Islands, W. Sumatra.

36. CALLOSCIURUS TENUIS PUMILUS, Miller
1903. Smiths. Misc. Coll. XLV, p. 15.
South Pagi Island, W. Sumatra.

37. CALLOSCIURUS TENUIS PARVUS, Miller
1901. Proc. Biol. Soc. Washington, XIV, p. 33.
Sarawak, Borneo.

38. CALLOSCIURUS TENUIS SIANTANICUS, Chasen & Kloss
1928. Journ. Malay Branch Roy. Asiat. Soc. 6, p. 33.
Anamba Islands, South China Sea.

39. CALLOSCIURUS PROCERUS, Miller
1901. Proc. Washington Acad. Sci., X, p. 122.
Bunguran Island, North Natunas.

40. CALLOSCIURUS JENTINKI, Thomas
1887. Ann. Mag. Nat. Hist. 5, XX, p. 128.
Kina Balu, North Borneo.

41. CALLOSCIURUS FRATERCULUS, Thomas
1895. Ann. Mus. Civ. Stor. Nat. Genova, 2, XIV, p. 10.
Sipora, Mentawei Islands, West Sumatra.

lowi Group

42. CALLOSCIURUS LOWI LOWI, Thomas
1892. Ann. Mag. Nat. Hist. 6, IX, p. 253.
Sarawak, Borneo.

43. CALLOSCIURUS LOWI BANGUEYAE, Thomas
1910. Ann. Mag. Nat. Hist. 8, V, p. 387.
Banguey Island, North Borneo.

44. CALLOSCIURUS LOWI NATUNENSIS, Thomas
1895. Nov. Zool. II, p. 26.
Sirhassen Island, Natuna group, South China Sea.

45. CALLOSCIURUS LOWI ROBINSONI, Bonhote
1903. Fasciculi Malayenses, Zool. I, p. 24, pl. 1.
Bukit Besar, Patani, Malay Peninsula.

46. CALLOSCIURUS LOWI HUMILIS, Miller
1913. Smiths. Misc. Coll. LXI, no. 21, p. 24.
Kateman River, East Sumatra.

47. CALLOSCIURUS LOWI VANAKENI, Robinson & Kloss
1916. Journ. Straits Branch Roy. Asiat. Soc. 73, p. 270.
Barisan Range, Korinchi, Sumatra.

48. CALLOSCIURUS LOWI PINIENSIS, Miller
1903. Smiths. Misc. Coll. XLV, p. 14.
Pinie Island, Batu group, West Sumatra.

49. CALLOSCIURUS LOWI BALAE, Miller
1903. Smiths. Misc. Coll. XLV, p. 14.
Tana Bala Island, Batu group, W. Sumatra.

50. CALLOSCIURUS LOWI SEIMUNDI, Thomas & Wroughton
1909. Ann. Mag. Nat. Hist. 8, III, p. 440.
Kundur Island, Rhio-Lingga Archipelago, East Sumatra.

51. CALLOSCIURUS LOWI ALACRIS, Thomas
1908. Ann. Mag. Nat. Hist. 8, II, p. 306.
Semangko Pass, Selangor-Pahang boundary, Malaya.

52. CALLOSCIURUS LOWI SIBERU, Chasen & Kloss
1928. Proc. Zool. Soc. London (1927), p. 824.
Siberut Island, W. Sumatra.

53. CALLOSCIURUS LINGUNGENSIS, Miller
1901. Proc. Washington Acad. Sci., III, p. 123.
Pulo Lingung, North Natuna Islands.

erythraeus Group

54. CALLOSCIURUS ERYTHRAEUS ERYTHRAEUS, Pallas
1778. Nov. Sp. Quadr. Glir. Ord. p. 377.
Locality not known.

55. CALLOSCIURUS ERYTHRAEUS BHUTANENSIS, Bonhote

1901. Ann. Mag. Nat. Hist. 7, VII, p. 161.
Bhutan.

56. CALLOSCIURUS ERYTHRAEUS NAGARUM, Thomas & Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 228.
Sadiya, Assam.

57. CALLOSCIURUS ERYTHRAEUS ERYTHROGASTER, Blyth

1842. Journ. As. Soc. Bengal, XI, p. 970.
Manipur.

58. CALLOSCIURUS ERYTHRAEUS PUNCTATISSIMUS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 283.
Cachar, Assam.

59. CALLOSCIURUS ERYTHRAEUS INTERMEDIUS, Anderson

1879. Zool. & Anat. Res. Yunnan, p. 241.
Assam.

60. CALLOSCIURUS ERYTHRAEUS GORDONI, Anderson

1871. Proc. Zool. Soc. London, p. 140.
Bhamo, Upper Burma.

61. CALLOSCIURUS ERYTHRAEUS KINNEARI, Thomas & Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 229.
Tatkon, Kindat, Upper Chindwin, Burma.

62. CALLOSCIURUS ERYTHRAEUS HYPERYTHRUS, Blyth

1855. Journ. As. Soc. Bengal, XXIV, p. 474.
Tenasserim. (? Moulmein.)

63. CALLOSCIURUS ERYTHRAEUS RUBECULUS, Miller

1903. Smiths. Misc. Coll. XLV, p. 22.
Khow Sai Dow, Trong, Siamese Malaya.

64. CALLOSCIURUS ERYTHRAEUS YOUNGI, Robinson & Kloss

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 224.
Gunong Tahan, 5,000–6,000 ft. N. Pahang, Malaya.

65. CALLOSCIURUS ERYTHRAEUS CASTANEOVENTRIS, Gray

1842. Ann. Mag. Nat. Hist., X, p. 263.
Hainan.

66. CALLOSCIURUS ERYTHRAEUS AQUILO, Wroughton

1921. Journ. Bombay Nat. Hist. Soc. XXVII, p. 601.
Dibong River, Sadiya, Assam.

67. CALLOSCIURUS ERYTHRAEUS GLOVERI, Thomas

1921. Journ. Bombay Nat. Hist. Soc. XXVII, p. 502.
Nagohuka, W. Szechuan, China.

68. CALLOSCIURUS ERYTHRAEUS NINGPOENSIS, Bonhote

1901. Ann. Mag. Nat. Hist. 7, VII, p. 163.
Ningpo, China.
Synonym: *tsingtauensis*, Hilzheimer, 1905, Zool. Anz. XXIX, p. 298.
Tsingtau, China.

69. CALLOSCIURUS ERYTHRAEUS GRISEOPECTUS, Blyth

1847. Journ. As. Soc. Bengal, XVI, p. 873.
Locality not known.

70. CALLOSCIURUS ERYTHRAEUS STYANI, Thomas
1894. Ann. Mag. Nat. Hist. 6, XIII, p. 363.
Between Shanghai and Hangchow, probably Kalung, China.

71. CALLOSCIURUS ERYTHRAEUS BONHOTEI, Robinson & Wroughton
1911. Journ. Fed. Malay States Mus. IV, p. 234.
Chin Chien San, Szechuan, China.

72. CALLOSCIURUS ERYTHRAEUS MICHIANUS, Robinson & Wroughton
1911. Journ. Fed. Malay States Mus., IV, p. 234.
Mee-chee, Yunnan.

73. CALLOSCIURUS ERYTHRAEUS HAEMOBAPHES, G. M. Allen
1912. Proc. Biol. Soc. Washington, XXV, p. 177.
Chih-Ping, S.-E. Yunnan.

74. CALLOSCIURUS ERYTHRAEUS THAIWANENSIS, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 165.
Baksa, S. Formosa.

75. CALLOSCIURUS ERYTHRAEUS CENTRALIS, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 166.
Lak-Ku-Li, Central Formosa.

76. CALLOSCIURUS ERYTHRAEUS ROBERTI, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 166.
N.-W. Formosa.

77. CALLOSCIURUS ERYTHRAEUS CRUMPI, Wroughton
1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 425.
Sedonchen, Sikkim.

78. CALLOSCIURUS ERYTHRAEUS INSULARIS, Allen
1906. Bull. Amer. Mus. Nat. Hist., XXII, p. 473.
Lei-Mui-Mon, Hainan.

79. CALLOSCIURUS ERYTHRAEUS HENDEEI, Osgood
1932. Field. Mus. Nat. Hist. Publ. Zool. Ser. XVIII, p. 270.
Chapa, Tongking.

80. CALLOSCIURUS ERYTHRAEUS CROTALIUS, Thomas & Wroughton
1916. Journ. Bombay Nat. Hist. Soc. XXIV, 2, p. 229.
Hkamti, Chindwin, Burma.

81. CALLOSCIURUS ERYTHRAEUS WELLSI, Wroughton
1921. Journ. Bombay Nat. Hist. Soc. XXVII, p. 775.
Shangpung, Jaintia Hills, Assam.

82. CALLOSCIURUS ERYTHRAEUS NIGRIDORSALIS, Kuroda
1935. Journ. Mamm. Baltimore, p. 281.
Riran, Taito, S.-E. Formosa.

83. CALLOSCIURUS ERYTHRAEUS WOODI, Harris
1931. Occ. Pap. Mus. Zool. Univ. Mich. 228, p. 1.
Lung-Tan, 25 miles east of Nangking, Kiang-Su, China.

84. CALLOSCIURUS FLAVIMANUS FLAVIMANUS, Geoffroy
1832. Mag. Zool. 1, Mamm. Cl. 1, Ann. 2.
Tourane, Annam.

85. CALLOSCIURUS FLAVIMANUS QUANTULUS, Thomas

1927. Proc. Zool. Soc. London, p. 51.
Xieng Khouang, Laos, Annam.

86. CALLOSCIURUS FLAVIMANUS DACTYLINUS, Thomas

1927. Proc. Zool. Soc. London, p. 52.
Dak-to, Annam.

87. CALLOSCIURUS FLAVIMANUS CONTUMAX, Thomas

1927. Proc. Zool. Soc. London, p. 52.
Kontoum, south of Dak-to, Annam.

88. CALLOSCIURUS FLAVIMANUS PIRATA, Thomas

1929. Proc. Zool. Soc. London (1928), p. 836.
Napi, Laos, Annam.

89. CALLOSCIURUS FLAVIMANUS BOLOVENSIS, Osgood

1932. Field. Mus. Nat. Hist. Pub. Zool. Ser. XVIII, p. 276.
Paksong, Boloven Plateau, Laos, Annam.

90. CALLOSCIURUS SLADENI SLADENI, Anderson

1871. Proc. Zool. Soc. London, p. 139.
Thigyain, Upper Burma.
Synonym: *kemmisi*, Wroughton, 1908, Ann. Mag. Nat. Hist. 8, XI, p. 491. Katha, Upper Irrawaddy.

91. CALLOSCIURUS SLADENI MIDAS, Thomas

1914. Journ. Bombay Nat. Hist. Soc. XXIII, p. 198.
Myitkyina, Upper Burma.

92. CALLOSCIURUS SLADENI RUBEX, Thomas

1914. Journ. Bombay Nat. Hist. Soc. XXIII, p. 198.
Lonkin, Myitkyina district, Upper Burma.

93. CALLOSCIURUS SLADENI BARTONI, Thomas

1914. Journ. Bombay Nat. Hist. Soc. XXIII, p. 199.
Uyu River, 50 miles east of Homalin, Upper Chindwin, Burma.

94. CALLOSCIURUS SLADENI SHORTRIDGEI, Thomas & Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 232, pl. fig. 1.
Hkamti, Upper Chindwin, Burma.

95. CALLOSCIURUS SLADENI FRYANUS, Thomas & Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 232, pl. fig. 2.
Minsin, Upper Chindwin, Burma.

96. CALLOSCIURUS SLADENI CAREYI, Thomas & Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 233, pl. fig. 3.
Tamanthe, Upper Chindwin, Burma.

97. CALLOSCIURUS SLADENI HARINGTONI, Thomas

1905. Ann. Mag. Nat. Hist. 7, XVI, p. 314.
Moungkan, Upper Chindwin, Burma.

98. CALLOSCIURUS SLADENI MILLARDI, Thomas & Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 234, pl. fig. 5.
Pyaungbyin, 40 miles north of Kindat, Upper Chindwin, Burma.

99. CALLOSCIURUS SLADENI SOLUTUS, Thomas

1914. Journ. Bombay Nat. Hist. Soc. XXIII, p. 199.
Homalin, Upper Chindwin, Burma.

100. CALLOSCIURUS FERRUGINEUS FERRUGINEUS, F. Cuvier[1]

1829. Hist. Nat. Mamm. iii, pl. 238.
Pegu, Lower Burma.

101. CALLOSCIURUS FERRUGINEUS FRANDSENI, Kloss

1916. Proc. Zool. Soc. London, p. 46.
Koh Chang Island, S.-E. Siam.

102. CALLOSCIURUS FERRUGINEUS CINNAMOMEUS, Temminck

1853. Esq. Zool. Côte de Guiné, p. 250.
Cambodia.

103. CALLOSCIURUS FERRUGINEUS WILLIAMSONI, Robinson & Kloss

1922. Ann. Mag. Nat. Hist. 9, IX, p. 90.
Xieng Khan, Mekong River, Siam.

104. CALLOSCIURUS FERRUGINEUS HERBERTI, Robinson & Kloss

1922. Ann. Mag. Nat. Hist. 9, IX, p. 90.
Hup Bon, near Sriracha, S.-E. Siam.

105. CALLOSCIURUS FERRUGINEUS PIERREI, Robinson & Kloss

1922. Ann. Mag. Nat. Hist. 9, IX, p. 91.
Phu Quoc Island, Cambodia.

106. CALLOSCIURUS FERRUGINEUS PHANRANGIS, Robinson & Kloss

1922. Ann. Mag. Nat. Hist. 9, IX, p. 91.
Tour Cham, near Phanrang, S. Annam.

107. CALLOSCIURUS FERRUGINEUS MENAMICUS, Thomas

1929. Proc. Zool. Soc. London (1928), p. 839.
Nan, N. Siam.

108. CALLOSCIURUS FERRUGINEUS ANNELLATUS, Thomas

1929. Proc. Zool. Soc. London (1928), p. 839.
Angkor, Cambodia.

109. CALLOSCIURUS COCKERELLI, Thomas

1928. Ann. Mag. Nat. Hist. 10, II, p. 100.
Nan, N. Siam.

110. CALLOSCIURUS FINLAYSONI FINLAYSONI, Horsfield

1824. Zool. Res. Java, p. 151.
Koh Si Chang Islands, Bight of Bangkok, Siam.
Synonym: *keraudreni*, Lesson, 1830, Cent. Zool. pl. 1. Burma.
siamensis, Gray, 1860, Ann. Mag. Nat. Hist., 3, V, p. 500. Siam.
portus, Kloss, 1915, Journ. Nat. Hist. Soc. Siam, I, p. 158. Koh Si Chang Islands.

111. CALLOSCIURUS FINLAYSONI FOLLETTI, Kloss

1915. Journ. Nat. Hist. Soc. Siam, I, p. 159.
Koh Phai, Inner Gulf of Siam.

112. CALLOSCIURUS FINLAYSONI TACHARDI, Robinson

1916. Journ. Fed. Malay States Mus. VII, p. 36.
Krabin, Central Siam.

113. CALLOSCIURUS FINLAYSONI TROTTERI, Kloss

1916. Journ. Nat. Hist. Soc. Siam, II, p. 178.
Koh Lan Island, Inner Gulf of Siam.

[1] 100a. Callosciurus ferrugineus splendens, Gray; omitted in error; for reference see p. 653.

114. CALLOSCIURUS BOCOURTII BOCOURTII, Milne-Edwards

1867. Rev. Zool. p. 193.
Ayutha, Siam.
Synonym: *leucocephalus*, Bonhote, Proc. Zool. Soc. London, 1901, p. 54.

115. CALLOSCIURUS BOCOURTII HARMANDI, Milne-Edwards

1876. Bull. Soc. Philom. 6, XII, p. 8.
Island Phu Quoc, off Chantabun, Siam.

116. CALLOSCIURUS BOCOURTII SINISTRALIS, Wroughton

1908. Ann. Mag. Nat. Hist. 8, II, p. 399.
Pichit, Menam River, Central Siam.

117. CALLOSCIURUS BOCOURTII DEXTRALIS, Wroughton

1908. Ann. Mag. Nat. Hist. 8, II, p. 400.
Kampeng, Lower Me-Ping Valley, Siam.

118. CALLOSCIURUS BOCOURTI GRUTEI, Gyldenstolpe

1917. Kungl. Svenska Vet. Akad. Handl. LVII, no. 2, p. 37.
Bang Hue Pong, N. Siam.

119. CALLOSCIURUS BOCOURTI LYLEI, Wroughton

1908. Ann. Mag. Nat. Hist. 8, II, p. 401.
Chiengmai, N. Siam.

120. CALLOSCIURUS BOCOURTI FLOWERI, Bonhote

1901. Ann. Mag. Nat. Hist. 7, VII, p. 455.
Klong Morn, near Bangkok, Siam.

121. CALLOSCIURUS GERMAINI GERMAINI, Milne-Edwards

1867. Rev. Zool. p. 193.
Pulau Condor, off Cambodian coast.

122. CALLOSCIURUS GERMAINI ALBIVEXILLI, Kloss

1916. Proc. Zool. Soc. London, p. 47.
Koh Kut Island, S.-E. Siam.

123. CALLOSCIURUS GERMAINI NOX, Wroughton

1908. Ann. Mag. Nat. Hist. 8, II, p. 397.
Sea coast south-east of Bangkok, Siam.

124. CALLOSCIURUS ATRODORSALIS ATRODORSALIS, Gray

1842. Ann. Mag. Nat. Hist. X, p. 263.
Bhutan (error), substitute Moulmein.

125. CALLOSCIURUS ATRODORSALIS THAI, Kloss

1917. Journ. Nat. Hist. Soc. Siam, II, p. 285.
Raheng, C. Siam.

126. CALLOSCIURUS ATRODORSALIS SHANICUS, Ryley

1914. Journ. Bombay Nat. Hist. Soc. XXII, p. 663.
Gokteik, N. Shan States, Burma.

127. CALLOSCIURUS ATRODORSALIS ZIMMEENSIS, Robinson & Wroughton

1916. Journ. Fed. Malay States Mus. VII, p. 91.
Chiengmai, N. Siam.

128. CALLOSCIURUS ATRODORSALIS TACHIN, Kloss

1916. Journ. Nat. Hist. Soc. Siam, II, p. 178.
Tachin, C. Siam.

129. CALLOSCIURUS ATRODORSALIS PRANIS, Kloss

1916. Journ. Nat. Hist. Soc. Siam, II, p. 178.
Koh Lak, Pran, S.-W. Siam.

130. CALLOSCIURUS GRISEIMANUS GRISEIMANUS, Milne-Edwards

1867. Rev. Zool. p. 195.
Cambodia.

131. CALLOSCIURUS GRISEIMANUS LEUCOPUS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 282.
Cochin China.

132. CALLOSCIURUS GRISEIMANUS VASSALI, Bonhote

1907. Proc. Zool. Soc. London, p. 9 (footnote).
Ninh Hoa, Annam.
Synonym: *Callosciurus griseimanus fumigatus*, Bonhote, 1907, Abstr. Proc. Zool. Soc. London, Jan. 15th, p. 2. Ninh Hoa, Annam. Preoccupied by *fumigatus*, Gray, 1867.

caniceps Group

133. CALLOSCIURUS IMITATOR, Thomas

1925. Proc. Zool. Soc. London, 2, p. 502.
Thai-Nien, Tongking.

134. CALLOSCIURUS CANICEPS CANICEPS, Gray

1842. Ann. Mag. Nat. Hist. X, p. 263.
Bhutan (error), substitute N. Tenasserim.
Synonym: *chrysonotus*, Blyth, 1847, Journ. Asiat. Soc. Bengal, XVI, p. 873. Amherst, Tenasserim.
epomophorus fluminalis, Wroughton & Robinson, 1911, Journ. Fed. Malay States Mus. IV, p. 233. Meping Rapids, N. Siam.

135. CALLOSCIURUS CANICEPS DAVISONI, Bonhote

1901. Ann. Mag. Nat. Hist. 7, VII, p. 273.
Bankachon, S. Tenasserim.

136. CALLOSCIURUS CANICEPS INEXPECTATUS, Kloss

1916. Journ. Nat. Hist. Soc. Siam, II, p. 178.
Koh Lak, Pran, S.-W. Siam.
Synonym: (?) *helgei*, Gyldenstolpe, 1917, Kungl. Svenska. Vet. Ak. Handl. LVII, 2, p. 34. South of Koh Lak, S.-W. Siam.

137. CALLOSCIURUS CANICEPS SULLIVANUS, Miller

1903. Smiths. Misc. Coll. XLV, p. 17.
Sullivan Island, Mergui Archipelago.

138. CALLOSCIURUS CANICEPS DOMELICUS, Miller

1903. Smiths. Misc. Coll. XLV, p. 18.
Domel Island, Mergui Archipelago.

139. CALLOSCIURUS CANICEPS BENTINCANUS, Miller

1903. Smiths. Misc. Coll. XLV, p. 19.
Bentinck Island, Mergui Archipelago.

140. CALLOSCIURUS CANICEPS MATTHAEUS, Miller

1903. Smiths. Misc. Coll. XLV, p. 19.
St. Matthew Island, Mergui Archipelago.

141. CALLOSCIURUS CANICEPS LUCAS, Miller

1903. Smiths. Misc. Coll. XLV, p. 20.
St. Luke Island, Mergui Archipelago.

142. CALLOSCIURUS CANICEPS CASENSIS, Miller

1903. Smiths. Misc. Coll. XLV, p. 20.
Chance Island, Mergui Archipelago.

143. CALLOSCIURUS CANICEPS ALTINSULARIS, Miller

1903. Smiths. Misc. Coll. XLV, p. 21.
High Island, Mergui Archipelago.

144. CALLOSCIURUS CANICEPS EPOMOPHORUS, Bonhote

1901. Ann. Mag. Nat. Hist. 7, VII, p. 272.
Salanga or Junk Ceylon Island, Siamese Malaya.

145. CALLOSCIURUS CANICEPS PANJIUS, Thomas & Robinson

1921. Ann. Mag. Nat. Hist. 9, VII, p. 119.
Telok Pah, east of Salanga, Pulau Panjang, Peninsular Siam.

146. CALLOSCIURUS CANICEPS PANJIOLI, Thomas & Robinson

1921. Ann. Mag. Nat. Hist. 9, VII, p. 120.
Pulau Panjang Anak, north of P. Panjang, Peninsular Siam.

147. CALLOSCIURUS CANICEPS NAKANUS, Thomas & Robinson

1921. Ann. Mag. Nat. Hist. 9, VII, p. 120.
Koh Naka, near Salanga, Peninsular Siam.

148. CALLOSCIURUS CANICEPS MAPRAVIS, Thomas & Robinson

1921. Ann. Mag. Nat. Hist. 9, VII, p. 120.
Koh Maprau, near Salanga, Peninsular Siam.

149. CALLOSCIURUS CANICEPS PIPIDONIS, Thomas & Robinson

1921. Ann. Mag. Nat. Hist. 9, VII, p. 121.
Koh Pipidon, near Salanga, Peninsular Siam.

150. CALLOSCIURUS CANICEPS TACOPIUS, Thomas & Robinson

1921. Ann. Mag. Nat. Hist. 9, VII, p. 121.
Koh Rah, Tacopah, Peninsular Siam.

151. CALLOSCIURUS CANICEPS TABAUDIUS, Thomas

1922. Journ. Bombay Nat. Hist. Soc. XXVIII, 4, p. 1067.
Tavoy Island, Mergui Archipelago.

152. CALLOSCIURUS CANICEPS HASTILIS, Thomas

1923. Journ. Bombay Nat. Hist. Soc. XXIX, 2, p. 377.
Hastings Island, Mergui Archipelago.

153. CALLOSCIURUS CANICEPS MILLERI, Robinson & Wroughton

1911. Journ. Fed. Malay States Mus. IV, p. 233.
Trong, Siamese Malaya.

154. CALLOSCIURUS CANICEPS SAMUIENSIS, Robinson & Kloss

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 226.
Koh Samui, Bandon, Siamese Malaya.

155. CALLOSCIURUS CANICEPS FALLAX, Robinson & Kloss

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 225.
Koh Pennan, Bandon, Siamese Malaya.

156. CALLOSCIURUS CANICEPS LANCAVENSIS, Miller

1903. Smiths. Misc. Coll. XLV, p. 16.
Pulau Langkawi, Straits of Malacca.

157. CALLOSCIURUS CANICEPS ADANGENSIS, Miller
1903. Smiths. Misc. Coll. XLV, p. 17.
Pulau Adang, Butang Archipelago, Straits of Malacca.

158. CALLOSCIURUS CANICEPS TERUTAVENSIS, Thomas & Wroughton
1909. Ann. Mag. Nat. Hist. 8, IV, p. 535.
Pulau Terutau, Straits of Malacca.

159. CALLOSCIURUS CANICEPS HELVUS, Shamel
1930. Journ. Mamm. Baltimore, p. 72.
Koh Tau, east coast of Malay Peninsula.

160. CALLOSCIURUS CANICEPS CANIGENUS, Howell
1927. Journ. Washington, Acad. Sci., XVII, p. 81.
Hayenhsien, Hangchow Bay, Chekiang, China.

161. CALLOSCIURUS CANICEPS CONCOLOR, Blyth
1855. Journ. As. Soc. Bengal, XXIV, p. 474.
Malacca.
Synonym: *erubescens*, Cabrera, 1917, Bol. Real. Soc. Espan. 17, p. 518. Selangor.

162. CALLOSCIURUS CANICEPS TELIBIUS, Thomas & Robinson
1921. Ann. Mag. Nat. Hist. 9, VII, p. 121.
Pulau Telibun, coast of Trang, Peninsular Siam.

163. CALLOSCIURUS MOHEIUS MOHEIUS, Thomas & Robinson
1921. Ann. Mag. Nat. Hist. 9, VII, p. 122.
Pulau Mohea (north), near Trang, Malaya.

164. CALLOSCIURUS MOHEIUS MOHILLIUS, Thomas & Robinson
1921. Ann. Mag. Nat. Hist. 9, VII, p. 122.
Pulau Mohea (south), near Trang, Malaya.

prevosti Group

165. CALLOSCIURUS PREVOSTI PREVOSTI, Desmarest
1822. Mamm., p. 335.
Malacca.
Synonym: *rufogularis*, Gray, 1842, Ann. Mag. Nat. Hist. X, p. 263.
prevosti prevosti "subsubspecies" *meticulosus*, Robinson, 1916, Journ. Fed. Malay States Mus. VII, p. 20. Triang, S.-W. Pahang, Malaya.

166. CALLOSCIURUS PREVOSTI RAFFLESI, Vigors & Horsfield
1828. Zool. Journ. IV, p. 113, pl. iv.
Sumatra; probably Bencoolen.

167. CALLOSCIURUS PREVOSTI HUMEI, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 170.
Klang, Selangor, Malay Peninsula.

168. CALLOSCIURUS PREVOSTI WRAYI, Kloss
1910. Journ. Fed. Malay States Mus. IV, p. 148.
Kuala Lipis, Pahang, Malaya.

169. CALLOSCIURUS PREVOSTI MELANOPS, Miller
1902. Proc. Acad. Nat. Sci. Philadelphia, p. 151.
Indragiri River, S.-E. Sumatra.

170. CALLOSCIURUS PREVOSTI PENIALIUS, Lyon

1908. Proc. U. S. Nat. Mus. XXXIV, p. 637.
Pulau Penjali, E. Sumatra.

171. CALLOSCIURUS PREVOSTI HARRISONI, Stone & Rehn

1902. Proc. Acad. Nat. Sci. Philadelphia, LIV, p. 132.
Gunong Sugi, Lampongs, S.-E. Sumatra.

172. CALLOSCIURUS PREVOSTI CONDURENSIS, Miller

1906. Proc. U. S. Nat. Mus. XXXI, p. 260.
Pulau Kundur, Rhio-Lingga Archipelago.

173. CALLOSCIURUS PREVOSTI CARIMONENSIS, Miller

1906. Proc. U.S. Nat. Mus. XXXI, p. 261.
Great Karimon Island, Rhio-Lingga Archipelago.

174 CALLOSCIURUS PREVOSTI BANGKANUS, Schlegel

1863. Ned. Tijds. Dierk, 1, p. 26, pl. 1, fig. 2.
Bangka Island, E. Sumatra.

175. CALLOSCIURUS PREVOSTI MENDANAUUS, Lyon

1906. Proc. U.S. Nat. Mus. XXXI, p. 589.
Pulau Mendanau, west of Billiton.

176. CALLOSCIURUS PREVOSTI CARIMATAE, Miller

1906. Proc. U.S. Nat. Mus. XXXI, p. 57.
Karimata Island, off Bornean coast.

177. CALLOSCIURUS PREVOSTI SANGGAUS, Lyon

1907. Proc. U.S. Nat. Mus. XXXIII, p. 554.
Sanggau, W. Borneo.

178. CALLOSCIURUS PREVOSTI ARMALIS, Lyon

1911. Proc. U.S. Nat. Mus. XL, p. 82.
Pulau Panebangan, west coast of Borneo.

179 CALLOSCIURUS PREVOSTI PELAPIS, Lyon

1911. Proc. U.S. Nat. Mus. XL, p. 82.
Pulau Pelapis, west coast of Borneo.

180. CALLOSCIURUS PREVOSTI BORNEOENSIS, Muller & Schlegel

1839–44. Verhandl. p. 86.
Pontianak, Borneo.

181. CALLOSCIURUS PREVOSTI PALUSTRIS, Lyon

1907. Proc. U.S. Nat. Mus. XXXIII, p. 553.
North bank of Kapuas River, W. Borneo.

182. CALLOSCIURUS PREVOSTI PROSERPINAE, Lyon

1907. Smiths. Misc. Coll. XLVIII, p. 275.
Pulau Temaju, W. Borneo.

183. CALLOSCIURUS PREVOSTI SARAWAKENSIS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 277.
Sarawak, Borneo.

184. CALLOSCIURUS PREVOSTI KUCHINGENSIS, Bonhote

1901. Ann. Mag. Nat. Hist. 7, VII, p. 170.
Kuching, Sarawak, Borneo.

185. CALLOSCIURUS PREVOSTI ATRICAPILLUS, Schlegel

1863. Ned. Tijd. Dierk, 1, p. 27, pl. ii, fig. 1.
Kapuas River, W. Borneo.

186. CALLOSCIURUS PREVOSTI ATROX, Miller
1913. Smiths. Misc. Coll. LXI, 21, p. 23.
Talisaian Mountain, Dutch S.-E. Borneo.

187. CALLOSCIURUS PREVOSTI CAROLI, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 173.
Baram, Borneo. (Low country.)

188. CALLOSCIURUS PREVOSTI GRISEICAUDA, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 174.
Mount Kalulong, Baram, Borneo.

189. CALLOSCIURUS PREVOSTI ERYTHROMELAS, Temminck
1853. Esq. Zool. Côte de Guiné, p. 248.
Menado, N.-W. Celebes.

190. CALLOSCIURUS PREVOSTI SCHLEGELI, Gray
1867. Ann. Mag. Nat. Hist. 3, XX, p. 278.
Koma, Celebes.

191. CALLOSCIURUS PREVOSTI BALUENSIS, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 174.
Mt. Kina Balu, N. Borneo.

192. CALLOSCIURUS PREVOSTI SUFFUSUS, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 175.
Tutong River, N.-W. Borneo.

193. CALLOSCIURUS PREVOSTI RUFONIGER, Gray
1842. Ann. Mag. Nat. Hist. X, p. 263.
Labuan Island, N.-W. Borneo.

194. CALLOSCIURUS PREVOSTI PLUTO, Gray
1867. Ann. Mag. Nat. Hist. 3, XX, p. 283.
Sarawak, Borneo.

195. CALLOSCIURUS PREVOSTI PICEUS, Peters
1866. Proc. Zool. Soc. London, p. 429.
Type locality uncertain.
Synonym: *erebus*, Miller, 1903, Proc. U.S. Nat. Mus. XXVI, p. 456.
Tapanuli Bay, N.-W. Sumatra.

196. CALLOSCIURUS PREVOSTI NYX, Miller
1908. Proc. U.S. Nat. Mus. XXXIV, p. 638.
Pulau Rapat, E. Sumatra.

197. CALLOSCIURUS PREVOSTI NAVIGATOR, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 171.
Sirhassen, Natuna Islands.

198. CALLOSCIURUS PREVOSTI MIMELLUS, Miller
1900. Proc. Washington Acad. Sci., II, p. 218.
Pulau Wai, Tambelan Islands.

199. CALLOSCIURUS PREVOSTI MIMICULUS, Miller
1900. Proc. Washington Acad. Sci., II, p. 219.
St. Barbe Island, S. China Sea.

200. CALLOSCIURUS PREVOSTI CAEDIS, Chasen & Kloss
1932. Bull. Raffles Mus. 6, p. 25.
Balambangan Island, N. Borneo.

201. CALLOSCIURUS PREVOSTI BANKSI, Chasen
1933. Bull. Raffles Mus. 8, p. 195.
Baram district, Borneo.

202. CALLOSCIURUS PREVOSTI SUMATRANA, Schlegel
1863. Ned. Tijds. Dierk. 1, p. 25.
Sumatra.

203. CALLOSCIURUS PREVOSTI REDIMITUS, Boon Mesch
1829. Verh. Ned. Ind. Inst. Amsterdam, II, p. 243.
(?) Sumatra. ("East Indies"); quoted by Robinson in Sumatran Mammals list.

notatus Group

204 CALLOSCIURUS NIGROVITTATUS NIGROVITTATUS, Horsfield
1824. Zool. Res. Java. p. 140.
Java; probably east central parts.

205. CALLOSCIURUS NIGROVITTATUS BESUKI, Kloss
1921. Journ. Fed. Malay States Mus. X, p. 231.
Tamansari, Idjen Massif, 1600 ft., E. Java.

206. CALLOSCIURUS NIGROVITTATUS BILIMITATUS, Miller
1903. Smiths. Misc. Coll. XLV, p. 8.
Tanjong Laboha, Trengganu, E. Malay Peninsula.

207. CALLOSCIURUS NIGROVITTATUS JOHORENSIS, Robinson & Wroughton
1911. Journ. Fed. Malay States Mus. IV, p. 166.
Pelepak, Johore, Malaya.

208. CALLOSCIURUS NIGROVITTATUS MICRORHYNCHUS, Kloss
1908. Journ. Fed. Mal. States Mus. II, p. 144.
Juara Bay, Pulau Tioman, coast of Pahang.

209. CALLOSCIURUS NIGROVITTATUS BOCKI, Robinson & Wroughton
1911. Journ. Fed. Malay States Mus. IV, p. 167.
Pajo, Padang Highlands, W. Sumatra.

210. CALLOSCIURUS NIGROVITTATUS ORESTES, Thomas
1895. Ann. Mag. Nat. Hist. 6, XV, p. 530.
Mt. Dulit, Baram, Borneo.

211. CALLOSCIURUS NIGROVITTATUS KLOSSI, Miller
1900. Proc. Washington, Acad. Sci. II, p. 225.
Saddle Island, Tambelan Group.

212. CALLOSCIURUS NIGROVITTATUS MADSOEDI, Sody
1929. Nat. Tijds. Ned. Ind. 89, p. 163.
Moeriah, Java.

213. CALLOSCIURUS NOTATUS NOTATUS, Boddaert
1785. Elench. Anim. p. 119.
West Java.
Synonym: *badging*, Kerr, An. Kingd. 1792, p. 262. Java.
plantani, Ljung, Vet. Akad. Handl. 1801, p. 99. Java.
bilineatus, Desmarest, 1817, Nouv. Dict. Hist. Nat. X, p. 106. Java.
gingianus, Shaw, Gen. Zool. 2, p. 147, 1801.
grisciventer, Geoffroy, 1834, Voy. Bel. p. 147.

214. CALLOSCIURUS NOTATUS TAMANSARI, Kloss
1921. Journ. Fed. Malay States Mus. X, p. 230.
Tamansari, Idjen Massif, 1600 ft., E. Java.

215. CALLOSCIURUS NOTATUS MADURAE, Thomas
1910. Ann. Mag. Nat. Hist. 8, V, p. 386.
Marengan, near Soemenep, E. Madura Island, N.-E. Java.

216. CALLOSCIURUS NOTATUS BALSTONI, Robinson & Wroughton
1911. Journ. Fed. Malay States Mus. IV, p. 234.
Tjilatjap, S. Central Java.

217. CALLOSCIURUS NOTATUS STRESEMANNI, Thomas
1913. Ann. Mag. Nat. Hist. 8, XI, p. 505.
Baleling, Bali.

218. CALLOSCIURUS NOTATUS MICROTIS, Jentink
1879. Notes Leyden Mus. 1, p. 41.
Saleyer Island, Java Sea.

219. CALLOSCIURUS NOTATUS GUILLEMARDI, Kloss
1926. Journ. Malay Branch Roy. Asiat. Soc. 4, p. 260.
Tenggol Island, Malay Peninsula.

220. CALLOSCIURUS NOTATUS VANHEURNI, Sody
1929. Nat. Tijds. Ned. Ind. 88, p. 327.
Tjipanas, Garoet, Java.

221. CALLOSCIURUS NOTATUS VERBEEKI, Sody
1929. Nat. Tijds. Ned. Ind. 88, p. 330.
Bandar, Distr. Padangan, Rembang, Java.

222. CALLOSCIURUS NOTATUS MALAWALI, Chasen & Kloss
1932. Bull. Raffles Mus. 6, p. 26.
Mallewallé Island, N. Borneo.

223. CALLOSCIURUS NOTATUS NICOTIANAE, Sody
1936. Nat. Tijds. Ned. Ind. 96, p. 217.
Kampong Silalas, near Medan, Deli, N. Sumatra.

224. CALLOSCIURUS ATRISTRIATUS, Miller
1913. Smiths. Misc. Coll. LXI, no. 21, p. 22.
Lo Bon Bon, Dutch S.-E. Borneo.

225. CALLOSCIURUS ANDREWSI, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 456.
Tjigombong, Java.

226. CALLOSCIURUS VITTATUS VITTATUS, Raffles
1822. Trans. Linn. Soc. XIII, p. 259.
Bencoolen, W. Sumatra.
Synonym: *tarussanus*, Lyon, 1907, Smiths. Misc. Coll. XLVIII, p. 279. Tarussan Bay, W. Sumatra.

227. CALLOSCIURUS VITTATUS SATURATUS, Miller
1903. Proc. U.S. Nat. Mus. XXVI, p. 453.
Pulau Mansalar, off Tapanuli Bay, W. Sumatra.

228. CALLOSCIURUS VITTATUS PRETIOSUS, Miller
1903. Proc. U.S. Nat. Mus. XXVI, p. 454.
Pulau Bangkaru, Banjak Islands, W. Sumatra.

229. CALLOSCIURUS VITTATUS UBERICOLOR, Miller
1903. Proc. U.S. Nat. Mus. XXVI, p. 455.
Pulau Tuangku, Banjak Islands, W. Sumatra.

230. CALLOSCIURUS VITTATUS TAPANULIUS, Lyon
1907. Smiths. Misc. Coll. XLVIII, p. 280.
Tapanuli Bay, W. Sumatra.

231. CALLOSCIURUS VITTATUS PENINSULARIS, Miller
1903. Smiths. Misc. Coll. XLV, p. 10.
N. bank of Endau River, S.-E. Pahang, Malaya.

232. CALLOSCIURUS VITTATUS RUPATIUS, Lyon
1908. Proc. U.S. Nat. Mus. XXXIV, p. 640.
Pulau Rupat, E. Sumatra.

233. CALLOSCIURUS VITTATUS SUBLUTEUS, Thomas & Wroughton
1909. Ann. Mag. Nat. Hist. 8, III, p. 440.
Si Karang, S.-E. Johore, Malaya.

234. CALLOSCIURUS VITTATUS SINGAPURENSIS, Robinson
1916. Journ. Fed. Malay States Mus. VII, p. 73.
Changi, Singapore Island.

235. CALLOSCIURUS VITTATUS MAPORENSIS, Robinson
1916. Journ. Fed. Malay States Mus. VII, p. 64.
Pulau Mapor, Rhio-Lingga Archipelago.

236. CALLOSCIURUS VITTATUS NESIOTES, Thomas & Wroughton
1909. Ann. Mag. Nat. Hist. 8, III, p. 440.
Pulau Batam, Rhio-Lingga Archipelago.

237. CALLOSCIURUS VITTATUS TENUIROSTRIS, Miller
1900. Proc. Washington Acad. Sci., II, p. 221.
Tioman Island, off coast of Pahang.

238. CALLOSCIURUS VITTATUS ANAMBENSIS, Miller
1900. Proc. Washington Acad. Sci., II, p. 223.
Pulau Siantan, Anamba Islands.

239. CALLOSCIURUS VITTATUS ABBOTTI, Miller
1900. Proc. Washington Acad. Sci., II, p. 224.
Big Tambelan Island, S. China Sea.

240. CALLOSCIURUS VITTATUS AORIS, Miller
1903. Smiths. Misc. Coll. XLV, p. 10.
Pulau Aor, near Pulau Tioman.

241. CALLOSCIURUS VITTATUS FAMULUS, Robinson
1912. Ann. Mag. Nat. Hist. 8, X, p. 592.
Pulau Dayang, near Pulau Aor, S. China Sea.

242. CALLOSCIURUS VITTATUS PANNOVIANUS, Miller
1903. Smiths. Misc. Coll. XLV, p. 11.
Pulau Panau, Atas Islands, S. China Sea.

243. CALLOSCIURUS VITTATUS PEMANGILENSIS, Miller
1903. Smiths. Misc. Coll. XLV, p. 9.
Pemangil Island, near Pulau Tioman.

244. CALLOSCIURUS VITTATUS ICTERICUS, Miller
1903. Smiths. Misc. Coll. XLV, p. 12.
Tana Bala, Batu Island, W. Sumatra.

245. CALLOSCIURUS VITTATUS SERUTUS, Miller
1906. Proc. U.S. Nat. Mus. XXXI, p. 58.
Pulau Serutu, Karimata Islands.

246. CALLOSCIURUS VITTATUS DIRECTOR, Lyon
1909. Proc. U.S. Nat. Mus. XXXVI, p. 509.
Direction Island, S. China Sea.

247. CALLOSCIURUS VITTATUS LUTESCENS, Miller
1901. Proc. Washington Acad. Sci., III, p. 124.
Sirhassen Island, Natuna Islands.

248. CALLOSCIURUS VITTATUS LAMUCOTANUS, Lyon
1911. Proc. U.S. Nat. Mus. XL, p. 85.
Pulau Lamukotan, W. Borneo.

249. CALLOSCIURUS VITTATUS DATUS, Lyon
1911. Proc. U.S. Nat. Mus. XL, p. 86.
Pulau Dato, W. Borneo.

250. CALLOSCIURUS VITTATUS SIRIENSIS, Lyon
1911. Proc. U.S. Nat. Mus. XL, p. 87.
Pulau Mata Siri, Java Sea.

251. CALLOSCIURUS VITTATUS ARENDSIS, Lyon
1911. Proc. U.S. Nat. Mus. XL, p. 87.
Arends Island, Java Sea.

252. CALLOSCIURUS VITTATUS MARINSULARIS, Lyon
1911. Proc. U.S. Nat. Mus. XL, p. 89.
Pulau Laut, off S.-E. Borneo.

253. CALLOSCIURUS VITTATUS LAUTENSIS, Miller
1901. Proc. Washington Acad. Sci., III, p. 128.
Pulau Laut, N. Natuna Islands.

254. CALLOSCIURUS VITTATUS RUTILIVENTRIS, Miller
1901. Proc. Washington Acad. Sci., III, p. 126.
Pulau Midei, S. Natuna Islands.

255. CALLOSCIURUS VITTATUS RUBIDIVENTRIS, Miller
1901. Proc. Washington Acad. Sci., III, p. 127.
Bunguran, Natuna Islands.

256. CALLOSCIURUS VITTATUS SERAIAE, Miller
1901. Proc. Washington Acad. Sci., III, p. 125.
Pulau Seraia, Natuna Islands.

257. CALLOSCIURUS VITTATUS ALBESCENS, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 446.
Acheen, N. Sumatra.

258. CALLOSCIURUS VITTATUS DULITENSIS, Bonhote
1901. Ann. Mag. Nat. Hist. 7, VII, p. 451.
Mount Dulit, Baram, Borneo.

259. CALLOSCIURUS VITTATUS DILUTUS, Miller
1913. Smiths. Misc. Coll. LXI, no. 21, p. 23.
Tanjong Batu, S.-E. Borneo.

260. CALLOSCIURUS VITTATUS CONIPUS, Lyon

1911. Proc. Biol. Soc. Washington, XXIV, p. 98.
Pamukang Bay, S. Borneo.
Synonym: *pohopus*, Lyon, 1911, Proc. U.S. Nat. Hist. XL, p. 88, preoccupied.

261. CALLOSCIURUS VITTATUS TEDONGUS, Lyon

1907. Proc. U.S. Nat. Mus. XXXI, p. 591.
Tanjong Tedong, Banka Island.

262. CALLOSCIURUS VITTATUS BILLITONUS, Lyon

1907. Proc. U.S. Nat. Mus. XXXI, p. 592.
Buding Bay, Billiton Island.

263. CALLOSCIURUS VITTATUS MINIATUS, Miller

1900. Proc. Washington Acad. Sci., II, p. 79.
Trang, Siamese Malaya.

264. CALLOSCIURUS VITTATUS SCOTTI, Kloss

1911. Ann. Mag. Nat. Hist. 8, VII, p. 117.
Bedung Island, off Trengganu, E. Malay Peninsula.

265. CALLOSCIURUS VITTATUS PLASTICUS, Kloss

1911. Ann. Mag. Nat. Hist. 8, VII, p. 117.
Great Redang Island, off Trengganu, E. Malay Peninsula.

266. CALLOSCIURUS VITTATUS PERHENTIANI, Kloss

1911. Ann. Mag. Nat. Hist. 8, VII, p. 118.
W. Perhentian Island, off Trengganu, E. Malay Peninsula.

267. CALLOSCIURUS VITTATUS PROTEUS, Kloss

1911. Ann. Mag. Nat. Hist. 8, VII, p. 118.
E. Perhentian Island, off Trengganu, E. Malay Peninsula.

268. CALLOSCIURUS VITTATUS WATSONI, Kloss

1911. Ann. Mag. Nat. Hist. 8, VII, p. 118.
Lantinga Island, off Trengganu, E. Malay Peninsula.

269. CALLOSCIURUS VITTATUS LIGHTI, Chasen & Kloss

1924. Journ. Malay Branch Roy. Asiat. Soc. 2, p. 58.
Penang Island, Malaya.

270. CALLOSCIURUS VITTATUS STELLARIS, Chasen & Kloss

1924. Journ. Malay Branch Roy. Asiat. Soc. 2, p. 58.
Bintang Island, Malaya.

271. CALLOSCIURUS VITTATUS LUNARIS, Chasen & Kloss

1924. Journ. Malay Branch Roy. Asiat. Soc. 2, p. 58.
Bulan Island, Malaya.

272. CALLOSCIURUS ADAMSI, Kloss

1921. Journ. Straits Branch Roy. Asiat. Soc. 83, p. 151.
N. Sarawak, Borneo (Baram River).

pygerythrus Group

273. CALLOSCIURUS LOKROIDES LOKROIDES, Hodgson

1836. Journ. As. Soc. Bengal, V, p. 232.
Sikkim.
Synonym; *assamensis*, Gray, ex McClelland, 1843, List. Mamm. p. 143; nom. nud

274. CALLOSCIURUS LOKROIDES OWENSI, Thomas & Wroughton
1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 236.
Minsin (east bank), Upper Chindwin, Burma.

275. CALLOSCIURUS LOKROIDES SIMILIS, Gray
1867. Ann. Mag. Nat. Hist. 3, XX, p. 281.
Sikkim.

276 CALLOSCIURUS BLYTHI BLYTHI, Tytler
1854. Ann. Mag. Nat. Hist. 2, XIV, p. 172.
Dacca, Bengal, India.

277. CALLOSCIURUS BLYTHI MEARSI, Bonhote
1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 337.
Chinbyit, Lower Chindwin, Burma.

278. CALLOSCIURUS BLYTHI BELLONA, Thomas & Wroughton
1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 420.
Kin, Middle Chindwin, Burma.

279. CALLOSCIURUS BLYTHI VIRGO, Thomas & Wroughton
1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 421.
Tatkon, Upper Chindwin, Burma.

280. CALLOSCIURUS STEVENSI, Thomas
1908. Journ. Bombay Nat. Hist. Soc. XVIII, p. 246.
Beni-Chang, Abor-Miri Hills, Upper Assam.

281. CALLOSCIURUS PYGERYTHRUS PYGERYTHRUS, Geoffroy
1832. Mag. Zool. Cl. 1; Belanger Voy. Zool. p. 145, pl. vii, 1847.
Pegu, Burma.
Synonym: *inornatus*, Gray, Ann. Mag. Nat. Hist. 1867, 3, XX, p. 282.

282. CALLOSCIURUS PYGERYTHRUS JANETTA, Thomas
1914. Journ. Bombay Nat. Hist. Soc. XXIII, p. 203.
Mandalay, Upper Burma.

283. CALLOSCIURUS PHAYREI PHAYREI, Blyth
1855. Journ. Asiat. Soc. Bengal, XXIV, pp. 472, 476.
Moulmein, Burma.

284. CALLOSCIURUS PHAYREI BLANFORDI, Blyth
1862. Journ. Asiat. Soc. Bengal, XXXI, p. 333.
Ava, Upper Burma.

quinquestriatus Group

285. CALLOSCIURUS QUINQUESTRIATUS QUINQUESTRIATUS, Anderson
1871. Proc. Zool. Soc. London, p. 142, pl. x.
Ponsee, Kakhyen Hills, Yunnan border.
Synonym: *beebei*, Allen, 1911, Bull. Amer. Mus. Nat. Hist. XXX, p. 338. Kuching, Sarawak (erroneous).

286. CALLOSCIURUS QUINQUESTRIATUS IMARIUS, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 640.
Kachin, N. Burma.

287. CALLOSCIURUS QUINQUESTRIATUS SYLVESTER, Thomas
1926. Ann. Mag. Nat. Hist. 9, XVII, p. 641.
Schweli-Salween Divide, W. Yunnan.

hippurus Group

288. CALLOSCIURUS HIPPURUS HIPPURUS, Geoffroy

1832. Mag. Zool. Cl. 1, pl. VI.
Java (erroneous), substitute Malacca.
Synonym: *rufogaster*, Gray, 1842, Ann. Mag. Nat. Hist. X, p. 263. Malacca.

289. CALLOSCIURUS HIPPURUS GRAYI, Bonhote

1901. Ann. Mag. Nat. Hist. 7, VII, p. 171.
Sarawak, Borneo.

290. CALLOSCIURUS HIPPURUS HIPPUROSUS, Lyon

1907. Smiths. Misc. Coll. L, Pt. 1, p. 26.
Tarussan Bay, W. Sumatra.

291. CALLOSCIURUS HIPPURUS HIPPURELLUS, Lyon

1907. Smiths. Misc. Coll. L, Pt. 1, p. 27.
Batu Ampar, Landak Range, W. Borneo.

292. CALLOSCIURUS PRYERI PRYERI, Thomas

1892. Ann. Mag. Nat. Hist. 6, X, p. 214.
Near Sandakan, British N. Borneo.

293. CALLOSCIURUS PRYERI INQUINATUS Thomas

1908. Journ. Bombay Nat. Hist. Soc. XVIII, p. 247.
Lawas River, N.-W. Borneo.

294. CALLOSCIURUS MELANOGASTER MELANOGASTER, Thomas

1895. Ann. Mus. Civ. Stor. Genoa, XIV, p. 668.
Sipora, Mentawei Islands, W. Sumatra.

295. CALLOSCIURUS MELANOGASTER ATRATUS, Miller

1903. Smiths. Misc. Coll. XLV, p. 13.
N. Pagi Island, W. Sumatra.

296. CALLOSCIURUS MELANOGASTER MENTAWI, Chasen & Kloss

1928. Proc. Zool. Soc. London, p. 822.
Siberut Island, W. Sumatra.

297. CALLOSCIURUS BROOKEI, Thomas

1892. Ann. Mag. Nat. Hist. 6, IX, p. 253.
Sarawak, Borneo.

298. CALLOSCIURUS SAMARENSIS, Steere

1890. List Birds. Mamm. Steere Exp. Philippines, p. 30.
Samar, Philippine Islands.

299. CALLOSCIURUS MINDANENSIS, Steere

1890. List Birds. Mamm. Steere Exp. Philippines, p. 29.
Mindanao, Philippine Islands.
Synonym: *cagsi*, Meyer, 1890, Proc. Zool. Soc. London, p. 600. Davao, S. Mindanao.

300. CALLOSCIURUS PHILIPPINENSIS, Waterhouse

1839. Proc. Zool. Soc. London, p. 117.
Mindanao, Philippine Islands.

301. CALLOSCIURUS STEERII, Gunther

1876. Proc. Zool. Soc. London, p. 735, pl. xix, fig. 1.
Balabac Island, Philippine Islands.

302. CALLOSCIURUS JUVENCUS, Thomas
1908. Ann. Mag. Nat. Hist. 8, II, p. 498.
Palawan, Philippine Islands.

303. CALLOSCIURUS MOLLENDORFFI, Matschie
1898. Sitz. Ber. Ges. Nat. Fr. Berlin, 5, p. 41.
Calamianes, Philippine Islands.

304. CALLOSCIURUS ALBICAUDA, Matschie
1898. Sitz. Ber. Ges. Nat. Fr. Berlin, 5, p. 42.
Calamianes, Philippine Islands.

leucomus Group

305. CALLOSCIURUS LEUCOMUS LEUCOMUS, Müller & Schlegel
1839. Verhandl. Nat. Gesch., p. 87.
Celebes.

306. CALLOSCIURUS LEUCOMUS OCCIDENTALIS, Meyer
1898. Abh. Mus. Dresden, no. 4, p. 2.
West Celebes.

307. CALLOSCIURUS TOPAPUENSIS, Roux
1910. Zool. Anz. 35, p. 518.
Mt. Topapu, Central Celebes.

308. CALLOSCIURUS MOWEWENSIS, Roux
1910. Zool. Anz. 35, p. 519.
Mowewe, S.-E. Celebes.

309. CALLOSCIURUS ELBERTAE, Schwarz
1911. Ann. Mag. Nat. Hist. 8, VII, p. 639.
E. Kabaena, off Celebes.

310. CALLOSCIURUS TONKEANUS, Meyer
1896. Abh. Mus. Dresden, no. 6, p. 25, pl. x, fig. 1.
Tonkean, Celebes.

311. CALLOSCIURUS SARASINORUM, Meyer
1898. Abh. Mus. Dresden, no. 4, p. 1.
Central Celebes.

312. CALLOSCIURUS WEBERI, Jentink
1890. Weber. Zool. Ergebn. 1, p. 115, pls. viii, x.
Central Celebes.

313. CALLOSCIURUS TINGAHI, Meyer
1896. Abh. Mus. Dresden, no. 6, p. 27, pl. x, fig. 4.
Sangir Islands, Celebes.

314. CALLOSCIURUS ROSENBERGI, Jentink
1879. Notes Leyden Mus. p. 37.
Sangir Islands, Celebes.

rubriventer Group

315. CALLOSCIURUS RUBRIVENTER, Forsten
1839. Müller & Schlegel, Verhandl. Nat. Gesch. p. 86.
Minahassa, N. Celebes.

incertae sedis; not allocated to groups

316. CALLOSCIURUS ALSTONI, Anderson

1879. Zool. W. Yunnan, p. 252, pl. xxi.
(?) Borneo.

317. CALLOSCIURUS DIARDI, Jentink

1879. Notes Leyden Mus. 1, p. 39.
Nusa Kambangan, off Tjilatjap, Java.

318. CALLOSCIURUS CHINENSIS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 282.
"China" (based on a specimen of *tenuis*?).

Addenda:

maclellandi Group

CALLOSCIURUS MACLELLANDI DOLPHOIDES, Kloss.

1921. Journ. Nat. Hist. Soc. Siam, IV, p. 101.
Kompong Som Bon, Cambodia.

erythraeus Group

CALLOSCIURUS FINLAYSONI RAJASIMA, Kloss.

1920. Journ. Nat. Hist. Soc. Siam, IV, p. 103.
Lat Bua Kao, East Siam.

CALLOSCIURUS FINLAYSONI PRACHIN, Kloss.

1916. Journ. Nat. Hist. Soc. Siam, II, p. 16.
Krabin, Central Siam.

There are also at the British Museum skulls bearing the names "*nigrovittatus rubrigula*" and "*caniceps tabitus*." The references to these races have not been traced.

Genus 9. FUNAMBULUS, Lesson

1835. FUNAMBULUS, Lesson, Illustr. de Zool. (15) pl. 43, 2 pp. text.
1890. EOXERUS, Forsyth Major, Proc. Zool. Soc. London, p. 189, part, subgenus of *Xerus* containing species now referred to this genus, *Menetes*, *Lariscus* and *Rhinosciurus*.
1923. TAMIODES, Pocock, Proc. Zool. Soc. London, p. 215. (*Funambulus tristriatus*, Waterhouse.)

TYPE SPECIES.—*Funambulus indicus*, Lesson = *Sciurus palmarum*, Linnaeus.

RANGE.—Ceylon, Southern Peninsular India, north to Surat, Palanpur, Central Provinces, Bihar, Rawalpindi (North Punjab), and Baluchistan.

NUMBER OF FORMS.—Twenty-four.

CHARACTERS.—Skull with more or less elongate rostrum; postorbital process not large; parietal ridges frequently joined together. Zygomatic plate as a rule slanting upwards far forwards, and relatively prominently ridged. Infraorbital foramen normal. Palate normal. Coronoid process usually low. Cheekteeth with upper series characterized in the young by noticeably high cusps; P.3 well developed; the ridges high and the depressions deep, in the main teeth; the small outer third cusp, usually present in *Sciurus*, is generally absent or scarcely traceable in this genus. Lower cheekteeth with four well-marked cusps each tooth, the small subsidiary cusps of *Sciurus* usually not clear; the central depression tending to be rather smaller than is usual in *Sciurus* or *Callosciurus*; the transverse ridge extending from the anteroexternal to the antero-internal cusp present.

Forsyth Major transferred this group to *Xerus* (with *Menetes*, *Lariscus*, *Rhinosciurus*, etc.), evidently rather on cranial than dental characters, remarking, "the less semihypsodont oriental *S. tristriatus* and *S. palmarum* tend to connect the *Xerus* type with the *Sciurus vulgaris* type (of tooth) in approaching the form of molar of most of the middle-sized Oriental Squirrels" (referring to *Callosciurus*).

But no one, so far as I have traced, has ever defined this genus, and to do so is no easy matter. Thomas proposed that all subgenera of Forsyth Major (of *Xerus* and *Sciurus*) should be given generic rank; but the above-mentioned dental characters are scarcely of generic importance. The characters of the baculum, so far as I have read, while very variable within the genus, are not those either of *Sciurus* or *Callosciurus*. Other than the fact that the cusps are noticeably high as a rule in the cheekteeth (when young), and that the coronoid process appears rather low, and the zygomatic plate which seems different from *Sciurus*, though not from *Callosciurus* in every case, I can find no constant difference between this genus and *Callosciurus* on the one hand, *Sciurus* on the other. As I feel uncertain to which of these *Funambulus* stands nearest, and it has long been regarded as forming a natural group, I retain it. Externally with three prominent white stripes usually present (five in *pennanti*); the central one is mid-dorsal. In *sublineatus*, a small thick-furred type with the tail normally more narrow than is usual, these stripes much reduced. In *layardi*, all but the mid-dorsal stripe are becoming reduced. These two species are rather darker than the other forms. Fur normally rather coarse and short. Tail not reduced in length; digits normal (arboreal type).

Pocock erected *Tamiodes* in 1923, based solely on formation of baculum, for *F. tristriatus*. In 1936, Osman Hill (Ceylon Journ. Sci. Section B, Zool. & Geol., XX, pt. 1, p. 100) reviewed the penial characters of the squirrels of Ceylon, and remarks: "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 the 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. The alternative is to re-define the genera *Tamiodes* and *Funambulus* to fit the new knowledge, and probably in addition to institute a third genus for *sublineatus*." In the same paper he writes: "*Ratufa* would appear to be very different from the smaller Squirrels in its penial characters, but there is apparently less uniformity through the genus than would have been expected. The differences of *R. macroura* from the others cannot at this stage, however, be granted to be of generic importance, though differences of similar order have been used by Pocock in separating some of the smaller Squirrels generically."

It is clear that if each species (or subspecies) which differs in this respect is to be given a new generic name, we shall soon have to deal with over a thousand genera in this Order! But whereas differences in baculum may be valid as regards solving the problem of whether two forms belong to the same species or not, I am strongly of opinion that no generic names based solely on the shape of this organ can be retained. This view is held by Howell, 1938, who remarks: "The writer does not believe, however, that in the absence of trenchant cranial characters, the morphology of the baculum alone should be considered of generic value."

List of Named Forms

palmarum Group

1. FUNAMBULUS PALMARUM PALMARUM, Linnaeus

1766. Syst. Nat. 1, p. 86.
Madras.
Synonym: *penicillatus*, Leach, 1814, Zool. Misc. 1, p. 6, pl. 1.
indicus, Lesson, 1835, Illustr. de Zool. (15) pl. 43.

2. FUNAMBULUS PALMARUM COMORINUS, Wroughton

1905. Journ. Bombay Nat. Hist. Soc. XVI, p. 411.
Trivandrum, Travancore.

3. FUNAMBULUS PALMARUM BELLARICUS, Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 647.
Vizayanagar, Bellary, South India.

4. FUNAMBULUS PALMARUM FAVONICUS, Thomas & Wroughton

1915. Journ. Bombay Nat. Hist. Soc. XXIV, p. 39.
Udugama, Southern Province, Ceylon.

5. FUNAMBULUS PALMARUM KELAARTI, Layard

1849. Blyth, Journ. Asiat. Soc. Bengal, XVIII, p. 602, footnote, id. op. cit. XX, p. 166, 1852.
Hambalotte, Ceylon.

6. FUNAMBULUS PALMARUM BRODIEI, Blyth

1849. Journ. Asiat. Soc. Bengal, XVIII, p. 602.
Point Pedro, Ceylon.

7. FUNAMBULUS PALMARUM OLYMPIUS, Thomas & Wroughton

1915. Journ. Bombay Nat. Hist. Soc. XXIV, p. 41.
Urugalla, Highlands of Central Ceylon.

8. FUNAMBULUS PALMARUM ROBERTSONI, Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 647.
Pachmarhi, Hoshangabad, Central Provinces, India.

9. FUNAMBULUS PALMARUM BENGALENSIS, Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 648.
Hazaribagh, Bengal (now Bihar).

10. FUNAMBULUS PALMARUM MATUGAMENSIS, Lindsay

1926. Journ. Bombay Nat. Hist. Soc. XXXI, p. 239.
Matugama, Western Province, Ceylon.

11. FUNAMBULUS THOMASI, Wroughton & Davidson

1919. Journ. Bombay Nat. Hist. Soc. XXVI, 3, p. 729.
Khandalla, Bombay Presidency.

12. FUNAMBULUS GOSSEI, Wroughton & Davidson

1919. Journ. Bombay Nat. Hist. Soc. XXVI, 3, p. 730.
Kotagiri, Nilgiris, India.

13. FUNAMBULUS PENNANTI PENNANTI, Wroughton

1905. Journ. Bombay Nat. Hist. Soc. XVI, 3, p. 411.
Mandvi Taluka, Surat district, Bombay.

14. FUNAMBULUS PENNANTI ARGENTESCENS, Wroughton

1905. Journ. Bombay Nat. Hist. Soc. XVI, p. 413.
Rawalpindi, North Punjab.

15. FUNAMBULUS PENNANTI LUTESCENS, Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 430.
Deesa, Palanpur.

16. FUNAMBULUS TRISTRIATUS TRISTRIATUS, Waterhouse

1837. Charlesworth's Mag. Nat. Hist. 1, pp. 496–9.
Madras (by designation).
Synonym: *dussumieri*, Milne-Edwards, 1867, Rev. Zool. XIX, p. 226. Malabar.

17. FUNAMBULUS TRISTRIATUS NUMARIUS, Wroughton

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 646.
Helwak, Satara district, Western Ghats, Bombay.

18. FUNAMBULUS TRISTRIATUS ANNANDALEI, Robinson

1917. Rec. Ind. Mus. XIII, p. 41.
Shasthancotta, west of Western Ghats, Travancore.

19. FUNAMBULUS WROUGHTONI, Ryley

1913. Journ. Bombay Nat. Hist. Soc. XXII, p. 437.
Makut, S. Coorg.

layardi Group

20. FUNAMBULUS LAYARDI LAYARDI, Blyth

1849. Journ. Asiat. Soc. Bengal, XVIII, p. 602.
Ambegamoa Hills, Ceylon.

21. FUNAMBULUS LAYARDI DRAVIDIANUS, Robinson

1917. Rec. Ind. Mus. XIII, p. 42.
West side Western Ghats, Travancore.

22. FUNAMBULUS LAYARDI SIGNATUS, Thomas

1924. Ann. Mag. Nat. Hist. 9, XIII, p. 241.
Ratnapura, S. Ceylon.

sublineatus Group

23. FUNAMBULUS SUBLINEATUS SUBLINEATUS, Waterhouse

1838. Proc. Zool. Soc. London, p. 19.
Nilgiris, India.
Synonym: *delesserti*, Gervais, 1841, L'Institut, p. 171. Nilgiris.

24. FUNAMBULUS SUBLINEATUS OBSCURUS, Pelzeln & Kohl

1886. Verh. Zool. Bot. Ges. Wien, XXXV, p. 525.
Uplands of Ceylon.
Synonym: *kathleenae*, Thomas & Wroughton, Journ. Bombay Nat. Hist. Soc. XXIV, p. 38, 1915. Kottawa, South Province, Ceylon.
trilineatus, Kelaart, Prodr. Faun. Zeylon, p. 54, 1852; for status see Robinson & Kloss, Nominal List Oriental Sciuridae, Rec. Indian Mus. XV, pt. 4.

Forms seen: *argentescens*, *bellaricus*, *brodiei*, *comorinus*, *favonicus*, *gossei*, *kathleenae*, *kelaarti*, *layardi*, *lutescens*, *matugamensis*, *numarius*, *obscurus*, *olympus*, *palmarum*, *pennanti*, *robertsoni*, *signatus*, *sublineatus*, *thomasi*, *tristriatus*, *wroughtoni*.

Genus 10. DREMOMYS, Heude

1898. DREMOMYS, Heude, Mém. Hist. Nat. Emp. Chinois, IV, pt. 2, p. 54.
1908. ZETIS, Thomas, Journ. Bombay Nat. Hist. Soc. XVIII, p. 245. (*Sciurus rufigenis*, Blanford.)

TYPE SPECIES.—*Sciurus pernyi*, Milne-Edwards.

RANGE.—Indo-Malayan chiefly, but touching extreme south of Palaearctic China. Hupeh, Szechuan; Fukien, Kweichow, Anhwei, Kwantung, Yunnan; Formosa, Hainan; Nepal, Sikkim, Assam, Burma, Tenasserim; Tongking, Annam, south to Selangor; Borneo.

NUMBER OF FORMS.—About twenty-nine.

CHARACTERS.—This genus, which is said to agree with the "*Tomentes*" section of *Callosciurus* in the characters of the baculum, is only separable on average characters from that genus. The rostrum becomes progressively elongated until at extreme development it is abnormal, being second only to the extreme genus *Rhinosciurus*. But in *D. lokriah*, which is the shortest-nosed species of the genus, the rostrum is probably not longer than in some forms of *Callosciurus*.

The lachrymal is situated farther back in relation to the toothrows than is normal, and the postorbital process is not very far in front of the level of the posterior zygomatic root. The parietal ridges evidently do not join, or very rarely tend to come together. Bullae often relatively small. Zygomatic plate moderately ridged, not essentially different from *Sciurus*. Frontals broad; postorbital process moderate. Cheekteeth evidently not essentially different from *Sciurus*. Lower cheekteeth without abnormalities. P.3 present. Forsyth Major referred a species of this genus to *Sciurus*, in his paper on the dental characters of the family; later the group was transferred, with *Rhinosciurus*, *Menetes*, and *Lariscus*, to the genus *Funambulus*; still later Thomas erected *Zetis* for the group, which is antedated by *Dremomys*, Heude. It is evidently a natural group, though as indicated above very close to *Callosciurus*.

Tail rather shorter than head and body. Fur thick and soft. Hindfoot rather narrow; digits arranged in the manner characteristic of normal Tree-squirrels. The rostrum apparently reaches its extreme development in members of the *rufigenis* group.

Forms seen: *adamsoni, belfieldi, bhotia, calidior, chintalis, everetti, flavior, fuscus, garonum, griselda, gularis, howelli, imus, laomache, lichiensis, lokriah, macmillani, mentosus, modestus, opimus, ornatus, owstoni, pernyi, pyrrhomerus, rufigenis, senex, "subflaviventris."*

I am inclined provisionally to recognize three groups in this genus:

rufigenis group: rostrum usually extreme, cheeks usually red, underside of tail bright red throughout its length.

lokriah group: rostrum apparently shortest of genus; belly bright yellow. *D. macmillani* appears to me to be not more than racially distinct from *lokriah*. Underside tail and cheeks not red, so far as seen.

pernyi group: the other species; rostrum moderate to extreme; underside tail and cheeks not red, so far as seen; belly usually white (transitionary towards *lokriah* in *D. owstoni*). *D. everetti*, Borneo, appears to have a narrower shorter tail than is usual in the genus.

List of Named Forms

lokriah Group

1. DREMOMYS LOKRIAH LOKRIAH, Hodgson

1836. Journ. Asiat. Soc. Bengal, V, p. 232.
Nepal.

2. DREMOMYS LOKRIAH BHOTIA, Thomas

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 426.
Sedonchen, E. Sikkim.
Synonym: (?) *subflaviventris*, Gray, 1843, Hand List Mamm. Brit. Mus. p. 144. (?) Assam. Considered a *nomen nudum* by Robinson & Kloss, 1918.

3. DREMOMYS LOKRIAH GARONUM, Thomas

1922. Journ. Bombay Nat. Hist. Soc. XXVIII, 2, p. 430.
Tura, Garo Hills, Assam.

4. DREMOMYS LOKRIAH MACMILLANI, Thomas

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 238.
Kindat, Chindwin River, Upper Burma.
(Listed as a valid species by Robinson & Kloss.)

pernyi Group

5. DREMOMYS PERNYI PERNYI, Milne-Edwards

1867. Rev. et Mag. Zool. p. 230, pl. XIX.
Szechuan, China.

6. DREMOMYS PERNYI FLAVIOR, Allen

1912. Proc. Biol. Soc. Washington, XXV, p. 178.
S.-E. Yunnan, China.

7. DREMOMYS PERNYI GRISELDA, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVII, p. 392.
Nagchuka, W. Szechuan, China.

8. DREMOMYS PERNYI MODESTUS, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVII, p. 393.
Kwei-Chow, Sui-Yang, China.

9. DREMOMYS PERNYI SENEX, Allen

1912. Mem. Mus. Harvard, XL, no. 4, p. 229.
Ichang, China.

10. DREMOMYS PERNYI CHINTALIS, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVII, p. 394.
Chinteh, Anh-wei, China.

11. DREMOMYS PERNYI CALIDIOR, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVII, p. 394.
Kuatun, N.-W. Fo-Kien, China.

12. DREMOMYS PERNYI LICHIENSIS, Thomas

1922. Ann. Mag. Nat. Hist. 9, X, p. 403.
Li-Kiang Valley, Yunnan, China.

13. DREMOMYS PERNYI HOWELLI, Thomas

1922. Ann. Mag. Nat. Hist. 9, X, p. 401.
Ma Chang Kai, near Tengyueh, Upper Irrawaddy, Burma.

14. DREMOMYS PERNYI MENTOSUS, Thomas

1922. Ann. Mag. Nat. Hist. 9, X, p. 401.
Kindat, Chin Hills, Burma.

15. DREMOMYS PERNYI IMUS, Thomas

1922. Ann. Mag. Nat. Hist. 9, X, p. 402.
Mount Imaw Bum, N. Burma.

16. DREMOMYS OWSTONI, Thomas

1908. Journ. Bombay Nat. Hist. Soc. XVIII, p. 248.
Mount Arizan, Central Formosa.

17. DREMOMYS EVERETTI, Thomas

1890. Ann. Mag. Nat. Hist. 6, VI, p. 71.
Penrisen, Sarawak, Borneo.

rufigenis Group

18. DREMOMYS RUFIGENIS RUFIGENIS, Blanford

1878. Journ. Asiat. Soc. Bengal, XLVII, 2, p. 156, pl. viii.
Mount Mooleyit, Central Tenasserim.

19. DREMOMYS RUFIGENIS BELFIELDI, Bonhote

1908. Journ. Fed. Malay States Mus. III, p. 9, pl. 1.
Mountains of Selangor, Malay Peninsula.

20. DREMOMYS RUFIGENIS FUSCUS, Bonhote

1907. Abstr. Proc. Zool. Soc. London, p. 2; Proc. Zool. Soc. London, 1907, p. 10.
Bali, Annam.

21. DREMOMYS RUFIGENIS ADAMSONI, Thomas

1914. Journ. Bombay Nat. Hist. Soc. XXIII, p. 25.
Maymyo, Upper Burma.

22. DREMOMYS RUFIGENIS ORNATUS, Thomas

1914. Journ. Bombay Nat. Hist. Soc. XXIII, p. 26.
Near Mong-tze, Yunnan.

23. DREMOMYS RUFIGENIS OPIMUS, Thomas

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 237.
Hkamti, Upper Chindwin, Burma.

24 DREMOMYS RUFIGENIS PYRRHOMERUS, Thomas

1895. Ann. Mag. Nat. Hist. 6, XVI, p. 472.
Ichang, China.

25. DREMOMYS RUFIGENIS RIUDONENSIS, Allen

1906. Bull. Amer. Mus. Nat. Hist. XXII, p. 472.
Riudon, Hainan.

26. DREMOMYS RUFIGENIS GULARIS, Osgood

1932. Field Mus. Nat. Hist. Publ. Zool. Ser. XVIII, p. 284.
Mt. Fan Si Pan, near Chapa, Tongking.

27. DREMOMYS RUFIGENIS LAOMACHE, Thomas

1921. Ann. Mag. Nat. Hist. 9, VII, p. 182.
Ban Hoi Mak, near Pak Hin Bun, Mekong River, Laos.

28. DREMOMYS RUFIGENIS LENTUS, Howell

1927. Journ. Washington Acad. Nat. Sci., XVII, p. 80.
Wenchaunshein, Szechuan, China.

incertae sedis

29. DREMOMYS MELLI, Matschie

1922. Beitr. Faun. Sinica, 88, 10, p. 23.
Mountains east of Shiuchow, Kwantung Province, China.

Genus 11. RATUFA, Gray

1867. RATUFA, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 273.
1880. EOSCIURUS, Trouessart, Le Naturaliste, ii, no. 37, p. 291. (*Sciurus bicolor*, Sparrmann.)
1867. RUKAIA, Gray, Ann. Mag. Nat. Hist. 3, XX, pp. 275–276. (*Sciurus macrourus*, Pennant.)

TYPE SPECIES.—*Sciurus indicus*, Erxleben.

RANGE.—Indo-Malayan; Ceylon, Southern India (Malabar, Coorg, Mysore); Bombay, Surat, Central Provinces, Orissa; Nepal; Bengal, Assam, Burma, Tenasserim; West Yunnan; Hainan; Annam, Siam, Malay Peninsula and small adjacent islands; Sumatra, Java, Borneo; Banka, Billiton, Bali, Natunas.

NUMBER OF FORMS.—About seventy-two.

CHARACTERS.—Very large arboreal Squirrels with heavy broad skull, very prominent postorbital processes, brachyodont cheekteeth in which the cusps are low and the pattern as a rule not clear, and feet considerably specialized for arboreal life.

Skull with somewhat depressed frontals, and large heavy postorbital process which stands out noticeably from the skull in all species of the genus. Braincase smooth, the hinder portion depressed downwards posteriorly. Rostrum short and broad; frontals very broad. The parietal ridges evidently show no sign of coming together. Zygomatic plate broad, moderately ridged on its upper border and slanting gradually upwards, as in *Sciurus*. Infraorbital foramen normal, forming canal, and with masseter knob present. Mandible normal, angular process not much inflected. Bullae relatively large; palate broad, normal. Incisors without special peculiarities.

Cheekteeth $\frac{4}{4}$. Originally there is evidently a pattern characteristic of the family in the upper series, but the cusps are always extremely low, and the pattern is usually obscured by many small depressions and pits, and appears always less definite than in *Sciurus*. The lower cheekteeth with the central depression normally moderately well marked, but the cusps much flatter than in *Sciurus* and allies, even the anterointernal cusp normally being only very slightly raised above the general level of the tooth, and sometimes wearing down altogether. A short re-entrant fold between the two outer main cusps normally traceable.

Size large, usually over 250 mm. or even over 300 mm. up to 470 head and body length, or perhaps more. Tail long, thickly bushy, rarely a little shorter than head and body, often much longer. Forefoot extremely broad, and rather reminiscent in some ways of that of the Erethizontidae; D.4 longer than D.3; D.5 and D.2 shorter, subequal; the inner pad is very much expanded and probably takes the place of the pollex and is used for gripping. Hindfoot broad, with well-developed hallux and normal arrangement of the digits, D.4 being the longest. Claws thick, powerful. The plantar and palmar pads, which are evidently considerably specialized, have been described by Pocock, Proc. Zool. Soc. London, 1922, p. 1185.

As noticed under the genus *Funambulus* there is some variation in the shape of the baculum in this genus.

Forms seen: *affinis*, *aureiventer*, *baliensis*, *baramensis*, *bengalensis*, *bicolor*, *bunguranensis*, *carimonensis*, *celaenopepla*, *centralis*, *ceylonica*, *condurensis*, *conspicua*, *cothurnata*, *dandolena*, *dealbata*, *decolorata*, *ephippium*, *felli*, *fretensis*, *gigantea*, *hainana*, *indica*, *insignis*, *johorensis*, *laenata*, *leucogenys*, *lutrina*, *macroura*, *macruroides*, *marana*, *masae*, *maxima*, *melanochra*, *melanopepla*, *nanogigas*, *palliata*, *penangensis*, *phaeopepla*, *piniensis*, *pyrsonota*, *sandakanensis*, *sinhala*, *sinus*, *sirhassensis*, *smithi*, *stigmosa*, *superans*, *tennenti*, *tiomanensis*.

The classification of Robinson & Kloss, 1918, Rec. Indian Mus. XV, pt. IV, pp. 171–250, Nominal List of Oriental Sciuridae, is accepted.

The genus apparently does not divide clearly into groups; it may be mentioned that the ear is heavily tufted in *indica*, all races of which except *dealbata* are coloured red so far as seen, and which appears distinct from most of the other forms; the ear also is tufted in *gigantea*, and more or less so in *macroura*.

List of Named Forms

1. RATUFA MACROURA MACROURA, Pennant

1769. Ind. Zool. 1, Pl. 1.

Highlands of Ceylon.

Synonym: *ceylonicus*, Erxleben, 1777, Syst. Regn. An. p. 416. Ceylon.
tennenti, Blyth, 1851, Journ. Asiat. Soc. Bengal, XX, p. 165. Mountains, Ceylon.
zeylanicus, Ray, 1693, Syn. Quadr. p. 215 (*fide* Trouessart).

2. RATUFA MACROURA MELANOCHRA, Thomas & Wroughton

1915. Journ. Bombay Nat. Hist. Soc., XXIV, p. 36.
Kottawa, Southern Ceylon.

3. RATUFA MACROURA ALBIPES, Blyth

1859. Journ. Asiat. Soc. Bengal, XXVIII, p. 287.
Locality unknown.

4. RATUFA MACROURA DANDOLENA, Thomas & Wroughton

1915. Journ. Bombay Nat. Hist. Soc., XXIV, p. 36.
Wellawaya, Uva, Lowland Ceylon. (This race is also known from S. India.)

5. RATUFA MACROURA SINHALA, Phillips

1931. Ceylon Journ. Sci. Sec. B, XVI, p. 215.
Nikawewa, near Kantalai, Eastern Province, Ceylon.

6. RATUFA INDICA INDICA, Erxleben

1777. Syst. Regn. An. p. 420.
Bombay Presidency.
Synonym: *purpureus*, Zimmermann, 1777, Spec. Zool. Geogr. Quad. p. 518. Bombay.
(?) *elphinstonei*, Sykes, 1831, Proc. Zool. Soc. London, p. 103. Deccan.
(?) *malabarica*, Schinz, 1845, Syn. Mamm. II, p. 32. Malabar.

7. RATUFA INDICA SUPERANS, Ryley

1913. Journ. Bombay Nat. Hist. Soc., XXII, p. 436.
Wotekolli, South Coorg, India.

8. RATUFA INDICA BENGALENSIS, Blanford

1897. Journ. Bombay Nat. Hist. Soc., XI, p. 303, Pl. B, fig. 2.
Locality not precisely specified.

9. RATUFA INDICA CENTRALIS, Ryley

1913. Journ. Bombay Nat. Hist. Soc., XXII, p. 436.
Hoshangabad, Central Provinces, India.

10. RATUFA INDICA MAXIMA, Schreber

1784. Säugth. IV, p. 784, Pl. CCXXII, B.
Malabar, India.

11. RATUFA INDICA DEALBATA, Blanford

1897. Journ. Bombay Nat. Hist. Soc., XI, p. 299, Pl. A, fig. 1.
Surat Dangs, India.

12. RATUFA BICOLOR BICOLOR, Sparrmann

1778. Gotheb. Wet. Seversk. Handl. I, p. 70.
Anjer, West Java.
Synonym: *major*, Miller, 1911, Proc. Biol. Soc. Washington, XXIV, p. 28. Anjer, West Java.
(?) *albiceps*, Desmarest, 1817, Nouv. Dict. Hist. Nat., X, p. 105. Java.
javensis, Zimmermann, Geog. Ges., II, 1780, p. 342.
(?) *leschenaulti*, Desmarest, Mamm., 1820, p. 335.
(?) *humeralis*, Coulon, Mém. Soc. Sci. Nat. Neuchatel, 1835, I, p. 122.

13. RATUFA BICOLOR BALIENSIS, Thomas

1913. Ann. Mag. Nat. Hist. 8, XI, p. 506.
Tjetoekambawang, Bali.

14. RATUFA BICOLOR PALLIATA, Miller
1902. Proc. Acad. Nat. Sci. Philadelphia, LIV, p. 147.
Indragiri River, E. Sumatra.

15. RATUFA BICOLOR LAENATA, Miller
1903. Proc. U.S. Nat. Mus., XXVI, p. 449.
Pulau Tuangku, Banjak Islands, W. Sumatra.

16. RATUFA BICOLOR BATUANA, Lyon
1916. Proc. U.S. Nat. Mus., LII, p. 445.
Tana Bala, Batu Islands, W. Sumatra.

17. RATUFA BICOLOR SMITHI, Robinson & Kloss
1922. Ann. Mag. Nat. Hist. 9, IX, p. 89.
Langbian Peaks, South Annam.

18. RATUFA NOTABILIS NOTABILIS, Miller
1902. Proc. Acad. Nat. Sci. Philadelphia, p. 150.
Lingga Island, Rhio-Lingga Archipelago.

19. RATUFA NOTABILIS INSIGNIS, Miller
1903. Smiths. Misc. Coll., XLV, p. 4.
Pulau Sugi, Rhio-Lingga Archipelago.

20. RATUFA NOTABILIS BULANA, Lyon
1909. Proc. U.S. Nat. Mus., XXXVI, p. 482.
Pulau Bulan, Rhio-Lingga Archipelago.

21. RATUFA NOTABILIS CARIMONENSIS, Miller
1906. Proc. U.S. Nat. Mus., XXXI, p. 257.
Great Karimon Island, Rhio-Lingga Archipelago.

22. RATUFA NOTABILIS CONDURENSIS, Miller
1906. Proc. U.S. Nat. Mus., XXXI, p. 258.
Pulau Kundur, Rhio-Lingga Archipelago.

23. RATUFA NOTABILIS CONFINIS, Miller
1906. Proc. U.S. Nat. Mus., XXXI, p. 259.
Sinkep Island, Rhio-Lingga Archipelago.

24. RATUFA NOTABILIS CONSPICUA, Miller
1903. Smiths. Misc. Coll., XLV, p. 5.
Pulau Bintang, Rhio-Lingga Archipelago.

25. RATUFA EPHIPPIUM EPHIPPIUM, Muller
1838. Tijds. Nat. Gesch. Physiol., V, p. 147.
S.-E. Borneo, low country.

26. RATUFA EPHIPPIUM COTHURNATA, Lyon
1911. Proc. U.S. Nat. Mus., XL, p. 93.
Mount Palung, near Sukadana, W. Borneo.

27. RATUFA EPHIPPIUM BARAMENSIS, Bonhote
1900. Ann. Mag. Nat. Hist. 7, V, p. 496.
Baram district, Sarawak, Borneo.

28. RATUFA EPHIPPIUM SANDAKANENSIS, Bonhote
1900. Ann. Mag. Nat. Hist. 7, V, p. 497.
Sandakan, British N. Borneo.

29. RATUFA EPHIPPIUM GRISEICOLLIS, Lyon

1911. Proc. U.S. Nat. Mus., XL, p. 94.
Panebangen Island, W. Borneo.

30. RATUFA EPHIPPIUM VITTATA, Lyon

1911. Proc. U.S. Nat. Mus., XL, p. 94.
Pulau Laut, S.-E. Borneo.

31. RATUFA EPHIPPIUM VITTATULA, Lyon

1911. Proc. U.S. Nat. Mus., XL, p. 95.
Pulau Sebuku, S.-E. Borneo.

32. RATUFA EPHIPPIUM BUNGURANENSIS, Thomas & Hartert

1894. Nov. Zool. I, p. 658.
Bunguran Island, Natunas.

33. RATUFA EPHIPPIUM SIRHASSENENSIS, Bonhote

1900. Ann. Mag. Nat. Hist. 7, V, p. 498.
Sirhassen Island, Natunas.

34. RATUFA EPHIPPIUM NANOGIGAS, Thomas & Hartert

1895. Nov. Zool., II, p. 491.
Pulau Laut, N. Natunas.

35. RATUFA EPHIPPIUM POLIA, Lyon

1906. Proc. U.S. Nat. Mus., XXXI, p. 585.
Billiton Island, between Sumatra and Borneo.

36. RATUFA EPHIPPIUM BANCANA, Lyon

1906. Proc. U.S. Nat. Mus., XXXI, p. 587.
Banka Island, off Sumatra.

37. RATUFA EPHIPPIUM LUMHOLZI, Lönnberg

1925. Ann. Mag. Nat. Hist. 9, XVI, p. 514.
Pipoh Boelengan, E. Central Borneo.

38. RATUFA EPHIPPIUM DULITENSIS, Lönnberg & Mjöberg

1925. Ann. Mag. Nat. Hist. 9, XVI, p. 514.
Mount Dulit, Borneo.

39. RATUFA AFFINIS AFFINIS, Raffles

1822. Trans. Linn. Soc., XIII, p. 258.
Singapore.

40. RATUFA AFFINIS HYPOLEUCA, Horsfield

1824. Zool. Res. in Java, p. 165.
Bencoolen, Sumatra.

41. RATUFA AFFINIS CATEMANA, Lyon

1907. Proc. U.S. Nat. Mus., XXXII, p. 443.
Kateman River, S.-E. Sumatra.

42. RATUFA AFFINIS JOHORENSIS, Robinson & Kloss

1911. Journ. Fed. Malay States Mus., IV, p. 244.
Padang Tuan, Segamat, N.-W. Johore.

43. RATUFA AFFINIS AURIVENTER, Is. Geoffroy

1832. Mag. Zool. Cl. 1, pl. v.
"Java" (in error): substitute Malacca.

44. RATUFA AFFINIS ARUSINUS, Lyon

1907. Proc. U.S. Nat. Mus., XXXII, p. 442.
Aru Bay, N.-E. Sumatra.

45. RATUFA AFFINIS PYRSONOTA, Miller
1900. Proc. Washington Acad. Sci., II, p. 75.
Trang, Siamese Malaya.

46. RATUFA AFFINIS FEMORALIS, Miller
1903. Proc. U.S. Nat. Mus., XXVI, p. 447.
Pulau Tuangku, Banjak Islands, off W. Sumatra.

47. RATUFA AFFINIS NIGRESCENS, Miller
1903. Proc. U.S. Nat. Mus., XXVI, p. 448.
Pulau Mansalar, near Tapanuli Bay, W. Sumatra.

48. RATUFA AFFINIS BALAE, Miller
1903. Smiths. Misc. Coll., XLV, p. 7.
Tana Bala, Batu Islands, W. Sumatra.

49. RATUFA AFFINIS MASAE, Miller
1903. Smiths. Misc. Coll., XLV, p. 8.
Tana Masa, Batu Islands, W. Sumatra.

50. RATUFA AFFINIS PINIENSIS, Miller
1903. Smiths. Misc. Coll., XLV, p. 7.
Pulau Pinie, Batu Islands, W. Sumatra.

51. RATUFA AFFINIS BANGUEYI, Chasen & Kloss
1932. Bull. Raffles Mus. 6, p. 22.
Banguey Island, N. Borneo.

52. RATUFA AFFINIS INTERPOSITA, Kloss
1933. Bull. Raffles Mus. 7, p. 2.
Selangor, Malaya.

53. RATUFA AFFINIS FRONTALIS, Kloss
1933. Bull. Raffles Mus. 7, p. 2.
Perak, Malaya.

54. RATUFA GIGANTEA GIGANTEA, Macclelland
1839. Proc. Zool. Soc. London, p. 150.
Assam.

55. RATUFA GIGANTEA LUTRINA, Thomas & Wroughton
1916. Journ. Bombay Nat. Hist. Soc., XXIV, p. 226.
West bank of Upper Chindwin, Upper Burma.

56. RATUFA GIGANTEA MACRUROIDES, Hodgson
1849. Journ. Asiat. Soc. Bengal, XVIII, p. 775.
Bengal.

57. RATUFA GIGANTEA FELLI, Thomas & Wroughton
1916. Journ. Bombay Nat. Hist. Soc., XXIV, p. 226.
Yin, Lower Chindwin, Burma.

58. RATUFA GIGANTEA HAINANA, Allen
1906. Bull. Amer. Mus. Nat. Hist., XXII, p. 472.
Cheteriang, Hainan.

59. RATUFA GIGANTEA STIGMOSA, Thomas
1923. Journ. Bombay Nat. Hist. Soc., XXIX, 1, p. 86.
Doi Sritepe, Chiengmai, Siam.

60. RATUFA PHAEOPEPLA PHAEOPEPLA, Miller

1913. Smiths. Misc. Coll., LXI, no. 21, p. 25.
Sungei Balik, S. Tenasserim.
(Robinson & Kloss evidently consider this species doubtfully distinguishable from *melanopepla*.)

61. RATUFA PHAEOPEPLA MARANA, Thomas & Wroughton

1916. Journ. Bombay Nat. Hist. Soc., XXIV, p. 227.
Mount Popa, Burma.

62. RATUFA PHAEOPEPLA LEUCOGENYS, Kloss

1916. Proc. Zool. Soc. London, p. 43.
Lem Ngop, S.-E. Siam.

63. RATUFA PHAEOPEPLA SINUS, Kloss

1916. Proc. Zool. Soc. London, p. 44.
Koh Kut Island, S.-E. Siam.

64. RATUFA MELANOPEPLA MELANOPEPLA, Miller

1900. Proc. Washington Acad. Sci., II, p. 71.
Telibon Island, Trong, Siamese Malaya.

65. RATUFA MELANOPEPLA PENINSULAE, Miller

1913. Smiths. Misc. Coll., LXI, 21, p. 25.
Lay Song Hong, Trong, Siamese Malaya.

66. RATUFA MELANOPEPLA DECOLORATA, Robinson & Kloss

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 227.
Koh Samui Island, Bandon Bight, Siamese Malaya.

67. RATUFA MELANOPEPLA CELAENOPEPLA, Miller

1913. Smiths. Misc. Coll., LXI, no. 21, p. 26.
Domel Island, Mergui Archipelago.

68. RATUFA MELANOPEPLA FRETENSIS, Thomas & Wroughton

1909. Ann. Mag. Nat. Hist. 8, IV, p. 535.
Pulau Langkawi, Malaya.

69. RATUFA MELANOPEPLA PENANGENSIS, Robinson & Kloss

1911. Journ. Fed. Malay States Mus., IV, p. 242.
Telok Bahang, Penang Island.

70. RATUFA MELANOPEPLA TIOMANENSIS, Miller

1900. Proc. Washington Acad. Sci., II, p. 216.
Pulau Tioman, E. coast Malay Peninsula.

71. RATUFA MELANOPEPLA ANAMBAE, Miller

1900. Proc. Washington Acad. Sci., II, p. 215.
Pulau Jimaja, Anamba Islands.

72. RATUFA MELANOPEPLA ANGUSTICEPS, Miller

1901. Proc. Washington Acad. Sci., III, p. 130.
Pulau Lingung, Natuna Islands.

Section C. SPECIALIZED INDO-MALAYAN GENERA, all clearly distinct from *Sciurus* and immediate allies. In this section, which is not a natural group as regards relationships, but rather holds several very distinct offshoots from the more normal *Sciurus* branch, I include *Menetes, Lariscus, Glyphotes, Rheithrosciurus, Rhinosciurus* and *Hyosciurus*.

Genus 12. MENETES, Thomas

1908. MENETES, Thomas, Journ. Bombay Nat. Hist. Soc., XVIII, no. 2, p. 244.

TYPE SPECIES.—*Sciurus berdmorei*, Blyth.

RANGE.—Northern portion of Malayan region; Siam, Annam, Cambodia, Burma, Tenasserim.

NUMBER OF FORMS.—Ten.

CHARACTERS.—Skull long and narrow, with markedly elongated rostrum; postorbital process medium in size or relatively small. Infraorbital foramen and zygomatic plate rather variable; in some specimens the part of the zygomatic plate behind the infraorbital foramen is very narrow, and the foramen is well open; in others, there is an approach to the condition found in more normal genera. A well-developed masseter knob is present. The parietal ridges may join. The cheekteeth approach the type of the African *Paraxerus*, but the pattern tends to wear down very quickly. P.3 present, strong. The central depression in the upper main teeth remains in adult as a well-marked re-entrant fold, but the anterior and posterior folds tend to wear out, so that the tooth takes on a more or less horseshoe-like shape. Lower teeth quickly wearing down to a two-lobed structure from a pattern originally like that of *Paraxerus*; the central depression becomes quickly reduced, and remaining as a deep narrow pit, often isolated in the centre of the tooth in old age. Posterointernal cusp and its adjoining ridge strong. The upper incisors rather shortened; the lower ones long.

Tail shorter than head and body. Digits with the arrangement characteristic of arboreal Squirrels. Black and white flank-stripes present, usually strong; in *M. b. decoratus* the pattern takes on a superficial resemblance to *Tamias*, including a black mid-dorsal stripe. Mammae 6 (Thomas).

Forms seen: *berdmorei*, *consularis*, *decoratus*, *moerescens*, *mouhotei*, *peninsularis*, *rufescens*, *umbrosus*.

LIST OF NAMED FORMS

1. MENETES BERDMOREI BERDMOREI, Blyth

1849. Journ. Asiat. Soc. Bengal, XVIII, p. 603.
Thoungyeen district, Lower Burma.

2. MENETES BERDMOREI AMOTUS, Miller

1913. Smiths. Misc. Coll., LXI, no. 21, p. 24.
Domel Island, Mergui Archipelago.

3. MENETES BERDMOREI KORATENSIS, Gyldenstolpe

1917. Kungl. Svenska. Vet. Akad. Handl., LVII, no. 2, p. 39.
Sakerat, near Korat, E. Siam.

4. MENETES BERDMOREI MOUHOTEI, Gray

1861. Proc. Zool. Soc. London, p. 137.
Cambodia.
Synonym: *pyrrocephalus*, Milne-Edwards, 1867, Rev. Mag. Zool. 2, XIX, p. 225. Cochin China.

5. MENETES BERDMOREI DECORATUS, Thomas

1914. Journ. Bombay Nat. Hist. Soc., XXIII, p. 24.
Mount Popa, Burma.

6. MENETES BERDMOREI MOERESCENS, Thomas

1914. Journ. Bombay Nat. Hist. Soc., XXIII, p. 25.
Bali, near Nhatrang, Annam.

7. MENETES BERDMOREI CONSULARIS, Thomas

1914. Journ. Bombay Nat. Hist. Soc., XXIII, p. 24.
Nan, North Siam.

8. MENETES BERDMOREI UMBROSUS, Kloss

1916. Proc. Zool. Soc. London, p. 49.
Koh Chang Island, S.-E. Siam.

9. MENETES BERDMOREI RUFESCENS, Kloss

1916. Proc. Zool. Soc. London, p. 50.
Koh Kut Island, S.-E. Siam.

10. MENETES BERDMOREI PENINSULARIS, Robinson & Kloss

1919. Journ. Nat. Hist. Soc. Siam, III, no. 4, p. 375.
Ban Kok Klap, Nakon Sritamaret, Peninsular Siam.

Genus 13. LARISCUS, Thomas & Wroughton

1867. Laria, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 276. (Not of Scopoli.)
1909. Lariscus, Thomas & Wroughton, Proc. Zool. Soc. London, p. 389.

Type Species.—*Sciurus insignis*, Cuvier.

Range.—Southern part of the Malay Peninsula, Sumatra, Java, Borneo, and neighbouring small islands.

Number of Forms.—Fourteen.

Characters.—Cheekteeth hypsodont, almost completely simplified in pattern. The lower series are roughly two-lobed, and even in the very young the pattern is nearly lost. Thus, when cut, the central depression is already narrow and much reduced. Upper cheekteeth with a vague pattern reminiscent of *Funisciurus* sometimes traceable, but usually completely simple; P.3 present. A short sagittal ridge may be present in old age. Rostrum tending to be long. Bullae rather small as a rule. Zygomatic plate near the *Sciurus* type; infraorbital foramen normal.

Tail relatively short, usually about sixty per cent of length of head and body. Digits as in normal arboreal genera. The type and allies have three black stripes present; *hosei* is rather more brightly coloured, and has four black stripes. Mammae, type species 6 (Thomas).

Forsyth Major in 1893 (Proc. Zool. Soc. London, p. 185) wrote fully on the dentition of this genus. He states that the simplification of the teeth is probably due to the food, comparing these Squirrels with certain Bats, which feed on juicy fruits whose contents need not be chewed, and differ in a similar manner from their allies ("*Macroglossi*, *Pteropus scapulatus*, *Epomophori*, compared with other *Pteropi*"). He remarks that the species of *Lariscus* are Ground-squirrels.

Forms seen: *diversus, fornicatus, hosei, insignis, jalorensis, javanus, meridionalis, niobe, siberu, vulcanis.*

Robinson & Kloss, 1918, considered all forms other than *hosei* as races of *insignis*, though *niobe* is sometimes considered as a distinct species.

List of Named Forms

insignis Group

1. LARISCUS INSIGNIS INSIGNIS, F. Cuvier

1821. Hist. Nat. Mamm. (ii) 34, pl. 233.
Sumatra.

2. LARISCUS INSIGNIS JALORENSIS, Bonhote

1903. Fascic. Malay. Zool. 1, p. 25.
Jalor, N. Malay Peninsula.
Synonym: *peninsulae*, Miller, 1903, Smiths. Misc. Coll., XLV, p. 25.
Khow Sai Dow, Trong, Siamese Malaya.

3. LARISCUS INSIGNIS MERIDIONALIS, Robinson & Kloss

1911. Journ. Fed. Malay States Mus., IV, p. 172.
Changi, Singapore Island.

4. LARISCUS INSIGNIS FORNICATUS, Robinson

1917. Journ. Fed. Malay States Mus., VII, p. 102.
Tioman Island, E. coast Malay Peninsula.

5. LARISCUS INSIGNIS DIVERSUS, Thomas

1898. Ann. Mag. Nat. Hist. 7, II, p. 248.
Baram district, Borneo.

6. LARISCUS INSIGNIS CASTANEUS, Miller

1900. Proc. Acad. Sci. Washington, II, p. 217.
Pulau Siantau, Anamba Islands.

7. LARISCUS INSIGNIS SATURATUS, Chasen

1934. Bull. Raffles. Mus. 9, p. 99.
Rhio Archipelago, Malaya; Bintang Island.

8. LARISCUS INSIGNIS NIOBE, Thomas

1898. Ann. Mag. Nat. Hist. 7, II, p. 249.
Pajo, highlands of W. Sumatra.

9. LARISCUS INSIGNIS SIBERU, Chasen & Kloss

1928. Proc. Zool. Soc. London, p. 827.
Siberut, Mentawei Islands, W. Sumatra.

10. LARISCUS INSIGNIS VULCANUS, Kloss

1921. Journ. Fed. Malay States, Mus., X, p. 233.
Ongop Ongop, Idjen Massif, 5,700 ft., Besoeki, E. Java.

11. LARISCUS INSIGNIS JAVANUS, Thomas & Wroughton

1909. Proc. Zool. Soc. London, Abstr., p. 19, id. tom. cit., p. 389.
Buitenzorg, W. Java.

12. LARISCUS INSIGNIS OBSCURUS, Miller

1903. Smiths. Misc. Coll., XLV, p. 23, pl. 1, fig. 2.
South Pagi Island, W. Sumatra.

13. LARISCUS INSIGNIS ROSTRATUS, Miller
1903. Smiths. Misc. Coll., XLV, p. 24.
Tana Bala, Batu Islands, W. Sumatra.

hosei Group

14. LARISCUS HOSEI, Thomas
1892. Ann. Mag. Nat. Hist. 6, XX, p. 215, 216.
Mount Dulit, Baram district, Borneo.

Genus 14. GLYPHOTES, Thomas

1898. GLYPHOTES, Thomas, Ann. Mag. Nat. Hist. 7, II, p. 251.

TYPE SPECIES.—*Glyphotes simus*, Thomas.

RANGE.—Borneo.

NUMBER OF FORMS.—One.

CHARACTERS.—A small Squirrel with peculiar and specialized incisors. Muzzle short and broad; nasals short. Postorbital process small. Zygomatic plate slanting upwards somewhat vertically (though not comparable to *Nannosciurus* section); infraorbital foramen rather well open, the part of the zygomatic plate behind it rather reduced. Mandible weak, with coronoid process very low, and condylar process slender. Upper incisors very broad, but not thickened anteroposteriorly; their lower tips tending to curve away from each other. Lower incisors similar, but their upper portions more strongly divergent from each other. Cheekteeth $\frac{5}{4}$, the pattern evidently not abnormal; P.3 small.

Externally with no special features; tail rather narrow, relatively long; flank-stripes present (white over black).

Forms seen: *simus*. (Only the type skull and skin.)

LIST OF NAMED FORMS

1. GLYPHOTES SIMUS, Thomas
1898. Ann. Mag. Nat. Hist. 7, II, p. 251.
Kina Balu, N. Borneo.

Genus 15. RHEITHROSCIURUS, Gray

1867. RHEITHROSCIURUS, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 272.

TYPE SPECIES.—*Sciurus macrotis*, Gray.

RANGE.—Borneo.

NUMBER OF FORMS.—One.

CHARACTERS.—Skull and teeth abnormal, the incisors greatly thickened from before backwards, the toothrow much reduced, in these characters paralleling the African Anomaluroid genera *Zenkerella* and *Idiurus*. Incisors with a strong subapical notch present. Their anterior faces clearly

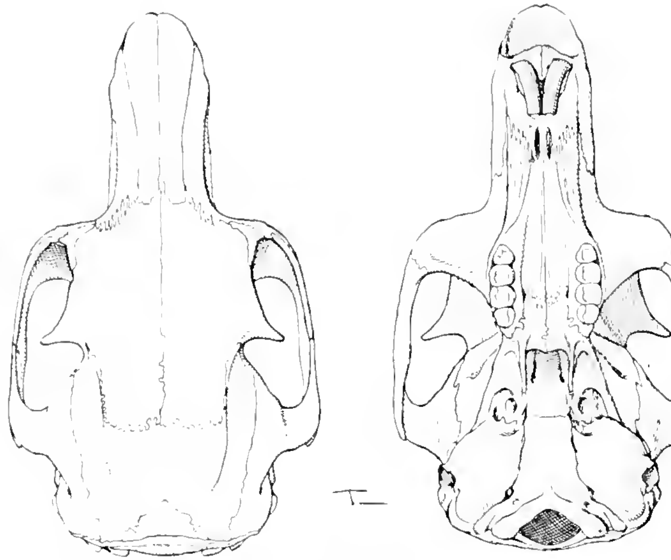


Fig. 97. Rheithrosciurus macrotis, Gray.
B.M. No. 27.8.6.5, ♂; 1.

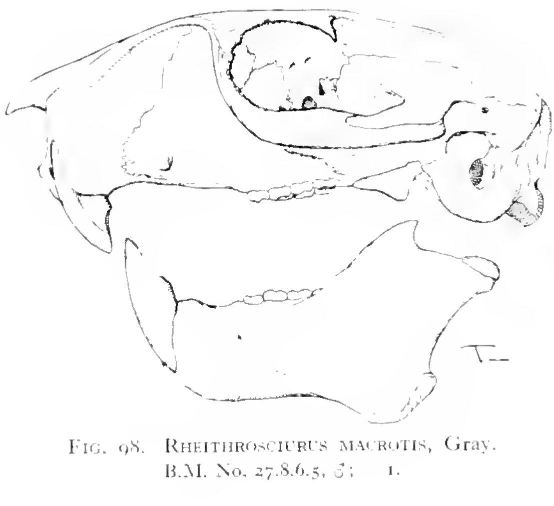


Fig. 98. Rheithrosciurus macrotis, Gray.
B.M. No. 27.8.6.5, ♂; 1.

marked with very many narrow parallel grooves, a structure traceable also in *Tamias* and *Marmota*, though in these genera not so well marked. The incisors are much compressed. Toothrow considerably reduced, the premolars of both upper and lower series smaller than the molars. All teeth brachyodont, basin-shaped, nearly simplified in pattern; those of the upper series near *Lariscus*, and with traces of pattern nearly obliterated in all skulls seen; the lower teeth square, with a more or less well-marked small cusp at each corner.

The hinder part of the mandible is more rounded than usual, the angular process higher, well ridged below, the coronoid not reduced, but not higher than the condylar, the bone running from one to the other nearly straight. Palate depressed between toothrows, ending abruptly just behind them, the posterior termination forming three sides of a square with the hamular processes. Rostrum much elongated; zygomatic plate slanting abruptly upwards, flat, not heavily ridged, placed rather far back; but orbit as in normal Sciurinae. Infra-orbital foramen forming a long canal, its anterior opening far in front of P.4. Frontals broad; postorbital processes moderately well developed.

Size large; about 23 inches head and body length (or more?); ear large, with extremely enlarged ear-tufts. Tail excessively thick and bushy, relatively long. Fur crisp and harsh. Digits of hindfoot as in normal Tree-squirrels. Manus with normally D.4 longer than D.3, though evidently there may be some variation in this character.

Mr. W. Frost told me that these animals are Ground-squirrels.

Remarks.—One of the most specialized and distinct genera in the group.

Forms seen: *macrotis*.

List of Named Forms

1. RHEITHROSCIURUS MACROTIS, Gray
1856. Proc. Zool. Soc. London, p. 341, pl. XLVI.
Sarawak, Borneo.

Genus 16. RHINOSCIURUS, Gray

1843. Rhinosciurus, Gray, List. Mamm., p. 195. (According to Tate, 1935, Amer. Mus. Nov., 807, *R. tupaioides*, Gray, is nom. nud. and the name *Rhinosciurus* should date from Blyth, 1855, with type *S. laticaudatus*, Müller & Schlegel.)

Type Species.—*Rhinosciurus tupaioides*, Gray.

Range.—Southern portions of the Malay Peninsula, Sumatra, Borneo, and adjacent islands.

Number of Forms.—Seven.

Characters.—Skull highly abnormal, with immensely elongated rostrum; upper incisors much reduced, very narrow, nearly vestigial; upper cheekteeth rapidly wearing down and simplifying. The rostrum in its length is quite unique in the family, except *Hyosciurus*, in which it is even longer. Postorbital process short. Bullae considerably enlarged. Zygomatic plate with its upper border ridged but short, and the portion behind the infraorbital foramen, which is rather well open, much narrowed. Palatal foramina far in front of toothrows.

Upper incisors appearing hardly functional; lower incisors long, not much reduced. Upper cheekteeth originally with rather complicated pattern, cusps and ridges well marked, but the pattern quickly wearing down, the main depression remaining at first as a wide outer fold, later simplifying and wearing away altogether. Lower cheekteeth with the same elements as the upper series as regards the change of pattern brought about by wear; posterointernal cusp originally well marked; the central depression seems in this genus to take the form of an outer re-entrant fold rather than an inner one, differing from other genera in this respect. P.3 large, well developed.

Hindfoot narrow, but arrangement of digits as usual, D.4 slightly longer than D.3. Forefoot with arrangement of digits as usual. Tail bushy, considerably shorter than head and body length. Of the habits of this genus Robinson & Kloss write: "They are strictly terrestrial and very shy . . . their diet, judging from numerous specimens examined, is principally insectivorous, consisting of large ants and beetles. The tongue is very long, and remarkably protrusile, and it is probable that gritty matter taken up with the insects by means of this organ accounts for the rapid wear of the teeth."

The genus appears to show certain resemblances in the infraorbital foramen, original pattern of upper teeth, and tendency to elongation of rostrum, to *Menetes*, which genus is, however, much less specialized.

But I think in this genus we have probably a parallel in evolution to the remarkable Murine genus *Rhynchomys*. In *Rhynchomys* there is the same elongation of muzzle, while the upper incisors are even more reduced; but the cheekteeth in this case have become so reduced as to be nearly invisible. Thomas thought that this Rat was insectivorous; it appears that *Rhinosciurus* in many respects is going well on the same road, in fact had some teeth, for instance the premolars, become suppressed, the parallel between these two unrelated genera would be nearly complete.

Forms seen: *leo*, *laticaudatus*, *tupaioides*, *robinsoni*, *rhionis*.

List of Named Forms

1. RHINOSCIURUS LATICAUDATUS LATICAUDATUS, Muller & Schlegel

1839. Verhandl. Nat. Gesch. p. 100, pl. XV, figs. I, II, III.
Pontianak, Borneo.

2. RHINOSCIURUS LATICAUDATUS SATURATUS, Robinson & Kloss

1919. Journ. Fed. Malay States Mus., VII, p. 274.
Barisan Range, W. Sumatra.

3. RHINOSCIURUS LATICAUDATUS TUPAIOIDES, Gray

1843. List. Mamm., p. 195.
Singapore.
Synonym: *peracer*, Thomas & Wroughton, 1909, Ann. Mag. Nat. Hist. 8, III, p. 440. Perak.

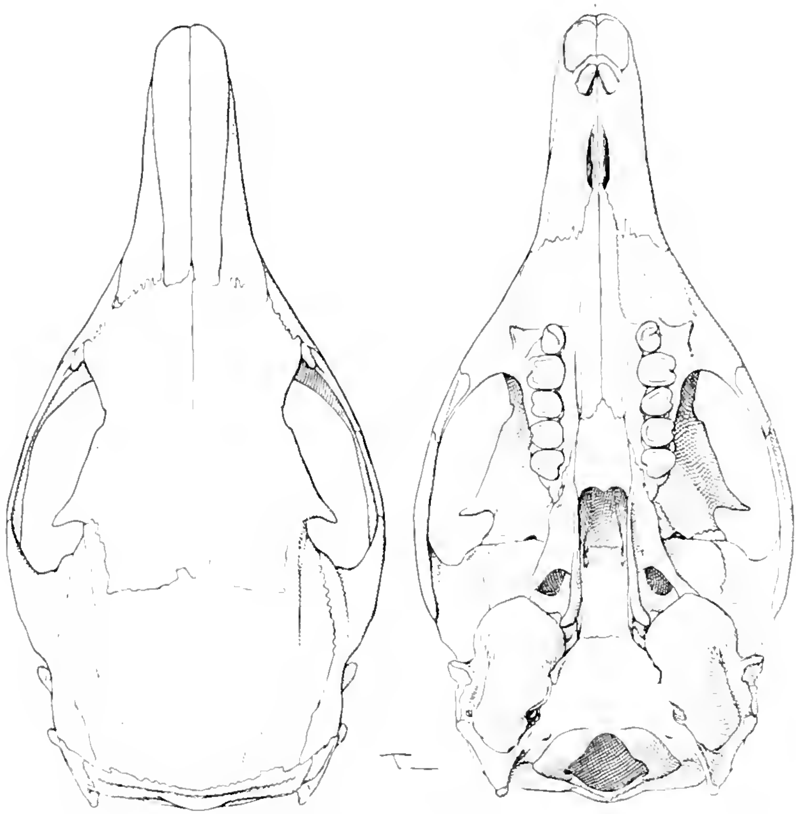


Fig. 99. Rhinosciurus laticaudatus tupaioides, Gray.
B.M. No. 9.4.1.228; × 2.

Fig. 100. Rhinosciurus laticaudatus tupaioides, Gray.
B.M. No. 9.4.1.228; × 2.

4. RHINOSCIURUS LATICAUDATUS LEO, Thomas & Wroughton

1909. Ann. Mag. Nat. Hist. 8, III, p. 440.
Changi, Singapore Island.

5. RHINOSCIURUS LATICAUDATUS RHIONIS, Thomas & Wroughton

1909. Ann. Mag. Nat. Hist. 8, III, p. 441.
Karimon, Rhio-Lingga Archipelago.

6. RHINOSCIURUS LATICAUDATUS ROBINSONI, Thomas

1908. Journ. Fed. Malay States Mus., II, p. 104.
Tioman Island, E. Malay Peninsula.

7. RHINOSCIURUS LATICAUDATUS INCULTUS, Lyon

1916. Proc. U.S. Nat. Mus., LII, p. 444.
Pulau Tuanku, Banjak Islands, W. Sumatra.

Genus 17. HYOSCIURUS, Tate & Archbold

1935. Hyosciurus, Tate & Archbold, Amer. Mus. Nov. 807, p. 2.

Type Species.—*Hyosciurus heinrichi*, Tate & Archbold.

Range.—Celebes.

Number of Forms.—Two.

This genus was not represented in the British Museum when this work was originally written, but a fine series of a dozen has been obtained in 1939 by Mr. Frost from the Molengraff Range, Mid Celebes.

Characters.—Skull with extremely elongate rostrum, if anything more so than in *Rhinosciurus*. Postorbital process small. In the adult, the temporal ridges fuse to form a short but strong sagittal ridge. Infraorbital foramen forming a long canal. Zygomatic plate slanting upwards anteriorly, rather flat, and much less projecting forwards than in *Rhinosciurus*. Nasals projecting anteriorly far forwards over the incisors. The upper incisors are not reduced, but are thick and strong (compare *Rhinosciurus*). Bullae medium-small. Palatal foramina far in front of toothrows; palate normal. Mandible stronger than in *Rhinosciurus*, the angular portion inflected to a degree (not extremely so, for instance, not comparing with that of *Cynomys*). Lower incisors robust, not extremely long. Cheekteeth $\frac{5}{4}$; molars quite normal, Sciurine in pattern, without the peculiarities of *Rhinosciurus*. M.3 is rather small. In the oldest specimen seen, a male with pattern of teeth obliterated and a strong sagittal ridge to the skull, there is not the slightest sign of the extreme deterioration in the molars which takes place in *Rhinosciurus* with wear.

Tail very short. Claws enormous, particularly those of the forefoot, but even so, less strongly enlarged than in *Spermophilopsis*.

Forms seen: *heinrichi*.

List of Named Forms

1. HYOSCIURUS HEINRICHI HEINRICHI, Tate & Archbold

1935. Amer. Mus. Nov. 801, p. 2.
Latimodjong Mountains, S. Celebes.

2. HYOSCIURUS HEINRICHI ILEILE, Tate & Archbold

1936. Amer. Mus. Nov. 846, p. 1,
Ile-ile, N. Celebes; 1700 m.

Mr. Frost states that it is a burrowing form, living underground, or more or less, and that the natives know it as a species of Rat.

Section D. AFRICAN ARBOREAL GENERA. All except *Heliosciurus* are clearly distinguishable from *Sciurus* on dental characters, and there is a tendency present for the lower molars to lose the central depression characteristic of normal Squirrels, and for these teeth to become transversely ridged, as in the upper series. In *Protoxerus* and allies the infraorbital foramen is normally unusually large, and forms no canal.

Genus 18. HELIOSCIURUS, Trouessart

1880. HELIOSCIURUS, Trouessart, le Naturaliste, II, no. 37, p. 292.
1916. AETHOSCIURUS, Thomas, Ann. Mag. Nat. Hist. 8, XVII, p. 271. *Sciurus poensis*, Smith. Valid as a subgenus.

TYPE SPECIES.—*Sciurus gambianus*, Ogilby.

RANGE.—Africa: Sudan, Abyssinia, Kenya, Uganda, Tanganyika; Senegal, Gambia, Sierra Leone, Liberia, Ivory Coast, Gold Coast, Nigeria, Cameroons, Fernando Po, Congo, Angola, Rhodesia, Nyasaland, Mozambique.

NUMBER OF FORMS.—About fifty-two.

REMARKS.—The genus was originally given generic rank by Thomas in 1909 on the single character that, compared with *Sciurus*, P.3 is absent. This is not a valid character. To the genus *Sciurus* in the same paper were referred three African Squirrels, *S. poensis*, *S. lucifer*, and *S. ruwenzori*. In 1916 Thomas referred these to a new genus *Aethosciurus*, on the grounds that the baculum differed from *Sciurus* (*vulgaris*), though only *poensis* had been examined.

Hollister, 1919 (U.S. Nat. Mus. Bull. 99, p. 9), pointed out that the teeth of *Heliosciurus* and *Aethosciurus* agreed with each other and differed from those of *Sciurus vulgaris* in certain details, and treated the two groups as a single genus, remarking that it was not wise to give *Aethosciurus* generic rank simply on account of the small extra premolar, which was also known to be present occasionally in typical *Heliosciurus*.

But the dental characters pointed out by Hollister, while constant, and separate from *Sciurus vulgaris*, agree with certain Asiatic forms, such as *Callosciurus*.

There are then only two characters which seem to me to separate the present genus clearly from *Callosciurus*. First the baculum, which according to Pocock is absent in *Heliosciurus* (apparently a very rare feature in the Order, but known elsewhere in the American *Tamiasciurus* in the present family), and minute in *Aethosciurus* (*poensis*). But it must be admitted that only *punctatus*, *rufobrachium*, and *poensis* were examined or mentioned in Pocock's paper; so that it may be that this character will later be found to be invalid; though it must be stated that all typical *Heliosciurus* are apparently so closely related that Ingoldby has suggested that all forms should be referred to one species only.

Secondly, the zygomatic plate, which seems to me to be constantly more strongly ridged, and with an extremely powerful masseter knob present, in typical *Heliosciurus* and in *Aethosciurus ruwenzorii*. The other species referred to *Aethosciurus* agree with *Paraxerus* and *Funisciurus* in the curiously shortened zygomatic plate, with the ridge stopping abruptly over the infraorbital foramen, and not approaching the superior border of rostrum. Further, *ruwenzorii* has a vestigial P.3, while this tooth is quite well developed and relatively large in all other *Aethosciurus* seen (as in *Paraxerus*). The baculum is minute also in *Funisciurus* and *Paraxerus*, or those of this genus which Pocock examined. Apart from *poensis* and *ruwenzorii*, I very much suspect that the other species named for *Aethosciurus*, namely *lucifer*, *vexillaris*, will be found when a representative collection comes to hand, to belong to *Paraxerus*. The lower cheekteeth, which afford the only character by which *Aethosciurus* may be separated from *Paraxerus*, appear to me to be very suggestive of *Paraxerus* in all skulls examined, but all seen are much too worn for me to be able to say. "*Aethosciurus*" *byatti* is definitely based on a *Paraxerus*, so far as the type skull shows, and is here transferred to that genus. But *poensis*, though agreeing in zygomatic plate formation with *Funisciurus* and *Paraxerus*, has definitely the unspecialized teeth found in *Heliosciurus* and must remain in this genus; and the same remarks apply to *ruwenzorii*, which is probably a primitive *Heliosciurus* s.s. in which the minute premolar has not yet become suppressed.

CHARACTERS.—Skull often with parietal ridges, which may tend to join. Postorbital process usually rather well developed. Bullae of moderate size. Palate normal. Infraorbital foramen usually rather well open, the upper part of the zygomatic plate prominently ridged, approaching the *Xerus* type though less extreme, slanting upwards far forwards, and there is a very strong masseter knob present. The upper incisors are in rare individual cases with a faint groove traceable. Upper cheekteeth like *Sciurus*, but with the main ridges strongly convergent internally, particularly the third (=the second principal) ridge, which runs almost from the outer corner to the middle of the inner part of the tooth. The inner side of M.1 and M.2 nearly square. The anterior cusp of P.4 is extremely well developed, projecting forwards, the depression immediately behind it well marked. Lower cheekteeth with elements not very different from *Sciurus*, but with a narrow transverse valley extending from first outer main cusp to the anterointernal cusp; this structure is present in some of the Indo-Malayan Squirrels. It evidently marks the beginning of the type of tooth found in *Paraxerus* and *Funisciurus*. The central depression is not obliterated, and is usually present as an important feature of the teeth.

External characters as in normal Tree-squirrels. Tail long. Back not striped.

The subgenus *Heliosciurus* contains the *gambianus* group only, all the members of which are referred to a single species by Ingoldby (Proc. Zool. Soc. London, 1927, p. 471).

The subgenus *Aethosciurus* at the moment consists of three groups: *ruwenzorii*, P.3 minute, zygomatic plate more as in typical *Heliosciurus*; *poensis*, P.3

rather large; zygomatic plate as in *Paraxerus*, size smaller than is usual in the genus, head and body less than 200 mm. (St. Leger); and the *lucifer* group, zygomatic plate and P.3 as in *poensis*, but size larger, over 200; this group will probably ultimately be found to be referable to the genus *Paraxerus*. *lucifer* may be remarked on as a species with an attractive colour pattern.

Forms seen: *acticola, annulatus, aubryi, bongensis, brauni, canaster, caurinus, coenosus, daucinus, elegans, emissus, gambianus, hardyi, isabellinus, kaffensis, keniae, lateris, leonensis, libericus, loandius, lualabae, lucifer, maculatus, madogae, multicolor, mutabilis, nyansae, obfuscatus, omensis, pasha, poensis, punctatus, rhodesiae, rufobrachium, ruwenzorii, semliki, senescens, undulatus, vexillaris, vulcanius.*

List of Named Forms

Subgenus *Heliosciurus*, Trouessart

(Revised by Ingoldby, Proc. Zool. Soc. London, 1927, p. 471)

1. HELIOSCIURUS GAMBIANUS GAMBIANUS, Ogilby

1835. Proc. Zool. Soc. London, p. 103.
Gambia.
Synonym: (?) *annulatus*, Desmarest, 1822, Mamm. ii, p. 338. This species often regarded as unidentifiable.
annularis, Schinz, 1845, Syn. Mamm. Bd, II, p. 14.
albina, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 329, 1867, nom. nud.

2. HELIOSCIURUS GAMBIANUS SENESCENS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 544.
Thies, Senegal.

3. HELIOSCIURUS GAMBIANUS LIMBATUS, Schwarz

1916. Wiesbaden Jahrb. ver Natk. 68, p. 65.
E. Cameroons.

4. HELIOSCIURUS GAMBIANUS BONGENSIS, Heuglin

1877. Reis. Nord. Ost. Afr., II, p. 59.
Bahr-El-Ghazal, Sudan.

5. HELIOSCIURUS GAMBIANUS CANASTER, Thomas & Hinton

1923. Proc. Zool. Soc. London, p. 256.
Jebel Marra, Darfur.

6. HELIOSCIURUS GAMBIANUS MULTICOLOR, Rüppell

1835. Neue Wirbelth, p. 38, pl. 13.
Valleys of Kulla and east slope of coast range, Abyssinia.

7. HELIOSCIURUS GAMBIANUS LATERIS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 102.
Lado, Sudan.

8. HELIOSCIURUS GAMBIANUS ELEGANS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 103.
Mount Elgon, Kenya.

9. HELIOSCIURUS GAMBIANUS COENOSUS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 104.
19° 30′ E. on River Ubangui, Congo.

10. HELIOSCIURUS GAMBIANUS OMENSIS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 104.
Lower Omo River, near Lake Rudolf, E. Africa.

11. HELIOSCIURUS GAMBIANUS MADOGAE, Heller

1911. Smiths. Misc. Coll. 56, no. 17, p. 1.
Uma, 50 miles north of Nimula, Uganda.

12. HELIOSCIURUS GAMBIANUS KAFFENSIS, Neumann

1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 57.
Anderatscha, Kaffa, Abyssinia.

13. HELIOSCIURUS GAMBIANUS ABASSENSIS, Neumann

1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 57.
South of Lake Abassi, Abyssinia.

14. HELIOSCIURUS GAMBIANUS RHODESIAE, Wroughton

1907. Manch. Mem. Lit. Phil. Soc., no. 5, p. 15.
Plateau west of Mchinga Escarpment, N. Rhodesia.

15. HELIOSCIURUS GAMBIANUS LOANDICUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 521.
N'dola Tando, Northern Angola.

16. HELIOSCIURUS GAMBIANUS MUTABILIS, Peters

1852. Monatsber. Ak. Wiss. Berlin, p. 273.
Boror, Portuguese E. Africa.
Synonym: *shirensis*, Gray, 1867, Ann. Mag. Nat. Hist. 3, XX, p. 327.
Shire River, Nyasaland.

17. HELIOSCIURUS GAMBIANUS BEIRAE, Roberts

1913. Ann. Transv. Mus., IV, p. 78.
Beira, Portuguese E. Africa.

18. HELIOSCIURUS GAMBIANUS CHIRINDENSIS, Roberts

1913. Ann. Transv. Mus., IV, p. 78.
Chirinda Forest, S.-E. Mashonaland.

19. HELIOSCIURUS GAMBIANUS UNDULATUS, True

1892. Proc. U.S. Nat. Mus., XV, p. 465.
Kilimanjaro, Tanganyika.
Synonym: *undulatus marwitzi*, Müller, 1911, Zool. Anz. 37, p. 82
Kilimanjaro.

20. HELIOSCIURUS GAMBIANUS DAUCINUS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 101.
Mombasa, Kenya.

21. HELIOSCIURUS GAMBIANUS DOLOSUS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 100.
Mafia Island, Tanganyika.

22. HELIOSCIURUS GAMBIANUS SHINDI, Heller

1914. Smiths. Misc. Coll., LXIII, no. 7, p. 7.
Mt. Umengo, Taita Hills, Kenya.

23. HELIOSCIURUS GAMBIANUS PUNCTATUS, Temminck

1853. Esq. Zool. Côte de Guiné, p. 138.
Guinea Coast.

24. HELIOSCIURUS GAMBIANUS SAVANNIUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 521.
Beoumi, Ivory Coast.

25. HELIOSCIURUS GAMBIANUS KENIAE, Neumann

1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 176.
Mount Kenya.

26. HELIOSCIURUS GAMBIANUS RUFOBRACHIUM, Waterhouse

1842. Ann. Mag. Nat. Hist. 1, X, p. 202 (published November).
Fernando Po.
Synonym: *rufobrachiatus*, Waterhouse, 1842, Proc. Zool. Soc. London, p. 128 (published January, 1843).
aubryi, Milne-Edwards, 1867, Rev. Zool., XIX, p. 228. Gaboon.

27. HELIOSCIURUS GAMBIANUS PASHA, Schwann

1904. Ann. Mag. Nat. Hist. 7, XIII, p. 72.
Bellima, Monbuttu, N.-E. Congo.

28. HELIOSCIURUS GAMBIANUS BENGA, Cabrera

1917. Bol. Real. Soc. Espanola, 17, p. 517.
Cabo San Juan, Spanish Guinea.

29. HELIOSCIURUS GAMBIANUS ISABELLINUS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 329.
Lower Niger.

30. HELIOSCIURUS GAMBIANUS LEONENSIS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 523.
Sierra Leone.

31. HELIOSCIURUS GAMBIANUS EMISSUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 520.
S.-E. Nigeria.

32. HELIOSCIURUS GAMBIANUS ACTICOLA, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 525.
Fernando Po.

33. HELIOSCIURUS GAMBIANUS CAURINUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 523.
Gunnal, Portuguese Guinea.

34. HELIOSCIURUS GAMBIANUS HARDYI, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 519.
Beoumi, N. Ivory Coast.

35. HELIOSCIURUS GAMBIANUS OBFUSCATUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 526.
Oban district, S.-E. Nigeria.

36. HELIOSCIURUS GAMBIANUS MACULATUS, Temminck

1853. Esq. Zool. Côte de Guiné, p. 130.
"Guinea." Probably Gold Coast.
Synonym: *aschantiensis*, Neumann, 1902, Sitz. Ber. Ges. Nat. Fr. Berlin, p. 175. Ashanti, Gold Coast.
waterhousii, Gray, Ann. Mag. Nat. Hist. 3, XX, p. 328, 1867.

37. HELIOSCIURUS GAMBIANUS NYANSAE, Neumann

1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 56.
Kwa Kitoto, Kavirondo, Uganda.

38. HELIOSCIURUS GAMBIANUS SEMLIKII, Thomas

1907. Ann. Mag. Nat. Hist. 7, XIX, p. 120.
Beni, Semliki, Congo.

39. HELIOSCIURUS GAMBIANUS MEDJIANUS, Allen

1922. Bull. Amer. Mus. Nat. Hist., XLVII, p. 46.
Medje, Ituri Forest, Congo.

40. HELIOSCIURUS GAMBIANUS RUBRICATUS, Allen

1922. Bull. Amer. Mus. Nat. Hist., XLVII, p. 47.
Near Lubila River, 50 miles S.-W. of Avakubi, Congo.

41. HELIOSCIURUS GAMBIANUS ARRHENII, Lonnberg

1917. Stockholm Vet. Akad. Handl. 58, 2, p. 68.
Masisi, near Lake Kivu.

42. HELIOSCIURUS GAMBIANUS LUALABAE, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 520.
Lodja, Upper Lukenge River, S. Congo.

43. HELIOSCIURUS GAMBIANUS LIBERICUS, Miller

1900. Proc. Washington Acad. Sci., II, p. 633.
Mount Coffee, Liberia.

44. HELIOSCIURUS GAMBIANUS BRAUNI, St. Leger

1935. Nov. Zool. XXXIX, p. 252.
Fazenda Congulu, Amboim district, Angola.

Subgenus *Aethosciurus*, Thomas

ruwenzorii Group

45. HELIOSCIURUS RUWENZORII RUWENZORII, Schwann

1904. Ann. Mag. Nat. Hist. 7, XIII, p. 71.
Luimi Valley, Ruwenzori.

46. HELIOSCIURUS RUWENZORII VULCANIUS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 476.
Volcanoes north of Lake Kivu, Belgian Congo.

poensis Group

47. HELIOSCIURUS POENSIS POENSIS, Smith

1830. S. Afr. Quart. Journ., 2, p. 128.
Fernando Po.
Synonym: *olivaceus*, Milne-Edwards, 1867, Rev. Mag. Zool., XIX, p. 228.
affinis, Rhoads, 1896, Proc. Acad. Philadelphia, p. 521.

48. HELIOSCIURUS POENSIS MUSCULINUS, Temminck

1853. Esq. Zool. Côte de Guiné, p. 141.
"Guinea." Probably Gold Coast.

49. HELIOSCIURUS POENSIS SUBVIRIDESCENS, Le Conte

1857. Proc. Acad. Philadelphia, p. 11.
Gaboon.

lucifer Group

(For remarks on generic status of this group see p. 400.)

50. HELIOSCIURUS LUCIFER, Thomas

1897. Proc. Zool. Soc. London, p. 430.
Kombe Forest, Masuku Range, N. Nyasa.

51. HELIOSCIURUS VEXILLARIUS, Kershaw

1923. Ann. Mag. Nat. Hist. 9, XI, p. 591.
Usambara, Tanganyika.

incertae sedis

52. HELIOSCIURUS(?) BAYONII, Bocage

1890. Jorn. Sci. Lisbon, II, p. 3.
Braganca, Angola.
(A *Funisciurus* according to G. M. Allen, 1939.)

Genus 19. PARAXERUS, Major

1893. PARAXERUS, Forsyth Major, Proc. Zool. Soc. London, p. 189.
1918. TAMISCUS, Thomas, Ann. Mag. Nat. Hist. 9, I, p. 33. *Sciurus emini*, Stuhlmann.

TYPE SPECIES.—*Sciurus cepapi*, Smith.

RANGE.—Eastern and South Africa: Sudan, Somaliland, Kenya, Uganda, Tanganyika, Zanzibar, Congo, Rhodesia, Mozambique; South-west Africa, Bechuanaland, Zululand.

NUMBER OF FORMS.—About forty-four.

CHARACTERS.—Cheekteeth semihypsodont, the upper molars with the three depressions, particularly the second, tending to take the form of re-entrant folds, the pattern clear and definite, and apparently usually long retained. M.3 with two depressions, the second very broad, or occasionally in this tooth three depressions traceable. P.3 present, well marked; P.4 with no prominent anterior cusp. In the lower teeth, the posterointernal cusp is strong, the teeth are more or less transversely ridged, with three depressions separating four ridges; the second, which corresponds to the main depression of less specialized Sciurinae, appearing as a broad inner re-entrant fold, with a small outer re-entrant fold opposite to it. The cusps, particularly the anterointernal, moderately high. In old age, the teeth are more or less simplified to a two-lobed structure.

Skull essentially as in *Funisciurus* (next to be described), except that the rostrum does not tend to become elongated.

External characters as in normal Tree-squirrels.

The *boehmi* group were referred to a genus *Tamiscus* by Thomas, which Hollister regarded as a subgenus, on account of their dorsal stripes, the infra-orbital foramen said to be less open (but the difference is very small; there appears to be less difference to me between *Paraxerus* and "*Tamiscus*" than between individual specimens of *Menetes berdmorei*); the "molars less hypsodont, the crowns more abruptly marked off from the roots . . . the large internal root narrow, well spaced from its neighbours on each side, and abruptly broadens out above at crown." The incisors are more proödont, but within other genera this is a very variable character; compare, for instance, *Callosciurus*. This division may be of subgeneric value, but to me *Tamiscus* seems no more than a specific group of *Paraxerus*.

Forms seen: *alexandri*, *angustus*, *animosus*, *antoniae*, *aruscensis*, *boehmi*, *bridgemani*, *byatti*, *capitis*, *cepapi*, *electus*, *emini*, *exgeanus*, *flavivittis*, *frerei*, *ganana*, *gazellae*, *ibeanus*, *jacksoni*, *lastii*, *lunaris*, *mossambicus*, *ochraceus*, *ornatus*, *palliatus*, *percivali*, *phalaena*, *quotus*, *sindi*, *soccatus*, *sponsus*, *suahelicus*, *swynnertoni*, *tunae*, *vulcanorum*, *yulei*.

I am inclined provisionally to divide this genus into four groups:

boehmi group: smallish striped squirrels; usually four black stripes bordering three lighter ones, general effect *Tamias*-like; *boehmi* is coloured rather differently from the other species referred to the group; the stripes can become faint; the genus "*Tamiscus*" of Thomas.

flavivittis group: *Atlantoxerus*-like forms; usually pale, with thick white flank-stripe present.

palliatus group: usually larger than *cepapi* group, becoming about maximum size for genus; tail red or orange; belly red; sometimes head red. *P. bridgemani* is a type which tends to be intermediate between this group and the *cepapi* group.

cepapi group: usually smaller than the last; dull-coloured squirrels with no red or orange markings, so far as seen. Includes *ochraceus*.

Not allocated: *byatti*, hitherto referred to *Aethosciurus*, is a *Paraxerus* as regards the dental formation of the type skull. I have not seen the subspecies described by Allen & Loveridge.

This arrangement must be regarded as provisional.

List of Named Forms

cepapi Group

1. PARAXERUS CEPAPI CEPAPI, Smith

1836. App. Report Explor. S. Africa, p. 43.
Marico River, Rustenburg district, Transvaal.
Synonym: *mutabilis*, Huet, 1880, Nouv. Arch. Mus., p. 143 (not of Peters).
(?) *superciliaris*, Wagner, Schreb. Säugth. Suppl., III, 1843, p. 212.

2. PARAXERUS CEPAPI CHOBIENSIS, Roberts

1932. Ann. Transv. Mus., XV, p. 9.
Kabulabula, Chobi River, N. Bechuanaland.

3. PARAXERUS CEPAPI MAUNENSIS, Roberts

1932. Ann. Transv. Mus., XV, p. 9.
Maun, Ngamiland.

4. PARAXERUS CEPAPI SOCCATUS, Wroughton

1909. Ann. Mag. Nat. Hist. 8, III, p. 515.
Hewe River, N. Angoniland, Nyasaland.

5. PARAXERUS CEPAPI PHALAENA, Thomas

1926. Proc. Zool. Soc. London, p. 296.
Between Ukuambi and Ondongwa, Ovamboland.

6. PARAXERUS CEPAPI SINDI, Thomas & Wroughton

1908. Proc. Zool. Soc. London, p. 543.
Tete, Lower Zambesi.

7. PARAXERUS CEPAPI KALAHARICUS, Roberts

1932. Ann. Transv. Mus., XV, p. 10.
Mabeleapudi, Kalahari.

8. PARAXERUS CEPAPI AURIVENTRIS, Roberts

1926. Ann. Transv. Mus., XI, p. 250.
Magudi, Portuguese E. Africa.

9. PARAXERUS CEPAPI QUOTUS, Wroughton

1909. Ann. Mag. Nat. Hist. 8, III, p. 516.
Katanga, Congo.

10. PARAXERUS CEPAPI YULEI, Thomas

1902. Proc. Zool. Soc. London, p. 120.
Muezo, near Lake Mweru.

11. PARAXERUS OCHRACEUS OCHRACEUS, Huet

1880. Nouv. Arch. Mus., p. 154, pl. VII, fig. 2.
Bagamoyo, near Dar-es-Salaam, Tanganyika.

12. PARAXERUS OCHRACEUS ARUSCENSIS, Pagenstecher

1885. Jahrb. Hamb. Wiss. Aust. 2, p. 42.
Pangani River near the coast and Aruscha, Mt. Meru, Tanganyika.
Synonym: (?) *pauli*, Matschie, 1894, Sitz. Ber. Ges. Nat. Fr. Berlin, p. 256. Tanganyika.

13. PARAXERUS OCHRACEUS SALUTANS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 106.
Dar-es-Salaam, Tanganyika.

14. PARAXERUS OCHRACEUS ELECTUS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 106.
Elgeyo, Kenya Colony.

15. PARAXERUS OCHRACEUS ANIMOSUS, Dollman

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 655.
Mount Nyiro, Kenya Colony.

16. PARAXERUS OCHRACEUS PERCIVALI, Dollman

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 653.
Marsabit, Kenya Colony.
(According to G. M. Allen the correct name for this subspecies is *P. o. affinis*, Trouessart, Cat. Mamm., Viv. Foss. pt. 3, p. 406, 1897.)
Synonym: *ochraceus angustus*, Dollman, 1911, Ann. Mag. Nat. Hist. 8, VIII, p. 654. Marsabit, Kenya.

17. PARAXERUS OCHRACEUS KAHARI, Heller

1911. Smiths. Misc. Coll. LVI, no. 17, p. 2.
Meru Boma, north-east of Mount Kenya.

18. PARAXERUS OCHRACEUS JACKSONI, de Winton
1897. Ann. Mag. Nat. Hist. 6, XIX, p. 574.
Kikuyu, Kenya Colony.
Synonym: *jacksoni capitis*, Thomas, 1909, Ann. Mag. Nat. Hist. 8, IV, p. 105. Nairobi Forest.

19. PARAXERUS OCHRACEUS GANANA, Rhoads
1896. Proc. Acad. Sci. Philadelphia, XLVIII, p. 522.
Ganana River at Bar Madu, Abyssinia.

palliatus Group

20. PARAXERUS BRIDGEMANI, Dollman
1914. Ann. Mag. Nat. Hist. 8, XIV, p. 152.
Panda, Portuguese E. Africa.

21. PARAXERUS PALLIATUS PALLIATUS, Peters
1852. Monatsber. Akad. Wiss. Berlin, p. 273.
Mozambique.

22. PARAXERUS PALLIATUS ORNATUS, Gray
1864. Proc. Zool. Soc. London, p. 13, pl. 1.
Zululand.

23. PARAXERUS PALLIATUS SUAHELICUS, Neumann
1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 178.
Tanganyika coast, opposite Zanzibar.

24. PARAXERUS PALLIATUS FREREI, Gray
1873. Ann. Mag. Nat. Hist. 4, XII, p. 265.
Zanzibar.

25. PARAXERUS PALLIATUS LASTII, Thomas
1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 297.
Zanzibar.
(According to St. Leger probably not distinguishable from *frerei*.)

26. PARAXERUS PALLIATUS SWYNNERTONI, Wroughton
1908. Ann. Mag. Nat. Hist. 8, I, p. 305.
Chirinda Forest, N. Rhodesia.

27. PARAXERUS PALLIATUS TANAE, Neumann
1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 178.
Tana River, Kenya Colony.

28. PARAXERUS PALLIATUS BARAWENSIS, Neumann
1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 178.
Somaliland.

29. PARAXERUS SPONSUS SPONSUS, Thomas & Wroughton
1907. Proc. Zool. Soc. London, p. 292.
Inhambane, Zululand.

30. PARAXERUS SPONSUS TONGENSIS, Roberts
1931. Ann. Transv. Mus., XIV, p. 229.
Mangusi Forest, N. Zululand.

flavivittis Group

31. PARAXERUS FLAVIVITTIS FLAVIVITTIS, Peters
1852. Reise Mossamb., I, taf. XXIX.
Mossimba, near Mozambique.

32. PARAXERUS FLAVIVITTIS MOSSAMBICUS, Thomas
1919. Ann. Mag. Nat. Hist. 9, IV, p. 31.
Lumbo, Portuguese E. Africa.

33. PARAXERUS FLAVIVITTIS EXGEANUS, Hinton
1920. Ann. Mag. Nat. Hist. 9, V, p. 311.
Kilwa Kisiwani, Tanganyika.

34. PARAXERUS FLAVIVITTIS IBEANUS, Hinton
1920. Ann. Mag. Nat. Hist. 9, V., p. 312.
Mombasa, Kenya.

boehmi Group

35. PARAXERUS BOEHMI, Reichenow
1886. Zool. Anz., IX, p. 315.
Marungu, S. Congo.

36. PARAXERUS EMINI EMINI, Stuhlmann
1894. Mit. Emin. Pasha Herz. Afrika, p. 320.
Upper Semliki River, Belgian Congo.
Synonym: *emini ugandae*, Neumann, 1902, Sitz. Ber. Ges. Nat. Fr. Berlin, p. 180. Uganda.

37. PARAXERUS EMINI GAZELLAE, Thomas
1918. Ann. Mag. Nat. Hist. 9, I, p. 34.
Meridi, Bahr-el-Ghazal.

38. PARAXERUS VULCANORUM VULCANORUM, Thomas
1918. Ann. Mag. Nat. Hist. 9, I, p. 35.
Buhamba, near Lake Kivu, Belgian Congo.

39. PARAXERUS VULCANORUM LUNARIS, Thomas
1918. Ann. Mag. Nat. Hist. 9, I, p. 36.
Mubuku Valley, Ruwenzori East.

40. PARAXERUS VULCANORUM TANGANYIKAE, Thomas
1918. Ann. Mag. Nat. Hist. 9, I, p. 36.
10 miles west of Baraka, Burton Gulf, Lake Tanganyika.

41. PARAXERUS ALEXANDRI, Thomas & Wroughton
1907. Ann. Mag. Nat. Hist. 7, XIX, p. 376.
Gudima, R. Iri, Upper Welle.

42. PARAXERUS ANTONIAE, Thomas & Wroughton
1907. Ann. Mag. Nat. Hist. 7, XIX, p. 377.
Ponthierville, Upper Congo.

Not allocated to group

43. PARAXERUS BYATTI BYATTI, Kershaw
1923. Ann. Mag. Nat. Hist. 9, XI, p. 592.
Moshi, Kilimanjaro.

44. PARAXERUS BYATTI LAETUS, Allen & Loveridge
1933. Bull. Mus. Comp. Zool. Harvard, LXXV, no. 2, p. 96.
Ukinga Mountains, north of Lake Nyasa, Tanganyika.

Genus 20. FUNISCIURUS, Trouessart

1880. FUNISCIURUS, Trouessart, le Naturaliste, II, no. 37, p. 293.

TYPE SPECIES.—*Sciurus lemniscatus*, Le Conte.

RANGE.—Africa: Gambia, Sierra Leone, Ivory Coast, Gold Coast, Nigeria, Cameroons, Fernando Po, Gaboon, Congo, Angola, Tanganyika, Ruwenzori, S.-W. Africa.

NUMBER OF FORMS.—Thirty-four.

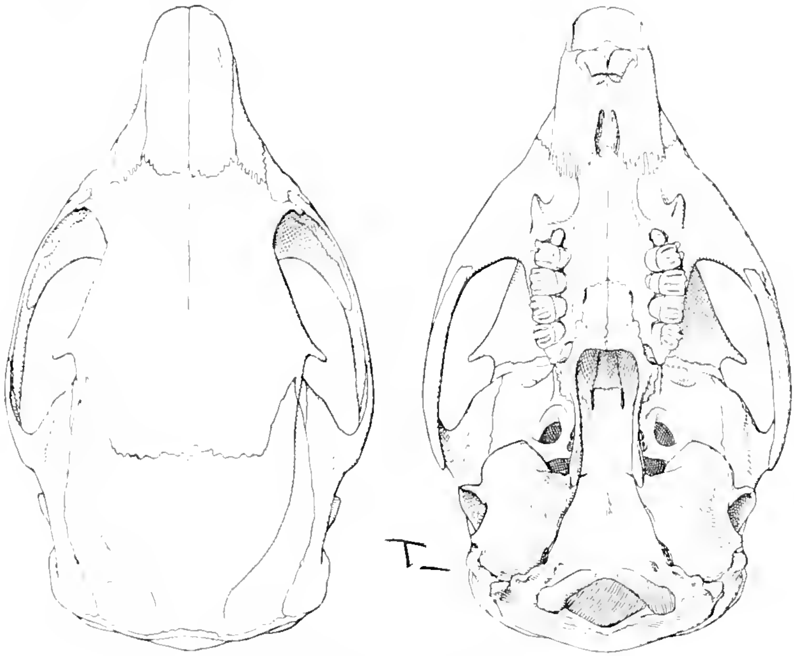


FIG. 101. FUNISCIURUS PYRRHOPUS LEONIS, Thomas.
B.M. No. 1938.6.10.9. ♀; 2.

CHARACTERS.—Skull weakly ridged, the parietal ridges usually not joining. Postorbital process moderate. Palate normal. Zygomatic plate well ridged, but short, the ridge stopping abruptly above the upper border of the infraorbital foramen, not approaching the superior border of the rostrum. Masseter knob weak or absent. Infraorbital foramen sometimes with a ridge curving upwards from its upper border and joining the forepart of ridge of zygomatic plate. Rostrum tends to become elongated. Cheekteeth more specialized than in *Paraxerus*, or for that matter almost all other Squirrels; tending to become completely flat-crowned, or nearly so; semihypsodont. P.3

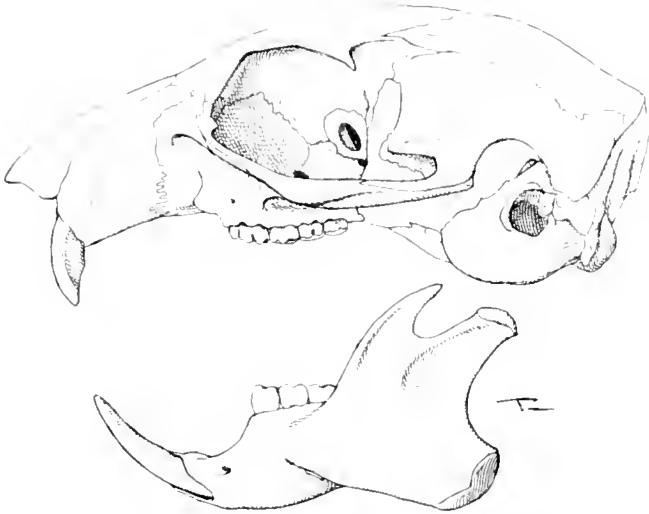


FIG. 102. FUNISCIURUS PYRRHOPUS LEONIS, Thomas.
B.M. No. 1938.6.10.9, ♀; × 2.

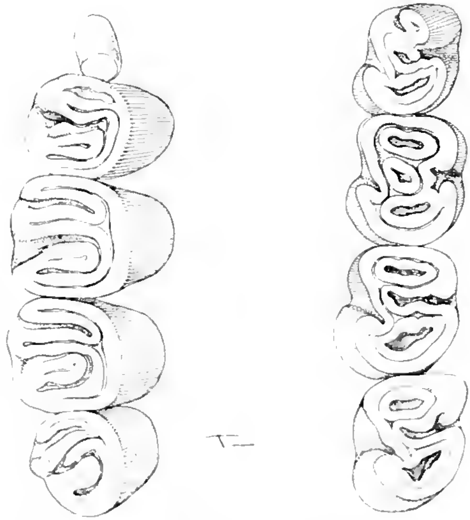


FIG. 103. FUNISCIURUS PYRRHOPUS LEONIS, Thomas.
Cheekteeth: B.M. No. 1938.6.10.9, ♀; × 8.

well developed. Lower molars like those of *Anomalurus* or *Erethizon* in general appearance; three wide inner re-entrant folds, and one wide outer re-entrant fold present. Upper molars flat in adult, the three depressions more or less appearing as re-entrant folds; the first sometimes curving round and joining the third; the second depression the widest. M.3 usually with elements as the other teeth, and often relatively small.

External characters as in normal Tree-squirrels. According to Pocock, baculum minute in this genus and in *Paraxerus*, of those he examined.

Forms seen: *akka*, *anerythrus*, *auriculatus*, *bandarum*, *beatus*, *boydii*, *carruthersi*, *chrysippus*, *congicus*, *erythrogenys*, *flavinus*, *interior*, *isabella*, *lemniscatus*, *leonis*, *leucostigma*, *mandingo*, *mayumbicus*, *mystax*, *nigrensis*, *niveatus*, *ochrogaster*, *oenone*, *olivellus*, *oliviae*, *pembertoni*, *pyrrhopus*, *raptorum*, *substriatus*, *talboti*, *tanganyikae*.

Three groups are recognizable among the material examined, though these must be treated as provisional:

lemniscatus group: back longitudinally striped, as in *Paraxerus boehmi* group; usually four black stripes bordering three paler ones.

congicus group: back without longitudinal stripes; usually pale forms reminiscent of *Atlantoxerus* or *Paraxerus flavivittis* group; with a well-marked whitish flank-stripe each side; only the race *interior* is darker in colour.

pyrrhopus group: all others. Normally darker than *congicus* group (which perhaps should be referred to present group); limbs and head red in *pyrrhopus*, usually, which in most cases has a narrow light flank-stripe present; *auriculatus* has some red colouring on head and rump, but not on the limbs, and the flank-stripe is present; *carruthersi* is a dark form, without stripes. But intermediate forms appear to exist between these types.

List of Named Forms

lemniscatus Group

1. FUNISCIURUS LEMNISCATUS LEMNISCATUS, Le Conte

1857. Proc. Acad. Nat. Sci. Philadelphia, p. 11.
Rio Muni, Gaboon.
Synonym: *sharpei*, Gray, 1873, Ann. Mag. Nat. Hist. 4, XII, p. 265. Gaboon.

2. FUNISCIURUS LEMNISCATUS ISABELLA, Gray

1862. Proc. Zool. Soc. London, p. 180, pl. XXIV.
Cameroon Mountain.

3. FUNISCIURUS MAYUMBICUS, Kershaw

1923. Rev. Zool. Afr., XI, 4, p. 363.
Ganda Sundi, Mayumbe Province, Lower Congo.

4. FUNISCIURUS POOLII, Jentink

1906. Notes Leyd. Mus., XXVIII, p. 139.
Stanley Falls, Upper Congo.

congicus Group

5. FUNISCIURUS CONGICUS CONGICUS, Kuhl

1820. Beitr. Zool., p. 66.
Canboca, N. Angola.
Synonym: *praetextus*, Wagner, Schreb. Säug. Suppl. 3, p. 216, 1843.

6. FUNISCIURUS CONGICUS OLIVELLUS, Thomas

1904. Ann. Mag. Nat. Hist. 7, XIII, p. 410.
Cunga, N. Angola.

7. FUNISCIURUS CONGICUS FLAVINUS, Thomas

1904. Ann. Mag. Nat. Hist. 7, XIII, p. 411.
Capongombi, S. Angola.

8. FUNISCIURUS CONGICUS OENONE, Thomas

1926. Proc. Zool. Soc. London, p. 297.
Cunene Falls, Ovamboland.

9. FUNISCIURUS CONGICUS INTERIOR, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVIII, p. 236.
Inkongo, South Congo.

pyrrhopus Group

10. FUNISCIURUS PYRRHOPUS PYRRHOPUS, F. Cuvier

1833. Hist. Nat. Mamm. IV (66), p. 2.
Gaboon.
Synonym: *rubripes*, du Chaillu, 1860, Proc. Boston Soc. Nat. Hist., VII, p. 366. Gaboon. (A valid race according to G. M. Allen, 1939.)
erythrops, Gray, 1867, Ann. Mag. Nat. Hist. 3, XX, p. 330.

11. FUNISCIURUS PYRRHOPUS LEONIS, Thomas

1905. Ann. Mag. Nat. Hist. 7, XV, p. 79.
Bo, Sierra Leone.

12. FUNISCIURUS PYRRHOPUS AKKA, de Winton

1899. Ann. Mag. Nat. Hist. 7, IV, p. 356 (footnote).
Tingasi, Monbuttu, N.-E. Congo.
Synonym: *emini*, de Winton, 1895, Ann. Mag. Nat. Hist. 6, XVI, p. 197. Not of Stuhlmann.
wintoni, Neumann, 1900, Zool. Jahrb., 13, p. 547.

13. FUNISCIURUS LEUCOSTIGMA LEUCOSTIGMA, Temminck

1853. Esq. Zool. Côte de Guiné, p. 133.
Gold Coast.

14. FUNISCIURUS LEUCOSTIGMA TALBOTI, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 478.
Oban, S.-E. Nigeria.

15. FUNISCIURUS LEUCOSTIGMA NIVEATUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 522.
Beoumi, 12 miles east of Bandama, Ivory Coast.

16. FUNISCIURUS PEMBERTONI, Thomas

1904. Ann. Mag. Nat. Hist. 7, XIV, p. 201.
Dondo, Cuanza River, Angola. (A race of *F. pyrrhopus* according to G. M. Allen.)

17. FUNISCIURUS RAPTORUM, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 80.
Forcados, Lower Nigeria.

18. FUNISCIURUS ANERYTHRUS ANERYTHRUS, Thomas

1890. Proc. Zool. Soc. London, p. 447.
Buguera, west of Lake Albert, Congo.

19. FUNISCIURUS ANERYTHRUS BANDARUM, Thomas

1915. Ann. Mag. Nat. Hist. 8, XVI, p. 146.
Bamingui River, Upper Shari.

20. FUNISCIURUS ANERYTHRUS NIAPU, Allen

1922. Bull. Amer. Mus. Nat. Hist., XLVII, p. 52.
Niapu, Belgian Congo.

21. FUNISCIURUS AURICULATUS AURICULATUS, Matschie

1891. Archiv. Naturg., I, 3, p. 353.
Kribi, Cameroons.

22. FUNISCIURUS AURICULATUS BEATUS, Thomas

1910. Ann. Mag. Nat. Hist. 8, V, p. 196.
Benito River, French Congo.

23. FUNISCIURUS AURICULATUS BOYDI, Thomas

1910. Ann. Mag. Nat. Hist. 8, V, p. 196.
Mussaka, Lower Mongo River, east of Cameroon Mountain.

24. FUNISCIURUS AURICULATUS OLIVIAE, Dollman

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 733.
Oban, S.-E. Nigeria.

25. FUNISCIURUS MYSTAX MYSTAX, de Winton

1898. Ann. Mag. Nat. Hist. 7, II, p. 9.
Benito River, French Congo.

26. FUNISCIURUS MYSTAX OCHROGASTER, Cabrera & Ruxton

1926. Ann. Mag. Nat. Hist. 9, XVII, p. 597.
Luluabourg, Kasai, S. Congo.

27. FUNISCIURUS LEUCOGENYS, Waterhouse

1842. Ann. Mag. Nat. Hist. X, p. 202.
Fernando Po.
Synonym: *erythrogenys*, Waterhouse, 1843, Proc. Zool. Soc. London, p. 129, 1842.

28 FUNISCIURUS SUBSTRIATUS, de Winton

1899. Ann. Mag. Nat. Hist. 7, IV, p. 357.
Kintampo, Gold Coast.

29. FUNISCIURUS MANDINGO MANDINGO, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 79.
Nianimaru, Gambia.

30. FUNISCIURUS MANDINGO NIGRENSIS, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 478.
Abutschi, Lower Niger.

31. FUNISCIURUS CARRUTHERSI CARRUTHERSI, Thomas

1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 140.
Ruwenzori East.

32. FUNISCIURUS CARRUTHERSI TANGANYIKAE, Thomas

1909. Ann. Mag. Nat. Hist. 8, IV, p. 477.
Usumbura, north end of Lake Tanganyika.

33. FUNISCIURUS CARRUTHERSI CHRYSIPPUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 522.
Wabembe, north-west of Lake Tanganyika.

34. FUNISCIURUS CARRUTHERSI BIRUNGENSIS, Gyldenstolpe

1927. Arkiv. Zoologi, Band 19B, no. 6, p. 1.
Mount Karissimbi, Birunga volcanoes, East Congo.

Genus 21. PROTOXERUS, Forsyth Major

1893. Protoxerus, Forsyth Major, Proc. Zool. Soc. London, p. 189.

Type Species.—*Sciurus stangeri*, Waterhouse.

Range.—Africa: Kenya, Uganda; Gold Coast, Nigeria, Cameroons, Fernando Po, Gaboon, Congo, Angola.

Number of Forms.—Fourteen.

Characters.—Infraorbital foramen large, round, and at maximum development for the family, not forming a canal, and apparently well open enough to transmit a small strand of muscle. The portion of the zygomatic plate behind it considerably narrowed. Zygomatic plate strongly ridged, but less so than in *Xerus*, though it approaches the type found in that genus. Frontals broad, postorbital process moderately developed; rostrum short, broad. Parietal ridges not heavy, but joining in adult. Palate normal. Bullae not reduced. Toothrows not reduced. Cheekteeth $\frac{4}{4}$, relatively brachyodont, in structure suggesting the *Xerus* type; the usual four ridges and three depressions traceable in the upper series, but the whole effect usually rather simple. The centre depression rather broad, the anterior and posterior ones narrow. Forsyth Major suggested that this was the type of tooth from which the normal *Xerus* dentition was derived. Central depression in lower molars not becoming obliterated, but in most seen the pattern is not clear. Upper and lower incisors considerably thickened anteroposteriorly, their surfaces plain; there is a certain tendency towards this character in all genera of African Tree-squirrels.

Size large, up to 310 mm. head and body. Tail densely bushy, often rather longer than head and body. Digits with the arrangement characteristic of arboreal types. Ventral surface of body poorly furred, often tending to be nearly naked, a rare feature in the Order.

Forms seen: *bea*, *caliurus*, *centricola*, *dissonus*, *eborivorus*, *loandae*, *moerens*, *nigeriae*, *notabilis*, *signatus*, *stangeri*, *temmincki*.

List of Named Forms

1. PROTOXERUS STANGERI STANGERI, Waterhouse

1842. Proc. Zool. Soc. London, p. 127.
Fernando Po.
Synonym: *nordhoffi*, du Chaillu, 1860, Proc. Boston Soc. Nat. Hist., VII, p. 363. Gaboon.

2. PROTOXERUS STANGERI CALLIURUS, Peters

1874. Monatsber. Akad. Wiss. Berlin, p. 707.
Cameroons.

3. PROTOXERUS STANGERI DISSONUS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 527.
Bitye, Ja River, Cameroons.

4. PROTOXERUS STANGERI NIGERIAE, Thomas

1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 296.
Abutschi, Lower Niger.

5. PROTOXERUS STANGERI TEMMINCKI, Anderson

1879. Zool. Yunn, p. 229 (note).
Gold Coast.
Synonym: *caniceps*, Temminck, 1853, Esq. Zool. Côte de Guiné, p. 127, Gold Coast. Not of Gray, 1842.

6. PROTOXERUS STANGERI EBORIVORUS, du Chaillu

1860. Proc. Boston Soc. Nat. Hist., VII, p. 363.
Gaboon.
Synonym: (?) *subalbidus*, du Chaillu, same reference, p. 365.

7. PROTOXERUS STANGERI PERSONATUS, Kershaw

1923. Rev. Zool. Afr., XI, 4, p. 364.
Makia Ntete, Lower Mayumbe, Congo.

8. PROTOXERUS STANGERI TORRENTIUM, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 529.
Stanley Falls, Congo River.

9. PROTOXERUS STANGERI NOTABILIS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 528.
Avakubi, Ituri Forest, Belgian Congo.

10. PROTOXERUS STANGERI MOERENS, Thomas

1923. Ann. Mag. Nat. Hist. 9, XI, p. 527.
Lobi, near Angu, Uelle River, Belgian Congo.

11. PROTOXERUS STANGERI SIGNATUS, Thomas

1910. Ann. Mag. Nat. Hist. 8, V, p. 85.
Lodja, near Upper Lukenye River, S. Congo.

12. PROTOXERUS STANGERI LOANDAE, Thomas

1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 296.
Canhoca, N. Angola.

13. PROTOXERUS STANGERI CENTRICOLA, Thomas

1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 297.
Entebbe, Uganda.

14. PROTOXERUS STANGERI BEA, Heller

1912. Smiths. Misc. Coll., LIX, no. 16, p. 2.
Lukosa River, Kakamega Forest, Kenya.

Genus 22. MYRSILUS, Thomas

1909. Myrsilus, Thomas, Ann. Mag. Nat. Hist. 8, III, p. 470.

Type Species.—*Sciurus aubinnii*, Gray.

RANGE.—West Africa: Liberia, Ashanti.

NUMBER OF FORMS.—Two.

CHARACTERS.—Essential skull characters, including the large infraorbital foramen, as *Protoxerus*, but skull higher in frontal region, and nasals slanting downwards anteriorly. Zygomatic plate rather weaker. In the four skulls examined, the cheekteeth have much more clearly marked ridges and depressions than the majority of *Protoxerus*. P.3 present, very small. Incisors of similar type to those of *Protoxerus*.

Externally differing from *Protoxerus* in the normally furred belly, and the narrower tail, which is less densely bushy. Smaller than *Protoxerus*.

REMARKS.—This genus is not very clearly distinguishable from *Protoxerus*, but probably must stand, at any rate provisionally, until more material comes to hand. The well-furred belly and the more strongly ridged cheekteeth (constant?) are the main distinguishing characters.

Forms seen: *aubinnii*.

LIST OF NAMED FORMS

1. MYRSILUS AUBINNII AUBINNII, Gray

1873. Ann. Mag. Nat. Hist. 4, XII, p. 65.
Fantee, Ashanti, W. Africa.

2. MYRSILUS AUBINNII SALAE, Jentink

1881. Notes Leyden Mus., III, p. 63.
Liberia.

Genus 23. EPIXERUS, Thomas

1909. EPIXERUS, Thomas, Ann. Mag. Nat. Hist. 8, III, p. 472.

TYPE SPECIES.—*Sciurus wilsoni*, du Chaillu.

RANGE.—West Africa: Gold Coast, Cameroons, Gaboon.

NUMBER OF FORMS.—Two.

CHARACTERS.—Closely related to *Protoxerus*; skull longer and narrower; infraorbital foramen of similar type, but much less open in adult skulls examined, its appearance slitlike, though scarcely forming a canal. Frontals relatively narrower, and muzzle longer. Bullae considerably reduced. Palate extending very slightly more behind toothrows. Toothrows strongly reduced. In all skulls seen, the depressions tend to take the form of re-entrant folds. Cusps low. Lower cheekteeth with the elements apparently near *Xerus*; a well-marked outer re-entrant fold appearing between the outer main cusps. P.3 absent. Incisors plain, much thickened anteroposteriorly.

Externally large; tail thickly bushy, rather longer than the head and body; belly poorly furred, nearly naked often, as in *Protoxerus*; digits of arboreal type.

REMARKS.—Not clearly very separable from *Protoxerus*.

Forms seen: *wilsoni*, *ebii*.

LIST OF NAMED FORMS

1. EPIXERUS WILSONI, du Challu

1860. Proc. Boston Soc. Nat. Hist., VII, p. 364.
Gaboon.

2. EPIXERUS EBII, Temminck

1853. Esq. Zool. Côte de Guiné, p. 129.
Forests of Guinea, most abundant at Dabocrom.

SECTION E. XERUS. African and Palaearctic terrestrial Squirrels presenting the following features: lachrymal usually much enlarged; bullae usually more enlarged than is normal; palate always extending considerably behind the toothrows; claws prominent to extremely enlarged; fur most often bristly.

Genus 24. XERUS, Hemprich & Ehrenberg

1833. XERUS, Hemprich & Ehrenberg, Symb. Phys. Mamm. 1, text to pl. IX.

1834. GEOSCIURUS, Smith, S. Afr. Quart. Journ., ii, p. 128. *Sciurus capensis*, Kerr. Valid as a subgenus.

1909. EUXERUS, Thomas, Ann. Mag. Nat. Hist. 8, III, p. 473. *Sciurus erythropus*, Geoffroy. Valid as a subgenus.

TYPE SPECIES.—*Xerus brachyotis*, Hemprich & Ehrenberg = *Sciurus rutilus*, Cretzchmar.

RANGE.—Africa: Sudan, Sahara, Abyssinia, Somaliland, Kenya, Uganda; Senegal, Sierra Leone, Gaboon; South-west Africa, South Africa.

NUMBER OF FORMS.—Nineteen.

CHARACTERS.—Palate produced posteriorly considerably behind level of last molars; bullae large, round and inflated; lachrymal conspicuously enlarged. Zygomatic plate much narrower, particularly above, very strongly ridged along anterior border; infraorbital foramen with well-developed masseter knob. Parietal ridges, though not well marked, joining in old age. Hamular processes thick, long, joining bullae. Postorbital process short, directed backwards. Incisors so far as seen without trace of grooving (compare *Atlantoxerus*).

Cheekteeth $\frac{4}{3}$ in *Xerus* s.s. and *Geosciurus*; the extra premolar present, minute, in *Euxerus*. The depressions are well marked; the cusps and ridges not high; originally there are three depressions between four ridges; in old age, the posterior ridge and depression tend to become obliterated. M.3 smaller and rather simpler than M.1 and M.2. Lower cheekteeth with well-developed posterointernal cusp, and the central depression of each tooth more or less compressed, and restricted, not taking up the greater part of the tooth, as it does in most genera. With wear the depression takes the form of a wide re-entrant fold. The anterointernal cusp, as usual the highest, but the cusps not particularly developed. Cheekteeth strongly hypsodont in *Euxerus* and *Geosciurus*; less so in typical *Xerus*.

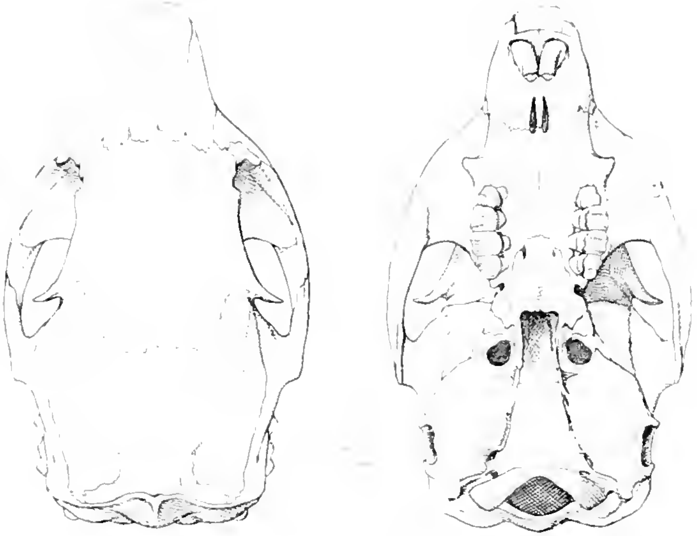


FIG. 104. XERUS RUTILUS RUTILUS, Cretzchmar.
B.M. No. 97.8.9.11, ♂; × 1½.

FIG. 105. XERUS RUTILUS RUTILUS, Cretzchmar.
B.M. No. 97.8.9.11, ♂, × 1½.

Fur in the form of short bristles, which cover the head, limbs and more or less the whole body. D.3 in the forefoot definitely longer than D.4, which is longer than D.2 and D.5. Hindfoot rather long, the three central digits longer than the outer two, D.3 very slightly the main digit. Tail bushy, nearly as long as head and body. Ear short.

In the typical subgenus, there is no side-stripe, but in both the other subgenera there is a white stripe on each flank.

Euxerus retains the extra small premolar, which is said to be lost early; and has a narrow skull, and reduced postorbital processes.

Geosciurus, from South Africa, has a much broader skull than is normal in the genus; the skull is not unlike that of *Spermophilopsis* except that the bullae are more evenly inflated, the interparietal is not so clearly marked, and the parietal ridges tend to join. The hindfoot is as a rule relatively larger than in allies.

These two groups are currently given full generic rank, but the time, I think, has come not to recognize genera on the least or vaguest excuses. The three groups are essentially congeneric in all main characters; much more nearly allied to each other than are some of the numerous subgenera now referred to *Citellus* in North America.

The following table should indicate that it is no longer necessary to retain *Euxerus* and *Geosciurus* as full genera, in that the characters of the three groups intergrade to a considerable degree.

	Xerus	*Euxerus*	*Geosciurus*
Head and Body Length	230–250 (St. Leger)	240–300	250–290
Flank-stripe	Absent	Present	Present
Cheekteeth	More brachyodont	Hypsodont	Hypsodont
P.3	Absent	Present	Absent
Skull	Rather broad	Narrow	Broad

Forms seen: *agadius*, *capensis*, *chadensis*, *dabagalla*, *dorsalis*, *erythropus*, *fulvior*, *internus*, *lacustris*, *leucoumbrinus*, *limitaneus*, *maestus*, *microdon*, *namaquensis*, *princeps*, *rufifrons*, *rutilus*, *saturatus*, *stephanicus*.

List of Named Forms

Subgenus *Xerus*, Hemprich & Ehrenberg

1. XERUS RUTILUS RUTILUS, Cretzchmar

1826. Ruppell Atlas, p. 50, pl. 24.
Eastern slope of Abyssinia.
Synonym: *brachyotis*, Hemprich & Ehrenberg, 1832, Symp. Phys., 1, text to pl. IX.
(?) *abessinicus*, Gmelin, Syst. Nat. 1, p. 140. 1788.
fuscus, Huet, 1880, Nouv. Arch. Mus. N. H. Paris, 2, 3, 139.

2. XERUS RUTILUS DABAGALLA, Heuglin.
1861. Nov. Act. Acad. Leop. Car. Nat. Cur., XXVIII, p. 4, Tab. 2.
Probably Eritrea.

3. XERUS RUTILUS INTENSUS, Thomas
1904. Ann. Mag. Nat. Hist. 7, XIV, p. 100.
Gerlogubi Wells, Somaliland.

4. XERUS RUTILUS STEPHANICUS, Thomas
1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 301.
Lake Stephanie, Abyssinia.

5. XERUS RUTILUS RUFIFRONS, Dollman.
1911. Ann. Mag. Nat. Hist. 8, VII, p. 518.
N. Guaso Nyiro, Kenya.
Synonym: (?) *flavus*, Milne-Edwards, 1867, Rev. Mag. Zool. 229. "Gaboon" error; Somaliland. Not of Linnaeus.

6. XERUS RUTILUS SATURATUS, Neumann
1900. Zool. Jahrb. Syst., XIII, p. 546.
Kibwezi, Kenya.

7. XERUS RUTILUS DORSALIS, Dollman
1911. Ann. Mag. Nat. Hist. 8, VII, p. 519.
Lake Baringo, Kenya.

Subgenus *Euxerus*, Thomas

8. XERUS ERYTHROPUS ERYTHROPUS, Geoffroy
1803. Cat. Mamm. p. 178.
W. Africa; possibly Senegal.
Synonym: *albovittatus*, Desmarest, 1817, Nouv. Dict. Hist. Nat., X, p. 110.
(?) *simplex*, Lesson, 1836, Hist. Nat. Mamm., V, p. 402. Senegal.
marabutus, Lesson, Comp. Buffon, 2, Paris, 1, 467, 1838.
prestigiator, Lesson, same reference, p. 468.
lessonii, Fitzinger, 1867, Sitz. K. Ak. Wiss. Wien. math. nat. Cl. 55, 1, 488.

9. XERUS ERYTHROPUS MOESTUS, Thomas
1910. Ann. Mag. Nat. Hist. 8, V, p. 419.
Daru, Sierra Leone.

10. XERUS ERYTHROPUS AGADIUS, Thomas & Hinton
1921. Nov. Zool., XXVIII, p. 6.
Agades, Air, Sahara.

11. XERUS ERYTHROPUS CHADENSIS, Thomas
1905. Ann. Mag. Nat. Hist. 7, XV, p. 387.
Yo, Lake Chad.

12. XERUS ERYTHROPUS LACUSTRIS, Thomas
1905. Ann. Mag. Nat. Hist. 7, XV, p. 388.
Masindi, Unyoro, Uganda.

13. XERUS ERYTHROPUS LIMITANEUS, Thomas & Hinton
1923. Proc. Zool. Soc. London, p. 255.
Zalingei, Darfur, Sudan.

14. XERUS ERYTHROPUS LEUCOUMBRINUS, Ruppell

1835. Neue Wirb. Fauna Abyss. Säugeth. p. 38.
Abyssinia or Sudan.

15. XERUS ERYTHROPUS MICRODON, Thomas

1905. Ann. Mag. Nat. Hist. 7, XV, p. 389.
Kitui, Kenya.
Synonym: *microdon fulvior*, Thomas, 1905, Ann. Mag. Nat. Hist. 7, XV, p. 389. Fort Hall, Kenya.

Subgenus *Geosciurus*, Smith

16. XERUS INAURIS INAURIS, Zimmerman

1780. Geogr. Geschichte, 2, 344.
Kaffirland, 100 miles north of Cape of Good Hope.
Synonym: *levaillanti*, Kuhl, 1820, Beit. Zool. 67.
setosus, Smuts, 1832, Enum. Mamm. Cap. 33.
capensis, Kerr, 1792, Linn. Anim. Kingd. 266.
ginginianus, Shaw, Gen. Zool. 2, pt. 1, 147, 1801.
dschinshicus, Gmelin, Syst. Nat. 1, p. 151, 1788.
africanus, Shaw, Gen. Zool. 2, pt. 1, 172, 1801.

17. XERUS INAURIS NAMAQUENSIS, Lichtenstein

1793. Cat. Rer. Nat. p. 2.
Orange River, Namaqualand.

18. XERUS PRINCEPS, Thomas

1929. Proc. Zool. Soc. London, p. 106.
Otjitundua, Central Kaokoveld.

The incisors are white in *X. capensis*, but normal (yellow) in *X. princeps*.

Genus 25. ATLANTOXERUS, Forsyth Major

1893. Atlantoxerus, Forsyth Major, Proc. Zool. Soc. London, p. 189.

Type Species.—*Sciurus getulus*, Linnaeus.

Range.—Palaearctic section of Africa (North-west): Morocco, Algeria: "All the Grand Atlas from the Atlantic coast between the Uad Tensift and Uad Sus, at extreme east of the chain extending to the middle Atlas and the Algerian Sahara" (G. M. Allen).

Number of Forms.—One.

Characters.—Like *Xerus*, but fur not definitely bristly, though short and stiff. D.4 appears in the manus to be relatively longer, so that rarely D.3 and D.4 may be subequal. A prominent white stripe on each flank, and sometimes a mid-dorsal stripe may be indicated. Skull flatter than is normal in *Xerus*; upper incisors frequently with traces of a groove.

Parietal ridges poorly marked, evidently not tending to join. P.3 present, fairly well developed; dentition essentially as *Xerus*. Lachrymal not specially enlarged.

Remarks.—The smaller lachrymal, and fur which is not bristly, may be used for retaining this genus. It is evidently a primitive member of the *Xerus* section, with the characters of that section at least development. It is the only Squirrel in Africa north of the Sahara.

Forms seen: *getulus*.

List of Named Forms

1. ATLANTOXERUS GETULUS, Linnaeus

1758. Syst. Nat. 1, 10th Ed. p. 64.
Agadir, Morocco.
Synonym: *trivittatus*, Gray, 1842, Ann. Mag. Nat. Hist., X, p. 264.

There is at the British Museum a skull labelled "*barbarus*." The reference to this name has not been traced.

Genus 26. SPERMOPHILOPSIS, Blasius

1884. Spermophilopsis, Blasius, Tageblatt 57ten. Versamml. Deutsch Naturf. Magdeburg, 5, pp. 322–325.

Type Species.—*Spermophilus leptodactylus*, Lichtenstein.

Range.—Afghanistan and Russian Turkestan (from Caspian Sea to Semirechyia district) (Vinogradov).

Number of Forms.—Three.

Characters.—In essential cranial characters this genus is clearly a member of the *Xerus* section. It differs from all Sciuridae seen in the extreme development of the claws, except *Hyosciurus* from Celebes. The frontals are very broad indeed, the braincase behind the postorbital process wide. Postorbital process not very large. In none of the skulls is there the slightest sign of the parietal ridges coming together; the interparietal is well marked. Occipital region relatively weak. Infraorbital foramen well open, barely forming canal. Bullae not evenly inflated, though larger than is usual. Palate rather shorter posteriorly than *Xerus*.

P.3 minute. In all the skulls seen, the upper cheekteeth are more or less flat-crowned and well on the way towards complete simplification, but all are much worn. The teeth are strongly hypsodont. One main outer re-entrant fold is traceable in all teeth, with sometimes a short fold in front of it. The teeth in extreme age seem to wear down to a simple ring-shape. Lower cheekteeth of all seen with one short outer and one long inner fold; or tending to become completely simple at later development. The dentition appears to indicate a nearer relationship with the *Xerus* section rather than with the *Citellus* section.

D.3 of forefoot the longest. Claws of all digits of hindfoot, and the four main digits of forefoot, excessively long, thick and powerful. Pollex very short, but clawed. Sole thickly haired in those examined. Summer pelage rough, almost bristly as in *Xerus*; winter pelage long, silky. Mammae 6 or 8 (Obolensky).

FIG. 106. SPERMOPHILOPSIS LEPTODACTYLUS LEPTODACTYLUS, Lichtenstein.
B.M. No. 9.4.3.23, ♂; × 1½.

FIG. 107. SPERMOPHILOPSIS LEPTODACTYLUS LEPTODACTYLUS, Lichtenstein.
B.M. No. 9.4.3.23, ♂; × 1½.

Tail strongly reduced, not much longer than hindfoot. Cheek-pouches present (Vinogradov).

Forms seen: *leptodactylus*.

The genus is revised by Obolensky, 1927, C.R. Acad. Sci. Leningrad, p. 188.

List of Named Forms

1. SPERMOPHILOPSIS LEPTODACTYLUS LEPTODACTYLUS, Lichtenstein

1823. Eversmann. Reise, p. 119.
Karata, 140 versts north-west of Bokhara.
Synonym: *turcomanus*, Eichwald, Reise 1, p. 305, 1834.

2. SPERMOPHILOPSIS LEPTODACTYLUS SCHUMAKOVI, Satunin

1908. Mitt. Kauk. Mus. p. 255.
Kushka, S. Transcaspia.

3. SPERMOPHILOPSIS BACTRIANUS, Scully

1888. Journ. Asiat. Soc. Bengal, LVI, p. 70.
Khamiab, North Afghanistan.

Considered by Vinogradov, 1933, Rodents of U.S.S.R., as probably a subspecies of *leptodactylus*.

Section F. Tamias and Allies. Semiterrestrial Squirrels with narrow rather flattened skull, relatively small postorbital process, cheek-pouches present, digits 3 and 4 of manus about equal to each other in length (neither constantly longer than the other), dentition of *Sciurus* type.

Genus 27. SCIUROTAMIAS, Miller

1901. Sciurotamias, Miller, Proc. Biol. Soc. Washington, XIV, p. 23.
1922. Rupestes, Thomas, Ann. Mag. Nat. Hist. 9, X, p. 398. (*Rupestes forresti*, Thomas.) Valid as a subgenus.

Type Species.—*Sciurus davidianus*, Milne-Edwards.

Range.—China: Moupin, Szechuan, Kansu, Shensi, Shansi, Chihli; Yunnan.

Number of Forms.—Five.

Characters.—Skull much like Asiatic *Tamias*, but infraorbital foramen not abnormally open, though more so than is usual in Sciurinae. Tail thickly bushy; no colour pattern; and differing "in the direction of *Sciurus* in the reduction of the capacity of the cheek-pouches." Skull long, relatively narrow, with smooth braincase, much reduced postorbital process, and with posterior portion of skull not depressed posteriorly, agreeing in this respect with *Tamias*, but differing from *Sciurus*. Zygomatic plate, as in *Tamias*, short and little tilted upwards, the ridges of its superior border weak. Infraorbital foramen scarcely forming canal; masseter knob weak or absent. Upper cheekteeth as in *Tamias*; P.3 present, though vestigial. Lower cheekteeth not essentially different from *Tamias*; palate normal.

Tail about three-quarters of head and body length, bushy. D.3 and D.4 in manus subequal in length. Hindfoot rather broad, with sole hairy; arrangement of digits as in *Tamias*, with tendency for D.4 to be slightly longer than D.3. Fur thick and soft.

Upper incisors rather short.

Rupestes described as a full genus by Thomas is not distinguishable in cranial and dental characters in any way that could be considered as of generic value. P.3 is absent. The hindfoot is narrow, with naked sole, and an additional sole pad halfway between heel and digital pad at base of hallux. Fur and digit arrangement as in normal *Sciurotamias*. Three pairs of mammae (Thomas). Further specimens would be welcome to make the exact status of this species clear; at the moment there are no characters which distinguish it as a genus except the form of the hindfoot, which may be very variable elsewhere within a genus.

Forms seen: *davidianus*, *consobrinus*, *forresti*.

List of Named Forms

Subgenus *Sciurotamias*, Miller

1. SCIUROTAMIAS DAVIDIANUS DAVIDIANUS, Milne-Edwards

1867. Rev. Mag. Zool. p. 196.
N. China, mountains near Pekin.

2. SCIUROTAMIAS DAVIDIANUS THAYERI, G. Allen

1913. Mem. Mus. Comp. Zool. 40, p. 231.
Washan, W. Szechuan, China.

3. SCIUROTAMIAS DAVIDIANUS CONSOBRINUS, Milne-Edwards

1868. Rech. Hist. Nat. Mamm. p. 305.
Moupin, Szechuan, China.

4. SCIUROTAMIAS DAVIDIANUS OWSTONI, Allen

1909. Bull. Amer. Mus. Nat. Hist., XXVI, p. 429.
Tai-Pa-Shiang Mts., Shen-Si, China.

Subgenus *Rupestes*, Thomas

5. SCIUROTAMIAS FORRESTI, Thomas

1922. Ann. Mag. Nat. Hist. 9, X, p. 398.
Mekong-Yangtze Divide, 27° N., Yunnan, China.

Genus 28. TAMIAS, Illiger

1811. Tamias, Illiger, Prod. Syst. Mamm. et Avium, p. 83.

1880. Eutamias, Trouessart, Cat. Mamm. Viv. et Foss. Rodentia, in Bul. Soc. Etudes Sci. d'Angers, 10, p. 86. (*Sciurus striatus asiaticus*, Gmelin.) Valid as a subgenus

1929. Neotamias, Howell, North Amer. Fauna, No. 26, p. 52. (*Eutamias merriami*, Allen.) Valid as a subgenus.

Type Species.—*Sciurus striatus*, Linnaeus.

RANGE.—Holarctic: U.S.S.R., eastwards from River Dwina and Kama, northwards from 58° N. in European Russia, also widely distributed in wooded and wood-steppe districts of Siberia and Far East (Vinogradov); Altai, Ussuri; Manchuria, Chihli, Korea, Shansi, Shensi, Kansu, Szechuan; Japan, Kurile Islands; Yukon, Mackenzie, Ontario, Alberta, British

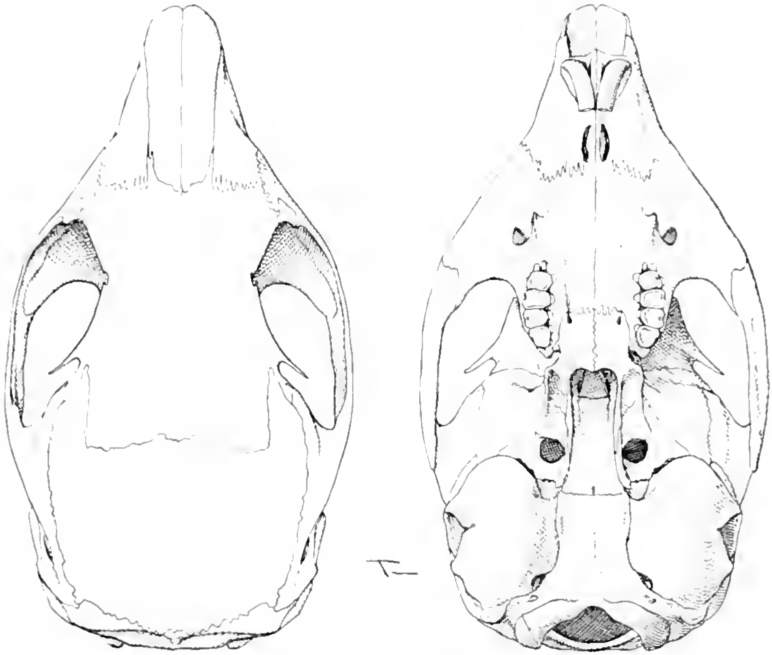


FIG. 108. TAMIAS DORSALIS DORSALIS, Baird.
B.M. No. 88.9.24.1, ♂; × 2½.

Columbia, Washington, Oregon, Idaho, Montana, Wyoming, Wisconsin, California, Lower California, Nevada, Utah, Arizona, Colorado, New Mexico, Texas, New York, South Carolina; south into Northern Mexico.

NUMBER OF FORMS.—About eighty-one.

REMARKS.—This genus is usually split into two, *Tamias* and *Eutamias*, the former containing the type species only.

The subgenus *Eutamias* was originally proposed by Trouessart with the single character that the premolars are $\frac{2}{1}$ instead of $\frac{1}{1}$ as in typical *Tamias*. Merriam in 1897 (Proc. Biol. Soc. Washington, XI, p. 189), gave *Eutamias* full generic rank, stating, "it will be observed that the name *Eutamias*, proposed by Trouessart in 1880 as a subgenus of *Tamias* is here adopted as a full genus. This is because of the conviction that the superficial resemblance between the two groups is accidental parallelism, in no way indicative of affinity. In fact the two groups, if my notion of their relationship is correct, had very different ancestors, *Tamias* being an offshoot of the ground-squirrels of the subgenus *Ictidomys* of Allen, and *Eutamias* of the subgenus *Ammospermophilus*, Merriam." At the same time he gives no characters which would separate the two "genera."

Howell in 1929 (Revision of the Chipmunks, North Amer. Fauna, No. 52, p. 1, 1929), erected a new subgenus for American "*Eutamias*," and keys the three groups thus:

FIG. 109. TAMIAS DORSALIS DORSALIS, Baird.
B.M. No. 88.9.24.1, ♂; × 2½.

Upper premolars two; dorsal stripes unequally spaced (median bordered on either side by a much broader band). Genus TAMIAS

Upper premolars four; dorsal stripes equally spaced (all of approximately equal width). Genus EUTAMIAS

Anteorbital foramen suborbicular; postorbital processes broad at base. Subgenus *Eutamias*

Anteorbital foramen narrowly oval; postorbital processes narrow at base. Subgenus *Neotamias*

This key convinces me that all these forms must be referred to one genus only. The characters given to separate "*Eutamias*" from *Tamias* are based only on the absence or presence of the functionless premolar, and on the colour pattern. If colour pattern is to be used as a generic character, it seems *Citellus suslicus* will require a new name when compared with *C. citellus*, etc.

The Asiatic Chipmunk is intermediate between typical *Tamias* and the smaller American forms in many characters. Comparing *Neotamias* with *Eutamias*, Howell, writing of the latter, states, "the ears are broad, rounded, of medium height, much as in *Tamias*; postorbital broad at base, tapering to a point, much as in *Tamias*; interorbital constriction slight, as in *Tamias*; upper molariform toothrows slightly convergent posteriorly, as in *Tamias*." He also states, "*Eutamias* of Asia resembles *Tamias* of North America and differs from American *Eutamias* in a number of characters, notably the shape of the anteorbital foramen, the postorbital process, the breadth of the interorbital region, the development of the lambdoidal crest, and the shape of the external ears. On the other hand, American *Eutamias* agrees with the Asiatic members of the genus in the shape of the rostrum, the well-defined striations of the upper incisors, the presence of the extra peg-like premolar, and in the pattern of the dorsal stripes."

It becomes clear that these forms agree in far too many essential characters for the *Eutamias* group to be retained longer as a distinct genus.

CHARACTERS.—(Subgenus *Eutamias*; Palaearctic). Skull lightly built, narrow, and with no prominent ridges for muscle attachment, except the upper border of the zygomatic plate, which is ridged superiorly, though not tilted upwards as much as is usual owing to the skull being flatter than in most Sciuridae. Postorbital process small and weak, though broader than in subgenus *Neotamias*. Bullae relatively large. Palate broad, normal, not continued far backwards; lachrymal not much enlarged. Infraorbital foramen forming no canal, large, round and apparently well open enough to transmit a strand of muscle. The part of the zygomatic plate behind it is narrow; a small masseter knob is usually present. Mandible with angular portion somewhat pulled inward.

Cheekteeth of *Sciurus* type; P.3 present, but vestigial. The ridges and depressions well marked originally, but evidently tending to wear down rather early. The lower teeth are not unlike those of *Citellus*, but without the great height of the cusps characteristic of normal members of that genus, and the posterointernal cusp more developed; the ridge connecting the two outer main cusps weaker. Upper incisors with traces of many minute grooves, as in *Marmota*.

Externally, tail relatively long, though rather shorter than the head and body, as a rule; not densely bushy, though fully haired. In the manus, D.4 and D.3 are usually roughly equal to each other in length. It has been stated (Winge, Weber) that D.3 is the longest digit; but out of two hundred and twenty-seven skins examined (including Asiatic and American species of the genus), only fifty-two had the middle digit slightly longer than the fourth; and sometimes D.4 may be slightly the longer; in some skins of Asiatic *Tamias*, the digit lengths vary in the two hands. Sole usually partly haired. Hindfoot with the outer digits shorter than D.3 and D.4, with a tendency for D.4 to be slightly the longest; hallux rather reduced. The back typically with five black stripes, bordering four white ones. There is some variation in colour pattern; in (*Neotamias*) *dorsalis*, only one mid-dorsal stripe is clearly marked.

Neotamias, containing the American forms with a roughly similar colour pattern and P.3 present, have the infraorbital foramen rather less open and less rounded, but still of large size compared with most Sciuridae. The postorbital process is narrower at the base, and lighter. The skull is less heavily built. But as shown above, Asiatic *Tamias* connects these forms with the typical subgenus. The baculum is said to differ from subgenus *Eutamias*.

Tamias s.s. has P.3 absent, and there are only two white flank-stripes each side, though the five black ones of the other forms are present. The rostrum is less abruptly constricted near the base, and narrowing evenly from base to tip; the upper incisors have the grooves shallow or absent. Further, Howell states that the palate is relatively longer (but the differences in British Museum material seems to amount to very little); and that the bullae are relatively smaller. The tail is usually rather shorter. This subgenus is confined to eastern North America.

Tamias and *Eutamias* contain a single species each. *Neotamias* is divided by Howell into five specific groups:

The *alpinus* group: small, skull 30·3–31·7 in length; interorbital region broader than in other small species; (coloration rather pale).

The *minimus* group: small-medium in size; hindfoot 26–35 mm.; skull length 28·7–34·2.

The *amoenus* group: evidently not very clearly distinguishable from the *minimus* group (hindfoot 29·5–35; skull length 31·3–35·6); "certain forms in the two groups . . . inhabiting widely separated areas are so closely similar both in external and cranial characters that many specimens are difficult to identify without recourse to the locality label" (Howell).

The *quadrivittatus* group: size medium; hindfoot 32–36; skull larger than races of *minimus* or *amoenus*, 34·5–36·8.

The *townsendii* group: large; hindfoot 34–39; skull 36·8–40·8.

Forms seen: *alpinus*, *amoenus*, "*asiaticus*" = *sibiricus*, *borealis*, *bulleri*, *callipeplus*, *cinereicollis*, *consobrinus*, *dorsalis*, *frater*, *hindsi*, *intercessor*, *inyoensis*, *lineatus*, *lysteri*, *merriami*, *minimus*, *neglectus*, *ochrogenys*, *ordinalis*, *orientalis*, *panamintinus*, *pricei*, *quadrimaculatus*, *quadrivittatus*, *senescens*, *senex*, *speciosus*, *striatus*, *townsendi*.

List of Named Forms

Subgenus *Neotamias*, Howell

alpinus Group

1. TAMIAS ALPINUS, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 137.
Big Cottonwood Meadows, south of Mount Whitney, Tulare County, California.

minimus Group

2. TAMIAS MINIMUS MINIMUS, Bachman

1839. Journ. Acad. Nat. Sci. Philadelphia, VIII, pt. 1, p. 71.
Near Green River City, Sweetwater County, Wyoming.

3. TAMIAS MINIMUS PICTUS, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 115.
Kelton, Boxelder County, Utah.
Synonym: *minimus melanurus*, Merriam, 1890, N. A. Fauna, No. 4, p. 22. Snake R., Blackfoot, Bingham County, Idaho.

4. TAMIAS MINIMUS GRISESCENS, Howell

1925. Journ. Mamm. Baltimore, 6, p. 52.
Farmer, Douglas County, Washington.

5. TAMIAS MINIMUS CARYI, Merriam

1908. Proc. Biol. Soc. Washington, XXI, p. 143.
Medano Ranch, San Luis Valley, Costilla County, Colorado.

6. TAMIAS MINIMUS PALLIDUS, Allen

1874. Proc. Boston Soc. Nat. Hist., XVI, p. 289.
Camp Thorne, near Glendive, Dawson County, Montana.

7. TAMIAS MINIMUS CACODEMUS, Cary

1906. Proc. Biol. Soc. Washington, XIX, p. 89.
Sheep Mountain, Big Bad Lands, South Dakota; Fall River County.

8. TAMIAS MINIMUS CONFINIS, Howell

1925. Journ. Mamm. Baltimore, 6, p. 52.
Crescent Lake, Oneida County, Wisconsin.

9. TAMIAS MINIMUS CONSOBRINUS, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 112.
Wasatch foothills, 18 miles east of Salt Lake City, Utah.
Synonym: *clarus*, Bailey, 1918, Proc. Biol. Soc. Washington, XXXI, p. 31. Swan Lake Valley, Yellowstone National Park.
lectus, Allen, 1905, Mus. Brooklyn Inst. Arts & Sci.: Sci. Bull. 1, p. 117. Beaver Valley, Beaver County, Utah.

10. TAMIAS MINIMUS OPERARIUS, Merriam

1905. Proc. Biol. Soc. Washington, XVIII, p. 164.
Gold Hill, Boulder County, Colorado.

11. TAMIAS MINIMUS ATRISTRIATUS, Bailey

1913. Proc. Biol. Soc. Washington, XXVI, p. 129.
Penasco Creek, Sacramento Mountains, Lincoln County (12 miles east of Cloudcroft), New Mexico.

12. TAMIAS MINIMUS ARIZONENSIS, Howell

1922. Journ. Mamm. Baltimore, 3, p. 178.
Prieto Plateau, Blue Range, Greenlee County, Arizona.

13. TAMIAS MINIMUS OREOCETES, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 207.
Summit Mountain, Flathead County, Montana.

14. TAMIAS MINIMUS BOREALIS, Allen

1877. Monogr. N. Amer. Rodents, p. 793.
Fort Liard, Mackenzie, Canada.
Synonym: *neglectus*, Allen, 1890, Bull. Amer. Mus. Nat. Hist. III, p. 106. Mouth of Montreal River, Lake Superior, Canada.

15. TAMIAS MINIMUS CANICEPS, Osgood

1900. North Amer. Fauna, No. 19, p. 28.
Lake Lebarge, Yukon, Canada.

16. TAMIAS MINIMUS JACKSONI, Howell

1925. Journ. Mamm. Baltimore, 6, p. 53.
Crescent Lake, Oneida County, Wisconsin.

17. TAMIAS MINIMUS SCRUTATOR, Hall & Hatfield

1934. Univ. Calif. Publ. Zool. 40, p. 321.
Near Blanco Mountain, White Mountains, Mono County, California.

amoenus Group

18. TAMIAS AMOENUS AMOENUS, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 90.
Fort Klamath, Klamath County, Oregon.
Synonym: *amoenus propinquus*, Anthony, 1913, Bull. Amer. Mus. Nat. Hist., XXXII, p. 6. Ironside, Malheur County, Oregon.

19. TAMIAS AMOENUS OCHRACEUS, Howell

1925. Journ. Mamm. Baltimore, 6, p. 54.
Studhorse Canyon, Siskiyou Mountains, California.

20. TAMIAS AMOENUS MONOENSIS, Grinnell & Storer

1916. Univ. Calif. Publ. Zool. 17, p. 3.
Warren Fork, Mono County, California.

21. TAMIAS AMOENUS LUTEIVENTRIS, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 101.
Chief Mountain Lake (Waterton Lake), Alberta, $3\frac{1}{2}$ miles north of U.S.A.-Canada boundary.

22. TAMIAS AMOENUS VALLICOLA, Howell

1922. Journ. Mamm. Baltimore, 3, p. 179.
Bass Creek, near Stevensville, Ravalli County, Montana.

23. TAMIAS AMOENUS CANICAUDUS, Merriam

1903. Proc. Biol. Soc. Washington, XVI, p. 77.
Spokane, Spokane County, Washington.

24 TAMIAS AMOENUS AFFINIS, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 103.
Ashcroft, British Columbia.

25. TAMIAS AMOENUS LUDIBUNDUS, Hollister

1911. Smiths. Misc. Coll., LVI, no. 26, p. 1.
Yellowhead Lake, British Columbia.

26. TAMIAS AMOENUS FELIX, Rhoads

1895. Amer. Nat. 29, p. 941.
Church Mountain, Mount Baker Range, British Columbia (New Westminster district).

27. TAMIAS AMOENUS CAURINUS, Merriam

1898. Proc. Acad. Nat. Sci. Philadelphia, p. 352.
Near head of Soleduc River, Olympic Mountains, Clallam County, Washington.

28. TAMIAS PANAMINTINUS PANAMINTINUS, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 134.
Johnson Canyon, Panamint Mountains, Inyo County, California.

29. TAMIAS PANAMINTINUS JUNIPERUS, Burt

1931. Journ. Mamm. Baltimore, 12, p. 298.
Charleston Mountains, Clark County, Nevada.

quadrivittatus Group

30. TAMIAS QUADRIVITTATUS QUADRIVITTATUS, Say

1823. Long's Exp. Rocky Mountains, 2, p. 45.
Arkansas River, Colorado, about 26 miles below Canyon City, Pueblo County.
Synonym: *quadrivittatus gracilis*, Allen, 1890, Bull. Amer. Mus. Nat. Hist., III, p. 99. San Pedro, Socorro County, New Mexico.
quadrivittatus animosus, Warren, 1909, Proc. Biol. Soc. Washington, XXII, p. 105. Las Animas County, Colorado; Irwin's Ranch.

31. TAMIAS QUADRIVITTATUS HOPIENSIS, Merriam

1905. Proc. Biol. Soc. Washington, XVIII, p. 165.
Keam Canyon, Navajo County, Arizona.

32. TAMIAS QUADRIVITTATUS INYOENSIS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 208.
White Mountains, Inyo County, California.

33. TAMIAS QUADRIVITTATUS FRATER, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 88.
Donner, Placer County, California.

34. TAMIAS QUADRIVITTATUS SEQUOIENSIS, Howell

1922. Journ. Mamm. Baltimore, 3, p. 180.
Mineral King, east fork of Kaweah River, Tulare County, California.

35. TAMIAS QUADRIVITTATUS SPECIOSUS, Merriam

1890. Bull. Amer. Mus. Nat. Hist., III, p. 86.
Head of White Water Creek, San Bernardino Mountains, San Bernardino County, California.

36. TAMIAS QUADRIVITTATUS NEVADENSIS, Burt

1931. Journ. Mamm. Baltimore, 12, p. 299.
Sheep Mountains, Clark County, Nevada.

37. TAMIAS CALLIPEPLUS, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 136.
Mount Piños, Ventura County, California.

38. TAMIAS PALMERI, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 208.
Charleston Peak, Clark County, Nevada.

39. TAMIAS ADSITUS, Allen

1905. Mus. Brooklyn Arts & Sci.: Sci. Bull. 1, p. 118.
Briggs Meadows, Beaver Mountains, Millard County, Utah.

40. TAMIAS UMBRINUS, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 96.
Black Fork, Uinta Mountains, Utah.

41 TAMIAS RUFICAUDUS RUFICAUDUS, Howell
1920. Proc. Biol. Soc. Washington, XXXIII, p. 91.
Upper St. Mary Lake, Glacier County, Montana.

42 TAMIAS RUFICAUDUS SIMULANS, Howell
1922. Journ. Mamm. Baltimore, 3, p. 179.
Coeur d'Alene, Kootenai County, Idaho.

43. TAMIAS CINEREICOLLIS CINEREICOLLIS, Allen
1890. Bull. Amer. Mus. Nat. Hist. III, p. 94.
San Francisco Mountain, Coconino County, Arizona.

44 TAMIAS CINEREICOLLIS CINEREUS, Bailey
1913. Proc. Biol. Soc. Washington, XXVI, p. 130.
Magdalena Mountains, Socorro County, New Mexico.

45. TAMIAS CINEREICOLLIS CANIPES, Bailey
1902. Proc. Biol. Soc. Washington, XV, p. 117.
Guadaloupe Mountains, El Paso County, Texas.

46 TAMIAS BULLERI BULLERI, Allen
1889. Bull. Amer. Mus. Nat. Hist., II, p. 173.
Sierra de Valparaiso, Zacatecas, Mexico.

47. TAMIAS BULLERI DURANGAE, Allen
1903. Bull. Amer. Mus. Nat. Hist., XIX, p. 594.
Arroyo de Bucy, N.-W. Durango, Mexico.
Synonym: *nexus*, Elliot, 1905, Proc. Biol. Soc. Washington, XVIII, p. 233.
Coyotes, Durango, Mexico.

48. TAMIAS BULLERI SOLIVAGUS, Howell
1922. Journ. Mamm. Baltimore, 3, p. 179.
Sierra Guadalupe, Coahuila, Mexico.

townsendii Group

49 TAMIAS TOWNSENDII TOWNSENDII, Bachman
1839. Journ. Acad. Nat. Sci. Philadelphia, VIII, pt. 1, p. 68.
Lower Columbia River, Oregon.
Synonym: *hindsi*, Gray, 1842, Ann. Mag. Nat. Hist., X, p. 264. Fort Vancouver, Washington.
townsendii littoralis, Elliot, 1903, Field Columb. Mus. pub. 74, zool. ser. 3, p. 153. Marshfield, Oregon.

50. TAMIAS TOWNSENDII COOPERI, Baird
1855. Proc. Acad. Nat. Sci. Philadelphia, p. 334.
Klickitat Pass, Cascade Mountains, Washington; Skamania County.

51. TAMIAS TOWNSENDII OCHROGENYS, Merriam
1897. Proc. Biol. Soc. Washington, XI, p. 195.
Mendocino, Mendocino County, California.

52. TAMIAS TOWNSENDII SISKIYOU, Howell
1922. Journ. Mamm. Baltimore, 3, p. 180.
Near summit of White Mountain, Siskiyou County, California.

53 TAMIAS TOWNSENDII SENEX, Allen
1890. Bull. Amer. Mus. Nat. Hist., III, p. 83.
Summit of Donner Pass, Placer County, California.

54. TAMIAS TOWNSENDII SONOMAE, Grinnell

1915. Univ. Calif. Publ. Zool. 12, p. 321.
Guerneville, Sonoma County, California.

55. TAMIAS ALLENI, Howell

1922. Journ. Mamm. Baltimore, 3, p. 181.
Inverness, Marin County, California.
Synonym: *hindsi*, Merriam, Proc. Biol. Soc. Washington, XI, p. 194, 1897. Not of Gray.

56. TAMIAS QUADRIMACULATUS, Gray

1867. Ann. Mag. Nat. Hist. 3, XX, p. 435.
East of Michigan Bluff, Placer County, California.
Synonym: *macrorhabdotes*, Merriam, 1886, Proc. Biol. Soc. Washington, III, p. 25. Blue Canyon, Placer County, California.

57. TAMIAS MERRIAMI MERRIAMI, Allen

1889. Bull. Amer. Mus. Nat. Hist., II, p. 176.
San Bernardino Mountains, San Bernardino County, California.
Synonym: *merriami mariposae*, Grinnell & Storer, 1916, Univ. Calif. Publ. Zool. 17, p. 4. El Portal, Mariposa County, California.

58. TAMIAS MERRIAMI PRICEI, Allen

1895. Bull. Amer. Mus. Nat. Hist., VII, p. 333.
Portola, San Mateo County, California.

59. TAMIAS MERRIAMI KERNENSIS, Grinnell & Storer

1916. Univ. Calif. Publ. Zool. 17, p. 5.
Fay Creek, Kern County, California.

60. TAMIAS MERRIAMI OBSCURUS, Allen

1890. Bull. Amer. Mus. Nat. Hist., III, p. 70.
San Pedro Martir Mountains, Lower California, Mexico.

61. TAMIAS MERRIAMI MERIDIONALIS, Nelson & Goldman

1909. Proc. Biol. Soc. Washington, XXII, p. 23.
Aguaje de San Esteban, north-west of San Ignacio, Lower California.

62. TAMIAS DORSALIS DORSALIS, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 332.
Fort Webster, Gila River, Grant County, New Mexico.
Synonym: *canescens*, Allen, 1904, Bull. Amer. Mus. Nat. Hist., XX, p. 208. Guanacevi, Durango, Mexico.

63. TAMIAS DORSALIS UTAHENSIS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 210.
Ogden, Weber County, Utah.

64. TAMIAS DORSALIS GRINNELLI, Burt

1931. Journ. Mamm. Baltimore, 12, p. 300.
Sheep Mountains, Clark County, Nevada.

Subgenus *Eutamias*, Trouessart

65. TAMIAS SIBIRICUS SIBIRICUS, Laxmann

1769. Sibirisches Briefe, p. 69.
Barnaul, Siberia.
Synonym: *asiaticus*, Gmelin, 1788, Syst. Nat. p. 150. Barnaul, Siberia.
pallasi, Baird, 1856, Ann. Rep. p. 55 (*fide* Trouessart).

66. TAMIAS SIBIRICUS ALTAICUS, Hollister

1912. Proc. Biol. Soc. Washington, XX, p. 183.
Tapucha, Altai Mountains, Siberia.

67. TAMIAS SIBIRICUS ORIENTALIS, Bonhote

1899. Ann. Mat. Nat. Hist. 7, IV, p. 385.
Sungatscha River, Upper Ussuri, East Siberia.

68. TAMIAS SIBIRICUS UTHENSIS, Pallas

1831. Zoograph. Rosso-Asiat. 1, p. 189.
Uda River, N.-E. Siberia.

69. TAMIAS SIBIRICUS ORDINALIS, Thomas

1908. Abstr. Proc. Zool. Soc. London, p. 44; Proc. Zool. Soc. London, p. 968.
Yu-lin-fu, Shensi, China.

70. TAMIAS SIBIRICUS UMBROSUS, Howell

1927. Journ. Washington Acad. Sci., XVII, p. 80.
140 miles south of Lanchowfu, vicinity of Archuen, Minshan Mountains, Kansu, China.

71. TAMIAS SIBIRICUS INTERCESSOR, Thomas

1908. Abstr. Proc. Zool. Soc. London, p. 44; Proc. Zool. Soc. London, p. 969.
Ning-wu-fu, Shensi, China.

72. TAMIAS SIBIRICUS ALBOGULARIS, Allen

1909. Bull. Amer. Mus. Nat. Hist., XXVI, p. 429.
Tai-pa-shiang, Shensi, China.

73. TAMIAS SIBIRICUS SENESCENS, Miller

1898. Proc. Acad. Nat. Sci. Philadelphia, p. 349.
15 miles west of Peking, China.

74. TAMIAS SIBIRICUS OKADAE, Kuroda

1932. Journ. Mamm. Baltimore, 13, p. 58.
Mt. Chachanupuri, Kunashiri Island, South Kurile Islands.

75. TAMIAS SIBIRICUS LINEATUS, Siebold

1824. Spic. Faun. Japon in Diss. Hist. Nat. Japon, p. 13.
Japan.

76. TAMIAS SIBIRICUS JACUTENSIS, Ognev

1935. Wiss. Ber. Moskaeur Staats. Univ. 4, p. 93.
Yakutsk, East Siberia.

Subgenus *Tamias*, Illiger

77. TAMIAS STRIATUS STRIATUS, Linnaeus

1758. Syst. Nat. Ed. 10. 1, p. 64.
Unknown; probably near Savannah River, South Carolina.
Synonym: *americanus*, Gmelin, Syst. Nat. 1, p. 150, 1788.

78. TAMIAS STRIATUS FISHERI, Howell

1925. Journ. Mamm. Baltimore, 6, p. 51.
Merritts Corners, Ossining, New York.

79. TAMIAS STRIATUS LYSTERI, Richardson

1829. Fauna Boreali-Americana, 1, p. 181.
Penetanguishene, Georgian Bay, Ontario, Canada.

80. TAMIAS STRIATUS GRISEUS, Mearns

1891. Bull. Amer. Mus. Nat. Hist., III, p. 231.
Fort Snelling, Hennepin County, Minnesota.

81. TAMIAS STRIATUS VENUSTUS, Bangs

1896. Proc. Biol. Soc. Washington, X, p. 137.
Stilwell, Adair County, Oklahoma.

Section G. MARMOTA SECTION. Ground-squirrels with the following characters. Palate not produced far behind last molars, and lachrymal not enlarged. Infraorbital foramen forming a canal, postorbital process usually well developed, and D.3 in manus so far as seen constantly longer than D.4. Tendency present for upper main cheekteeth to become much constricted on inner side; usually strongly hypsodont.

Genus 29. CITELLUS, Oken

1816. CITELLUS, Oken, Lehrbuch der Zoologie, pt. 3, vol. 2, p. 842.
1817. ANISONYX, Rafinesque, Amer. Monthly Mag. 2, 1, 45. (*Anisonyx brachyurus*, Rafinesque = *Arctomys columbianus*, Ord.)
1825. SPERMOPHILUS, F. Cuvier, Dents des Mamm. 160, 161, pl. LV, p. 255.
1844. COLOBOTIS, Brandt, Bull. Cl. Phys. Math. Acad. Imp. Sci. St. Petersb. II, no. 23, 24, pp. 365, 366. (*Spermophilus fulvus*, Lichtenstein.)
1844. OTOSPERMOPHILUS, Brandt, Bull. Cl. Phys. Math. Acad. Imp. Sci. St. Petersb. vol. 2, p. 379. (*Sciurus grammurus*, Say.) Valid as a subgenus.
1877. ICTIDOMYS, Allen, Monogr. Nth. Amer. Rodentia, p. 821. (*Sciurus tridecemlineatus*, Mitchill.) Valid as a subgenus.
1893. XEROSPERMOPHILUS, Merriam, Proc. Biol. Soc. Washington, VII, p. 27. (*Spermophilus mohavensis*, Merriam.) Valid as a subgenus.
1892. AMMOSPERMOPHILUS, Merriam, Proc. Biol. Soc. Washington, VII, p. 27. (*Tamias leucurus*, Merriam.) Valid as a subgenus.
1901. CALLOSPERMOPHILUS, Merriam, Proc. Biol. Soc. Washington, XI, p. 189. (*Sciurus lateralis*, Say.) Valid as a Subgenus.
1907. ICTIDOMOIDES, Mearns, Mamm. Mex. Boundary, U.S. pt. 1, p. 328. (*Sciurus mexicanus*, Erxleben.)
1927. UROCITELLUS, Obolensky, C. R. Acad. Leningrad, p. 192. (*Spermophilus eversmanni*, Brandt.)
1938. NOTOCITELLUS, Howell, North Amer. Fauna, No. 56, p. 162. (*Spermophilus annulatus*, Audubon & Bachman.) Valid as a subgenus.
1938. POLIOCITELLUS, Howell, North Amer. Fauna, No. 56, p. 133. (*Arctomys franklinii*, Sabine.) Valid as a subgenus.

TYPE SPECIES.—*Mus citellus*, Linnaeus.

RANGE.—Holarctic: Silesia, Bohemia, Galicia, Hungary, Rumania, Bulgaria, Greece, Turkey, Asia Minor, Caucasus; the whole of southern European Russia, north to Rivers Kama and Oka; most of South-western Siberia (Kazakstan area), south into Persia, north to Ural River, Irtish River, Semipalatinsk, etc.; Altai; Zungaria; Transbaikalia, East Siberia (Okhotsk, Verhoiansk, Anadyr districts, etc.); Mongolia, Manchuria, Shansi, Shensi, Kansu; Alaska, Mackenzie, Saskatchewan, Alberta, British Columbia; Washington, Oregon, Idaho, Montana, Wyoming, Minnesota, California, Nevada, Utah, Arizona, New Mexico, Texas, southwards to Central Mexico.

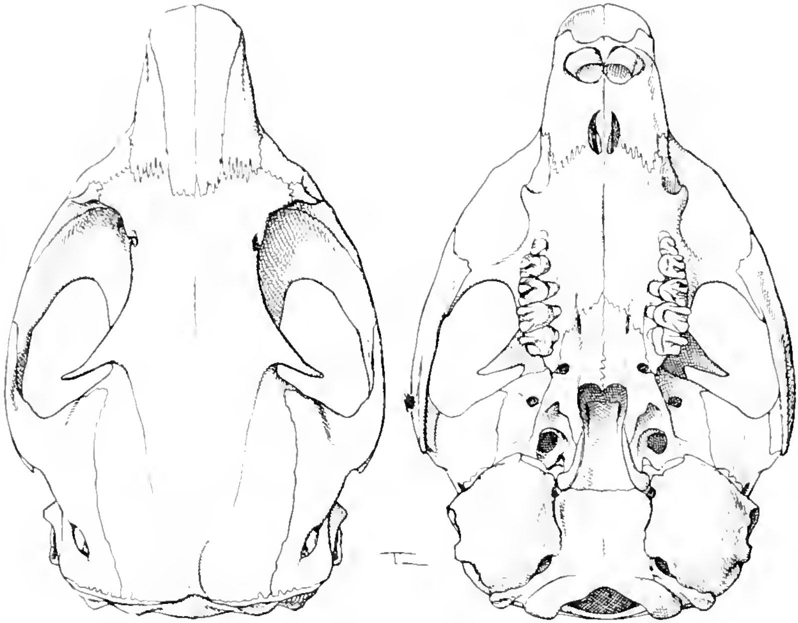


Fig. 110. Citellus citellus citellus, Linnaeus.
B.M. No. 8.9.10.7, ♀; × 2.

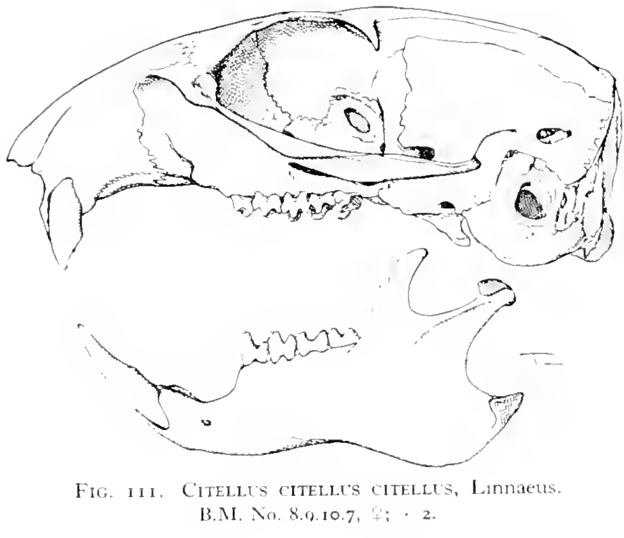


Fig. 111. Citellus citellus citellus, Linnaeus.
B.M. No. 8.9.10.7, ♀; × 2.

NUMBER OF FORMS.—About a hundred and forty-four.

REMARKS.—The American forms of this genus have been recently revised by Howell, 1938 (North Amer. Fauna, No. 56). This revision has long been needed, and completes the list of all large Nearctic genera revised. The genus is made much larger by Howell, by the inclusion of the groups hitherto regarded as distinct genera, *Callospermophilus*, *Ammospermophilus* and *Otospermophilus*. I had endeavoured to keep these three names standing as valid genera, and except in the case of *Ammospermophilus* had found it no easy matter. They are all evidently much better regarded as subgenera of *Citellus*, being at once distinguishable from *Tamias*, with which they were formerly classed, by the character of the infraorbital foramen which is quite normal, whereas in *Tamias* it forms no canal and is relatively very large. But their inclusion in *Citellus* makes it desirable to make some of the other Sciurine genera, as, for instance, *Xerus*, wider than they are at the moment currently accepted. Howell very rightly states that in many cases the genera recognized to-day are little better than specific groups.

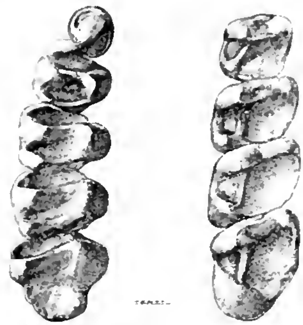


FIG. 112. CITELLUS CITELLUS. Cheekteeth; × 5.

Oholensky revised the Palaearctic *Citellus* in 1927 (C. R. Acad. Sci. Leningrad, p. 188). These were arranged in three subgenera, *Citellus* (*citellus* and *suslicus* groups as here understood), soles haired, tail one-fifth to a third head and body length, interorbital region relatively narrow; *Colobotis* (*fulvus* and *pygmaeus* groups as here understood), with bare soles, tail length and interorbital region about as in *Citellus* s.s.; and *Urocitellus* (*eversmanni* group), with haired soles, tail a third to a half head and body length, interorbital region relatively broad. Howell regards these groups as belonging to *Citellus* s.s. The dentition of all Palaearctic forms examined agrees with Howell's *Citellus* s.s.; and I am of the opinion that Obolensky's names must be disregarded; the Palaearctic *Citellus* form with the North American typical subgenus of Howell a natural group as far as I have had occasion to examine.

CHARACTERS.—(*Citellus* s.s.). Upper cheekteeth noticeably constricted on inner side, so that the teeth appear roughly three-sided instead of rounded or nearly square as in most Sciurinae. Skull with slender postorbital processes, which always appear well developed in the typical group. Certain constriction is usually apparent in front of the postorbital processes; braincase not flattened. Palate extending very slightly behind toothrows, which are not or scarcely convergent posteriorly. Infraorbital foramen often rather well open; masseter knob at its lower border prominent. Zygomatic plate with upper border strongly ridged, extending upwards far forwards, and with upper part much narrowed. Sagittal ridge rarely formed by parietal ridges in material examined; if present, never as conspicuous or heavy as in *Marmota* or *Cynomys*, in British Museum material, though a skull of *parryii* figured by Howell appears to have a rather conspicuous ridge present. Mandible with angular portion as a rule strongly pulled inwards.

Upper cheekteeth with inner side strongly hypsodont; P.3 very little reduced, and functional; main teeth with three strong outer cusps present; the ridges from the second and third cusps high, converging to the inner cusp. The anterior ridge, from the front cusp, is short. The main ridges separated by deep depressions. M.3 with only one well-marked main ridge, the posterior part of the tooth flatter, and with less defined elements. Lower teeth with two very high anterior cusps, the anterointernal one the highest, the two cusps joined by a ridge; and a moderately high posteroexternal cusp; the three main cusps of the teeth surrounding a deep depression. Posterointernal cusp vestigial or absent. M.3, as in the upper series, tends to be the largest tooth. The two outer main cusps in the lower teeth joined by a short ridge.

External characters somewhat variable, but always in the whole genus so far as I have seen characterized by the fact that the digits are arranged in the manner of terrestrial forms, D.3 being in the manus the main digit. Hindfoot with the two outer digits, particularly the hallux, shorter than the three central ones. Pollex much reduced. Ear small. Tail always considerably shorter than head and body; from about half this measurement to little longer than hindfoot. Claws as a rule prominent; particularly in such forms as *parryii*; never so developed as *Spermophilopsis*.

Mammae 10, 12 or 14 in Palaearctic species (Obolensky), 10, 12 or 8 according to Howell in Nearctic species, cheek-pouches present.

In the Palaearctic, I provisionally recognize five species groups; the *eversmanni* (characters indicated above, p. 439); the *citellus* group (characters as above); the *suslicus* group, like *citellus* but with a well-marked spotted colour-pattern, this much more developed than in any other Palaearctic species seen; the *pygmaeus* group, like *citellus* group but with naked soles; and the *fulvus* group, which has a much heavier skull and dentition than is normal in the genus.

Eight subgenera are recognized by Howell as occurring in America. He keys them as follows:

Molars relatively hypsodont; parastyle ridge on M.1 and M.2 joining protocone with an abrupt change of direction.

  Metaloph of P.4 continuous. — CITELLUS s.s.

  Metaloph of P.4 not continuous. — ICTIDOMYS

Molars relatively brachyodont, parastyle ridge on M.1 and M.2 rising evenly to join protocone, without abrupt change of direction.

  Anterior upper premolar simple, less than one-fourth size of P.4.

    Upper incisors relatively stout, distinctly recurved.

      Braincase rounded on upper surface.

        Supraorbital foramen open. — OTOSPERMOPHILUS

        Supraorbital foramen closed. — NOTOCITELLUS

Braincase flattened on upper surface. AMMOSPERMOPHILUS

Upper incisors relatively slender, not distinctly recurved.

Postorbital process long and slender; rostrum longer. CALLOSPERMOPHILUS

Postorbital process short and stout; rostrum shorter. XEROSPERMOPHILUS

Anterior upper premolar more than a quarter size of P.4, bearing two cusps and a functional cutting edge. POLIOCITELLUS

Subgenus ICTIDOMYS. This includes *tridecemlineatus*, also according to Howell the species *mexicanus* and *spilosoma*. The braincase is relatively narrower than *Citellus*; P.3 is relatively much smaller, and the upper incisors are said to be shorter and stouter.

C. tridecemlineatus has the most specialized colour-pattern of any living Squirrel. The postorbital process appears to be much smaller than in *Citellus* s.s. *C. mexicanus* has a spotted colour-pattern; and *spilosoma*, of which very few are in the British Museum, is described as spotted, though apparently in some forms the spots may be faint. Tail 60–80 per cent head and body length (Howell).

Subgenus POLIOCITELLUS. This is based on *franklinii* only; a plain non-striped species which in many respects appears to me to resemble the *tridecemlineatus* group (e.g. cranial characters). P.3 is more reduced than in *Citellus* s.s. The dentition is, however, not like that of typical *Citellus*, but more transitionary to the *Tamias* or *Sciurus*-like type found in all the remaining subgenera. The tail is more than half head and body length. The zygomata are less expanded than in normal *Citellus*.

Subgenus OTOSPERMOPHILUS. Rather large forms, in which the postorbital process is relatively large, and a sagittal crest present in all adult skulls seen. The teeth have no tendency to the internal constriction of typical *Citellus* (in the upper series). Zygomatic plate as in normal *Citellus*. Externally more *Sciurus*-like; ears moderately large; tail about two-thirds head and body length, bushy; upper incisors stout. The cheekteeth are not very different from those of *Sciurus*. P.3 is small.

Subgenus NOTOCITELLUS. Based on *annulatus*, heretofore placed in *Otospermophilus*. Not seen, not represented in the British Museum. Tail described as more than two-thirds head and body length. Supraorbital foramen closed (differing from *Otospermophilus* in this character). P.3 relatively small.

Subgenus AMMOSPERMOPHILUS. This group seems to me to be the most distinct of all Howell's subgenera. Bullae large and inflated in all skulls examined. Palate usually ending in long and conspicuous spinous process. Dental characters not essentially different from *Sciurus* or *Tamias*. Externally very reminiscent of the African *Euxerus*, except for the much shorter tail, which is said to be carried over the back when the animal is running, and is about half head and body length. Fur sometimes slightly bristly. A white stripe on each flank. Ears small. Postorbital process slender; incisors stout; infraorbital foramen narrower than in normal *Citellus* (agreeing with *Otospermophilus*).

Subgenus XEROSPERMOPHILUS. This is based on *mohavensis* and the *tereticaudus* group. Very few have been seen. The claws are described as long, sharp; the sole is heavily haired; ears very low; tail 40–60 per cent head and body length. Molars (said to be) near *Otospermophilus*.

Subgenus CALLOSPERMOPHILUS. Postorbital process rather prominent; cranial characters near *Otospermophilus*, except that sagittal crest, so far as seen, is usually absent, the masseter knob moderate or small, the postorbital process rather lighter; upper incisors relatively more slender. Tail usually more than half head and body length. Ear low. Form *Tamias*-like, with the white flank-stripes bordered usually by four black ones; but no mid-dorsal stripe.

Forms seen: *beecheyi*, *beldingi*, *bernardinus*, *brauneri*, *brevicauda*, *carruthersi*, *chrysodeirus*, *citellus*, *cinerascens*, *concolor*, *dauricus*, *douglasi*, *elegans*, *erythrogenys*, *eversmanni*, *fisheri*, *franklinii*, *fulvus*, *gradojevici*, *grammurus*, *harrisi*, *herbicola*, *jacutensis*, *kodiakensis*, *lateralis*, *leucurus*, *macrourus*, *mexicanus*, *mollis*, *mongolicus*, *mugosaricus*, *nelsoni*, *oregonus*, *oxianus*, *pallidus*, *parthianus*, *parryii*, *peninsulae*, *planicola*, *pygmaeus*, *ramosus*, *richardsoni*, *rufescens*, *spilosoma*, *suslicus*, *tereticaudus*, *townsendi*, *tridecemlineatus*, *umbratus*, *variegatus*, *vinulus*, *wortmani*, *xanthoprymnus*.

The differences in the four groups recognized by Howell in American *Citellus* s.s. refer mainly apparently to size and colour. *C. washingtoni* is described as a spotted species, in colour near the Old World *guttatus* (*suslicus*). Members of the *parryii* group are, according to Howell's key, also spotted or mottled.

In his revision some new forms are described, which, however, are not listed here as, in all other genera, forms described to 1936 only are included.

LIST OF NAMED FORMS

Subgenus *Citellus*, Oken

Palaearctic Species

incertae sedis

1. CITELLUS FLAVESCENS, Pallas

1778. Nov. Spec. Quadr. Glir. Ord. p. 122.
Locality not known.

Not seen; not allocated to group

2. CITELLUS ATRICAPILLA, Orlov[1]

1927. Mat. Contra fauna L. Volga, 1, p. 92.
Lower Volga, U.S.S.R.

[1] This appears to be preoccupied by *atricapillus*, Bryant, No. 108 of this list. I therefore rename it *binominatus*.

fulvus Group

3. CITELLUS FULVUS FULVUS, Lichtenstein

1823. Eversmann Reise. p. 119.
River Kuwandzaliur, east of Mugodsharski Mountains, north of Sea of Aral, Siberia.

4. CITELLUS FULVUS OXIANUS, Thomas

1915. Ann. Mag. Nat. Hist. 8, XV, p. 422.
50 miles south-west of Bokhara.

5. CITELLUS FULVUS PARTHIANUS, Thomas

1915. Ann. Mag. Nat. Hist. 8, XV, p. 423.
Meshed, N.-E. Persia.

6. CITELLUS FULVUS CONCOLOR, Geoffroy

1834. Belanger, Voyages, p. 151.
Sultenia, near Kazvin, N.-W. Persia.

7. CITELLUS FULVUS HYPOLEUCUS, Satunin

1909. Ann. Mus. Zool. St. Petersb. 14, p. 1.
Kutshun, Central Persia.

pygmaeus Group

8. CITELLUS RUFESCENS RUFESCENS, Keyserling & Blasius

1840. Wirbelth. Europas, p. 42.
Ural Mountains, Russia.
Synonym: *undulatus*, Eversmann, 1840, Bull. Nat. Moscou, p. 35 (*fide* Trouessart).

9. CITELLUS RUFESCENS ERYTHROGENYS, Brandt

1841. Bull. Acad. Sci. St. Petersb. p. 41.
Altai.

10. CITELLUS RUFESCENS UNGAE, Martino

1923. Ann. Mus. Zool. Petrograd, 24, p. 23.
Kirghiz Steppes.

11. CITELLUS PALLIDICAUDA, Satunin

1902. Ann. Mus. Zool. St. Petersb., VII, p. 5.
Mongolian Altai; Cholmu Noor, Ullyn-Bulyk, River Baidarak.

12. CITELLUS PYGMAEUS PYGMAEUS, Pallas

1778. Nov. Spec. Quadr. Glir. Ord. p. 122.
Between Emba and Ural Rivers.

13. CITELLUS PYGMAEUS BREVICAUDA, Brandt

1843. Bull. Acad. Sci. St. Petersb., I, 23, p. 364.
Altai.
Synonym: *intermedius*, Brandt, l.c. p. 378 (*fide* Trouessart).

14. CITELLUS PYGMAEUS MUGOSARICUS, Lichtenstein

1823. Eversmann Reise, p. 19.
Mugodshary Mountains, Kirghisia.

15. CITELLUS PYGMAEUS HERBICOLA, Martino

1916. Ann. Mus. Zool. Petrograd, 21, pp. 269–301.
North Kirghisia.

16. CITELLUS PYGMAEUS SEPTENTRIONALIS, Obolensky

1927. C. R. Acad. Sci. Leningrad, p. 190.
Ferapontovka, Samara.

17. CITELLUS PYGMAEUS ORLOVI, New Name
To replace *pallidus*, Orlov & Feniuk

1927. Mat. Contr. Faun. Lower Volga, 1, p. 63 Not of Allen, 1877.
Kalmouk Steppes, near Astrakhan, South Russia.

18. CITELLUS PYGMAEUS PLANICOLA, Satunin

1908. Mitt. Kauk. Mus. p. 46.
Karanogai Steppes, Kizljar, Caucasus.

19. CITELLUS PYGMAEUS MUSICUS, Ménétriés

1832. Catal. Rais. p. 21.
Elburz, Caucasus.

20. CITELLUS PYGMAEUS SATUNINI, Sviridenko

1922. Bull. Mus. Georgie, 1, p. 69.
Daghestan, Caucasus.

21. CITELLUS PYGMAEUS BRAUNERI, Martino

1920. Notes Crimea Soc. Naturalists, 3.
Ecaterinoslav, Crimea, South Russia.

22. CITELLUS PYGMAEUS NIKOLSKII, Heptner

1934. Folia Zool. Hydrob. 6, p. 20.
Aral Lake Shore.

23. CITELLUS PYGMAEUS KAZAKSTANICUS, Goodwin

1935. Amer. Mus. Nov. 769, p. 5.
Kazakstan, Central Asia; Tuz Bulak, 150 miles north of Kizilorda (Perovsk).

24. CITELLUS PYGMAEUS CARRUTHERSI, Thomas

1912. Ann. Mag. Nat. Hist. 8, IX, p. 393.
Barlik Mountains, N.-W. Dzungaria.

25. CITELLUS RELICTUS, Kashkarov

1923. Trans. Sci. Soc. Turkest. p. 185.
Talass-Alatau, Namanghan, Ferghana.

citellus Group

26. CITELLUS CITELLUS CITELLUS, Linnaeus

1766. Syst. Nat. I, 12th Ed. p. 80.
Austria.

27. CITELLUS CITELLUS GRADOJEVICI, Martino

1929. Journ. Mamm. Baltimore, 10, p. 76.
Djerdjelija, Macedonia.

28. CITELLUS CITELLUS ISTRICUS, Calinescu

1934. Zeitschr. für Säugetierk, 9, p. 106.
E. Rumania; Munteni.

29. CITELLUS XANTHOPRYMNUS XANTHOPRYMNUS, Bennett

1835. Proc. Zool. Soc. London, p. 90.
Erzerum, Asia Minor. This species is probably not more than a subspecies of *C. citellus*.

30. CITELLUS XANTHOPRYMNUS SCHMIDTI, Satunin
1908. Mitt. Kauk. Mus. IV, p. 28.
Transcaucasia.

31. CITELLUS ALASCHANICUS ALASCHANICUS, Buchner
1888. Wiss. Res. Przewalski Central-Asien Reisen: Zool. Th. I, Säugeth., p. 11.
South Alashan, Mongolia.

32. CITELLUS ALASCHANICUS DILUTUS, Formozov
1927. C. R. Acad. Leningrad, p. 192.
Ikhe-Bogdo, Mongolian Altai.

33. CITELLUS ALASCHANICUS OBSCURUS, Buchner
1888. Wiss. Res. Przewalski Central-Asien Reisen: Zool. Th. I, Säugeth., p. 17.
Kansu, China.

34. CITELLUS ALASCHANICUS SICCUS, G. M. Allen
1925. Amer. Mus. Nov. 163, p. 3.
Shansi, China, 10 miles west of Taiyuanfu.

35. CITELLUS DAURICUS DAURICUS, Brandt
1843. Bull. Acad. St. Petersb. p. 379.
South Transbaikalia.

36. CITELLUS DAURICUS MONGOLICUS, Milne-Edwards
1867. Ann. Sci. Nat. p. 376.
Manchuria; Pekin.

37. CITELLUS DAURICUS UMBRATUS, Thomas
1908. Proc. Zool. Soc. London, p. 970.
Taboul, 100 miles north-west of Kalgan, Mongolia.

38. CITELLUS DAURICUS RAMOSUS, Thomas
1909. Ann. Mag. Nat. Hist. 8, IV, p. 501.
Fan Chia Tun, Kirin Province, Manchuria.

suslicus Group

39. CITELLUS SUSLICUS SUSLICUS, Guldenstaedt
1770. N. Comm. Ac. Sc. Petr. xiv, pt. 1, p. 389.
Voronezh, Russia.
Synonym: *guttatulus*, Schinz, 1895, Synop. Mamm., II, p. 70.
leucopictus, Donndorff, 1792, Zool. Beyträge, 1, p. 486.

40. CITELLUS SUSLICUS GUTTATUS, Pallas
1770. N. Comm. Ac. Sc. Petr. xiv, pt. 1, p. 506.
Locality not known.

41. CITELLUS SUSLICUS AVERINI, Migulin
1927. Proc. Nat. Hist. Soc. Kharhov, p. 50, pt. 2.
Russka Lesonia, 18 km. north of Kharkov, Russia.

42. CITELLUS SUSLICUS MERIDIOOCCIDENTALIS, Migulin
1927. Proc. Nat. Hist. Soc. Kharkov, 50, pt. 2.
Environs of Odessa, Russia.

eversmanni Group

43. CITELLUS EVERSMANNI EVERSMANNI, Brandt
1841. Bull. Acad. St. Petersb. p. 43.
Altai Mountains.
Synonym: *altaicus*, Eversmann, 1841, Add. Zoog. R. Asiat. fasc. 2, p. 1.

44. CITELLUS EVERSMANNI STRAMINEUS, Obolensky

1927. C. R. Acad. Sci. Leningrad, p. 192.
N.-W. Mongolia.

45. CITELLUS EVERSMANNI LEUCOSTICTUS, Brandt

1843. Bull. Acad. Sci. St. Petersb., II, p. 379.
Okhotsk River, N.-E. Siberia.

46. CITELLUS EVERSMANNI BUXTONI, Allen

1903. Bull. Amer. Mus. Nat. Hist., XIX, p. 139.
Gichiga, west coast Okhotsk Sea = *eversmanni leucostictus* according to Chaworth-Musters, Ann. Mag. Nat. Hist., 1934, 10, XIII, p. 555.

47. CITELLUS EVERSMANNI TRANSBAICALICUS, Obolensky

1927. C. R. Acad. Sci. Leningrad, p. 192.
Lake Ivan, Transbaikalia.

48. CITELLUS EVERSMANNI JACUTENSIS, Brandt

1844. Bull. Ac. Sci. St. Petersb., II, 23–24, p. 378.
Yakutsk, Siberia.

49. CITELLUS EVERSMANNI STEJNEGERI, Allen

1903. Bull. Amer. Mus. Nat. Hist., XIX, p. 142.
Kamtchatka.

Nearctic Forms. Revised by Howell, 1938.

townsendii Group

50. CITELLUS TOWNSENDII TOWNSENDII, Bachman

1839. Journ. Acad. Nat. Sci. Philadelphia, VIII, p. 61.
Columbia River, about 300 miles above its mouth, near mouth of Walla Walla River, Washington.
Synonym: *mollis yakimensis*, Merriam, 1898, Proc. Biol. Soc. Washington XII, p. 70. Mabton, Yakima County, Washington.

51. CITELLUS TOWNSENDII CANUS, Merriam

1898. Proc. Biol. Soc. Washington, XII, p. 70.
Antelope, Wasco County, Oregon.

52. CITELLUS TOWNSENDII VIGILIS, Merriam

1913. Proc. Biol. Soc. Washington, XXVI, p. 137.
Vale, Malheur County, Oregon.

53. CITELLUS TOWNSENDII MOLLIS, Kennicott

1863. Proc. Acad. Nat. Sci. Philadelphia, p. 157.
Camp Floyd, near Fairfield, Wasatch County, Utah.
Synonym: *stephensi*, Merriam, 1898, Proc. Biol. Soc. Washington, XII, p. 69. Esmeralda County (Queen Station), Nevada.
washoensis, Merriam, 1913, Proc. Biol. Soc. Washington, XXVI, p. 138. Carson Valley, Douglas County, Nevada.
leurodon, Merriam, 1913, Proc. Biol. Soc. Washington, XXVI, p. 136. Murphy, Owyhee County, Idaho.

54. CITELLUS TOWNSENDII ARTEMISIAE, Merriam

1913. Proc. Biol. Soc. Washington, XXVI, p. 137.
Birch Creek, Fremont County, Idaho.
Synonym: *pessimus*, Merriam, 1913, Proc. Biol. Soc. Washington, XXVI, p. 138. Big Lost River, Fremont County, Idaho.

55. CITELLUS IDAHOENSIS, Merriam
1913. Proc. Biol. Soc. Washington, XXVI, p. 135.
Payette, Payette County, Idaho.

washingtoni Group

56. CITELLUS WASHINGTONI, Howell
(1938). North Amer. Fauna, No. 56, p. 69.
Touchet, Walla Walla County, Washington.
Synonym: *townsendi*, Dice, 1919, Journ. Mamm. Baltimore 1, p. 18, not *townsendi*, Bachman.

57. CITELLUS BRUNNEUS, Howell
1928. Proc. Biol. Soc. Washington, XLI, p. 211.
New Meadows, Adams County, Idaho.

richardsoni Group

58. CITELLUS RICHARDSONI RICHARDSONI, Sabine
1822. Trans. Linn. Soc., XIII, p. 589.
Carlton House, Saskatchewan.

59. CITELLUS RICHARDSONI ELEGANS, Kennicott
1863. Proc. Acad. Nat. Sci. Philadelphia, p. 158.
Fort Bridger, Uinta County, Wyoming.

60. CITELLUS RICHARDSONI NEVADENSIS, Howell
1928. Proc. Biol. Soc. Washington, XLI, p. 211.
Paradise, Humboldt County, Nevada.

61. CITELLUS ARMATUS, Kennicott
1863. Proc. Acad. Nat. Sci. Philadelphia, p. 158.
Near Fort Bridger, Uinta County, Wyoming.

62. CITELLUS BELDINGI BELDINGI, Merriam
1888. Ann. New York Acad. Sci. 4, p. 317.
Donner, Placer County, California.

63. CITELLUS BELDINGI OREGONUS, Merriam
1898. Proc. Biol. Soc. Washington, XII, p. 69.
Swan Lake Valley, Klamath County, Oregon.

parryii Group

64. CITELLUS COLUMBIANUS COLUMBIANUS, Ord
1815. Guthrie's Geography, 2nd Amer. Ed. vol. 2, p. 292.
Camas prairie, between forks of Clearwater and Kooskooskie, Lincoln County, Idaho.
Synonym: *brachiura*, Rafinesque, 1817, Amer. Monthly Mag., 2, p. 45.
erythrogluteius, Richardson, 1829, Fauna Boreali-Americana 1, p. 161.
columbianus albertae, Allen, 1903, Bull. Amer. Mus. Nat. Hist., XIX, p. 537. Canadian National Park, Alberta.

65. CITELLUS COLUMBIANUS RUFICAUDUS, Howell
1928. Proc. Biol. Soc. Washington, XLI, p. 212.
Wallowa Lake, Oregon.

66. CITELLUS PARRYII PARRYII, Richardson

1825. Appendix to Parry's Second Voyage, p. 316.
Five Hawser Bay, Lyon Inlet, Melville Peninsula, Franklin, Canada.
Synonym: *empetra*, True, 1885, Proc. U.S. Nat. Mus., VII, p. 594.
phaeognathus, Richardson, 1829, Fauna Boreali-Americana, p. 161. Hudson Bay.
kennicotti, Ross, 1861, Canadian Nat. & Geol. 6, p. 434. Mackenzie, near Fort Good Hope.

67. CITELLUS PARRYII BARROWENSIS, Merriam

1900. Proc. Washington Acad. Sci., II, p. 19.
Point Barrow, Alaska.
Synonym: *beringensis*, Merriam, 1900, Proc. Acad. Sci. Washington, II, p. 20. Cape Lisburne, Alaska.

68. CITELLUS PARRYII PLESIUS, Osgood

1900. North Amer. Fauna, No. 19, p. 29.
Bennett City, head of Lake Bennett, British Columbia.

69. CITELLUS PARRYII ABLUSUS, Osgood

1903. Proc. Biol. Soc. Washington, XVI, p. 25.
Nushagak, Alaska.
Synonym: *stonei*, Allen, 1903, Bull. Amer. Mus. Nat. Hist., XIX, p. 537. Stevana Flats, Alaska Peninsula, Alaska.

70. CITELLUS PARRYII NEBULICOLA, Osgood

1903. Proc. Biol. Soc. Washington, XVI, p. 26.
Nagai Island, Shumagin Islands, Alaska.

71. CITELLUS PARRYII LYRATUS, Hall & Gilmore

1933. Univ. Calif. Publ. Zool. 28, p. 396.
St. Lawrence Island, Behring Sea.

72. CITELLUS KODIACENSIS, Allen

1874. Proc. Boston Soc. Nat. Hist. 16, p. 292.
Kodiak Island, Alaska.

73. CITELLUS OSGOODI, Merriam

1900. Proc. Washington Acad. Sci., II, p. 18.
Fort Yukon, Alaska.

Subgenus *Ictidomys*, Allen

tridecemlineatus Group

74. CITELLUS TRIDECEMLINEATUS TRIDECEMLINEATUS, Mitchill

1821. Med. Repos. n.s. vol. 6 (21), p. 248.
Central Minnesota.
Synonym: *hoodi*, Sabine, 1822, Trans. Linn. Soc., XIII, p. 590.

75. CITELLUS TRIDECEMLINEATUS TEXENSIS, Merriam

1898. Proc. Biol. Soc. Washington, XII, p. 71.
Gainesville, Cooke County, Texas.
Synonym: *badius*, Bangs, 1899, Proc. New Engl. Club, 1, p. 1. Stotesbury, Missouri.

76. CITELLUS TRIDECEMLINEATUS ARENICOLA, Howell

1928. Proc. Biol. Soc. Washington, XLI, p. 213.
Pendennis, Kansas.

77. CITELLUS TRIDECEMLINEATUS PALLIDUS, Allen

1877. Monogr. North Amer. Rodents, p. 872.
Plains of Lower Yellowstone River, Montana.
Synonym: *olivaceus*, Allen, 1895, Bull. Amer. Mus. Nat. Hist. VII, p. 337. Custer, Custer County, South Dakota.

78. CITELLUS TRIDECEMLINEATUS ALLENI, Merriam

1898. Proc. Biol. Soc. Washington, XII, p. 71.
Bighorn Mountains, Washakie County, Wyoming.

79. CITELLUS TRIDECEMLINEATUS HOLLISTERI, Bailey

1913. Proc. Biol. Soc. Washington, XXVI, p. 131.
Elk Valley, Sacramento Mountains, Lincoln County, New Mexico.

80. CITELLUS TRIDECEMLINEATUS MONTICOLA, Howell

1928. Proc. Biol. Soc. Washington, XLI, p. 214.
Marsh Lake, White Mountains, Arizona.

81. CITELLUS TRIDECEMLINEATUS PARVUS, Allen

1895. Bull. Amer. Mus. Nat. Hist. VII, p. 337.
Uncompahgre Indian Reservation, N.-E. Utah.

82. CITELLUS MEXICANUS MEXICANUS, Erxleben

1777. Syst. Regn. Anim. vol. 1, p. 428.
South Central Mexico.

83. CITELLUS MEXICANUS PARVIDENS, Mearns

1896. Prelim. diagn. new Mamm. Mex. Border U.S., p. 1, (Reprint: Proc. U.S. Nat. Mus. XVIII, p. 443).
Fort Clark, Kinney County, Texas.

spilosoma Group

84. CITELLUS SPILOSOMA SPILOSOMA, Brandt

1833. Proc. Zool. Soc. London, p. 40.
N. Mexico and extreme W. Texas.

85. CITELLUS SPILOSOMA PALLESCENS, Howell

1928. Proc. Biol. Soc. Washington, XLI, p. 212.
La Ventura, Coahuila, Mexico.

86. CITELLUS SPILOSOMA CANESCENS, Merriam

1890. North. Amer. Fauna, No. 4, p. 38.
Wilcox, Cochise County, Arizona.
Synonym: *macrospilotus*, Merriam, 1890, North. Amer. Fauna, No 4, p. 38. Oracle, Pinal County, Arizona.
arens, Bailey, 1902, Proc. Biol. Soc. Washington, XV, p. 118. El Paso, Texas.

87. CITELLUS SPILOSOMA MAJOR, Merriam

1890. North Amer. Fauna, No. 4, p. 39.
Albuquerque, Bernalillo County, New Mexico.
Synonym: *marginatus*, Bailey, 1902, Proc. Biol. Soc. Washington. XV, p. 118. Alpine, Brewster County, Texas.

88. CITELLUS SPILOSOMA ANNECTENS, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 132.
Padre Island, Cameron County, Texas.

89. CITELLUS SPILOSOMA PRATENSIS, Merriam

1890. North Amer. Fauna, No. 3, p. 55.
Pine Plateau at north foot of San Francisco Mountain, Coconino County, Arizona.
Synonym: *obsidianus*, Merriam, 1890, North Amer. Fauna, No. 3, p. 56. (North-east of San Francisco Mountain, Coconino County, Arizona.)

90. CITELLUS SPILOSOMA CRYPTOSPILOTUS, Merriam

1890. North Amer. Fauna, No. 3, p. 57.
Tenebito Wash, Painted Desert, Coconino County, Arizona.

91. CITELLUS SPILOSOMA OBSOLETUS, Kennicott

1863. Proc. Acad. Nat. Sci. Philadelphia, p. 157.
Extreme W. Nebraska.

92. CITELLUS PEROTENSIS, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 131.
Perote, Vera Cruz, Mexico.

Subgenus *Poliocitellus*, Howell

93. CITELLUS FRANKLINII, Sabine

1822. Trans. Linn. Soc. XIII, p. 587.
Vicinity of Carlton House, Saskatchewan, Canada.

Subgenus *Otospermophilus*, Brandt

94. CITELLUS VARIEGATUS VARIEGATUS, Erxleben

1777. Syst. Regn. Anim. 1, p. 421.
South Central Mexico.
Synonym: *buccatus*, Lichtenstein, Abh. k. Akad. Wiss. Berlin, 1827 (1830), p. 117.
macrurus, Bennett, 1833, Proc. Zool. Soc., London, p. 41. Mexico.

95. CITELLUS VARIEGATUS RUPESTRIS, Allen

1903. Bull. Amer. Mus. Nat. Hist. XIX, p. 595.
Rio Sestin, N.-W. Durango, Mexico.

96. CITELLUS VARIEGATUS COUCHII, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 332.
Santa Catarina, Nuevo Leon, Mexico.

97. CITELLUS VARIEGATUS BUCKLEYI, Slack

1861. Proc. Acad. Nat. Sci. Philadelphia, p. 314.
Packsaddle Mountain, Llano County, Texas.

98. CITELLUS VARIEGATUS GRAMMURUS, Say

1823. Long's Exp. Rocky Mountains, p. 72.
Purgatory River, near mouth of Chacuaco Creek, Colorado, Las Animas County.
Synonym: *juglans*, Bailey, 1913, Proc. Biol. Soc. Washington, XXVI, p. 131. Glenwood, Rio San Francisco, Socorro County, New Mexico.

99. CITELLUS VARIEGATUS TULAROSAE, Benson

1932. Univ. Calif. Publ. Zool. 38, p. 335.
New Mexico: French's Ranch, 12 miles north-west of Carrizozo, Lincoln County.

100. CITELLUS VARIEGATUS UTAH, Merriam
1903. Proc. Biol. Soc. Washington, XVI, p. 77.
Foot of Wasatch Mountains, near Ogden, Weber County, Utah.

101. CITELLUS BEECHEYI BEECHEYI, Richardson
1829. Fauna Boreali-Americana, 1, p. 170.
Neighbourhood of San Francisco and Monterey, California.

102. CITELLUS BEECHEYI DOUGLASI, Richardson
1829. Fauna Boreali-Americana, 1, p. 172.
Banks of Columbia River, Oregon.

103. CITELLUS BEECHEYI FISHERI, Merriam
1893. Proc. Biol. Soc. Washington, VIII, p. 133.
South Fork, Kern River, Kern County, 3 miles above Onyx, California.

104. CITELLUS BEECHEYI PARVULUS, Howell
1931. Journ. Mamm. Baltimore, 12, p. 160.
Shepherd Canyon, Argus Mountains, California.

105. CITELLUS BEECHEYI NUDIPES, Huey
1931. Trans. S. Diego Soc. Nat. Hist. 7, p. 18.
Hanson Laguna, Sierra Guarez : Lower California.

106. CITELLUS BEECHEYI RUPINARUM, Huey
1931. Trans. S. Diego Soc. Nat. Hist. 7, p. 17.
Catavina : Lower California.

107. CITELLUS BEECHEYI NESIOTICUS, Elliot
1904. Field Columb. Mus. publ. 90, zool. ser. vol. 3, p. 263.
Santa Catalina Island, Santa Barbara Islands, California.

108. CITELLUS ATRICAPILLUS, Bryant
1889. Proc. Calif. Acad. Sci. ser. 2, vol. 2, p. 26.
Comondu, Lower California, Mexico.

Subgenus *Notocitellus*, Howell

109. CITELLUS ANNULATUS ANNULATUS, Audubon & Bachman
1842. Journ. Acad. Nat. Sci. Philadelphia, 8, pt. 2, p. 319.
Unknown; probably W. Mexico.

110. CITELLUS ANNULATUS GOLDMANI, Merriam
1902. Proc. Biol. Soc. Washington, XV, p. 69.
Santiago, Nayarit, Mexico.

111. CITELLUS ADOCETUS, Merriam
1903. Proc. Biol. Soc. Washington, XVI, p. 79.
La Salada, 40 miles south of Uruapan, Mexico (Michoacan).

Subgenus *Ammospermophilus*, Merriam

112. CITELLUS HARRISII HARRISII, Audubon & Bachman
1854. Quadr. N. Amer., vol. 3, p. 267.
Unknown; probably S.-W. Arizona.

113. CITELLUS HARRISII SAXICOLA, Mearns
1896. Prelim. diagn. Mamm. Mex. border U.S., p. 2. Reprint, Proc. U.S. Nat. Mus. 18, p. 444, 1896.
Tinajas Atlas, Gila Mountains, Yuma County, Arizona.

114. CITELLUS LEUCURUS LEUCURUS, Merriam

1889. North Amer. Fauna, No. 2, p. 20.
San Gorgonio Pass, Riverside County, California.
Synonym: *vinulus*, Elliott, 1903, Field. Columb. Mus. publ. 87, zool. ser. 241. Keeler, Inyo County, California.

115. CITELLUS LEUCURUS TERSUS, Goldman

1929. Journ. Washington Acad. Sci. 19, p. 435.
Arizona: Prospect Valley, Grand Canyon, Hualpai Indian Reservation.

116. CITELLUS LEUCURUS CINNAMOMEUS, Merriam

1890. North Amer. Fauna, No. 3, p. 52.
Echo Cliffs, Painted Desert, Coconino County, Arizona.

117. CITELLUS LEUCURUS PENNIPES, Howell

1931. Journ. Mamm. Baltimore, 12, p. 162.
Grand Junction, Colorado.

118. CITELLUS LEUCURUS PENINSULAE, Allen

1893. Bull. Amer. Mus. Nat. Hist. V, p. 197.
San Telmo, Lower California, Mexico.

119. CITELLUS LEUCURUS CANFIELDAE, Huey

1929. Trans. San Diego Soc. Nat. Hist. 5, p. 243.
Punta Prieta, Lower California.

120. CITELLUS LEUCURUS EXTIMUS, Nelson & Goldman

1929. Journ. Wash. Acad. Sci. 19, p. 281.
Lower California; Saccaton, 15 miles north of Cape San Lucas.

121. CITELLUS INTERPRES, Merriam

1890. North Amer. Fauna, No. 4, p. 21.
El Paso, El Paso County, Texas.

122. CITELLUS INSULARIS, Nelson & Goldman

1909. Proc. Biol. Soc. Washington, XXII, p. 24.
Esperitu Santo Island, Gulf of California, Mexico.

123. CITELLUS NELSONI, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 129.
Tipton, San Joaquin Valley, California, Tulare County.
Synonym: *amplus*, Taylor, 1916, Univ. Calif. Publ. Zool. 17, p. 15. Twenty miles south of Los Banos, Merced County, California.

Subgenus *Xerospermophilus*, Merriam

124. CITELLUS MOHAVENSIS, Merriam

1889. North Amer. Fauna, No. 2, p. 15.
Mohave River, San Bernardino County, California.

125. CITELLUS TERETICAUDUS TERETICAUDUS, Baird

1857. Mamm. N. Amer., p. 315.
Old Fort Yuma, Imperial County, California.
Synonym: *vociferans*, Huey, 1927, Proc. Biol. Soc. Washington, XXXIX, p. 29. San Felipe, Lower California.
eremonomus, Elliot, 1903, Field Columb. Mus., publ. 87, 3, p. 243. Furnace Creek, Death Valley, Inyo County, California.

126. CITELLUS TERETICAUDUS NEGLECTUS, Merriam

1889. North Amer. Fauna, No. 2, p. 17.
Dolan's Spring, Mohave County, Arizona.
Synonym: *sonoriensis*, Ward, 1891, Amer. Nat. 25, p. 158. Hermosillo, Sonora, Mexico.
arizonae, Grinnell, 1918, Proc. Biol. Soc. Washington, XXXI, 105. Tempe, Maricopa County, Arizona.

127. CITELLUS TERETICAUDUS CHLORUS, Elliot

1903. Field Mus. Columb. Publ. 87, zool. ser. 3, p. 242.
Palm Springs, Riverside County, California.

128. CITELLUS TERETICAUDUS APRICUS, Huey

1927. Trans. S. Diego Soc. Nat. Hist. 5, p. 85.
Lower California, Valle de la Trinidad.

Subgenus *Callospermophilus*, Merriam

129. CITELLUS LATERALIS LATERALIS, Say

1823. Long's Exp. Rocky Mountains, 2, p. 46.
Arkansas River, below Canyon City, Pueblo County, Colorado.

130. CITELLUS LATERALIS WORTMANI, Allen

1895. Bull. Amer. Mus. Nat. Hist. VII, p. 335.
Kinney Ranch, Bitter Creek, Wyoming (Sweetwater County).

131. CITELLUS LATERALIS ARIZONENSIS, Bailey

1913. Proc. Biol. Soc. Washington, XXVI, p. 130.
Arizona, San Francisco Mountain.

132. CITELLUS LATERALIS CARYI, Howell

1917. Proc. Biol. Soc. Washington, XXX, p. 105.
Seven miles south of Fremont Peak, Wind River Mountains, Fremont, Wyoming.

133. CITELLUS LATERALIS CINERASCENS, Merriam

1890. North Amer. Fauna, No. 4, p. 20.
Helena, Lewis and Clarke County, Montana.

134. CITELLUS LATERALIS TESCORUM, Hollister

1911. Smiths. Misc. Coll. LVI, no. 26, p. 2.
Head of Moose Pass Branch of Smoky River, Alberta, Canada.

135. CITELLUS LATERALIS CASTANURUS, Merriam

1890. North Amer. Fauna, No. 4, p. 19.
Park City, Wasatch Mountains, Summit County, Utah.

136. CITELLUS LATERALIS CHRYSODEIRUS, Merriam

1890. North Amer. Fauna, No. 4, p. 91.
Fort Klamath, Klamath County, Oregon.

137. CITELLUS LATERALIS CONNECTENS, Howell

1931. Journ. Mamm. Baltimore, 12, p. 161.
Homestead, Oregon.

138. CITELLUS LATERALIS TREPIDUS, Taylor

1910. Univ. Calif. Pub. Zool. 5, p. 283.
Head of Big Creek, Pine Forest Mountains, Humboldt County, Nevada.
Synonym: *perpallidus*, Grinnell, 1918, Univ. Calif. Pub. Zool. 17, p. 429. Big Prospector Meadow, White Mountains, Mono County, California.

139. CITELLUS LATERALIS CERTUS, Goldman

1921. Journ. Mamm. Baltimore, 2, p. 232.
Charleston Peak, Clark County, Nevada.

140. CITELLUS LATERALIS BERNARDINUS, Merriam

1898. Science, n.s., 8, p. 782.
San Bernardino County, California; San Bernardino Peak.
Synonym: *brevicaudus*, Merriam, 1893, Proc. Biol. Soc. Washington VIII, p. 134. Not of Brandt, 1844.

141. CITELLUS LATERALIS MITRATUS, Howell

1931. Journ. Mamm. Baltimore, 12, p. 161.
South Yolla Bolly Mountain, California.

142. CITELLUS LATERALIS TRINITATIS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 126.
Trinity Mountains, Humboldt County, California (east of Hoopa Valley).

143. CITELLUS SATURATUS, Rhoads

1895. Proc. Acad. Nat. Sci. Philadelphia, p. 43.
Lake Keechelus, Kittitas County, Washington.

144. CITELLUS MADRENSIS, Merriam

1901. Proc. Washington Acad. Sci. III, p. 363.
Sierra Madre, Chihuahua, Mexico, near Guadalupe y Calvo.

Genus 30. MARMOTA, Blumenbach

1779. MARMOTA, Blumenbach, Handb. Naturgesch, 1, p. 79.
1780. ARCTOMYS, Schreber, Säugthiere, pls. CCVII–CCXI, ibid. text, IV, 721–743, 1782.
1922. MARMOTOPS, Pocock, Proc. Zool. Soc. London, p. 1200. (*M. monax*, Linnaeus).

TYPE SPECIES.—*Mus marmota*, Linnaeus.

RANGE.—Holarctic: Alps (France, Switzerland, North Italy) and Carpathians; Poland, North Rumania (Bukowina); European Russia (steppes of Rivers Don, Donez, Middle and Lower Volga, Mid Ural), northern Kazakstan; Fergana, Pamir, Semirechyia, Altai, Tomsk; Transbaikalia; Verhoyansk district, Anadyr region, and Kamtchatka (Russian localities quoted by Vinogradov); Tibet, Chinese Turkestan, Kansu, northern Mongolia, Manchuria; Afghanistan, Kashmir; Nepal, Sikkim, to Yunnan.

The greater part of Canada and the United States, from Alaska to Labrador and the Atlantic coast of U.S.A.; south to California, New Mexico, and northern Oklahoma, and Alabama. (Distribution maps of Nearctic species are published by Howell, and in Anthony, Field Book North American Mammals, 1928.)

NUMBER OF FORMS.—About fifty.

CHARACTERS.—Skull much more powerfully ridged for muscle attachment than in *Citellus*, and size becoming very large, largest of family, head and body up to 620 mm. Postorbital process very thick and heavy; little sign of interorbital constriction; parietal ridges usually join to form a sharp sagittal crest near hinder part of postorbital process. Frontals depressed. Occiput strong, prominent. Infraorbital foramen wider below, but not well open; masseter knob appears less produced than is usual in *Citellus*; upper border of zygomatic plate well ridged, relatively narrow. Jugal, as usual in the family, long and extending to lachrymal. Palate not narrowed posteriorly. Mandible as a rule less angular than in *Citellus* or *Cynomys*. P.3 very little reduced, functional. Upper cheekteeth like those of *Citellus*, but rather less constricted internally; strongly hypsodont, particularly on the inner side. Cusps and ridges high, depressions deep, as in *Citellus*; often the third depression, at the back of the main teeth, wears out, like *Citellus* in this feature, but unlike the few *Cynomys* examined. M.3 the largest tooth, with its posterior elements more or less obliterated as a rule. Lower teeth like those of *Citellus*, the posterointernal cusp not developed. Incisors, both upper and lower, usually with traces of several faint grooves. Cheek-pouches (said to be) rudimentary or absent. In the above notes "*Citellus*" refers to *Citellus* s.s.

Form thickset; tail less than or rarely exceeding a third head and body length except in *caudata* group, in which it approaches half this measurement, and perhaps in *caligata* group. Ear short. Hindfoot rather broad, with digits arranged as in other terrestrial genera. Forefoot with D.3 the main digit; pollex rudimentary; or absent in the type species. On this account Pocock restricted the genus to the type species, and erected "*Marmotops*" for the others; but the presence or absence of a minute and functionless digit of this type is of no importance, and an examination of the skeleton of the manus of *M. marmota* and *M. caudata* representing "*Marmotops*" presents very little essential difference. Claws usually well developed, powerful. Mammae 10 in *flaviventris*, *caligata*, *marmota*, *bobak*; 8 in *monax*.

It must be added that *Marmotops* is recognized as a subgenus by Howell, 1938.

The American species were revised by Howell in 1915 (North Amer. Fauna, no. 37). Three specific groups are recognized: the *monax* group ("Woodchucks": mammae 8, sagittal crest according to Howell weaker, less developed; general appearance and coloration distinct at a glance from all others judging by material examined); the *flaviventris* group (Yellow-bellied Marmots; of western U.S.A.); and the *caligata* group (dark thick-furred types from Alaska, extreme west Canada and adjacent parts of U.S.A.; also from North-east Siberia; becoming rather larger than the above; apparently darkest of genus in general coloration, and tail apparently tending to be rather longer). In both the two latter groups, the mammae are 10.

In *flaviventris* group, the ear is stated to be smaller than in *monax* group, and the tail is relatively longer. The *monax* group ranges right across Canada, and in much of the eastern U.S.A. Good distribution maps of the three groups are published by Howell, and in Anthony, 1928, Field Book North American Mammals.

The Palaearctic species are not yet revised. Other than the Siberian representatives of the *caligata* group, I provisionally recognize three groups; *marmota* group (Alps; tail approximately 27 per cent head and body length; general

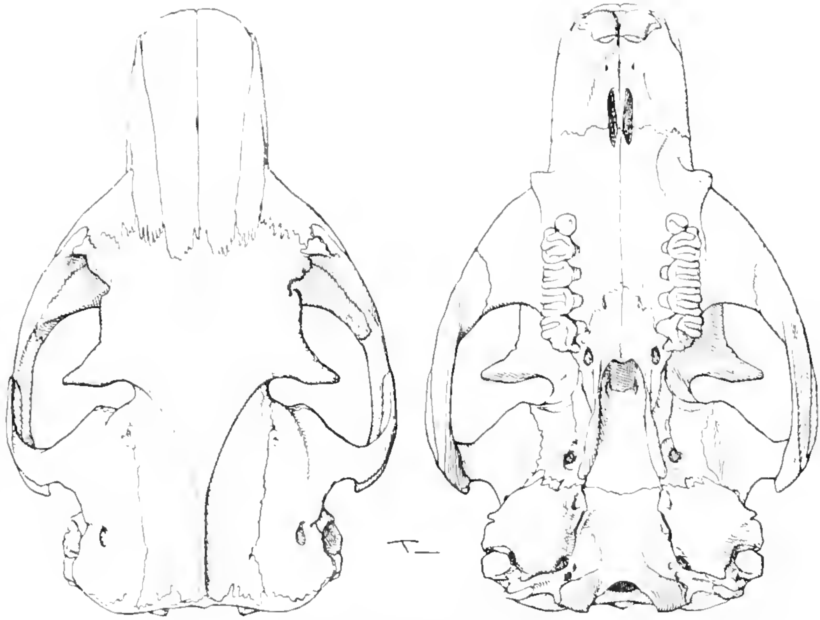


Fig. 113. Marmota marmota, Linnaeus.
B.M. No. 7.1.1.195 bis; 1.

Fig. 114. Marmota marmota, Linnaeus.
B.M. No. 7.1.1.195 bis; 1.

appearance as regards coloration at once distinguishable from all other species; mammae 10); *caudata* group (tail longest of genus, about 45 per cent head and body length; rather large; thick-furred) includes *caudata* (yellowish, with conspicuous black mid-dorsal area noticeably contrasting with sides), *aurea*, from which *littledalei* seems not more than racially distinct, *dichrous* and *stirlingi*, differing from each other in minor colour distinctions, but all clearly separable from *caudata*.

M. bobak group: provisionally including all other Palaearctic forms examined; tail normally strongly reduced, about a quarter length head and body (or slightly more); coloration principally light, often more or less unicolor; and typically with short fur. Includes *bobak*, the related but larger *himalayana*, *sibirica* (evidently differing in colour), and *centralis*, a thicker-furred form, which is now regarded as a race of *baibacina*; *robusta* is, I think, a race of *himalayana*.

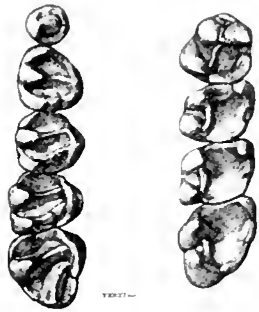


FIG. 115
MARMOTA MARMOTA, Linnaeus.
Cheekteeth; × 2.

Forms seen: *aurea*, *baibacina*, *bobak*, *caligata*, *camtschatica*, *caudata*, *centralis*, *cliftoni*, *dichrous*, *flavinus*, *flaviventer*, *himalayana*, *littledalei*, *marmota*, *monax*, *okanagana*, *robusta*, *sibirica*, *stirlingi*.

List of Named Forms

monax Group

1. MARMOTA MONAX MONAX, Linnaeus
1758. Syst. Nat., 10th Ed., vol. 1, p. 60.
Maryland.

2. MARMOTA MONAX RUFESCENS, Howell
1914. Proc. Biol. Soc. Washington, XXVII, p. 13.
Elk River, Minnesota, Sherburne County.

3. MARMOTA MONAX PREBLORUM, Howell
1914. Proc. Biol. Soc. Washington, XXVII, p. 14.
Wilmington, Middlesex County, Massachusetts.

4. MARMOTA MONAX IGNAVA, Bangs
1899. Proc. New England Zool. Club, 1, p. 13.
Black Bay, Strait of Belle Isle, Labrador.

5. MARMOTA MONAX CANADENSIS, Erxleben
1777. Syst. Regn. Anim. 1, p. 363.
Quebec, Canada.
Synonym: *empetra*, Pallas, Nov. Sp. Quadr. Glir. Ord., p. 75, 1778.

6. MARMOTA MONAX PETRENSIS, Howell
1915. North Amer. Fauna, No. 37, p. 33.
Revelstoke, British Columbia, Canada.

7. MARMOTA MONAX OCHRACEA, Swarth
1911. Univ. Calif. Publ. Zool. 7, p. 203.
Forty-mile Creek, Alaska.

8. MARMOTA MONAX BUNKERI, Black

1935. Journ. Mamm. Baltimore, 16, p. 319.
Lawrence, Douglas County, Kansas.

flaviventris Group

9. MARMOTA FLAVIVENTRIS FLAVIVENTRIS, Audubon & Bachman

1841. Proc. Acad. Nat. Sci. Philadelphia, p. 99.
Mount Hood, Oregon.

10. MARMOTA FLAVIVENTRIS AVARA, Bangs

1899. Proc. New England Zool. Club, 1, p. 68.
Okanagan, British Columbia, Canada.

11. MARMOTA FLAVIVENTRIS SIERRAE, Howell

1915. North Amer. Fauna, No. 37, p. 43.
Head of Kern River, Mount Whitney, California, Tulare County.

12. MARMOTA FLAVIVENTRIS FORTIROSTRIS, Grinnell

1921. Univ. Calif. Publ. Zool. 21, p. 242.
McAfee Meadow, White Mountains, Mono County, California.

13. MARMOTA FLAVIVENTRIS PARVULA, Howell

1915. Proc. Biol. Soc. Washington, XXVII, p. 14.
Jefferson, Nye County, Nevada.

14. MARMOTA FLAVIVENTRIS ENGELHARDTI, Allen

1905. Mus. Brooklyn Inst. Arts & Sci. Science, Bull. 1, p. 120.
Briggs Meadows, Beaver Range Mountains, Beaver County, Utah.

15. MARMOTA FLAVIVENTRIS NOSOPHORA, Howell

1914. Proc. Biol. Soc. Washington, XXVII, p. 15.
Willow Creek, Montana, Ravalli County, 7 miles east of Corvallis.

16. MARMOTA FLAVIVENTRIS DACOTA, Merriam

1889. North Amer. Fauna, No. 2, p. 8.
Custer, Black Hills, Custer County, South Dakota.

17. MARMOTA FLAVIVENTRIS LUTEOLA, Howell

1914. Proc. Biol. Soc. Washington, XXVII, p. 15.
Woods Post Office, Medicine Bow Mountains, Albany County, Wyoming.

18. MARMOTA FLAVIVENTRIS CAMPIONI, Figgins

1915. Proc. Biol. Soc. Washington, XXVIII, p. 147.
Eight miles north of Higho, Jackson County, Colorado.

19. MARMOTA FLAVIVENTRIS WARRENI, Howell

1914. Proc. Biol. Soc. Washington, XXVII, p. 16.
Crested Butte, Gunnison County, Colorado.

20. MARMOTA FLAVIVENTRIS OBSCURA, Howell

1914. Proc. Biol. Soc. Washington, XXVII, p. 16.
Wheeler Peak, Taos County, New Mexico; 5 miles south of Twining.

21. MARMOTA FLAVIVENTRIS NOTIOROS, Warren

1934. Journ. Mamm. Baltimore, 15, p. 62.
Marion Lake, West Mountains, Custer County, Colorado.

caligata Group

22. MARMOTA CALIGATA CALIGATA, Eschscholtz

1829. Zool. Atlas, pt. 2, p. 1, pl. 6.
Near Bristol Bay, Alaska.
Synonym: (?) *pruinosus*, Gmelin, 1788, Syst. Nat. 1, p. 144. Regarded as unidentifiable by Howell, 1915.

23. MARMOTA CALIGATA VIGILIS, Heller

1909. Univ. Calif. Publ. Zool., 5, p. 248.
West shore of Glacier Bay, Alaska.

24. MARMOTA CALIGATA SHELDONI, Howell

1914. Proc. Biol. Soc. Washington, XXVII, p. 18.
Montague Island, Alaska.

25. MARMOTA CALIGATA OXYTONA, Hollister

1914. Science, n.s., vol. 39, p. 251.
Moose Pass Branch, Smoky River, Alberta, Canada.
Synonym: *sibila*, Hollister, 1912, Smiths. Misc. Coll. LVI, 35, p. 1 (not of Wolf, 1808).

26. MARMOTA CALIGATA OKANAGANA, King

1836. Narr. Journ. Shores Arctic Ocean, vol. 2, p. 236.
Gold Range, British Columbia, Canada.

27. MARMOTA CALIGATA NIVARIA, Howell

1914. Proc. Biol. Soc. Washington, XXVII, p. 17.
Mountains near Upper St. Mary's Lake, Teton County, Montana.

28. MARMOTA CALIGATA CASCADENSIS, Howell

1914. Proc. Biol. Soc. Washington, XXVII, p. 17.
Mount Rainier, Pierce County, Washington.

29. MARMOTA CALIGATA RACEYI, Anderson

1932. Bull. Nat. Mus. Canada, 70, p. 112.
British Columbia; Itcha Mountains, Chilcotin Plateau.

30. MARMOTA CALIGATA BROWERI, Hall & Gilmore

1934. Canad. Field Nat., 48, p. 57.
North Alaska; Point Lay, Arctic coast.

31. MARMOTA OLYMPUS, Merriam

1898. Proc. Acad. Nat. Sci. Philadelphia, p. 352.
Head of Soleduc River, Olympic Mountains, Clallam County, Washington.

32. MARMOTA VANCOUVERENSIS, Swarth

1911. Univ. Calif. Publ. Zool. 7, p. 201.
Mount Douglas, Vancouver Island, British Columbia.

33. MARMOTA CAMTSCHATICA CAMTSCHATICA, Brandt

1843. Bull. Acad. St. Petersb., II, p. 364.
Kamtchatka.

34. MARMOTA CAMTSCHATICA BUNGEI, Kascenko

1901. Ann. Mus. St. Petersb., VI, p. 615.
Omoloy, Verhoyansk Mountains, N. Siberia.

35. MARMOTA CAMTSCHATICA DOPPELMAYRI, Birula

1922. Ann. Mus. Zool. Acad. Sci., XXII, 4, 80 pages.
The upper reaches of the River Nergili (east shore of Lake Baikal, 50 km. northwards from Sviatoi Nos).

36. MARMOTA CAMTSCHATICA CLIFTONI, Thomas

1902. Ann. Mag. Nat. Hist. 7, IX, p. 444.
Versiansk Mountains, Yakutsk, N.-E. Siberia.

bobak Group

37. MARMOTA BOBAK, Müller

1776. Natursyst. Suppl. Regist. Band, p. 40.
Poland.
Synonym: *arctomys*, Pallas, 1778, Nov. Sp. Quadr. Glir. Ord., p. 75. (Poland.)

38. MARMOTA HIMALAYANA HIMALAYANA, Hodgson

1841. Journ. Asiat. Soc. Bengal, X, p. 777.
Nepal.
Synonym: *tataricus*, Jameson, 1847, L'Institut, XV, p. 384.
hodgsoni, Blanford, 1876, Yarkand Mission, Mamm., p. 35. Nepal.
hemachalanus, Hodgson, 1843, Journ. Asiat. Soc. Bengal, XII, p. 410. Nepal.

39. MARMOTA HIMALAYANA ROBUSTA, Milne-Edwards

1870. Nouv. Arch. Mus., VII, Bull., p. 92.
Moupin, Szechuan.

40. MARMOTA SIBIRICA, Radde

1862. Reise Sud. Ost. Sibir., p. 159.
Transbaikalia.

41. MARMOTA BAIBACINA BAIBACINA, Brandt

1843. Bull. Acad. Sci. St. Petersb., II, p. 364.
Altai.

42. MARMOTA BAIBACINA CENTRALIS, Thomas

1909. Ann. Mag. Nat. Hist. 8, III, p. 260.
Aksai Plateau, 120 miles north of Kashgar, Turkestan.

caudata Group

43. MARMOTA CAUDATA, Jacquemont

1844. Voy. dans l'Inde, IV, Zool., p. 66.
Kashmir.

44. MARMOTA AUREA AUREA, Blanford

1875. Journ. Asiat. Soc. Bengal, XLIV, pp. 106, 123.
Mountains west of Yarkand (E. Turkestan).

45. MARMOTA AUREA LITTLEDALEI, Thomas

1909. Ann. Mag. Nat. Hist. 8, III, p. 259.
Alai Mountains, Pamir.

46. MARMOTA AUREA FLAVINUS, Thomas

1909. Ann. Mag. Nat. Hist. 8, III, p. 259.
Hissar Mountains, 100 miles east of Samarkand.

47. MARMOTA STIRLINGI, Thomas

1916. Journ. Bombay Nat. Hist. Soc. XXIV, p. 341.
Head of Chitral Nullah, Chitral (N.-W. Kashmir).

48. MARMOTA DICHROUS, Anderson

1875. Ann. Nat. Hist., XVI, p. 283.
Hills north of Kabul, Afghanistan.

marmota Group

49. MARMOTA MARMOTA, Linnaeus

1758. Syst. Nat., 10th Ed., vol. 1, p. 60.
Alps.
Synonym: *alpina*, Blumenbach, 1779, Handb. der Naturg, 1, p. 80.
tigrina, Bechstein, 1801, Gemeinn Naturg. 1, 2nd ed., p. 1029.
alba, Bechstein, same reference, p. 1030.
nigra, Bechstein, same reference, p. 1030.

Not seen, and not allocated to group

50. MARMOTA MENZBIERI, Kashkarov

1925. Trans. Sci. Soc. Turkestan, 2, p. 47.
Tian-Shan, Central Asia.

Genus 31. CYNOMYS, Rafinesque

1817. CYNOMYS, Rafinesque, Amer. Monthly Mag., II, no. 1, p. 45.
1916. LEUCOCROSSUROMYS, Hollister, North Amer. Fauna, No. 40, p. 23. *Spermophilus gunnisoni*, Baird. Valid as a subgenus.

TYPE SPECIES.—*Cynomys socialis*, Rafinesque = *Arctomys ludoviciana*, Ord.

RANGE.—Western United States: forms named from Upper Missouri River, Arizona, Wyoming, Utah, Colorado, New Mexico; and Coahuila, northern Mexico. Good distribution maps of this genus are published by Hollister, and in Anthony, Field Book North American Mammals, 1928, pp. 219, 221.

NUMBER OF FORMS.—Seven. The genus is revised by Hollister, 1916, North Amer. Fauna, no. 40.

CHARACTERS.—Dentition extremely heavy. Cheekteeth with the general plan of *Citellus*, the inner border of each main tooth strongly constricted. P.3 very little reduced, nearly as large as P.4. Upper cheekteeth extremely hypsodont on inner side, and slanting outwards. Three depressions on each tooth evidently remaining for a long time; these separate the four main ridges; also M.3, which in related genera shows signs of simplification normally, does not do so in this genus, the elements being as in the other molars (i.e. two main ridges), and tending to persist. Lower cheekteeth about as in *Citellus*; the posteroexternal cusp rather low, and in worn teeth separated from the cusp in front of it by a small but well-marked re-entrant fold; M.3 with a narrow depression running down the centre of the tooth.

Skull massive and angular. Toothrows markedly converging posteriorly. Occipital region prominent. A well-marked sagittal crest developed in all skulls seen. Infraorbital foramen triangular, its outer border much thickened, and with a prominent masseter knob present. Zygomatic plate with upper border well ridged, the infraorbital foramen apparently situated farther forward with relation to this ridge than in related genera. Zygomatic width relatively great. Mandible angular, powerfully ridged, the angular portion strongly pulled inward, probably more so than in any other genus of squirrel.

Mammae 8 to 12 (Hollister). External form heavy, with tail much reduced, probably not exceeding a quarter of head and body length. Digits of forefoot, including the pollex, all with strong claws; D.3 the main digit, D.2 and D.4 subequal. Hindfoot with digits arranged as usual in terrestrial types.

In the typical subgenus, the jugal bone is described as strong, its outer surface at angle of ascending branch very broad, triangular. *C. mexicanus* is stated to have bullae larger than is usual in the genus.

In the subgenus *Leucocrossuromys*, the jugal is "weak, thin and flat, the outer surface at angle of ascending branch only very slightly thickened, the margin rounded, not triangular. . . . Teeth smaller than in subgenus *Cynomys*, not so much expanded laterally." The tail is tipped with white, instead of black (as in the typical subgenus).

REMARKS.—A very distinct genus. Not well represented in the British Museum.

Forms seen: *ludovicianus*, *gunnisoni*.

List of Named Forms

Subgenus *Cynomys*, Rafinesque

1. CYNOMYS LUDOVICIANUS LUDOVICIANUS, Ord

1815. Guthrie's Geography, 2nd Amer. ed., vol. 2, p. 292.
Upper Missouri River.
Synonym: *socialis*, Rafinesque, 1817, Amer. Monthly Mag., II, p. 45.
pyrrhotrichus, Elliot, 1905, Proc. Biol. Soc. Washington, XVIII, p. 139. Oklahoma.
missouriensis, Warden, 1819, Stat. Pol. Hist. Acc. U.S. 1, p. 226.
latrans, Harlan, 1825, Faun. Amer., p. 306.

2. CYNOMYS LUDOVICIANUS ARIZONENSIS, Mearns

1890. Bull. Amer. Mus. Nat. Hist. II, p. 305.
Point of Mountain, near Wilcox, Cochise County, Arizona.

3. CYNOMYS MEXICANUS, Merriam

1892. Proc. Biol. Soc. Washington, VII, p. 157.
La Ventura, Coahuila, Mexico.

Subgenus *Leucocrossuromys*, Hollister

4. CYNOMYS LEUCURUS, Merriam

1890. North Amer. Fauna, No. 40, p. 34.
Fort Bridger, Wyoming, Uinta County.
Synonym: *lewisii*, Allen, Bull. Amer. Mus. Nat. Hist. X, p. 456, 1898. Not of Audubon & Bachman, a *Marmota* from shores of of Columbia River (see Hollister, North Amer. Fauna, No. 40, p. 26, 1916).

5. CYNOMYS PARVIDENS, Allen

1905. Mus. Brooklyn Inst. Arts & Sci., Science Bull. 1, p. 119.
Buckskin Valley, Iron County, Utah.

6. CYNOMYS GUNNISONI GUNNISONI, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 334.
Cochetopa Pass, Saguache County, Colorado.
Synonym: *columbianus*, True, Proc. U.S. Nat. Mus., VII, p. 593, 1885.

7. CYNOMYS GUNNISONI ZUNIENSIS, Hollister

1916. North Amer. Fauna, No. 40, p. 32.
Wingate, McKinley County, New Mexico.

The family Sciuridae is known fossil from the Oligocene.

FAMILY SCIURIDAE:

GENERAL WORKS OF REFERENCE

FORSYTH MAJOR, 1893, Proc. Zool Soc. London, 1893, p. 179. On some Miocene Squirrels, with remarks on the dentition and classification of the Sciuridae.

THOMAS, 1908, Journ. Bombay Nat. Hist. Soc., XVIII, p. 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, other than Flying-squirrels.)

THOMAS, 1908, Ann. Mag. Nat. Hist. 8, I, p. 1. The genera and subgenera of the *Sciuropterus* group. (Rearrangement of genera of smaller Flying-squirrels.)

THOMAS, 1909. The generic arrangement of the African Squirrels: Ann. Mag. Nat. Hist. 8, III, p. 467.

ALLEN, 1915, Review of the South American Sciuridae. Bull. Amer. Mus. Nat. Hist., XXXIV, p. 147.

THOMAS, 1915, Ann. Mag. Nat. Hist. 8, XV, p. 383. The penis bone or baculum as a guide to classification of certain Squirrels.

MILLER, 1912, Catalogue of Mammals of Western Europe, pp. 897–946: Sciuridae and Petauristidae: *Sciurus*, *Citellus*, *Marmota*, *Sciuropterus* (= *Pteromys*).

POCOCK, 1923, Classification of Sciuridae on the baculum. Proc. Zool. Soc. London, p. 209, 1923.

POCOCK, 1922, Proc. Zool. Soc. London, p. 1171. On the external characters of the Beaver and some Squirrels.

HOWELL, 1938, North Amer. Fauna, No. 56, p. 1. Revision of North American *Citellus* and rearrangement of genera and subgenera of North American Squirrels.

ALLEN, 1877, Monograph of North American Rodents, p. 637. Sciuridae.

TULLBERG, 1899, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, 1.

WROUGHTON, 1911, Journ. Bombay Nat. Hist. Soc., XX, p. 1012. Key to the Indo-Malayan species of *Petaurista*.

WROUGHTON, 1919, Journ. Bombay Nat. Hist. Soc., XVI, p. 352. Indian Mammal Survey: Sciuridae.

VINOGRADOV, 1933, Tab. Anal. Faune de l'URSS, Inst. Zool. Acad. Sciences, 10, p. 1. Key to Rodents of the U.S.S.R.: Sciuridae: *Sciurus*, *Eutamias*, *Spermophilopsis*, *Citellus*, *Marmota*, *Pteromys*.

HOWELL, 1918, North Amer. Fauna, No. 44. Revision of genus *Glaucomys*.

THOMAS, 1888, Journ. Asiat. Soc. Bengal, LVII, p. 258. *Eupetaurus*.

ALLEN, 1914, Bull. Amer. Mus. Nat. Hist. XXXIII, p. 145. Review of *Microsciurus*.

NELSON, 1899, Proc. Washington Acad. Sci., I, p. 38. Revision of Mexican and Central American Squirrels (*Sciurus*).

ALLEN, 1898, Bull. Amer. Mus. Nat. Hist. X, p. 249. Revision of *Tamiasciurus*.

Robinson & Kloss, 1918, Rec. Indian Mus., XV, pt. IV, pp. 171–250. Nominal List of Oriental Sciuridae. (Arrangement of species and subspecies of *Petaurista*, *Eupetaurus*, *Iomys*, *Belomys*, *Pteromyscus*, *Petaurillus*, *Hylopetes*, *Petinomys*, *Aeromys*, *Eoglaucomys*, *Ratufa*, *Callosciurus*, "*Tomeutes*," *Menetes*, *Lariscus*, *Dremomys*, *Rhinosciurus*, *Rheithrosciurus*, *Glyphotes*, "*Tamiops*," *Funambulus*, *Nannosciurus*.)

Ingoldby, 1927, Proc. Zool. Soc. London, p. 471. Revision of *Heliosciurus*.

Howell, 1929, North Amer. Fauna, No. 52, p. 1. Revision of Chipmunks, *Tamias* "*Eutamias*."

Obolensky, 1927, C.R. Acad. Sci. Leningrad, p. 188. Revision of Palaearctic Ground-squirrels: *Citellus*, *Spermophilopsis*.

Howell, 1915. Revision of American species of *Marmota*, North. Amer. Fauna, no. 37.

Hollister, 1916, Revision of genus *Cynomys*. North Amer. Fauna, no. 40.

Hollister, East African Mammals: *Sciuridae*. Smiths. Inst. U. S. Nat. Mus. Bull. 99, 1919, p. 1.

Superfamily CASTOROIDAE

As here understood this contains one living family.

Family CASTORIDAE

1896. Thomas: Sciuromorpha, part: Family Castoridae.
1899. Tullberg: Sciuromorpha, part: *Castoroidei*, Family Castoridae.
1918. Miller & Gidley: Superfamily Sciuroidae. Family Castoridae.
1924. Winge: Family Sciuridae, part: Castorini.
1928. Weber: Castoroidea: Family Castoridae.

Geographical Distribution.—Palaearctic and Nearctic. In North America forms have been described from Hudson Bay, Newfoundland, Alaska, Vancouver Island, Carolina, Michigan, North Dakota, Texas, California, New Mexico, and Sonora (near Mexican boundary line), Mexico. The genus formerly probably extended over the greater part of the continent, and Anthony in Field Book of North American Mammals, 1928, gives as the range for *Castor canadensis*, "most of North America from Alaska and Labrador to the Rio Grande." In Europe, formerly extending across most of the Continent, and including England; but now restricted to Norway, and probably some of the main rivers of Central Europe, as the Rhone, Elbe, Danube and Pripet (Flower); occurs in parts of the U.S.S.R. (quoted by Vinogradov from basins of Rivers Vistula and Dnieper, former Minsk, Smolensk, Chernigov, Poltava govts., former Voronej govt., basin of River Sosva (north Ural mountains), and Mongolian Altai).

Number of Genera.—One.

Characters.—Skull and external form heavy; zygomasseteric structure as in typical specialized Sciuridae; the infraorbital foramen forming a canal. Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$ = 20. Cheekteeth excessively hypsodont, but not evergrowing, the pattern changing little during life, and characterized by narrow inner and outer enamel folds, as in certain Hystricoid genera; bullae with neck protruding upwards and outwards; a pit-like depression in basi-occipital; jugal in contact with the lachrymal, and immensely thickened

Fig. 116. Cynomys ludovicianus ludovicianus, Ord.
B.M. No. 19.7.7.2841; 1.

Fig. 117. Cynomys ludovicianus, Ord.
Cheekteeth; 3.

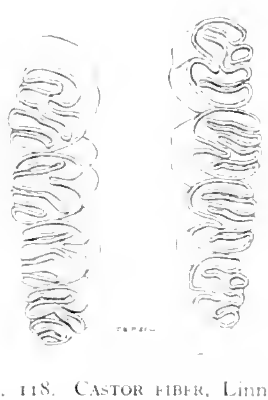


Fig. 118. Castor fiber, Linnaeus.
Cheekteeth; 1½.

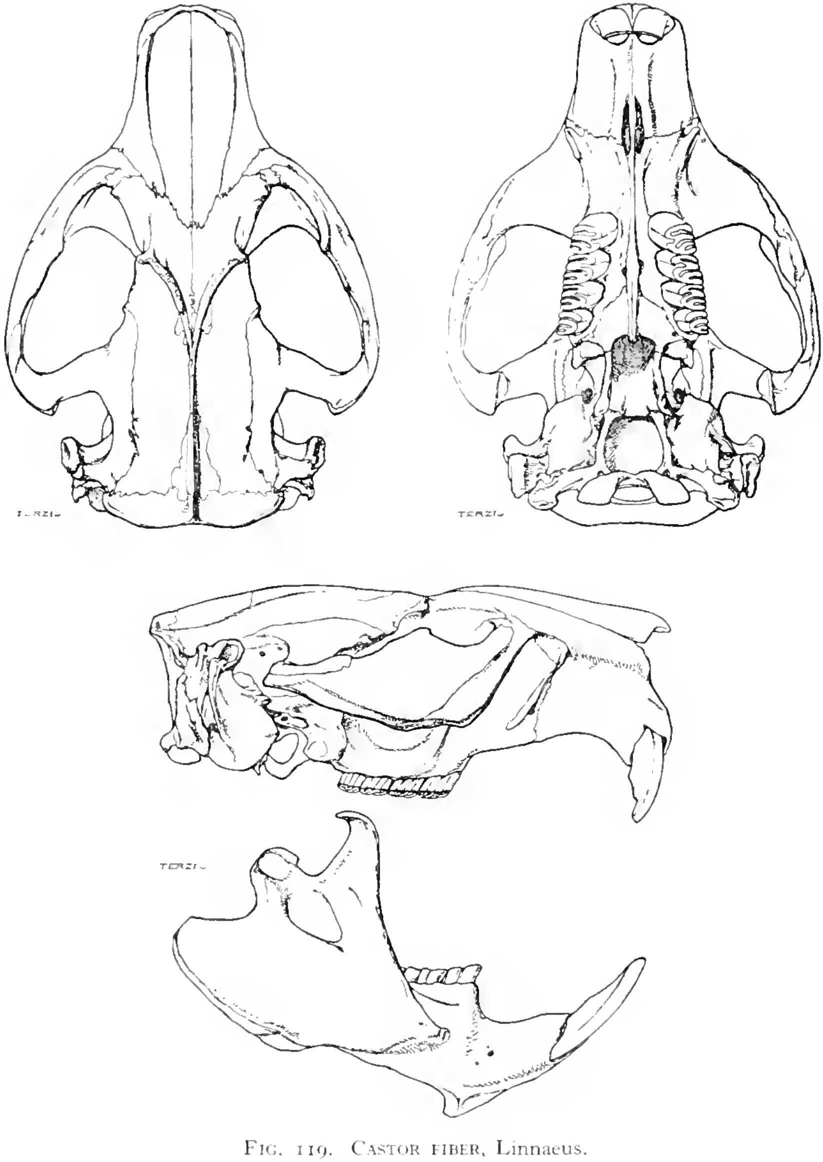


FIG. 119. CASTOR FIBER, Linnaeus.
(From Miller's *Catalogue of the Mammals of Western Europe*)
$\frac{1}{2}$.

anteriorly; externally highly modified for aquatic life, the hindfeet much enlarged, the digits webbed; tail broad, flat, scaly and naked, the caudal vertebrae flattened; anal and urinogenital orifices open within a common cloaca; tibia and fibula united at base, but not fully fused (i.e. not comparing in this specialization with Muridae, Dipodidae, etc.).

REMARKS.—The differences between *Castor* and the Sciuridae appear to relate entirely to the internal characters (other than the cheek-teeth), so far as superfamily separation goes. Tullberg mentions that it may be that *Castor* has more in common with the Muridae than the Sciuridae, and that it is possible that instead of forming a supergroup containing Sciuridae, Castoridae and Geomyidae as he did, and one containing Muridae, Anomaluridae, Ctenodactylidae, it might be correct to unite Castoridae, Geomyidae and Muridae in one group, and possibly Ctenodactylidae, Anomaluridae and Sciuridae in another. Bearing this in mind, and also that Weber regards the group as a superfamily, it is retained as such here, though some doubt is felt as regards the desirability of this classification; in most essential cranial characters the family stands close to the Sciuroidae.

It may be noted that, according to Miller & Gidley, many Castoroid genera of Rodents are known fossil from the Holarctic and have been distinct from the Sciuridae since the Oligocene; at least in their classification both groups are quoted from that period.

There is one living Castoroid genus.

Genus 1. CASTOR, Linnaeus

1758. CASTOR, Linnaeus, Syst. Nat., 10th Ed., vol. 1, p. 58.

TYPE SPECIES.—*Castor fiber*, Linnaeus.

RANGE.—As in the family Castoridae.

NUMBER OF FORMS.—Twenty.

CHARACTERS.—Skull with narrowed frontals, narrow braincase, rostrum thick and relatively short. Temporal ridges forming a sharp sagittal ridge in the adult, which divides anteriorly, the ridges extending forward to about half-way along orbits, and forming short postorbital notches. Lambdoid crest thick, occipital region prominent and angular. Paroccipital process of medium length. Jugal greatly broadened anteriorly, a process directed upwards on the anterior half of the upper border; jugal in contact with lachrymal. Bullae of moderate size, the neck protruding sharply upwards and backwards, appearing in superior view of skull as a conspicuous upwardly projecting tube, on either side of the squamosals. Basioccipital with a pit-like depression situated near base of foramen magnum. Palate slightly wider posteriorly than anteriorly, ending in a short spinous process, at level just behind M.3. Incisive foramina relatively small, narrow and situated considerably in front of the toothrows, as in the Sciuridae. Mandible with coronoid process high, considerably higher than the condylar, and angular portion flattened and rounded; the mandibular symphysis extending back to P.4 in adult. Upper part of zygomatic plate deeply ridged. Nasals noticeably longer in Palaearctic forms than in American species, so far as seen.

Incisors thick. Cheekteeth extremely hypsodont, decreasing in size from P.4 to M.3. Upper series with three long narrow enamel folds externally and one internally, which tends to meet the first outer fold. Lower teeth with this pattern reversed, the outer fold curving backwards between the second and third inner folds.

Size very large, second only to *Hydrochoerus* in the Order at extreme development. Form thickset; legs short; ears very small; hindfeet large, broad, with five well-developed digits, the digits webbed, the claws powerful. D.2 with a horny supplement rising beneath the claw, this probably used for dressing the fur. Forefoot much smaller than hindfoot, with five well-developed digits, and long curved claws, that of the pollex quite well developed, but noticeably weaker than the others. D.3 the main digit. Fur very thick, consisting of a dense soft underportion, and abundant growth of coarser longer hair. Tail much broadened, almost without a vestige of hair, though slightly furred at extreme base; of medium length (unique in the Order as regards structure).

The habits of these animals are too well known to need more than passing mention, though that an animal of this size can cut down trees is remarkable to say the least.

It is to be hoped that the excellent work in the preservation of these animals by the late "Grey Owl" will be carried on and will preserve them from extinction.

More or less closely allied forms are known fossil from the Holarctic, as already mentioned; the Castoroididae, containing a genus (*Castoroides*) with evergrowing laminate cheekteeth and slightly modified zygomasseteric structure (Pleistocene), and the Chalicomyidae (*Chalicomys*, European Miocene and Pliocene, *Trogontherium*, European Pliocene to Pleistocene, *Palaeocastor* and others, North American Oligocene and Pliocene (Miller & Gidley)), seem worthy of mention.

Forms examined: *fiber*, *canadensis*.

CASTORIDAE:

SPECIAL WORKS OF REFERENCE

J. ALLEN, Monograph North American Rodentia, 1877, p. 431.
TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, ser. 3, no. 1, 1899.
POCOCK, On the external characters of the Beaver and some Squirrels, Proc. Zool. Soc. London, p. 1171, 1922.
MILLER, Catalogue of Mammals of Western Europe, 1912, p. 947: Castoridae.

LIST OF NAMED FORMS

(The references and type localities are the work of Mr. R. W. Hayman.)

As already noted, so far as seen the Palaearctic forms differ from the North American ones in the length of the nasals.

canadensis Group

1. CASTOR CANADENSIS CANADENSIS, Kuhl

1820. Beiträge z. Zoologie, p. 64.
Hudson Bay.
Synonym: *americanus*, Richardson, Faun. Bor. Amer., 1829, p. 105.

2. CASTOR CANADENSIS BELUGAE, Taylor

1916. Univ. Calif. Publ. Zool. 12, p. 429.
Beluga River, Cook Inlet region, Alaska.

3. CASTOR CANADENSIS PHAEUS, Heller

1909. Univ. California Publ. Zool. 5, p. 250.
Admiralty Island, Alaska.

4. CASTOR CANADENSIS SAGITTATUS, Benson

1933. Journ. Mamm. Baltimore, 14, p. 320.
Indianpoint Creek, north-east of Barkerville, British Columbia.

5. CASTOR CANADENSIS LEUCODONTA, Gray

1869. Ann. Mag. Nat. Hist. 4, IV, p. 293.
Vancouver Island, British Columbia.
Synonym: *pacificus*, Rhoads, Trans. Amer. Philos. Soc., n.s., vol. 19, p. 422, 1898. Lake Keechelus, Cascade Mountains, Washington.

6. CASTOR CANADENSIS MICHIGANENSIS, Bailey

1913. Proc. Biol. Soc. Washington, XXVI, p. 192.
Tahquamenaw River, Luce County, Michigan.

7. CASTOR CANADENSIS MISSOURIENSIS, Bailey

1919. Journ. Mamm. Baltimore, 1, p. 32.
Apple Creek, 7 miles east of Bismarck, Burleigh County, North Dakota.

8. CASTOR CANADENSIS CAROLINENSIS, Rhoads

1898. Trans. Amer. Philos. Soc., n.s., 19, p. 420.
Dan River, Stokes County, North Carolina.

9. CASTOR CANADENSIS REPENTINUS, Goldman

1932. Journ. Mamm. Baltimore, 13, p. 266.
Bright Angel Creek, Grand Canyon, Arizona River, Colorado.

10. CASTOR CANADENSIS BAILEYI, Nelson

1927. Proc. Biol. Soc. Washington, XL, p. 125.
Humboldt River, near Winnemucca, Nevada.

11. CASTOR CANADENSIS TEXENSIS, Bailey

1905. North Amer. Fauna, No. 25, p. 122.
Cummings Creek, Colorado County, Texas.

12. CASTOR CANADENSIS MEXICANUS, Bailey

1913. Proc. Biol. Soc. Washington, XXVI, p. 191.
Ruidoso Creek, 6 miles below Ruidoso, Lincoln County, New Mexico.

13. CASTOR CANADENSIS FRONDATOR, Mearns

1897. Prelim. diag. new Mamm. Mexican border of U.S.A., p. 2 (Reprinted Proc. U.S. Nat. Mus. XX, p. 502, 1898).
San Pedro River, Sonora, Mexico, near monument No. 98 of the Mexican boundary line.

14. CASTOR CAECATOR, Bangs

1913. Bull. Mus. Comp. Zool. 54, p. 513.
Near Bay St. George, Newfoundland.

15. CASTOR SUBAURATUS SUBAURATUS, Taylor

1912. Univ. Calif. Publ. Zool. 10, p. 167.
Grayson, San Joaquin River, Stanislaus County, California.

16. CASTOR SUBAURATUS SHASTENSIS, Taylor

1916. Univ. Calif. Publ. Zool. 12, p. 433.
Cassel, Pitt River, Shasta County, California.

fiber Group

17. CASTOR FIBER FIBER, Linnaeus

1758. Syst. Nat., 10th Ed., vol. 1, p. 58.
Sweden. (Range: Western European range of the genus.)
Synonym: *albicus*, Matschie, 1907, Sitz. Ber. Ges. Nat. Fr. Berlin, p. 216. Anhalt, Germany.
balticus, Matschie, 1907. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 217. Pomerania.

Miller, Catalogue Mammals of Western Europe, also quotes as synonyms:

albus, Kerr, 1792, Anim. Kingd., p. 222.
solitarius, Kerr, same reference, p. 224.
variegatus, Bechstein, Gemeinn. Naturgesch, Deutschlands 1, 2nd ed., p. 913, 1801.
fulvus, Bechstein, same reference.
galliae, Geoffroy, 1803, Cat. Mamm. Mus. Nat. Hist. Paris, p. 168. (Rhone, France.) 1803.
niger, Desmarest, 1822, Mammalogie, pt. II, p. 278.
varius, Desmarest, same reference.
flavus, Desmarest, same reference.
gallicus, Fischer, Synops. Mamm., p. 287, 1829.
proprius, Billberg, Linn. Samf., p. 34, 1833.

18. CASTOR FIBER VISTULANUS, Matschie

1907. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 219.
West Poland.
(Listed as a valid race by Vinogradov, Rodents occurring in U.S.S.R., 1933.)

19. CASTOR FIBER POHLEI, Serebrennikov

1929. C.R. Acad. Leningrad, p. 275.
River Leplja, tributary of the N. Sosva, east slope of N. Urals, Russia.

20. CASTOR FIBER BIRULAI, Serebrennikov

1929. C.R. Acad. Leningrad, p. 276.
River Bulungun, south of Kobdo, Mongolian Altai.

Superfamily GEOMYOIDAE

This group contains as here understood two families, the Geomyidae and the Heteromyidae.

1896. Thomas: MYOMORPHA, part: Family Heteromyidae (with subfamilies Heteromyinae (*Heteromys*, *Perognathus*), and Dipodomyinae (*Dipodomys*, *Microdipodops*)). Family Geomyidae.

1899. Tullberg: SCIUROMORPHA, part: *Geomyoidei*. One family only recognized, the Geomyidae, with subfamilies Dipodomyini and Geomyini.
1918. Miller & Gidley: Superfamily SCIUROIDAE: Family Geomyidae (living genera referred to subfamily Geomyinae); and Family Heteromyidae.
1924. Winge: Family "Saccomyidae" (=Heteromyidae): Saccomyini and Geomyini.
1928. Weber: GEOMYOIDEA: Family Heteromyidae, and Family Geomyidae.

GEOGRAPHICAL DISTRIBUTION.—America: the greater part of the United States; South-western Canada; Mexico and Central America south to Venezuela, Colombia and Ecuador.

CHARACTERS.—Zygomasseteric structure essentially as in Sciuridae or Castoridae, but rather more modified than in either group; infraorbital foramen excessively reduced; zygomatic plate tilted strongly upwards.

Cheekteeth frequently evergrowing, and frequently becoming completely simplified in pattern. Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}=20$, the premolars not or rarely showing any sign of reduction.

Large externally opening cheek-pouches present.

Fibula reduced and fully fused with the tibia high on the leg.

Zygoma abnormal; either extremely reduced and slender (Heteromyidae), or comparatively robust, but with strongly shortened jugal which becomes progressively reduced until the zygomatic arch is in specialized forms complete without it (Geomyidae).

External form primitively Murine (*Perognathus*, *Liomys*, *Heteromys*); or modified for bipedal saltatorial life (*Microdipodops*, *Dipodomys*), in which genera the mastoids and auditory bullae become abnormally inflated, and the digits of the hindfoot may be reduced to four; or in all Geomyidae much specialized for underground life.

REMARKS.—No doubt is felt in retaining this group as a superfamily. Most zoologists who have classified the Order and given proper consideration to zygomasseteric structure have placed this group in the neighbourhood of the Sciuromorph series of Rodents, where they appear to belong.

In some ways the Geomyidae appear to me at their highest development to be among the most highly specialized of all living Rodents.

KEY TO THE FAMILIES OF GEOMYOIDAE

Skull and external form modified for subfossorial life; cheekteeth always evergrowing in living members of the group, their structure always near complete simplification. Incisors thick and powerful. Zygoma comparatively robust, the jugal becoming progressively reduced until the zygomatic arch is complete without it. Bullae and mastoids never abnormally inflated. Palate much narrowed. Frontals relatively narrow to extremely so. Family GEOMYIDAE

Skull and external form never modified for subfossorial life; cheekteeth rarely evergrowing (*Dipodomys* only), and their structure rarely near complete simplification (adult *Dipodomys* only). Incisors thin and compressed. Zygoma much narrowed and reduced, thread-like. A marked tendency towards great inflation of mastoids and bullae. Palate not narrowed. Frontals relatively broad to extremely so. Family HETEROMYIDAE

Family HETEROMYIDAE

1896. Thomas: MYOMORPHA, part: Heteromyidae, with subfamilies Heteromyinae (*Heteromys*, *Perognathus*), and Dipodomyinae (*Microdipodops*, *Dipodomys*).
1899. Tullberg: SCIUROMORPHA, part: *Geomyoidei*; Family Geomyidae, part, subfamily Dipodomyini.
1918. Miller & Gidley: Superfamily SCIUROIDAE, part: Family Heteromyidae.
1924. Winge: "Saccomyidae" (=Heteromyidae), part: "Saccomyini."
1928. Weber: GEOMYOIDEA, part: Family Heteromyidae.

GEOGRAPHICAL DISTRIBUTION.—Western North America, from British Columbia southwards; west in U.S.A. to the Dakotas and Texas; through Mexico and Central America south to Ecuador, Colombia and Venezuela.

NUMBER OF GENERA.—Five.

CHARACTERS.—As indicated in the above key. "Orifice of infraorbital foramen protected from muscle pressure by countersinking in a vacuity which extends transversely through rostrum" (Miller & Gidley). (Compare Geomyidae, p. 505.) Hindfoot long and narrow; in specialized forms of bipedal saltatorial type. Cheekteeth hypsodont, but not evergrowing except in *Dipodomys*; molars in adult usually with a two-lobed pattern, in *Dipodomys* more or less simple.

The family is the subject of a recent and most extensive monograph by Wood (Ann. Carnegie Mus, XXIV, p. 75, 1935); in this paper all known fossil and recent forms have been very fully dealt with.

Wood divides the family into three subfamilies: Heteromyinae, Perognathinae, and Dipodomyinae. The Heteromyinae contain, of living genera, *Heteromys* and *Liomys* only. The Perognathinae contain *Perognathus* and *Microdipodops*. The Dipodomyinae *Dipodomys* alone. He remarks, discussing the Dipodomyinae, "this subfamily is definitely related to the Perognathinae, to which it shows much closer relationships than does either to the Heteromyinae; it may be that a more correct idea of relationships within the family would be attained by consolidating these first two subfamilies."

For the purposes of the present work I propose to do so, recognizing only two subfamilies, the Dipodomyinae to include *Perognathus* and *Microdipodops* and to be divided into two generic groups. The classification here adopted is based on Wood's monograph, therefore, with the above modification; this being the most up-to-date work on the entire family, which in common with many other North American groups is not well represented at the British Museum.

At first sight the family seems composed of two types of animal, the "murine" *Heteromys* (from which, though unquestionably closely related to it, *Liomys* was separated by Merriam in 1902 and is currently accepted as a full genus by American authors), and *Perognathus*; and the "Dipodide" saltatorial type, *Microdipodops* and *Dipodomys*.

It is therefore of great interest that, according to Wood, *Microdipodops* is more closely allied to *Perognathus* (see notes under genus *Microdipodops*), and not to *Dipodomys* as has been previously held; and that *Heteromys* (with *Liomys*) stands rather apart from the rest of the family. From the teeth of the one skull of *Microdipodops* examined it would appear that the above assumption as to its relationship with *Perognathus* rather than *Dipodomys* is correct, and that the external saltatorial characters and the abnormal inflation of mastoids and bullae has in each genus been developed independently.

Key to the Subfamilies of Heteromyidae

"Lophs of lower premolars uniting first at buccal side, next at lingual; those of upper premolars uniting first at lingual, next at buccal; those of upper molars always and lower molars usually uniting at the two ends surrounding a central basin; pattern of cheekteeth preserved for a long time" (Wood). Bullae showing no signs of excessive inflation, and never reaching the level of grinding surfaces of molars. (Incisors as far as seen not grooved.)
Subfamily Heteromyinae
(*Heteromys*, *Liomys*)

"Lophs of lower premolars uniting at centre of tooth; those of upper premolars uniting first at or near centre of tooth; those of upper molars uniting progressively from lingual to buccal margins; those of lower molars uniting primitively at buccal margin, progressively at centre of tooth; the pattern being lost early in life" (Wood). Bullae always well inflated; at highest development extremely so. Subfamily Dipodomyinae

Cheekteeth not evergrowing, in adult the pattern not completely simplified; anterior zygomatic root not greatly enlarged. Bullae moderate (*Perognathus*), or abnormally inflated (*Microdipodops*). *Perognathus* Group (Perognathi)
(*Perognathus*, *Microdipodops*)

Cheekteeth evergrowing, in adult and usually early in life the pattern near complete simplification; anterior zygomatic root greatly enlarged; bullae much inflated.
Dipodomys Group (Dipodomyes)
(*Dipodomys*)

Subfamily HETEROMYINAE

Geographical Distribution.—Southern Texas and Mexico southwards to Panama, Colombia, Venezuela, Ecuador.

Characters.—As indicated in the above key. Skull with bullae little inflated, the mastoids not or scarcely showing in superior aspect; nasals thick and projecting far forwards over incisors, which are narrow and opisthodont. Frontals normally scarcely constricted at all, and usually with relatively well-developed supraorbital ridges which extend backwards over the sides of the braincase. Palate moderately broad; two pairs of pits present for the pterygoid muscles; hamulars not joining the bullae. Infraorbital foramen, as is usual in the family, minute, and situated far forwards, on side of rostrum. Incisive foramina very small, and situated far in front of toothrow Upper incisors (of those seen) plain. Lower jaw small and weak. External form Murine, not specialized for saltatorial life. Fur usually bristly.

Containing two closely allied genera.

Key to the Genera of Heteromyinae

Adult pattern of cheekteeth less complicated, the enamel islands wearing out; posterior loop of P.4 with no deep re-entrant anterior fold. Liomys

Adult pattern of cheekteeth not simplified, the enamel islands persisting; posterior loop in crown of P.4 with a deep re-entrant anterior fold. Heteromys

Genus 1. HETEROMYS, Desmarest

1817. Heteromys, Desmarest, Nouv. Dict. Hist. Nat., vol. 14, p. 181.
1823. Saccomys, Cuvier, Dents des Mamm., p. 186. (*Saccomys anthopilus*; this name is usually considered synonymous with *Heteromys*; the type species of *Saccomys* is presumably unidentifiable.)
1902. Xylomys, Merriam, Proc. Biol. Soc. Washington, XV, p. 43. *Heteromys nelsoni*, Merriam. Valid as a subgenus.

Type Species.—*Mus anomalus*, Thompson.

Range.—Southern Mexico (Vera Cruz, Oaxaca, Yucatan), through Guatemala, Salvador, Honduras, Nicaragua, Costa Rica and Panama to Ecuador, Colombia and Venezuela.

Number of Forms.—Twenty-two.

Characters.—Skull as described above; upper molars of adult in two loops with a median enamel island which is long, frequently open exteriorly, and persistent. P.4 with a fold extending across and dividing the tooth completely into two lobes, and with a well-marked fold entering anteriorly into the inner side of the hinder lobe. Lower molars with the same elements of the upper teeth, but the folds when open do so interiorly. P.4 also with a small anterior outer fold, which may wear out. M.3 is not reduced in size. Tail longer than head and body as a rule, poorly haired, with scales visible. Fur normally bristly or spiny. Forefoot with medium claws; D.5 short, three centre digits longer; pollex rudimentary. Hindfoot narrow, long though not extremely

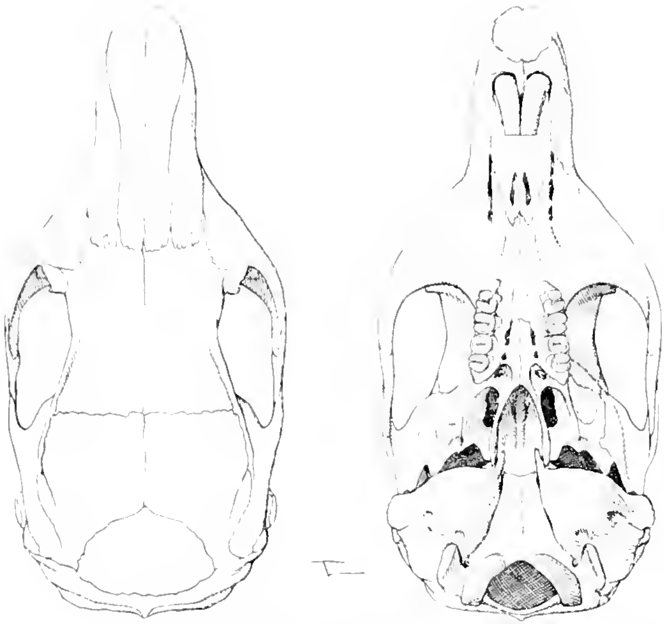


FIG. 120. HETEROMYS ANOMALUS ANOMALUS, Thompson.
B.M. No. 97.4.7.2, ♀; × 2½.

FIG. 121. HETEROMYS ANOMALUS ANOMALUS, Thompson.
B.M. No. 97.4.7.2, ♀; × 2½.

so; with the three central digits much elongated, D.5 shorter, the hallux short. This arrangement of digits is constant in all non-saltatorial members of the family I have seen.

H. nelsoni, not represented at the British Museum, is separated subgenerically as *Xylomys*, with the following characters:

"Pelage soft, without stiff bristles . . . skull light, braincase high and rounded, supraorbital beads small and faint; upper surface of maxillary root of zygomata large, heavy and rectangular; frontals much elongated, pushing nasals and premaxillae far forward; underjaw broad, without trace of tubercle over root of incisor and with angle very slightly everted. Dentition heavy. Posterior prism of last upper molar more or less completely double, the crown of the tooth

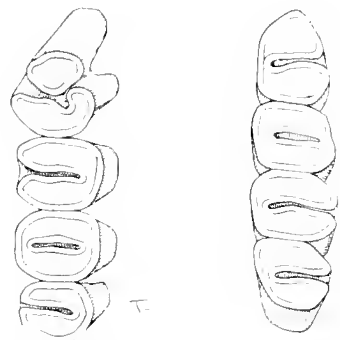


FIG. 122. HETEROMYS ANOMALUS ANOMALUS, Thompson.
Cheekteeth: B.M. No. 97.4.7.2, ♀; × 9.

presenting two complete transverse loops and a more or less perfect posterior loop."

The species of *Heteromys* are fully revised by Goldman (North Amer. Fauna, No. 34, p. 14, 1911). A key to these will be seen on consulting the abovementioned work. With the exception of *H. gaumeri*, all seem very closely allied. In *gaumeri*, the sole is hairy from near posterior tubercle to the heel; in all other species it is naked.

Forms seen: *anomalus*, *australis*, *bicolor*, *desmarestianus*, *gaumeri*, *goldmani*, *longicaudatus*, "*melanoleucas*," *repens*.

List of Named Forms

(The references and type localities in all genera of Heteromyidae are the work of Mr. G. W. C. Holt.)

Subgenus *Heteromys*, Desmarest

1. HETEROMYS ANOMALUS ANOMALUS, Thompson

1815. Trans. Linn. Soc. XI, p. 161.
St. Ann's Barracks, island of Trinidad.
Synonym: *melanoleucas*, Gray, 1868, Proc. Zool. Soc. London, p. 204.
Venezuela (see Alston, Biol. Cent. Amer. Mamm., p. 167, Ann. Mag. Nat. Hist. 5, VI, 1880).

2. HETEROMYS ANOMALUS BRACHIALIS, Osgood

1912. Field Mus. Zool. Pub. 10, p. 54.
El Panorama, Rio Aurare, Venezuela.

3. HETEROMYS JESUPI, Allen

1899. Bull. Amer. Mus. Nat. Hist. XII, p. 201.
Colombia.

4. HETEROMYS BICOLOR, Gray

1868. Proc. Zool. Soc. London, p. 202.
Sallé, Honduras.

5. HETEROMYS LOMITENSIS, Allen

1912. Bull. Amer. Mus. Nat. Hist. XXXI, p. 77.
Las Lomitas, Cauca, Columbia.

6. HETEROMYS AUSTRALIS AUSTRALIS, Thomas

1901. Ann. Mag. Nat. Hist., ser. 7, VII, p. 194.
St. Javier, Lower Cachabi River, N. Ecuador.

7. HETEROMYS AUSTRALIS CONSCIUS, Goldman

1913. Smiths. Misc. Coll. LX, no. 22, p. 8.
Cana, mountains of E. Panama.

8. HETEROMYS DESMARESTIANUS DESMARESTIANUS, Gray

1868. Proc. Zool. Soc. London, p. 204.
Coban, Guatemala.

9. HETEROMYS DESMARESTIANUS GRISEUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 42.
Mountains near Tonala, Chiapas, Mexico.

10. HETEROMYS DESMARESTIANUS PSAKASTUS, Dickey

1928. Proc. Biol. Soc. Washington, XLI, p. 10.
Los Essemiles, Dept. Chalatenango, El Salvador.

11. HETEROMYS ZONALIS, Goldman

1912. Smiths. Misc. Coll. LVI, no. 36, p. 9.
Rio Indio, near Gatun, Canal zone, Panama.

12. HETEROMYS LONGICAUDATUS, Gray

1868. Proc. Zool. Soc. London, p. 204.
Mexico.

13. HETEROMYS GOLDMANI, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 41.
Chicharras, Chiapas, Mexico.

14. HETEROMYS LEPTURUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 42.
Mountains near Santo Domingo, Oaxaca, Mexico.

15. HETEROMYS TEMPORALIS, Goldman
1911. North Amer. Fauna, no. 34, p. 26.
Motzorongo, Vera Cruz, Mexico.

16. HETEROMYS REPENS, Bangs
1902. Bull. Mus. Comp. Zool. XXXIX, p. 45.
Boquete, southern slope of Volcan de Chiriqui, Panama.

17. HETEROMYS ORESTERUS, Harris
1932. Occ. Pap. Mus. Zool. Univ. Michigan, no. 248, p. 4.
El Copey de Dota, Cordillerade Talamanca, Costa Rica.

18. HETEROMYS PANAMENSIS, Goldman
1912. Smiths. Misc. Coll. LVI, no. 36, p. 9.
Cerro Azul. near headwaters of Chagres River, Panama.

19. HETEROMYS CRASSIROSTRIS, Goldman
1912. Smiths. Misc. Coll. LX, no. 2, p. 10.
Near head of Rio Limon, Mount Pirri, E. Panama.

20. HETEROMYS FUSCATUS, Allen
1908. Bull. Amer. Mus. Nat. Hist. XXIV, p. 652.
Tuma, Nicaragua.

21. HETEROMYS GAUMERI, Allen & Chapman
1897. Bull. Amer. Mus. Nat. Hist. IX, p. 9.
Chichenitza, Yucatan, Mexico.

Subgenus *Xylomys*, Merriam

22. HETEROMYS NELSONI, Merriam
1902. Proc. Biol. Soc. Washington, XV, p. 43.
Pinabete, Chiapas, Mexico.

Genus 2. LIOMYS, Merriam

1902. Liomys, Merriam, Proc. Biol. Soc. Washington, XV, p. 44.

Type Species.—*Heteromys alleni*, Coues.

Range.—Southern Texas, Mexico, Guatemala, Nicaragua, Honduras, Costa Rica and Panama.

Number of Forms.—Twenty-nine.

Characters.—Like *Heteromys*, but angle of mandible more strongly everted, and teeth becoming more simplified, the enamel islands not persistent, but wearing out with age; P.4 with the posterior loop slightly notched but with no deep re-entrant angle.

This genus is revised by Goldman (North. Amer. Fauna, p. 32, no. 34, 1911). He recognizes three specific groups:

the *irroratus* group, with light greyish coloration and five-tuberculate soles on hindfeet;
the *pictus* group, characterized by rich orange rufous lateral lines, and six-tuberculate hindfeet; and

the *crispus* group, including small species with short tails, plain coloration, and peculiar dental characters.

(The dental characters do not seem to be constant, according to Wood.)

Forms seen: *adspersus*, *alleni*, *bulleri*, "*hispidus*," *irroratus*, *nigrescens*, *obscurus*, *pictus*, *salvini*.

List of Named Forms

pictus Group

1. LIOMYS PICTUS PICTUS, Thomas

1893. Ann. Mag. Nat. Hist. 6, XII, p. 233.
Mineral San Sebastian, Jalisco, Mexico.
Synonym: *hispidus*, Allen, 1897, Bull. Amer. Mus. Nat. Hist. IX, p. 56. Compostela, Nayarit, Mexico.

2. LIOMYS PICTUS ESCUINAPAE, Allen

1906. Bull. Amer. Mus. Nat. Hist. XXII, p. 211.
Escuinapa, Sinaloa, Mexico.

3. LIOMYS PICTUS SONORANUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 47.
Alamos, Sonora, Mexico.

4. LIOMYS PICTUS PLANTINARENSIS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 46.
Plantinar, Jalisco, Mexico.

5. LIOMYS PICTUS PARVICEPS, Goldman

1904. Proc. Biol. Soc. Washington, XVII, p. 82.
La Salada, 40 miles south of Uruapan, Michoacan, Mexico.

6. LIOMYS PICTUS ROSTRATUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 46.
Near Ometepec, Guerrero, Mexico.

7. LIOMYS PICTUS PHAEURUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 48.
Pinotepa, Oaxaca, Mexico.

8. LIOMYS PICTUS ISTHMIUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 46.
Tehuantepec, Oaxaca, Mexico.

9. LIOMYS PICTUS VERAECRUCIS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 47.
San Andres Tuxtla, Vera Cruz, Mexico.
Synonym: *orbitalis*, Merriam, 1902, Proc. Biol. Soc. Washington, XV, p. 48. Catemaco, Vera Cruz, Mexico.

10. LIOMYS PICTUS OBSCURUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 48.
Carrizal, Vera Cruz, Mexico.
Synonym: *paralius*, Elliot, 1903, Field Columb. Mus. Publ. 80, zool. ser., vol. 3, p. 233. San Carlos, Vera Cruz.

11. LIOMYS ANNECTENS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 43.
Pluma, Oaxaca, Mexico.

crispus Group

12. LIOMYS CRISPUS CRISPUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 49.
Tonala, Chiapas, Mexico.

13. LIOMYS CRISPUS SETOSUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 49.
Huehuetan, Chiapas, Mexico.

14. LIOMYS VULCANI, Allen

1908. Bull. Amer. Mus. Nat. Hist. XXIV, p. 652.
Volcan de Chinandega, Nicaragua.

15. LIOMYS HETEROTHRIX, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 50.
San Pedro Sula, Honduras.

16. LIOMYS SALVINI SALVINI, Thomas

1893. Ann. Mag. Nat. Hist. 6, XI, p. 331.
Duenas, Guatemala.

17. LIOMYS SALVINI NIGRESCENS, Thomas

1893. Ann. Mag. Nat. Hist. 6, XII, p. 234.
Costa Rica.

18. LIOMYS ANTHONYI, Goodwin

1932. Amer. Mus. Nov. no. 528, p. 2.
Sacapulas, Central Guatemala.

19. LIOMYS ADSPERSUS, Peters

1874. Monatsb. k. preuss. Akad. Wiss. Berlin, p. 357.
Panama.

irroratus Group

20. LIOMYS IRRORATUS IRRORATUS, Gray

1868. Proc. Zool. Soc. London, p. 205.
State of Oaxaca, Mexico.
Synonym: *albolimbatus*, Gray, Proc. Zool. Soc. London, p. 205, 1868. La Parada, Oaxaca, Mexico.

21. LIOMYS IRRORATUS TORRIDUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 45.
Cuicatlan, Oaxaca, Mexico.
Synonym: *exiguus*, Elliot, Field Columb. Mus. Publ. 71, zool. ser., vol. 3, p. 146, 1903. Puente de Ixtla, Morelos, Mexico.

22. LIOMYS IRRORATUS MINOR, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 45.
Huajuapam, Oaxaca, Mexico.

23. LIOMYS IRRORATUS ALLENI, Coues

1881. Bull. Mus. Comp. Zool. Harvard Coll. VIII, p. 187.
Rio Verde, San Luis Potosi, Mexico.

24. LIOMYS IRRORATUS PRETIOSUS, Goldman

1911. North Amer. Fauna, no. 34, p. 58.
Metlaltoyuca, Puebla, Mexico.

25. LIOMYS IRRORATUS TEXENSIS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 44.
Brownsville, Cameron County, Texas.

26. LIOMYS IRRORATUS CANUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 44.
Near Parral, Chihuahua, Mexico.

27. LIOMYS IRRORATUS JALISCENSIS, Allen

1906. Bull. Amer. Mus. Nat. Hist., XXII, p. 251.
Las Canoas, about 20 miles west of Zapotlan, Jalisco, Mexico.

28. LIOMYS BULLERI, Thomas

1893. Ann. Mag. Nat. Hist. 6, XI, p. 330.
Laguna, Sierra de Juanactlan, Jalisco, Mexico.

29. LIOMYS GUERRERENSIS, Goldman

1911. North Amer. Fauna, no. 34, p. 62.
Omilteme, Guerrero, Mexico.

Subfamily DIPODOMYINAE

Geographical Distribution.—The northern part of the range of the family, south to Central Mexico.

Number of Genera.—As here understood three, divided into two generic groups.

Characters.—As indicated in the key, p. 471; external form Murine in *Perognathus*, otherwise specialized for bipedal saltatorial life. Skull characterized by wide braincase and moderately or abnormally inflated bullae, the skull becoming gradually narrower towards the anterior zygomatic root; frontals not or scarcely constricted, as in Heteromyinae; rostrum slender; nasals projecting far forwards over incisors, which are narrowed, opisthodont, and grooved in living genera. Incisive foramina very small; palate relatively broad. Cheekteeth hypsodont, at extreme development evergrowing; M. $\frac{3}{3}$ tending to become reduced in size.

A key to the two generic groups is given on p. 471.

The *Perognathus* Group

Cheekteeth not evergrowing, not becoming simplified in pattern; anterior zygomatic root not greatly enlarged on joining the lachrymal.

Key to the Genera of the Perognathus Group

Mastoids and bullae not abnormally inflated; hindfoot shorter; not specialized for saltatorial life. Perognathus

Mastoids and bullae abnormally inflated, at maximum for family and perhaps for the whole Order; hindfoot longer; specialized for saltatorial life. Microdipodops

Genus 1. PEROGNATHUS, Wied.

1839. PEROGNATHUS, Wied, Nova Acta Phys. Med. Acad. Caes. Leop. Carol, XIX, pt. 1, p. 368.
1848. CRICETODIPUS, Peale, Mamm. and Ornith. Wilkes Exped., VIII, 2nd ed., p. 52. (*Cricetodipus parvus*, Peale.)
1889. CHAETODIPUS, Merriam, North Amer. Fauna, no. 1, p. 5. *Perognathus spinatus*, Merriam. Valid as a subgenus.

TYPE SPECIES.—*Perognathus fasciatus*, Wied.

RANGE.—Western North America from British Columbia to Central Mexico (in U.S.A. known from Washington, Oregon, Idaho, Wyoming, North and South Dakota, Nebraska, California (and Lower California), Nevada, Utah, Arizona, Colorado, New Mexico, Kansas, Oklahoma, Texas).

NUMBER OF FORMS.—About one hundred and twenty-six.

CHARACTERS.—Frontals scarcely constricted, with supraorbital ridges feebly marked or absent; bullae inflated, the mastoids in the typical subgenus appearing in superior aspect of the skull; the bullae nearly meeting anteriorly. Incisive foramina minute; palate broad, extending to M.3.

Cheekteeth originally showing marked signs of three longitudinal rows of cusps (to be seen for instance in No. 2.3.6.27, *P. hispidus*, Texas, at British Museum); but soon wearing down; general adult plan not unlike that of *Heteromys*; a long fold more or less separating the molars into two lobes; premolar with narrow anterior lobe and much wider posterior one; M. $\frac{3}{3}$ very small. P.4 lower with four cusps, one at each corner, apparently more or less persistent; this tooth reduced, smaller than M.1; and with three folds, one external, one internal, one anterior; lower molars much like the upper series in general arrangement; in very young teeth, there is a pattern apparently strongly reminiscent of Murinae, i.e. three rows of cusps, the outer row very much reduced.

Size usually small to very small; tail about subequal to head and body, or may be longer, well haired; hindfoot moderately long, general arrangement of the digits as in *Heteromys*; forefoot not abnormal. Spines present on the rump of some species (subgenus *Chaetodipus*).

Two well-marked subgenera are admitted: the typical, and *Chaetodipus*, Merriam.

In *Chaetodipus*, the soles are naked, the pelage harsh, often with spiny bristles on rump.

In *Perognathus* s.s. the pelage is normal, without spines; the soles are usually hairy (except *formosus*).

In *Chaetodipus*, the bullae are less inflated than in *Perognathus*, the mastoids relatively small, not projecting beyond plane of occiput; the "mastoid side of parietal is equal to or shorter than the other sides" (Osgood), the audital bullae are separated by full width of basisphenoid, and the ascending branches of the supraoccipital are heavy and laminate, instead of slender and threadlike in

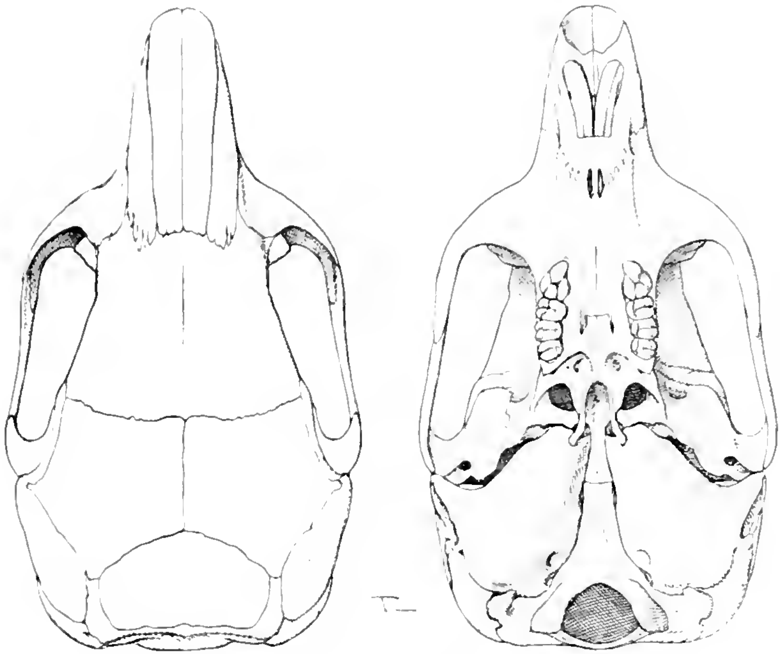


Fig. 123. Perognathus hispidus hispidus, Baird.
B.M. No. 2.3.6.47, ♀; × 3½.

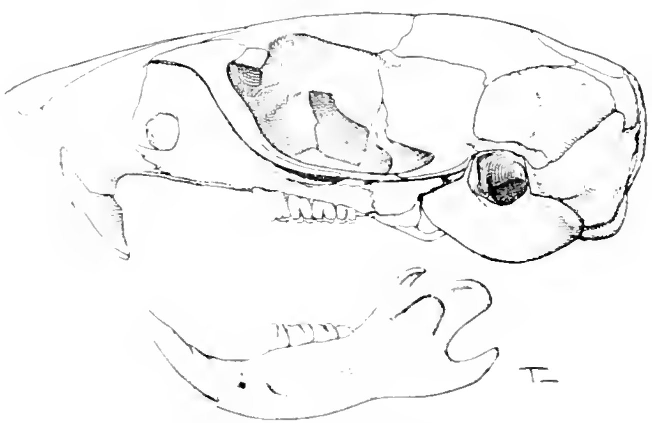


Fig. 124. Perognathus hispidus hispidus, Baird.
B.M. No. 2.3.6.47, ♀; × 3½.

Perognathus proper. As indicated above, the characters of the bullae of *Perognathus* s.s. do not agree with one of these characters.

The genus has been fully revised by Osgood (North Amer. Fauna, no. 18, 1900).

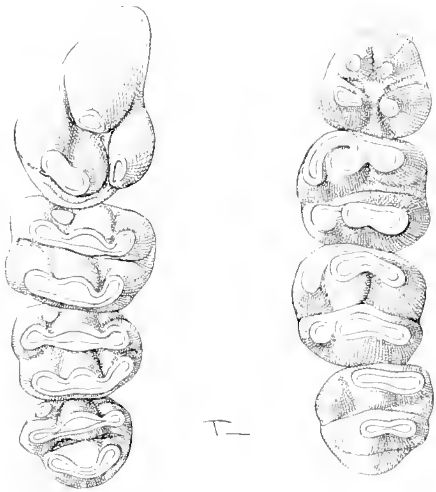


Fig. 125. Perognathus hispidus hispidus, Baird.
Cheekteeth: B.M. No. 2.3.6.47, ♂; × 17.

From Osgood's key, it would appear that the essential characters of the ten specific groups currently recognized are as follow:

Subgenus Perognathus

1. Antitragus not lobed; hindfoot 20 or less.

   fasciatus group: tail about equal to head and body, or slightly shorter; lower premolar smaller than or subequal to M.3.

   longimembris group: tail longer than head and body except *pacificus*; lower premolar larger than M.3.

2. Antitragus lobed; hindfoot more than 20.

   parvus group: sole normal for subgenus; tail moderate.

   formosus group: sole naked; tail long and heavily crested.

Subgenus Chaetodipus

1. Rump with spines or bristles.

   californicus group: lateral line present; bristles moderate, usually confined to rump; ears elongated.

intermedius group: similar to *californicus*, but ears not elongated. (Rump not spiny in *artus*.)

spinatus group: no lateral line, or this very faint; pelage very hispid, with bristles extending to sides.

2. Rump without bristles.

hispidus group: tail not crested, shorter than head and body; skull with supraorbital bead in adult.

baileyi group: tail crested; no supraorbital bead in adult; tail much longer than head and body; interparietal width about equal to interorbital width.

penicillatus group: tail slightly longer than head and body, crested; interparietal width exceeds interorbital width.

Forms seen: *flavus*, *formosus*, *infraluteus*, *lordi*, *parvus*, *panamintinus*; *angustirostris*, *femoralis*, *hispidus*, *inornatus*, *peninsulae*, *pernix*, *pricei*.

List of Named Forms

Subgenus *Perognathus*, Wied

fasciatus Group

1. PEROGNATHUS FASCIATUS FASCIATUS, Wied

1839. Nova Acta Phys. Med. Acad. Caes. Leop. Carol., XIX, pt. 1, p. 369. Upper Missouri River, North-western N. Dakota.

2. PEROGNATHUS FASCIATUS INFRALUTEUS, Thomas

1893. Ann. Mag. Nat. Hist. 6, II, p. 406.
Loveland, Larimer County, Colorado.

3. PEROGNATHUS FASCIATUS LITUS, Cary

1911. Proc. Biol. Soc. Washington, XXIV, p. 61.
Sun, Sweetwater Valley, Fremont County, Wyoming.

4. PEROGNATHUS FLAVESCENS FLAVESCENS, Merriam

1889. North Amer. Fauna, no. 1, p. 11.
Kennedy, Cherry County, Nebraska.

5. PEROGNATHUS FLAVESCENS COPEI, Rhoads

1893. Proc. Acad. Nat. Sci. Philadelphia, p. 404.
Near Mobeetie, Wheeler County, Texas.

6. PEROGNATHUS FLAVESCENS PERNIGER, Osgood

1904. Proc. Biol. Soc. Washington, XVII, p. 127.
Vermilion, Clay County, South Dakota.

7. PEROGNATHUS MERRIAMI MERRIAMI, Allen

1892. Bull. Amer. Mus. Nat. Hist., IV, p. 45.
Brownsville, Cameron County, Texas.
Synonym: *mearnsi*, Allen, 1896, Bull. Amer. Mus. Nat. Hist., VIII, p. 237. Watson's Ranch, Bexar County, Texas.

8. PEROGNATHUS MERRIAMI GILVUS, Osgood

1900. North Amer. Fauna, no. 18, p. 22.
Eddy, near Carlsbad, Eddy County, New Mexico.

9. PEROGNATHUS FLAVUS FLAVUS, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 332.
El Paso, El Paso County, Texas.

10. PEROGNATHUS FLAVUS PIPERI, Goldman

1917. Proc. Biol. Soc. Washington, XXX, p. 148.
Twenty-three miles south-west of Newcastle, Weston County, Wyoming.

11. PEROGNATHUS FLAVUS BIMACULATUS, Merriam

1889. North Amer. Fauna, no. 1, p. 12.
Fort Whipple, Yavapai County, Arizona.

12. PEROGNATHUS FLAVUS FULIGINOSUS, Merriam

1890. North Amer. Fauna, no. 3, p. 74.
Cedar belt north-east of San Francisco Mountain, Coconino County, Arizona.

13. PEROGNATHUS FLAVUS MEXICANUS, Merriam

1894. Proc. Acad. Nat. Sci. Philadelphia, p. 265.
Tlalpam, Federal district, Mexico.

14. PEROGNATHUS FLAVUS HOPIENSIS, Goldman

1932. Proc. Biol. Soc. Washington, XLV, p. 89.
Oraibi, Hopi Indian Reservation, Navajo County, Arizona.

15. PEROGNATHUS FLAVUS SONORIENSIS, Nelson & Goldman

1934. Journ. Washington Acad. Sci. XXIV, p. 267.
Costa Rica Ranch, Sonora, Mexico.

16. PEROGNATHUS APACHE APACHE, Merriam

1889. North Amer. Fauna, no. 1, p. 14.
Keam Canyon, Apache County, Arizona.

17. PEROGNATHUS APACHE CLEOMOPHILA, Goldman

1918. Proc. Biol. Soc. Washington, XXXI, p. 23.
Winona, Coconino County, Arizona.

18. PEROGNATHUS APACHE CARYI, Goldman

1918. Proc. Biol. Soc. Washington, XXXI, p. 24.
Eight miles west of Rifle, Garfield County, Colorado.

19. PEROGNATHUS APACHE MELANOTIS, Osgood

1900. North Amer. Fauna, no. 18, p. 27.
Casas Grandes, Chihuahua, Mexico.

20. PEROGNATHUS GYPSI, Dice

1929. Occ. Pap. Mus. Zool. Univ. Mich., 203, p. 1.
New Mexico: White Sands, 12 miles south-west of Alamogordo, Otero County.

21. PEROGNATHUS CALLISTUS, Osgood

1900. North Amer. Fauna, no. 18, p. 28.
Kinney Ranch, Sweetwater County, Wyoming.

longimembris Group

22. PEROGNATHUS ELIBATUS, Elliot

1903. Field Columb. Mus. Publ. 87, zool. ser., vol. 3, p. 252.
Lockwood Valley, near Mount Pinos, Ventura County, California. Regarded by Osgood as identical with *longimembris longimembris* (Proc. Biol. Soc. Washington, XXXI, p. 96, 1918).

23. PEROGNATHUS LONGIMEMBRIS LONGIMEMBRIS, Coues

1875. Proc. Acad. Nat. Sci. Philadelphia, p. 305.
Old Fort Tejon, Tehachapi Mountains, Kern County, California.

24. PEROGNATHUS LONGIMEMBRIS PANAMINTINUS, Merriam

1894. Proc. Acad. Nat. Sci. Philadelphia, p. 265.
Perognathus Flat, Panamint Mountains, Inyo County, California.

25. PEROGNATHUS LONGIMEMBRIS ARENICOLA, Stephens

1900. Proc. Biol. Soc. Washington, XIII, p. 153.
San Felipe Mountains, San Diego County, California.

26. PEROGNATHUS LONGIMEMBRIS BANGSI, Mearns

1898. Bull. Amer. Mus. Nat. Hist. X, p. 300.
Palm Springs, Colorado Desert, Riverside County, California.

27. PEROGNATHUS LONGIMEMBRIS BREVINASUS, Osgood

1900. North Amer. Fauna, no. 18, p. 30.
San Bernardino, San Bernardino County, California.

28. PEROGNATHUS LONGIMEMBRIS AESTIVUS, Huey

1928. Trans. S. Diego Soc. Nat. Hist. 5, p. 87.
Sangre de Cristo, Lower California, Mexico.

29. PEROGNATHUS LONGIMEMBRIS VENUSTUS, Huey

1930. Trans. S. Diego Soc. Nat. Hist. 6, p. 233.
Lower California, Mexico, San Agustin.

30. PEROGNATHUS LONGIMEMBRIS ARIZONENSIS, Goldman

1931. Proc. Biol. Soc. Washington, XLIV, p. 134.
North side of Marble Canyon of Colorado River, Arizona.

31. PEROGNATHUS LONGIMEMBRIS CANTWELLI, Bloeker

1932. Proc. Biol. Soc. Washington, XLV, p. 128.
Hyperion, Los Angeles County, California.

32. PEROGNATHUS LONGIMEMBRIS KINOENSIS, Huey

1935. Trans. S. Diego Soc. Nat. Hist. 8, p. 73.
Bahia Kino, Sonora, Mexico.

33. PEROGNATHUS LONGIMEMBRIS ARCUS, Benson

1935. Univ. Cal. Pub. Zool. XL, p. 451.
Utah: Rainbow Bridge, San Juan County.

34. PEROGNATHUS PERICALLES, Elliot

1903. Field Columb. Mus. publ. 87, zool. ser. vol. 3, p. 252.
Keeler, Owens Lake, Inyo County, California.

35. PEROGNATHUS BOMBYCINUS, Osgood

1907. Proc. Biol. Soc. Washington, XX, p. 19.
Yuma, Yuma County, Arizona.

36. PEROGNATHUS NEVADENSIS, Merriam
1894. Proc. Acad. Nat. Sci. Philadelphia, p. 264.
Halleck, E. Humboldt Valley, Elko County, Nevada.

37. PEROGNATHUS PACIFICUS, Mearns
1898. Bull. Amer. Mus. Nat. Hist. X, p. 299.
Mexican boundary monument no. 258, shore of Pacific Ocean, San Diego County, California.

38. PEROGNATHUS AMPLUS AMPLUS, Osgood
1900. North Amer. Fauna, no. 18, p. 32.
Fort Verde, Yavapai County, Arizona.

39. PEROGNATHUS AMPLUS TAYLORI, Goldman
1932. Journ. Washington Acad. Sci. XXII, p. 488.
Santa Rita Range Reserve, Pima County, Arizona.

40. PEROGNATHUS AMPLUS ROTUNDUS, Goldman
1932. Journ. Washington Acad. Sci. XXII, p. 387.
Wellton, Yuma County, Arizona.

41. PEROGNATHUS AMPLUS PERGRACILIS, Goldman
1932. Journ. Washington Acad. Sci. XXII, p. 387.
Hackberry, Mohave County, Arizona.

42. PEROGNATHUS AMPLUS JACKSONI, Goldman
1933. Journ. Washington Acad. Sci. XXIII, p. 465.
Yavapai County, Arizona.

43. PEROGNATHUS AMPLUS CINERIS, Benson
1933. Proc. Biol. Soc. Washington, XLVI, p. 109.
Wupatki Ruins, Coconino County, Arizona.

44. PEROGNATHUS AMPLUS AMMODYTES, Benson
1933. Proc. Biol. Soc. Washington, XLVI, p. 110.
Two miles south of Cameron, Coconino County, Arizona.

45. PEROGNATHUS INORNATUS INORNATUS, Merriam
1889. North Amer. Fauna, no. 1, p. 15.
Fresno, Fresno County, California.

46. PEROGNATHUS INORNATUS NEGLECTUS, Taylor
1912. Univ. Calif. Publ. Zool. X, p. 155.
McKittrick, Kern County, California.

parvus Group

47. PEROGNATHUS PARVUS PARVUS, Peale
1848. U.S. Explor. Exped. vol. 8, mamm. & ornith. p. 53.
Oregon: probably neighbourhood of the Dalles, Wasco County.
Synonym: *monticola*, Baird, 1857, Mamm. N. Amer. p. 422. Montana.

48. PEROGNATHUS PARVUS IDAHOENSIS, Goldman
1922. Proc. Biol. Soc. Washington, XXXV, p. 105.
Echo Crater, 20 miles south of Arco, Blaine County, Idaho.

49. PEROGNATHUS PARVUS MOLLIPILOSUS, Coues
1875. Proc. Acad. Nat. Sci. Philadelphia, p. 296.
Fort Crook, Shasta County, California.

50. PEROGNATHUS PARVUS OLIVACEUS, Merriam

1889. North Amer. Fauna, no. 1, p. 15.
Kelton, Boxelder County, Utah.
Synonym: *olivaceus amoenus*, Merriam, North Amer. Fauna, no. 1, p. 16. Nephi, Juab County, Utah, 1889.

51. PEROGNATHUS PARVUS CLARUS, Goldman

1917. Proc. Biol. Soc. Washington, XXX, p. 147.
Cumberland, Lincoln County, Wyoming.

52. PEROGNATHUS PARVUS MAGRUDERENSIS, Osgood

1900. North Amer. Fauna, no. 18, p. 38.
Mt. Magruder, Nevada, near boundary between Inyo County, California, and Esmeralda County, Nevada.

53. PEROGNATHUS XANTHONOTUS, Grinnell

1912. Proc. Biol. Soc. Washington, XXV, p. 128.
Freeman Canyon, Kern County, California.

54. PEROGNATHUS ALTICOLA ALTICOLA, Rhoads

1893. Proc. Acad. Nat. Sci. Philadelphia, p. 412.
Squirrel Inn, San Bernardino Mountains, San Bernardino County, California.

55. PEROGNATHUS ALTICOLA INEXPECTATUS, Huey

1926. Proc. Biol. Soc. Washington, XXXIX, p. 121.
Fourteen miles west of Lebec, Kern County, California.

56 PEROGNATHUS LAINGI, Anderson

1932. Bull. Nat. Mus. Canada, 70, p. 100.
British Columbia, Anarchist Mountain, near Osoyoos-Bridesville summit, about 8 miles east of Osoyoos Lake.

57. PEROGNATHUS LORDI LORDI, Gray

1868. Proc. Zool. Soc. London, p. 202.
Southern British Columbia, Canada.

58. PEROGNATHUS LORDI COLUMBIANUS, Merriam

1894. Proc. Acad. Nat. Sci. Philadelphia, p. 263.
Pasco, Franklin County, Washington.

formosus Group

59. PEROGNATHUS FORMOSUS FORMOSUS, Merriam

1889. North Amer. Fauna, no. 1, p. 17.
St. George, Washington County, Utah.

60. PEROGNATHUS FORMOSUS CINERASCENS, Nelson & Goldman

1929. Proc. Biol. Soc. Washington, XLII, p. 105.
Lower California: San Felipe.

61. PEROGNATHUS MESEMBRINUS, Elliot

1903. Field Columb. Mus. publ. 87, zool. ser. vol. 3, p. 251.
Palm Springs, Riverside County, California.

Subgenus *Chaetodipus*, Merriam

baileyi Group

62. PEROGNATHUS BAILEYI BAILEYI, Merriam

1894. Proc. Acad. Nat. Sci. Philadelphia, p. 262.
Magdalena, Sonora, Mexico.

63. PEROGNATHUS BAILEYI RUDINORIS, Elliot

1903. Field Columb. Mus. publ. 74, zool. ser. vol. 3, p. 167.
San Quintin, Lower California, Mexico.

64. PEROGNATHUS BAILEYI INSULARIS, Townsend

1912. Bull. Amer. Mus. Nat. Hist. XXXI, p. 122.
Tiburon Island, Gulf of California, Sonora, Mexico.

65. PEROGNATHUS BAILEYI DOMENSIS, Goldman

1928. Proc. Biol. Soc. Washington, XLI, p. 204.
Arizona: Castle Dome, at base of Castle Dome Peak.

66. PEROGNATHUS BAILEYI HUEYI, Nelson & Goldman

1928. Proc. Biol. Soc. Washington, XLII, p. 106.
Lower California: San Felipe.

67. PEROGNATHUS BAILEYI FORNICATUS, Burt

1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 164.
Montserrat Island, Gulf of California.

68. PEROGNATHUS KNEKUS, Elliot

1903. Field Columb. Mus. publ. 74, zool. ser. vol. 3, p. 169.
Rosarito, San Pedro Martir Mountains, Lower California.

hispidus Group

69. PEROGNATHUS HISPIDUS HISPIDUS, Baird

1857. Mamm. N. Amer. p. 421.
Charco Escondido, Tamaulipas, Mexico.
Synonym: *paradoxus spilotus*, Merriam, 1889, North Amer. Fauna, no. 1, p. 25. Gainesville, Cook County, Texas.

70. PEROGNATHUS HISPIDUS PARADOXUS, Merriam

1889. North Amer. Fauna, no. 1, p. 24.
Banner, Trego County, Kansas.
Synonym: *latirostris*, Rhoads, Amer. Nat. XXVIII, p. 185, 1894. Rocky Mountains.
conditi, Allen, 1894, Bull. Amer. Mus. Nat. Hist. VI, p. 318. San Bernardino Ranch, Cochisa County, Arizona.

71. PEROGNATHUS HISPIDUS MAXIMUS, Elliot

1903. Field Columb. Mus. publ. 87, zool. ser. vol. 3, p. 253.
Noble, Cleveland County, Oklahoma.

72. PEROGNATHUS HISPIDUS ZACATECAE, Osgood

1900. North Amer. Fauna, no. 18, p. 45.
Valparaiso, Zacatecas, Mexico.

penicillatus Group

73. PEROGNATHUS PENICILLATUS PENICILLATUS, Woodhouse

1852. Proc. Acad. Nat. Sci. Philadelphia, VI, p. 200.
San Francisco Mountain, Coconino County, Arizona.

74. PEROGNATHUS PENICILLATUS ALBULUS, Nelson & Goldman

1923. Proc. Biol. Soc. Washington, XXXVI, p. 159.
Magdalena Island, Lower California, Mexico.

75. PEROGNATHUS PENICILLATUS ANGUSTIROSTRIS, Osgood
1900. North Amer. Fauna, no. 18, p. 47.
Carriso Creek, Colorado Desert, Imperial County, California.

76. PEROGNATHUS PENICILLATUS PRICEI, Allen
1894. Bull. Amer. Mus. Nat. Hist. VI, p. 318.
Oposura, Sonora, Mexico.

77. PEROGNATHUS PENICILLATUS EREMICUS, Mearns
1898. Bull. Amer. Mus. Nat. Hist. X, p. 300.
Fort Hancock, El Paso County, Texas.

78. PEROGNATHUS PENICILLATUS AMMOPHILUS, Osgood
1907. Proc. Biol. Soc. Washington, XX, p. 20.
Margarita Island, Lower California, Mexico.

79. PEROGNATHUS PENICILLATUS SICCUS, Osgood
1907. Proc. Biol. Soc. Washington, XX, p. 20.
Ceralbo Island, Gulf of California, Mexico.

80. PEROGNATHUS PENICILLATUS SERI, Nelson
1912. Proc. Biol. Soc. Washington, XXV, p. 116.
Tiburon Island, Gulf of California, Sonora, Mexico.
Synonym: *goldmani*, Townsend, 1912, Bull. Amer. Mus. Nat. Hist. XXXI, p. 122. Same locality.

81. PEROGNATHUS PENICILLATUS MINIMUS, Burt
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 164.
Turner Island, Gulf of California.

82. PEROGNATHUS HELLERI, Elliot
1903. Field Columb. Mus. publ. 74, zool. ser. vol. 3, p. 166.
San Quintin, Lower California, Mexico.

83. PEROGNATHUS STEPHENSI, Merriam
1894. Proc. Acad. Nat. Sci. Philadelphia, p. 267.
Mesquite Valley, Inyo County, California.

84. PEROGNATHUS ARENARIUS ARENARIUS, Merriam
1894. Proc. Calif. Acad. Sci. ser. 2, vol. 4, p. 461.
San Jorge, near Comondu, Lower California, Mexico.

85. PEROGNATHUS ARENARIUS ALBESCENS, Huey
1926. Proc. Biol. Soc. Washington, XXXIX, p. 67.
Lower California: San Felipe.

86. PEROGNATHUS ARENARIUS AMBIGUUS, Nelson & Goldman
1929. Proc. Biol. Soc. Washington, XLII, p. 108.
Lower California: Yubay, 30 miles south-east of Calamahue.

87. PEROGNATHUS ARENARIUS SUBLUCIDUS, Nelson & Goldman
1929. Proc. Biol. Soc. Washington, XLII, p. 109.
Lower California: La Paz.

88. PEROGNATHUS PERNIX PERNIX, Allen
1898. Bull. Amer. Mus. Nat. Hist. X, p. 149.
Rosario, Sinaloa, Mexico.

89. PEROGNATHUS PERNIX ROSTRATUS, Osgood
1900. North Amer. Fauna, no. 18, p. 51.
Camoa, Rio Mayo, Sonora, Mexico.

intermedius Group

90. PEROGNATHUS INTERMEDIUS INTERMEDIUS, Merriam

1889. North Amer. Fauna, no. 1, p. 18.
Mud Spring, Mohave County, Arizona.
Synonym: *obscurus*, Merriam, 1889, North Amer. Fauna, no. 1, p. 20.
Camp Apache, Grant County, New Mexico.

91. PEROGNATHUS INTERMEDIUS PHASMA, Goldman

1918. Proc. Biol. Soc. Washington, XXXI, p. 22.
Tinajas Atlas, Gila Mountains, Yuma County, Arizona.

92. PEROGNATHUS INTERMEDIUS ATER, Dice

1929. Occ. Pap. Mus. Zool. Univ. Mich. no. 203, p. 2.
New Mexico: Malpais Spring, Otero County, 15 miles west of Three Rivers.

93. PEROGNATHUS INTERMEDIUS RUPESTRIS, Benson

1932. Univ. Cal. Pub. Zool. XXXVIII, p. 337.
New Mexico: Lava beds nearest to Kenzin, Dona Ana County.

94. PEROGNATHUS INTERMEDIUS NIGRIMONTIS, Blossom

1933. Occ. Pap. Mus. Zool. Univ. Mich. 265, p. 1.
Arizona: Black Mountain, 10 miles south of Tucson, Pima County.

95. PEROGNATHUS INTERMEDIUS CRINITUS, Benson

1934. Proc. Biol. Soc. Washington, XLVII, p. 199.
Arizona: 2 miles west of Wupatki Ruins, Coconino County.

96. PEROGNATHUS INTERMEDIUS UMBROSUS, Benson

1934. Proc. Biol. Soc. Washington, XLVII, p. 200.
Camp Verde, Yavapai County, Arizona.

97. PEROGNATHUS INTERMEDIUS PINICATE, Blossom

1933. Occ. Pap. Mus. Zool. Univ. Mich. 273, p. 4.
Sonora, Mexico: Papago Tanks, Pinacate Mountains.

98. PEROGNATHUS NELSONI NELSONI, Merriam

1894. Proc. Acad. Nat. Sci. Philadelphia, p. 266.
Hacienda la Parada, San Luis Potosi, Mexico.

99. PEROGNATHUS NELSONI CANESCENS, Merriam

1894. Proc. Acad. Nat. Sci. Philadelphia, p. 267.
Jaral, Coahuila, Mexico.

100. PEROGNATHUS GOLDMANI, Osgood

1900. North Amer. Fauna, no. 18, p. 54.
Sinaloa, State of Sinaloa, Mexico.

101. PEROGNATHUS ARTUS, Osgood

1900. North Amer. Fauna, no. 18, p. 55.
Batopilas, Chihuahua, Mexico.

102. PEROGNATHUS FALLAX FALLAX, Merriam

1889. North Amer. Fauna, no. 1, p. 19.
Reche Canyon, San Bernardino County, California.

103. PEROGNATHUS FALLAX PALLIDUS, Mearns

1901. Proc. Biol. Soc. Washington, XIV, p. 135.
Mountain Spring, halfway up east slope of Coast Range Mountains, Imperial County, California.

104. PEROGNATHUS FALLAX INOPINUS, Nelson & Goldman

1929. Proc. Biol. Soc. Washington, XLII, p. 110.
Lower California: Turtle Bay.

105. PEROGNATHUS ANTHONYI, Osgood

1900. North Amer. Fauna, no. 18, p. 56.
South Bay, Cerros Island, Lower California, Mexico.

californicus Group

106. PEROGNATHUS FEMORALIS FEMORALIS, Allen

1891. Bull. Amer. Mus. Nat. Hist. III, p. 281.
Dulzura, San Diego County, California.

107. PEROGNATHUS FEMORALIS MESOPOLIUS, Elliot

1903. Field Columb. Mus. publ. 74, zool. ser. vol. 3, p. 168.
Piñon, San Pedro Martir Mountains, Lower California, Mexico.

108. PEROGNATHUS CALIFORNICUS CALIFORNICUS, Merriam

1889. North Amer. Fauna, no. 1, p. 26.
Berkeley, Alameda County, California.
Synonym: *armatus*, Merriam, 1889, North Amer. Fauna, no. 1, p. 27.
Mt. Diablo, Contra Costa County, California.

109. PEROGNATHUS CALIFORNICUS DISPAR, Osgood

1900. North Amer. Fauna, no. 18, p. 58.
Carpenteria, Santa Barbara County, California.

110. PEROGNATHUS CALIFORNICUS OCHRUS, Osgood

1904. Proc. Biol. Soc. Washington, XVII, p. 128.
Santiago Springs, 16 miles south-west of McKittrick, Kern County, California.

111. PEROGNATHUS CALIFORNICUS BERNARDINUS, Benson

1930. Univ. Calif. Publ. Zool. XXXII, p. 449.
San Bernardino County, California.

spinatus Group

112. PEROGNATHUS SPINATUS SPINATUS, Merriam

1889. North Amer. Fauna, no. 1, p. 21.
Colorado River, San Bernardino County, California (twenty-five miles below the Needles).

113. PEROGNATHUS SPINATUS PENINSULAE, Merriam

1894. Proc. Calif. Acad. Sci. ser. 2, vol. 4, p. 460.
San Jose del Cabo, Lower California, Mexico.

114. PEROGNATHUS SPINATUS MAGDALENAE, Osgood

1907. Proc. Biol. Soc. Washington, XX, p. 21.
Magdalena Island, Lower California, Mexico.

115. PEROGNATHUS SPINATUS OCCULTUS, Nelson

1912. Proc. Biol. Soc. Washington, XXV, p. 116.
Carmen Island, Lower California, Mexico.
Synonym: *spinatus nelsoni*, Townsend, 1912, Bull. Amer. Mus. Nat. Hist. XXXI, p. 122.

116. PEROGNATHUS SPINATUS LAMBI, Benson
1930. Univ. Calif. Publ. Zool. XXXII, p. 452.
Espiritu Santo Island, Lower California, Mexico.

117. PEROGNATHUS SPINATUS RUFESCENS, Huey
1930. Trans. S. Diego Soc. Nat. Hist. 6, p. 231.
Mouth of Palm Canyon, Borego Valley, San Diego County, California.

118. PEROGNATHUS SPINATUS PRIETAE, Huey
1930. Trans. S. Diego Soc. Nat. Hist. 6, p. 232.
Lower California: 25 miles north of Punta Prieta.

119. PEROGNATHUS SPINATUS MARCOSENSIS, Burt
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 166.
S. Marcos Island, Gulf of California.

120. PEROGNATHUS SPINATUS GUARDIAE, Burt
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 165.
Angel de la Guardia Island, Gulf of California.

121. PEROGNATHUS SPINATUS PULLUS, Burt
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 166.
Coronados Island, Gulf of California.

122. PEROGNATHUS SPINATUS SEORSUS, Burt
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 167.
Daurzante Island, Gulf of California.

123. PEROGNATHUS SPINATUS LATIJUGULARIS, Burt
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 168.
San Francisco Island, Gulf of California.

124. PEROGNATHUS BRYANTI, Merriam
1894. Proc. Calif. Acad. Sci. ser. 2, vol. 4, p. 458.
San Jose Island, Lower California, Mexico.

125. PEROGNATHUS MARGARITAE, Merriam
1894. Proc. Calif. Acad. Sci. ser. 2, vol. 4, p. 459.
Margarita Island, Lower California, Mexico.

126. PEROGNATHUS EVERMANNI, Nelson & Goldman
1929. Proc. Biol. Soc. Washington, XLII, p. 111.
Lower California: Mejia Island, near north end of Angel de la Guardia Island.

Genus 2. MICRODIPODOPS, Merriam

1891. Microdipodops, Merriam, North Amer. Fauna, no. 5, p. 115.

Type Species.—*Microdipodops megacephalus*, Merriam.

Range.—Western U.S.A.: known from California, Oregon and Nevada.

Number of Forms.—Seven.

Characters.—As indicated above, this genus has usually been regarded as most closely allied to *Dipodomys*, but Wood states that "many of the resemblances to *Dipodomys* are obviously connected with its ricochetal habits and are not necessarily significant of close relationships. The foot structure seems indicative of relationship with *Perognathus*." And further, "Of the characters allying *Microdipodops* with *Dipodomys*, all but two, the transverse processes of the caudal vertebrae and the process of the pubis at the anterior end of the obturator foramen, are either obviously habitus characters or else are shared with *Perognathus* too."

This genus is represented by one skull and skin only at the British Museum.

Essential skull characters near *Dipodomys*, but anterior zygomatic root not abnormally inflated, and bullae and mastoids even larger, extending relatively further forward in the skull, almost in contact superiorly, and nearly half as long as the skull at greatest length. (This excessive inflation of bullae is reminiscent of that present in some of the Old World genera as *Salpingotus* and *Cardiocranius* (Dipodidae), and to a lesser degree *Pachyuromys* (Gerbillinae).)

"Upper molars form enamel lakes by surrounding median valley as *Liomys*; P.4 as in *Perognathus*; M. $\frac{3}{3}$ much reduced; cheekteeth extremely highcrowned, but apparently not evergrowing" (Wood).

The dental pattern seems much nearer *Perognathus* than *Dipodomys* in the one skull seen.

Tail not tufted, well haired; hindfoot greatly lengthened, sole densely hairy; five toes present.

The bullae curve forward at the sides, and overlap the posterior portion of the zygoma; the abnormal inflation found in this genus is carried to a further degree than in any other Rodent genus I have examined.

Forms seen: *megacephalus*.

List of Named Forms

1. MICRODIPODOPS MEGACEPHALUS MEGACEPHALUS, Merriam

1891. North Amer. Fauna, no. 5, p. 116.
Halleck, East Humboldt Valley, Elko County, Nevada.

2. MICRODIPODOPS MEGACEPHALUS OREGONUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 127.
Lake Alvord, Alvord Desert, Harney County, Oregon.

3. MICRODIPODOPS MEGACEPHALUS LUCIDUS, Goldman

1926. Proc. Biol. Soc. Washington, XXXIX, p. 127.
Clayton Valley, Blair, Nevada.

4. MICRODIPODOPS MEGACEPHALUS DICKEYI, Goldman

1927. Proc. Biol. Soc. Washington, XL, p. 115.
Three miles south-east of Oasis, Mono County, California.

5. MICRODIPODOPS CALIFORNICUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 128.
Sierra Valley, near Vinton, Plumas County, California.

6. MICRODIPODOPS PALLIDUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 127.
Ten miles east of Stillwater, Churchill County, Nevada.

7. MICRODIPODOPS POLIONOTUS, Grinnell

1914. Univ. Calif. Publ. Zool. XII, p. 302.
McKeever's Ranch, 2 miles south of Benton Station, Mono County, California.

The *Dipodomys* Group

Cheekteeth evergrowing, early in life completely simplified in pattern. Anterior zygomatic root greatly enlarged on joining lachrymal. External form bipedal saltatorial; hallux present or absent; a tendency present towards fusion of some of the cervical vertebrae (parallel—Dipodinae).

Containing one genus only.

Genus 3. DIPODOMYS, Gray

1841. Dipodomys, Gray, Ann. Mag. Nat. Hist. VII, p. 521.
1867. Perodipus, Fitzinger, Sitzber. math.-nat. Cl. k. Akad. Wiss. Wien. LVI, abth. 1, p. 126. (*Dipodomys agilis*, Gambel.)
1890. Dipodops, Merriam, North Amer. Fauna, No. 3, p. 71. (*Dipodomys agilis*, Gambel.)

Type Species.—*Dipodomys phillipsii*, Gray.

Range.—Western United States, and Mexico (in U.S.A. known from Oregon, Wyoming, California, Utah, Arizona, Colorado, New Mexico, Oklahoma, Texas, also Lower California; and in Mexico south to Vera Cruz).

Number of Forms.—Eighty-two.

Remarks.—Formerly the genus "*Perodipus*" was recognized to contain the forms with the minute hallux present; but this division is not now maintained, and it seems that the hallux may be even absent or present in different specimens of the same species, which demonstrates clearly the inadvisability of retaining generic names for forms in which a minute and functionless digit usually present may have become suppressed; as for instance such forms as "*Scarturus*" or "*Marmotops*."

If two species have gone 99 per cent of the way towards suppressing a digit and one of them goes the other 1 per cent and loses the digit altogether, it is surely at very most a specific, perhaps even a racial distinction; certainly not a generic one.

Characters.—Apices of bullae in contact for a short distance behind the posterior portion of the palate. Mastoids enormously inflated, taking up most of the posterior part of superior border of skull, and projecting considerably beyond the occipital plane. Skull progressively broader from back of lachrymals to mastoids; at all points very broad. Superior border of zygomatic plate usually heavily ridged, but degree of spreading and ridging of this portion of the skull variable in the different species. Skull differing markedly from *Microdipodops* in the large expansion of the upper part of the anterior zygomatic root. Nasals projecting conspicuously forward beyond the

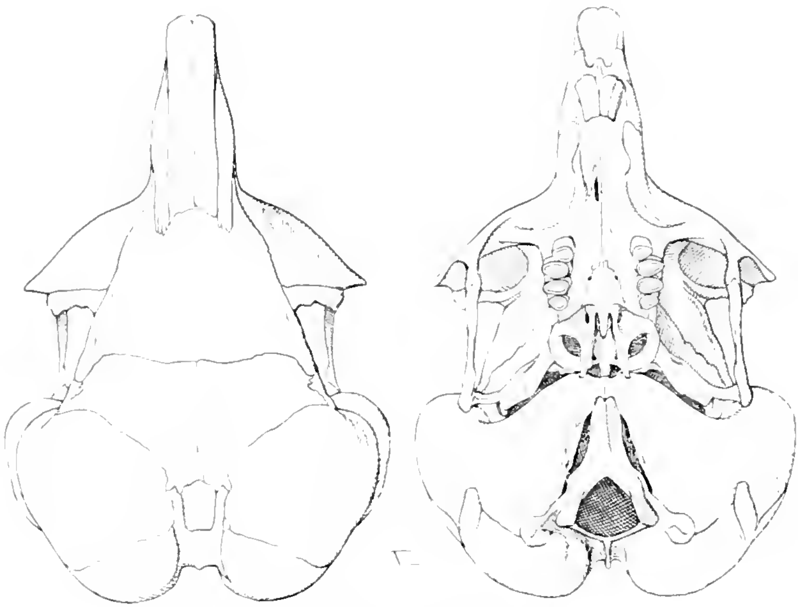


FIG. 126. DIPODOMYS MERRIAMI MELANURUS, Merriam.
B.M. No. 98.3.1.158, ♂; × 2½.

FIG. 127. DIPODOMYS MERRIAMI MELANURUS, Merriam.
B.M. No. 98.3.1.158 ♂; × 2½.

incisors; the top of the nose in the living animal can be seen on close inspection to be curiously projecting forwards, no doubt caused by this bone formation. Mandible with angular process somewhat pulled inwards, and coronoid process small. Occipital region much reduced, between the mastoids. In *D. deserti* the mastoid inflation reaches its greatest degree.

Lower incisors said to be frequently grooved in *D. spectabilis*, as well as the upper ones.

Cheekteeth evergrowing, "with tendency for thinning and breaking of enamel on buccal and lingual margins of teeth leaving only an anterior and

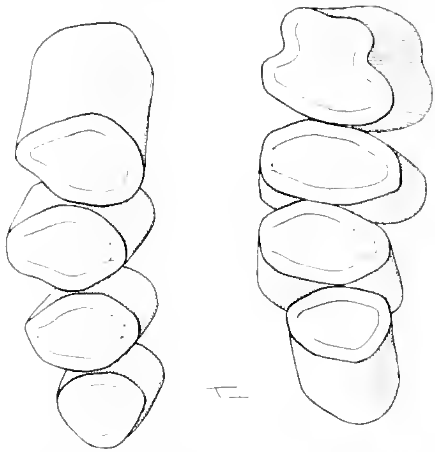


FIG. 128. DIPODOMYS MERRIAMI MELANURUS, Merriam.
Cheekteeth: B.M. No. 98.3.1.158, ♂; × 13.

posterior blade in more progressive species." Upper cheekteeth wider than long, simplifying to a ring pattern in adult, P.4 slightly the largest, and M.3 slightly the smallest tooth. Lower teeth like the upper series except that P.4 appears to retain one inner and one outer shallow indentation normally.

When cut, the teeth present a more complicated pattern, which is said to vary somewhat in the different species. Calcaneum articulating with the navicular. Some of the cervical vertebrae tend to fuse.

Size largest of family. Form Dipodide. Hindlimbs elongated, foot very long and narrow, soles hairy. Hindfoot with three main digits; D.5 moderately developed; hallux vestigial or absent, when present placed high on the leg, as in *Allactaga*; but hindfoot differing from this genus in the length and position of D.5. Tail considerably longer than head and body as a rule, well haired, tufted terminally. Ear large. Forefoot with minute pollex; the two centre digits (3 and 4) subequal and tending to be slightly longer than D.2 and D.5 so far as seen. Claws long, sharp.

Forms seen: *agilis*, *ambiguus*, *columbianus*, *deserti*, *exilis*, *levipes*, *melanurus*, *merriami*, *nitratoides*, *ordii*, *richardsoni*, *simiolus*, *spectabilis*, "*streatori*."

Nine specific groups are currently recognized. As no revision of the genus has been published, no description or key to these groups is at present available. Six of them are characterized by Grinnell, A Geographical Study of the Kangaroo-Rats of California, Univ. Calif. Publ. Zool., XXIV, p. 1, 1922.

Wood keys certain species which have been examined by him on dental characters. His results were as follows:

"Crowns of teeth persist an appreciable time after all teeth are erupted.	
Enamel complete through life.	*compactus*
Enamel interrupted slightly after much wear.	*nitratoides*
Enamel interrupted slightly after little wear.	*merriami*
Crowns of teeth destroyed by or shortly after the time the last tooth has been erupted.	
Enamel breaks small, developing late.	
Unworn teeth with oval ends.	*ordii*
Unworn teeth with square ends.	*agilis*
Enamel breaks small to medium, with an appreciable period before they show on grinding surface.	
Unworn teeth with square ends.	*heermanni*
Unworn teeth with oval ends.	*spectabilis*
Enamel breaks very large, developing very early.	*deserti*."

Further characters which I have compiled from Grinnell's diagnosis of his groups are:

Maxillary arches

In *heermanni* group, very broad, widely spreading and as a rule with posteroexternal angles prominent and sharp.

In *ordii* group, broad, spreading fairly widely as a rule, with angles more or less well developed.

In *merriami* group, broad, widely spreading, sharply angled.

In *agilis* group, rather narrow, narrowly spreading, and as a rule weakly angled.

In *microps* group, very narrow, spreading narrowly, and very weakly angled.

In *deserti* group, extremely narrow, with very narrow posteroexternal angles, indicated but faintly.

The *spectabilis* group, which appears to consist of the largest forms of the genus as a rule (other than *deserti*, which is nearly as large), agrees as far as I have seen with the broad "maxillary-arch type," as *heermanni*.

Normally four toes are present in the hindfoot in the groups typified by *heermanni*, *spectabilis*, *phillipsii*, *merriami*, *deserti*; and normally five toes are present in the groups typified by *agilis*, *ordii* and *microps*.

In the *heermanni* group the metatarsal of the first toe is developed, according to Grinnell.

In both cranial and dental characters *D. deserti* appears to be very distinct from other forms of the genus.

For the characters of *D. phillipsii* see Merriam, Proc. Biol. Soc. Washington, VIII, p. 83, 1893, "Rediscovery of the Mexican Kangaroo-rat *Dipodomys phillipsii*, Gray." The mastoids are described as "both actually and relatively smaller than in any other species."

The remaining characters given by Grinnell appear for the most part not to divide the groups very clearly, nor are the measurements given by Anthony in Field Book of North American Mammals 1928 for the forms occurring north of Mexico indicative of any clear size distinction between the various groups, except that, as indicated above, the *spectabilis* group and the *deserti* group approach the maximum size, and that the smallest forms belong to the *merriami* and the *compactus* groups; but even here the measurements of total length overlap those of the smaller members of the *ordii* group.

List of Named Forms

heermanni Group

1. DIPODOMYS HEERMANNI HEERMANNI, Le Conte

1853. Proc. Acad. Nat. Sci. Philadelphia, VI, p. 224.
Sierra Nevada, California.
Synonym: *streatori*, Merriam, 1894, Proc. Biol. Soc. Washington, IX, p. 113. Carbondale, Amador County, California.

2. DIPODOMYS HEERMANNI CALIFORNICUS, Merriam

1890. North Amer. Fauna, no. 4, p. 49.
Ukiah, Mendocino County, California.
Synonym: *californicus trinitatis*, Kellogg, 1916, Univ. Calif. Publ. Zool. XII, p. 366. Hellena, Trinity County, California.
californicus pallidulus, Bangs, 1899, Proc. New Engl. Zool. Club. 1, p. 65. Sites, Colusa County, California.

3. DIPODOMYS HEERMANNI EXIMIUS, Grinnell

1919. Proc. Biol. Soc. Washington, XXXII, p. 205.
Marysville Buttes, 3 miles north-west of Sutter, Sutter County, California.

4. DIPODOMYS HEERMANNI TULARENSIS, Merriam

1904. Proc. Biol. Soc. Washington, XVII, p. 143.
Alila, now Earlimart, Tulare County, California.

5. DIPODOMYS HEERMANNI DIXONI, Grinnell

1919. Univ. Calif. Publ. Zool. XXI, p. 45.
Delhi, near Merced River, Merced County, California.

6. DIPODOMYS HEERMANNI BERKELEYENSIS, Grinnell

1919. Proc. Biol. Soc. Washington, XXXII, p. 204.
Berkeley (Head of Dwight Bay), Alameda County, California.

7. DIPODOMYS HEERMANNI GOLDMANI, Merriam

1904. Proc. Biol. Soc. Washington, XVII, p. 143.
Salinas, Monterey County, California.

8. DIPODOMYS HEERMANNI JOLONENSIS, Grinnell

1919. Proc. Biol. Soc. Washington, XXXII, p. 203.
One mile south-west of Jolon, Monterey County, California.

9. DIPODOMYS HEERMANNI SWARTHI, Grinnell

1919. Univ. Publ. Calif. Zool. XXI, p. 44.
Seven miles south-east of Simmler, Carrizo Plain, San Luis Obispo County, California.

10. DIPODOMYS HEERMANNI SAXATILIS, Grinnell & Linsdale

1929. Univ. Calif. Publ. Zool. XXX, p. 453.
Mesa, near Dalés, Tehema County, California.

11. DIPODOMYS HEERMANNI GABRIELSONI, Goldman

1925. Proc. Biol. Soc. Washington, XXXVIII, p. 33.
Brownsboro, Jackson County, Oregon.

12. DIPODOMYS MORROENSIS, Merriam

1907. Proc. Biol. Soc. Washington, XX, p. 78.
Morro, San Luis Obispo County, California.

13. DIPODOMYS MOHAVENSIS, Grinnell

1918. Univ. Cal. Publ. Zool. XVII, p. 428.
Warren, Kern County, California.

14. DIPODOMYS LEUCOGENYS, Grinnell

1919. Univ. Calif. Publ. Zool. XXI, p. 46.
Pellisier Ranch, 5 miles north of Benton Station, Mono County, California.

15. DIPODOMYS PANAMINTINUS, Merriam

1894. Proc. Biol. Soc. Washington, IX, p. 114.
Willow Creek, Panamint Mountains, Inyo County, California.

16. DIPODOMYS STEPHENSI, Merriam

1907. Proc. Biol. Soc. Washington, XX, p. 78.
San Jacinto Valley, Riverside County, California.

17. DIPODOMYS INGENS, Merriam

1904. Proc. Biol. Soc. Washington, XVII, p. 141.
Painted Rock, 20 miles south-east of Simmler, Carrizo Plain, San Luis Obispo County, California.

18. DIPODOMYS GRAVIPES, Huey

1925. Proc. Biol. Soc. Washington, XXXVIII p. 83.
Santo Domingo Mission, Lower California, Mexico.

spectabilis Group

19. DIPODOMYS SPECTABILIS SPECTABILIS, Merriam

1890. North Amer. Fauna, no. 4, p. 46.
Dos Cabezos, Cochise County, Arizona.

20. DIPODOMYS SPECTABILIS BAILEYI, Goldman

1923. Proc. Biol. Soc. Washington, XXXVI, p. 140.
Forty miles west of Roswell, Chaves County, New Mexico.

21. DIPODOMYS SPECTABILIS CRATODON, Merriam

1907. Proc. Biol. Soc. Washington, XX, p. 75.
Chicalote, Aguas Calientes, Mexico.

22. DIPODOMYS SPECTABILIS ZYGOMATICUS, Goldman

1923. Proc. Biol. Soc. Washington, XXXVI, p. 140.
Parral, Southern Chihuahua, Mexico.

23. DIPODOMYS SPECTABILIS PERBLANDUS, Goldman

1933. Journ. Washington Acad. Sci. XXIII, p. 466.
Calabassus, Santa Cruz County, Arizona.

24. DIPODOMYS SPECTABILIS CLARENCEI, Goldman

1933. Journ. Washington Acad. Sci. XXIII, p. 467.
Blanco, San Juan County, New Mexico.

25. DIPODOMYS NELSONI, Merriam

1907. Proc. Biol. Soc. Washington, XX, p. 75.
La Ventura, Coahuila, Mexico.

phillipsii Group

26. DIPODOMYS PHILLIPSII, Gray

1841. Ann. Mag. Nat. Hist. VII, p. 522.
Valley of Mexico, Mexico.
Synonym: *halticus*, Wagner, 1846, Arch. Naturg. p. 176.

27. DIPODOMYS ELATOR, Merriam

1894. Proc. Biol. Soc. Washington, IX, p. 109.
Henrietta, Clay County, Texas.

28. DIPODOMYS PEROTENSIS, Merriam

1894. Proc. Biol. Soc. Washington, IX, p. 111.
Perote, Vera Cruz, Mexico.

29. DIPODOMYS ORNATUS, Merriam

1894. Proc. Biol. Soc. Washington, IX, p. 110.
Berriozabel, Zacatecas, Mexico.

merriami Group

30. DIPODOMYS MERRIAMI MERRIAMI, Mearns

1890. Bull. Amer. Mus. Nat. Hist. II, p. 290.
New River, Maricopa County, Arizona.
Synonym: *merriami nevadensis*, Merriam, 1894, Proc. Biol. Soc. Washington, IX, p. 111. Pyramid Lake, Washoe County, Nevada.
merriami nitratus, Merriam, 1894, Proc. Biol. Soc. Washington, IX, p. 112. Keeler, Inyo County, California.
merriami mortivallis, Elliot, 1903, Field Columb. Mus. Publ. 87, zool. ser. vol. 3, p. 250. Furnace Creek, Inyo County, California.
merriami kernensis, Merriam, 1907, Proc. Biol. Soc. Washington, XX, p. 77. Onyx, Kern County, California.

31. DIPODOMYS MERRIAMI AMBIGUUS, Merriam

1890. North Amer. Fauna, no. 4, p. 42.
El Paso, El Paso County, Texas.

32. DIPODOMYS MERRIAMI ATRONASUS, Merriam

1894. Proc. Biol. Soc. Washington, IX, p. 113.
Hacienda la Parada, San Luis Potosi, Mexico.

33. DIPODOMYS MERRIAMI PARVUS, Rhoads

1894. Amer. Nat. XXVIII, p. 69.
Reche Canyon, San Bernardino County, California.

34. DIPODOMYS MERRIAMI SIMIOLUS, Rhoads
1893. Proc. Acad. Nat. Sci. Philadelphia, p. 410.
Agua Caliente, near Palm Springs, Riverside County, California.
Synonym: *similis*, Rhoads, 1893, Proc. Acad. Nat. Sci. Philadelphia, p. 411. Whitewater, Riverside County, California.

35. DIPODOMYS MERRIAMI ARENIVAGUS, Elliot
1903. Field Columb. Mus. Publ. 87, zool. ser. vol. 3, p. 249.
San Felipe, Lower California, Mexico.

36. DIPODOMYS MERRIAMI MELANURUS, Merriam
1893. Proc. Calif. Acad. Sci. ser. 2, vol. 3, p. 345.
San Jose del Cabo, Lower California, Mexico.

37. DIPODOMYS MERRIAMI SEMIPALLIDUS, Huey
1927. Trans. S. Diego Soc. Nat. Hist. 5, p. 65.
Santa Catarina, Lower California, Mexico.

38. DIPODOMYS MERRIAMI MAYENSIS, Goldman
1928. Proc. Biol. Soc. Washington, XLI, p. 141.
Alamos, Sonora, Mexico.

39. DIPODOMYS MERRIAMI VULCANI, Benson
1934. Proc. Biol. Soc. Washington, XLVII, p. 181.
Towoweap Valley, Mohave County, Arizona.

40. DIPODOMYS MERRIAMI FRENATUS, Bole
1936. Sci. Publ. Cleveland Mus. 5, no. 1, p. 1.
Toquerville, Washington County, Utah.

41. DIPODOMYS NITRATOIDES NITRATOIDES, Merriam
1894. Proc. Biol. Soc. Washington, IX, p. 112.
Tipton, San Joaquin Valley, Tulare County, California.

42. DIPODOMYS NITRATOIDES EXILIS, Merriam
1894. Proc. Biol. Soc. Washington, IX, p. 113.
Fresno, Fresno County, California.

43. DIPODOMYS NITRATOIDES BREVINASUS, Grinnell
1920. Journ. Mamm. Baltimore, 1, p. 179.
Hayes Station, Fresno County, California (19 miles south-west of Mendota).

44. DIPODOMYS PLATYCEPHALUS, Merriam
1907. Proc. Biol. Soc. Washington, XX, p. 76.
Calmalli, Lower California, Mexico.

45. DIPODOMYS MARGARITAE, Merriam
1907. Proc. Biol. Soc. Washington, XX, p. 76.
Margarita Island, Lower California, Mexico.

46. DIPODOMYS INSULARIS, Merriam
1907. Proc. Biol. Soc. Washington, XX, p. 77.
San José Island, Lower California, Mexico.

47. DIPODOMYS MITCHELLI, Mearns
1897. Proc. U.S. Nat. Mus. XIX, p. 719.
Tiburon Island, Gulf of California, Sonora, Mexico.

ordii Group

48. DIPODOMYS ORDII ORDII, Woodhouse

1853. Proc. Acad. Nat. Sci. Philadelphia, VI, p. 224.
El Paso, El Paso County, Texas.

49. DIPODOMYS ORDII COLUMBIANUS, Merriam

1894. Proc. Biol. Soc. Washington, IX, p. 115.
Umatilla, Umatilla County, Oregon.

50. DIPODOMYS ORDII MONOENSIS, Grinnell

1919. Univ. Calif. Publ. Zool. XXI, p. 46.
Pellisier Ranch, 5 miles north of Benton Station, Mono County, California.

51. DIPODOMYS ORDII UTAHENSIS, Merriam

1904. Proc. Biol. Soc. Wash. XVII, p. 143.
Ogden, Weber County, Utah.

52. DIPODOMYS ORDII CHAPMANI, Mearns

1890. Bull. Amer. Nat. Hist. II, p. 291.
Fort Verde, Yavapai County, Arizona.

53. DIPODOMYS ORDII OBSCURUS, Allen

1903. Bull. Amer. Mus. Nat. Hist. XIX, p. 603.
Rio Sestin, Durango, Mexico.

54. DIPODOMYS ORDII MONTANUS, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 334.
Fort Massachusetts (now Fort Garland), Costilla County, Colorado.

55. DIPODOMYS ORDII LONGIPES, Merriam

1890. North Amer. Fauna, no. 3, p. 72.
Foot of Echo Cliffs, Painted Desert, Coconino County, Arizona.

56. DIPODOMYS ORDII LUTEOLUS, Goldman

1917. Proc. Biol. Soc. Washington, XXX, p. 112.
Casper, Natrona County, Wyoming.

57. DIPODOMYS ORDII RICHARDSONI, Allen

1891. Bull. Amer. Mus. Nat. Hist. III, p. 277.
One of the sources of Beaver River, Beaver County, Oklahoma.

58. DIPODOMYS ORDII PALMERI, Allen

1891. Bull. Amer. Mus. Nat. Hist. III, p. 276.
San Luis Potosi, State of San Luis Potosi, Mexico.

59. DIPODOMYS ORDII CUPIDINEUS, Goldman

1924. Journ. Washington Acad. Sci. XIV, p. 372.
Kanab Wash, Arizona (southern boundary of Kainab Indian Reservation).

60. DIPODOMYS ORDII EVEXUS, Goldman

1933. Journ. Washington Acad. Sci. XXIII, p. 468.
Salida, Chaffee County, Colorado.

61. DIPODOMYS ORDII CLEOMOPHILA, Goldman

1933. Journ. Washington Acad. Sci. XXIII, p. 469.
Coconino County (Winoma), Arizona.

62. DIPODOMYS ORDII NEXILIS, Goldman
1933. Journ. Washington Acad. Sci., XXIII, p. 470.
Naturita, Montrose County, Colorado.

compactus Group

63. DIPODOMYS COMPACTUS, True
1889. Proc. U.S. Nat. Mus., II, 1888, p. 160.
Padre Island, Cameron County, Texas.

64. DIPODOMYS SENNETTI, Allen
1891. Bull. Amer. Mus. Nat. Hist., III, p. 226.
Santa Rosa, Cameron County, Texas.

agilis Group

65. DIPODOMYS AGILIS AGILIS, Gambel
1848. Proc. Acad. Nat. Sci. Philadelphia, IV, p. 77.
Los Angeles, Los Angeles County, California.

66. DIPODOMYS AGILIS SIMULANS, Merriam
1904. Proc. Biol. Soc. Washington, XVII, p. 144.
Dulzura, San Diego County, California.

67. DIPODOMYS AGILIS PENINSULARIS, Merriam
1907. Proc. Biol. Soc. Washington, XX, p. 79.
Santo Domingo, Lower California, Mexico.

68. DIPODOMYS AGILIS CABEZONAE, Merriam
1904. Proc. Biol. Soc. Washington, XVII, p. 144.
Cabezon, San Gorgonio Pass, Riverside County, California.

69. DIPODOMYS AGILIS PERPLEXUS, Merriam
1907. Proc. Biol. Soc. Washington, XX, p. 79.
Walker Basin, Kern County, California.

70. DIPODOMYS AGILIS MARTIRENSIS, Huey
1927. Trans. S. Diego Soc. Nat. Hist. 5, p. 7.
La Grulla, Sierra San Pedro Martir, Lower California, Mexico.

71. DIPODOMYS AGILIS LATIMAXILLARIS, Huey
1925. Proc. Biol. Soc. Washington, XXXVIII, p. 84.
Two miles west of Santo Domingo Mission, Lower California; Lat. 30° 45′ N., Long. 115° 58′ W.

72. DIPODOMYS VENUSTUS VENUSTUS, Merriam
1904. Proc. Biol. Soc. Washington, XVII, p. 142.
Santa Cruz, Santa Cruz County, California.

73. DIPODOMYS VENUSTUS SANCTILUCIAE, Grinnell
1919. Proc. Biol. Soc. Washington, XXXII, p. 204.
One mile south of Jolon, Monterey County, California.

74. DIPODOMYS ELEPHANTINUS, Grinnell
1919. Univ. Calif. Publ. Zool. XXI, p. 43.
One mile north of Cook P.O., Bear Valley, San Benito Valley, California.

microps Group

75. DIPODOMYS MICROPS MICROPS, Merriam

1904. Proc. Biol. Soc. Washington, XVII, p. 145.
Lone Pine, Owens Valley, Inyo County, California.

76. DIPODOMYS MICROPS PREBLEI, Goldman

1921. Journ. Mamm. Baltimore, 2, p. 233.
Narrows, Malheur Lake, Harney County, Oregon.

77. DIPODOMYS MICROPS CELSUS, Goldman

1924. Journ. Washington Acad. Sci. XIV, p. 372.
Six miles north of Wolf Hole, Arizona.

78. DIPODOMYS MICROPS LEUCOTIS, Goldman

1931. Proc. Biol. Soc. Washington, XLIV, p. 135.
Houserock Valley, Marble Canyon, Colorado River, Arizona.

79. DIPODOMYS MICROPS AQUILONIUS, Willett

1935. Journ. Mamm. Baltimore, 16, p. 63.
Three miles east of Eagleville, Modoc County, California.

80. DIPODOMYS LEVIPES, Merriam

1904. Proc. Biol. Soc. Washington, XVII, p. 145.
Perognathus Flat, Panamint Mountains, Inyo County, Californa.

deserti Group

81. DIPODOMYS DESERTI DESERTI, Stephens

1887. Amer. Nat. XXI, p. 42.
Mohave River, San Bernardino County, California.
Synonym: *deserti helleri*, Elliot, 1903, Field. Columb. Mus. Publ. Zool. ser. vol. 3, p. 249. Keeler, Owens Lake, Inyo County, California.

82. DIPODOMYS DESERTI SONORIENSIS, Goldman

1923. Proc. Biol. Soc. Washington, XXXVI, p. 139.
La Libertad Ranch, 30 miles east of Sierra Seri, Sonora, Mexico.

The family Heteromyidae is known fossil from the Oligocene, from North America only. Wood recognizes five extinct genera placed in the living subfamilies, as well as a number of Oligocene types.

GENERAL WORKS OF REFERENCE

WOOD, Ann. Carnegie Mus. XXIV, p. 73, 1935. (Monographic review of living and fossil Heteromyidae.)

GOLDMAN, North Amer. Fauna, no. 34, 1911. Revision of the genera *Heteromys* and *Liomys*.

OSGOOD, North Amer. Fauna, no. 18, 1900. Revision of the genus *Perognathus*.

GRINNELL, A Geographical Study of the Kangaroo-Rats of California, Univ. Calif. Publ. Zool. XXIV, p. 1, 1922.

HOWELL, 1932, Proc. Amer. Acad. Arts Sci. Boston, LXVII, p. 378. The Saltatorial Rodent *Dipodomys*, Functional and comparative anatomy of its muscular and osseous systems.

COUES, Monograph North American Rodentia, p. 487, 1877. "Saccomyidae."

Family GEOMYIDAE

1896. Thomas: MYOMORPHA, part: Family Geomyidae.
1899. Tullberg: SCIUROMORPHA, part: *Geomyoidei*: Family Geomyidae, part, subfamily Geomyini.
1918. Miller & Gidley: Superfamily SCIUROIDAE, part: Family Geomyidae.
1924. Winge: Family "Saccomyidae" (= Heteromyidae), part, Geomyini.
1928. Weber: GEOMYOIDEA, part: Family Geomyidae.

GEOGRAPHICAL DISTRIBUTION.—North America, and Central America; from British Columbia through Western and Central United States, and also from Florida and Texas, south through Mexico to Panama.

NUMBER OF GENERA.—Nine are currently recognized.

CHARACTERS.—Cheekteeth $\frac{4}{4}$, evergrowing in living genera, simplified in pattern. Skull much modified for subfossorial life. Fibula reduced, and fused with tibia high on the leg (as in Muridae). Externally specialized for underground life; digits of hindfoot five; claws of forefoot strongly lengthened. Incisors thick. Infraorbital foramen always forming long canal, "its orifice protected from muscle pressure by countersinking in an oblique sulcus" (Miller & Gidley). Mastoids never excessively inflated. Zygoma robust (at any rate as compared with the Heteromyidae); the jugal progressively shortened until the zygomatic arch is in extreme forms complete without it.

The infraorbital foramen seems more reduced in this family, and in the Heteromyidae, than in any living Rodents.

Skull characters. According to Merriam, it may be mentioned that there are strong cranial differences between the sexes in this group.

The skull is flattened, the bullae moderately large, with neck directed forward and outward; mastoids noticeable in back view of skull between the exoccipital and the upper border of the supraoccipital. Squamosals largely developed. Palate long, very narrow, a deep pit each side between last molars, "posterior to which the palatines usually unite with the pterygoids to form a palatopterygoid plate on each side of the posterior nares." Incisive foramina excessively small, jugal short, never approaching lachrymal. Anterior border of zygomatic plate usually prominently ridged. Occipital region powerfully developed, though relatively low; squamosals usually with strong ridges present, which frequently unite to form a sagittal crest. Lower incisor forming powerful process between condylar and angular processes. Coronoid higher than condyle. Incisors thick, the upper ones prominently grooved, except in *Thomomys*. Premaxillae very large and heavy, nasals usually narrow.

Cheekteeth rootless and simplified, the premolar, the largest tooth in the series, being more or less eight-shaped, with an outer and an inner fold. Other molars ring-shaped, except sometimes M.3, which may have a posterior heel.

As figured by Merriam, the unworn teeth are less simplified when cut than in the adult; evidently they simplify very soon in life.

External form as in other underground Rodents, thickset, with eyes and ears small. Large cheekpouches present, which open externally. Tail usually naked, moderately hairy in the more northern species, rather longer than the hindfoot, the tip said to be supplied with tactile nerves, and to be used as a guide when the animal runs backwards, which according to Merriam they do as easily as they run forwards.

Forefoot with five digits, bearing very large and powerful claws, D.3 the longest, the pollex and D.5 the shortest.

According to Merriam the development of the claws varies greatly, and the hairiness on the tail of northern species varies seasonally. Hindfeet with general arrangement of digits the same as in forefoot, but claws less enlarged.

The Geomyidae, exclusive of *Thomomys*, were monographed very fully by Merriam, North American Fauna, no. 8, 1895, pp. 11–258. He divided the former genus *Geomys* into eight genera, based mainly on the presence or absence of enamel plate in the upper premolar and first two molars; the number of grooves of the incisors, and certain bones in the interior part of the skull. Most authors have retained these genera.

The family as a whole is so inadequately represented at the British Museum that I have mostly to give abridged versions of Merriam's original genus descriptions.

I have seen only two skulls of *Cratogeomys*, one of *Platygeomys*, four of *Orthogeomys*, one of *Zygogeomys*, and few, at any rate less than ten, of *Macrogeomys* and *Heterogeomys*.

As regards the presence or absence of enamel plate, the following teeth have a constant pattern throughout the family, excepting the genus *Thomomys*:

Lower molars: a single posterior enamel plate only.
Lower premolar: four enamel plates always present.
Third upper molar: three enamel plates, one inner, one outer, one anterior.

In *Thomomys*, there are present in:

Lower molars: two enamel plates, an anterior and a posterior.
Lower premolar: as in the rest of the family.
Third upper molar: two enamel plates only.

It is perhaps not out of place to remark that there is a very strong resemblance between all the genera included in the family as regards essential cranial and dental characters, and that two famous zoologists at least have considered that the seven extra genera of Merriam are of at most subgeneric value only.

Key to the Genera of Geomyidae
(modified from that of Merriam)

Frontals with no marked constriction between the orbits. ORTHOGEOMYS

Frontals strongly constricted between the orbits.

Third upper molar with two enamel plates; lower molars with an anterior enamel plate; forefoot relatively more slender, and claws lighter (Bailey). Incisors not grooved, or with a single fine sulcus on inner side. THOMOMYS

Third upper molar with three enamel plates; lower molars without anterior enamel plate; forefoot relatively heavier. Incisors strongly grooved.

No enamel plate on posterior surface of upper premolar.

Posterior enamel plate present on M.1 and M.2.

Upper incisor bisulcate. GEOMYS

Upper incisor unisulcate. PAPPOGEOMYS

Posterior enamel plate absent on M.1 and M.2.

Breadth of cranium across squamosals much less than zygomatic width; lambdoid crest not sinuous; angle of mandible short. CRATOGEOMYS

Breadth of cranium across squamosals greater than zygomatic width; lambdoid crest strongly sinuous; angle of mandible very long. PLATYGEOMYS

Enamel present on posterior surface of upper premolar.

Posterior enamel present on inner side only of M.1 and M.2; incisors bisulcate (zygoma complete without jugal). ZYGOGEOMYS

Posterior enamel complete on M.1 and M.2. Incisors unisulcate.

Postorbital process absent; palatopterygoid long and slender, the pterygoid part narrow. HETEROGEOMYS

Postorbital process strongly marked; palatopterygoid short and broad, the pterygoid part broad. MACROGEOMYS

The key is weakened by the fact that in *Orthogeomys*, posterior enamel plate may be present or absent in the upper premolar. It is, according to Merriam, becoming suppressed, and when present (*O. latifrons*), is restricted to the inner fourth. In other species of *Orthogeomys* it is absent.

In addition to the characters indicated above, the genus *Thomomys* appears to differ from the other genera, as regards those examined, in that the cheekteeth are less rounded in aspect, though whether this character is absolutely constant I do not know.

Genus 1. THOMOMYS, Wied

1839. THOMOMYS, Wied, Nova Acta Phys. Med. Acad. Caes. Leop. Carol. XIX, pt. 1, p. 377.

1903. MEGASCAPHEUS, Elliot, Field Columb. Mus. Publ. 76, Zool. ser. vol. 3, p. 190. (*Diplostoma bulbivorum*, Richardson.) Valid as a subgenus.

TYPE SPECIES.—*Thomomys rufescens*, Wied.

RANGE.—"From the Valley of Mexico and Mount Orizaba northward to British Columbia and North Saskatchewan River; and from Pacific coast eastward to the great Plains" (Merriam).

NUMBER OF FORMS.—I have listed one hundred and ninety-two.

CHARACTERS.—As already noted, the arrangement of the enamel of the lower molars and M.3 differs from the other genera in that there are two enamel plates on the lower teeth instead of one, and that there are only

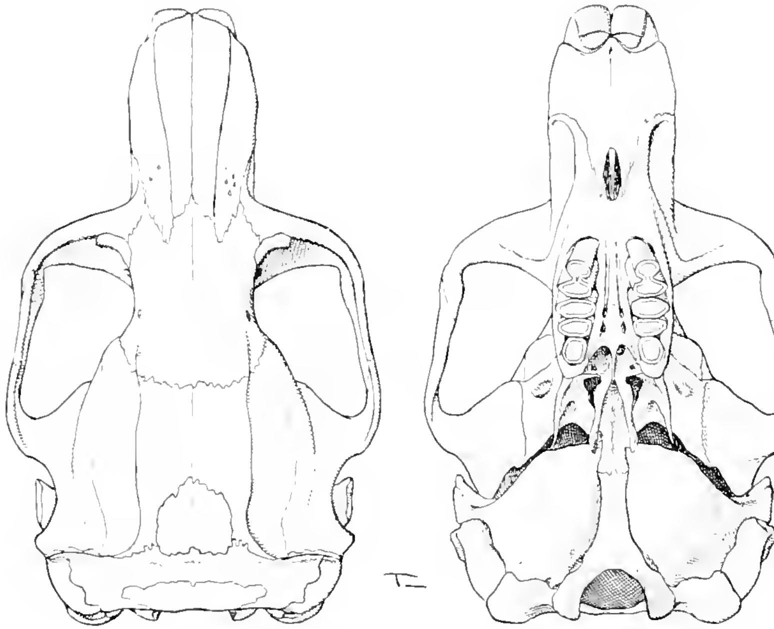


FIG. 129. THOMOMYS PERPALLIDUS PERPALLIDUS, Merriam.
B.M. No. 29.11.7.43, [illegible]; $2\frac{1}{2}$.

two enamel plates on M. 3 instead of the usual number of three. There are also two enamel plates on M.1 and M.2; in P.4 there are four enamel plates.

Upper incisor plain, or with a narrow sulcus close to the inner side of the tooth, the main groove characteristic of other genera of the family absent. The sulcus when present may rarely, as in *monticola*, be relatively large and deep. Molars, so far as seen, less rounded than in *Geomys* and allies, the upper teeth with a tendency to point outwards at the centre of each tooth, the lower teeth with tendency to point inwards. Lower incisor root forming large process

FIG. 130. THOMOMYS PERPALLIDUS PERPALLIDUS, Merriam.
B.M. No. 29.11.7.43, [illegible]; 2½.

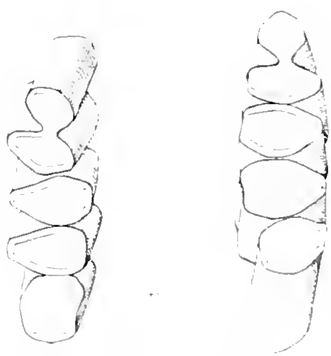


FIG. 131. THOMOMYS PERPALLIDUS PERPALLIDUS, Merriam.
Cheekteeth: B.M. No. 29.11.7.43, [illegible]; 6.

which turns angular portion of mandible noticeably outwards. The basioccipital seems in those seen to tend to be relatively narrower than in other genera. Sagittal crest rarely formed in skulls seen, and more often than not undeveloped in the large series of skulls figured by Bailey in his revision of the genus.

Externally differing from allied genera in the relatively smaller size of the forefoot.

The species *bulbivorus*, the largest known form, is separated as a subgenus *Megascapheus* by American authors, differing in the following characters from normal *Thomomys*:

"Central surface of exoccipital next condyle occupied by a deep groove running obliquely to axis of skull; bullae flatter, less inflated; pterygoids broad laterally, concave internally, with hamuli converging at tips."

This genus was fully revised by Bailey (North Amer. Fauna, no. 39, 1915).

He divides the genus into twelve specific groups, and he keys these groups as follows:

"Rostrum deep and evenly sloping in front of upper molars.
  Pterygoid concave on inner surface and convex on outer; mammae in four pairs. — *bulbivorus* group
  Pterygoid flat and straight.
    Mammae in three pairs (inguinal 2, pectoral 1). — *umbrinus* group
    Mammae in four pairs (inguinal 2, pectoral 2).
      Skull short and wide; colour mainly dark or light ochraceous. — *bottae* group
      Skull not conspicuously short and wide.
        Skull long and narrow; colour dark. — *alpinus* group
        Skull not conspicuously long and narrow; colour mainly pale.
          Colour pale buffy yellowish, or grey and black.
            Colour buffy yellowish (except *apache*). — *perpallidus* group
            Colour grey and black. — *townsendi* group
          Colour tawny. — *fulvus* group
Rostrum slender, abruptly arched in front of upper molars.
  Mammae in six pairs or more. — *talpoides* group
  Mammae in four or five pairs.
    Mammae in five pairs (inguinal 2, pectoral 3). — *fossor* group
    Mammae in four pairs (inguinal 2, pectoral 2).
      Ears rather large and rounded at tips. — *douglasi* group
      Ears large or small and pointed at tips.
        Ears relatively large and pointed. — *monticola* group
        Ears relatively small and pointed. — *fuscus* group."

It may be noted as a matter of interest that only two groups, *talpoides* and *fuscus*, appear to range as far north as Canada.

Forms examined: *anitae*, *alticola*, *atrovarius*, *angularis*, *altivallis*, *bottae*, *bulbivorus*, *douglasi*, *monticola*, *perpallidus*, *talpoides*, *toltecus*, *umbrinus*.

List of Named Forms

(The references and type localities for all members of the family Geomyidae are the work of Mr. G. W. C. Holt. Mr. Holt has also provided me with notes on the relationships of the distinct species recently described.)

Subgenus *Thomomys*, Wied

townsendi Group

1. THOMOMYS TOWNSENDI TOWNSENDI, Bachman

1839. Journ. Acad. Nat. Sci. Philadelphia, VIII, p. 105.
Probably Southern Idaho, near Nampa, Canyon County.
Synonym: *nevadensis atrogriseus*, Bailey, 1914, Proc. Biol. Soc. Washington, XXVII, p. 118. Southern Idaho.

2. THOMOMYS TOWNSENDI NEVADENSIS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 213.
Austin, Lamber County, Nevada.

3. THOMOMYS RELICTUS, Grinnell

1926. Univ. Cal. Publ. Zool. XXX, p. 2.
Susanville, Lassen County, California.

bottae Group

4. THOMOMYS BOTTAE BOTTAE, Eydoux & Gervais

1836. Mag. de. Zool. VI, p. 23.
Coast of California.

5. THOMOMYS BOTTAE LATICEPS, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 335.
Humboldt Bay, Humboldt County, California.

6. THOMOMYS BOTTAE LEUCODON, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 215.
Grant Pass, Rogue River Valley, Oregon.

7. THOMOMYS BOTTAE NAVUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 112.
Red Bluff, Tehama County, California.

8. THOMOMYS BOTTAE MEWA, Merriam

1908. Proc. Biol. Soc. Washington, XXI, p. 146.
Raymond, Madera County, California.

9. THOMOMYS BOTTAE MINOR, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 116.
Fort Bragg, Mendocino County, California.

10. THOMOMYS BOTTAE DIABOLI, Grinnell

1914. Univ. Cal. Publ. Zool. XII, p. 313.
Sweeney's Ranch, Diablo Range, Merced County, California.

11. THOMOMYS BOTTAE ANGULARIS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 214.
Los Banos, Merced County, California.

12. THOMOMYS BOTTAE PALLESCENS, Rhoads

1895. Proc. Acad. Nat. Sci. Philadelphia, p. 36.
Grapelands, San Bernardino Valley, San Bernardino County, California.

13. THOMOMYS BOTTAE INFRAPALLIDUS, Grinnell

1914. Univ. Cal. Publ. Zool. XII, p. 314.
Seven miles south-east of Simmler, Carrizo Plain, San Luis Obispo County, California.

14. THOMOMYS BOTTAE NIGRICANS, Rhoads

1895. Proc. Acad. Nat. Sci. Philadelphia, p. 36.
Witch Creek, 7 miles west of Julian, San Diego County, California.
Synonym: *aphrastus*, Elliot, 1903, Field Columb. Mus. Publ. 79, zool. ser. vol. 3, p. 219. San Tomas, Lower California.

15. THOMOMYS BOTTAE PASCALIS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 111.
Fresno, San Joaquin Valley, Fresno County, California.

16. THOMOMYS BOTTAE PUERTAE, Grinnell

1914. Univ. Calif. Publ. Zool. XII, p. 315.
La Puerta, 5 miles west of Vallecitos, Eastern San Diego County, California.

17. THOMOMYS BOTTAE ANITAE, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 146.
Santa Anita, Lower California, Mexico.

18. THOMOMYS BOTTAE ALTICOLA, Allen

1899. Bull. Amer. Mus. Nat. Hist. XII, p. 13.
Sierra Laguna, Lower California, Mexico.

19. THOMOMYS BOTTAE RUSSEOLUS, Nelson & Goldman

1909. Proc. Biol. Soc. Washington, XXII, p. 25.
San Angel, 30 miles west of San Ignacio, Lower California, Mexico.

20. THOMOMYS BOTTAE ABBOTTI, Huey

1928. Trans. S. Diego Soc. Nat. Hist. 5, p. 89.
El Rosario, Lower California, Mexico.

21. THOMOMYS BOTTAE DEPRESSUS, Hall

1932. Univ. Calif. Publ. XXXVIII, p. 326.
Churchill County, Nevada (Dixie Meadows, at south end of Humboldt Salt Marsh).

22. THOMOMYS BOTTAE CINEREUS, Hall.

1932. Univ. Calif. Publ. Zool. XXXVIII, p. 327.
Smith's Valley, Lyon County, Nevada.

23. THOMOMYS BOTTAE LACRYMALIS, Hall

1932. Univ. Calif. Publ. Zool. XXXVIII, p. 328.
Arlemont, Esmeralda County, Nevada.

24. THOMOMYS BOTTAE CURTATUS, Hall

1932. Univ. Calif. Publ. Zool. XXXVIII, p. 329.
San Antonio, Nye County, Nevada.

25. THOMOMYS BOTTAE FUMOSUS, Hall

1932. Univ. Calif. Publ. Zool. XXXVIII, p. 329.
Moore's Creek, Nye County, Nevada.

26. THOMOMYS BOTTAE NANUS, Hall
1932. Univ. Calif. Publ. Zool. XXXVIII, p. 331.
Whiterock Spring, Nye County, Nevada.

27. THOMOMYS BOTTAE BREVIDENS, Hall
1932. Univ. Calif. Publ. Zool. XXXVIII, p. 330.
Breen Creek, Nye County, Nevada.

28. THOMOMYS BOTTAE NASUTUS, Hall
1932. Proc. Biol. Soc. Washington, XLV, p. 96.
Black River, Apache County, Arizona.

29. THOMOMYS BOTTAE RUIDOSAE, Hall
1932. Proc. Biol. Soc. Washington, XLV, p. 96.
Ruidoso, Lincoln County, New Mexico.

30. THOMOMYS BOTTAE LUCIDUS, Hall
1932. Proc. Biol. Soc. Washington, XLV, p. 67.
Las Palmas Canyon, Lower California, Mexico.

31. THOMOMYS BOTTAE CATAVINENSIS, Huey
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 45.
Catavina, Lower California, Mexico.

32. THOMOMYS BOTTAE INGENS, Grinnell
1933. Univ. Calif. Publ. Zool. XXXVIII, p. 405.
Millux, Kern County, California.

33. THOMOMYS BOTTAE DIVERGENS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 122.
Huachinera, Sonora, Mexico.

34. THOMOMYS BOTTAE CONVERGENS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 123.
Hermosilla, Sonora, Mexico.

35. THOMOMYS BOTTAE SAXATILIS, Grinnell
1934. Proc. Biol. Soc. Washington, XLVII, p. 193.
Susanville, Lassen County, California.

36. THOMOMYS BOTTAE TRUMBULLENSIS, Hall & Davis
1934. Proc. Biol. Soc. Washington, XLVII, p. 51.
Nixon Spring, Mount Trumbull, Mohave County, Arizona.

37. THOMOMYS BOTTAE VANROSSEMI, Huey
1934. Trans. S. Diego Soc. Nat. Hist. 8, p. 1.
Punta Penascosa, Sonora, Mexico.

38. THOMOMYS BOTTAE VESCUS, Hall & Davis
1935. Univ. Calif. Publ. Zool. XL, p. 389.
Mount Jefferson, Nye County, Nevada.

39. THOMOMYS BOTTAE CONCISOR, Hall & Davis
1935. Univ. Calif. Publ. Zool. XL, p. 390.
Monitor Valley, Nye County, Nevada.

40. THOMOMYS BOTTAE ABSTRUSUS, Hall & Davis
1935. Univ. Calif. Publ. Zool. XL, p. 391.
Tulle Peak, Nye County, Nevada.

41 THOMOMYS BOTTAE LATUS, Hall & Davis

1935. Univ. Calif. Publ. Zool. XL, p. 393.
Cherry Creek, White Pine County, Nevada.

42 THOMOMYS BOTTAE EXTENUATUS, Goldman

1935. Proc. Biol. Soc. Washington, XLVIII, p. 149.
Willcox, Cochise County, Arizona.

43. THOMOMYS BOTTAE OPULENTUS, Goldman

1935. Proc. Biol. Soc. Washington, XLVIII, p. 150.
Las Palomas, Sierra County, New Mexico.

44. THOMOMYS BOTTAE CONFINALIS, Goldman

1936 Journ. Washington Acad. Sci. XXVI, p. 119.
Thirty-five miles east of Rock Springs, Texas.

45. THOMOMYS BOTTAE CONNECTENS, Hall

1936. Journ. Washington Acad. Sci. XXVI, p. 296.
Clawson Dairy, 5 miles north of Albuquerque, Bernalillo County, New Mexico.

46. THOMOMYS BOTTAE DESITUS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 113.
Big Sandy River Valley and desert region south-eastward to Wickenburg, Arizona.

47. THOMOMYS BOTTAE GUADALUPENSIS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 117.
McKittrick Canyon, Guadelupe Mountains, Texas.

48. THOMOMYS BOTTAE HOWELLI, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 116.
Grand Junction, Mesa County, Colorado.

49. THOMOMYS BOTTAE INTERNATUS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 115.
Salida, Chaffee County, Colorado.

50. THOMOMYS BOTTAE HUALPAIENSIS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 113.
Hualpai Peak, Hualpai Mountains, Mohave County, Arizona.

51. THOMOMYS BOTTAE OPTABILIS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 116.
Coventry, Naturita Creek Valley, Montrose County, Colorado.

52. THOMOMYS BOTTAE DETUMIDUS, Grinnell

1936. Univ. Calif. Publ. Zool. XL, p. 405.
One and a half miles south of town of Pistol River, Curry County, Oregon.

53. THOMOMYS BOTTAE ACRIROSTRATUS, Grinnell

1936. Univ. Calif Publ. Zool. XL, p. 408.
Valley of Mad River, 7 miles above Ruth, Trinity County, California.

54 THOMOMYS BOTTAE AGRICOLARIS, Grinnell

1936. Univ. Calif. Publ. Zool. XL, p. 409.
Stralock Farm, 3 miles west of Davis, Yolo County, California.

55 THOMOMYS BOTTAE SILVIFUGUS, Grinnell

1936. Univ. Calif. Publ. Zool. XL, p. 406.
Near Coyote Peak, 3,000 ft. altitude, Humboldt County, California.

56. THOMOMYS BOTTAE PIUTENSIS, Grinnell & Hill

1936. Proc. Biol. Soc. Washington, XLIX, p. 103.
Kern County, California; French Gulch, Piute Mountains, 2½ miles north-west of Claraville.

57. THOMOMYS MURALIS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 112.
Lower end of Prospect Valley, Grand Canyon, Hualpai Indian Reservation, Arizona.

58. THOMOMYS MAGDALENAE, Nelson & Goldman

1909. Proc. Biol. Soc. Washington, XXII, p. 24.
Magdalena Island, Lower California, Mexico.

59. THOMOMYS ALTIVALLIS, Rhoads

1895. Proc. Acad. Nat. Sci. Philadelphia, p. 34.
San Bernardino Mountains, California.

alpinus Group

60. THOMOMYS ALPINUS ALPINUS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 216.
Big Cottonwood Meadows, 8 miles south-east of Mount Whitney Peak, Tulare County, California.

61. THOMOMYS ALPINUS AWAHNEE, Merriam

1908. Proc. Biol. Soc. Washington, XXI, p. 146.
Yosemite Valley, Mariposa County, California.

62. THOMOMYS NEGLECTUS, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 117.
Bear Flat Meadows, San Antonio Peak, San Gabriel Mountains, Los Angeles County, California.

63. THOMOMYS JACINTEUS, Grinnell & Swarth

1914. Proc. Calif. Acad. Sci. 4, IV, p. 154.
Round Valley, San Jacinto Mountains, Riverside County, California.

64. THOMOMYS MARTIRENSIS, Allen

1898. Bull. Amer. Mus. Nat. Hist. X, p. 147.
San Pedro Martir Mountains, Lower California.

perpallidus Group

65. THOMOMYS PERPALLIDUS PERPALLIDUS, Merriam

1886. Science, VIII, p. 588.
Palm Springs, Riverside County, California.

66. THOMOMYS PERPALLIDUS ALBATUS, Grinnell

1912. Univ. Calif. Publ. Zool. X, p. 172.
West side of Colorado River, at Old Hanlon Ranch, Imperial County, California.

67. THOMOMYS PERPALLIDUS MOHAVENSIS, Grinnell

1918. Univ. Calif. Publ. Zool. XVII, p. 427.
Mohave River bottom near Victorville, San Bernardino County, California.

68. THOMOMYS PERPALLIDUS CHRYSONOTUS, Grinnell

912. Univ. Calif. Publ. Zool. X, p. 174.
Ehrenberg, Yuma County, Arizona.

69. THOMOMYS PERPALLIDUS PERPES, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 111.
Lone Pine, Owen's Valley, Inyo County, California.
Synonym: *scapterus*, Elliot, 1903, Field Columb. Mus. Publ. 87, zool. ser. vol. 3, p. 248. Hannopee Canyon, Panamint Mountains, Inyo County, California.

70. THOMOMYS PERPALLIDUS AMARGOSAE, Grinnell

1921. Univ. Calif. Publ. Zool. XXI, p. 239.
Shoshone, Amargosa River, Inyo County, California.

71. THOMOMYS PERPALLIDUS CANUS, Bailey

1910. Proc. Biol. Soc. Washington, XXIII, p. 79.
Deep Hole, Smoke Creek Desert, Washoe County, Nevada.

72. THOMOMYS PERPALLIDUS AUREUS, Allen

1893. Bull. Amer. Mus. Nat. Hist. V, p. 49.
Bluff City, San Juan County, Utah.

73. THOMOMYS PERPALLIDUS APACHE, Bailey

1910. Proc. Biol. Soc. Washington, XXIII, p. 79.
Lake la Jara, Jicarilla Apache Indian Reservation, New Mexico.

74. THOMOMYS PERPALLIDUS ALBICAUDATUS, Hall

1930. Univ. Calif. Publ. Zool. XXXII, p. 444.
Provo, Utah County, Utah.

75. THOMOMYS PERPALLIDUS AUREIVENTRIS, Hall

1930. Univ. Calif. Publ. Zool. XXXII, p. 444.
Kelton, Box Elder County, Utah.

76. THOMOMYS PERPALLIDUS CENTRALIS, Hall

1930. Univ. Calif. Publ. Zool. XXXII, p. 445.
Baker, White Pine County, Nevada.

77. THOMOMYS PERPALLIDUS PLANIROSTRIS, Burt

1931. Proc. Biol. Soc. Washington, XLIV, p. 38.
Zion National Peak, Washington County, Utah.

78. THOMOMYS PERPALLIDUS OSGOODI, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 424.
Hanksville, Wayne County, Utah.

79. THOMOMYS PERPALLIDUS DISSIMILIS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 425.
Mount Ellen, Garfield County, Utah.

80. THOMOMYS PERPALLIDUS ABSONUS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 425.
Houserock Valley, Coconino County, Arizona.

81. THOMOMYS PERPALLIDUS DEPAUPERATUS, Grinnell & Hill

1936. Journ. Mamm. Baltimore, 17, p. 4.
East base Tinajas Altas Mountains, 7 miles south of Raven Butte, Yuma County, Arizona.

82. THOMOMYS PERPALLIDUS RIPARIUS, Grinnell & Hill
1936. Journ. Mamm. Baltimore, 17, p. 4.
Blythe, Riverside County, California.

83. THOMOMYS PROVIDENTIALIS, Grinnell
1932. Univ. Calif. Publ. Zool. XXXVIII, p. 1.
Providence Range, San Bernardino County, California.

84. THOMOMYS OREOECUS, Burt
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 154.
Greenwater, Black Mountains, Inyo County, California.

85. THOMOMYS ARGUSENSIS, Huey
1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 43.
Argus Mountains, Inyo County, California.

86. THOMOMYS PHELLEOECUS, Burt
1933. Journ. Mamm. Baltimore, 14, p. 56.
Sheep Mountains, Clark County, Nevada.

87. THOMOMYS SOLITARIUS, Grinnell
1926. Univ. Calif. Publ. Zool. XXX, p. 177.
Stewart Valley, Mineral County, Nevada.

88. THOMOMYS ALEXANDRAE, Goldman
1933. Journ. Washington Acad. Sci. XXIII, p. 464.
Rainbow Lodge, Coconino County, Arizona.

89. THOMOMYS MELANOTIS, Grinnell
1918. Univ. Calif, Publ. Zool. XVII, p. 425.
Big Prospector Meadow, White Mountains, Mono County, California.

90. THOMOMYS CABEZONAE, Merriam
1901. Proc. Biol. Soc. Washington, XIV, p. 110.
Cabezon, San Gorgonio Pass, California (Riverside County).

91. THOMOMYS OPERARIUS, Merriam
1897. Proc. Biol. Soc. Washington, XI, p. 215.
Keeler, east side Owen's Lake, Inyo County, California.

92. THOMOMYS LATIROSTRIS, Merriam
1901. Proc. Biol. Soc. Washington, XIV, p. 107.
Little Colorado River, Painted Desert, Coconino County, Arizona.

93. THOMOMYS CERVINUS, Allen
1895. Bull. Amer. Mus. Nat. Hist. VII, p. 203.
Phoenix, Maricopa County, Arizona.

94. THOMOMYS HARQUAHALAE, Grinnell & Hill
1936. Journ. Mamm. Baltimore, 17, p. 7.
Ranegras Plain, 10 miles west of Hope, Yuma County, Arizona.

95. THOMOMYS SINALOAE, Merriam
1901. Proc. Biol. Soc. Washington, XIV, p. 108.
Altata, Sinaloa, Mexico.

fulvus Group

96. THOMOMYS FULVUS FULVUS, Woodhouse
1852. Proc. Acad. Nat. Sci. Philadelphia, VI, p. 201.
San Francisco Mountain, Coconino County, Arizona.

97. THOMOMYS FULVUS PERVAGUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 110.
Espanola, Santa Fe County, New Mexico.

98. THOMOMYS FULVUS DESERTORUM, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 114.
Mud Spring, Detrital Valley, Mohave County, Arizona.

99. THOMOMYS FULVUS INTERMEDIUS, Mearns

1897. Proc. U.S. Nat. Mus. XIX, p. 719.
Summit of Huachuca Mountains, Southern Arizona.

100. THOMOMYS FULVUS TEXENSIS, Bailey

1902. Proc. Biol. Soc. Washington, XV, p. 119.
Head of Limpia Creek, David Mountains, Jeff Davis County, Texas.

101. THOMOMYS FULVUS TOLTECUS, Allen

1893. Bull. Amer. Mus. Nat. Hist. V, p. 52.
Juarez, Chihuahua, Mexico.

102. THOMOMYS FULVUS SUBOLES, Goldman

1928. Proc. Biol. Soc. Washington, XLI, p. 203.
Old Searchlight Ferry, Colorado River, north-west of Kingman, Arizona.

103. THOMOMYS FULVUS FLAVIDUS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 417.
Parker, Yuma County, Arizona.

104. THOMOMYS FULVUS MODICUS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 418.
La Osa, Pima County, Arizona.

105. THOMOMYS FULVUS CATALINAE, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 419.
Summerhaven, Pima County, Arizona.

106. THOMOMYS FULVUS GRAHAMENSIS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 420.
Graham Mountains, Graham County, Arizona.

107. THOMOMYS FULVUS COLLINUS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 421.
Fly Park, Cochise County, Arizona.

108. THOMOMYS FULVUS PUSILLUS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 422.
Coyote Mountains, Pima County, Arizona.

109. THOMOMYS FULVUS PERAMPLUS, Goldman

1931. Journ. Washington Acad. Sci. XXI, p. 423.
Wheatfield Creek, Tunicha Mountains, Apache County, Arizona.

110. THOMOMYS FULVUS PHASMA, Goldman

1933. Proc. Biol. Soc. Washington, XLVI, p. 72.
Two miles south of Tule Tank, Tule Desert, Arizona (Yuma County).

111. THOMOMYS FULVUS SUBSIMILIS, Goldman

1933. Proc. Biol. Soc. Washington, XLVI, p. 74.
Harquahala Mountains, Yuma County, Arizona.

112. THOMOMYS FULVUS MUTABILIS, Goldman

1933. Proc. Biol. Soc. Washington, XLVI, p. 75.
Camp Verde, Yavapai County, Arizona.

113. THOMOMYS FULVUS EMOTUS, Goldman

1933. Proc. Biol. Soc. Washington, XLVI, p. 76.
Animas Park, Animas Mountains, Hidalgo County, New Mexico.

114. THOMOMYS MEARNSI, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 117.
Gray's Ranch, Animas Valley, south-west corner of Grant County, New Mexico.

115. THOMOMYS BAILEYI BAILEYI, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 109.
Sierra Blanca, El Paso County, Texas.

116. THOMOMYS BAILEYI TULAROSAE, Hall

1933. Univ. Calif. Publ. Zool. XXXVIII, p. 411.
Tularosa, Otero County, New Mexico.

117. THOMOMYS LACHUGUILLA LACHUGUILLA, Bailey

1902. Proc. Biol. Soc. Washington, XV, p. 120.
Near El Paso, El Paso County, Texas.

118. THOMOMYS LACHUGUILLA LIMITARIS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 118.
Four miles west of Boquillas, Brewster County, Texas.

119. THOMOMYS PECTORALIS, Goldman

1936. Journ. Washington Acad. Sci. XXVI, p. 120.
Vicinity of Carlsbad Cave, Carlsbad Cave National Monument, Eddy County, New Mexico.

120. THOMOMYS BURTI BURTI, Huey

1932. Trans. S. Diego Soc. Nat. Hist. 7, p. 158.
Madera Canyon, Santa Rita Mountains, Arizona (Santa Cruz County).

121. THOMOMYS BURTI QUERCINUS, Burt & Campbell

1934. Journ. Mamm. Baltimore, 15, p. 150.
Pena Blanca Spring, Pajarito Mountains, Arizona (near Mexican boundary).

122. THOMOMYS BURTI PROXIMUS, Burt & Campbell

1934. Journ. Mamm. Baltimore, 15, p. 151.
Santa Rita Mountains, Pima County, Arizona.

umbrinus Group

123. THOMOMYS UMBRINUS UMBRINUS, Richardson

1829. Fauna Boreali-Americana, vol. 1, p. 202.
Southern Mexico; probably the vicinity of Boca del Monte, Vera Cruz.

124. THOMOMYS UMBRINUS ORIZABAE, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 145.
Mount Orizaba, Puebla, Mexico.

125. THOMOMYS UMBRINUS PEREGRINUS, Merriam

1893. Proc. Biol. Soc. Washington, VIII, p. 146.
Salazar, State of Mexico, Mexico.

126. THOMOMYS UMBRINUS ALBIGULARIS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 106.
El Chico, Sierra de Pachuca, Hidalgo, Mexico.

127. THOMOMYS UMBRINUS MARTINENSIS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 108.
San Martin Texmeleuan, Puebla, Mexico.

128. THOMOMYS UMBRINUS TOLUCAE, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 109.
Volcano of Toluca, Mexico.

129. THOMOMYS UMBRINUS VULCANIUS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 109.
Popocatepetl, Mexico.

130. THOMOMYS UMBRINUS SUPERNUS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 110.
Santa Rosa, Guanajuato, Mexico.

131. THOMOMYS UMBRINUS POTOSINUS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 111.
La Tinaja, San Luis Potosi, Mexico.

132. THOMOMYS UMBRINUS ATRODORSALIS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 111.
Alvarez, San Luis Potosi, Mexico.

133. THOMOMYS UMBRINUS ZACATECAE, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 112.
Berriozabel, Zacatecas, Mexico.

134. THOMOMYS UMBRINUS ENIXUS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 112.
Sierra Moroni, Zacatecas, Mexico.

135. THOMOMYS UMBRINUS CRASSIDENS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 113.
Sierra de Valparaiso, Zacatecas, Mexico.

136. THOMOMYS UMBRINUS CHIHUAHUAE, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 114.
Sierra Madre, Chihuahua, Mexico.

137. THOMOMYS UMBRINUS DURANGI, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 114.
Durango, Durango, Mexico.

138. THOMOMYS UMBRINUS EVEXUS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 115.
Mount San Gabriel, Durango, Mexico.

139. THOMOMYS UMBRINUS MADRENSIS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 115.
Pilares Canyon, Colonia Garcia, Mexico.

140. THOMOMYS UMBRINUS CALIGINOSUS, Nelson & Goldman

1934. Journ. Mamm. Baltimore, 15, p. 116.
Altamirano, Sierra Madre, Chihuahua, Mexico.

141. THOMOMYS UMBRINUS CHIRICAHUAE, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 117.
Chiricahua Mountains, Arizona.

142. THOMOMYS UMBRINUS SONORIENSIS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 118.
Chinapa, Sonora River Valley, Mexico.

143. THOMOMYS UMBRINUS EXTIMUS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 119.
Colomo, Nayarit, Mexico.

144. THOMOMYS UMBRINUS MUSCULUS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 119.
Sierra de Teponahuaxtla, Nayarit, Mexico.

145. THOMOMYS UMBRINUS EXIMIUS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 118.
Choix, Sinaloa, Mexico.

146. THOMOMYS NELSONI, Merriam
1901. Proc. Biol. Soc. Washington, XIV, p. 109.
Parral, Chihuahua, Mexico.

147. THOMOMYS SHELDONI, Bailey
1915. North Amer. Fauna, no. 39, p. 93.
Santa Teresa, Nayarit, Mexico.

148. THOMOMYS GOLDMANI, Merriam
1901. Proc. Biol. Soc. Washington, XIV, p. 108.
Mapimi, Durango, Mexico.

149. THOMOMYS PERDITUS, Merriam
1901. Proc. Biol. Soc. Washington, XIV, p. 108.
Lampazos, Nuevo Leon, Mexico.

150. THOMOMYS ATROVARIUS, Allen
1898. Bull. Amer. Mus. Nat. Hist. X, p. 148.
Tatemeles, Sinaloa, Mexico.

151. THOMOMYS SIMULUS SIMULUS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 120.
Alamos, Southern Sonora, Mexico.

152. THOMOMYS SIMULUS PARVICEPS, Nelson & Goldman
1934. Journ. Mamm. Baltimore, 15, p. 121.
Chacala, Western Durango, Mexico.

talpoides Group

153. THOMOMYS TALPOIDES TALPOIDES, Richardson
1828. Zool. Journ. vol. 3, p. 518.
Near Fort Carlton, Saskatchewan, Canada.
Synonym: *borealis*, Richardson, 6th Ann. Rept. Brit. Assn. for 1836, V, pp. 150, 157, 1837 (*fide* Bailey).

154. THOMOMYS TALPOIDES RUFESCENS, Wied
1839. Nova Acta. Phys. Med. Acad. Caes. Leop. Carol. XIX, pt. i, p. 378.
Minnetaree Village, now Old Fort Clark, about 6 miles south of Stanton, Mercer County, North Dakota.

155. THOMOMYS TALPOIDES CLUSIUS, Coues

1875. Proc. Acad. Nat. Sci. Philadelphia, p. 138.
Bridger Pass, 18 miles south-west of Rawlins, Carbon County, Wyoming.

156. THOMOMYS TALPOIDES BULLATUS, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 115.
Powderville, Custer County, Montana.

157. THOMOMYS TALPOIDES NEBULOSUS, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 116.
Jack Boyden's Ranch, Sand Creek Canyon, Crook County, Wyoming.

158. THOMOMYS TALPOIDES CARYI, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 115.
Head of Trapper Creek, Bighorn Mountains, Bighorn County, Wyoming.

159. THOMOMYS TALPOIDES PRYORI, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 116.
Sage Creek, Pryor Mountains, Montana.

160. THOMOMYS TALPOIDES AGRESTIS, Merriam

1908. Proc. Biol. Soc. Washington, XXI, p. 144.
Medano Ranch, San Luis Valley, Colorado.

161. THOMOMYS TALPOIDES MACROTIS, F. Miller

1920. Proc. Colorado Mus. 9, p. 41.
D'Arcy Ranch, Parker, Douglas County, Colorado.

162. THOMOMYS COLUMBIANUS, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 117.
Touchet, Walla Walla County, Washington.

163. THOMOMYS OCIUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 114.
Six miles south-west of Old Fort Bridger, Uinta County, Wyoming.

164. THOMOMYS IDAHOENSIS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 114.
Birch Creek, Fremont County, Idaho.

165. THOMOMYS PYGMAEUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 115.
Montpelier Creek, Bear County, Idaho.

fossor Group

166. THOMOMYS FOSSOR, Allen

1893. Bull. Amer. Mus. Nat. Hist. V, p. 51.
Florida, La Plata County, Colorado.

167. THOMOMYS BRIDGERI, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 113.
Six miles south-west of Old Fort Bridger, Uinta County, Wyoming.

168. THOMOMYS UINTA, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 112.
Black's Fork, north base of Gilbert's Peak, Uinta Mountains, Summit County, Utah.

169. THOMOMYS QUADRATUS QUADRATUS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 214.
The Dalles, Wasco County, Oregon.

170. THOMOMYS QUADRATUS FISHERI, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 111.
Beckwith, Sierra Valley, Plumas County, California.

171. THOMOMYS QUADRATUS WALLOWA, Hall & Orr

1933. Proc. Biol. Soc. Washington, XLVI, p. 41.
Catherine Peak, Telocaset, Oregon.

172. THOMOMYS QUADRATUS MONOENSIS, Huey

1934. Trans. S. Diego Soc. Nat. Hist. 7, p. 373.
Dexter Creek Meadow, Mono County, California.

173. THOMOMYS FALCIFER, Grinnell

1926. Univ. Cal. Publ. Zool. XXX, p. 180.
Bell's Ranch, Nye County, Nevada.

douglasii group

174. THOMOMYS DOUGLASII DOUGLASII, Richardson

1829. Fauna Boreali-Americana, vol. 1, p. 200.
Near mouth of Columbia River, Oregon.

175. THOMOMYS DOUGLASII YELMENSIS, Merriam

1899. Proc. Biol. Soc. Washington, XIII, p. 21.
Penino, Yelm Prairie, Thurston County, Washington.

176. THOMOMYS DOUGLASII OREGONUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 115.
Ely, near Oregon City, Clackamas County, Oregon.

177. THOMOMYS DOUGLASII TACOMENSIS, Taylor

1919. Proc. Biol. Soc. Washington, XXXII, p. 169.
Six miles south of Tacoma, Pierce County, Washington.

178. THOMOMYS DOUGLASII MELANOPS, Merriam

1899. Proc. Biol. Soc. Washington, XIII, p. 21.
Timberline at head of Soleduc River, Olympic Mountains, Clallam County, Washington.

179. THOMOMYS DOUGLASII SHAWI, Taylor

1921. Proc. Biol. Soc. Washington, XXXIV, p. 121.
Owyhigh Lake, Mount Rainier, Pierce County, Washington.

180. THOMOMYS DOUGLASII LIMOSUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 116.
White Salmon, Gorge of the Columbia, Klickitat County, Washington.

181. THOMOMYS NIGER, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 117.
Seaton, Umpqua River, Douglas County, Oregon.

monticola Group

182. THOMOMYS MONTICOLA MONTICOLA, Allen

1893. Bull. Amer. Mus. Nat. Hist. V, p. 48.
Mount Tallac, El Dorado County, California.

183. THOMOMYS MONTICOLA MAZAMA, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 214.
Anna Creek, near Crater Lake, Mt. Mazama, Klamath County, Oregon.

184. THOMOMYS MONTICOLA PINETORUM, Merriam

1899. North Amer. Fauna, no. 16, p. 97.
Sisson, Siskiyou County, California.
Synonym: *monticola premaxillaris*, Grinnell, 1914, Univ. Calif. Publ. Zool. XII, p. 312. Two miles south of S. Yolla Bolly Mountain, Tehama County, California.

185. THOMOMYS MONTICOLA NASICUS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 216.
Farewell Bend, Deschutes River, Crook County, Oregon.

186. THOMOMYS MONTICOLA HELLERI, Elliot

1903. Field Columb. Mus. Publ. Zool. Ser. 74, vol. 3, p. 165.
Goldbeach, Rogue River, Curry County, Oregon.

fuscus group

187. THOMOMYS FUSCUS FUSCUS, Merriam

1891. North Amer. Fauna, no. 5, p. 70.
Mountains at head of Big Lost River, Custer County, Idaho.

188. THOMOMYS FUSCUS SATURATUS, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 117.
Silver, near Saltese, Coeur D'Alene Mountains, Missoula County, Montana.

189. THOMOMYS FUSCUS LORINGI, Bailey

1914. Proc. Biol. Soc. Washington, XXVII, p. 118.
South Edmonton, Alberta, Canada.

190. THOMOMYS FUSCUS MYOPS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 112.
Conconully, east base of Cascade Range, Okanogan County, Washington.

191. THOMOMYS HESPERUS, Merriam

1901. Proc. Biol. Soc. Washington, XIV, p. 116.
Tillamook, Tillamook County, Oregon.

Subgenus *Megascapheus*, Elliot

192. THOMOMYS BULBIVORUS, Richardson

1829. Fauna Boreali-Americana, vol. 1, p. 206.
Columbia River, probably near Portland, Oregon.

Genus 2. GEOMYS, Rafinesque

1817. GEOMYS, Rafinesque, Amer. Monthly Mag. II, p. 45.

TYPE SPECIES.—*Geomys pinetis*, Rafinesque = *Mus tuza*, Barton.

RANGE.—"Middle U.S.A. from Red River Valley in North-west Minnesota and north-eastern North Dakota to Mexican boundary along Rio Grande; also southern half of Alabama and Georgia, and northern half of

Florida." Evidently now known to extend across the border into North-eastern Mexico (Tamaulipas).

Number of Forms.—Nineteen.

Characters.—Upper premolar with posterior enamel plate absent. M.1 and M.2 with two enamel plates each, the posterior one incomplete. M.3 with no well-marked heel. Upper incisors with two grooves, the main one placed centrally. "Orbitosphenoid small and narrow, not reaching alisphenoid . . . alisphenoid short posteriorly . . . pterygoids large, always forming more than half of palatopterygoid extensions."

(Further characters appertaining to the detail cranial characters of this genus will be found in p. 109 of Merriam's monograph (reference on p. 506).)

Merriam gives a most interesting account of the activities of a live Pocket-Gopher in which the animal's method of using the cheekpouches is fully explained. He states: "A live *Geomys* from Vernon, Texas, has been carefully observed for the purpose of ascertaining how the reserve food is placed in the cheekpouches. The animal soon became sufficiently tame to eat freely from hand, and was commonly fed bits of potato of which he was particularly fond. The manner of eating was peculiar and interesting, and showed an ability to use the huge forefeet and claws in a way previously unsuspected. After satisfying the immediate demands of hunger it was his practice to fill one or both cheek-pouches. . . . The usual course is as follows: a piece of potato, root or other food is seized between the incisor teeth and is immediately transferred to the fore-paws which are held in a horizontal position, the tips of the claws curving toward one another. If the food required reduction in size, the trimming is done while held in this position. The piece is passed rapidly across the side of the face with a sort of wiping motion which forces it into the open mouth of the pouch. Sometimes a single rapid stroke with one hand is sufficient, at other times both hands are used . . . in such cases the long claws of one hand are used to draw down the lower side of the opening, while the food is poked in with the other. It is obviously impossible for the animal to pass food from the mouth to the pouches without the aid of the foreclaws. The most remarkable thing connected with the pouches is the way they are emptied. The forefeet are brought back simultaneously along the sides of the head until they reach a point opposite the hinder end of the pouches. They are then pressed firmly against the head and carried rapidly forward. In this way the contents of the pouches are promptly dumped in front of the animal."

In connection with the last paragraph, it may be of interest to note that I have seen very much the same way of emptying pouches practised by the Golden Hamster, *Mesocricetus auratus*; though in this case of course the cheekpouch does not open externally.

The tail is already noted in these animals as being used apparently for feeling purposes; the tails of those examined appear, though sometimes naked, to be quite devoid of any scales.

The species of *Geomys* were revised by Merriam, who recognized three specific groups: the *tuza* group, in which the tail is more naked than in the others;

the *bursarius* group, containing a large form, differing from the other species in cranial characters, among which the sagittal crest is said to be more strongly developed; and the *breviceps* group, containing forms which Merriam regards as the most primitive of the genus.

Forms examined: *tuza*, *bursarius*, *personatus*, *floridanus*.

List of Named Forms

(For status of "*Geomys mexicanus*," Lichtenstein, nec Kerr, Anim. Kingd., p. 207, 1792, see Merriam, 1895, North Amer. Fauna, no. 8, p. 201.)

tuza Group

1. GEOMYS TUZA TUZA, Barton

1806. Voigt's Mag. der Naturkunde, vol. 12, p. 488.
Georgia.
Synonym: *pinetis*, Rafinesque, Amer. Monthly Mag. II, p. 45, 1817.

2. GEOMYS TUZA MOBILENSIS, Merriam

1895. North Amer. Fauna, no. 8, p. 119.
Point Clear, Mobile Bay, Baldwin County, Alabama.

3. GEOMYS FLORIDANUS FLORIDANUS, Audubon & Bachman

1854. Quadr. N. Amer. vol. 3, p. 242.
St. Augustine, St. John County, Florida.

4. GEOMYS FLORIDANUS AUSTRINUS, Bangs

1898. Proc. Boston Soc. Nat. Hist. 28, p. 177.
Belleair, Hillsboro County, Florida.

5. GEOMYS COLONUS, Bangs

1898. Proc. Boston Soc. Nat. Hist. 28, p. 178.
St. Mary's, Camden County, Georgia.

6. GEOMYS CUMBERLANDIUS, Bangs

1898. Proc. Boston Soc. Nat. Hist. 28, p. 180.
Stafford Place, Cumberland Island, Camden County, Georgia.

bursarius Group

7. GEOMYS BURSARIUS BURSARIUS, Shaw

1800. Trans. Linn. Soc. V, p. 227.
Upper Mississippi Valley; exact locality unknown.
Synonym: *fusca*, Rafinesque, 1817, Amer. Monthly Mag. II, p. 45.
cinerea, Rafinesque, 1817. Same reference.
canadensis, Lichtenstein, Ab. Akad. Berlin, p. 20, 1822.
saccatus, Mitchill, N. Y. Med. Repos. xxi, 1821.
(The above names quoted as synonyms by Trouessart.)

8. GEOMYS BURSARIUS ILLINOENSIS, Komarek & Spencer

1931. Journ. Mamm. Baltimore, 12, p. 405.
Momence, Kankakee County, Illinois.

breviceps Group

9. GEOMYS LUTESCENS, Merriam

1890. North Amer. Fauna, no. 4, p. 51.
Birdwood Creek, Lincoln County, Western Nebraska.

10. GEOMYS BREVICEPS BREVICEPS, Baird

1855. Proc. Acad. Nat. Sci. Philadelphia, VII, p. 335.
Prairie Mer Rouge, Morehouse Parish, Louisiana.

11. GEOMYS BREVICEPS SAGITTALIS, Merriam

1895. North Amer. Fauna, no. 8, p. 134.
Clear Creek, Galveston Bay, Galveston County, Texas.

12. GEOMYS BREVICEPS ATTWATERI, Merriam

1895. North Amer. Fauna, no. 8, p. 135.
Rockport, Aransas County, Texas.

13. GEOMYS BREVICEPS LLANENSIS, Bailey

1905. North Amer. Fauna, no. 25, p. 129.
Llano, Llano County, Texas.

14. GEOMYS TEXENSIS, Merriam

1895. North Amer. Fauna, no. 8, p. 137.
Mason, Mason County, Texas.

15. GEOMYS ARENARIUS ARENARIUS, Merriam

1895. North Amer. Fauna, no. 8, p. 139.
El Paso, El Paso County, Texas.

16. GEOMYS ARENARIUS BREVIROSTRIS, Hall

1932. Proc. Biol. Soc. Washington, XLV, p. 97.
Tularosa, Otero County, New Mexico.

17. GEOMYS PERSONATUS PERSONATUS, True

1889. Proc. U.S. Nat. Mus. II, 1888, p. 159.
Padre Island, Cameron County, Texas.

18. GEOMYS PERSONATUS FALLAX, Merriam

1895. North Amer. Fauna, no. 8, p. 144.
South side of Nueces Bay, Cameron County, Texas.

19. GEOMYS PERSONATUS TROPICALIS, Goldman

1915. Proc. Biol. Soc. Washington, XXVIII, p. 134.
Alta Mira, Tamaulipas, Mexico.

Genus 3. PAPPOGEOMYS, Merriam

1895. PAPPOGEOMYS, Merriam, North Amer. Fauna, no. 8, p. 145.

TYPE SPECIES.—*Geomys bulleri*, Thomas.

RANGE.—Jalisco, Mexico.

NUMBER OF FORMS.—Two.

CHARACTERS.—Arrangement of enamel plate on molars and premolar as in *Geomys*. M.3 an imperfectly developed double prism, a sulcus on outer side, behind which crown narrows to form a moderate heel. Upper incisors one-grooved. No sagittal crest developed. Zygomata slender. "Palatopterygoids little more than vertical lamellae. Orbitosphenoids broad, articulating firmly with alisphenoids" (compare *Geomys*). For further cranial details see p. 145 of Merriam's monograph.

Forms examined: *bulleri*.

List of Named Forms

1. PAPPOGEOMYS BULLERI, Thomas

1892. Ann. Mag. Nat. Hist. 6, X, p. 196.
Near Talpa, Sierra de Mascota, Jalisco, Mexico.
Synonym: *nelsoni*, Merriam, 1892, Proc. Biol. Soc. Washington, VII, p. 164. Sierra Nevada of Colima, Jalisco, Mexico.

2. PAPPOGEOMYS ALBINASUS, Merriam

1895. North Amer. Fauna, no. 8, p. 149.
Atemajac, Guadalajara, Jalisco, Mexico.

Genus 4. CRATOGEOMYS, Merriam

1895. Cratogeomys, Merriam, North Amer. Fauna, no. 8, p. 150.

Type Species.—*Geomys merriami*, Thomas.

Range.—"Great Plains of U.S.A., from Arkansas River in Eastern Colorado southward, and eastern tableland of Mexico, to extreme southern edge, in the states of Mexico and Puebla" (Merriam).

Number of Forms.—Twenty-four are now named.

Characters.—Enamel of upper premolar as in *Geomys*, but M.1 and M.2 with one enamel plate each, the posterior one absent. M.3 with deep sulcus on outer side. Upper incisors one-grooved. "Orbitosphenoids short and broad, articulating with alisphenoid anteriorly." (Further cranial details will be found in Merriam's monograph, p. 150.) Sagittal crest usually developed, apparently.

Differing from *Platygeomys*, which has a similar arrangement of enamel plate, in the following characters: breadth of cranium posteriorly much less than zygomatic breadth; breadth of occipital plane not more than twice its height; lambdoid crest broadly convex posteriorly; mandible including incisors longer than broad; squamosal expansion chiefly towards median line.

Cratogeomys is the only genus besides *Thomomys* and *Geomys* which ranges north into the United States, the other six being entirely either Mexican or Central American.

Forms examined: *merriami*, *estor*, *castanops* (skin).

List of Named Forms

1. CRATOGEOMYS MERRIAMI MERRIAMI, Thomas

1893. Ann. Mag. Nat. Hist. 6, XII, p. 271.
Southern Mexico, probably in the Valley of Mexico.

2. CRATOGEOMYS MERRIAMI SACCHARALIS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 149.
Atlixco, Puebla, Mexico.

3. CRATOGEOMYS MERRIAMI IROLONIS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 150.
Irolo, Hidalgo, Mexico.

4. CRATOGEOMYS PEROTENSIS, Merriam

1895. North Amer. Fauna, no. 8, p. 154.
Cofre de Perote, Vera Cruz, Mexico.

5. CRATOGEOMYS ESTOR, Merriam

1895. North Amer. Fauna, no. 8, p. 155.
Las Vigas, Vera Cruz, Mexico.

6. CRATOGEOMYS OREOCETES, Merriam

1895. North Amer. Fauna, no. 8, p. 156.
Mt. Popocatepetl, State of Mexico, Mexico.

7. CRATOGEOMYS PEREGRINUS, Merriam

1895. North Amer. Fauna, no. 8, p. 158.
Mt. Iztaccihuatl, State of Mexico, Mexico.

8. CRATOGEOMYS CASTANOPS CASTANOPS, Baird

1852. Report Stansbury's Exped. to Great Salt Lake, p. 313.
Prairie Road to Bent's Fort, near present town of Las Animas, Bent County, Colorado.
Synonym: *clarkii*, Baird, Proc. Acad. Nat. Sci. Philadelphia, 1855, p. 332.

9. CRATOGEOMYS CASTANOPS GOLDMANI, Merriam

1895. North Amer. Fauna, no. 8, p. 160.
Canitas, Zacatecas, Mexico.

10. CRATOGEOMYS CASTANOPS PERPLANUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 136.
Tascosa, Oldham County, Texas.

11. CRATOGEOMYS CASTANOPS LACRIMALIS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 137.
Roswell, Chaves County, New Mexico.

12. CRATOGEOMYS CASTANOPS HIRTUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 138.
Albuquerque, New Mexico.

13. CRATOGEOMYS CASTANOPS ANGUSTICEPS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 139.
Eagle Pass, Texas.

14. CRATOGEOMYS CASTANOPS CONSITUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 140.
Gallego, Chihuahua, Mexico.

15. CRATOGEOMYS CASTANOPS TAMAULIPENSIS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 141.
Matamoros, Tamaulipas, Mexico.

16. CRATOGEOMYS CASTANOPS EXCELSUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 143.
San Pedro, Coahuila, Mexico.

17. CRATOGEOMYS CASTANOPS SUBSIMUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 144.
Jaral, Coahuila, Mexico.

18. CRATOGEOMYS CASTANOPS SUBNUBILIS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 145.
Carneros, Coahuila, Mexico.

19. CRATOGEOMYS CASTANOPS PLANIFRONS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 146.
Miquihuana, Nuevo Leon, Mexico.

20. CRATOGEOMYS CASTANOPS CONVEXUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 142.
Las Vacas, Coahuila, Mexico.

21. CRATOGEOMYS CASTANOPS PERIDONEUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 148.
Rio Verde, San Luis Potosi, Mexico.

22. CRATOGEOMYS CASTANOPS RUBELLUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 147.
Soledad, San Luis Potosi, Mexico.

23. CRATOGEOMYS FULVESCENS FULVESCENS, Merriam

1895. North Amer. Fauna, no. 8, p. 161.
Chalchicomula, Puebla, Mexico.

24. CRATOGEOMYS FULVESCENS SUBLUTEUS, Nelson & Goldman

1934. Proc. Biol. Soc. Washington, XLVII, p. 152.
Perote, Vera Cruz, Mexico.

Genus 5. PLATYGEOMYS, Merriam

1895. PLATYGEOMYS, Merriam, North Amer. Fauna, no. 8, p. 162.

TYPE SPECIES.—*Geomys gymnurus*, Merriam.

RANGE.—"Southern border of Mexican tableland; States of Colima, Jalisco, Michoacan, Mexico and Hidalgo."

NUMBER OF FORMS.—Six.

CHARACTERS.—Arrangement of enamel plate on upper premolar and molars as in *Cratogeomys*. Upper incisor one-grooved. "Hinder part of cranium extraordinarily broad and flat, the great breadth chiefly due to the lateral expansion of the squamosals, which completely arch over and conceal the postglenoid notch. Zygomatic arches massive, broadly spreading anteriorly; jugal normally large, forming an important part of the arch. Pterygoids vertical lamellae with inferior border everted. Orbitosphenoids larger than in *Cratogeomys*, but not normally articulating with alisphenoid. . . . Lambdoid crest sinuous, presenting three posterior concavities. Mandible very much broader than long, the angular process extremely long and spreading, reaching so far out laterally that the knob of the root of the incisor is midway between condyle and end of angular process."

Forms examined: *fumosus*.

LIST OF NAMED FORMS

1. PLATYGEOMYS GYMNURUS, Merriam

1892. Proc. Biol. Soc. Washington, VII, p. 166.
Zapotlan, Jalisco, Mexico.

2. PLATYGEOMYS TYLORHINUS TYLORHINUS, Merriam

1895. North Amer. Fauna, no. 8, p. 167.
Tula, Hidalgo, Mexico.

3. PLATYGEOMYS TYLORHINUS ANGUSTIROSTRIS, Merriam

1903. Proc. Biol. Soc. Washington, XVI, p. 81.
Patamban, Michoacan, Mexico.

4 PLATYGEOMYS NEGLECTUS, Merriam

1902. Proc. Biol. Soc. Washington, XV, p. 68.
Cerro de la Calentura, about 8 miles north-west of Pinal de Amoles, Queretaro, Mexico.

5. PLATYGEOMYS PLANICEPS, Merriam

1895. North Amer. Fauna, no. 8, p. 168.
Volcan of Toluca, State of Mexico, Mexico.

6. PLATYGEOMYS FUMOSUS, Merriam

1895. North Amer. Fauna, no. 8, p. 170.
Colima City, Colima, Mexico.

Genus 6. ORTHOGEOMYS, Merriam

1895. Orthogeomys, Merriam, North Amer. Fauna, no. 8, p. 172.

Type Species.—*Geomys scalops*, Thomas.

Range.—Oaxaca and Chiapas in extreme Southern Mexico and adjacent parts of Guatemala. Ranging into Guerrero; and known also from Honduras and Salvador.

Number of Forms.—Twelve.

Characters.—Upper premolar with three or four enamel plates, the posterior one, when present (*latifrons* only, according to Merriam), restricted to the inner fourth. M.1 and M.2 with two enamel plates each. Upper incisors one-grooved. M.3 with backwardly projecting heel. "Skull as a whole much elongated. Frontals extraordinarily broad and flat, much broader than muzzle, with sides nearly parallel. Zygomata narrow or moderately spreading. Angle of mandible short. Orbitosphenoids rather large, articulating with anterior part of alisphenoids; . . . third endoturbinal larger and much broader than second, a unique condition in the family. Palatopterygoids long and narrow, of nearly equal breadth throughout." (For further cranial details see p. 173 of Merriam's monograph.) Sagittal crest so far as seen developed. The members of this genus are large forms, with coarse pelage, apparently easily distinguishable from other genera by their unconstricted frontals.

Forms seen: *scalops*, *grandis*.

List of Named Forms

1 ORTHOGEOMYS CUNICULUS, Elliot

1905. Proc. Biol. Soc. Washington, XVIII, p. 234.
Yautepec, Oaxaca, Mexico.

2. ORTHOGEOMYS SCALOPS, Thomas
1894. Ann. Mag. Nat. Hist. 6, XIII, p. 437.
Tehuantepec, Oaxaca, Mexico.

3. ORTHOGEOMYS GRANDIS GRANDIS, Thomas
1893. Ann. Mag. Nat. Hist. 6, XII, p. 270.
Duenas, Guatemala.

4. ORTHOGEOMYS GRANDIS ALLENI, Nelson & Goldman
1930. Journ. Mamm. Baltimore, 11, p. 156.
Acapulco, Guerrero, Mexico.

5. ORTHOGEOMYS GRANDIS FELIPENSIS, Nelson & Goldman
1930. Journ. Mamm. Baltimore, 11, p. 157.
Cerro San Felipe, Oaxaca, Mexico.

6. ORTHOGEOMYS GRANDIS GUERRERENSIS, Nelson & Goldman
1930. Journ. Mamm. Baltimore, 11, p. 158.
El Limon, La Union, Guerrero, Mexico.

7. ORTHOGEOMYS GRANDIS VULCANI, Nelson & Goldman
1930. Proc. Biol. Soc. Washington, XLIV, p. 105.
Volcan Santa Maria, Guatemala.

8. ORTHOGEOMYS GRANDIS PLUTO, Lawrence
1933. Proc. New England Zool. Club, 13, p. 66.
Cerro Cantoral, Tegucigalpa, Honduras.

9. ORTHOGEOMYS GRANDIS ANNEXUS, Nelson & Goldman
1933. Proc. Biol. Soc. Washington, XLVI, p. 195.
Tuxtla Gutierrez, Chiapas, Mexico.

10. ORTHOGEOMYS NELSONI, Merriam
1895. North Amer. Fauna, no. 8, p. 176.
Mount Zempoaltepec, Oaxaca, Mexico.

11. ORTHOGEOMYS LATIFRONS, Merriam
1895. North Amer. Fauna, no. 8, p. 178.
Guatemala; exact locality unknown.

12. ORTHOGEOMYS PYGACANTHUS, Dickey
1928. Proc. Biol. Soc. Washington, XLI, p. 9.
Cacaguatique, San Miguel, El Salvador.

Genus 7. HETEROGEOMYS, Merriam

1895. Heterogeomys, Merriam, North Amer. Fauna, no. 8, p. 179.

Type Species.—*Geomys hispidus*, Le Conte.

Range.—Mexico, Vera Cruz to Campeche, extending south into Guatemala.

Number of Forms.—Seven.

Characters.—Upper premolar with four enamel plates, the posterior one restricted to the inner half. M.1 and M.2 with two enamel plates. M.3 a double prism, crown longer than broad, the heel well developed. "Skull as a whole high and narrow; frontal broad and flat; . . . temporal depressions anteriorly defining a well-marked frontal shield. Inferior surface of palatopterygoid cuneate-linguate, long and slender, the palatal arms much elongated; pterygoid part small and postpalatal pits deep. Orbitosphenoids shield-shaped, rather narrow and long, not articulating with alisphenoids. . . . Mandible with angular process short." Pelage harsh.

Forms seen: ***hispidus, torridus.***

List of Named Forms

1. HETEROGEOMYS HISPIDUS HISPIDUS, Le Conte
1852. Proc. Acad. Nat. Sci. Philadelphia, VI, p. 158.
Near Jalapa, Vera Cruz, Mexico.

2. HETEROGEOMYS HISPIDUS CONCAVUS, Nelson & Goldman
1929. Proc. Biol. Soc. Washington, XLII, p. 148.
Pinal de Amoles, Queretaro, Mexico.

3. HETEROGEOMYS HISPIDUS ISTHMICUS, Nelson & Goldman
1929. Proc. Biol. Soc. Washington, XLII, p. 149.
Jaltipam, Vera Cruz, Mexico.

4. HETEROGEOMYS HISPIDUS YUCATANENSIS, Nelson & Goldman
1929. Proc. Biol. Soc. Washington, XLII, p. 150.
Campeche, Mexico.

5. HETEROGEOMYS HISPIDUS CHIAPENSIS, Nelson & Goldman
1929. Proc. Biol. Soc. Washington, XLII, p. 151.
Tenejapa, San Cristobal, Chiapas, Mexico.

6. HETEROGEOMYS LANIUS, Elliot
1905. Proc. Biol. Soc. Washington, XVIII, p. 235.
Xuchil, Vera Cruz, Mexico.

7. HETEROGEOMYS TORRIDUS, Merriam
1895. North Amer. Fauna, no. 8, p. 183.
Chichicaxtle, Vera Cruz, Mexico.

Genus 8. MACROGEOMYS, Merriam

1895. Macrogeomys, Merriam, North Amer. Fauna, no. 8, p. 185.

Type Species.—*Geomys heterodus*, Peters.

Range.—Now known from Nicaragua, Costa Rica and Panama.

Number of Forms.—Nine.

Characters.—Upper premolar with four enamel plates, the posterior restricted to the inner third. M.3 with deep outer sulcus and elongated heel which is greatly developed, attaining the maximum size known in the family. Upper incisor one-grooved. "Frontals broad, flat, depressed or concave along median line, deeply excavated laterally between orbits, the notch immediately succeeded by a strongly developed postorbital process. Palatopterygoids broad, short, and truncated posteriorly, the horizontal part composed above wholly of palatal, the pterygoid simply capping the end and abruptly upturned at right angles. Braincase rising above posterior root of zygoma. . . . The occipital plane is flat and slopes strongly forwards as in *Heterogeomys*."

There is a marked tendency apparently for the jugal to become abnormally reduced; in more than one specimen seen it is nearly as in *Zygogeomys* in that the zygomatic arch appears complete without it; also in *costaricensis*, according to Merriam, the zygoma is in this condition.

Species of this genus are large forms. A sagittal crest is evidently developed in the adult.

Forms seen: *cavator*, *heterodus*, *dolichocephalus*.

List of Named Forms

1. MACROGEOMYS HETERODUS, Peters

1864. Monatsber. k. preuss. Akad. Wiss. Berlin, p. 177.
Costa Rica.

2. MACROGEOMYS DOLICHOCEPHALUS, Merriam

1895. North Amer. Fauna, no. 8, p. 189.
San José, Costa Rica.

3. MACROGEOMYS CAVATOR, Bangs

1902. Bull. Mus. Comp. Zool. Harvard Coll. XXXIX, p. 42.
Boquete, Chiriqui, Panama.

4. MACROGEOMYS DARIENSIS, Goldman

1912. Smiths. Misc. Coll. LX, no. 2, p. 8.
Cana, mountains of Eastern Panama.

5. MACROGEOMYS PANSA, Bangs

1902. Bull. Mus. Comp. Zool. Harvard Coll. XXXIX, p. 44.
Bogava, Chiriqui, Panama.

6. MACROGEOMYS COSTARICENSIS, Merriam

1895. North Amer. Fauna, no. 8, p. 192.
Pacuare, Costa Rica.

7. MACROGEOMYS CHERRIEI, Allen

1893. Bull. Amer. Mus. Nat. Hist. V, p. 337.
Santa Clara, Costa Rica.

8. MACROGEOMYS MATAGALPAE, Allen

1910. Bull. Amer. Mus. Nat. Hist. XXVIII, p. 97.
Peña Blanca, Matagalpa, Nicaragua.

9. MACROGEOMYS UNDERWOODI, Osgood

1931. Field. Mus. Publ. Zool. 18, p. 143.
Alto de Jabillo Pirris, Western Costa Rica.

Genus 9. ZYGOGEOMYS, Merriam

1895. Zygogeomys, Merriam, North Amer. Fauna, no. 8, p. 195.

Type Species.—*Zygogeomys trichopus*, Merriam.

RANGE.—Mexico: "The Sierra Madre of Michoacan, from Patzcuaro to Nahuatzin; strictly limited to the pine zone, between altitudes of 6,800 and 9,500 feet" (Miller).

NUMBER OF FORMS.—One.

CHARACTERS.—Upper premolar with four enamel plates, the posterior restricted to the lingual third. M.1 and M.2 with two enamel plates each. M.3 with crown longer than broad, the heel well developed; upper incisors two-grooved. "Cranium as a whole long and narrow; zygomata not widely spreading; . . . zygomatic arch normally complete without the jugal, maxillary and squamosal arms in contact above it; jugal inferior, rudimentary, and chiefly external. Rostrum long and narrow. . . . Pterygoids vertical lamellae as in *Thomomys*, meeting or nearly meeting in median line behind palate. . . . Mandible rather long and slender, as in *Geomys bursarius*. Orbitosphenoids relatively larger than in any other genus in the family, closing upper part of the sphenoidal fissure except for a foramen at apex, and ankylosed broadly with the alisphenoid as in some species of *Thomomys*." Sagittal crest well developed in the one skull seen.

Forms examined: *trichopus*.

LIST OF NAMED FORMS

1. ZYGOGEOMYS TRICHOPUS, Merriam

1895. North Amer. Fauna, no. 8, p. 196.
Nahuatzin, Michoacan, Mexico.

GEOMYIDAE:
SPECIAL WORKS OF REFERENCE

MERRIAM, North American Fauna, no. 8, pp. 11–258, 1895. Monograph and full revision of all forms then known of all genera except *Thomomys*.

BAILEY, North American Fauna, no. 39, Nov. 15, 1915. Full revision of *Thomomys* with figures of skulls of all leading species.

COUES, Monograph of North American Rodents, 1877: Geomyidae: p. 607.

The family Geomyidae is known from the Oligocene, but apparently not outside the North American continent.

Superfamily ANOMALUROIDAE

As here understood this contains one family, the Anomaluridae, with two widely separated subfamilies the Anomalurinae and the Idiurinae, the last regarded as of family rank by Miller & Gidley.

Family ANOMALURIDAE

1896. Thomas: ANOMALURI: Family Anomaluridae.

1899. Tullberg: SCIUROGNATHI: *Myomorpha*: Anomaluroidei, part: Family Anomaluridae.

1918. Miller & Gidley: Superfamily DIPODOIDAE, part, Family Anomaluridae (*Anomalurus*); Family Idiuridae, the latter with subfamilies Idiurinae (*Idiurus*), and Zenkerellinae (*Zenkerella*).
1924. Winge: Family Anomaluridae, part, Anomalurini.
1928. Weber: ANOMALUROIDEA, part, Family Anomaluridae.

GEOGRAPHICAL DISTRIBUTION.—Africa, Western and Central: from Sierra Leone to Uganda, Tanganyika and Northern Rhodesia.

NUMBER OF GENERA.—Four.

CHARACTERS.—Zygomasseteric structure (so far as it affects shape of skull) essentially as defined by Miller & Gidley for their Superfamily Dipodoidae, "Masseter lateralis superficialis with anterior head not distinct, this portion of muscle attaching along a considerable area on anterior border of zygoma; zygomatic plate nearly horizontal, always narrow and completely beneath infraorbital foramen; angular portion of mandible not distorted outwards to permit . . . passage of branch of masseter lateralis." Infraorbital foramen large, transmitting muscle, extremely enlarged in the subfamily Idiurinae; skull with no special peculiarities in the typical subfamily; zygomatic region comparatively unmodified; jugal long; auditory bullae not excessively inflated.

Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}=20$, the cheekteeth rooted, flatcrowned, relatively brachyodont, characterized by a pattern of narrow cross ridges separating wide recurrent spaces.

Externally considerably modified for arboreal life; form usually Pteromyine; a flying-membrane usually attached to sides; underside of tail with scaly outgrowths on posterior portion near the body. Tibia and fibula (so far as known) not fully fused.

REMARKS.—The Anomaluridae have by some authors been placed in the neighbourhood of the Squirrels. But so far as zygomasseteric structure is concerned there exists between the two families a very wide distinction.

DIVISIONS.—Two well-marked subfamilies may be recognized, as indicated above. Although the Idiurinae are very much more specialized in cranial characters, the two groups present many features in common, so that it seems undesirable to refer them to two separate families.

KEY TO THE SUBFAMILIES OF ANOMALURIDAE

Infraorbital foramen moderate in size, and zygomatic plate not projected forwards conspicuously, the upper and lower zygomatic roots above one another. Cheekteeth not reduced in size, less brachyodont. Incisors not greatly thickened. Palate not excessively narrowed. Bullae more inflated. Anterior point of masseteric insertion on mandible beneath hinder part of M.1 (Miller & Gidley).
Subfamily ANOMALURINAE
(*Anomalurus*, *Anomalurops*)

Infraorbital foramen extremely enlarged, owing to zygomatic plate being projected forwards to a point nearly immediately behind the incisors. Cheekteeth extremely brachyodont, greatly reduced in size. Incisors much thickened from before backwards. Palate much narrowed. Bullae less inflated. Anterior point of masseteric insertion on mandible in front of P.4 (Miller & Gidley).

Subfamily IDIURINAE
(*Zenkerella*, *Idiurus*)

Subfamily ANOMALURINAE

GEOGRAPHICAL DISTRIBUTION.—As in the family Anomaluridae.

NUMBER OF GENERA.—Two.

CHARACTERS.—Cranial characters as indicated in the above key. Flying-membrane always present, the bony outgrowth supporting it anteriorly rising from the elbow; the membrane extending to the hindfoot; a well-developed interfemoral membrane present. Tail well haired, relatively long though usually somewhat shorter than head and body; usually thickly bushy terminally, and well haired; two thick rows of jagged scales are present on underside near the body and extend downwards for about a quarter or a third of its length. Digits of hindfoot five, the hallux shortest, the others subequal, each digit bearing a prominent curved claw; functional digits of forefoot four, all well developed, and with prominent claws.

This group has been revised recently by Rümmler. He recognizes two genera, as here retained, and four distinct species only.

KEY TO THE GENERA OF THE ANOMALURINAE

Cheekteeth with three transverse ridges surrounded by four depressions; tail broader, terminal tuft stronger. ANOMALURUS

Cheekteeth with two transverse ridges surrounded by three depressions; tail narrowed, terminal tuft weaker. ANOMALUROPS

Genus 1. ANOMALURUS, Waterhouse

1842. ANOMALURUS, Waterhouse, Proc. Zool. Soc. London, p. 124.
1915. ANOMALURODON, Matschie, S.B. Ges. Nat. Fr. Berlin, p. 350. (*A. auzembergeri*, Matschie = *A. peli*, Temminck.)
1915. ANOMALURELLA, Matschie, S.B. Ges. Nat. Fr. Berlin, p. 350. (*A. pusillus*, Thomas.)

TYPE SPECIES.—*Anomalurus fraseri*, Waterhouse.

RANGE.—About as in the family Anomaluridae; perhaps not extending farther west than the Gold Coast.

NUMBER OF FORMS.—Sixteen.

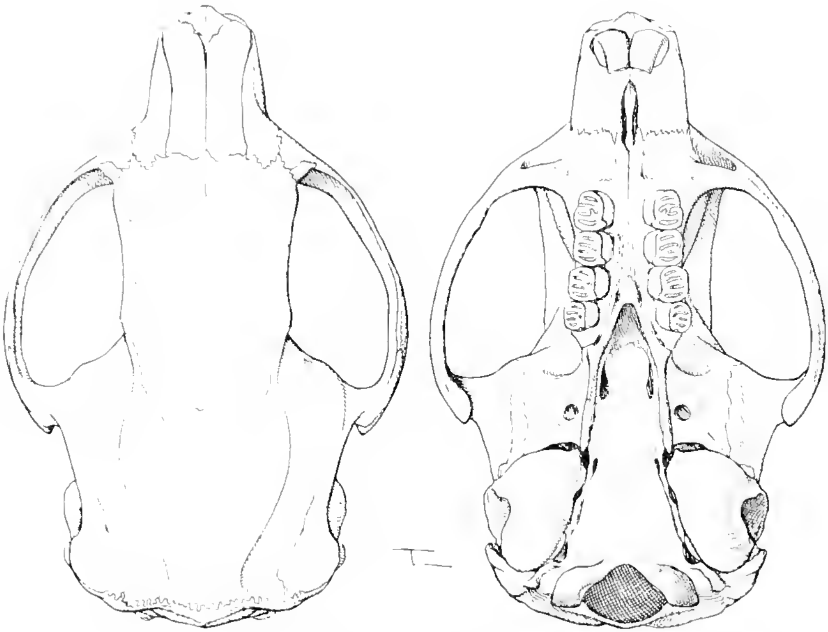


Fig. 132. Anomalurus fraseri jacksoni, de Winton.
B.M. No. 35.1.6.82, ♀; × 1½.

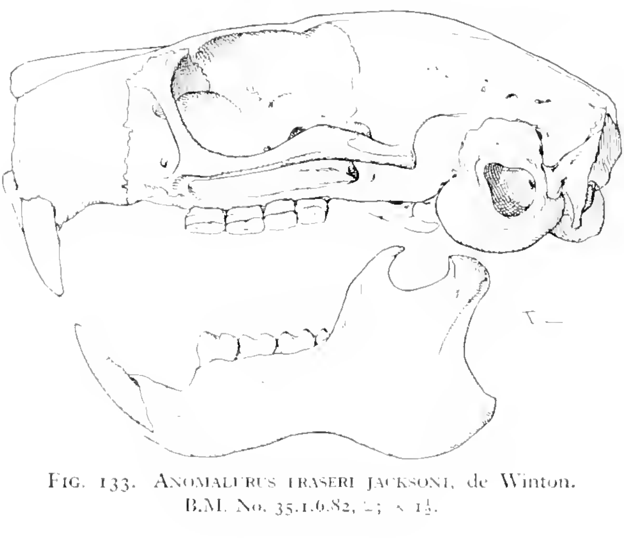


Fig. 133. Anomalurus fraseri jacksoni, de Winton.
B.M. No. 35.1.6.82, ♀; × 1½.

CHARACTERS.—Skull with moderate frontals, little constricted; short nasals thick, widely open anteriorly; frontals depressed, and bordered by moderately developed ridges which may appear as a small postorbital process, behind which the ridges tend to extend over the braincase, but show no signs of coming together. Incisive foramina medium, in front of toothrows. Palate tends to be slightly constricted anteriorly. Bullae relatively large, well inflated. Jugal long, forming most of zygoma, but not extending to lachrymal, its posterior upper border somewhat raised up. Infraorbital foramen moderately large, well open; zygomatic plate completely beneath it, and narrow. Mandible without special peculiarities.

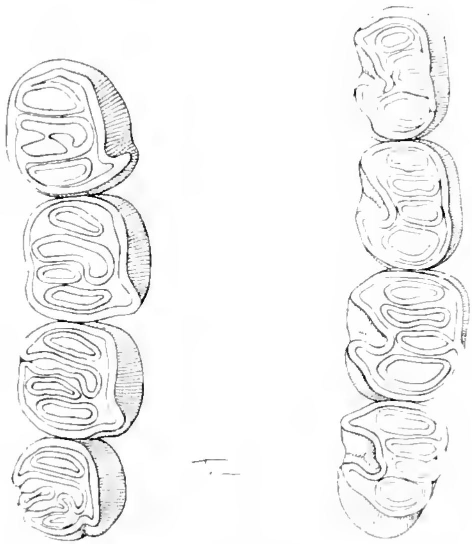


FIG. 134. ANOMALURUS FRASERI JACKSONI, de Winton.
Cheekteeth: B.M. No. 35.1.6.82, ; × 5.

Upper cheekteeth with three narrow transverse ridges cutting the tooth into four wide depressions; flatcrowned in adult, the pattern ultimately obliterated. Lower cheekteeth like the upper series, but also with one prominent external fold to each tooth.

Externally as described above; fur soft; ear prominent.

Tullberg mentions that the pairs of ribs in the specimens examined by him were nine (the highest number he quotes for any Rodent), and that the palmar and plantar tubercles are more numerous than in any other Rodent he examined.

Anomalurus has been revised by Rummler (Sitz. Ber. Ges. Nat. Fr. Berlin, 1933, p. 389). He recognizes three species, which in his key are based entirely on size.

Hindfoot more than 65: *peli.*

Hindfoot less than 40: *pusillus.*

Hindfoot longer than 40, shorter than 65: *fraseri.*

Measurements of condylobasal length, total length, and upper toothrow will be found for the three species in the above-mentioned paper.

A. peli may be noted for its specialized black and white colour pattern.

A. batesi, de Winton, he synonymizes with *pusillus*; there appears a tangible difference in the size of the bullae in the type skulls of the two species; and also apparently in the colour. Mr. R. W. Hayman has suggested to me that in his opinion *batesi* should not be regarded as a synonym, and I propose to retain it here as a valid race.

Forms seen: *batesi, cinereus, erythronotus, fraseri, griselda, imperator, jacksoni, jordani, neavei, nigrensis, orientalis, peli, perustus, pusillus.*

List of Named Forms

(The references and type localities for all members of the Anomaluridae are the work of Mr. R. W. Hayman.)

fraseri Group

1. ANOMALURUS FRASERI FRASERI, Waterhouse

1842. Proc. Zool. Soc. London, p. 124.
Fernando Po.
Synonym: *derbianus*, Gray, 1842, Ann. Mag. Nat. Hist. X, p. 262.
squamicaudus, Schinz, 1845, Syn. Mamm. 2, p. 58.
chrysophaenus, Dubois, 1888, Bull. Soc. Zool. Paris, XIII, p. 23.
beldeni, du Chaillu, 1861, Proc. Boston Soc. Nat. Hist. VII, p. 303.

2. ANOMALURUS FRASERI LATICEPS, Aguilar-Amat

1922. Bull. Inst. Catal. N.H. Barcelona, 2, 2, p. 52, pl. 1.
Fernando Po.
(A synonym of *fraseri fraseri* according to G. M. Allen, 1939.)

3. ANOMALURUS FRASERI GRISELDA, Dollman

1914. Ann. Mag. Nat. Hist. 8, XIV, p. 490.
Bitye, South Cameroons.

4. ANOMALURUS FRASERI ERYTHRONOTUS, Milne-Edwards

1879. C.R. Acad. Sci. Paris, LXXXIX, p. 771.
Gaboon.

5. ANOMALURUS FRASERI NIGRENSIS, Thomas

1904. Abstr. Proc. Zool. Soc. London, no. 10, p. 12.
Abutschi, Lower Niger.

6. ANOMALURUS FRASERI IMPERATOR, Dollman

1911. Ann. Mag. Nat. Hist. 8, VIII, p. 257.
Bibianaha, Gold Coast.

7. ANOMALURUS FRASERI FORTIOR, Lonnberg

1917. Stockholm Vet. Akad. Handl. 58, no. 2, p. 66.
Central Africa: no exact locality; specimens quoted from Masisi, near Kivu, and forest west of Beni.

8. ANOMALURUS FRASERI PERUSTUS, Thomas

1914. Ann. Mag. Nat. Hist. 8, XVIII, p. 235.
River Lubefu, 75 miles north of Lusambo, S. Congo.

9. ANOMALURUS FRASERI NEAVEI, Dollman

1909. Ann. Mag. Nat. Hist. 8, III, p. 351.
Katanga, South Congo.

10. ANOMALURUS FRASERI JORDANI, St. Leger

1935. Nov. Zool., XXXIX, p. 251.
Near Amboin, Angola.

11. ANOMALURUS FRASERI JACKSONI, de Winton

1898. Ann. Mag. Nat. Hist. 7, I, p. 251.
Entebbe, Uganda.

12. ANOMALURUS FRASERI ORIENTALIS, Peters

1880. Monats. Ber. Akad. Berlin, XLV, p. 164.
Zanzibar (? Mainland).

13. ANOMALURUS FRASERI CINEREUS, Thomas

1895. Ann. Mag. Nat. Hist. 6, XV, p. 188.
Upper Rovuma River, near Lake Nyasa.

pelii Group

14. ANOMALURUS PELII, Temminck

1845. Verhandl. Nat. Ges. Ned. Bez. I, 2, p. 109.
Daboerom, Gold Coast.
Synonym: *auzembergeri*, Matschie, 1914, S.B. Ges. Nat. Fr. Berlin, p. 350. Near boundary between Liberia and Ivory Coast; middle Cavalle River.

pusillus Group

15. ANOMALURUS PUSILLUS PUSILLUS, Thomas

1887. Ann. Mag. Nat. Hist. 5, XX, p. 440.
Bellima, Monbuttu, N.-E. Congo.

16. ANOMALURUS PUSILLUS BATESI, de Winton

1897. Ann. Mag. Nat. Hist. 6, XX, p. 524.
Como River, Gaboon.

Genus 2. ANOMALUROPS, Matschie

1914. Anomalurops, Matschie, Sitz. Ber. Ges. Nat. Fr. Berlin, p. 351.

Type Species.—*Anomalurus beecrofti*, Fraser.

Range.—Africa: Sierra Leone to Congo (Ituri).

Number of Forms.—Four.

Characters.—Like *Anomalurus*, but cheekteeth with, in the upper series, only two transverse ridges and three depressions, the anterior and posterior depression isolated, but the centre one remaining widely open. Lower cheekteeth with four depressions, the anterior and posterior ones isolated; the other two caused by one external and one internal fold.

Externally differing from *Anomalurus* in the tail, which is much narrower, and less bushy at the end.

REMARKS.—The considerable difference in the pattern of the cheekteeth seems to warrant the separation of the two genera.

Forms seen: *beecrofti, argenteus, citrinus, "laniger," "fulgens."*

(Revised by Rummler, Sitz. Ber. Ges. Nat. Fr. Berlin, 1933, p. 389.)

LIST OF NAMED FORMS

1. ANOMALUROPS BEECROFTI BEECROFTI, Fraser

1852. Proc. Zool. Soc. London, p. 17, pl. 32.
Fernando Po.
Synonym: *fulgens*, Gray, Ann. Mag. Nat. Hist. 4, III, p. 467, 1869. Gaboon.
laniger, Temminck, 1853, Esq. Zool. Côte de Guiné, p. 149. Gold Coast.

2. ANOMALUROPS BEECROFTI CHAPINI, Allen

1922. Bull. Amer. Mus. Nat. Hist. XLVII, p. 65.
Medje, Ituri.

3. ANOMALUROPS BEECROFTI CITRINUS, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVIII, p. 236.
Benito River, Spanish Guinea.

4. ANOMALUROPS BEECROFTI ARGENTEUS, Schwann

1904. Ann. Mag. Nat. Hist. 7, XIII, p. 70.
Abutschi, River Niger.

Subfamily IDIURINAE

GEOGRAPHICAL DISTRIBUTION.—Tropical Africa: Cameroons and Congo, east to Lake Kivu.

NUMBER OF GENERA.—Two.

CHARACTERS.—Size smaller than in Anomalurinae; infraorbital foramen greatly enlarged owing to anterior prolongation of the zygomatic plate, which projects far forwards to a level immediately behind the incisors, and is extremely narrow. Incisors greatly thickened from before backwards, and with prominent subapical notch. Cheekteeth extremely reduced and brachyodont. Palate greatly narrowed. Bullae less inflated. Flying-membrane present or absent.

REMARKS.—This subfamily was regarded as a distinct family by Miller & Gidley, and further divided into two subfamilies the Idiurinae and the Zenkerellinae mainly on account of the presence or absence of the flying-membrane.

This division hides the close relationship obviously existing between *Zenkerella* and *Idiurus*; further, the presence or absence of a flying-membrane certainly does not seem indicative of subfamily distinctions if one believes what one has read about the relationships occurring in the family Phalangeridae

(Marsupialia). In this group, apparently, a flying-membrane has been developed, independently in three cases; and each of these three genera appear more closely allied to a non-flying member than to each other; indeed the large Flying-phalanger, *Petauroides*, is sometimes referred to a distinct subfamily, the Pseudochirinae, containing also the non-flying *Pseudochirus*; while the smaller flying genera *Acrobates* and *Petaurus* are usually held to be related not to each other, but more to *Distaechurus* and *Gymnobelideus* respectively, neither of which has a flying-membrane.

If cranial characters or resemblances are to be trusted, *Idiurus* is certainly so closely allied to *Zenkerella* that there is no need for referring them to two distinct subfamilies.

Key to the Genera of Idiurinae

Cheekteeth with two complete transverse ridges; infraorbital foramen less widely open; flying-membrane present. — Idiurus

Cheekteeth with one complete transverse ridge; infraorbital foramen more widely open; flying-membrane absent. — Zenkerella

Genus 1. IDIURUS, Matschie

1894. Idiurus, Matschie, Sitz. Ber. Ges. Nat. Fr. Berlin, p. 194.

Type Species.—*Idiurus zenkeri*, Matschie.

Range.—As in the subfamily.

Number of Forms.—Five.

Characters.—Anterior portion of skull rendered abnormal by the great anterior prolongation of the zygomatic plate, which slants downwards and forwards from the ascending root of the zygomatic process of the maxillary to a level just behind the incisors. Infraorbital foramen with no canal for nerve transmission. The bones forming the upper margin of the infraorbital foramen broadened, so that the foramen is less open than in *Zenkerella*. Nasals short, narrow, well open anteriorly. Frontals with moderately developed supraorbital ridges. No sign of postorbital process. Braincase smooth and rounded. Zygoma not essentially different from *Anomalurus*. Bullae medium, smaller than in *Anomalurus* relatively. Palate very narrow, extending back to M.3, continued forwards as a straight shelf far in front of level of premolars. Incisive foramina very small, situated far forwards, between zygomatic plates. Incisors greatly thickened from before backwards, much compressed.

Toothrow extremely reduced; cheekteeth very small; M.3 considerably reduced in all skulls seen. Upper teeth cut into three subequal depressions by two narrow transverse ridges; lower teeth similar in pattern to the upper series, but apparently the outer fold present in *Anomalurus* can be present, and M.3 is not specially reduced. Mandible high in proportion to its length.

Size very small for the family, head and body not exceeding 116 mm. in those examined. Fur soft. Ear large, "its form strongly suggestive of that of some of the smaller Bats" (Miller: *Idiurus macrotis*). Tail considerably longer than head and body, the upper part moderately or well haired, and long hairs present throughout its length, the tail ending in a moderate brush. Scales on underside moderately developed, less so than in *Zenkerella* and *Anomalurus* evidently. Flying-membrane present, its formation apparently similar to that of *Anomalurus*, but the interfemoral membrane appears less developed than

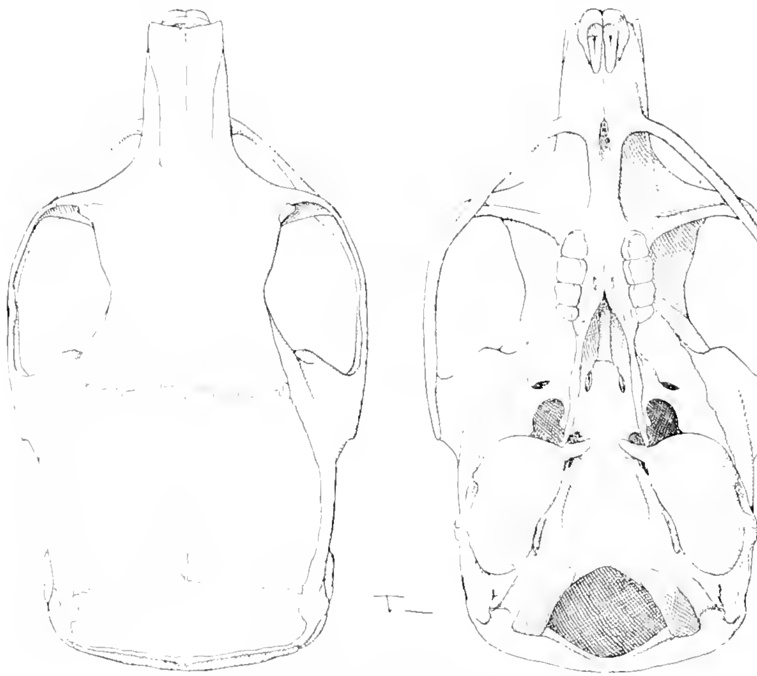


FIG. 135. IDIURUS MACROTIS, Miller.
B.M. No. 3.2.4.16, ♂; × 3½.

in that genus. Functional digits of forefoot four, the pollex not traceable in dried skins; claws prominent, curved. Hindfoot with five digits, the hallux shorter than the others; claws as in forefoot.

Forms examined: *zenkeri*, *macrotis*.

Two well-marked species are represented at the British Museum, the type, much smaller, head and body about 85–90 or less, and *macrotis*, Miller, with head and body measurement of 105–116 or more.

But Allen, 1922, described two new forms, of the *macrotis* group, one of which has a head and body measurement of only 73, or is about the size of *zenkeri*.

FIG. 136. IDIURUS MACROTIS, Miller.
B.M. No. 3.2.4.16, ♀; × 3½.

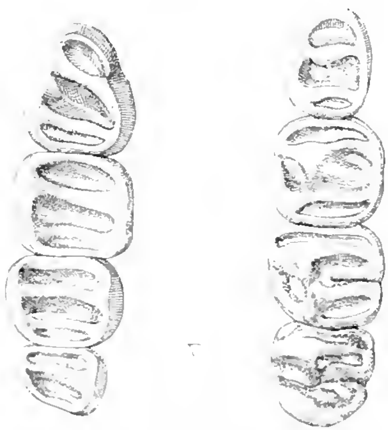


FIG. 137. IDIURUS MACROTIS, Miller.
Cheekteeth: B.M. No. 3.2.4.16, ♀; × 15.

The difference between the two groups, if Allen's species are to be regarded as species and not races, therefore lies in the measurement of the ear and the tail. The tail in Allen's measurements is at the highest 108 in *zenkeri* (none of our specimens exceed 93); while Allen's lowest tail measurement for the *macrotis* group is 117. The ear averages 13·6 in a series of male *zenkeri*, and 13·4 in a series of females (the highest measurement being 14), whereas in the *macrotis* group the lowest measurement is 14, the average being in *langi* 15·7, in *panga* 17·3 and in *macrotis* (two specimens quoted), 16 or 15·5.

The total length measurements quoted for the various species are in Allen, 187 highest, *zenkeri* (160–187); 218 (207–224) for *langi*; 206 average (199–212) *panga*; and 228–241 for *macrotis*.

Full details will be found in Allen's paper.

List of Named Forms

zenkeri Group

1. IDIURUS ZENKERI ZENKERI, Matschie

1894. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 197.
Yaunde, S. Cameroons.

2. IDIURUS ZENKERI KIVUENSIS, Lonnberg

1917. Stockholm Vet. Akad. Handl. 58, no. 2, p. 67.
Masisi, about 40 miles north-west of Lake Kivu, Belgian Congo.

macrotis Group

3. IDIURUS MACROTIS, Miller

1898. Proc. Biol. Soc. Washington, XII, p. 73, figs. 15–19.
Efulen, Cameroons.

4. IDIURUS LANGI, Allen

1922. Bull. Amer. Mus. Nat. Hist., XLVII, p. 69.
Medje, Ituri.

5. IDIURUS PANGA, Allen

1922. Bull. Amer. Mus. Nat. Hist., XLVII, p. 70.
Panga, Ituri.

Genus 2. ZENKERELLA, Matschie

1898. Zenkerella, Matschie, Sitz. Ber. Ges. Nat. Fr. Berlin, no. 4, p. 23, no. 5, p. 63.
1898. Aethurus, de Winton, Proc. Zool. Soc. London, p. 450, pls. XXXIV, XXXV. (*Aethurus glirinus*, de Winton = *Zenkerella insignis*, Matschie.)

Type Species.—*Zenkerella insignis*, Matschie.

Range.—West Africa: Cameroons.

Number of Forms.—One.

Characters.—General cranial characters much as *Idiurus*; frontals appear relatively narrower, straight and well ridged, with no post-orbital process. Infraorbital foramen more widely open. Mandible high in proportion to its length, the ascending portion from the incisors to the coronoid being straight; angular process relatively small. Jugal and lachrymal in contact in the one skull seen.

P.4 and M.3 both considerably reduced in size. Cheekteeth simpler than *Idiurus*; one transverse ridge divides the tooth into two lobes, most of which are occupied by a deep depression; lower molars like the upper series, P.4 much reduced.

Size larger than *Idiurus*; tail long, naked for about a fifth of its length near body, then thickly haired and bushy for the remainder of its length. Scales on underside very coarse and large. Digits of forefoot four; hindfoot broad, with five digits; general digit arrangement as in other genera; a tuft of brush-like hairs present on ankles. Ears large. Flying-membrane absent.

The genus is evidently very rare.

Forms seen: *insignis.*

List of Named Forms

1. ZENKERELLA INSIGNIS, Matschie

1898. Sitz. Ber. Ges. Nat. Fr. Berlin, no. 4, p. 24.
Yaunde, Cameroons.
Synonym: *glirinus*, de Winton, 1898, Proc. Zool. Soc. London, p. 450.
Benito River, French Congo.

Nothing appears to be known of the fossil history of the family.

ANOMALURIDAE: *SPECIAL WORKS OF REFERENCE*

Tullberg, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, ser. 3, no. 1, 1899. (*Anomalurus.*)

Rümmler, Sitz. Ber. Ges. Nat. Fr. Berlin, p. 389, 1933. Revision of *Anomalurus* and *Anomalurops.*

Miller, Proc. Biol. Soc. Washington, XII, 1898, p. 73. Description of a new Rodent of the genus *Idiurus.*

De Winton, Proc. Zool. Soc. London, 1898, p. 450. (Description of *Aethurus* = *Zenkerella.*)

Alston, On *Anomalurus*, its structure and position: Proc. Zool. Soc. London, 1875, p. 88.

Superfamily PEDETOIDAE

As here understood this contains one living family.

Family PEDETIDAE

1896. Thomas: Hystricomorpha, part. Family Pedetidae.
1899. Tullberg: Sciurognathi: *Myomorpha*: Anomaluroidei, part: Family Pedetidae.
1918. Miller & Gidley: Superfamily Dipodoidae, part. Family Pedetidae.
1924. Winge: Family Anomaluridae, part: Pedetini.
1928. Weber: Anomaluroidea, part: Family Pedetidae.

Geographical Distribution.—Central and Southern Africa: from Kenya and Angola to Cape Province.

NUMBER OF GENERA.—One.

CHARACTERS.—Zygomasseteric structure essentially as in Anomaluroidae, so far as it concerns the shape of the mandible, infraorbital foramen (which is greatly enlarged), and zygomatic plate. According to Tullberg's figures, the temporalis muscles of *Pedetes* are much more reduced than in *Anomalurus*; and the pterygoid muscles and pits for their insertion are much more extensive in *Pedetes* (being apparently very weak in all Anomaluridae). Skull massive and Hystricoid in general appearance, but mandible with angular portion small, not distorted outwards; zygomatic region much thickened; mastoids extremely inflated; cheekteeth evergrowing, simplified in pattern; dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$ = 20, the premolars not reduced in size. Fibula reduced and fully fused with the tibia in adult. External form modified for bipedal saltatorial life; digits of hindfoot reduced to four, the metatarsals normal, not becoming fused (compare specialized Dipodidae).

REMARKS.—Great diversity of opinion has prevailed on the systematic position of this family. Most authorities are now agreed that the relationship with the Dipodidae, in which it was formerly classed, is remote. Winge, Tullberg, and Weber place the family in the Anomaluroid division. But there seems to be remarkably little in common between Pedetes and the Anomaluridae as known to-day other than that both are clearly somewhat archaic groups of Rodents. Although the zygomasseteric structure is essentially the same in the two groups, the following characters appear to me to indicate a rather wide gap between the two families, and show that the Pedetidae are very much more specialized in many ways than the Anomaluridae:

Cheekteeth evergrowing in *Pedetes*; rooted and brachyodont in the Anomaluridae.

Pattern of cheekteeth simplified in *Pedetes*; very rarely showing any sign of simplification in the Anomaluridae, usually of the rather primitive complex type found in some Sciuridae, Erethizontinae. (Only in *Zenkerella*, in which the whole toothrow is extremely reduced, is there sign of simplification in the one skull seen.)

Fibula fused with the tibia in *Pedetes*, as far as known separate or not fully fused in Anomaluridae.

Digits reduced in the pes to four in *Pedetes*; not so in Anomaluridae.

Skull specialized, characterized by large inflated mastoids, thickened zygoma, massive frontals, heavy rostrum, deepened pterygoid fossae in *Pedetes*; not so in Anomaluridae.

Some of the above may be adaptive characters. But taken altogether they seem to indicate a wide difference to-day, whatever the ancestors of the two groups may have had in common.

The two families cannot in my opinion be regarded as so closely allied to each other as, say, any two families of Hystricoidae, or any two families of Muroidae.

On the other hand Tullberg lists a number of points which are shared by

Pedetes and the Anomaluridae, some of which are in the alimentary canal; the lachrymal foramen is placed high up; the great similarity in the hyoid bone of the two genera (he evidently did not examine *Idiurus* and *Zenkerella*); the number of cheekteeth (but this also applies, for instance, to Muscardinidae!); the large infraorbital foramen (as Dipodidae, Ctenodactylidae, etc.); and the absence of a transverse canal in the corpus of the sphenoideum.

Thomas transferred the family to the Hystricomorpha, remarking: "while many naturalists have noticed the Hystricomorph affinities of *Pedetes*, no one in modern times (except Dobson, who transferred the whole of the Dipodidae) seems to have thought of actually placing it among them. To me this appears to be clearly the proper course as there seems to be scarcely a character in its skull or teeth which is not found in one member or another of that group." But the "Hystricomorpha" of Alston, on which Thomas's classification is based, are defined as with the tibia and fibula persisting as free bones, whereas in *Pedetes* they fuse. Taking into account that this structure is not a sufficiently important one on which to base major groups, the fact remains that though there may be a suggestion of the "twisted" lower jaw characteristic of the Hystricoidae in *Pedetes*, it is nothing like fully developed; indeed, the angular process is in this genus reduced; and in Tullberg's figures of the zygomasseteric structure of *Pedetes*, on the lower jaw it will be seen that the portion marked mls. (masseter lateralis superficialis), which in every member figured of his Hystricognathi (=Bathyergidae+Hystricoidea) except the Caviidae, takes up the greater portion of the jaw, is in *Pedetes*, as in *Ctenodactylus*, *Anomalurus* and others, small and unimportant.

There appears to be to me no alternative to the classification of *Pedetes* as a superfamily distinct from all others in living Rodentia.

Genus 1. PEDETES, Illiger

1811. Pedetes, Illiger, Prodr. Syst. Mamm. & Avium, p. 81.

Type Species.—*Mus cafer*, Pallas.

Range.—As in the family Pedetidae.

Number of Forms.—Ten or eleven.

Characters.—Skull with broad nasals, extremely broad frontals; mastoid portion of bullae appearing conspicuously in superior aspect of skull; lower zygomatic root projected forwards to a point immediately behind the incisors, the zygomatic plate continued forwards and forming nearly a right angle with the ascending portion of the maxillary process of zygoma, as a consequence of which the infraorbital foramen is greatly enlarged. No canal for nerve transmission in the infraorbital foramen. Jugal immensely broadened anteriorly, and in contact with the lachrymal. Bony palate short, extending backwards only to M.1 or the front portion of M.2. Basisphenoid much narrowed; pterygoid fossae deep. A pitlike depression is situated in front of the toothrows, which extends forward to incisors and lies between the zygomatic plates.

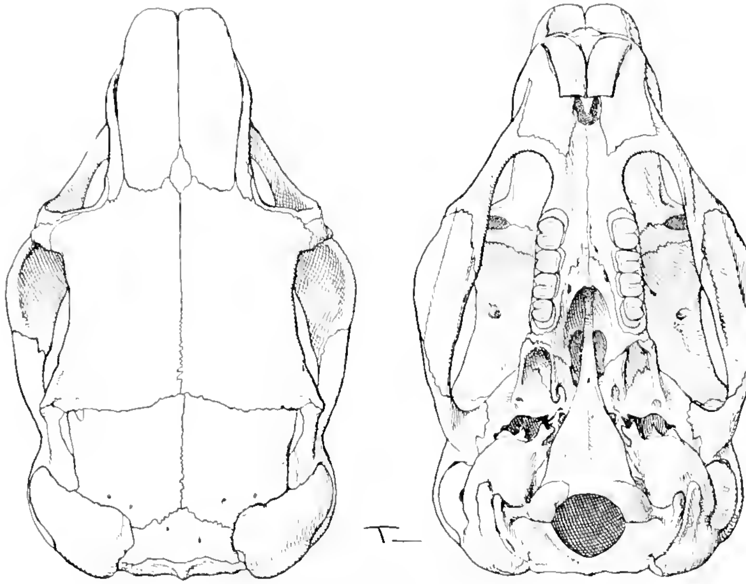


Fig. 138. Pedetes surdaster larvalis, Hollister.
B.M. No. 28.12.7.14; × 1.

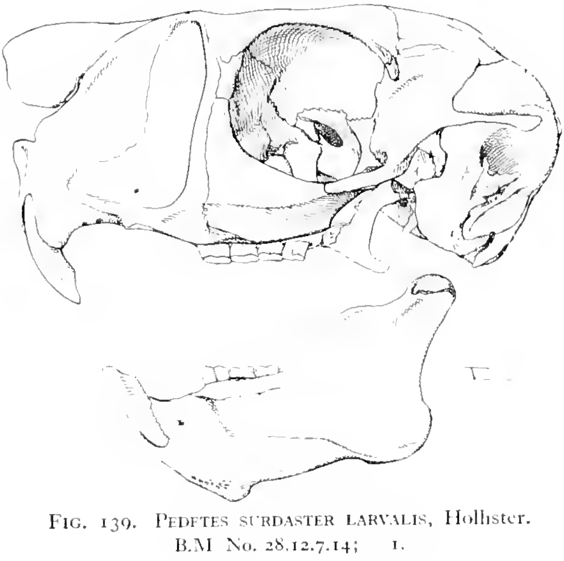


Fig. 139. Pedetes surdaster larvalis, Hollister.
B.M. No. 28.12.7.14; × 1.

Mandible with angular portion short and somewhat reduced; coronoid process much reduced; a strong ridge for muscle attachment on lower border of angular portion, which is, however, not "lifted outwards" as it is in Hystricoidae and Bathyergidae.

Incisors thick. Cheekteeth evergrowing, each tooth divided into two lobes by a re-entrant angle, in the upper series externally, in the lower series internally.

The teeth when cut are not entirely simplified, and traces of more than one inner cusp may be seen in the inner side of the centre of the upper molars; but the lower molars of the one very young specimen examined are practically simple.

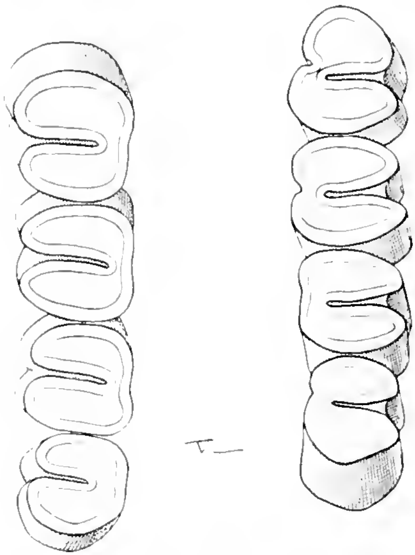


FIG. 140. PEDETES SURDASTER LARVALIS, Hollister.
Cheekteeth: B.M. No. 28.12.7.14; × 4.

Externally like a giant Jerboa. Hindfoot perissodactyle in arrangement of digits, elongated; claws more or less hooflike; hallux absent; D.5 short but well developed. Tail about as long as head and body or frequently longer than this measurement, heavily haired, with a thick black brush terminally. Ears prominent. Manus with five digits, the claws strong, that of the pollex apparently in no way reduced and as large as the others (a rare feature in the Order).

Pocock states, with reference to the fact that this genus is not to be associated in the Hystricoidae, that "the penis is elongated . . . but there is no trace of the glandular pouch which is so characteristic of the Hystricomorphs."

The family is, as far as I have traced, not known fossil outside Africa, though a related fossil genus, *Parapedetes*, has been described from that continent.

The species admitted are unquestionably very closely related to each other.

Forms examined: *angolae*, *cafer*, *orangiae*, *salinae*, *surdaster*.

SPECIAL WORKS OF REFERENCE

TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, no. 1, 1899.
HOLLISTER, East African Mammals in the United States National Museum: Smiths. Inst. Bull. 99, p. 156, 1919.
POCOCK, External Characters of *Scarturus* and other Jerboas compared with *Zapus* and *Pedetes*: Proc. Zool. Soc. London, p. 659, 1922.

LIST OF NAMED FORMS

(The references and type localities have been collected by Mr. R. W. Hayman.)

1. PEDETES CAFER CAFER, Pallas
1778. Nov. Spec. Quadr. Glir. Ord., p. 87.
Cape Colony.
Synonym: *capensis*, Forster, Svensk. Vet. Acad., p. 108, pl. III, 1778.
typicus, Smith, Ill. S. Afr. Zool., 1849, p. 20.

2. PEDETES CAFER ORANGIAE, Wroughton
1907. Ann. Mag. Nat. Hist. 7, XX, p. 32.
Aberfeldy district, Orange River Colony.

3. PEDETES CAFER SALINAE, Wroughton
1907. Ann. Mag. Nat. Hist. 7, XX, p. 33.
Woodbush, Zoutspansberg district, N.-E. Transvaal.

4. PEDETES CAFER DAMARENSIS, Roberts
1926. Ann. Transvaal Mus. XI, p. 261.
Okahandja, S.-W. Africa.

5. PEDETES CAFER TABORAE, Allen & Loveridge
1927. Proc. Boston Nat. Hist. Soc. 38, p. 438.
Tabora, Tanganyika.

6. PEDETES CAFER DENTATUS, Miller
1927. Proc. Biol. Soc. Washington, XL, p. 113.
Dodoma, Tanganyika.

7. PEDETES CAFER ANGOLAE, Hinton
1920. Ann. Mag. Nat. Hist. 9, VI, p. 102.
About 20 miles north-east of Bihe, Angola.

8. PEDETES SURDASTER SURDASTER, Thomas
1902. Ann. Mag. Nat. Hist. 7, IX, p. 440.
Morendat, mile 365 of Uganda Railway, Naivasha, Kenya.

9. PEDETES SURDASTER CURRAX, Hollister
1918. Smiths. Misc. Coll. LXVIII, no. 10, p. 3.
Kabalalot Hill, Sotik, Kenya.

10. PEDETES SURDASTER LARVALIS, Hollister
1918. Smiths. Misc. Coll. LXVIII, no. 10, p. 2.
Ulukenia Hills, Athi Plains, Kenya.

There are specimens at the British Museum labelled "*Pedetes cafer bradfieldi*," from the Kalahari. The reference to this form has not been traced.

Superfamily CTENODACTYLOIDAE

As here understood this contains one living family.

Family CTENODACTYLIDAE

1896. Thomas: HYSTRICOMORPHA: Family Octodontidae, part, Subfamily Ctenodactylinae, part, included *Petromys*.
1899. Tullberg: SCIUROGNATHI: *Myomorpha*: Ctenodactyloidei: Family Ctenodactylidae.
1918. Miller & Gidley: Superfamily DIPODOIDAE, part. Family Ctenodactylidae.
1924. Winge: Hystricidae, part, Ctenodactylini, part, included *Petromys*.
1928. Weber: HYSTRICOIDEA: part, Family Ctenodactylidae.

GEOGRAPHICAL DISTRIBUTION.—Northern Africa: from Senegal and Morocco (including Palaearctic coastal area) to Somaliland.

NUMBER OF GENERA.—Four.

CHARACTERS.—Zygomasseteric structure, so far as it affects the shape of the skull, about as in Dipodidae, though the mandible is slightly more modified than in that family. Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$ or $\frac{2}{2}$, m. $\frac{3}{3}$ = 20 or 24, at full dentition. The extra upper and lower premolars in the genus *Pectinator* are shed before the posterior molars are cut; in the remaining genera, with cheekteeth at full dentition normally $\frac{4}{4}$, the premolar is shed early during life, and is rarely present in the specimens examined. Cheekteeth evergrowing, practically or completely simplified in pattern. Auditory bullae and mastoids considerably inflated, the mastoids normally a prominent feature in the superior aspect of the skull. Jugal divided into two portions, a horizontal and a vertical, as in the subfamily Dipodinae. Lachrymal large. Mandible with no coronoid process, and usually a weak ridge present for (presumably) attachment of masseter medialis, this structure foreshadowing that present in Caviidae but very much less developed than in that family. Angular portion of mandible produced backwards to a greater or lesser degree, not excessively so. Digits of both fore and hindfoot reduced to four. Tail fully haired, much shortened. Tibia and fibula not fused.

REMARKS.—The Ctenodactylidae have been associated with the Hystricoid Rodents by Thomas, Weber, and Winge. Miller & Gidley place the family among the Dipodoidae, in the neighbourhood of Dipodidae and Pedetidae; Tullberg regards them as more nearly related to Muroid (and Dipodoid) Rodents than to the Hystricoids. Pocock states: "The claims of *Ctenodactylus*, indeed, to a place in the Hystricomorphs seem to me to be more than questionable."

Peters in an extensive paper on the genus *Pectinator* came to the following conclusions: "The Ctenodactyli cannot be associated with the Dipodes, their relation to them being not greater than that of the Chinchillae, Octodontes, and

Echinomyes; they show in nearly every part of their structure their near relationship with the last-named groups, and deviate from them only in a very few points, the form of the hyoid bone, of the sacral and caudal vertebral column, of the development of the crest of the humerus and femur, in which they do not show any inclination towards the Dipodes, but rather some affinity with the Murinae; they form a peculiar group of the Hystricidae as understood by Waterhouse, which in some points is more allied to the Chinchillae, in other points to the Octodontes. *Petromys* is not to be associated with the Ctenodactyli, but with the Octodontes."

(It may be noted that Waterhouse divided his Hystricidae into six groups, the Hystricina, Echimyina, Octodontina, Dasyproctina, Chinchillina, and Caviina.)

None of the authors who place the Ctenodactylidae in the Hystricomorph series note, however, that the form of the mandible in Ctenodactylidae does not agree with either that present in Hystricoidae, as here understood, or with that of the Caviidae. It may be transitionary towards the latter, but it certainly, so far as I have had occasion to examine, does not agree with it in structure.

This being the case, the zygomasseteric structure of this family cannot be said to agree with that of the Hystricoidae. I do not think that the faint resemblances between these animals and the Caviidae in lower jaw structure need indicate any close relationship.

Tullberg has dealt extensively with the relationships of this group, and comes to the conclusion that on account of the formation of the mandible they cannot be regarded as Hystricoid Rodents, a view which I fully support. He is evidently of the opinion that they may not be distantly related to the Anomaluroid-Pedetoid branch of the Order. He writes extensively on the parallel evolution of this group and the Chinchillidae.

The separation of Ctenodactylidae from the Hystricoidae is supported by Miller & Gidley, who rightly place it in a superfamily (Dipodoidae) in which the angular portion of the mandible is not distorted outwards.

Further characters which should be mentioned are that according to Tullberg the radiale and intermedium are separate, alone in Rodents (as examined by him) excepting the Bathyergidae; and that the malleus and incus are fused, as in Hystricoidae and Bathyergoidae, but unlike the remainder of the Rodents.

Four rather closely allied genera are now admitted.

Of these *Pectinator* seems to be the most primitive, in that the full dentition is $\frac{5}{5}$ instead of $\frac{4}{4}$, the palate is relatively shorter, and the tail appears rather less reduced than in allied forms. *Massoutiera* and *Felovia* have the "eight-shaped" type of cheekteeth found in South American Octodontinae in the genera *Octomys*, *Aconaemys* and *Spalacopus*; *Ctenodactylus* parallels the Octodont genera *Ctenomys* and *Octodon* in having "kidney-shaped" cheekteeth, and in this genus the tail reaches its greatest reduction in the family; also *Ctenodactylus* appears to tend to be a little larger than other members of the family.

Skull Characters.—The following skull characters appear constant in the family:

The skull is flattened, with broad frontals; it is wider posteriorly than anteriorly; the rostrum is moderate or narrow and inclined to be bowed downwards. The supraorbital ridges are comparatively well developed; and a small postorbital-like ridge on the parietal is situated immediately in front of and above the squamosal roots of the zygoma, similar to that present in *Jaculus*. The apices of the bullae are not in contact. Jugal extending up to the lachrymal. General scheme of zygoma like that of *Jaculus*, but horizontal portion about as broad as the vertical portion, and the vertical part does not rise to such a high degree, due perhaps to the much lower skull. Incisive foramina large and well open, extending about to the toothrows, broader posteriorly. Paroccipital process closely applied to bullae, and quite large. A prominent canal on maxillae running through the infraorbital foramen, the latter much enlarged. Except in the genus *Pectinator* the toothrows tend to converge in front, and the palate projects behind M.3. In all genera the upper incisors are opisthodont.

Key to the Genera of Ctenodactylidae

Cheekteeth at full dentition $\frac{5}{5}$; lower cheekteeth less simplified, with two well-marked inner folds. Palate not extending behind toothrows. PECTINATOR

Cheekteeth at full dentition $\frac{4}{4}$. Lower cheekteeth simpler, with one inner fold only. Palate normally extending behind toothrows.

- Upper cheekteeth simpler, with no inner fold, the general effect "kidney-shaped." CTENODACTYLUS
- Upper cheekteeth less simple, with inner fold present, general effect becoming "eight-shaped."
  - Inflation of bullae and mastoids at maximum for the family; outer fold of upper cheekteeth very narrow. MASSOUTIERA
  - Inflation of bullae and mastoids at minimum for the family; outer fold of upper cheekteeth remaining widely open. FELOVIA

Genus 1. PECTINATOR, Blyth

1855. PECTINATOR, Blyth, Journ. Asiat. Soc. Bengal, XXIV, p. 294.

TYPE SPECIES.—*Pectinator spekei*, Blyth.

RANGE.—Africa: Abyssinia, Somaliland, Eritrea.

NUMBER OF FORMS.—Three.

CHARACTERS.—Palate shorter than *Ctenodactylus*, not extending behind last molars. Bullae and mastoids considerably inflated. Cheekteeth $\frac{5}{5}$ at full dentition (it may be mentioned that this genus and the Bathyergoid *Heliophobius* are the only living genera of Rodents with a cheekteeth formula of more than $\frac{4}{4}$). P. $\frac{3}{3}$ minute; M. $\frac{3}{3}$ cut late in life; the small extra premolars shed before the posterior molars are cut as a rule. The upper cheekteeth are tolerably similar to those of *Ctenodactylus*, but in addition to the shallow outer open fold there is a very small inner fold. The lower cheekteeth are more complicated than in other members of the family; there are two sharp well-marked inner folds, and one outer one.

Form more or less Guineapig-like. Fur soft. Digits of forefoot four, subequal, the claws not large. Digits of hindfoot four, the two inner digits with well-developed brush of comb-like bristles, the outer digits with similar structure rather less developed. Hindfoot relatively narrow; tail bushy, a little longer than hindfoot.

Pocock, writing of this genus and *Ctenodactylus*, states: "Assuming that their ears are similar, these two genera differ markedly not only from all the Hystricomorphs but from all other Rodents known to me in the structure of this organ."

Forms examined: *spekei*.

List of Named Forms

1. PECTINATOR SPEKEI SPEKEI, Blyth

1855. Journ. Asiat. Soc. Bengal, XXIV, p. 294, pl. II, fig. 1.
Somaliland, 11° 40′ N.

2. PECTINATOR SPEKEI MERIDIONALIS, de Beaux

1922. Atti. Soc. Ital. Sci. Nat. 61, p. 27.
Dolo, Somaliland.

3. PECTINATOR SPEKEI LEGERAE, de Beaux

1934. Atti. Soc. Ital. Sci. Nat. 73, p. 293.
Assab, Eritrea.

Genus 2. CTENODACTYLUS, Gray

1828. Ctenodactylus, Gray, Spicil. Zool., p. 10.

Type Species.—*Ctenodactylus massonii*, Gray.

Range.—Northern Africa: Morocco, Algeria and Tripoli.

Number of Forms.—Four.

Characters.—Cheekteeth $\frac{4}{4}$ at full dentition. In nearly all specimens examined there are only $\frac{3}{3}$; but as pointed out by Lataste, the premolar is present, though shed early. This author takes from a series of specimens seven skulls, each with different teeth in place, and describes first the newly-born, with two teeth, P.4 and M.1, the teeth described as tuberculated; next a young skull, with the four teeth in place, the posterior one being cut; the next stage with only three, the front premolar having been shed; then with the same teeth present, but P.4 being cut; then with the four teeth in place; then an older animal with three teeth but with a scar marking where the premolar had been shed; finally the adult, with three cheekteeth only, and all trace of P.4 lost.

Cheekteeth simple, reminiscent to a certain degree of those of *Ctenomys*; with no inner fold in the upper series, but with a shallow widely open outer

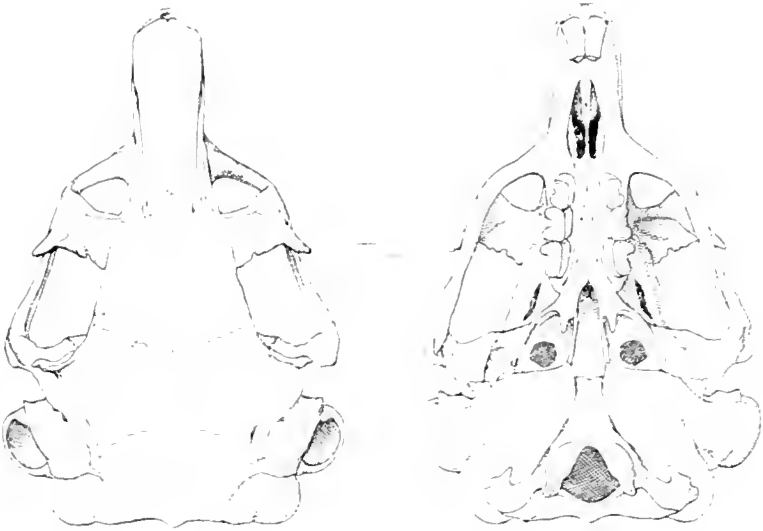


FIG. 141. CTENODACTYLUS GUNDI GUNDI, Rothman.
B.M. No. 97.6.9.19. ; 1½.

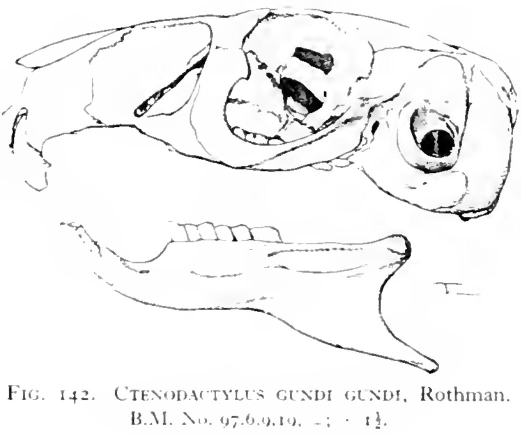


FIG. 142. CTENODACTYLUS GUNDI GUNDI, Rothman.
B.M. No. 97.6.9.19. ; 1½.

fold in all teeth. Lower cheekteeth with one widely open outer and inner re-entrant fold in all teeth.

Palate longer than in *Pectinator*. Bullae and mastoids considerably inflated, most so in *C. vali*.

Externally like *Pectinator* except that the tail is considerably shorter than the hindfoot, and almost obsolete.

These animals are described as being born hairy, and not blind, and able to run at birth.

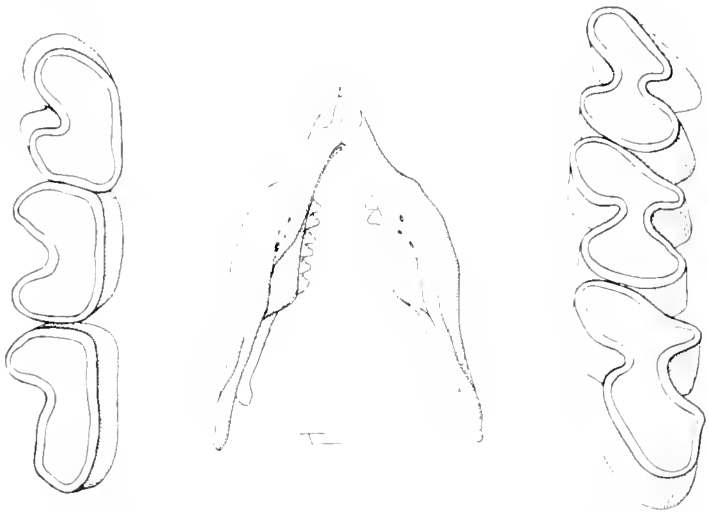


FIG. 143. CTENODACTYLUS GUNDI GUNDI, Rothman.
Mandible from below, 1½; Cheekteeth 7; B.M. No. 97.6.9.10, [illegible].

Two species are at present admitted, which as indicated above differ in the size of the mastoids and bullae; whether such differences would be valid in the event of a really large number of specimens coming to hand is at the moment not known.

Forms examined: *gundi*, *massonii*, *vali*.

LIST OF NAMED FORMS

1. CTENODACTYLUS GUNDI GUNDI, Rothman

1776. Schloezer's Briefwechsel, p. 339.
Gharian, 80 km. south of Tripoli.
Synonym: *arabicus*, Shaw, Gen. Zool., II, 1801, p. 123.

2. CTENODACTYLUS GUNDI MASSONII, Gray

1828. Spicil. Zool., p. 10, pl. 10.
Biskra, south slope of Atlas Mountains.

3. CTENODACTYLUS VALI, Thomas
1902. Proc. Zool. Soc. London, p. 11.
Wadi Bey, north-west of Bonjem, Tripoli.

4. CTENODACTYLUS JOLEAUDI, Heim de Balsac
1936. Suppl. Bull. Biol. de France et de Belgique, Paris, 21, p. 315.
Beni Ounif, Jebel Melias, Algeria.

Genus 3. MASSOUTIERA, Lataste

1885. MASSOUTIERA, Lataste, Le Naturaliste, no. 3, p. 21.

TYPE SPECIES.—*Massoutiera mzabi*, Lataste.

RANGE.—Africa: Central and Western Sahara.

NUMBER OF FORMS.—Three.

CHARACTERS.—Like *Ctenodactylus*, but mastoids typically more inflated, and cheekteeth less simplified; those of upper series divided into two lobes by narrow folds, the folds meeting in the middle of the teeth, the structure in general reminiscent of that present in the South American *Aconaemys*. M.3 the largest tooth. Lower cheekteeth with the same elements, but rather more angular, the folds more open. Tail less reduced than in *Ctenodactylus*, about as long as hindfoot; bushy; other essential external characters as in *Ctenodactylus*.

Three species are admitted in this genus at present: *harterti*, with mastoids and bullae at maximum inflation for the family; *rothschildi*, in which the bullae are more moderate; and *mzabi*, in which they are smallest for the genus, but still relatively very large. Each appears to be known, so far as the London collection is representative, by a comparatively small number of specimens.

Forms examined: *harterti*, *rothschildi*, *mzabi*.

LIST OF NAMED FORMS

1. MASSOUTIERA MZABI, Lataste
1881. Bull. Soc. Zool. France, VI, p. 314.
Ghardaia, Algerian Sahara.

2. MASSOUTIERA ROTHSCHILDI, Thomas & Hinton
1921. Nov. Zool., XXVIII, p. 11.
Mount Baguezan, Asben, Sahara.

3. MASSOUTIERA HARTERTI, Thomas
1913. Nov. Zool., XX, p. 31.
Oued Mya, south of Fort Mirabel, Western Sahara, about 28° 30′ N. 3° E.

Genus 4. FELOVIA, Lataste

1886. FELOVIA, Lataste, Le Naturaliste, iii, p. 287.

TYPE SPECIES.—*Felovia vae*, Lataste.

RANGE.—Known from Senegal (N.-W. Africa).

NUMBER OF FORMS.—One.

CHARACTERS.—Like *Massoutiera*, but bullae and mastoids considerably less inflated, appearing on the top of the skull to a lesser degree than in any other member of the family.

Cheekteeth differing from *Massoutiera* in that the outer fold of the upper series remains widely open. In the lower series M.3 has a short backwardly pointing heel. The upper incisors are faintly grooved. Externally like *Massoutiera*.

REMARKS.—Though closely allied to *Massoutiera*, the differences indicated above seem sufficient to warrant the retention of this genus.

Forms examined: *vae*.

LIST OF NAMED FORMS

1. FELOVIA VAE, Lataste

1886. Le Naturaliste, iii, p. 287.
Felou, Medina district, Upper Senegal River, Senegal.

The references and type localities to all named forms of this family have been collected for me by Mr. R. W. Hayman.

The Family Ctenodactylidae is known from the Pliocene, from the Mediterranean region. *Pectinator* has been described fossil from the Miocene of India.

CTENODACTYLIDAE:
SPECIAL WORKS OF REFERENCE

TULLBERG, Nova Acta Regiale Soc. Sci. Upsaliensis, XVIII, ser. 3, no. 1, 1899. (*Ctenodactylus*).

PETERS, Contribution to the knowledge of *Pectinator*, a genus of Rodent Mammalia from North-eastern Africa: Trans. Zool. Soc. London, VII, p. 397, 1871.

LATASTE, Le Naturaliste, 1885, p. 1. Sur le système dentaire du genre *Ctenodactylus*, Gray.

ST. LEGER, Key to Families and Genera of African Rodentia: Proc. Zool. Soc. London, 1931, p. 978.

Superfamily DIPODOIDAE

This contains, as here understood, one family, the Dipodidae, with subfamilies Sicistinae, Zapodinae, Cardiocraniinae, Euchoreutinae, and Dipodinae, the relationships and characters of which are fully discussed below.

Family DIPODIDAE

1896. Thomas: MYOMORPHA, part: Family Dipodidae. Subfamilies Sminthinae (= Sicistinae), Zapodinae, and Dipodinae.

1899. Tullberg: MYOMORPHA: *Dipodiformes*, Family Dipodidae.

1918. Miller & Gidley: Superfamily DIPODOIDAE: Family Zapodidae (Subfamilies Sicistinae, Theridomyinae (fossil), and Zapodinae); Family Dipodidae (Subfamilies Protoptychinae (fossil), and Dipodinae).

1924. Winge: Family Dipodidae, part (includes *Spalax*): Dipodini.

1928. Weber: DIPODOIDEA: Family Sicistidae (*Sicista* only), and Family Dipodidae.

Geographical Distribution.—Holarctic region: Europe from Norway, Denmark, Hungary and Bulgaria, eastwards across Asia south to Kashmir, Szechuan, Afghanistan, Arabia; east to Sakhalin. Africa, northern, from Senegambia and Morocco to Egypt and Somaliland; North America from Alaska to the Atlantic coast, covering the greater part of Canada and the United States but evidently not occurring in Mexico.

Number of Genera.—Fifteen are here retained, based as far as possible on Vinogradov's papers on the family. The only modifications I make are that *Scarturus* is here considered a synonym of *Allactaga*; and that *Napaeozapus* and *Eozapus* are, following American authors, here given full generic rank, chiefly on account of their dental peculiarities.

Characters.—Infraorbital foramen greatly enlarged for muscle transmission; zygomatic plate narrow and remaining completely below it; mandible weak, the angular process not distorted outwards, this part of the jaw frequently with a perforation present.

Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{0}$ or $\frac{0}{0}$, m. $\frac{3}{3}$=16 or 18. When present, the extra premolar usually very small. It should be noted that in a skull in the British Museum of *Allactaga elater* there is a minute extra tooth at the back of the series. This might suggest that apparently, as in Muridae, reduction has taken place from behind so that the formula might be more correctly written as p. $\frac{2}{1}$ or $\frac{1}{1}$, m. $\frac{2}{2}$. But for convenience I adopt the notation given above.

Cheekteeth rooted, usually cuspidate, with broad re-entrant folds, the pattern often reminiscent of that of Cricetinae; in Zapodinae tending to become flatcrowned, in which case the re-entrant angles in progressive forms become narrow.

Tibia and fibula fused high on the leg, the fibula reduced, thread-like.

Externally showing a progressive series of adaptations towards bipedal saltatorial life, except in the genus *Sicista*; at highest development more specialized for saltatorial life than in any other Rodents, the three central metatarsal bones fusing to form a cannonbone (Dipodinae (including *Allactaga* group), Euchoreutinae). Some of the cervical vertebrae tend to become fused in Dipodinae. Zygoma in progressive forms divided into two portions, a horizontal and a vertical, these portions forming a sharp angle with each other. Infraorbital foramen always with a separate canal for nerve-transmission. Incisors compressed, frequently grooved. Hindfoot with hallux reduced or absent; three functional digits only present in all members of the family except *Cardiocranius* (not seen), *Sicista*, and the Zapodinae. In progressive genera, skull extremely specialized, by modification of zygomatic region, as indicated above, broadening of frontals and still more of braincase, and in certain abnormal cases by extreme inflation of mastoids and bullae.

Remarks.—The Dipodidae have frequently been referred to (Forsyth Major, Winge, etc.), as being the forerunners of the Muridae; in the opinion of Forsyth Major evidently they are to be considered more primitive than the Muridae.

All members of the present family with the exception of *Sicista* and probably *Zapus* seem to me to be so very much more highly specialized than any member of the Muridae or any member of the Superfamily Muroidae as here understood, in so many ways, that I very much question if this assumption is correct, and would regard them as at most parallel offshoots of a common ancestor in which the present group has become much more highly developed.

DIVISIONS.—In Vinogradov's earlier paper, on the genital organs of the Dipodidae, he recognizes two families, Zapodidae and Dipodidae, and seven subfamilies. In his later paper, on cranial characters, he states that the Zapodidae are best referred to the Dipodidae, and he reduces his subfamilies to five, by referring *Salpingotus* to the Cardiocraniinae, and *Sicista* to the Zapodinae. His classification is in the main followed, though I prefer to keep *Sicista* apart as type of a subfamily from the Zapodinae, and I think that the Allactaginae and Dipodinae of Vinogradov, though sharply separated as "groups," have too many characters in common for it to be necessary to refer them to separate subfamilies.

Miller & Gidley, and many American authors, referred the Zapodinae to a separate family chiefly on account of the lack of fusion of the three central metatarsals of the hindfoot. The discovery that the metatarsals are free in the exceedingly rare Palaearctic Pygmy Jerboas, *Salpingotus* and *Cardiocranius* is of great interest, and seems to render this course no longer necessary, striking as the differences are between the specialized fused metatarsals of higher members of the group and the more normal lower type found in *Sicista*, Zapodinae, and Cardiocraniinae.

Salpingotus and *Cardiocranius* appear to be true members of the Dipodidae as currently understood, agreeing with the higher forms, as far as one reads, in dental structure, foreshadowing them in the structure of their zygoma, and even exceeding them in inflation of the bullae and mastoids.

Euchoreutes, on the other hand, agreeing with *Allactaga* and *Dipus* in the fusion of the metatarsals, presents several cranial resemblances to the Zapodinae, as, for instance, the normal zygoma.

It would seem therefore that there are two alternatives, to recognize three families, based on metatarsal structure alone, the Zapodidae, Cardiocraniidae, and Dipodidae, the last including *Euchoreutes*, or to unite them altogether as a family, as do most Russian authors of to-day. Personally I am in agreement with the latter course. It must be noted, however, that the differences between the most generalized member of the present group, *Sicista*, and the most specialized member, say *Jaculus* or *Allactaga*, are greater than between those of the lowest and highest members of the other families in the Order.

According to Tullberg the malleus and incus of *Sicista* agree with or resemble those of *Cricetus* and the Muridae, but those of *Zapus* differ not only from *Sicista* but also from *Allactaga* and *Jaculus*.

Key to the Subfamilies of Dipodidae

The three central metatarsal bones not fused to form cannonbone.

Auditory bullae not inflated, relatively small. Jugal slanting gradually upwards to the lachrymal, zygoma simple.

Cheekteeth brachyodont, cuspidate, quadritubercular, with moderately marked re-entrant folds, the teeth not showing tendency to become flatcrowned. Hindfoot not lengthened; externally not specialized for saltatorial life. Subfamily SICISTINAE (*Sicista*)

Cheekteeth semihypsodont, not quadritubercular; primitively with strongly marked re-entrant folds; showing a tendency to become flatcrowned, in which case the re-entrant folds isolate on crown surface, or become narrowed. External form considerably modified for saltatorial life, the hindfoot lengthened. Subfamily ZAPODINAE (*Eozapus*, *Zapus*, *Napaeozapus*)

Auditory bullae and mastoids abnormally inflated, about at maximum development for the whole Order; occupying about a third of upper surface of skull. Jugal in two portions, a horizontal and a vertical, these portions connected by a curvature. (External form saltatorial.) Subfamily CARDIOCRANIINAE (*Cardiocranius* (not seen), *Salpingotus*)

The three central metatarsal bones fused to form a cannonbone.

Jugal slanting gradually upwards towards lachrymal, the zygoma simple; cheekteeth with extremely high cusps and shallow re-entrant folds; M.3 vestigial (so far as ascertainable); skull narrowed at a point considerably behind lachrymals; rostrum elongated. (Ear abnormally enlarged; mastoids well inflated.) Subfamily EUCHOREUTINAE (*Euchoreutes*)

Jugal in two portions, a horizontal and a vertical, these portions forming a sharp angle with each other, and not connected by a curvature. Cheekteeth with moderate or low cusps, and well-marked re-entrant folds. M.3 not vestigial. Skull not narrowed, or very slightly so immediately behind lachrymals; rostrum not elongated. (Ear less enlarged; mastoids well to extremely inflated.) Subfamily DIPODINAE

Mastoids and bullae little inflated (comparatively); upper incisors pro-odont; ears usually larger; functionless lateral digits of hindfoot not suppressed; infraorbital foramen more widely open, and anterior vertical portion of jugal not greatly broadened; os penis absent (Vinogradov). *Allactaga* Group (ALLACTAGAE) (*Allactaga*, *Alactagulus*, *Pygeretmus*)

Mastoids and bullae considerably to extremely inflated; upper incisors not pro-odont; ears usually smaller; lateral digits of hindfoot suppressed; infraorbital foramen less widely open, and anterior vertical portion of zygoma greatly broadened; os penis present (Vinogradov). *Dipus* Group (DIPODES)
(*Paradipus*, *Dipus*, *Scirtopoda*, *Jaculus*, *Eremodipus* (not seen))

Subfamily SICISTINAE

GEOGRAPHICAL DISTRIBUTION.—Palaearctic: Central Norway, Denmark, Finland, Eastern Roumania, Bulgaria, Hungary; European Russia (Ukraine, Crimea, the Caucasus; surroundings of Leningrad, Moscow, former Tver govt., lower part of River Pechora, former Archangel district, North Ural); Asiatic Russia; Kazakstan east to former Kusnetzk, Krasnoiar, Minusinsk and Irkutsk districts, Altai; East coast Lake Baikal; Tianshan mountains; Sakhalin, and Ussuri region (all Russian localities as quoted by Vinogradov, 1933). Also known from Chinese Turkestan, Manchuria, Szechuan, Kansu, Kashmir.

NUMBER OF GENERA.—One.

CHARACTERS.—As indicated in the above key. Skull little specialized; braincase rounded; bullae relatively small; upper and lower zygomatic roots above one another; jugal slanting gradually towards lachrymal, but not in contact with it; rostrum moderately long. External form Murine, limbs not lengthened, not modified for saltatorial life. Size very small. Cheekteeth $\frac{4}{3}$.

As compared with *Graphiurus* and *Deomys*, the only two genera included here in the Muroidae which present a similar arrangement of the zygomatic plate and infraorbital foramen, it appears that the infraorbital foramen of the present genus is relatively more widely open, and shaped differently, being considerably broader below than in either of the two genera mentioned above, and more or less triangular in shape. The infraorbital foramen of *Zapus* agrees essentially with that of *Sicista*.

Genus 1. SICISTA, Gray

1827. SICISTA, Gray, Griffith's Anim. Kingd., V, p. 227.
1840. SMINTHUS, Nathusius, A.V. Nordmann in Demidoff Voy. Russie, iii, p. 49. *Sminthus loriger*, Nathusius.

TYPE SPECIES.—*Mus subtilis*, Pallas.

RANGE.—As in the subfamily Sicistinae.

NUMBER OF FORMS.—About seventeen.

CHARACTERS.—Frontals constricted at considerable distance behind lachrymals, degree of constriction moderate. Palate projecting beyond M.3, terminating in a spinous process, the palate broad. Nasals not projecting beyond premaxillae. Skull without supraorbital ridges. Incisive foramina large, well open, extending about to toothrow.

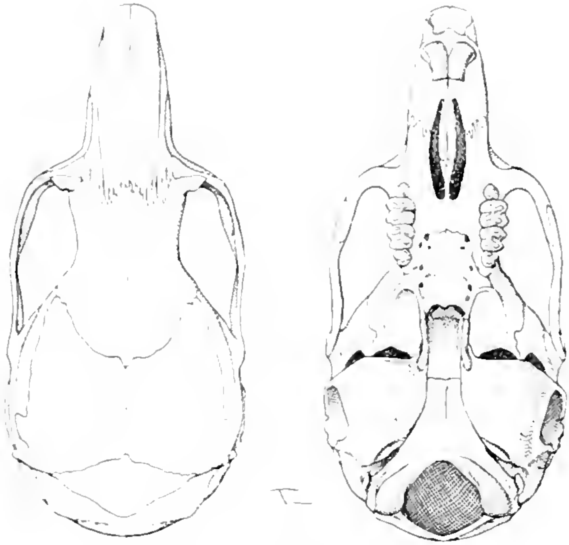


FIG. 144. SICISTA SUBTILIS LORIGER, Nathusius.
B.M. No. 12.12.17.13. ♂; × 4.

FIG. 145. SICISTA SUBTILIS LORIGER, Nathusius.
B.M. No. 12.12.17.13. ♂; × 4.

P.4 very small; M.3 small. M.1 and M.2 with four main cusps, the outer of which tend to be larger than the inner, the cusps, which are situated roughly at the corners of the teeth, separated by relatively wide folds. The cusps are evidently long retained, and the general effect is complex. Lower molars like those of the upper series, but M.3 less reduced, and the folds separating the cusps appear as a relatively more important element in the tooth. The general dental effect is reminiscent to a degree of that present in Cricetinae.

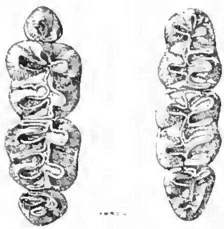


Fig. 146
Sicista subtilis loriger.
Cheekteeth; × 9.

Incisors not grooved. Mandible without perforation in the angular process.

Size very small indeed, under 100 mm. head and body length as far as seen. Tail considerably longer than head and body, moderately haired. Forefoot without peculiarities. Hindfoot with very short hallux, D.5 somewhat reduced, the foot very narrow.

There are 8 mammae in a specimen of *S. norvegica* given to me by Mr. J. L. Chaworth-Musters, who tells me that this species hibernates for a considerable portion of the year in Norway. I am much obliged to Mr. Chaworth-Musters for much information concerning this genus.

Forms seen: *betulina*, *caudata*, *concolor*, *leathemi*, *loriger*, *montana*, *norvegica*, *subtilis*, *tianschanica*, *trizona*.

Two groups are currently recognized, those species in which there is a middorsal stripe present, typified by *subtilis*, and those in which this is absent, typified by *concolor*.

The synonymy of the *subtilis* group has been published by Chaworth-Musters, Ann. Mag. Nat. Hist. ser. 10, vol. xiv, p. 554, 1934; in this paper the range of some of the races will be found.

S. betulina differs from *S. subtilis* in the relatively longer hindfoot and tail. The *concolor* group appears to consist of forms which are rather doubtfully separable from each other as full species, with the exception of *napaea*, which was described as near *flavus*, but which, according to Vinogradov, has many characters which separate it from the *concolor* group, including the genitalia.

List of Named Forms

(The references and type localities for all members of the family Dipodidae are the work of Mr. G. W. C. Holt.)

Not allocated to group

1. SICISTA NAPAEA, Hollister
1912. Smiths. Misc. Coll., LX, no. 14, p. 2.
Tapucha, Altai Mountains, Siberia.

subtilis Group

2. SICISTA SUBTILIS SUBTILIS, Pallas

1773. Reise, ii, p. 705.
Mouth of Ural River, Siberia.
Synonym: *vagus*, Pallas, 1778, Nov. Spec. Quadr. Glir, Ord. p. 327. Russia.
lineatus, Lichtenstein, 1823, Eversmann's Reis. Buch., p. 123.

3. SICISTA SUBTILIS LORIGER, Nathusius

1840. Nordm. Voy. Demidoff, iii, p. 49.
Odessa, South Russia.
Synonym: *nordmanni*, Keyserling & Blasius, 1840, Wirb. Europ., X, p. 38. Crimea.

4. SICISTA SUBTILIS PALLIDA, Kaschkaroff, ex Vinogradov

1926. Rodents of Turkestan, p. 11, in Usbekistan Exp. Plant. Prot.
Djetysu, Turkestan.

5. SICISTA SUBTILIS TRIZONA, Petenyi

1882. Termeszetrajzi Füzetek, V, p. 103.
Hungary.
With alternatives *interzonus*, *interstriatus*, *tripartitus*, *virgulosus* and *tristriatus*: same reference.

6. SICISTA SUBTILIS SIBIRICA, Ognev

1935. Abstr. Works. Zool. Inst. Moscow, 2, p. 54.
Central part of Russian Altai.

7. SICISTA SUBTILIS SEVERTZOWI, Ognev

1935. Abstr. Works. Zool. Inst. Moscow, 2, p. 54.
Kamennaja Steppe, Bobrow, Voronesh, South Russia.

8. SICISTA BETULINA BETULINA, Pallas

1778. Nov. Spec. Quad. Glir. Ord., p. 90.
Banks of River Ischim, Siberia.

9. SICISTA BETULINA MONTANA, Méhely

1913. Allattani Kozlem, 12, p. 69.
Zuberecz, Hungary.

10. SICISTA BETULINA STRANDI, Formozov

1931. Folia Zool. Hydrob. Riga, 3, p. 79.
Caucasus, Ortschaft Igerá Höhe, 2,100 m. Distrikt Utschkulak, Karatschai.

11. SICISTA BETULINA NORVEGICA, Chaworth-Musters

1927. Ann. Mag. Nat. Hist. 9, XIX, p. 542.
Surendal, Nordmore, Norway.

concolor Group

12. SICISTA CONCOLOR, Buchner

1892. Mél. Biol. Acad. St. Petersb., xiii, p. 268.
Si-ning, Kansu, China.
Synonym: (?) *weigoldi*, Jacobi, 1923, Abh. Mus. Dresden, 16, no. 1, p. 15. Hsueschau, West China.

13. SICISTA LEATHEMI, Thomas

1893. Ann. Mag. Nat. Hist. 6, XI, p. 184.
Krishnye Valley, Wardwan, Kashmir.

14. SICISTA FLAVUS, True

1894. Proc. U.S. Nat. Mus. Washington, XVII, p. 341.
Kashmir.

15. SICISTA TIANSCHANICA, Salensky

1903. Ann. Mus. St. Petersb., VIII, p. 17.
Thian Shan, Chinese Turkestan.

16. SICISTA CAUDATA, Thomas

1907. Proc. Zool. Soc. London, p. 413.
Korsakoff, Saghalien.

17. SICISTA CAUCASICA, Vinogradov

1925. Proc. Zool. Soc. London, p. 584.
Kuban, North Caucasus.

Subfamily ZAPODINAE

GEOGRAPHICAL DISTRIBUTION.—The greater part of Canada and the United States; China, states of Kansu and Szechuan.

NUMBER OF GENERA.—Three.

CHARACTERS.—Skull not essentially different from the Sicistinae; interorbital constriction moderate; jugal in contact with lachrymal; anterior end of nasals projecting beyond premaxillae; palate not continued backwards behind M.3; and not terminating in spinous process. Cheekteeth semihypsodont, becoming flatcrowned in American genera, but with relatively high cusps in the Asiatic genus, which has also wide re-entrant folds. External form considerably modified for bipedal saltatorial life; hindlimbs and tail lengthened. Cheekteeth $\frac{4}{3}$ or $\frac{3}{3}$. Bullae relatively small, not inflated. (Metatarsals normal. Zygoma simple.)

KEY TO THE GENERA OF ZAPODINAE

Cheekteeth with high cusps and broad re-entrant folds, showing no sign of becoming flatcrowned (so far as ascertainable). EOZAPUS

Cheekteeth with low cusps and moderate re-entrant folds, the folds considerably narrowed; or the teeth becoming flatcrowned.

- Cheekteeth nearly completely flatcrowned, with numerous narrow isolated islands on crown surface in adult. NAPAEOZAPUS

- Cheekteeth less flatcrowned, without numerous small isolated islands on crown surface in adult. ZAPUS

Genus 1. EOZAPUS, Preble

1899. EOZAPUS, Preble, North Amer. Fauna, o. 15, p. 37.

Type Species.—*Zapus setchuanus*, Pousargues.

Range.—China: Szechuan and Kansu.

Number of Forms.—Two.

Characters.—Like *Zapus*, next to be described, but with, in the three skulls examined, a considerably different dental pattern. The cheekteeth have very wide re-entrant folds separating high cusps and ridges. Four outer, one inner folds in the upper main teeth (M.1 and M.2); in the lower teeth there is one very wide main outer fold, and a small extra one in front of it; three inner folds, and in M.1 also an anterior fold. Teeth more or less prismatic, showing no sign of becoming flatcrowned; it would be desirable to examine a much larger number before giving any guarantee that these characters are constant. In the upper jaw, M.3 is considerably reduced; P.4 is present, and minute.

Forms seen: *setchuanus*, *vicinus*.

List of Named Forms

1. EOZAPUS SETCHUANUS SETCHUANUS, Pousargues

1896. Bull. Mus. Paris, no. 2, p. 13.
Szechuan, China.

2. EOZAPUS SETCHUANUS VICINUS, Thomas

1912. Ann. Mag. Nat. Hist. 8, X, p. 402.
Kansu, China; 46 miles south-east of Tao-chou.

Genus 2. ZAPUS, Coues

1876. Bull. U.S. Geol. & Geogr. Surv. Terr., ser. 2, vol. 1, p. 253.

Type Species.—*Dipus hudsonius*, Zimmermann.

Range.—Canada and the United States; forms named from Alaska, Hudson Bay, Labrador, Saskatchewan, British Columbia, Oregon, Idaho, Wyoming, California, Nevada, Utah, Colorado, New Mexico, Pennsylvania.

Number of Forms.—Twenty-six.

Characters.—Superior margin of canal for nerve-transmission frequently fused to maxilla in adult. Angular portion of mandible with no perforation, strongly ridged for muscle attachment, the inner side of the angular portion pulled inwards, after the manner of that of *Aplodontia* though less extreme than in that genus. Incisive foramina large, well open, generally extending to toothrows. Upper incisors one-grooved, lower incisors plain.

Cheekteeth $\frac{4}{3}$, the premolar minute; M.3 smaller than other molars. In the upper series, there is one main fold internally, curving forwards, and apparently originally four outer folds, some of which tend to isolate as islands in the adult. The folds are wider and more definite than in *Napaeozapus*, and never so far as seen isolate to the same extent. Lower molars with two outer, four inner folds.

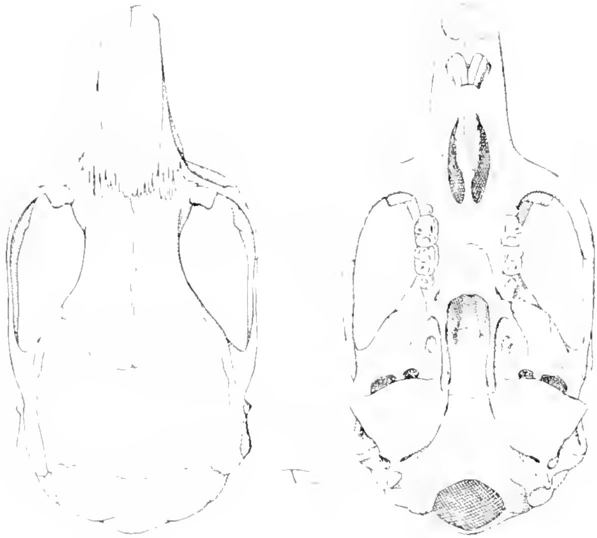


Fig. 147. Zapus hudsonius hudsonius, Zimmermann.
B.M. No. 95.1.7.95, ♂; × $3\frac{1}{2}$.

Fig. 148. Zapus hudsonius hudsonius, Zimmermann.
B.M. No. 95.1.7.95, ♂; × $3\frac{1}{2}$.

Mammae normally 8 (Preble). Hindlimbs elongated, the hindfeet narrow, with the three central digits long, D.5 reaching about to base of D.4, the hallux much shortened. Forefoot narrow; D.3 and D.4 slightly longer than D.2 and D.5; pollex rudimentary. Tail very long, moderately or poorly haired, the scales visible; a small pencil at the end. Cheek-pouches present.

Forms seen: *hudsonius, trinotatus, campestris, ladas.*

The genus is revised by Preble (North Amer. Fauna, 15, p. 13, 1899). All species admitted appear closely allied to each other.

Fig. 149. Zapus hudsonius hudsonius, Zimmermann.
Cheekteeth: B.M. No. 95.1.7.95, ♂; × 15.

List of Named Forms

1. ZAPUS HUDSONIUS HUDSONIUS, Zimmermann

1780. Geogr. Gesch., vol. 2, p. 358.
Hudson Bay.
Synonym: *hudsonius hardyi,* Batchelder, Proc. New England Zool. Club, 1, p. 5, 1899. Mount Desert Island, Hancock County, Maine.

Trouessart quotes as synonyms:

longipes, Zimmermann, Pennants Arctic Zool., 1787, p. 131.
canadensis, Davies, Trans. Linn. Soc., 1798, IV, p. 157.
labradorius, Turton, 1806, Syst. Nat., I, p. 99.
nemoralis, Geoffroy, Dict. Class. Hist. Nat., VII, p. 323, 1825.
daviesi and *soricinus,* Rafinesque, Somiol., p. 14, 1810.
leonurus and *megalops,* Rafinesque, Amer. Monthly Mag., 1818, p. 446.
microcephalus, Harlan, 1839, Proc. Zool. Soc. London, VII, p. 1.

2. ZAPUS HUDSONIUS LADAS, Bangs

1899. Proc. New England Zool. Club, I, p. 10.
Rigolet, Hamilton Inlet, Labrador, Canada.

3. ZAPUS HUDSONIUS ALASCENSIS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 223.
Yakutat Bay, Alaska.

4. ZAPUS HUDSONIUS AMERICANUS, Barton

1799. Trans. Amer. Philos. Soc., IV, p. 115.
Near Philadelphia, Pennsylvania.

5. ZAPUS HUDSONIUS CAMPESTRIS, Preble

1899. North Amer. Fauna, no. 15, p. 20.
Bear Lodge Mountains, Crook County, Wyoming.

6. ZAPUS TENELLUS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 103.
Kamloops, British Columbia, Canada.

7. ZAPUS PRINCEPS PRINCEPS, Allen

1893. Bull. Amer. Mus. Nat. Hist., V, p. 71.
Florida, La Plata County, Colorado.

8. ZAPUS PRINCEPS MINOR, Preble

1899. North Amer. Fauna, no. 15, p. 23.
Wingard, Carlton House, Saskatchewan, Canada.

9. ZAPUS PRINCEPS OREGONUS, Preble

1899. North Amer. Fauna, no. 15, p. 24.
Elgin, Union County, Oregon.

10. ZAPUS PRINCEPS CINEREUS, Hall

1931. Univ. Calif. Publ. Zool. XXXVII, p. 7.
Pine Canyon, Raft River Mountains, Boxelder County, Utah.

11. ZAPUS PRINCEPS CURTATUS, Hall

1931. Univ. Calif. Publ. Zool. XXXVII, p. 7.
Big Creek, Humboldt County, Nevada.

12. ZAPUS PRINCEPS PALATINUS, Hall

1931. Univ. Calif. Publ. Zool. XXXVII, p. 8.
Wisconsin Creek Toyabe Mountains, Nye County, Nevada.

13. ZAPUS PRINCEPS KOOTENAYENSIS, Anderson

1933. Bull. Nat. Mus. Canada, no. 70, p. 108.
British Columbia, Canada, near summit of Green Mountain, head of Murphy Creek, about 10 miles north of Rossland West Kootenay district.

14. ZAPUS PRINCEPS IDAHOENSIS, Davis

1934. Journ. Mamm. Baltimore, 15, p. 221.
Valley County, Idaho, 5 miles east of Warm Lake.

15. ZAPUS PRINCEPS UTAHENSIS, Hall

1934. Occ. Pap. Mus. Zool. Mich., no. 296, p. 3.
Beaver Creek, Manilla, Daggett County, Utah.

16. ZAPUS MAJOR, Preble

1899. North Amer. Fauna, no. 15, p. 24.
Warner Mountains, Lake County, Oregon.

17. ZAPUS NEVADENSIS, Preble

1899. North Amer. Fauna, no. 15, p. 25.
Ruby Mountains, Elko County, Nevada.

18. ZAPUS TRINOTATUS TRINOTATUS, Rhoads

1894. Proc. Acad. Nat. Sci. Philadelphia, p. 421.
Lulu Island, Fraser River, British Columbia, Canada.
Synonym: *imperator*, Elliot, 1899, Field Columb. Mus. Publ. 30, zool. ser., vol. 1, p. 228. Sieg's Range, Elwah R., Clallam County, Washington.

19. ZAPUS TRINOTATUS ALLENI, Elliot

1898. Field Columb. Mus. Publ. 27, zool. ser., vol. 1, p. 212.
Pyramid Peak, Lake Tahoe, Eldorado County, California.

20. ZAPUS TRINOTATUS EUREKA, Howell

1920. Univ. Calif. Publ. Zool., XXI, p. 229.
Fair Oaks, Humboldt County, California.

21. ZAPUS LUTEUS LUTEUS, Miller

1911. Proc. Biol. Soc. Washington, XXIV, p. 253.
Espanola, Santa Fe County, New Mexico.

22. ZAPUS LUTEUS AUSTRALIS, Bailey

1913. Proc. Biol. Soc. Washington, XXVI, p. 132.
Socorro, Socorro County, New Mexico.

23. ZAPUS MONTANUS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 104.
Crater Lake, Mount Mazama, Klamath County, Oregon.

24. ZAPUS ORARIUS, Preble

1899. North Amer. Fauna, no. 15, p. 29.
Point Reyes, Marin County, California.

25. ZAPUS PACIFICUS, Merriam

1897. Proc. Biol. Soc. Washington, XI, p. 104.
Prospect, Rogue River Valley, Jackson County, Oregon.

26. ZAPUS SALTATOR, Allen

1899. Bull. Amer. Mus. Nat. Hist., XII, p. 3.
Telegraph Creek, Stikine River, British Columbia, Canada.

Genus 3. NAPAEOZAPUS, Preble

1899. Napaeozapus, Preble, North Amer. Fauna, no. 15, p. 33.

Type Species.—*Zapus insignis*, Miller.

Range.—Eastern North America; forms described from New Brunswick, Ontario, Wisconsin and North Carolina.

Number of Forms.—Four.

Characters.—Like *Zapus*, but M.2 appearing relatively larger, and dental pattern differing; the teeth nearly completely flatcrowned, the folds extremely narrow, isolating and dividing on the surface of the tooth, so that there may be ten or more small islands on the tooth surface in adult. Lower molars similar to the upper series. P.4 absent. Interorbital constriction greater than *Zapus* (Preble).

Essential external characters as *Zapus* (but tail with white tip).

REMARKS.—The dental peculiarities of these three types seem sufficient to warrant the retention of *Eozapus* and *Napaeozapus* as full genera. The three types are well figured in Preble's revision of *Zapus*. A much larger series, however, would be welcome, as comparatively few skulls are represented in London.

Forms seen: *insignis*.

LIST OF NAMED FORMS

(Genus revised by Preble, North Amer. Fauna, no. 15, p. 33, 1899.)

1. NAPAEOZAPUS INSIGNIS INSIGNIS, Miller

1891. Amer. Nat., XXV, p. 743.
Restigouche River, New Brunswick, Canada.

2. NAPAEOZAPUS INSIGNIS ROANENSIS, Preble

1899. North Amer. Fauna, no. 15, p. 35.
Roan Mountain, Mitchill County, North Carolina.

3. NAPAEOZAPUS INSIGNIS ABIETORUM, Preble

1899. North Amer. Fauna, no. 15, p. 36.
Peninsula Harbour, north shore of Lake Superior, Ontario, Canada.

4. NAPAEOZAPUS INSIGNIS FRUTECTANUS, Jackson

1919. Proc. Biol. Soc. Washington, XXXII, p. 9.
Crescent Lake, Oneida County, Wisconsin.

Subfamily CARDIOCRANIINAE

GEOGRAPHICAL DISTRIBUTION.—Central Asia: Northern Tibet, Mongolia (Gobi, Altai), and Afghanistan.

NUMBER OF GENERA.—Two.

REMARKS.—The two genera included in this subfamily are represented at the British Museum by only one badly smashed skull, type of *Salpingotus thomasi*.

The important character in this subfamily is that the three central metatarsal bones of the hindfoot are not fused, in which the genera agree with Zapodinae and Sicistinae, but differ from Euchoreutinae and Dipodinae. They agree, however, with the higher Jerboas in that the bullae and mastoids are inflated, this inflation indeed being carried much further in this group than in any other Jerboas, according to figures published of the skulls; and in the general form of the zygoma, which differs from *Euchoreutes* but stands nearer the form found in Dipodinae in that there are already two portions, a horizontal and a vertical; but these portions are connected by a curvature in Cardiocraniinae, and do not apparently form such a sharp angle with each other as they do in the Dipodinae. The cheekteeth apparently also agree more with Dipodinae than with Zapodinae.

Genus 1. SALPINGOTUS, Vinogradov

1923. SALPINGOTUS, Vinogradov, Kozlow "Mongolia & Amdo," p. 540.

TYPE SPECIES.—*Salpingotus kozlovi*, Vinogradov.

Range.—Known from the Gobi desert, and Afghanistan.

Number of Forms.—Three.

Characters.—"Hindfoot with three toes and three not-ankylosed metatarsals. Bullae as in *Cardiocranius*. Zygomata broad in their anterior half, a process directed obliquely downwards and backwards and rising from the middle of each zygomatic arch. Jugal not reaching lachrymal. . . . Infraorbital foramen relatively narrower than in true Jerboas. Bony palate spreading far backwards, pterygoids very short. A horizontal process rising externally between angular and articular process of mandible. . . . Upper incisors without grooves. Cheekteeth, P. $\frac{1}{0}$, M. $\frac{3}{3}$; . . . Toes covered with long curved hairs which form a thick brush" (Vinogradov).

The mandible as figured is strongly reminiscent of the formation found in *Aplodontia*.

The degree of development of the downwardly projecting process on the zygomatic arch differs, I believe, in the different species. The tail is described as very long in the type species, and normal, but shorter and more or less of the thickened shape in *crassicauda*, which has a perforation in the angular portion of the mandible. *S. thomasi* belongs evidently to the thicktailed group. The mastoids and bullae are enormous, the mastoids occupying about a third of the upper surface of the skull.

According to Vinogradov, the "tubercular structure of molars is visible only in young and subadult specimens."

Forms seen: *thomasi*.

List of Named Forms

kozlovi Group

1. SALPINGOTUS KOZLOVI, Vinogradov

1923. Kozlow "Mongolia & Amdo," p. 540.
Gobi, Mongolia (near the ruins of Khara-khoto).

crassicauda Group

2. SALPINGOTUS THOMASI, Vinogradov

1928. Ann. Mag. Nat. Hist. 10, I, p. 373.
Afghanistan.

3. SALPINGOTUS CRASSICAUDA, Vinogradov

1924. Zool. Anzeiger, 61, p. 150.
Gobi Altai.

These forms are here treated as separate groups on account of the tail formation, which has elsewhere in this family been used as a generic character. Vinogradov suggests that *S. crassicauda* may ultimately have to form a new genus. The mammae of this species are quoted by him as p. 2—2; i. 2—2.

Genus 2. CARDIOCRANIUS, Satunin

1903. Annuaire Mus. St. Petersb., vii, p. 582.

Type Species.—*Cardiocranius paradoxus*, Satunin.

RANGE.—River Scharogol-dschin, in Nan Shan, Central Asia.

NUMBER OF FORMS.—One.

REMARKS.—This genus is not represented at the British Museum. I am not including any genus I have not seen in my keys, as to endeavour to key an unexamined genus is always difficult, in the case of a Muroid impossible.

Vinogradov has keyed the genera *Salpingotus* and *Cardiocranius* in cranial characters as follows:

" Infraorbital canal complete, its external wall being in contact with wall of maxilla. Zygoma with well-developed process rising from its middle and directed downwards posteriorly. Anterior ends of nasals projecting beyond premaxillae. Palate bones considerably longer than upper toothrow, projecting unusually backwards. SALPINGOTUS

Infraorbital canal incomplete, its external plate not reaching wall of maxilla. Zygomatic arch simple, without any process rising from its middle. Anterior ends of nasals not projecting beyond premaxillae. Palate bones about as long as upper toothrows, not considerably projecting backwards. CARDIOCRANIUS "

In addition to these differences, it may be noticed that in *Cardiocranius*, as described, there are five toes to the hindfoot, the outer toes placed higher up than the central three, the hallux considerably higher than D.5, and functionless. The tail is described as broad and flattened, like that of *Pygeretmus*. Cheekteeth $\frac{4}{}$, considered in the original description to be similar to those of *Dipus* and *Allactaga*, having nothing in common with those of *Euchoreutes*. Jugal not reaching lachrymal. Apices of bullae in contact. Upper incisors grooved. Mastoids enormous, as in *Salpingotus*, and evidently mandible strongly inflected, in a similar manner.

Both *Cardiocranius* and *Salpingotus* are very small forms; *Cardiocranius* has a head and body measurement of 73 mm. (type).

The genus is, I believe, exceedingly rare, and still only known by a very few specimens, though first described over thirty years ago.

LIST OF NAMED FORMS

1. CARDIOCRANIUS PARADOXUS, Satunin

1903. Annuaire Mus St. Petersb., vii, p. 584.
Nan Shan (Scharogol-dschin), Central Asia.

Subfamily EUCHOREUTINAE

GEOGRAPHICAL DISTRIBUTION.—China: known from Yarkand, Chinese Turkestan, and the Alashan desert (Inner Mongolia, bordering Kansu).

NUMBER OF GENERA.—One.

Characters.—Hindfoot with three central metatarsals fused to form a cannonbone. Differing from the Dipodinae, with which it shares these characters, in cranial and dental characters.

Jugal slanting gradually up towards lachrymal; rostrum much elongated; frontals with constriction placed considerably behind the lachrymals (skull as a whole broad, and constriction noticeable but certainly not excessive, at any rate as compared with a typical Murine); lachrymal small; bullae considerably inflated, their apices in contact, mastoids relatively large; mandible with perforation in angular process. Incisive foramina large, and a large second pair are situated between the toothrows. Ear abnormally large. Os penis present (Vinogradov); skeleton of hindfoot as in *Allactaga* group (Vinogradov). Cheekteeth, described below, differing considerably in pattern from Dipodinae; M.3 (so far as seen, and as figured by Vinogradov) vestigial.

Genus 1. EUCHOREUTES, Sclater

1890. Euchoreutes, Sclater, Proc. Zool. Soc. London, p. 610.

Type Species.—*Euchoreutes naso*, Sclater.

Range.—As in the subfamily Euchoreutinae.

Number of Forms.—Two.

Characters.—As indicated above. Zygomata very narrow. Jugal in contact with lachrymal. Nasals projecting beyond premaxillae. Incisors white, the upper ones plain. Palate broad, projecting beyond M.3, terminating in spinous process. Pterygoid fossae deep.

Cheekteeth $\frac{4}{3}$, hypsodont, narrow. M.3 extremely reduced, simple, smaller than P.4. (Two skulls seen only). M.1 slightly larger than M.2, with four main cusps, each cusp separated from its neighbours by a deep valley. Posterior part of teeth straight, not rounded. Lower teeth narrow, like the upper series in pattern, but M.1 with an extra shallow re-entrant fold posterior to second inner cusp, and M.2 with this peculiarity, and with a very small extra cusp, external, anteriorly.

Cusps of cheekteeth high.

Mammae 8 (Sclater). Ears extremely elongated, appearing about half the length of head and body. Snout elongated. Tail considerably longer than head and body, well haired, with a black and white brush at the end. Forelimbs short, foot with five digits, claws well developed. Hindfoot extremely elongated, narrow; five digits present, but only three reaching the ground. Fur long and soft.

Remarks.—Although agreeing with Dipodinae in the highly specialized character of the skeleton of the hindfoot, this genus differs so markedly from them in dental characters, and also in the important character of the zygoma (in which it is transitionary towards Sicista and Zapodinae), that I think the subfamily Euchoreutinae must be retained.

Forms seen: *naso*.

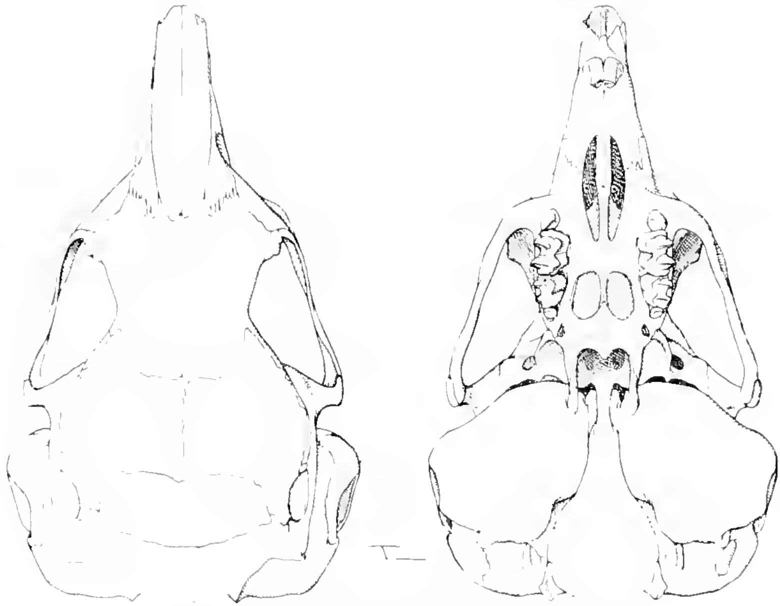


FIG. 150. EUCHOREUTES NASO NASO, Sclater.
B.M. No. 99.11.5.6, [illegible]; × 3.

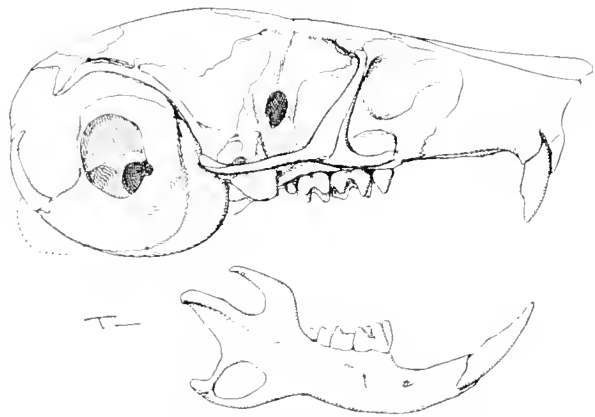


FIG. 151. EUCHOREUTES NASO NASO, Sclater.
B.M. No. 99.11.5.6, [illegible]; × 3.

LIST OF NAMED FORMS

1. EUCHOREUTES NASO NASO, Sclater

1890. Proc. Zool. Soc. London, p. 610.
Yarkand, Chinese Turkestan.

2. EUCHOREUTES NASO ALASCHANICUS, Howell

1928. Proc. Biol. Soc. Washington, XLI, p. 42.
Inner Mongolia, Alashan desert, 100 miles north-west of Ningsia, Kansu.

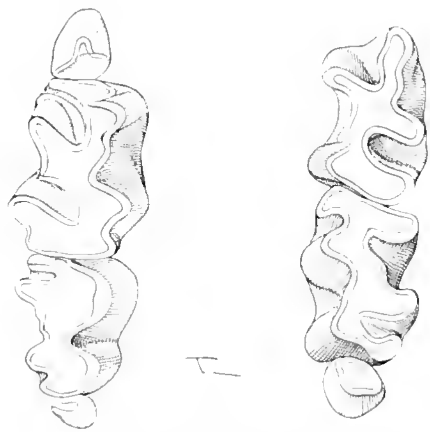


FIG. 152. EUCHOREUTES NASO NASO, Sclater.
Cheekteeth: B.M. No. 99.11.5.6, ♀; × 11.

It may be noted that according to Vinogradov's latest work on the family, the three metatarsals of *Euchoreutes* are less completely fused than in the *Allactaga* group or in the *Dipus* group (Faune de L'URSS, Inst. Zool. Ac. Sci. URSS, 1937, III, no. 4, p. 49, fig. 5).

Subfamily DIPODINAE

GEOGRAPHICAL DISTRIBUTION.—Africa: Senegambia and Morocco to Egypt and Somaliland; Europe, across southern Russia nearly to Roumanian border (Dnieper). Asia Minor, Persia, Arabia, Afghanistan, large portions of Russian Asia; Baluchistan, Kashmir; China east to Mongolia and Chihli.

NUMBER OF GENERA.—As here understood, there are eight genera in two generic groups, the equivalent of the Allactaginae and Dipodinae of Vinogradov.

Characters.—Jugal in two portions, a horizontal and a vertical, the portions forming a sharp angle with each other, and not connected by a curvature (compare Cardiocraniinae). Lachrymal enlarged. Frontals broad, very rarely showing any constriction; if this is present, it is very slight, and situated immediately behind the lachrymals. Functional digits of hindfoot 3. Three central metatarsals fused to form a cannonbone. Bullae moderately or greatly inflated. Externally highly specialized for bipedal saltatorial life.

The subfamily is here divided into two generic groups; a key to these groups has already been given (pp. 563, 564).

The *Allactaga* Group

Anterior vertical branch of the jugal not greatly broadened. Bullae feebly inflated, their apices not in contact. Anterior ends of nasals not reaching alveoli of upper incisors. Upper incisors not grooved, pro-odont. Ears large (larger than in *Dipus* group, but smaller than in Euchoreutinae). Digits of hindfoot five (four in one species of *Allactaga*), three only functional. Os penis absent.

Key to the Genera of the Allactaga Group

Cheekteeth relatively complex; upper main teeth with three external folds, lower main teeth with three internal folds. Vertical branch of zygoma about as broad as horizontal branch. — Allactaga

Cheekteeth simplified; in adult upper main teeth with only two external folds, M.2 lower with only two external folds. Vertical branch of zygoma narrower than horizontal branch.

- Tail longer than head and body, narrow, evenly round, tufted terminally. Margins of supraorbital less angular. — Alactagulus
- Tail shortened, flattened and thick throughout most of its length, not tufted terminally. Margins of supraorbital more angular. — Pygeretmus

Genus 1. ALLACTAGA, Cuvier

1836. Allactaga, Cuvier, Proc. Zool. Soc. London, p. 141.
1841. Scarturus, Gloger, Gemeinn. Naturgesch, 1, p. 106. *Dipus tetradactylus*, Lichtenstein.
1844. Scirtomys, Brandt, Bull. phys.-math. Ac. Sci. St. Petersb., II, p. 220. *Dipus tetradactylus*, Lichtenstein.
1841. Scirtetes, Wagner, Gelehrte Anz. k. bay. Ak. Wiss. München, XII, p. 413. New name for *Allactaga*, Cuvier.

Type Species.—*Dipus alactaga*, Olivier.

Range.—North Egypt; Mesopotamia; North Arabia; Asia Minor; the Caucasus, and southern European Russia (quoted by Vinogradov from former Chernigov, Kursk, southern part of Tula, Riasan, Tambor, Pensa, southern part of Kazan, Samara, Ufa govts., westwards to Dnieper; also Astrakhan and Kalmuck districts, and the Crimea); North Persia; throughout

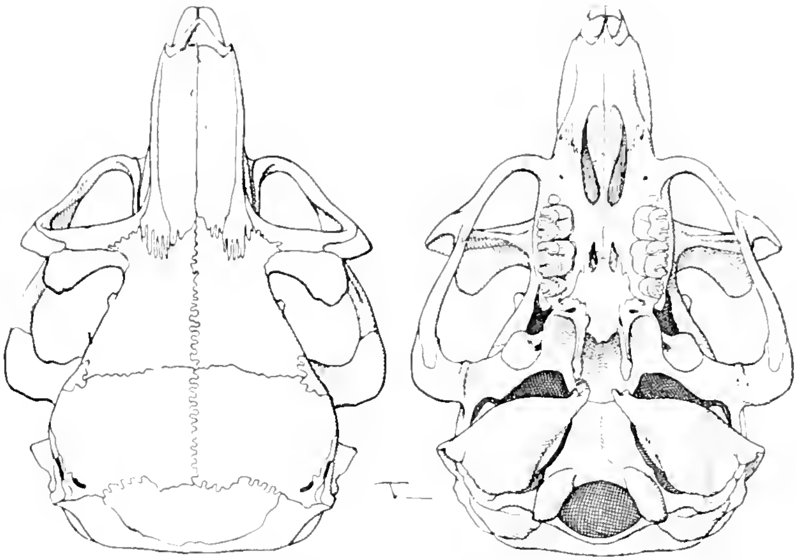


FIG. 153. ALLACTAGA EUPHRATICA, Thomas.
B.M. No. 5.7.2.12, ♂; × 2½.

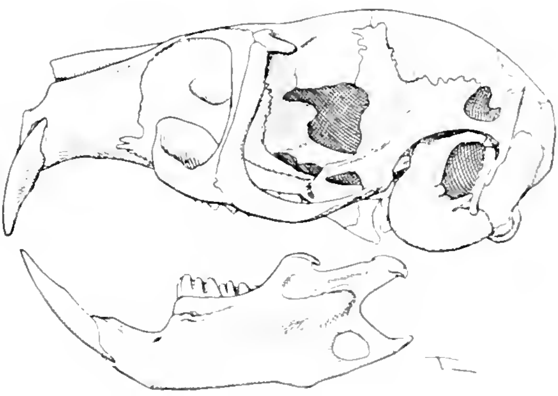


FIG. 154. ALLACTAGA EUPHRATICA, Thomas.
B.M. No. 5.7.2.12, ♂; × 2½.

Russian Turkestan and South-west Siberia to Semipalatinsk and the Altai; Afghanistan, probably Kashmir; the Altai Mountains; Persian Baluchistan; Kansu, Chinese Turkestan, Mongolia, Shansi, North Chihli, and Trans-baikalia.

NUMBER OF FORMS.—About twenty-nine.

CHARACTERS.—Frontals broad, braincase very broad. Lachrymal large. Bullae feebly inflated except in *bullata* (not seen), and slightly less than usual in *hotsoni*. Mastoids not appearing in superior aspect of skull, so far as seen. Incisive foramina relatively large; usually a well-marked second pair present between the toothrows. Skull without supraorbital ridges. Infraorbital foramen very large indeed. Mandible with angular process perforated, and root of incisor forms process below and beside condyle.

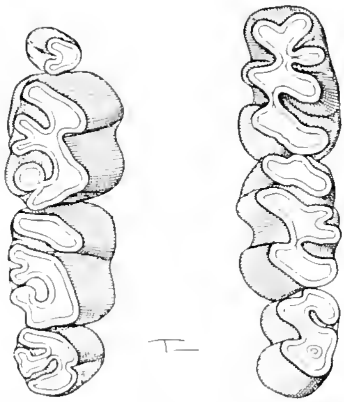


FIG. 155. ALLACTAGA EUPHRATICA, Thomas.
Cheekteeth: B.M. No. 5.7.2.12, ♂; × 8.

Jugal in two portions, a horizontal and a vertical, as in all higher Jerboas.

Cheekteeth $\frac{4}{3}$, semihypsodont, very complex; P.4 normally minute; M.3 considerably reduced, but larger than the premolar except in the *sibirica* group. M.1 and M.2 each with three external re-entrant folds, the middle one of which is small, and each tooth with one internal fold. Sometimes the small middle external fold may wear out, and the whole pattern ultimately becomes lost. Occasionally traces may be seen of a very small fourth extra outer fold in the posterior part of tooth. M.3 with one inner, three outer folds when cut, apparently.

In the lower teeth, M.1 has one small front fold, three inner folds, and two outer ones, the middle inner one being small; M.2 is like M.1 but without the anterior fold. M.3 with one outer fold, and one or two inner ones, which wear out.

Size moderately small to largest of family. Ears very large, though not comparing with those of *Euchoreutes*. Forefoot with five digits, the pollex short; claws well developed; hindfoot perissodactyle with three functional digits, and with two subequal outer digits placed high on the leg, not reaching the ground. Tail longer than head and body, with a black and white brush terminally, round and thin (normal) throughout most of its length. The tail well haired. Hindlimb enormously elongated, the claws of the three central digits with large pad present under each claw.

Lyon states: "*Allactaga* has the cannonbone of *Dipus*, but on either side of it is a small non-functional toe, consisting of a metatarsal and a digit; . . . the cervical vertebrae show a tendency towards consolidation, but not that complete fusion found in *Dipus*." The outer digits appear from Lyon's figure to be situated where the cannonbone finally breaks into three for the central digits.

In *A. tetradactyla*, North Egypt, the hallux is suppressed, but D.5 remains. On this account it has long been regarded as type of a genus "*Scarturus*." But the presence or absence of a functionless digit is scarcely to be considered a character of generic importance, as is seen when dealing with the genus *Dipodomys*. Neither Pocock nor Vinogradov were able to find any differences between the skulls of "*Scarturus*" and *Allactaga*; Vinogradov remarks, "The skull of *Scarturus* is very similar to that in *Allactaga*, especially the members of the *A. euphratica* group, the resemblance may be seen not only in general outlines but also in dimensions; the interorbital constriction is, however, considerably broader than in *A. euphratica* . . . the frontoparietal border of the squamosal has no incisure . . . the incisive foramina in *Scarturus* are somewhat broader and more opened than in *Allactaga*; it is impossible to find, however, more important cranial differences between the genera."

Compared, however, with *Dipodomys* it will be seen that both D.1 and D.5 in *Allactaga* are equal in size; whereas in *Dipodomys* the hallux is much shorter than D.5, and higher on the leg. The complete disappearance of D.5 in *A. tetradactyla* in this case may, therefore, I think be regarded as a specific group character, in the present state of our knowledge, and it is curious that in the several specific groups of *Allactaga* only this one rare species has for no apparent reason entirely lost the digit on one side of the foot, but retains the other functionless digit normally and unreduced.

As remarked above (p. 561), a skull of *A. elater* in the British Museum, no. 13.12.1.3, appears to have a very small extra molar situated at the back of the series on one side of the jaw.

The *A. sibirica* group differ rather noticeably from the other species in that M.3 has become more reduced, and apparently the premolar less so than in others, so that the premolar is only slightly smaller than M.3, or subequal with it, or even sometimes, according to Vinogradov, a little larger than it. The bodily size is larger than in the *elater* group. Vinogradov has keyed the species occurring in the U.S.S.R. The measurements here used are based on his measurements, and also on those of the British Museum specimens.

I am inclined provisionally to recognize five specific groups of *Allactaga*, as follows:

1. The *sibirica* group, with dental characters indicated above.
2. The *tetradactyla* group, with characters as indicated above.
3. The *elater* group. Small forms; hindfoot less than 65 mm. (usually about 48–55 according to B.M. material) in *elater*, slightly larger on average, 52–58 in *euphratica*. Including *hotsoni* (hindfoot 58 in type specimen; bullae more inflated than others).
4. The *major* group. Usually giant forms; typically hindfoot over 85; in *severtzovi* about 70–80.
5. The *williamsi* group. Like the last, but smaller, hindfoot 65–70, or smaller than *major* group, larger than *elater* group, and differing from the *major* group in the characters of the penis, according to Vinogradov.

I am unable to allocate *A. bullata*, Allen, as I have not seen it. It was described as a species with audital bullae about three times the size of *A. mongolica* (*sibirica* group), which may indicate that it should form a group by itself.

The proportions of the cheekteeth are, according to Vinogradov's key, normal, i.e. not agreeing with *sibirica* group (hindfoot 70 mm.).

It should be noted that in *tetradactyla*, as far as known, the size (head and body about 110, hindfoot about 57) agrees with the *elater* group, and it is probably a close ally of *euphratica*.

The nomenclature of the species of the genus here differs from that of Vinogradov and follows that of Chaworth-Musters, who has published several papers on this point. My thanks are due to Mr. Chaworth-Musters for much information regarding this genus.

Forms seen: *aralychensis*, *caucasica*, *decumana*, *elater*, *euphratica*, *hotsoni*, *indica*, "*jaculus*" (= *major*), *laticeps*, *mongolica*, *rückbeili*, *saliens*, *severtzovi*, *saltator*, *tetradactyla*, *williamsi*.

List of Named Forms

incertae sedis

1. ALLACTAGA ARUNDINIS, F. Cuvier

1836. Trans. Zool. Soc. London, II, p. 134.
"Barbary" (? error).

Not allocated to group

2. ALLACTAGA BULLATA, G. Allen

1925. Amer. Mus. Nov. 161, p. 2.
Tsagan Nor, Mongolia.

tetradactyla Group

3. ALLACTAGA TETRADACTYLA, Lichtenstein

1823. Verz. Doublet, Mus. Berlin, p. 2.
Egypt, near Alexandria.
Synonym: *brucei*, Lesson, Man. Mamm., p. 253, 1827. Barca.
abyssinicus, Illiger, 1804, Abh. ph. Kl. k. Akad. Wiss., Berlin, p. 77. (?)Egypt.

elater Group

4. ALLACTAGA EUPHRATICA, Thomas
1881. Ann. Mag. Nat. Hist. 5, XVIII, p. 14.
Mesopotamia.

5. ALLACTAGA ELATER ELATER, Lichtenstein
1825. Abh. k. Akad. Wiss. Berlin, p. 55.
Turkestan; desert region.

6. ALLACTAGA ELATER STRANDI, Heptner
1934. Folia Zool. Hydrob. 6, p. 19.
Transcaspia, "in der Nähe von Merw, Transkaspien."

7. ALLACTAGA ELATER CAUCASIA, Brandt
1855. Mél. Biol. Ac. St. Petersb., II, p. 303.
Transcaucasia (Saljany, Mugan-Steppe).

8. ALLACTAGA ELATER KIZLJARICUS, Satunin
1907. Mitt. Kaukas. Mus. 3, p. 45.
N.-E. Caucasus.

9. ALLACTAGA ELATER ARALYCHENSIS, Satunin
1901. Zool. Anz. XXIV, p. 461.
Transcaucasia.

10. ALLACTAGA ELATER DZUNGARIAE, Thomas
1912. Ann. Mag. Nat. Hist. 8, IX, p. 406.
Zungaria, Central Asia.

11. ALLACTAGA ELATER INDICA, Gray
1842. Ann. Nat. Hist. X, p. 262.
Simkoh Hills, Afghanistan.
Synonym: *bactriana*, Blyth, 1863, Cat. Mamm., p. 110. Afghanistan.

12. ALLACTAGA HOTSONI, Thomas
1920. Journ. Bombay Nat. Hist. Soc. XXVI, p. 936.
Kant, Sih, Persian Baluchistan.

williamsi Group

13. ALLACTAGA WILLIAMSI WILLIAMSI, Thomas
1897. Ann. Mag. Nat. Hist. 6, XX, p. 309.
Van, Kurdistan, Asia Minor.

14. ALLACTAGA WILLIAMSI LATICEPS, Nehring
1903. Sitz. Ber. Ges. Naturf. Berlin, p. 357.
N.-W. Asia Minor.

15. ALLACTAGA WILLIAMSI SCHMIDTI, Satunin
1907. Mit. Kaukas Mus. 3, p. 239.
Caucasus, Kasimabad, Kr. Geokcai.

major Group

16. ALLACTAGA SEVERTZOVI, Vinogradov
1925. Proc. Zool. Soc. London, p. 583.
Tomar-Utkul, district of Kopal, Province Semiretchensk, Russian Turkestan.

17. ALLACTAGA MAJOR MAJOR, Kerr

1792. Anim. Kingd., p. 274.
Between Caspian Sea and River Irtish, Siberia.
Synonym: *jaculus*, Pallas, 1778, Nov. Spec. Glir. Ord., p. 87 (preoccupied).
aulacotis, Wagner, 1843, Abh. Akad. Wiss. München III, p. 211. (?)Arabia.
macrotis, Brandt, 1844, Bull. Acad. Sci. St. Petersb., XI, p. 220.
flavescens, Brandt, 1844, same reference.
nigricans, Brandt, 1844, same reference.
brachyotis, Brandt, 1844, Bull. Acad. Imp. Sci. St. Petersb., II, p. 220.
For use of the name "*major*," Kerr, instead of "*jaculus*," auct., see Chaworth-Musters, Ann. Mag. Nat. Hist. 10, XIV, p. 556, 1934.

18. ALLACTAGA MAJOR SPICULUM, Lichtenstein

1825. Abh. Akad. Wiss. Berlin, p. 154.
Barnaul, N.-W. Altai.

19. ALLACTAGA MAJOR CHACLOVI, Martino

1930. Ann. Mus. Zool. Acad. Leningrad, 31, p. 209.
Karabulak Saissan, Russian Turkestan.

20. ALLACTAGA MAJOR DECUMANA, Lichtenstein

1825. Abhandl. Akad. Wiss. Berlin, p. 154.
Slatoust, Ural.

21. ALLACTAGA MAJOR FUSCUS, Ognev

1924. Rodents N. Caucasus, Rostov-on-Don, p. 8.
Tischlovsk, Kizljar, Daghestan, Caucasus.

22. ALLACTAGA MAJOR VEXILLARIS, Eversmann

1840. Bull. Nat. Moscow, p. 42.
No locality.

sibirica Group

23. ALLACTAGA SIBIRICA SIBIRICA, Forster

1778. Kongl. Vet. Akad. Handl. XXXIX, p. 112.
Transbaikalia.
Synonym: *saliens*, Shaw, 1790, Nat. Misc., vol. 2, p. 1. Transbaikalia.
media, Kerr, 1792, Anim. Kingd., p. 274. Transbaikalia.
brachyurus, Blainville, 1817, Nouv. Dict., XIII, p. 126.
halticus, Illiger, in Lichtenstein, Abhandl. Wiss. Berlin, 1825, p. 154; see Chaworth-Musters, Ann. Mag. Nat. Hist., 1934, 10, XIV, p. 556.
alactaga, Olivier, 1800, Bull. Soc. Philom., II, pl. iv, p. 121.
For use of the name "*sibirica*" instead of "*saliens*," auct., see Chaworth-Musters, Ann. Mag. Nat. Hist. 10, XX, p. 96, 1937.

24. ALLACTAGA SIBIRICA ANNULATA, Milne-Edwards

1867. Ann. Sci. Nat. VII, p. 376.
Mongolia.

25. ALLACTAGA SIBIRICA SUSCHKINI, Satunin

1900. Zool. Anz. XXIII, p. 139.
Desert Ssasa Kopa, south of Irgis, Turgai, Kirghiz Steppe, S.-W. Siberia.

26. ALLACTAGA SIBIRICA MONGOLICA, Radde

1861. Mél. Biol. Acad. Sci. St. Petersb., iii, p. 680.
North Gobi, Mongolia.
Synonym: (?) *longior*, Miller, 1911, Proc. Biol. Soc. Washington, XXIV, p. 54. Fifteen miles north-east of Ching-ning-chow, Kansu, China.

27. ALLACTAGA SIBIRICA RÜCKBEILI, Thomas

1914. Ann. Mag. Nat. Hist. 8, XIII, p. 571.
On banks of River Uszek, Djarkent, Semiretchensk, Central Asia.

28. ALLACTAGA SIBIRICA SALTATOR, Eversmann

1848. Bull. Nat. Moscow, p. 188.
Tchuya Steppe, Altai.

29. ALLACTAGA SIBIRICA (?)GRISESCENS, Hollister

1912. Smiths. Misc. Coll. LX, no. 14, p. 2.
Chuisaya Steppe, 8 miles south of Kosch Agatsch, Altai, Siberia.

Genus 2. ALACTAGULUS, Nehring

1897. ALACTAGULUS, Nehring, S.B. Ges. Nat. Berlin, p. 154.

TYPE SPECIES.—*Dipus acontion*, Pallas.

RANGE.—North Caucasus, Volgo-Ural Steppe, Kazakstan, south to Termez region; Semirechyia; and in Ordos desert, Mongolia.

NUMBER OF FORMS.—Three or four.

CHARACTERS.—Like *Allactaga*, but vertical branch of zygoma considerably narrower than horizontal branch, and cheekteeth simpler, with only two outer folds in M.1 and M.2 in the upper series, the folds straighter than in *Allactaga*; dentition generally appearing simpler, crowns flatter; in the lower teeth M.1 is similar to *Allactaga*, but M.2 lacks the small extra central inner fold, having only two folds each side. Essential external characters as in *Allactaga*. P.4 absent.

Vinogradov states: "*Alactagulus* differs from *Allactaga* not only in the number of the cheekteeth and their structure, but also by some peculiarities of the penis." The genus does not seem very distinct from *Pygeretmus*; on this point Vinogradov states: "*Pygeretmus platyurus* is very closely related to *Alactagulus*, such resemblance exists also in the characters of the external genitals."

Forms seen: "*acontion*" (= *pumilio*), *dinniki*.

LIST OF NAMED FORMS

1. ALACTAGULUS PUMILIO PUMILIO, Kerr

1792. Anim. Kingd., p. 275.
Between Caspian Sea and River Irtish, Siberia.
Synonym: *acontion*, Pallas, 1811, Zoograph. Rosso-Asiatica, p. 182. Kirghiz Steppes.
minor, Pallas, 1778, Nov. Spec. Quad. Glires, p. 205.
pygmaeus, Illiger, 1811, Abh. Akad. Berlin, p. 62, nom. nud.
minutus, Blainville, 1817, Nouv. Dict. Nat. Hist. XIII, p. 127.

For use of name *pumilio* in place of *acontion*, Pallas, auct., see Chaworth-Musters, Ann. Mag. Nat. Hist. 10, XIV, p. 556, 1934.

2. ALACTAGULUS PUMILIO DINNIKI, Satunin

1920. Trav. Mus. Georgie Tiflis, no. 2, p. 106.
Prikumsk Steppe, Caucasus.

3. ALACTAGULUS PUMILIO POTANINI, Vinogradov

1926. C.R. Acad. Leningrad, p. 233.
Ordos Desert, near Ulan Morin River, Mongolia.

In Vinogradov, 1933, List of Rodents of the U.S.S.R., there is quoted a race *Alactagulus pumilio pallidus*. The reference to this has not been found.

Genus 3. PYGERETMUS, Gloger

1841. PYGERETMUS, Gloger, Gemeinn. Hand- u. Hilfsbuch d. Naturgesch., i, p. 106.
1844. PLATYCERCOMYS, Brandt, Bull. phys.-math. Acad. Sci. St. Petersb., ii, p. 225. (*Dipus platyurus*, Lichtenstein.)

TYPE SPECIES.—*Dipus platyurus*, Lichtenstein.

RANGE.—S.-W. Siberia: Semirechia, and parts of valley of Ural, and adjoining plain, and Kuvan-Daria (Aral region).

NUMBER OF FORMS.—Two.

CHARACTERS.—Like *Alactagulus*; margins of interorbital region more angular; interorbital constriction more marked; cheekteeth $\frac{3}{3}$, essentially similar to those of *Alactagulus* in two skulls available for examination.

Externally differing from *Alactagulus* and *Allactaga* in the structure of the tail, which is relatively shorter, broad, flattened throughout its length, and not tufted terminally.

Two species are known, evidently considerably distinct from each other; Vinogradov gives measurements as follows:

platyurus: tail 80–90; hindfoot 32–35.
shitkovi: tail 95–107; hindfoot 40–43.

Forms seen: *platyurus*, *shitkovi*.

LIST OF NAMED FORMS

platyurus Group

1. PYGERETMUS PLATYURUS, Lichtenstein

1823. In Eversmann's Reise, p. 121.
Aral Sea region.

shitkovi Group

2. PYGERETMUS SHITKOVI, Kuznecov

1930. C.R. Acad. Sci. U.S.S.R., p. 623.
Kirghiz Steppes of Semipalatinsk, U.S.S.R.

The *Dipus* Group

Infraorbital foramen relatively smaller than in *Allactaga* group, and anterior vertical portion of zygoma greatly broadened. Bullae larger; mastoids considerably inflated, "their internal cavity consisting of two chambers separated only by one very low septum; this chamber is communicated with the cavity of the tympanic bullae, as it can be observed even in *Dipus*, with its relatively feebly inflated mastoids" (Vinogradov). Nasals reach alveoli of upper incisors. Incisors not pro-odont, the upper ones usually grooved. The ears smaller than in the *Allactaga* group (possibly excepting *Paradipus*). Outer functionless digits of hindfoot entirely suppressed. Os penis present (Vinogradov).

Key to the Genera of the Dipus Group

(not including the genus *Eremodipus*, which is unrepresented in British Museum)

Palate terminating on level with hinder part of third molars. Apices of bullae not in contact. Ear relatively larger. Upper incisors plain. Mandible lacks process formed by root of lower incisor. PARADIPUS

Palate terminating behind level of third molars. Bullae with apices in contact. Upper incisors grooved. Ear relatively smaller. Mandible with process formed by root of lower incisor.

- Mastoids not projecting on lateral sides of posterior part of braincase; cheekteeth normally with more complex pattern. DIPUS
- Mastoids projecting on lateral sides of posterior part of braincase; cheekteeth normally relatively simpler.
  - Mastoids not greatly inflated. Tail not heavily tufted, gradually increasing in width from about halfway along its length to the end. Squamosal with no ridge formed by lateral process of parietal. SCIRTOPODA
  - Mastoids relatively enormously inflated. Tail heavily tufted terminally, long; thin and round throughout most of its length. Squamosal with ridge formed by lateral process of parietal. JACULUS

Genus 4. PARADIPUS, Vinogradov

1930. PARADIPUS, Vinogradov, Bull. Acad. Sci. Leningrad, p. 333.

TYPE SPECIES.—*Scirtopoda ctenodactyla*, Vinogradov.

RANGE.—Described from Repetek, Turkmenia, U.S.S.R.

NUMBER OF FORMS.—One.

CHARACTERS.—Posterior edge of palate terminating on level with third molars, instead of considerably behind them. Anterointernal apices of bullae not in contact with each other. Mastoids rather inflated, appearing in superior aspect of skull, but not so large as in *Jaculus*. Postglenoid fenestrae very small. Mandible without process formed by root of lower incisor. Cheekteeth $\frac{3}{3}$. Upper incisors plain.

One skull of this interesting Jerboa has recently been acquired by the British Museum. It is evidently old; the cheekteeth appear to me to be quite different from those of other Jerboas examined; their crowns are completely flat, and with isolated enamel islands, these straight, surrounded by rather broad enamel, two on M.1, two on M.2, one on M.3, upper and lower series.

Externally large; differing from other members of the *Dipus* group in the relatively large ears. "Hindfoot with three long subequal toes; under surface of lateral toes covered internally with brush consisting of long hairs and externally it is furnished with a comb consisting of a row of thickened horny bristles about twice shorter than the long hairs." The ear is given as about 30 mm. by Vinogradov.

This genus, with its long ears, plain incisors, short palate, bullae with apices not in contact, and, if constant, rather different appearance of worn cheekteeth, (simpler than others), stands isolated in the *Dipus* group.

Forms seen: *ctenodactylus*.

List of Named Forms

1. PARADIPUS CTENODACTYLUS, Vinogradov
1929. C.R. Acad. Sci. Leningrad, p. 248.
Repetek, Turkmenia, U.S.S.R.

Genus 5. DIPUS, Zimmermann

1780. DIPUS, Zimmermann, Geog. Geschichte Menschen und vierfüss. Thiere, ii, p. 354.
1910. DIPODIPUS, Trouessart, Faune Mamm. Europe, p. 207. (*Mus sagitta*, Pallas.)

TYPE SPECIES.—*Mus sagitta*, Pallas.

RANGE.—U.S.S.R. and China; Kisljar district and North Caucasus; Volgo-Ural steppe; Kazakstan to south Semipalatinsk; Altai; Semirechie; Turkmenia, Usbekistan; Chinese Turkestan, Mongolia, to Shensi and Chihli.

NUMBER OF FORMS.—Eight.

CHARACTERS.—Like *Jaculus*, to be subsequently described (Genus no. 7), in cranial characters, except: mastoids much less inflated, less so than in other members of the *Dipus* group; not appearing in superior aspect of the skull. Postglenoid fenestrae "open into cavity of braincase"; "partly or entirely closed by portion of petromastoideum in *Scirtopoda*, *Jaculus*, *Paradipus*." Squamosal region without the ridge characteristic of *Jaculus*.

Cheekteeth $\frac{4}{3}$, semihypsodont. M.1 in the upper series with a deep outer fold, placed far backwards, an anterior fold, and an inner fold. M.2 with two outer, one inner folds, the anterior outer fold normally, so far as seen, retained (this fold becoming suppressed in allied genera). M.3 smaller than M.2, but with the same elements originally. P.4 minute.

The folds are deep, the cusps moderately high; four main cusps at corner of each tooth.

Lower cheekteeth with two outer and two inner folds in M.1 and M.2; sometimes the folds nearly meet across the teeth; and M.3 with two outer, one inner folds. In all these teeth, the front outer fold is considerably smaller than the second one, which is more persistent. Some of the folds wear out in old age. Essential external characters as *Jaculus*.

All described forms are evidently regarded now as races of the type, by Vinogradov.

Forms seen: *halli*, *lagopus*, *sowerbyi*, *deaysi*.

List of Named Forms

1. DIPUS SAGITTA SAGITTA, Pallas
1773. Reise, ii, p. 706.
Siberia.

2. DIPUS SAGITTA NOGAI, Satunin
1907. Tiflis Mitt. Kaukas. Mus. 3, p. 34.
N.-E. Caucasus.

3. DIPUS SAGITTA INNAE, Ognev
1930. Zool. Anzeiger, 91, p. 207.
Astrachan Gouv., S.-E. Russia.

4. DIPUS SAGITTA LAGOPUS, Lichtenstein
1823. In Eversmann's Reise, p. 121.
Transcaspia.

5. DIPUS SAGITTA ZAISSANENSIS, Selewin
1934. Bull. Univ. Tachkent, 19, p. 76.
Saissan-nor, Central Asia.

6. DIPUS SAGITTA DEASYI, Barrett-Hamilton
1900. Proc. Zool. Soc. London, p. 196.
Nura, S. Chinese Turkestan.

7. DIPUS SAGITTA HALLI, Sowerby
1920. Ann. Mag. Nat. Hist. 9, V, p. 279.
N.-E. Chihli, N. China.

8. DIPUS SAGITTA SOWERBYI, Thomas
1908. Ann. Mag. Nat. Hist. 8, II, p. 307.
Yu-lin-fu, Shensi, China.

Genus 6. SCIRTOPODA, Brandt

1844. Scirtopoda, Brandt, Bull. phys.-math. Acad. Sci. St. Petersbourg, ii, p. 212.
1844. Halticus, Brandt, Bull. phys.-math. Acad. Sci. St. Petersbourg, ii, p. 213. (*Dipus halticus*, Illiger.)
1925. Stylodipus, Allen, Amer. Mus. Nov., no. 161, p. 4. *Stylodipus andrewsi*, Allen: not seen; status *fide* Vinogradov.

Type Species.—According to Vinogradov the type is now taken to be *Dipus telum*, Lichtenstein.

Range.—Russia (Crimea, Ciscaucasia, Lower Volga, Kazakstan east to Saissan, Aral Sea and Lake Balkash regions, Semirechie, Kara-kum) (Vinogradov); also known from Mongolia.

Number of Forms.—Seven.

Characters.—Like *Jaculus* (next to be described) in cranial characters, but squamosal with no ridge formed by re-entrant lateral process of parietal, and mastoids much less inflated, though in this genus they are more advanced than in *Dipus* in that they show in the superior aspect of skull each side of the braincase. Cheekteeth normally $\frac{3}{3}$; $\frac{4}{3}$ in the type of "*Stylodipus*" *andrewsi*; but according to Vinogradov a minute upper premolar may be present in the young, but disappearing with age, in the other species. The pattern, as far as seen, not essentially different from *Jaculus*, but the teeth appearing rather flatter, less angular, and simpler than in *Dipus*. Upper incisors, as normal for this section, grooved.

Externally like *Jaculus* except that the tail is relatively shorter, with the tuft weaker, less terminal, less developed, the tail gradually becoming wider from about halfway up its length; the terminal portion not black and white. The tail in fact seems to be somewhat intermediate between the normal *Allactaga* or *Jaculus* type, and the *Pygeretmus* type.

S. andrewsi, the type of Allen's genus *Stylodipus*, is regarded as a *Scirtopoda* by Vinogradov. It is not represented at the British Museum; but it appears from the figures published that it is a closely allied form to *S. telum*, and rightly placed in this genus.

Forms seen: *telum*, *proximus*.

List of Named Forms

1. SCIRTOPODA TELUM TELUM, Lichtenstein

1823. In Eversmann's Reise, p. 120.
Aral Sea region.

2. SCIRTOPODA TELUM FALZFEINI, Ognev

1916. Bull. Soc. Nat. Crimée, 5, p. 101.
Taurida district, Crimea, S. Russia.

3. SCIRTOPODA TELUM TUROVI, Heptner

1934. Folia Zool. Hydrob. 6, p. 19.
Don Steppe, S.-E. Russia.

4. SCIRTOPODA TELUM KARELINI, Selewin

1934. Bull. Univ. Tachkent, 19, pp. 76–78.
Kazakstan, Russia. Mountains of Semej-Tau, near Semipalatinsk.

5. SCIRTOPODA TELUM AMANKARAGAI, Selewin

1934. Bull. Univ. Tachkent, 19, p. 76.
Kazakstan, Russia: Aman-Karagai, N. Kazakstan.

6. SCIRTOPODA TELUM PROXIMUS, Fairmaire

1853. Rev. et. Mag. Zool., p. 145.
Jamankala, Ural.

7. SCIRTOPODA ANDREWSI, Allen

1925. Amer. Mus. Nov. no. 161, p. 4.
Ussuk, Mongolia.

According to Vinogradov, *S. andrewsi* retains the vestigial premolar in adult specimens; the hindfoot is larger (about 55) than *telum* (46–51).

Genus 7. JACULUS, Erxleben

1777. JACULUS, Erxleben, Syst. Regn. Anim., p. 404.
1844. HALTOMYS, Brandt, Bull. phys.-math. Acad. Sci. St. Petersb., ii, p. 215. (*Dipus aegyptius*, Hasselquist).
(1922. *Scirtopoda*, Pocock, based on *J. orientalis*; not as now accepted. (For note on the type of the genus *Scirtopoda* see Vinogradov, Bull. Acad. Sci. L'URSS, 1930, p. 332.))

TYPE SPECIES.—*Jaculus orientalis*, Erxleben (see St. Leger, Proc. Zool. Soc. London, 1931: Genera of African Rodentia).

RANGE.—Northern Africa, Senegambia, Morocco, across the Sahara to Egypt and Somaliland; extending into Arabia, Palestine, Syria, Iraq and Persia.

NUMBER OF FORMS.—About twenty are named.

CHARACTERS.—Skull with extremely broad frontals, and even broader braincase, becoming gradually narrower from behind forwards; rostrum narrow; lachrymal large. Jugal as usual in the group, with anterior vertical portion much broadened. Superior margin of canal in infra-orbital foramen for nerve-transmission fused to wall of maxilla in adult. Bullae greatly inflated, mastoids appearing prominently in superior aspect of skull, much more than in other 3-toed Jerboas examined. Squamosal region with well-marked downwardly directed ridge formed by lateral process of parietal. Supraorbital region rather angular. Palate extending behind level of M.3; palatal foramina well open, relatively large, and a second pair present as pits between the toothrows. Mandible with perforation in the angular process, and a process formed by the lower incisor root.

Upper incisors one-grooved. Cheekteeth $\frac{3}{3}$, the upper teeth with one wide inner and one wide outer re-entrant fold which is placed further backwards than the inner one; M.1 also with anterior notch which tends to wear out; cusps lower than usual as a rule. M.1 the largest tooth, M.3 the smallest.

Lower cheekteeth with two outer folds in M.2, and one inner one; one outer fold persistent in M.3 only; M.1 with a fold each side as a rule, and an anterior notch.

Fur soft. Ear large, but considerably smaller than in members of the *Allactaga* group. Tail considerably longer than head and body, normal in shape (narrow, round, not thick, flat), and well-haired throughout, with a conspicuous black and white tuft terminally. Forefoot with five digits, D.5 moderate but shorter than the central three, the pollex less reduced than is usual among non-fossorial Rodents; claws thin but strong. Hindfoot immensely elongated, very narrow, with three digits; soles heavily hairy.

The forelimbs are proportionately extremely shortened, and can only be seen in the living animal on the rare occasions when the animal is still. Jerboas of this type (*J. jaculus*) are very fond of scratching and rolling in their sand; they have a curious habit of lying down and stretching the hindleg as far backwards as it will go, then bringing it round and stretching it forwards, so quickly

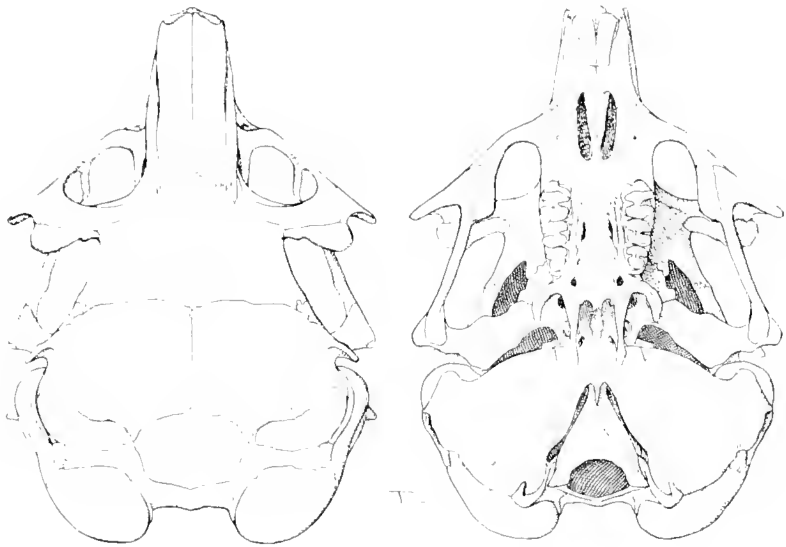


FIG. 156. JACULUS JACULUS JACULUS, Linnaeus.
B.M. No. 8.4 4.52, ; $2\frac{1}{2}$.

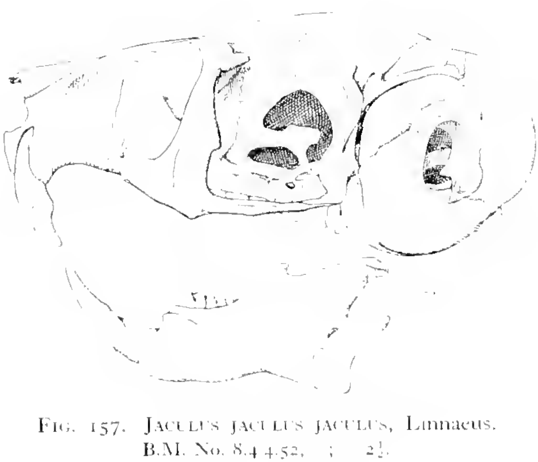


FIG. 157. JACULUS JACULUS JACULUS, Linnaeus.
B.M. No. 8.4 4.52, ; $2\frac{1}{2}$.

that the eye can scarcely follow the procedure; it is at such times that one gets a good idea of the elongation of the limb. Their leaping powers are prodigious, and they often walk along on their hindlimbs; they appear quite unable to go on all fours. The eye is very large.

According to Lyon, the axis and four succeeding vertebrae are completely fused into one large compound "axis." On the skeleton of the hindfoot all traces of the outer digits have disappeared. The femur is short, the tibia and cannonbone long. The upper caudal vertebrae are thick and powerful.

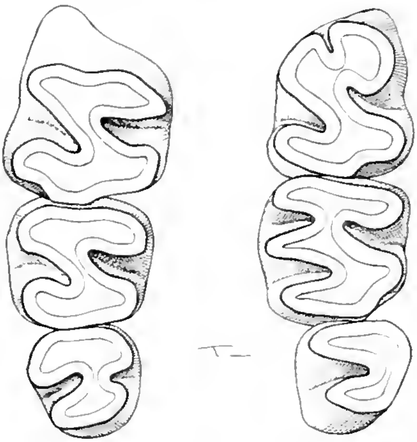


FIG. 158. JACULUS JACULUS JACULUS, Linnaeus.
Cheekteeth: B.M. No. 8.4.4.52, ♀; × 11.

The genus name *Scirtopoda* was revived by Pocock for the Greater Egyptian Jerboa, *J. orientalis*, on the grounds that the structure of the penis differs from that of the *jaculus* group. Vinogradov does not retain the division, and shows that *Scirtopoda* is not available for the species (Thomas having previously and apparently erroneously chosen the type of *Scirtopoda* for a different animal from *S. telum* which Vinogradov states should be considered the type).

As I have endeavoured to show, when dealing with Sciuridae, names based solely on the structure of the baculum are not to be considered valid as full genera.

Two clearly marked groups occur, the smaller *jaculus* (hindfoot about 60, only one in British Museum (*blanfordi*, Persia) exceeding 63), and the *orientalis* group, differing, as indicated above, in baculum structure, and larger size (hindfoot 70–81, exceeding any member of *jaculus* group, so far as seen).

All members of the *jaculus* group are regarded as of one species except *blanfordi*, which appears to be rather larger than the others. I think that many of the races of *jaculus* will ultimately have to be placed in synonymy.

Forms seen: *airensis, blanfordi, butleri, centralis, deserti, favonicus, florentiae, gordoni, jaculus, loftusi, orientalis, schlueteri, sefrius, syrius, vocator, vulturnus.*

List of Named Forms

incertae sedis

1. JACULUS MICROTIS, Reichenow
1887. Zool. Anz. X, p. 369.
Samar, N.-E. Africa.

2. JACULUS MACROTARSUS, Wagner
1840. Abh. Akad. Wiss. München, III, p. 214.
Arabia Petraea, Mount Sinai.

orientalis Group

3. JACULUS ORIENTALIS ORIENTALIS, Erxleben
1777. Syst. Regn. Anim., p. 404.
Egypt.
Synonym: *gerboa*, Olivier, Bull. Soc. Philom., 1, 2, No. 40, p. 121, 1800. Egypt.
locusta, Illiger, 1804–1811, Abh. Akad. Berlin, p. 77. Egypt.
bipes, Lichtenstein, 1823, Verz. Doublet. Mus. Berlin, p. 5. Egypt.
(?)*aegyptius*, Hasselquist, 1744, Acta. Soc. R. Sci. Upsala, p. 17. Egypt.

4. JACULUS ORIENTALIS MAURITANICUS, Duvernoy
1842. Mém. Soc. Hist. Nat. Strasb., iii, p. 30.
Oran, Algeria.

jaculus Group

5. JACULUS JACULUS JACULUS, Linnaeus
1758. Syst. Nat., 10th Ed., p. 63.
N. Egypt.
Synonym: (?)*hirtipes*, Lichtenstein, 1823, Verz. Doubl. Mus. Berlin, p. 5. Near Assuan, Upper Egypt.

6. JACULUS JACULUS BUTLERI, Thomas
1922. Ann. Mag. Nat. Hist. 9, IX, p. 296.
Khartoum.

7. JACULUS JACULUS GORDONI, Thomas
1903. Proc. Zool. Soc. London, i, p. 299.
Kaga Hills, W. Kordofan, Sudan.

8. JACULUS JACULUS VULTURNUS, Thomas
1913. Ann. Mag. Nat. Hist. 8, XI, p. 485.
Berbera, Somaliland.

9. JACULUS JACULUS AIRENSIS, Thomas & Hinton
1921. Nov. Zool. XXVIII, p. 10.
Aderbissinat, north of Damergou, Sudan.

10. JACULUS JACULUS CENTRALIS, Thomas & Hinton
1921. Nov. Zool. XXVIII, p. 11.
Oued el Abiad, In-Salah, Air, Sahara.

11. JACULUS JACULUS DESERTI, Loche

1867. Explor. Alger., p. 100.
Ouargla district, N. Algerian Sahara.
Synonym: *darricarrerei*, Lataste, 1883, Ann. Mus. Civ. Genova, XVIII, p. 661. Bou-Saada, Algeria.

12. JACULUS JACULUS SEFRIUS, Thomas & Hinton

1921. Nov. Zool. XXVIII, p. 10.
Ain-Sefra, Algeria.

13. JACULUS JACULUS FAVONICUS, Thomas

1913. Ann. Mag. Nat. Hist. 8, XI, p. 483.
Trarza country, S.-W. Mauritania.

14. JACULUS JACULUS SCHLUETERI, Nehring

1901. S.B. Ges. Nat. Fr. Berlin, p. 163.
Palestine.

15. JACULUS JACULUS SYRIUS, Thomas

1922. Ann. Mag. Nat. Hist. 9, IX, p. 296.
Karyatein, Syrian Desert.

16. JACULUS JACULUS FLORENTIAE, Cheesman & Hinton

1924. Ann. Mag. Nat. Hist. 9, XIV, p. 556.
Jabal Aqula, Jabrin, Central Arabia.

17. JACULUS JACULUS ORALIS, Cheesman & Hinton

1924. Ann. Mag. Nat. Hist. 9, XIV, p. 557.
Koweit, N.-E. Arabia.

18. JACULUS JACULUS VOCATOR, Thomas

1921. Ann. Mag. Nat. Hist. 9, VIII, p. 441.
Sohar, Muscat, Arabia.

19. JACULUS JACULUS LOFTUSI, Blanford

1875. Ann. Mag. Nat. Hist. 4, XVI, p. 312.
Mohumrah, Mesopotamia.

20. JACULUS BLANFORDI, Murray

1884. Ann. Mag. Nat. Hist. 5, XIV, p. 98.
Bushire, Persia.

Genus 8. EREMODIPUS, Vinogradov

1930. Bull. Acad. Sci. Leningrad, p. 334.

TYPE SPECIES.—*Scirtopoda lichtensteini*, Vinogradov.

RANGE.—Vicinity of Merv, Turkmenia.

NUMBER OF FORMS.—One.

REMARKS.—This genus is not represented at the British Museum. It evidently stands nearest *Jaculus*.

Vinogradov keys this genus against *Jaculus* as follows:

"Lateral process of each parietal bone is furnished with a sharply developed conical prong directed externally and downwards. Postglenoid fenestrae are very small, usually somewhat elongated. Superior margin of external wall of infraorbital canal not ankylosed to wall of maxilla. Root of lower incisor forms a feebly developed alveolar process. EREMODIPUS

Lateral process of each parietal bone is furnished with a sharply developed crista, its base being formed by surrounding parts of the squamosal. Postglenoid fenestrae are greatly enlarged and form nearly equilateral triangles. Superior margin of external wall of infraorbital canal is completely fused to wall of maxilla in adult specimens. Root of lower incisor forms a prominent alveolar process. JACULUS"

LIST OF NAMED FORMS

1. EREMODIPUS LICHTENSTEINI, Vinogradov

1927. Zeitschr. f. Säugetierk. 2, p. 92.
Vicinity of Merv, Turkmenia.

The family is known fossil from the Pleistocene at least, from both the Old and the New Worlds.

Miller & Gidley refer the European Eocene-Miocene family Theridomyidae to this group; Winge places them in the neighbourhood of the Anomaluridae.

DIPODIDAE:

GENERAL WORKS OF REFERENCE

VINOGRADOV, 1925, Proc. Zool. Soc. London, p. 577. Structure of external genitalia of Zapodidae and Dipodidae.

VINOGRADOV, Bull. Acad. Sci. Leningrad 1930, p. 331. Cranial Characters of genera of Family Dipodidae.

LYON, Proc. U.S. Nat. Mus. 7, XXIII, p. 659, 1901. Comparison of the osteology of Jerboas and Jumping-mice.

VINOGRADOV, 1933, Tab. Anal. de la Fauna de L'URSS, Inst. Zool. Acad. Sci. 10, p. 11. Rodents occurring in the U.S.S.R. (Sicistinae, Dipodinae.)

VINOGRADOV, 1923, Kozlow Mongolia & Amdo, p. 540. (*Salpingotus kozlovi.*)

VINOGRADOV, 1928, Zool. Anz. 61, p. 150. (*Salpingotus crassicauda.*)

PREBLE, North Amer. Fauna, no. 15, p. 13, 1899. Revision of Jumping-mice (*Zapus*, *Eozapus*, *Napaeozapus*).

COUES, Monogr. North American Rodentia, p. 461, 1877. Zapodidae.

MILLER, Cat. Mamm. W. Europe, 1912, p. 535. Zapodidae (*Sicista*).

POCOCK, External characters of *Scarturus* and other Jerboas, compared with *Zapus* and *Pedetes*, Proc. Zool. Soc. London, 1922, p. 659.

SCLATER, Proc. Zool. Soc. London, 1890, p. 610. (*Euchoreutes.*)

DOBSON, Proc. Zool. Soc. London, 1882, p. 640. (Dipodidae transferred to the "Hystricomorpha.")

TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, XVIII, 3, no. 1, 1899. (*Sicista*, *Zapus*, *Allactaga*, "*Dipus aegyptius*"–*Jaculus.*)

CHAWORTH-MUSTERS, Ann. Mag. Nat. Hist. 10, XIV, p. 556, 1934: Nomenclature of *Alactagulus* and certain species of *Allactaga*; Ann. Mag. Nat. Hist. 10, XX, p. 96, 1937: Nomenclature of *Allactaga sibirica*; Ann. Mag. Nat. Hist. 10, XIV, p. 554, 1934: Nomenclature of *Sicista subtilis* group.

VINOGRADOV, 1937, Inst. Zool. Acad. Sci. de L'URSS, no. 13, vol. II, no. 4. Family Dipodidae. (A Monograph of the Family, with figures of cranial, dental, skeletal and reproductive characters of all leading species, and distribution maps; Russian with English résumé.)

Superfamily MUROIDAE

1896. Thomas: MYOMORPHA, part, Families Gliridae (Glirinae and Platacanthomyinae); Muridae (Hydromyinae, Rhynchomyinae, Phloeomyinae, Gerbillinae, Otomyinae, Dendromyinae, Murinae, Lophiomyinae, Sigmodontinae, Neotominae, Microtinae, "Siphneinae" (= Myospalacinae)); Spalacidae (Rhizomyinae, Spalacinae).

1899. Tullberg: SCIUROGNATHI, *Myomorpha*, Myoidei, part, Myoxiformes (Myoxidae = Muscardinidae), and Muriformes; Spalacidae, Nesomyinae, Cricetidae, Lophiomyidae, Arvicolidae, Hesperomyidae, Muridae (Murini, Phloeomyini, Otomyini), Gerbillidae.

1918. Miller & Gidley: Superfamily MUROIDAE, part, Families Muscardinidae; Cricetidae (Cricetinae, Gerbillinae, Microtinae, Lophiomyinae); Platacanthomyidae; Rhizomyidae (Tachyoryctinae, Rhizomyinae); Spalacidae (Myospalacinae, Spalacinae); Muridae (Dendromyinae, Murinae, Phloeomyinae, Otomyinae, Hydromyinae). Superfamily DIPODOIDAE, part, Family Graphiuridae.

1924. Winge: Family Myoxidae (=Muscardinidae): (Graphiurini, Myoxini). Family Muridae (Rhizomyini, Cricetini, Murini). Family Dipodidae, part, Spalacini (*Spalax* only).

1928. Weber: MYOXOIDEA, Myoxidae (=Muscardinidae) and Platacanthomyidae. MUROIDEA, Spalacidae, Nesomyidae, Muridae (Cricetinae, Lophiomyinae, Microtinae, Murinae, Gerbillinae, Hydromyinae).

GEOGRAPHICAL DISTRIBUTION.—Cosmopolitan, including Madagascar and the Australasian region.

CHARACTERS.—I have already written at some length on the characters of the superfamily Muroidae as here understood, on pp. 35, 36. The infraorbital foramen always transmits muscle, but is never very much enlarged, at any rate as compared with Dipodoid, Anomaluroid, Pedetoid or Hystricoid types; except in the two genera *Graphiurus* and *Deomys* the zygomatic plate is tilted upwards to a greater or lesser degree. The fibula is, so far as known, always fused with the tibia high on the leg. In the whole of the family Muridae, containing well over half the entire Order, there are, except in abnormalities, never more than $\frac{3}{3}$ cheekteeth present.

In this group I include the Muscardinidae, which, though typically very distinct from Muridae, contains annectant forms such as *Typhlomys* which make it not possible to keep them separate as a distinct superfamily; the Muridae, and a few highly specialized or aberrant genera which it has seemed desirable to make types of distinct families, as *Rhizomys*, *Spalax*, and *Lophiomys*.

KEY TO THE FAMILIES OF MUROIDAE

Upper and lower cheekteeth with a pattern of many transverse crossridges extending across crown; in primitive forms more or less basin-shaped, as in Sciuridae, and with well-marked corner cusps, in progressive forms becoming flatcrowned, with the ridges separated

by depressions. Premolars usually, not always, present. Caecum usually, not always, absent. Jugal bone usually relatively long.
Family MUSCARDINIDAE

Upper and lower cheekteeth various, but never with pattern as just described. Premolars invariably absent (or cheekteeth formula not exceeding $\frac{3}{3}$, except in abnormalities). Caecum, so far as known, present. Jugal bone usually, not always, strongly shortened.

Temporal fossae roofed in by bony plates rising from jugals, frontals, and parietals. Family LOPHIOMYIDAE

Temporal fossae never roofed in by bony plates.

Infraorbital foramen much reduced, its lower border nearly straight; zygomatic plate tilted very strongly upwards, and masseter muscle extending line of attachment on inside of infraorbital foramen (Tullberg). Family RHIZOMYIDAE

Infraorbital foramen not much reduced, its lower border usually V-shaped; zygomatic plate tilted upwards less strongly; masseter muscle so far as known never extending line of attachment on inside of infraorbital foramen.

External form and skull extremely specialized for underground life; eyes suppressed; zygomatic plate much narrowed, and nearly completely below infraorbital foramen.
Family SPALACIDAE

External form and skull less extremely specialized for underground life; eyes always retained; in sub-fossorial genera, zygomatic plate not narrowed, and well tilted upwards.
Family MURIDAE

Family MUSCARDINIDAE

For use of the family name "Muscardinidae" instead of "Gliridae" see Palmer, Science, n.s., vol. X, no. 247, p. 412, 1899.

1896. Thomas: MYOMORPHA, Family Gliridae: Subfamily Glirinae (including *Graphiurus*); Subfamily Platacanthomyinae.
1899. Tullberg: MYOMORPHA: *Myoxiformes*. Family Myoxidae.
1918. Miller & Gidley: Superfamily MUROIDAE, part: Family Muscardinidae (*Eliomys*, *Dyromys*, *Glis*, *Muscardinus*); Family Platacanthomyidae (*Platacanthomys*, *Typhlomys*). Superfamily DIPODOIDAE, part: Family Graphiuridae (*Graphiurus*).
1924. Winge: Family Myoxidae. Subfamilies Graphiurini and Myoxini (the latter including *Platacanthomys*).
1928. Weber: MYOXOIDEA. Family Myoxidae (including *Graphiurus*); Family Platacanthomyidae.

GEOGRAPHICAL DISTRIBUTION.—Africa; Palaearctic region; parts of the Indo-Malayan region (Peninsular India and South China).

NUMBER OF GENERA.—Nine.

CHARACTERS.—Zygomasseteric structure in progressive genera (all but Graphiurinae), approaching or agreeing with that of the Muridae; infraorbital foramen transmitting muscle, though little enlarged, and comparatively unspecialized; zygomatic plate tilted upwards to a certain degree; mandible with angular portion usually pulled inwards, and sometimes with a perforation. In Graphiurinae, the zygomatic plate remains beneath the small infraorbital foramen, and the masseter muscle does not extend attachment on its forepart; masseter lateralis superficialis has its anterior head not distinct (according to Miller & Gidley and as figured by Tullberg), whereas in Muscardininae and Platacanthomyinae this portion of the muscle, as in Muridae, is distinct from the zygoma. The jugal is generally long.

Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$ = 20 in Muscardininae and Graphiurinae; or i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{0}{0}$, m. $\frac{3}{3}$ = 16, in Platacanthomyinae. Cheekteeth brachyodont, always with pattern of a series of ridges extending across the crown. In more primitive genera, as *Graphiurus*, *Eliomys*, the cusps are well marked, and the pattern and arrangement of cusps and ridges is strongly reminiscent of that of the Sciuridae. In progressive types, *Glis*, and to a greater degree *Muscardinus*, the crowns become nearly flat, with obsolete cusps, and well-marked narrow ridges surrounding moderately wide depressions. In Platacanthomyinae, which are slightly more hypsodont, the ridges become widened, and the depressions take on a more clear and definite pattern, and sometimes tend to isolate as islands.

Normally the bullae are large and well inflated, but are small in Platacanthomyinae, and flattened and rather reduced in *Glirulus*.

The external form is slightly modified as a rule for arboreal life. The tail normally is bushy.

The caecum most often is suppressed; but this is not the case in *Typhlomys*.

The systematic position of these animals is by no means clear, and has been one of the major problems of the present classification of the Order.

Winge recognized only eight families of Rodents as here understood, this group one of them (distinct from Muridae).

Weber has regarded the group as a superfamily.

Tullberg evidently regards the group as a natural one, separate from the Muridae (in his Muroidei he has three equal groups, the "Myoxiformes" (=Muscardinidae), Dipodiformes (=Dipodidae), and Muriformes (Muridae, Spalacidae, Lophiomyidae and Rhizomyidae as here understood).

Miller & Gidley refer *Graphiurus* to a separate superfamily, the Dipodoidae, from other Muscardinidae, which are placed in the Muroidae. This arrangement is based entirely on zygomasseteric structure, but is in my opinion rather an unnatural division, in that *Graphiurus* seems to share very many essential characters with *Eliomys* (Muscardininae). *Platacanthomys* and *Typhlomys* these authors refer to a family Platacanthomyidae in the "quadrituberculate series" of Muroidae; whereas their Muscardinidae are referred to the "trituberculate series" of Muroidae.

If we take *Graphiurus*, and compare it with *Eliomys*, as regards arrangement of zygomatic plate and infraorbital foramen, it is noticeable that if the infraorbital foramen of, say, *Graphiurus hueti* were slightly narrowed below and considerably above, the result would be as is now in *Eliomys*. On looking through the skulls at the British Museum I was struck by the fact that there seems a slight variation in form in the infraorbital foramen of various specimens of *Graphiurus*. In *G. surdus*, for instance, it is not far from the primitive Muroid type as characterizes *Muscardinus*, *Glis*, *Eliomys* and others.

In the Muridae, the African genus *Deomys* would certainly have to be referred to the "Dipodoidae" of Miller & Gidley if their classification were followed to the letter.

Although Miller & Gidley were not of opinion that any of their super-families were derived one from another, I am inclined to suspect that in the present case, one zygomasseteric structure, say that of Muscardininae, has been derived from the other as typified by *Graphiurus*. In zygomasseteric structure, as in many other characters, the present group seems to be one of the most primitive groups of Rodents, not very far removed, at any rate as regards arrangement of infraorbital foramen, from the type of Rodent (? Aplodontoid) that probably gave rise to most or all of the modern families.

We have now to consider whether the Muscardinidae (all Dormice being referred to one family) are distinguishable from the Muroidae as a superfamily. If we take *Dyromys* and compare it with, say, *Grammomys* representing the Muridae, we find the following differences.

The cheekteeth in *Dyromys* are basin-shaped, the upper and lower series being characterized by many narrow transverse ridges; in *Grammomys* the molars are cuspidate, the upper series bearing three longitudinal rows, the lower molars two longitudinal rows.

The fourth premolar is present in *Dyromys*; in *Grammomys* it is absent (or at any rate only $\frac{3}{3}$ cheekteeth are present in the latter). The mandible of *Dyromys* has the angular portion pulled inwards, after the manner of Dipodidae, Sciuridae, Aplodontiidae, etc. In *Grammomys* this is not the case. The jugal in *Dyromys* is long; whereas in *Grammomys* it is becoming shortened; in very many other Muridae it is strongly shortened. In *Dyromys* the caecum is suppressed; in *Grammomys*, presumably, this is not the case. The tail is thickly bushy in *Dyromys*; mostly naked and scaly in *Grammomys*. And in *Dyromys* the zygomatic plate is relatively weak and narrow, in *Grammomys* it is broader and strongly tilted upwards, as is often the case in Muridae. The bullae are large, inflated in *Dyromys*, rather small in *Grammomys*.

Between these two therefore there are clear distinctions. But there are intermediate genera which appear to break down all these characters. In *Platacanthomys* (Muscardinidae), the premolars are suppressed, and the dental formula is as in Muridae. The mandible in *Typhlomys* (Muscardinidae) has no perforation, and is reduced, and not noticeably inflected. The jugal in *Tachyoryctes*, *Brachyuromys* and others (Muridae), is long, forming the greater part of the zygoma. The caecum is not suppressed in *Typhlomys* (Muscardinidae), but becoming very reduced, according to Thomas, in *Ichthyomys* (Muridae). The tail is nearly naked in *Typhlomys* (Muscardinidae), thickly bushy in *Crateromys* (Muridae). The zygomatic plate is very narrow in *Hydromys* (Muridae), very much as in *Platacanthomys* representing the

Muscardinidae. The bullae are small in *Glirulus* (Muscardinidae); very large in many Gerbillinae (Muridae). The cheekteeth alone remain. I can call to mind no members of the vast group referred to Muridae which bear any close resemblance to Muscardinidae. Perhaps *Gymnuromys* of Madagascar stands nearest *Platacanthomys* in this respect. But pattern of cheekteeth seems scarcely a valid character on which to base superfamilies. Compare, for instance, the teeth of *Rattus*, *Cricetus*, *Microtus*, *Otomys*, *Sigmodon*. All appear widely distinct in pattern; yet all belong to the one family. Compare *Ctenodactylus* with *Ctenomys* (essentially similar but belonging to different superfamilies); or *Phloeomys* (Muridae) with *Diplomys* (Hystricoidae), which are also similar in general arrangement.

This being the case the Muscardinidae are regarded provisionally as primitive and aberrant members of the superfamily Muroidae.

Three subfamilies are here retained.

Key to the Subfamilies of Muscardinidae

Zygomatic plate very narrow, completely beneath infraorbital foramen.
Subfamily Graphiurinae
(*Graphiurus*)

Zygomatic plate broadened to a certain degree, always tilted upwards.

Cheekteeth $\frac{4}{4}$, with transverse ridges on crown moderately or well developed, always narrow, the depressions not tending to become isolated on crown surface, and not clearly marked as a rule. Palate without a series of foramina between the toothrows. Bullae usually large, well inflated. Subfamily Muscardininae
(*Myomimus* (not seen), *Eliomys*, *Dyromys*, *Glirulus*, *Glis*, *Muscardinus*)

Cheekteeth $\frac{3}{3}$, with transverse ridges clearly marked, broadened, and the depressions tending to become isolated on crown surface, always well marked. Palate with a series of foramina or a single very large pair between the toothrows. Bullae small, reduced.
Subfamily Platacanthomyinae
(*Platacanthomys*, *Typhlomys*)

Subfamily GRAPHIURINAE

Geographical Distribution.—Africa, south of the Sahara.

Number of Genera.—One.

Characters.—As indicated in the key. Cheekteeth $\frac{4}{4}$, basin-shaped, the ridges weak, the pattern as a rule not clear.

Though currently referred to three or four genera, it seems most convenient to regard all members of the present subfamily as belonging to one genus only.

Genus 1. GRAPHIURUS, Smuts

1832. GRAPHIURUS, Smuts. Enum. Mamm. Cap., pp. 32, 33.
1936. AETHOGLIS, Allen. Journ. Mamm. 17, p. 292. *Graphiurus nagtglasi*, Jentink.
1888. CLAVIGLIS, Jentink, Notes Leyden Mus., p. 41. *Claviglis crassicaudatus*, Jentink. Valid as a subgenus.
1925. GLIRISCUS, Thomas & Hinton, Proc. Zool. Soc. London, p. 232. *Graphiurus platyops*, Thomas. Valid as a subgenus.

TYPE SPECIES.—*Sciurus ocularis*, Smith. (*Graphiurus capensis*, Smuts.)

RANGE.—Africa: Sudan, Sahara, Abyssinia, Somaliland, Kenya, Uganda, Tanganyika; Senegal, Liberia, Gold Coast, Nigeria, Cameroons, Congo; Angola, Rhodesia, Nyasaland, Mozambique, South-west Africa, Bechuanaland, Transvaal, Cape.

NUMBER OF FORMS.—About fifty-three.

CHARACTERS.—Zygomatic plate not tilted upwards and completely beneath the infraorbital foramen. Skull considerably constricted between the frontals; braincase smooth and round; nasals projecting forwards. Palate relatively broad; palatal foramina situated considerably in front of toothrows. Bullae large and inflated as a rule; mandible normally without perforation in the angular process.

Crowns of cheekteeth concave, with two low main external cusps; the general arrangement in pattern evidently near *Eliomys* (below), but the ridges in most indistinct, and a general tendency towards simplification. The premolars are usually only moderately reduced; but in the type species are strongly reduced. *G. rupicola* has a rather reduced lower P.4.

Externally with thickly bushy tail (normally); hindfoot with five digits, the fifth relatively long, the hallux short; the feet are of arboreal type. Caecum (said to be) absent.

Thomas & Hinton divided the genus into three main groups, which they keyed as follows:

Premolar minute, simple; surface of teeth with scarcely perceptible ridges. *Graphiurus*

Premolar little smaller than the molars, its outer edge, when unworn, notched as in the molars; surface of teeth with distinct ridges.

Skull of normal height, braincase strongly convex upwards. *Claviglis*

Skull flattened, muzzle low, braincase scarcely convex upwards. *Gliriscus*

In the first case, it must be pointed out that *Gliriscus* cannot be used in a generic sense if only on the grounds of consistency. Hinton (Monograph of Voles and Lemmings, 1926, p. 44) writes, of the genus *Alticola*, "some remarkable species inhabiting the bare talus slopes of Central Asia, have acquired remarkably flattened skulls fitting them for life in rock crevices; these have been referred to a special subgenus *Platycranius* by Kascenko, but apart from the peculiar flattening of the skull there is nothing to distinguish them from

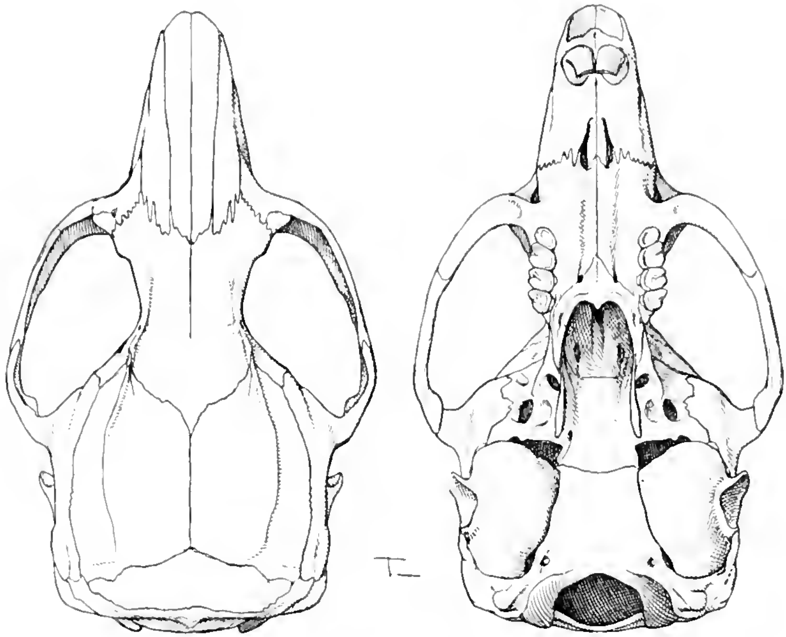


FIG. 159. GRAPHIURUS HUETI HUETI, Rochebrune.
B.M. No. 25.10.24.1; × 2½.

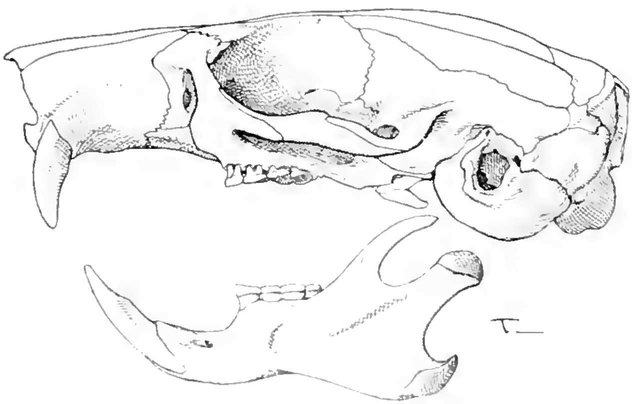


FIG. 160. GRAPHIURUS HUETI HUETI, Rochebrune.
B.M. No. 25.10.24 1; × 2½.

the more specialized forms of *Alticola*"; and (on p. 325), "The subgenus *Platycranius* seems to be an offshoot of the genus *Alticola* which has become specialized for life in the crevices of bare rocks; and in this habit and the correlated cranial characters it affords a parallel to *Gliriscus*, a similar offshoot from *Graphiurus*, the great African genus of Dormice."

No authors dealing with Palaearctic mammals have ever given *Platycranius* full generic rank so far as I know. But when exactly the same specialization occurs in Africa, it seems it must be generic! I have often failed to see why animals must have full generic rank just because they inhabit the African Continent, but in many cases this seems to be the sole reason.

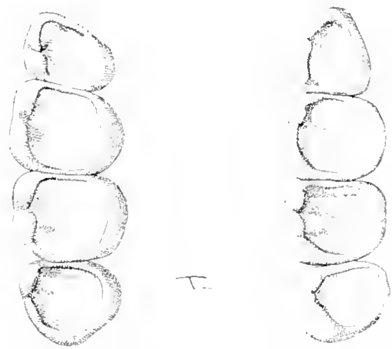


FIG. 161. GRAPHIURUS HUETI HUETI, Rochebrune.
Cheekteeth: B.M. No. 25.10.24.21; 10.

It may also be added that *Graphiurus* s.s. has the skull just as flattened as in *Gliriscus*.

Between *Graphiurus* (*ocularis*) and other subgenera there is a wide distinction in the cheekteeth; in the former the premolars are extremely reduced. But contra to the statement of the above key I have been quite unable to detect any difference in the vagueness of pattern of *Graphiurus* and many forms referred to *Claviglis*. On the reduction of the premolars alone I do not care to give this species full generic rank, bearing in mind that there is a very general tendency for certain reduction to take place throughout the genus in these teeth. Though *G. ocularis* has reached a stage rather sharply distinct from the others, it is rather at the end of a long series than so sharply distinct from all others that it must be considered as a full genus.

At the other end of the series stands the giant West African *G. hueti*. In 1936 Allen gave this species generic rank under the name *Aethoglis*, on a number of characters which do not prove to distinguish it clearly from all other members of the genus.

One of the main characters was the animal's larger size. It seems unnecessary for me to have to point out that size cannot possibly be used in a generic sense unless we have a genus name for almost every known species. Compared with *Claviglis*, the bullae are relatively smaller (the difference not great); the zygoma is said to be less bowed; the nasals narrowed throughout instead of being broad anteriorly. The vomer continuing to the posterior edge of bony palate, and dividing the posterior nares; the incisors face anteriorly normally, not turned inwards as in *Claviglis*; and P.4 is farther forward. But the species has evidently not been compared with the much smaller *G. crassicaudatus*, from the same area. In this species the nasals are precisely as in "*Aethoglis*," and the incisors are as in "*Aethoglis*." On the remaining characters it is difficult to regard the *hueti* group as more than a well-defined specific group of the subgenus *Claviglis*. Even the "large size" character is covered by the Angolan species *monardi*.

The genus, which is in much need of revision, is extremely difficult to arrange in any natural order. Apart from the subgenera, *Graphiurus*, for *ocularis*, and *Gliriscus* for *platyops* group, there remains a large assemblage of more normal African Dormice. Both Mr. Hayman and myself have tried to arrange these into groups, but without much success. Mr. Hayman reports:

"Subgenus *Claviglis*: this contains the remainder and by far the largest number of African dormice. Attempts have been made to divide them into groups of related forms, but apart from perhaps four easily distinguished forms the remainder do not appear separable into definite groups. Variation in size is considerable in some forms, so that overlapping invalidates any arrangement based on size, while although extremes of colour in the subgenus are wide (from pale grey to brown), division into groups based on colour breaks down when it is seen that in a very large series from northern Rhodesia nearly all the colour shades found in forms from elsewhere in the range of the genus are represented.

The following forms are easily distinguished.

crassicaudatus, Jentink. Nasals and incisors as "*Aethoglis*," but anterior end of toothrow behind zygoma root (not so in *hueti* group, but at base of it), and size small. (The frontals unusually broad (J.R.E.).)

surdus, Dollman. Nasals as "*Aethoglis*"; size small. (Infraorbital foramen foramen apparently not as usual in the genus (J.R.E.).)

woosnami, Dollman. Very pale grey form.

monardi, St. Leger. Size large, head and body 150–160. Skull normal, in no characters resembling *hueti*, as suggested by author."

The remainder have a normal skull, with nasals expanded anteriorly to form part of sides of rostrum. Head and body from 70 to 116.

Forms seen: *ansorgei, angolensis, brockmani, butleri, christyi, dorotheae, foxi, griselda, haedulus, hueti, internus, johnstoni, lorraineus, microtis, monardi, montosus, murinus, nanus, ocularis, olga, orobinus, parvus, platyops, raptor, rupicola, saturatus, smithi, spurrelli, solcatus, surdus, woosnami.*

Certainly *monardi* and *crassicaudatus* and, I think, probably *woosnami* and *surdus* are sufficiently distinct to be regarded as types of specific groups. The remainder will have to be referred to a single group, in which it appears that there are far too many outstanding "distinct species" at the present day.

List of Named Forms

(The references and type localities for all Muscardinidae are the work of Mr. R. W. Hayman.)

Subgenus *Graphiurus*, Smuts

1. GRAPHIURUS OCULARIS, Smith

1829. Zool. Journ. IV, p. 439.
Plattenberg Bay, Cape Province.
Synonym: *capensis*, Cuvier, 1829, Mamm., pl. 254.
typicus, Smith, Afr. Zool., 1834, p. 65.
elegans, Ogilby, Proc. Zool. Soc., London, 1838, p. 5. (Damaraland).
cattoiri, Fisch. Synops. Mamm., p. 310, 1829 (indeterminate according to G. M. Allen, 1939).

Subgenus *Gliriscus*, Thomas & Hinton

2. GRAPHIURUS PLATYOPS, Thomas

1897. Ann. Mag. Nat. Hist. 6, XIX, p. 388.
Enkeldoorn, Mashonaland.

3. GRAPHIURUS EASTWOODAE, Roberts

1913. Ann. Transv. Mus. IV, p. 80.
Woodbush, Transvaal. (Stated to be related to *ocularis*, but description does not bear this out; measurements suggest *Gliriscus* (R.W.H.).)

4. GRAPHIURUS RUPICOLA RUPICOLA, Thomas & Hinton

1925. Proc. Zool. Soc. London, p. 232.
Karibib, S.-W. Africa.

5. GRAPHIURUS RUPICOLA MONTOSUS, Thomas & Hinton

1925. Proc. Zool. Soc. London, p. 233.
Great Brukaros Mountain, S.-W. Africa.

Subgenus *Claviglis*, Jentink

hueti Group

6. GRAPHIURUS HUETI HUETI, Rochebrune

1883. Faune Seneg., p. 109, pl. vi, fig. 1.
St. Louis, Senegal.

7. GRAPHIURUS HUETI ARGENTEUS, Allen

1936. Journ. Mamm. Baltimore, 17, p. 293.
Lolodorf, Cameroons.

8. GRAPHIURUS HUETI NAGTGLASI, Jentink

1888. Notes Leyden Mus., X, p. 38.
Du Queah River, Liberia.

crassicaudatus Group

9. GRAPHIURUS CRASSICAUDATUS CRASSICAUDATUS, Jentink

1888. Notes Leyden Mus., p. 41.
Du Queah River, Liberia.

10. GRAPHIURUS CRASSICAUDATUS DOROTHEAE, Dollman
1912. Ann. Mag. Nat. Hist. 8, IX, p. 312.
Oban district, S.-E. Nigeria.

surdus Group

11. GRAPHIURUS SURDUS, Dollman
1912. Ann. Mag. Nat. Hist. 8, IX, p. 314.
Benito River, French Congo.

woosnami Group

12. GRAPHIURUS WOOSNAMI, Dollman
1910. Ann. Mag. Nat. Hist. 8, VI, p. 393.
North of Okwa, Kalahari Desert.

monardi Group

13. GRAPHIURUS MONARDI, St. Leger
1936. Ann. Mag. Nat. Hist. 10, XVII, p. 465.
Chiumbe River, Angola.

murinus Group

14. GRAPHIURUS OLGA, Thomas
1925. Ann. Mag. Nat. Hist. 9, XVI, p. 191.
Asben, South Sahara.

15. GRAPHIURUS OROBINUS, Wagner
1845. Arch. f. Naturgesch., XI, 1, p. 149.
Senaar, Sudan.

16. GRAPHIURUS BUTLERI, Dollman
1912. Ann. Mag. Nat. Hist. 8, IX, p. 319.
Jebel Ahmed Aga, Sudan.

17. GRAPHIURUS BROCKMANI BROCKMANI, Dollman
1910. Ann. Mag. Nat. Hist. 8, V, p. 287.
Burao, Somaliland.

18. GRAPHIURUS BROCKMANI INTERNUS, Dollman
1912. Ann. Mag. Nat. Hist. 8, IX, p. 318.
Northern Guaso Nyiro, Kenya.

19. GRAPHIURUS FOXI, Dollman
1914. Ann. Mag. Nat. Hist. 8, XIII, p. 196.
Kabwir, Bauchi Province, N. Nigeria.

20. GRAPHIURUS PARVUS PARVUS, True
1893. Proc. U.S. Nat. Mus., XVI, no. 95A, p. 601.
Tana River, Kenya.

21. GRAPHIURUS PARVUS DOLLMANI, Osgood
1910. Field Mus. Nat. Hist. Zool. ser., X, no. 3, p. 15.
Ulukenya Hills, Kenya.

22. GRAPHIURUS SOLEATUS SOLEATUS, Thomas & Wroughton
1910. Trans. Zool. Soc. London, XIX, p. 499.
Ruwenzori, Uganda.

23. GRAPHIURUS SOLLATUS COLLARIS, Allen & Loveridge
1933. Bull. Mus. Comp. Zool. Harvard Coll., LXXV, no. 2, p. 122.
Ukinga Mountains, north of Lake Nyasa, Tanganyika.

24. GRAPHIURUS PERSONATUS, Heller
1911. Smiths. Misc. Coll. LVI, no. 17, p. 2.
Rhino Camp, Lado Enclave, N. Uganda.

25. GRAPHIURUS MURINUS MURINUS, Desmarest
1822. Mamm. Suppl., p. 542.
Cape Colony.
Synonym: *coupei*, Cuvier, Mamm. 1822, pl. 251.
erythrobronchus, Smith, Zool. Journ. IV, 1829, p. 438.
cineraceus, Ruppell, Mus. Senck. 3, 1842, p. 136 (*fide* Trouessart).
lalandianus, Schinz, 1825, Cuvier's Thierreich, 4, p. 393.

26. GRAPHIURUS MURINUS TZANEENENSIS, Roberts
1913. Ann. Transv. Mus. IV, p. 79.
Transvaal.

27. GRAPHIURUS MURINUS ISOLATUS, Heller
1912. Smiths. Misc. Coll. LIX, no. 16, p. 3.
Taita Hills, Kenya.

28. GRAPHIURUS MURINUS GRISEUS, Allen
1912. Bull. Mus. Comp. Zool. Harvard Coll., LIV, p. 440.
Northern Guaso Nyiro, Kenya.
Synonym: *johnstoni*, Heller, 1912, Smiths. Misc. Coll. LIX, 16, p. 2, not of Thomas.

29. GRAPHIURUS MURINUS SATURATUS, Dollman
1910. Ann. Mag. Nat. Hist. 8, V, p. 204.
Mount Elgon, Kenya.

30. GRAPHIURUS MURINUS RAPTOR, Dollman
1910. Ann. Mag. Nat. Hist. 8, V, p. 96.
Mount Kenya.

31. GRAPHIURUS MICROTIS, Noack
1887. Zool. Jahrb., II, p. 248, pl. ix.
Marungu, S.-E. Congo.
A synonym of *G. m. murinus*, *fide* G. M. Allen, 1939.

32. GRAPHIURUS SMITHII, Thomas
1893. Ann. Mag. Nat. Hist. 6, XII, p. 267.
Speke Gulf, Victoria Nyanza.
Synonym: (?)*subrufus*, Neumann, 1900, Zool. Jahrb. Syst. XIII, p. 547. Tanga, Tanganyika.

33. GRAPHIURUS ANSORGEI, Dollman
1912. Ann. Mag. Nat. Hist. 8, IX, p. 317.
Mossamedes, S. Angola.

34. GRAPHIURUS LORRAINEUS, Dollman
1910. Ann. Mag. Nat. Hist. 8, V, p. 286.
Molegbwe, south of Setema Rapids, Uele River, Belgian Congo.

35. GRAPHIURUS SPURRELLI, Dollman
1912. Ann. Mag. Nat. Hist 8, IX, p. 315.
Bibianaha, Gold Coast.

36. GRAPHIURUS HAEDULUS, Dollman
1912. Ann. Mag. Nat. Hist. 8, IX, p. 316.
Bumba River, Cameroons.

37. GRAPHIURUS CHRISTYI, Dollman
1914. Extr. Rev. Zool. Afr., IV, fasc. 1, p. 80.
Mamboka, E. Congo.

38. GRAPHIURUS ANGOLENSIS ANGOLENSIS, de Winton
1897. Ann. Mag. Nat. Hist. 6, XX, p. 320.
Caconda, Angola.

39. GRAPHIURUS ANGOLENSIS JORDANI, Roberts
1929. Ann. Transv. Mus. XIII, p. 95.
Isoka, N. Rhodesia.

40. GRAPHIURUS GRISELDA GRISELDA, Schwann
1906. Proc. Zool. Soc. London, p. 105.
Kuruman, Bechuanaland.

41. GRAPHIURUS GRISELDA PRETORIAE, Roberts
1913. Ann. Transv. Mus. IV, p. 79.
Wonderboom, Pretoria, Transvaal.
(A race of *murinus* according to G. M. Allen, 1939.)

42. GRAPHIURUS KELLENI, Reuvens
1890. Die Myoxidae oder Schlaefer, p. 35, pl. 1, fig. 1, pl. iii, fig. 3.
Damaraland.

43. GRAPHIURUS NANUS, de Winton
1896. Proc. Zool. Soc. London, p. 799.
Mazoe, Mashonaland.

44. GRAPHIURUS JOHNSTONI, Thomas
1897. Proc. Zool. Soc. London, p. 934.
Zomba, Nyasaland.

Not seen and not allocated to group

45. GRAPHIURUS ALTICOLA, Roberts
1929. Ann. Transv. Mus., XIII, p. 98.
Wakkerstroom, Transvaal.

46. GRAPHIURUS LITTORALIS, Roberts
1929. Ann. Transv. Mus. XIII, p. 97.
Masiene, coast of Portuguese E. Africa.

47. GRAPHIURUS STREETERI, Roberts
1913. Ann. Transv. Mus. IV, p. 80.
Transvaal.

48. GRAPHIURUS TASMANI, Roberts
1929. Ann. Transv. Mus., XIII, p. 95.
Gwelo, S. Rhodesia.

49. GRAPHIURUS VANDAMI, Roberts

1920. Ann. Transv. Mus., XIII, p. 97.
Lower Olifants River, Portuguese E. Africa.

50. GRAPHIURUS ZULUENSIS, Roberts

1931. Ann. Transv. Mus., XIV, p. 229.
Ubombo Bush, North Zululand.

51. GRAPHIURUS SCHWABI, G. M. Allen

1912. Bull. Mus. Comp. Zool. Harvard Coll. LIV, p. 441.
Kribi, Cameroons;
(A synonym of *G. haedulus*, according to G. M. Allen, 1939.)

52. GRAPHIURUS PARVULUS, Monard

1932. Bull. Soc. Neuch. Sci. Nat. 57, p. 54.
Rio Mbale, Mossamedes, S. Angola.

53. GRAPHIURUS VULCANICUS, Lönnberg & Gyldenstolpe

1925. Arkiv. Zool. 17B, no. 9, p. 2.
Mount Karisimbi, Birunga Volcanoes, Kivu, E. Congo.

Subfamily MUSCARDININAE

GEOGRAPHICAL DISTRIBUTION.—Palaearctic region: Europe from southern Scandinavia to the Mediterranean, and England eastwards; Asia Minor; Sinai; North Africa, south to Rio de Oro; across Russian Asia to Tianshan, Zungaria, and North-west Frontier (specimens of *Dyromys* from last locality in British Museum); Japan.

NUMBER OF GENERA.—Six.

CHARACTERS.—Differing from the Graphiurinae in the more Murine zygomatic plate, which is tilted upwards to a certain extent, the muscle attaching line of attachment on its forepart; masseter lateralis superficialis with anterior head distinct. No caecum (so far as known). Cheek-teeth $\frac{4}{4}$.

In ELIOMYS, the cheekteeth are basin-shaped and cuspidate much as in *Graphiurus*; the premolar is not reduced, and there are on all main upper teeth two high main outer cusps, and one long main inner cusp (as in normal Sciuridae); the cross-ridges are arranged much as in Sciuridae. In DYROMYS, the premolars are reduced, and the cheekteeth are less concave, but the general dental effect is near *Eliomys*. In GLIS, the cheekteeth are more nearly flat-crowned, with five or six low cusps on outer margin of upper main teeth; the skull is more strongly ridged than in the other genera; but M.1 is not conspicuously different in size from M.2; in MUSCARDINUS, a more specialized dental effect is present, the premolar being vestigial, the first molar much larger than the second, the ridges arranged differently, and the crowns of the teeth are flat.

These four genera have been thoroughly dealt with in Miller, Catalogue of Mammals of Western Europe, p. 549, 1912. The remaining genera, GLIRULUS and MYOMIMUS are very little known; the latter is not represented at the British Museum.

Key to the Genera of Muscardininae
(not including the genus *Myomimus* which has not been examined)

Crowns of cheekteeth flat; M.1 much larger than M.2, the ridges of this tooth arranged differently, the depressions between them unusually wide (angular portion of mandible with perforation; tail not distichous). MUSCARDINUS

Crowns of cheekteeth not completely flat; M.1 not conspicuously larger than M.2, the ridges of this tooth not arranged differently, the depressions between them not unusually wide.

- Bullae low, relatively small, and flat, scarcely rising above general level of base of skull. (Mandible without perforation in angular process.) GLIRULUS
- Bullae large, well inflated, rising clearly above general level of base of skull.
  - Outer side of upper main cheekteeth with five or six low cusps; crowns nearly flat. Angular portion of mandible not perforated. (Tail conspicuously distichous; skull with rather well-marked supraorbital ridges.) GLIS
  - Outer side of upper main cheekteeth with two high cusps; crowns concave. Angular portion of mandible perforated. (Skull without clear supraorbital ridges.)
    - Cheekteeth markedly concave; premolars clearly cuspidate; tail not uniformly haired. ELIOMYS
    - Cheekteeth less markedly concave; premolars not clearly cuspidate; tail uniformly haired. DYROMYS

The position of the genus *Glirulus* must be regarded as provisional owing to the scarcity of material available. The unrepresented genus *Myomimus* differs from all the above in the character of its tail, which is stated to be scantily haired, like that of a Mouse.

Genus 1. ELIOMYS, Wagner

1843. ELIOMYS, Wagner, Abh. Bayer. Akad. Wiss. München, math.-phys. III, p. 176.
1885. BIFA, Lataste, Le Naturaliste, no. 8, pp. 61–63. *Bifa lerotina*, Lataste.

TYPE SPECIES.—*Eliomys melanurus*, Wagner.

RANGE.—Continental Europe, from Iberian Peninsula, France and Italy, north to Baltic coast of Germany; Dalmatia; Balearic Isles; Corsica, Sardinia; Sicily; Russia (former Smolensk, Leningrad, Novgorod, Tver, Orel, Kiev, Ulianov, Orenberg governments) (Vinogradov). Asia Minor (Miller). Sinai, Syria. North-western Africa, from Tunis, Cyrenaica, and Algeria to Morocco, south to Cape Blanco.

NUMBER OF FORMS.—Thirteen.

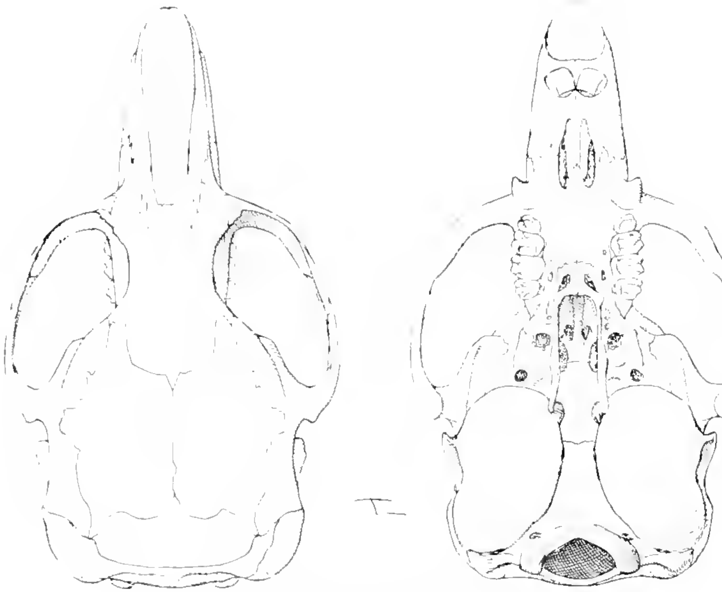


FIG. 162. ELIOMYS QUERCINUS QUERCINUS, Linnaeus.
B.M. No. 8.8.4.64, ; 2½.

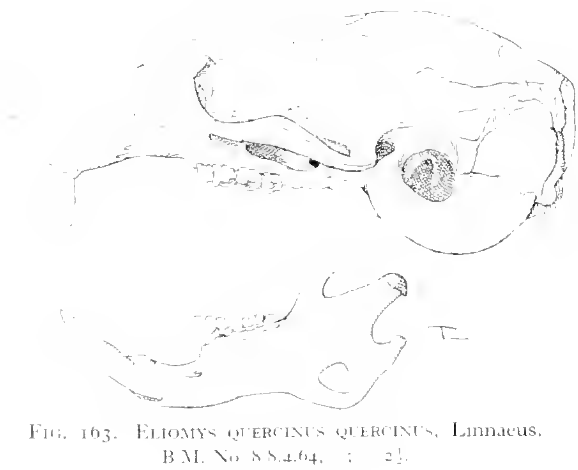


FIG. 163. ELIOMYS QUERCINUS QUERCINUS, Linnaeus.
B.M. No. 8.8.4.64, ; 2½.

CHARACTERS.—Skull strongly constricted between the frontals; rostrum relatively long; superior portion of skull not or scarcely ridged. Jugal relatively long. Palate broad, the palatal foramina situated considerably in front of toothrow, and narrowed anteriorly. Bullae large and inflated. The palate, as in allies, usually has a small pair of foramina present at posterior border. Infraorbital foramen narrow; zygomatic plate clearly tilted upwards, though relatively narrow compared with average Muridae. Angular portion of mandible perforated. Cheekteeth with crowns concave; in upper series, there are two high main cusps on the outer side, and one on the inner side; and four main transverse ridges are present, separating three depressions, the general effect reminiscent of that of Sciuridae. P.4 slightly smaller than the molars, well cusped. M.3 slightly smaller than M.2. Lower molars with three outer and two inner cusps; more basin-shaped than the upper teeth; four main ridges present, the anterior and posterior of which form the terminal margins of the teeth. Premolars with three cusps, one each side, one anteriorly, and with one ridge.

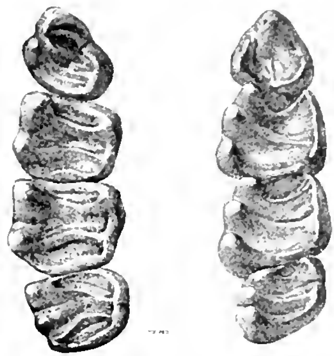


FIG. 164.
ELIOMYS QUERCINUS
Cheekteeth; × 10.

Mammae 8 (*quercinus*). Tail rather narrow, well haired but not conspicuously bushy, the hairs on the lower portion longer and more thick than those of the upper portion. Hindfoot with D.5 nearly as long as three central digits, and hallux short. Forefoot with four well-marked digits.

I do not think that there is more than one valid species of this genus in Europe. In fact I think with adequate material the North African species would mostly be referable to *quercinus* as races as well. A few skins seen of *melanurus* seem distinct by their paler coloration; and the bullae seem larger than in other forms except *cyrenaicus*, which also seems distinct externally in the uniformly dark and more bushy tail. But whether "*munbyanus*" is distinct from *quercinus* is at the moment not clear.

Forms seen: "*amori*," *cyrenaicus*, *gymnesicus*, *lerotinus*, *lusitanicus*, *melanurus*, *munbyanus*, *occidentalis*, *ophiusae*, *pallidus*, *quercinus*, *sardus*.

LIST OF NAMED FORMS

1. ELIOMYS QUERCINUS QUERCINUS, Linnaeus

1766. Syst. Nat. 1, 12th Ed., p. 84.
Germany.
Synonym: *hortualis*, Cabrera, 1904, Bol. Real. Soc. Espan. Hist. Nat. IV, p. 183. Valencia, Spain.
hamiltoni, Cabrera, 1907, Bol. Real. Soc. Espan. Hist. Nat. VII, p. 226. El Pardo, near Madrid, Spain.

2. ELIOMYS QUERCINUS SUPERANS, Ognev & Stroganov

1936. Abs. Works. Zool. Inst. Moscow State Univ. 3, p. 84.
Kalinin district, Penorsk region; River Jukopa, the right tributary of the Volga (former Ostashov subdistrict of the Tver government) (Russia).

3. ELIOMYS QUERCINUS GYMNESICUS, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 494.
San Cristobal, Minorca.

4. ELIOMYS QUERCINUS PALLIDUS, Barrett-Hamilton

1899. Ann. Mag. Nat. Hist. 7, III, p. 226.
Palermo, Sicily.
Synonym: *cincticauda*, Miller, 1901, Proc. Biol. Soc. Washington, XIV, p. 39. Sorrento, Italy.

5. ELIOMYS QUERCINUS SARDUS, Barrett-Hamilton

1901. Ann. Mag. Nat. Hist. 7, VII, p. 340.
Tricoli, Sardinia.

6. ELIOMYS QUERCINUS LUSITANICUS, Reuvens

1890. Die Myoxidae oder Schlaefer, p. 28, footnote.
Lisbon, Portugal.
Synonym: *amori*, Graels, 1897, Mem. Real. Acad. Sci. Madrid, XVII, p. 481. Cordova, Spain.

7. ELIOMYS QUERCINUS OPHIUSAE, Thomas

1925. Ann. Mag. Nat. Hist. 9, XVI, p. 389.
Formentera, Balearic Islands.

8. ELIOMYS MUNBYANUS MUNBYANUS, Pomel

1856. C.R. Ac. Sci. Paris, XLII, p. 653.
Tunis.

9. ELIOMYS MUNBYANUS LEROTINUS, Lataste

1885. Le Naturaliste, p. 61.
Ghardaia, Mzab, Algerian Sahara.

10. ELIOMYS MUNBYANUS TUNETAE, Thomas

1903. Ann. Mag. Nat. Hist. 7, XI, p. 495.
Karouana, Tunis.
(A synonym of *E. m. munbyanus*, according to G. M. Allen, 1939.)

11. ELIOMYS MUNBYANUS OCCIDENTALIS, Thomas

1903. Nov. Zool., X, p. 300. Rio de Oro, W. Sahara.

12. ELIOMYS CYRENAICUS, Festa

1922. Boll. Mus. Zool. Anat. Comp. Torino, 740, p. 4.
Ghemmez, Cyrenaica, N. Africa.

13. ELIOMYS MELANURUS, Wagner

1843. Abh. Bayer. Akad. Wiss. München, p. 176, pl. 3, fig. 1.
Sinai.

Genus 2. DYROMYS, Thomas

1906. DRYOMYS, Thomas, Proc. Zool. Soc. London, 1905, p. 348. Not of Philippi.
1907. DYROMYS, Thomas, Ann. Mag. Nat. Hist. 7, XX, p. 406.

TYPE SPECIES.—*Mus nitedula*, Pallas.

RANGE.—From Switzerland, North Italy, Silesia, and S.-E. Europe (Greece, Bulgaria, Yugoslavia), across Russia (Ukraine, former Tver, Orel,

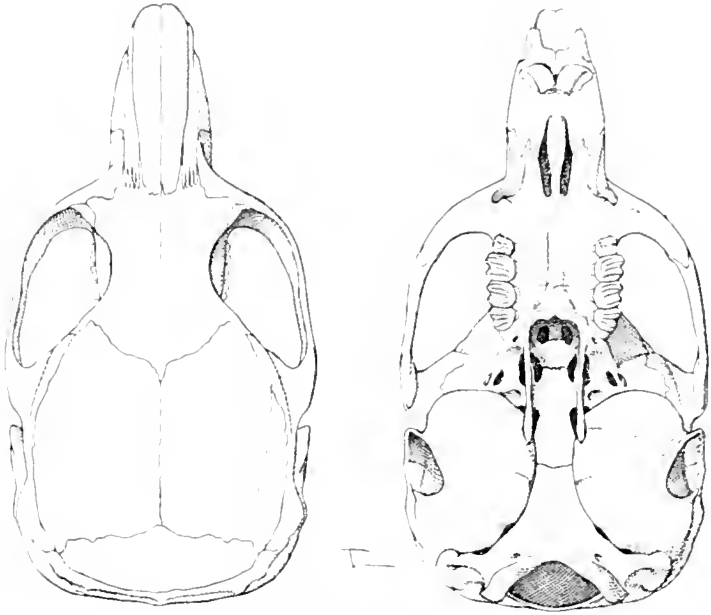


Fig. 165. Dyromys nitedula nitedula, Pallas.
B.M. No. 12.12.17.12; × 3½.

Fig. 166. Dyromys nitedula nitedula, Pallas.
B.M. No. 12.12.17.12; × 3½.

Voronej govts., Bessarabia, Astrakan, Lower Volga, former Kasan govt.) (Vinogradov), Caucasus and Asia Minor to Russian Turkestan (Tashkent district, Fergana, Semirechia, former Semipalatinsk govt.), Persia, Tianshan, Dzungaria, and North-West Frontier (North India).

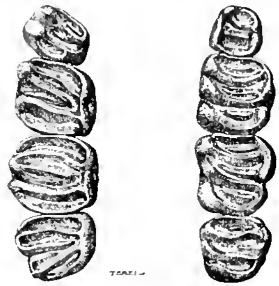


Fig. 167
Dyromys nitedula
Cheekteeth; × 10.

Number of Forms.—Eighteen.

Characters.—Very closely related to *Eliomys*; upper cheekteeth less concave; the main cusps arranged as in *Eliomys*; five main transverse ridges in upper teeth, the main central depression with quite a well-marked ridge, this vestigial in *Eliomys*; premolar more reduced, not strongly cuspidate. Lower molars with four main ridges, and three rudimentary ones between them. Premolar reduced, and simple.

Parietals not narrowed to a point anteriorly, differing in this character from *Eliomys*. Size smaller, and tail more uniformly haired, flattened and moderately bushy. Mammae 8 (type species).

Remarks.—This genus is not very widely separated from *Eliomys*. The cheekteeth are tending to be a little less complex.

List of Named Forms

1. DYROMYS NITEDULA NITEDULA, Pallas

1778. Nov. Spec. Quadr. Glir. Ord., p. 88.
Region of Lower Volga, Russia.
Synonym: *dryas*, Schreber, 1782, Säugth., pl. CCXXV, B.

2. DYROMYS NITEDULA INTERMEDIUS, Nehring

1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 155.
Near Lienz, Tirol, Austria.

3. DYROMYS NITEDULA WINGEI, Nehring

1902. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 5.
Parnassus, Greece.

4. DYROMYS NITEDULA CARPATHICUS, Brohmer

1927. Die Tierw. Mitt. Europ. 7, lief. 3, p. 32.
Upper Silesia.

5. DYROMYS NITEDULA PHRYGIUS, Thomas

1907. Ann. Mag. Nat. Hist. 7, XX, p. 407.
Murad Dagh, Ushak Province, Asia Minor.

6. DYROMYS NITEDULA TICHOMIROWI, Satunin

1920. Trav. Mus. Georg. Tiflis, no. 2, p. 161.
Tiflis, Caucasus.

7. DYROMYS NITEDULA OBOLENSKII, Ognev & Worobiev
1923. Fauna Woronesh, p. 129.
Voronej government district, Russia.

8. DYROMYS NITEDULA OGNEVI, Heptner & Formozoff
1928. Zool. Anz. 77, p. 278.
Daghestan, E. Caucasus.

9. DYROMYS NITEDULA BILKJEWICZI, Ognev & Heptner
1928. Zool. Anz. 75, p. 265.
Mikhailovsky, Kopet-Dagh, 46 miles west-south-west of Askhabad, Russian Turkestan.

10. DYROMYS NITEDULA ANGELUS, Thomas
1906. Ann. Mag. Nat. Hist. 7, XVII, p. 424.
Tian Shan, Central Asia; near Przewalsk.

11. DYROMYS NITEDULA CAUCASICUS, Ognev & Turov
1935. Wiss. Ber. Moskauer Staats. Univ. 4, p. 98.
Environs of Tarskaja station, Northern Caucasus (former Tersk Province).

12. DYROMYS NITEDULA DAGESTANICUS, Ognev & Turov
1935. Wiss. Ber. Moskauer Staats. Univ. 4, p. 98.
Khasav-Jurt, Daghestan, Caucasus.

13. DYROMYS NITEDULA KURDISTANICUS, Ognev & Turov
1935. Wiss. Ber. Moskauer Staats. Univ. 4, p. 101.
Riv. Terter, Kurdistan.

14. DYROMYS NITEDULA PALLIDUS, Ognev & Turov
1935. Wiss. Ber. Moskauer Staats. Univ. 4, p. 102.
Vall. Riv. Bosturgay, Karatau Mountains, former Province of Syr-Darya, Turkestan.

15. DYROMYS NITEDULA TANAITICUS, Ognev & Turov
1935. Wiss. Ber. Moskauer Staats. Univ. 4, p. 98.
Atamanovsky Khutor, Tarasovsky district (former Don Province), S. Russia.

16. DYROMYS NITEDULA PICTUS, Blanford
1875. Ann. Mag. Nat. Hist., 4, XVII, p. 311.
Kohrud, south of Caspian, Persia.

17. DYROMYS MILLERI, Thomas
1912. Ann. Mag. Nat. Hist. 8, IX, p. 394.
Bogdo-Ola Mountains, S.E. Dzungaria, Central Asia.

18. DYROMYS ROBUSTUS, Miller
1910. Ann. Mag. Nat. Hist. 8, VI, p. 459.
Rustschuk, Bulgaria.

Forms seen: *angelus, milleri, nitedula, obolenskii, pictus, phrygius, robustus, wingei.*

Genus 3. GLIRULUS, Thomas

1906. GLIRULUS, Thomas, Proc. Zool. Soc. London, 1905, p. 347.

TYPE SPECIES.—*Graphiurus elegans*, Temminck = *Myoxus japonicus*, Schinz.

RANGE.—Japan.

NUMBER OF FORMS.—One.

CHARACTERS.—"With regard to the generic position of this Dormouse I think it cannot be assigned to any of the existing groups, and must have a special name of its own. It is no doubt most nearly allied to *Eliomys* (*Dryomys*, subgen. *n.*) *nitedulus*, Pallas, but may be readily distinguished by the rather more complicated pattern of its teeth, its small bullae, the absence of the angular foramen in its mandible, and by its peculiar colour pattern" (Thomas).

There are only two skulls in the British Museum of this genus, and two specimens in spirit. The teeth are too worn in the skulls for any detailed notes, though apparently nearer *Dyromys* than *Glis*. The size is small, the tail bushy; according to Thomas the mammae are 8. The main genus distinction is the possession of the small low flattened bullae, conspicuously different from those of other Muscardininae examined. The premolars are smaller than the molars, as in *Dyromys*.

Forms seen: *japonicus*.

LIST OF NAMED FORMS

1. GLIRULUS JAPONICUS, Schinz (emended by Thomas from "*javanicus*")

1845. Syst. Verz. Säug., II, p. 530.

Japan.

Synonym: *elegans*, Temminck, 1845, Faun. Japon. Mamm., p. 53.
lasiotis, Thomas, 1880, Proc. Zool. Soc. London, p. 40.

Genus 4. GLIS, Brisson

1762. GLIS, Brisson, Regn. Anim. Class, IX, 2nd ed., p. 13.
1780. MYOXUS, Zimmermann, Geogr. Ges. II, p. 351. (*Sciurus glis*, Linn.)

TYPE SPECIES.—*Glis*, Brisson = *Sciurus glis*, Linnaeus.

RANGE.—Continental Europe from Atlantic coast of France eastwards, north to North Germany, south through Switzerland and Italy to Sicily; Northern Spain; Sardinia; Yugoslavia, Roumania; Asia Minor, Persia; Russia (former Minsk, Podol, Volyn, Kiev, Harkov, Astrakan, Samara, Saratov, Pensa, Ulianov govts.) (Vinogradov). Bessarabia, Caucasus, and South Turkmenia. Introduced in England.

NUMBER OF FORMS.—Eleven.

CHARACTERS.—Interorbital region of skull well ridged, the ridges tending to unite in old age. Jugal approaching the lachrymal. Rostrum less pointed than in *Eliomys*. Bullae prominent. Zygomatic spread relatively

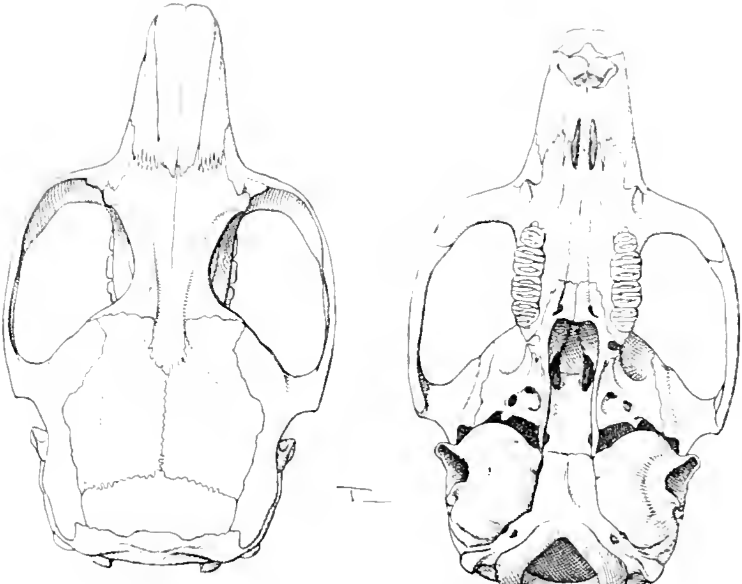


FIG. 168. GLIS GLIS GLIS, Linnaeus.
B.M. No. 6.8.4.1, ♀; × 2.

FIG. 169. GLIS GLIS GLIS, Linnaeus.
B.M. No. 6.8.4.1, ♀; × 2.

great. The zygoma is in some ways reminiscent of that of *Anomalurus*, though in the latter genus the infraorbital foramen has become much more widely open for muscle-transmission whereas in *Glis* the zygomatic plate has become more broadened. Mandible without perforation in angular process; coronoid noticeably powerful. Cheekteeth simpler than in *Eliomys*, more flat; the outer side of upper series with five low cusps, the inner side with four. M.1 and M.2 with seven transverse ridges of which four are well developed, the three alternating between them weaker. P.4 considerably smaller than the other teeth, and with its elements reduced. Lower teeth like the upper series in general arrangement.

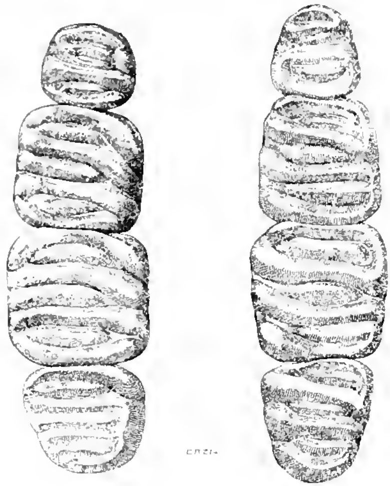


Fig. 170. Glis glis
Cheekteeth; × 10.

Fur thick and soft; tail densely bushy; feet broad; general appearance of animal Squirrel-like. Size rather large for family (head and body up to 190 mm.). Mammae 12. D.5 hindfoot long, about equal to D.2.

Forms seen: *glis*, *insularis*, *italicus*, *melonii*, "*postus*," *spoliatus*.

List of Named Forms

1. GLIS GLIS GLIS, Linnaeus

1766. Syst. Nat. I, 12th Ed., p. 87.

Germany.

Synonym: *esculentus*, Blumenbach, 1779, Handb. Nat., p. 79.
vulgaris, Oken, 1816, Lehrbuch. Naturg. III, pt. 2, p. 868. (Germany.)
avellanus, Owen, 1840, Odontography, II, p. 25, pl. 105.
(?)*giglis*, F. Cuvier, 1832, Nouv. Ann. Mus. d'Hist. Nat. Paris, I, p. 444, nom. nud.

2. GLIS GLIS ITALICUS, Barrett-Hamilton

1898. Ann. Mag. Nat. Hist. 7, II, p. 424.

Siena, Italy.

Synonym: *insularis*, Barrett-Hamilton, 1899, Ann. Mag. Nat. Hist. 7, III, p. 228. Palermo, Sicily.
postus, Montagu, 1923, Proc. Zool. Soc. London, p. 866. Yugo-Slavia.

3. GLIS GLIS INTERMEDIUS, Altobello

1920. Fauna dell' Abruzzo e del Molise. Mammiferi, III (Rodentia), p. 22.

Abruzzi, Italy.

4. GLIS GLIS ABRUTTI, Altobello
1924. Rend. Union. Zool., p. 30; fig. in Monitore Zool. Ital. 35.
S. Italy.

5. GLIS GLIS MINUTUS, Martino
1930. Proc. Russ. Sci. Inst. Belgr. 2, p. 60.
Serbia: Predejane, 30 km. south of Leskovac.

6. GLIS GLIS PYRENAICUS, Cabrera
1908. Ann. Mag. Nat. Hist. 8, I, p. 193.
Allo, Navarra, Spain.

7. GLIS GLIS MELONII, Thomas
1907. Ann. Mag. Nat. Hist. 7, XIX, p. 445.
Marcurighè, Ogliastra, Sardinia.

8. GLIS GLIS ORIENTALIS, Nehring
1903. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 187.
Near Scutari, Asia Minor.

9. GLIS GLIS SPOLIATUS, Thomas
1906. Ann. Mag. Nat. Hist. 7, XVIII, p. 220.
Khotz, near Trebizond, Asia Minor.

10. GLIS GLIS TSCHETSHENICUS, Satunin
1920. Trav. Mus. Georg. Tiflis, no. 2, p. 150.
Caucasus.

11. GLIS GLIS CASPICUS, Satunin
1905. Mitt. Kaukas. Mus., II, p. 55.
Aschabad, Transcaspia.

There is reason to believe that the name *persicus*, Erxleben, Syst. Regn. Anim. 1, p. 417, 1777 (which has been used for *Sciurus anomalus*), is based on a form of this species.

Genus 5. MUSCARDINUS, Kaup

1829. Muscardinus, Kaup, Entw. Ges. Nat. Europ. Thierwelt, I, p. 134.

Type Species.—*Mus avellanarius*, Linnaeus.

Range.—England; France; Southern Germany; Central Sweden; Italy, Sicily; Austria; Greece; Asia Minor; Russia (former Vitebsk, Minsk, Smolensk, Moscow, Vladimir, Kostroma, Harkov, Kasan, Ulianov, Kiev, Poltava, Volyn, Podol, Odessa governments, Bessarabia) (Vinogradov).

Number of Forms.—Five.

Characters.—Zygomatic plate rather broader than in allied genera, its superior border ridged; infraorbital foramen small. Incisive foramina rather longer than usual, and not widened posteriorly. Zygomata widely spreading anteriorly. Palate very short, not extending back to M.3. A small perforation in angular portion of mandible usually present. Bullae moderately inflated.

P.4 very small indeed. M.1 conspicuously larger than M.2, with five well-developed ridges, the depressions between them very broad; the ridges oblique, the tooth lengthened; M.2 with seven transverse ridges, the depressions between them narrow; M.3 like M.2 but smaller, with ridges less developed. P.4 usually with two ridges. In the lower cheekteeth there are six ridges extending across each tooth except the much reduced premolar; the lower first molar is less enlarged than the upper first molar, and its ridges less oblique.

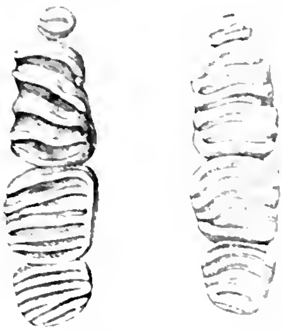


FIG. 173
MUSCARDINUS AVELLANARIUS
Cheekteeth. × 10.

Size very small, head and body under 100. Forefoot with "digits relatively longer than in the other European genera, and closing obliquely inward so as to come into opposition with the much enlarged inner tubercle, the unusual size of which . . . enables it to function as a low, broad thumb" (Miller). Hindfoot with four long digits, and hallux more rudimentary than usual. Tail uniformly haired, said to be partly prehensile, more narrowed than is usual in the group. Stomach extremely complex (Thomas). Mammae (type species) 8.

REMARKS.—This genus is very distinct from the other members of the subfamily, and in several ways its type of dentition seems to be leading towards that of the Platacanthomyinae.

Forms seen: "*anglicus*," *avellanarius*, *pulcher*, *trapezius*.

LIST OF NAMED FORMS

1. MUSCARDINUS AVELLANARIUS AVELLANARIUS, Linnaeus

1758. Syst. Nat. I, 10th Ed., p. 62.
Central Sweden.
Synonym: *muscardinus*, Schreber, 1782, Säugth., pl. CCXXVII. Germany.
avellanarius anglicus, Barrett-Hamilton, 1900, Proc. Zool. Soc. London, p. 86. Northampton, England.
corilinum, Fatio, 1869, Faune Vert. Suisse, 1, p. 183.

2. MUSCARDINUS AVELLANARIUS NIVEUS, Altobello

1920. Fauna dell' Abruzzo e del Molise. Mammiferi, III, Rodentia, p. 27.
Abruzzi, Italy.

3. MUSCARDINUS AVELLANARIUS ZEUS, Chaworth-Musters

1932. Ann. Mag. Nat. Hist. 10, IX, p. 170.
East slope Mount Olympus, Thessaly, Greece.

4. MUSCARDINUS PULCHER, Barrett-Hamilton

1898. Ann. Mag. Nat. Hist. 7, II, p. 423.
Perugia, Italy.
Synonym: (?)*speciosus*, Dehne, 1855, Allgem. Deutsche Naturhist. Zeitung, 1, p. 180. Tursi, Basilicata, Italy.

5. MUSCARDINUS TRAPEZIUS, Miller
1908. Ann. Mag. Nat. Hist. 8, I, p. 69.
Trebizond, Asia Minor.

Genus 6. MYOMIMUS, Ognev

1924. Myomimus, Ognev, Nature and Sport in Ukraine, Kharkov, p. 1.

Type Species.—*Myomimus personatus*, Ognev.

Range.—Described from Transcaspia, near the Persian frontier.

Number of Forms.—One.

This genus is not represented in the British Museum. The tail is described as being thinly haired, as in Mice. The cheekteeth are described as near those of *Dyromys*. In the skull as figured by Ognev & Heptner, it may be noted that the bullae are well inflated, the angular portion of the mandible perforated, and the palate normal (not as in Platacanthomyinae).

List of Named Forms

1. MYOMIMUS PERSONATUS, Ognev
1924. Nature & Sport in Ukraine, Kharkov, p. 1.
Transcaspia: near Persian frontier.

Subfamily PLATACANTHOMYINAE

Geographical Distribution.—Peninsular India; South China.

Number of Genera.—Two.

Characters.—Differing from Muscardininae in the suppression of the premolars, the more definite and more specialized pattern of the cheekteeth, the presence of a large series of foramina or a single pair of very large foramina between the toothrows, the much smaller bullae, and in the genus *Typhlomys* the presence of a small caecum.

There may be some doubt as to whether this group is rightly placed in the Muscardinidae. Peters came to the conclusion that *Platacanthomys* was a member of the Muridae showing signs of affinity with *Phloeomys* and *Meriones*. Thomas in his classification of the Order in 1896 stated: "Dr. Winge has placed *Platacanthomys* in the Gliridae, from which it was removed to the Muridae by Dr. Peters, and in this he has been followed by Dr. Tullberg, and I am informed by Dr. Forsyth Major . . that he holds a similar view. On the whole though I think there is enough evidence of Murine affinity in *Platacanthomys* and its ally *Typhlomys* to make the question rather doubtful, I am inclined to agree to the reference of these genera to the family Gliridae, on account of the structure of the teeth and interorbital region, the peculiar Glirine twisting of their mandibular angles, and of their (at least the former's) want of a caecum, a character found in the Gliridae alone of Rodents." But some years later Thomas discovered that in *Typhlomys* a small caecum is present.

Miller & Gidley, 1918, and Weber, 1928, separate the two genera as a family the Platacanthomyidae, which the former define as "Like the Cricetidae but zygomasseteric structure unusual; infraorbital foramen of normal Cricetine form, but zygomatic plate much narrowed, and masseter lateralis profundus extending its line of attachment along upper zygomatic border to side of rostrum above foramen. Cheekteeth subhypsodont, enamel pattern a modified heptamerous, with tendency to form oblique parallel cross-ridges (parallel Muscardinidae)."

But the zygomatic plate is no more narrowed than in *Hydromys*, which these authors refer to their Muridae; something similar judging from Tullberg's figure seems to occur in that genus, in the zygomasseteric structure.

It has been suggested to the present author that *Typhlomys* is a Dipodoid. But in dental structure, and in the much more important zygomasseteric structure, it is very clear that this is not the case.

I do not think that there is very much doubt that these two genera should form a well-marked subfamily of the present family. *Muscardinus*, as stated above, seems to be leading towards *Platacanthomys* in dental characters, though considerably less modified than in that genus. On the pattern of the cheekteeth I do not think the present group could be referable to the Muridae; and there is very little doubt that *Typhlomys* is a close ally of *Platacanthomys*.

Key to the Genera of Platacanthomyinae

Caecum absent (Thomas). Tail thickly bushy, shorter than head and body. Fur densely spiny. Skull with well-marked supraorbital ridges. Palate with one very large pair of foramina between the toothrows. — PLATACANTHOMYS

Caecum present (Thomas). Tail longer than head and body, poorly haired except terminally. Fur soft. Skull with supraorbital ridges feeble or absent. Palate with a series of foramina between the toothrows. — TYPHLOMYS

Genus 1. PLATACANTHOMYS, Blyth

1859. PLATACANTHOMYS, Blyth, Journ. Asiat. Soc. Bengal, XXVIII, p. 288.

TYPE SPECIES.—*Platacanthomys lasiurus*, Blyth.

RANGE.—Southern India (Malabar, Coorg, Travancore).

NUMBER OF FORMS.—One.

CHARACTERS.—Skull of the "arboreal" type seen in many Muridae, with broad frontals, even broader braincase, and very large interparietal. Heavy supraorbital ridges present, extending backwards on to braincase. Zygomatic plate very narrow, but tilted strongly upwards.

Jugal not extending so far forwards as in most Muscardinidae. Palate broad; a large pair of foramina between the toothrows take up most of this

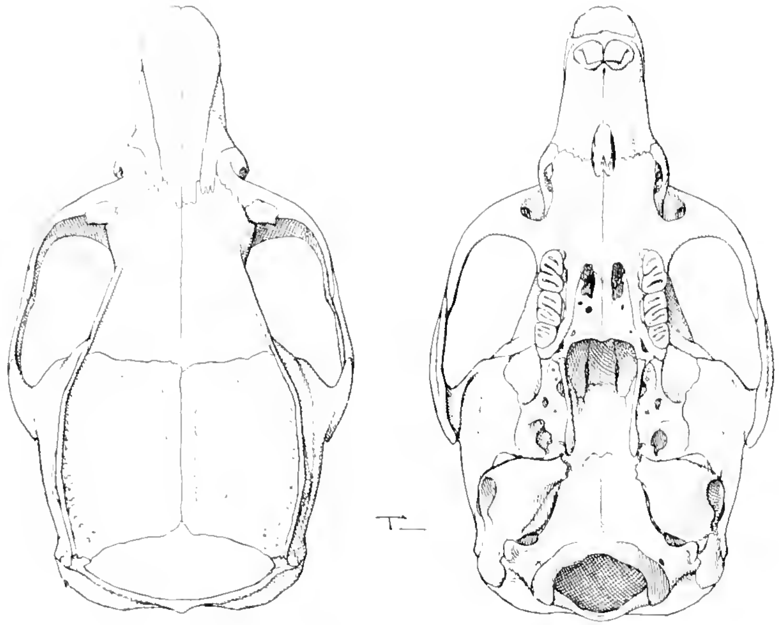


Fig. 174. Platacanthomys lasiurus, Blyth.
B.M. No. 13.8.22.57, ♂; × 2½.

Fig. 175. Platacanthomys lasiurus, Blyth.
B.M. No. 13.8.22.57, ♂; × 2½.

space. Incisive foramina very far forwards. Bullae small, reduced. Mandible with low coronoid, and angular portion without perforation, and pulled inwards as is usual in the family.

Upper cheekteeth with four depressions appearing as re-entrant folds, the second one cutting right across the tooth; in M.1 and M.2 the folds curving obliquely backwards from outer side. The transverse ridges (between the depressions) much broader than in Muscardininae. Lower cheekteeth with

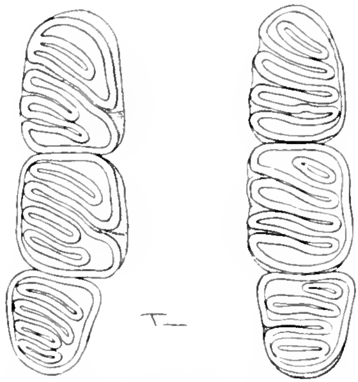


FIG. 176. PLATACANTHOMYS LASIURUS, Blyth.
Cheekteeth: B.M. No. 13.8.22.57, ♂; × 10.

four long re-entrant folds, the front one usually isolated on crown surface, the others placed externally. The pattern is clearer and more definite than in Muscardininae.

Tail thickly bushy terminally, less so on joining the body. Hindfoot very broad, hallux more reduced than in other members of the family, *Muscardinus* perhaps excepted, and with no claw (from its appearance on dried skins, perhaps opposable). D. 5 about as long as D.2. Back and sides covered with flattened spines.

Forms seen: *lasiurus*.

List of Named Forms

1. PLATACANTHOMYS LASIURUS, Blyth
1859. Journ. Asiat. Soc. Bengal, XXVIII, p. 289.
Alipi, Malabar, India.

Genus 2. TYPHLOMYS, Milne-Edwards

1877. TYPHLOMYS, Milne-Edwards, Bull. Soc. Philom. Paris, XII, for 1876, pt. 2, p. 9.

TYPE SPECIES.—*Typhlomys cinereus*, Milne-Edwards.

RANGE.—Known from Fokien (South China), and Tongking.

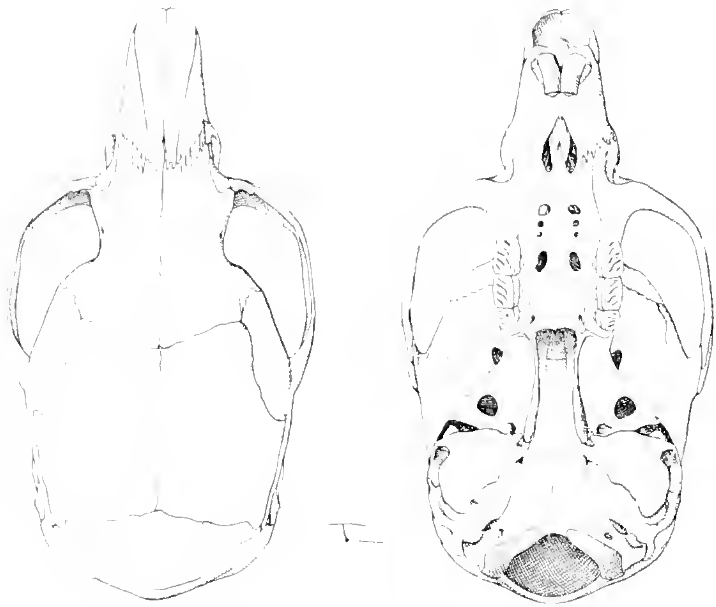


FIG. 177. TYPHLOMYS CINEREUS CINEREUS, Milne-Edwards.
B.M. No. 8.8.11.111, ♀; × 4.

FIG. 178. TYPHLOMYS CINEREUS CINEREUS, Milne-Edwards.
B.M. No. 8.8.11.111, ♀; × 4.

NUMBER OF FORMS.—Two.

CHARACTERS.—Skull with rounded braincase and almost unconstricted interorbital region. Infraorbital foramen and zygomatic plate much like *Platacanthomys*. Bullae small. Palate with a series of foramina extending from palatal foramina, which are as usual far in front of toothrows, to back of palate, the number of these foramina varying in different specimens. Coronoid low; angular process reduced, and scarcely pulled inwards. Cheek-teeth narrow. Originally evidently there are five folds cutting obliquely across

FIG. 179. TYPHLOMYS CINEREUS CINEREUS, Milne-Edwards.
Cheekteeth: B.M. No. 8.8.11.111, ♀; × 14.

each tooth (often isolated on surface), but sometimes some of these wear out. Lower teeth with five folds or depressions, less isolated than in the upper series, particularly the third and fourth, which are long. Only a small series of skulls at present available for examination.

Size very small. Tail considerably longer than head and body, scaly, naked or with a faint growth of rather long hairs through the lower part of its length, which at the end are produced into a brush. Fur without spines. Hindfoot evidently not specially broadened, but D.5 long. Eyes much reduced. A small caecum present (Thomas).

Forms seen: *cinereus*, *chapensis*.

LIST OF NAMED FORMS

1. TYPHLOMYS CINEREUS CINEREUS, Milne-Edwards

1877. Bull. Soc. Philom. Paris, XII, p. 9.
Fokien, China.

2. TYPHLOMYS CINEREUS CHAPENSIS, Osgood

1932. Field Mus. Nat. Hist. Zool. Ser. XVIII, no. 10, p. 298.
Chapa, Tongking.

The family Muscardinidae is known fossil in the Palaearctic region from the Middle Miocene.

Before passing to the other Muroid families, all of which are very closely allied to each other, it must be noticed that according to Tullberg all other Muroidae as here understood examined by him have a horny layer present in the cardiac portion of the stomach; but this is not the case in Muscardinidae examined by him; I have no notes on the character in *Platacanthomys* and *Typhlomys*.

MUSCARDINIDAE:

SPECIAL WORKS OF REFERENCE

MILLER, Catalogue of Mammals of Western Europe, 1912, p. 549. Muscardinidae.
TULLBERG, Nova Acta Reg. Soc. Sci. Upsaliensis, 1899.
CUVIER, Du genre Graphiure: Nouv. Ann. Mus. d'Hist. Nat. Paris, I, 1832.
PETERS, On the systematic position of *Platacanthomys lasiurus*, Proc. Zool. Soc. London, 1865, p. 397.
REUVENS, Die Myoxidae oder Schlaefer, 1890, p. 1.

The remaining families in the Order are all closely allied to each other; the majority of the genera are referred to the Family Muridae which contains well over half the Order. Three groups, one containing two genera, the others a single genus each, appear to be too aberrantly specialized to be referred to the Muridae.

Family LOPHIOMYIDAE

1896. Thomas: MYOMORPHA, part: Family Muridae, part, Subfamily Lophiomyinae.
1899. Tullberg: MYOMORPHA: Muriformes, part: Family Lophiomyidae.
1918. Miller & Gidley: MUROIDAE, part: Family Cricetidae, part, Subfamily Lophiomyinae.
1924. Winge: Family Muridae, Cricetini, part, Criceti, part.
1928. Weber: MUROIDEA, part: Family Muridae, part, Subfamily Lophiomyinae.

GEOGRAPHICAL DISTRIBUTION.—Eastern Africa: Abyssinia, Somaliland, Kenya, and Sudan (Kassala district).

NUMBER OF GENERA.—One.

CHARACTERS.—Zygomasseteric structure as in typical specialized Muridae, but skull highly abnormal, the temporal fossae roofed in by plates of bone rising from the frontals, parietals and jugals, a structure not known elsewhere in the Order. Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{0}{0}$, m. $\frac{3}{3}$ = 16; cheekteeth rooted laminate, each lamina separated by wide valleys, and bearing two cusps (parallel—cuspidate Cricetinae). Fur with an erectile crest on the centre of the back. Tail densely bushy. Bullae reduced, small. Feet considerably specialized for arboreal life, with hallux partly opposable.

Genus 1. LOPHIOMYS, Milne-Edwards

1867. LOPHIOMYS, Milne-Edwards, L'Institut, vol. 35, p. 46.

TYPE SPECIES.—*Lophiomys imhausi*, Milne-Edwards.

RANGE.—As in the Family Lophiomyidae.

NUMBER OF FORMS.—Six.

CHARACTERS.—Temporal fossae of skull completely roofed by bone, the surface of which is granulated, rising from the frontals and parietals and joining the centre of the jugals; extending backwards from jugal independently of and above the posterior portion of zygoma. Orbit thus rendered very small. Under these bony plates it may be seen that the skull is

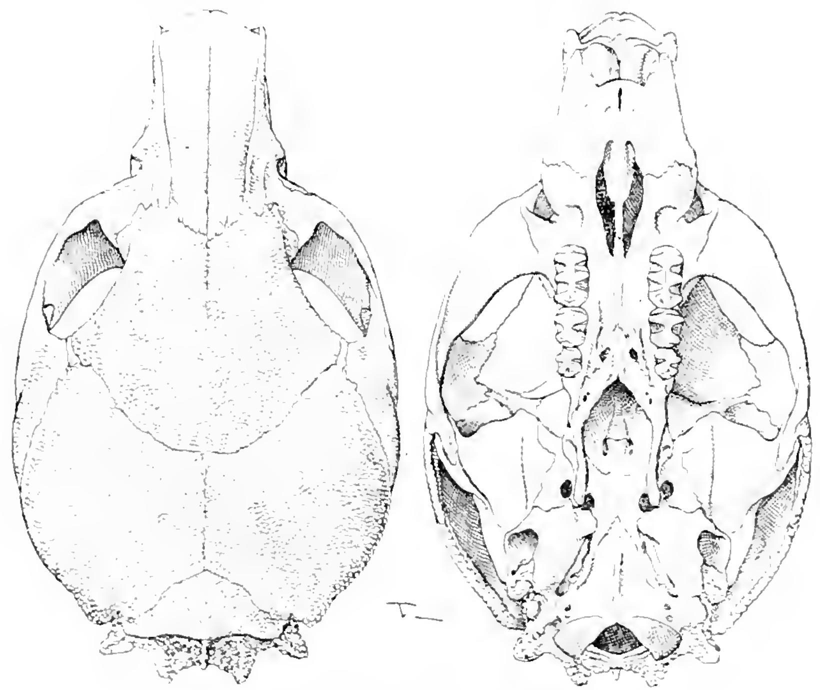


FIG. 180. LOPHIOMYS IMHAUSI IMHAUSI, Milne-Edwards.
B.M. No. 26.5.12.100, ♂; × 1½.

constricted between the orbits, as in many Muridae. Paroccipital process relatively long; occipital region prominently ridged. The granulations of the skull usually extend on to the occipital region, and on the nasals and sides of rostrum. Bullae very small. Incisive foramina long, extending to anterior molars. Hamular processes high and raised; palate with rather large lateral pits between posterior molars, and mesopterygoid space usually wide. Zygomatic plate of specialized Murine type; tilted prominently upwards, well ridged on its superior

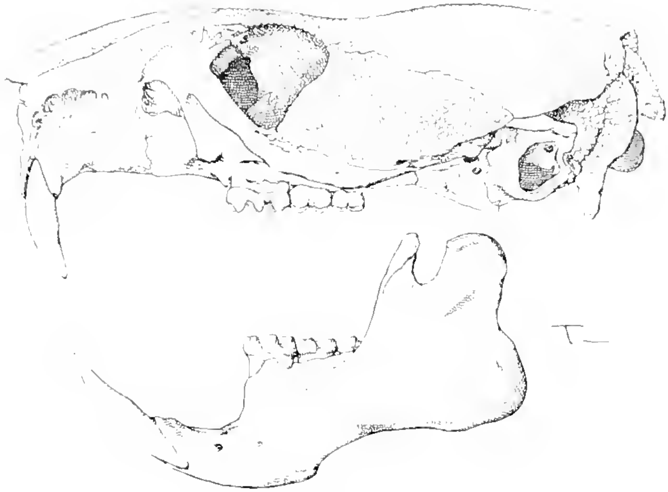


Fig. 181. Lophiomys imhausi imhausi, Milne-Edwards.
B.M. No. 26.5.12.100, ♂; × 1½.

Fig. 182. Lophiomys imhausi imhausi, Milne-Edwards.
Cheekteeth: B.M. No. 26.5.12.100; × 5.

border. Infraorbital foramen wider above than below, its outer side usually ridged. Mandible with hinder portion of angular process rather flat. Coronoid process well developed.

Incisors moderately broad. Cheekteeth decreasing in size from M.1 to M.3; three laminae on M.1, two on the other teeth, each lamina formed by an outer and inner cusp, the cusps approximately equal in size to each other; each lamina separated from the one behind it by a broad outer and inner re-entrant fold, these folds separated from each other by a narrow ridge running down the centre of the tooth, the general effect much as in the genus *Cricetus*; the cusps of each lamina separated from each other by a furrow. Teeth, excepting the raised cusps and longitudinal ridges, coloured black. Anterior portion of M.2 with a small inner and outer fold in front of the two anterior cusps. Lower teeth much like those of the upper series; the two anterior cusps on M.1 rather small; the furrow separating the two posterior cusps tending to take the form of an inner re-entrant fold.

Size rather large for a Muroid Rodent, head and body to 360 mm. Forefoot with four well-developed digits, of which D.3 is slightly the longest, and a rudimentary pollex. Hindfoot rather broad, with six plantar pads, three central digits slightly longer than the hallux and D.5, which are more or less subequal. The hallux is opposable, though clawed, and in appearance much less specialized than certain Indo-Malayan climbing Rats as *Chiropodomys*, *Hapalomys*, etc. Tail very thickly haired throughout its length; shorter than head and body, and terminating evidently in a small knob, which I have seen in captivity specimens used as an aid to climbing wire-netting. Ear relatively small. Fur excessively thick, the central portion forming an erectile crest; when this is lifted up, a long more or less bare patch of skin running along the sides is to be seen in dried skins, and in the living animal. In the young animal, it is much more evident than in the adult, perhaps owing to the fact that the coat, even at ten weeks old, is scanty. Clavicles imperfect. Dorsal vertebrae more numerous than is usual; fifteen pairs in a skeleton in my possession.

Some time ago I was fortunate enough to obtain some of these interesting animals, some of which I gave to the London Zoological Gardens, and some of which were kept by a friend of mine. They lived quite well for a time, and, moreover, my friend bred and reared a single young one which lived for fourteen months. The diet was the chief difficulty in keeping these animals alive, and the problem was not solved. They seemed to thrive best in a temperature of about 60 degrees. They were rather strictly nocturnal, and at first not easy to tame; but when placed in a large cage and given a hollow log to sleep in and plenty of climbing facilities they soon got to know us, and would come to call and feed from hand in the evening. I have seen it stated that these animals cannot climb; my impression is that they are the most perfect and natural climbers. When provided with a cage about six feet high they lost no time in climbing to the top of it, and they always climb down vertical wire-netting head downwards and front feet first; even the young one which was bred doing this rather astonishing feat quite naturally; moreover, they seemed able to swarm up concrete for a short distance. On the whole they were very slow-moving animals, and it is rather a mystery how they have managed to survive.

The remarkable skull structure seems to make it desirable to refer these animals to a distinct family; though perhaps derived from Cricetine Muridae I think that sometimes there are more important features to be taken into account in classification than similarity of cheekteeth alone.

Forms seen: *bozasi, hindei, ibeanus, imhausi, testudo.*

Thomas evidently came to the conclusion that all the East African "species" were one, as there is a note in his tracts to this effect. I am inclined to go further and think that until more material comes to hand all forms must be treated as races of the earliest name *imhausi.* I believe there would be many differences which could be regarded as individual or sexual, in a large series. Though I have seen very few alive, I must note that in every case the females seem to be larger than the males.

List of Named Forms

(References and type localities of the Lophiomyidae have been collected by Mr. R. W. Hayman.)

1. LOPHIOMYS IMHAUSI IMHAUSI, Milne-Edwards

1867. L'Institut, vol. 35, p. 46.
Somaliland.
Synonym: *smithi*, Rhoads, 1896, Proc. Acad. Nat. Sci. Philadelphia, p. 524. Somaliland.
bozasi, Oustalet, 1902, Bull. Mus. Hist. Nat. Paris, p. 400. Goba, S. Abyssinia.

2. LOPHIOMYS IMHAUSI AETHIOPICUS, Peters

1867. Zeitschr. Ges. Natur. XXIX, p. 195.
Near Kassala, Sudan.
(A synonym of *L. i. imhausi* according to G. M. Allen, 1939.)

3. LOPHIOMYS IMHAUSI IBEANUS, Thomas

1910. Ann. Mag. Nat. Hist. 8, VI, p. 223.
Mile 513 on Uganda Railway, between Londiani and Lumbwa Stations, Mau region, Kenya.

4. LOPHIOMYS IMHAUSI HINDEI, Thomas

1910. Ann. Mag. Nat. Hist. 8, VI, p. 223.
Mutaragwa, Aberdare Mountains, Kenya.

5. LOPHIOMYS IMHAUSI TESTUDO, Thomas

1905. Ann. Mag. Nat. Hist. 7, XV, p. 80.
Ravine Station, Kenya.

6. LOPHIOMYS IMHAUSI THOMASI, Heller

1912. Smiths. Misc. Coll. LIX, no. 16, p. 4.
Mount Gargues, Matthews Range, Kenya.

Family SPALACIDAE

1896. Thomas: MYOMORPHA, part: Family Spalacidae, part, Subfamily Spalacinae.

1899. Tullberg: MYOMORPHA, part: Family Spalacidae, part, included *Myospalax* ("*Siphneus*"), *Rhizomys*, *Tachyoryctes*.

1918. Miller & Gidley: MUROIDAE, part: Family Spalacidae, part, Subfamily Spalacinae.
1924. Winge: Family Dipodidae, part, Spalacini.
1928. Weber: MUROIDEA: Family Spalacidae, part, included *Rhizomys*, *Myospalax*, *Tachyoryctes*.

GEOGRAPHICAL DISTRIBUTION.—Palaearctic: Eastern Mediterranean region: Galicia, Hungary, Roumania, Yugoslavia, Turkey, Greece, Southern Russia to the Caspian Sea (Poltava, Harkov, Dnepropetrovsk, Voronej, Saratov, Don, Stalingrad districts, Ciscaucasia, Transcaucasia) (Vinogradov); Asia Minor, Syria, Palestine, North Egypt, into Libya.

NUMBER OF GENERA.—One.

CHARACTERS.—(As here understood the family contains the genus *Spalax* only.) Skull and external form extremely modified for subfossorial life. External eyes suppressed (in this character unique among Rodents). Tail absent; ear vestigial. Claws not specially enlarged. Skull with supraoccipital region sloping forwards to level of the posterior zygomatic root, this region occupying a third or more of whole length of skull. Zygomatic plate relatively narrow, and nearly completely beneath the infraorbital foramen, which is large for a Muroid Rodent; masseter lateralis superficialis with anterior head distinct from zygoma (as figured by Tullberg), as in normal Muroid Rodents. Dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{0}{0}$, m. $\frac{3}{3}$ = 16. Cheekteeth rooted, the inner and outer re-entrant folds forming the pattern of the young animal soon becoming isolated on crown surface. Lower incisor forming powerful process on mandible beside the condyle.

REMARKS.—As will be seen above, the family has in most previous classifications contained several other genera, such as *Myospalax*, *Rhizomys* and *Tachyoryctes*. Miller & Gidley show in their classification of the Order that the zygomasseteric structure of *Rhizomys* is totally different from that of *Spalax*, indeed the two groups being at the opposite end of two extremes; *Rhizomys* and *Tachyoryctes* were accordingly referred to a family Rhizomyidae by these authors, while *Spalax* and *Myospalax* were retained in the Spalacidae. But the genus *Myospalax* is very much less highly modified as regards the arrangement of zygomatic plate and infraorbital foramen than *Spalax*, if the two are compared with a normal member of the Muridae. Their cheekteeth also are very different; and most authors are agreed in placing *Myospalax* in the Muridae, where its position seems to be in the neighbourhood of the Cricetinae (as indicated by Winge), or the Microtinae. Such superficial resemblance as exists between *Spalax* and *Myospalax* cranially, such as the occipital region which is abnormally sloped forwards in both, is probably brought about by the similar mode of life which the two genera lead.

Winge regarded *Rhizomys*, *Tachyoryctes* and *Myospalax* as Muridae, but transferred *Spalax* to the Dipodidae. But according to Tullberg the stomach of *Spalax* agrees with the Muridae rather than the Dipodidae; and the infraorbital foramen and zygomatic plate of *Spalax* are certainly not Dipodoid.

It should be mentioned that the family Spalacidae of earlier authors appeared to contain all the Old World Rodents which live underground, and even formerly included the Bathyergidae! I do not think that there is much doubt that the grouping together of *Spalax*, *Myospalax*, *Tachyoryctes* and *Rhizomys* is a very unnatural arrangement.

Genus 1. SPALAX, Guldenstaedt

1770. Spalax, Guldenstaedt, Nov. Com. Acad. Sci. Imp. Petrop. XIV, pt. 1, p. 410.

1909. Macrospalax, Méhely, A Földi Kutyák Fajai, Budapest, p. 23. (New name for *Spalax* s.s.)

1909. Mesospalax, Méhely, A Földi Kutyák Fajai, Budapest, p. 22. (Based on *Spalax monticola*, Nehring, and *S. hungaricus*. No type designated. If the type has not already been chosen I here choose the former as type species.)

1898. Microspalax, Nehring, S.B. Ges. Nat. Fr. Berlin, p. 168, for December 1897. "Smaller species of *Spalax*." Not of Trouessart.

1903. Nannospalax, Palmer, Science, new ser., XVII, p. 873. (To replace *Microspalax*, Nehring. If the type has not heretofore been designated I choose *Spalax kirgisorum*, Nehring.)

1922. Ujhelyiana, Strand, Arch. Naturg. Berlin, 88, Abt. A. Hft. 4, p. 142. To replace *Microspalax*, Nehring.

Type Species.—*Spalax microphthalmus*, Guldenstaedt.

Range.—As in the Family Spalacidae.

Number of Forms.—About twenty-seven.

Characters.—Skull extremely fossorial; occiput high and broad, slanting forwards to level of the posterior zygomatic root. This region of skull roofs over the space between the auditory meatus and the posterior zygomatic root. Frontals extremely constricted. Rostrum long and heavy. Jugal short, reduced. Incisive foramina small, far in front of toothrow. Bullae of medium size. Zygomatic breadth considerable, greatest near the posterior zygomatic root. Foramen magnum less than half the height of occipital shield. Palate narrow. Infraorbital foramen relatively large, higher than wide. Zygomatic plate narrow, nearly completely beneath it. The ascending branch of the zygoma outside the infraorbital foramen is in some cases broader than the zygomatic plate. But compared, for instance, with *Jaculus* representing the Dipodidae, to which the genus was transferred by Winge, the infraorbital foramen is in this case very much less enlarged, and the zygomatic plate is rather more Murine in general appearance. A small protuberance on the lower part of the inner side of the infraorbital foramen is present, and might mark the division between the muscle-transmitting portion and the nerve-transmitting portion. Mandible with the lower incisor root forming a large process between the condylar and the top of the angular portion, and projecting considerably outwards and upwards above these bones; coronoid process high and slender; angular portion low, rather spread sideways.

Incisors broad and heavy, the root of the upper teeth forming a slight knob in the side of the palate in front of M.1. Molars small, semihypsodont. M.1 not much larger than M.2 and M.3 little smaller than this tooth. Good figures of the unworn teeth are supplied by Méhely; these show that as usual in the Order the very young teeth are extremely complex. At a later stage, inner and outer re-entrant folds form the tooth pattern, in which in M.1 and

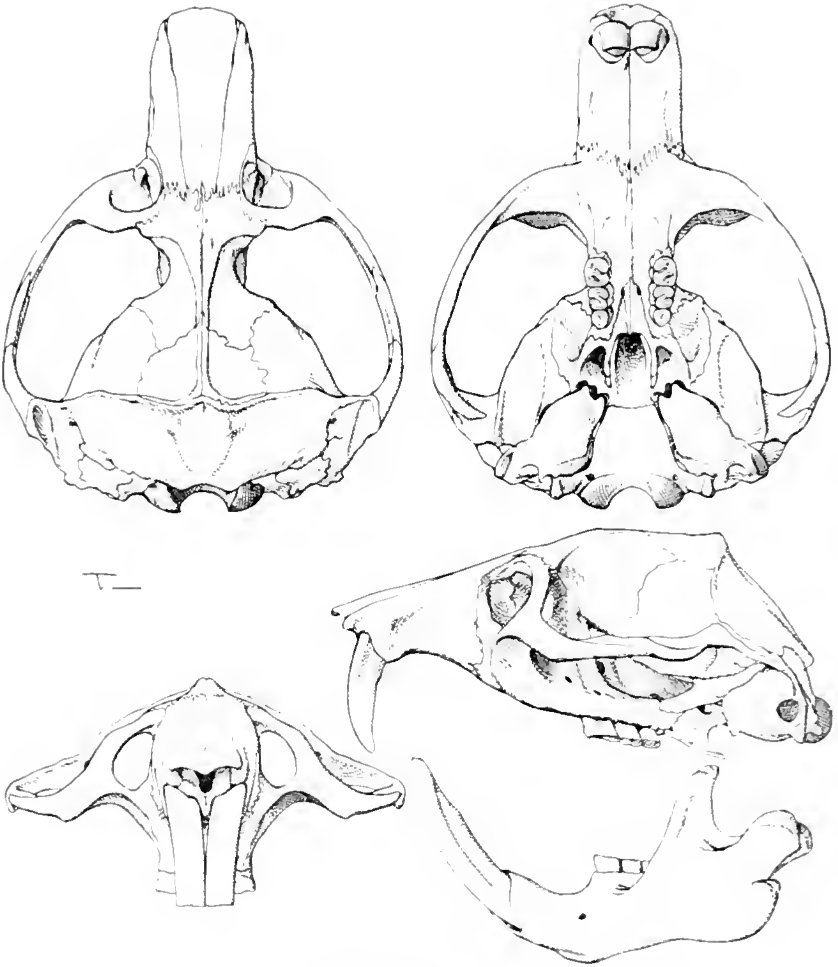


FIG. 183. SPALAX MONTICOLA DOLBROGEAE, Miller.
B.M. No. 5.10.25.2, [illegible]; × 1½.

M.2 there are usually two backwardly curved outer and one forwardly curved inner folds. The folds isolate as enamel islands, the second outer fold being the most persistent. M.3 varies in pattern; in the subgenus *Nannospalax* there are always two isolated more or less parallel enamel islands; in the subgenus *Mesospalax* there is one, the centre of which is joined as a rule by a short island at right angles to it. Typical *Spalax* appears to agree with *Mesospalax*. M.3 in young *Nannospalax* is S-shaped, formed by one inner and one outer re-entrant fold, and M.2 is more or less similar, when very young, but later seems to take on a pattern more like M.1 or as described above.

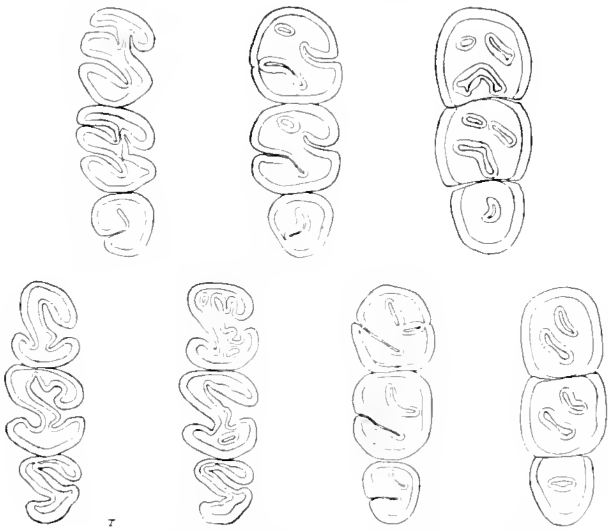


FIG. 184. SPALAX MONTICOLA DOLBROGEAE, Miller.
Cheekteeth showing enamel pattern at various stages of wear. Upper row, maxillary teeth; lower row, mandibular teeth (semi-diagrammatic); 5.
(From Miller's Catalogue of the Mammals of Western Europe.)

In each of the lower teeth there are in *Mesospalax* usually one inner and one outer fold in moderately worn specimens. In *Nannospalax* there appear to be generally two inner folds on the two front teeth; the islands generally in this subgenus are three on M.1, two on the other teeth; the other subgenera often have only two islands on M.1.

Form Mole-like. Head round, flat. External eyes absent; they are said to be more or less developed but quite functionless beneath the skin. Ears vestigial. Tail absent. Forefoot with five digits, the pollex very small, otherwise proportions of digits not unlike that of a human hand. Hindfoot digit proportions much as in forefoot. Claws medium, not specially developed, the digging being done apparently with the incisors. A line of stiff bristles running across face from the nostrils about half-way to the ear present, otherwise fur very short, soft.

The genus was thoroughly monographed by Méhely, Species Generis *Spalax*, 1909, A Földi Kutyák Fajai, Budapest.[1] This author divided the genus into three subgenera, *Mesospalax*, *Macrospalax*, and *Microspalax*. *Macrospalax* is a "new name for *Spalax* s. str," and is therefore unnecessary and must be placed in synonymy. *Microspalax* is preoccupied, and has been renamed twice; consequently the nomenclature of the genus is somewhat complicated.

The three valid subgenera are at the present time *Spalax* (synonym *Macrospalax*, Méhely); *Mesospalax*; and *Nannospalax* (synonyms *Microspalax*, *Ujhelyiana*).

Their main differences pointed out by Méhely are below.

	Subgenus *Nannospalax*	Subgenus *Mesospalax*	Subgenus *Spalax*
Length of Skull .	42–45 mm.	47–54 mm.	53–74 mm.
Supraoccipital .	Shorter	Shorter	Very long
Foramen supracondyleum	Present	Present	Absent
Petromastoideum .	Short and broad	Short and broad	Longer
External auditory meatus . .	Wider and longer	Wider and longer	Narrow
Pterygoid fossae .	More open	More open	More closed
Condyle . .	Little lower than incisor knob	Considerably lower than incisor knob	Considerably lower than incisor knob
Angular process .	Spread out from body of lower jaw	Spread out from body of lower jaw	Very slightly removed from body of lower jaw
M.3 . . .	With two enamel islands	One enamel island	One enamel island
M.1 and M.2, chewing surface	Two lingual folds	Two lingual folds, the posterior one early replaced by an island	One lingual enamel fold

[1] German edition in Math. u. Naturwiss. Ber. Ungarn. 88 (1910). Leipzig 1913. pp. 1-390. text and Atlas.

This table briefly summarizes the main characteristics pointed out by Méhely. The material examined does not show much difference in the characters of pterygoid fossae, condyle and angular process; but very few skulls are available of *Spalax* s.s.

Forms seen: *aegyptiacus*, *anatolicus*, *captorum*, *corybantium*, *dolbrogeae*, *ehrenbergi*, *hellenicus*, *hungaricus*, *insularis*, *microphthalmus*, *nehringi*, *serbicus*, *thermaicus*, *transsylvanicus*.

S. giganteus, not seen, is said to differ considerably from other members of subgenus *Spalax* in cranial characters (broadened rostrum, etc.).

List of Named Forms

(References and type localities for Spalacidae are the work of Mr. R. W. Hayman.)

Subgenus *Nannospalax*, Palmer

(All members of this group are regarded as one species by Méhely under the name *ehrenbergi*; but *kirgisorum* has page priority, and so must be used.)

1. SPALAX KIRGISORUM KIRGISORUM, Nehring

1898 (for 1897). Sitz. Ber. Ges. Nat. Fr. Berlin, p. 176.
Kirghiz Steppes. (? no *Spalax* of this type quoted by Vinogradov in Rodents of U.S.S.R.; according to Méhely comes from North Syria.)
Synonym: *intermedius*, Nehring, 1898, Sitz. Ber. Ges. Nat. Fr. Berlin, Dec. 1897, p. 181. Syria.
berytensis, Miller, 1903, Proc. Biol. Soc. Washington, XVI, p. 162. Beyrout, Syria.

2. SPALAX KIRGISORUM EHRENBERGI, Nehring

1898 (for 1897). Sitz. Ber. Ges. Nat. Fr. Berlin, p. 178.
Jaffa, Palestine.

3. SPALAX KIRGISORUM AEGYPTIACUS, Nehring

1898. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 180.
Ramleh, North Egypt.

Subgenus *Mesospalax*, Méhely

4. SPALAX MONTICOLA MONTICOLA, Nehring

1898. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 6.
Kupres, Bosnia, Yugoslavia.

5. SPALAX MONTICOLA NEHRINGI, Satunin

1898. Zool. Anz. XXI, p. 314.
Kasikoporan, Armenia.

6. SPALAX MONTICOLA ARMENIACUS, Méhely

1909. A Földi Kutyák Fajai, Budapest, p. 79.
Kura-Quellan, Armenia.

7. SPALAX MONTICOLA CILICICUS, Méhely

1909. A Földi Kutyák Fajai Budapest, p. 84.
Cilician Taurus, Asia Minor.

8. SPALAX MONTICOLA ANATOLICUS, Méhely
1909. A Földi Kutyák Fajai, Budapest, p. 88.
Burnabad, near Smyrna, Asia Minor.

9. SPALAX MONTICOLA HELLENICUS, Méhely
1909. A Földi Kutyák Fajai, Budapest, p. 100.
Lamia. Thessaly, Greece.

10. SPALAX MONTICOLA TURCICUS, Méhely
1909. A Földi Kutyák Fajai, Budapest, p. 105.
Makri-Koi, Constantinople, Turkey.

11. SPALAX MONTICOLA DOLBROGEAE, Miller
1903. Proc. Biol. Soc. Washington, XVI, p. 161.
Dobrudscha, Roumania.

12. SPALAX MONTICOLA HERCEGOVINENSIS, Méhely
1909. A Földi Kutyák Fajai, Budapest, p. 129.
Ulog-Obruga, Herzegovina, Yugo-Slavia.

13. SPALAX MONTICOLA SYRMIENSIS, Méhely
1909. A Földi Kutyák Fajai, Budapest, p. 133.
Szerem, Slavonia, Yugo-Slavia.

14. SPALAX MONTICOLA SERBICUS, Méhely
1909. A Földi Kutyák Fajai, Budapest, p. 140.
Serbia.

15. SPALAX MONTICOLA INSULARIS, Thomas
1917. Ann. Mag. Nat. Hist. 8, XX, p. 315.
Isle of Lemnos, Greece.

16. SPALAX MONTICOLA THERMAICUS, Hinton
1920. Ann. Mag. Nat. Hist. 9, V, p. 313.
Salonica, Greece.

17. SPALAX MONTICOLA CAPTORUM, Hinton
1920. Ann. Mag. Nat. Hist. 9, V, p. 318.
Changria, Asia Minor.

18. SPALAX MONTICOLA CORYBANTIUM, Hinton
1920. Ann. Mag. Nat. Hist. 9, V, p. 316.
One hundred and fifty miles east of Smyrna, Asia Minor.

19. SPALAX MONTICOLA LABAUMEI, Matschie
1919. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 35.
Eskischehir, Asia Minor.

20. SPALAX HUNGARICUS HUNGARICUS, Nehring
1898. Sitz. Ber. Ges. Nat. Fr. Berlin, p. 173.
Hungary.

21. SPALAX HUNGARICUS TRANSSYLVANICUS, Méhely
1909. A Földi Kutyák Fajai, Budapest, p. 159.
Transsylvania.

Subgenus *Spalax*, Guldenstaedt

22. SPALAX GRAECUS GRAECUS, Nehring
1898. Zool. Anz. XXI, p. 228.
? Neighbourhood of Athens, Greece.

23. SPALAX GRAECUS ANTIQUUS, Méhely

1909. A Földi Kutyák Fajai, Budapest, p. 175.
Roumania.

24. SPALAX ISTRICUS, Méhely

1909. A Földi Kutyák Fajai, Budapest, p. 186.
Barza, Roumania.

25. SPALAX POLONICUS, Méhely

1909. A Földi Kutyák Fajai, Budapest, p. 194.
Lemberg, Galicia.

26. SPALAX MICROPHTHALMUS, Guldenstaedt

1770. N. Comm. Ac. Sci. Imp. Petrop. XIV, pt 1, p. 411.
Steppes of Nobochopersk, S. Russia.
Synonym: *typhlus*, Pallas, 1778, Nov. Sp. Quadr. Glir. Ord., pp. 76, 154, pl. 8. S. Russia.
podolica, Pennant, 1771, Synop. Quadr. p. 277.
xanthodon, Nordmann, 1840, Demidoff Voy. I, p. 35, pl. II.
leucodon, Nordmann, same reference, p. 34.
pallasii, Nordmann, Bull. Ac. St. Petersb. 1835, p. 200.

27. SPALAX GIGANTEUS, Nehring

1898. Sitz. Ber. Ges. Nat. Fr. Berlin (for 1897), p. 169.
Petrovsk, Caspian Sea, Russia.

The family is known fossil from the Upper Oligocene, according to Miller & Gidley, but only from the range given above.

SPALACIDAE: *GENERAL WORKS OF REFERENCE*

Méhely, 1909, Species Generis Spalax: A Földi Kutyák Fajai, Budapest.
Miller, 1912, Catalogue Mammals Western Europe: Spalacidae, p. 887. (The "*Spalax graecus*" of this work is not *graecus* as understood by Méhely, but *monticola hellenicus*; see Thomas, 1917, Ann. Mag. Nat. Hist. 8, XX, p. 317.)

Family RHIZOMYIDAE

1896. Thomas: Myomorpha, part: Family Spalacidae, part, subfamily Rhizomyinae, part included *Tachyoryctes*.
1899. Tullberg: Myomorpha: Family Spalacidae, part.
1918. Miller & Gidley: Muroidae: Family Rhizomyidae, part, subfamily Rhizomyinae.
1924. Winge: Family Muridae, part: Rhizomyini, part, included *Tachyoryctes* and all genera of Muridae from Madagascar.
1928. Weber: Muroidea: Family Spalacidae, part.

Geographical Distribution.—Indo-Malayan region from China south of the Yangtsekiang (ranging north to Szechuan), and from the Eastern Himalayas (Nepal) south through Siam and the Malay Peninsula to Sumatra.

Number of Genera.—Two are here retained.

Characters.—Zygomasseteric structure more specialized than in the Muridae; zygomatic plate tilted very strongly upwards; infraorbital foramen much reduced, its lower border nearly straight (instead of V-shaped as is very general in Muridae), and situated on upper border of zygomatic plate, its neutral portion obliterated, the foramen usually broader than high. Skull modified for fossorial life; dental formula i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{0}{0}$, m. $\frac{3}{3} = 16$; cheekteeth semihypsodont, rooted, flatcrowned, characterized by a pattern of inner and outer re-entrant folds which become isolated on crown surface as islands; external form moderately specialized for fossorial life.

The systematic position of the Rhizomyidae is not clear; by many authors the group has been referred to the Spalacidae, but I have already pointed out when dealing with that family that the zygomasseteric structure as regards arrangement of zygomatic plate and infraorbital foramen is very distinct in the two groups. Thomas, 1896, remarked, "It is doubtful whether *Spalax* and *Rhizomys* . . . are rightly put even in one family, their resemblances being perhaps more adaptive than generic." Forsyth Major regarded *Rhizomys*, also *Spalax* and *Tachyoryctes* (the former family Spalacidae), as primitive Muridae; though in many respects these genera seem to me to be more highly specialized than is usual in the Muridae. Winge transferred *Rhizomys* to the Muridae, and formed a subfamily or group Rhizomyini including *Rhizomys*, *Tachyoryctes*, *Brachytarsomys*, *Brachyuromys*, *Eliurus*, *Nesomys*, and *Gymnuromys*, based fundamentally on the character that M.1 is not or scarcely larger than M.2, whereas in all other Muridae he states that M.1 has become larger than M.2. But I have not found this the case, as I shall show when dealing with the Muridae. Miller & Gidley, 1918, formed a family Rhizomyidae, defined as "Like the Cricetidae, but zygomasseteric structure unusual, the infraorbital foramen with neural portion reduced or obliterated by partial or entire fusion of zygomatic plate with side of rostrum." This family included *Tachyoryctes*, and also *Bramus*, a Pleistocene North African fossil genus which has since been shown by Hinton to be a synonym of the Microtine genus *Ellobius*.

Tachyoryctes has a much less specialized and abnormal infraorbital foramen than *Rhizomys* and *Cannomys*, and differs from them conspicuously in dental characters. I do not think *Tachyoryctes* is so closely allied to the *Rhizomyidae* as maintained by most authors. The genus is here referred to the Muridae, as its infraorbital foramen is clearly not highly abnormal, and as figured by Tullberg differs widely from the Rhizomyidae; whereas its cheekteeth are similar in pattern to one of the Rats of Madagascar (*Brachyuromys*), which has always been regarded as a member of the Muridae.

The Rhizomyidae are here kept apart from the Muridae solely on account of their peculiar zygomasseteric structure, the masseter muscle as figured by Tullberg rising up the zygomatic plate inside the infraorbital foramen, a condition so far as I know without parallel elsewhere among Muroid Rodents.

Thomas divided *Rhizomys* into three genera, *Nyctocleptes*, *Rhizomys* and *Cannomys*. But intermediate forms are now known between *Nyctocleptes* and *Rhizomys*, and the two groups are probably more correctly referred to a single genus.

Key to the Genera of Rhizomyidae

Upper incisors strongly pro-odont; sole pads normal, not granulated. M.1 never worn below level of M.2, and the largest tooth in the upper series. Cannomys

Upper incisors not strongly pro-odont; sole pads granulated; M.1 often smaller than M.2, and often worn below the level of the latter. Rhizomys

Genus 1. RHIZOMYS, Gray

1831. Rhizomys, Gray, Proc. Zool. Soc. London, p. 95.
1832. Nyctocleptes, Temminck, Bijdragen Nat. Wetensch. Amsterdam, VII, p. 7, pl. 1. (*Mus sumatrensis*, Raffles.) Valid as a subgenus.

Type Species.—*Rhizomys sinensis*, Gray.

Range.—Moupin, Assam, Burma, Tenasserim, Yunnan, Kwantung, Fukien, Siam, Indo-China, southern part of Malay Peninsula, Sumatra.

Number of Forms.—Thirteen.

Characters.—Frontals much constricted; behind them in larger species a strong sagittal ridge is formed which extends to lambdoid crest. Occipital region upstanding and prominent, rather sloped forwards, though not excessively so. Paroccipital process relatively long; zygomata widely spreading; rostrum heavy. Jugal thick and prominent, but most of anterior part of zygoma formed by zygomatic process of maxillae. Bullae large, the meatus directed outwards and upwards; the bullae appear conspicuously in back view of skull between the paroccipital process and the upper process of supraoccipital. Palate narrow; posterior nares typically compressed, higher than wide, but more open in *R. senex* and in subgenus *Nyctocleptes*. Zygomatic plate tilted very strongly upwards; infraorbital foramen reduced to a small orifice situated on its upper border, broader than high, its lower border as a rule nearly straight. Incisive foramina small, considerably in front of toothrows. Mandible with prominent knob caused by lower incisor root, nearly as high as the condylar process. Coronoid process high.

Incisors very broad, orthodont, or slightly pro-odont in *Nyctocleptes*. Cheekteeth semihypsodont; M.1 in subgenus *Rhizomys* smaller than M.2, considerably so in old individuals, and worn considerably below its level. M.1 with one inner fold (more persistent), and three outer folds which usually isolate as islands. M.2 when cut appears to have one inner fold which cuts the tooth into two lobes; the inner fold breaks in two and forms a fold in the anterior lobe; a deep outer fold cuts across the posterior lobe; with wear this simplifies to a pattern of three external, one deep internal enamel islands. M.3 appears to vary to a degree individually, but is not very different from M.2, and simplifies in a similar manner with wear. Lower series: M.1 not very much smaller than M.2; usually three enamel islands present in the first two molars; M.3 appears to consist of two lobes, the anterior of which is the larger and has in the centre

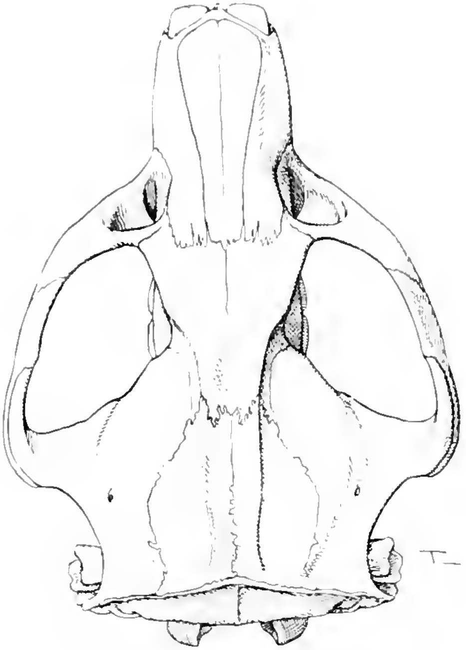


FIG. 185. RHIZOMYS PRUINOSUS PRUINOSUS, Blyth.
B.M. No. 20.11.1.44, [illegible]; × 1½.

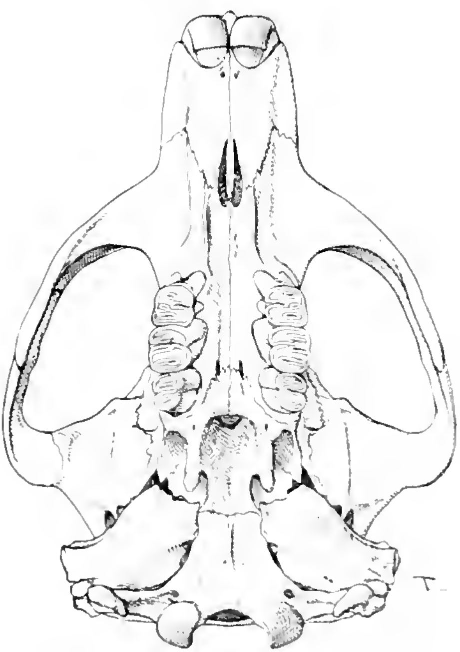


FIG. 186. RHIZOMYS PRUINOSUS PRUINOSUS, Blyth.
B.M. No. 20.11.1.44, [illegible]; × 1½.

FIG. 187. RHIZOMYS PRUINOSUS PRUINOSUS, Blyth.
B.M. No. 20.11.1.44, ♂; × $1\frac{1}{2}$.

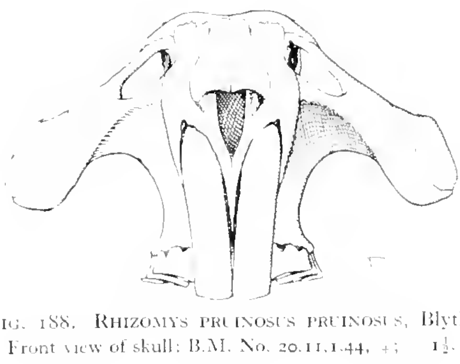


FIG. 188. RHIZOMYS PRUINOSUS PRUINOSUS, Blyth.
Front view of skull: B.M. No. 20.11.1.44, ♂; × $1\frac{1}{2}$.

a large isolated island. In the subgenus *Nyctocleptes*, M.1 upper is not smaller than M.2, but may be worn down to a lower level, as in typical *Rhizomys*.

Form more or less fossorial; fur very thick in the northern forms, becoming harsh and scanty in the tropical species. Eyes and ears small. Tail varying from about a third or more length head and body to little longer than hindfoot, not well haired. Claws rather prominent. Forefoot with D.3 longest, D.2 a little shorter but slightly longer than D.4; D.5 shortest. Proportions of digits of hindfoot nearly as in forefoot, but D.2 may be relatively longer, and hallux nearly as long as D.5. Mammae normally 1—3 = 8, though occasionally a minute

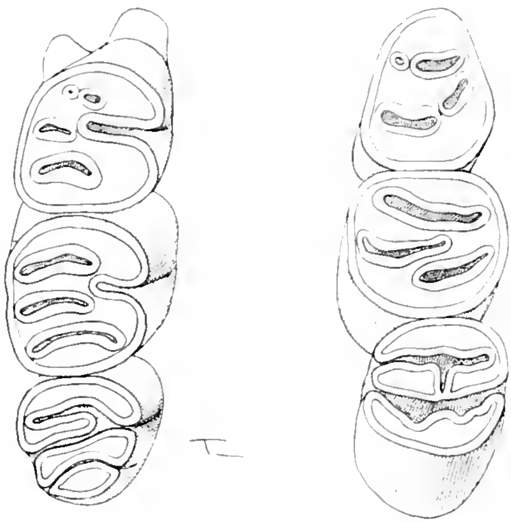


FIG. 189. RHIZOMYS PRUINOSUS PRUINOSUS, Blyth.
Cheekteeth: B.M. No. 20.11.1.44, ♂; × 5.

anterior pectoral pair may be present as well as these, and in subgenus *Nyctocleptes*, 2—3 = 10 (Thomas).

NYCTOCLEPTES was revived as a full genus by Thomas, the differences being the larger size (not a generic character), the infraorbital foramen oval or circular instead of subtriangular, but some specimens seen of *R. senex* appear in this formation indistinguishable from *Nyctocleptes*; the posterior nares well open, often nearly as wide as high (but *R. senex* is intermediate between the two groups in this character); the set of the incisors more pro-odont (but not approaching *Cannomys* in this character), and M.1 not smaller than M.2, and rarely worn to a lower level. The two posterior solepads are joined (separate in *Rhizomys*). Also there is a strong ridge each side of the front of the palate which extends forwards to the premaxillae, which is more developed than in *Rhizomys*. But these differences seem subgeneric rather than generic. The fur is harsh and short, and the size becomes very large, up to 450 mm. head and body, or more. The tail is nearly naked, and longest of genus. Hindfoot 53–65 mm. All named forms appear to belong to one species only.

Subgenus RHIZOMYS appears to me on the material examined to divide into two groups, and six species, as follows:

Sagittal ridge always strongly developed; occipital region of skull appearing higher; general colour grey; fur excessively thick; size at full development largest of subgenus. *R. vestitus* group. From Szechuan, Fokien, and North Burma. Includes *vestitus* (hindfoot 48–53), and the much smaller *davidi* (hindfoot 38–44).

Sagittal ridge weak, or maybe not developed in adult (i.e. the ridges may not fuse); occipital region appears lower; fur not or less excessively thick. *R. sinensis* group. *R. sinensis*, a little-known form from South China (hindfoot 46), has thicker fur than the remainder referred to the group, and is greyer in colour; the supraorbital ridges join. The remainder are browner in general coloration, and often the supraorbital ridges do not join; *R. senex* has the posterior nares well open, as in *Nyctocleptes* (hindfoot 44; Yunnan); *R. pruinosus* has the posterior nares narrow (normal) (hindfoot 46–50; Assam, Yunnan). These two species have moderate fur; in *R. pannosus* the fur is short and harsh, almost exactly like that of *Nyctocleptes* (hindfoot about 46; Perak, Siam).

Forms seen: *cinereus*, *davidi*, *insularis*, *latouchei*, *pannosus*, *pruinosus*, *senex*, *sinensis*, *sumatrensis*, *umbriceps*, *vestitus*, *wardi*.

List of Named Forms

(References and type localities for all Rhizomyidae are the work of Mr. R. W. Hayman.)

Subgenus *Rhizomys*, Gray

vestitus Group

1. RHIZOMYS DAVIDI, Thomas

1911. Abstr. Proc. Zool. Soc. London, 90, p. 5; Proc. Zool. Soc. London, 1911, p. 179.
Kuatun, N.-W. Fukien, S. China.

2. RHIZOMYS VESTITUS VESTITUS, Milne-Edwards

1871. Nouv. Arch. Mus. Nat. Hist., VII, Bull. p. 92.
Moupin, Szechuan.

3. RHIZOMYS VESTITUS WARDI, Thomas

1921. Journ. Bombay Nat. Hist. Soc. XXVII, p. 504.
Imaw Bum, Kachin Province, N. Burma.

sinensis Group

4. RHIZOMYS SINENSIS, Gray

1831. Proc. Zool. Soc. London, p. 95.
S. China.

5. RHIZOMYS SENEX, Thomas

1915. Ann. Mag. Nat. Hist. 8, XVI, p. 313.
Yunnan, S. China; probably neighbourhood of Mongtze.

6. RHIZOMYS PRUINOSUS PRUINOSUS, Blyth

1851. Journ. Asiat. Soc. Bengal, XX, p. 519.
Cherrapunji, Khasia Hills, Assam.

7. RHIZOMYS PRUINOSUS LATOUCHEI, Thomas

1915. Ann. Mag. Nat. Hist. 8, XVI, p. 59.
Quantung, S. China.

8. RHIZOMYS PANNOSUS PANNOSUS, Thomas

1915. Ann. Mag. Nat. Hist. 8, XVI, p. 60.
Chantabun, S. Siam.

9. RHIZOMYS PANNOSUS UMBRICEPS, Thomas

1916. Ann. Mag. Nat. Hist. 8, XVIII,, p. 445.
Perak, Malay Peninsula.

Subgenus *Nyctocleptes*, Temminck

10. RHIZOMYS SUMATRENSIS SUMATRENSIS, Raffles

1822. Cat. Zool. Coll. Sumatra, in Trans. Linn. Soc. London, XIII, p. 258.
Malacca.
Synonym: *javanicus*, Cuvier, 1829, Règne Animal, I, p. 211.
dekan, Temminck, 1835, Mon. Mamm. II, p. 44, pl. 33.

11. RHIZOMYS SUMATRENSIS PADANGENSIS, Brongersma

1936. Zool. Meded. Leiden, 19, p. 154.
Koto Gadang (Singgalang), Padang Highlands, W. Sumatra.

12. RHIZOMYS SUMATRENSIS INSULARIS, Thomas

1915. Ann. Mag. Nat. Hist. 8, XVI, p. 58.
Deli, Sumatra.

13. RHIZOMYS SUMATRENSIS CINEREUS, MacClelland

1842. Calcutta Journ. Nat. Hist. II, p. 456.
Tenasserim.
Synonym: *erythrogenys*, Anderson, 1877, Proc. Asiat. Soc. Bengal, p. 150. Salween Hill Tracts, Burma.

Genus 2. CANNOMYS, Thomas

1915. CANNOMYS, Thomas, Ann. Mag. Nat. Hist. ser. 8, vol. XVI, p. 57.

TYPE SPECIES.—*Rhizomys badius*, Hodgson.

RANGE.—Nepal, Burma, Siam.

NUMBER OF FORMS.—Six.

CHARACTERS.—Like *Rhizomys*, but incisors extremely pro-odont, and lengthened. Other cranial characters much as *Rhizomys*; supraorbital ridges evidently joining, normally. Infraorbital foramen sometimes extremely reduced; in some specimens it is slit-like, and about twice as wide as high.

Cheekteeth decreasing in size from M.1 backwards; M.2 smaller than M.1. M.1 often as *Rhizomys* in pattern, but the anterior island may wear out so that there are only two outer islands. M.2 with two isolated external islands, and one inner fold; M.3 as a rule with only two small isolated islands. The enamel islands as a rule more evident and the pattern more clear and definite than in *Rhizomys*.

Lower teeth: in adult there are usually two isolated islands on each tooth, though in young specimens a much more complex pattern is visible.

Size as a rule smaller than *Rhizomys*, usually not exceeding 250 mm. head and body (hindfoot about 29–36). Fur rather thick. Tail of moderate length, about twice or more length hindfoot, nearly naked. Digits more or less as in *Rhizomys*. Mammae 2—2 = 8 (Thomas).

Forms seen: *castaneus*, *badius*, *minor*, *plumbescens*, *pater*.

I do not think there is more than one valid species in this genus.

List of Named Forms

1. CANNOMYS BADIUS BADIUS, Hodgson

1842. Calcutta Journ. Nat. Hist. ii, pp. 60, 410.
Nepal.

2. CANNOMYS BADIUS PATER, Thomas

1915. Ann. Mag. Nat. Hist. 8, XVI, p. 315.
Mount Popa, dry zone of Burma.

3. CANNOMYS BADIUS CASTANEUS, Blyth

1843. Journ. Asiat. Soc. Bengal, XII, p. 1007.
(?) Arakan, Burma.

4. CANNOMYS BADIUS PLUMBESCENS, Thomas

1915. Ann. Mag. Nat. Hist. 8, XVI, p. 315.
Gokteik, N. Shan States, Burma.

5. CANNOMYS BADIUS MINOR, Gray

1842. Ann. Mag. Nat. Hist. X, p. 266.
S. Siam.

6. CANNOMYS BADIUS LÖNNBERGI, Gyldenstolpe

1916. Stockholm Vet. Ak. Handl. 57, no. 2, p. 47.
E. Siam.

The group is known fossil from the Pliocene, from Eastern Asia only.

RHIZOMYIDAE:
SPECIAL WORKS OF REFERENCE

Forsyth Major, on the Malagasy Rodent Genus *Brachyuromys*, Proc. Zool. Soc. London, p. 695, 1897. Rhizomyidae, *Spalax*, *Tachyoryctes* and Rodents from Madagascar fully compared.

All other genera of Rodentia are here regarded as belonging to the Family Muridae. A separate volume will be devoted to this family.[1]

[1] The first volume was completed for publication on January 27th, 1939. The second (and last) volume was completed for publication on June 30th, 1939.

Addendum to Subgenus *Tamiops*, Allen (p. 354 above).—

The forms of the subgenus *Tamiops* are reviewed by Osgood, Field. Mus. Nat. Hist. Zool. XVIII, pp. 286–97, 1932.

He arranges these in four species, as follows:

Callosciurus swinhoei swinhoei, Milne-Edwards, 1874
C. swinhoei clarkei.
C. swinhoei vestitus.
C. monticolus monticolus, Bonhote, 1900.
C. monticolus olivaceus.
C. monticolus spencei.
C. monticolus forresti.
C. monticolus russeolus, type locality Atentze, Tibet.
C. maritimus maritimus, Bonhote, 1900.
C. maritimus formosanus.
C. maritimus hainanus, with synonym *riudoni* (No. 12 of my list above).
C. maritimus laotum.
C. maritimus moi.
C. maclellandi maclellandi, Horsfield, 1839, with (?)synonym *manipurensis* (No. 2 of my list, above), "it stands directly between *maclellandi* and *barbei* and seasonal variations in both seem sufficient to cover its supposed characters."
C. maclellandi pembertoni, Blyth; listed above as a synonym of *m. maclellandi.*
C. maclellandi barbei.
C. maclellandi novemlineatus.
C. maclellandi liantis, with synonym *holti*, No. 23 of my list above, new name for *lylei*, Thomas, not of Bonhote.
C. maclellandi kongensis.
C. maclellandi rodolphei.
C. maclellandi dolphoides.
C. maclellandi inconstans.
C. m. sauteri, No. 11 of my list, is regarded as of doubtful status, based on characters which are likely to be seasonal.

References to all these forms will be found on pages 354 and 355, except *dolphoides*, which is on page 376.

Addendum to genus Callosciurus.

100a. CALLOSCIURUS FERRUGINEUS SPLENDENS, Gray
1861. Proc. Zool. Soc. London, p. 137.
S. Cambodia.
(omitted from p. 361 in error).

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