

RESULTS OF THE ARCHBOLD
EXPEDITIONS. NO. 56

ON THE ANATOMY AND CLASSIFICATION OF
THE DASYURIDAE (MARSUPIALIA)

G. H. H. TATE

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CONTENTS

| | |
|---|-----|
| INTRODUCTION | 102 |
| PART 1. ANATOMICAL AND PHYLOGENETIC NOTES ON THE DASYURIDAE | 103 |
| Dental Characters | 103 |
| Cranial Characters | 104 |
| External Characters | 107 |
| Criteria for Classification | 110 |
| The Hypothetically Primitive Dasyure | 112 |
| The Phylogeny of <i>Thylacinus</i> and the Dasyuridae | 112 |
| Geographical and Altitudinal Distribution | 115 |
| PART 2. TAXONOMIC TREATMENT OF SUBFAMILIES, GENERA, AND SPECIES | 116 |
| Subfamily Phascogalinae | 116 |
| <i>Murexia</i> Tate and Archbold | 116 |
| <i>Thylacinus</i> Temminck | 118 |
| <i>Sminthopsis</i> Thomas | 119 |
| <i>Antechinomys</i> Krefft | 125 |
| <i>Antechinus</i> Macleay | 126 |
| <i>Planigale</i> Troughton | 133 |
| <i>Phascogale</i> Temminck (restricted) | 135 |
| Subfamily Dasyurinae | 136 |
| <i>Neophascogale</i> Stein | 136 |
| <i>Parantechinus</i> , new genus | 137 |
| <i>Phascolosorex</i> Matschie | 137 |
| <i>Pseudantechinus</i> , new genus | 139 |
| <i>Myoictis</i> Gray | 139 |
| <i>Dasycercus</i> (Peters) | 141 |
| <i>Dasyuroides</i> Spencer | 142 |
| <i>Satanellus</i> Pocock | 142 |
| <i>Dasyurinus</i> Matschie | 143 |
| <i>Dasyurus</i> Geoffroy (restricted) | 144 |
| <i>Dasyurops</i> Matschie | 144 |
| <i>Sarcophilus</i> Geoffroy and Cuvier | 146 |
| BIBLIOGRAPHY | 146 |

INTRODUCTION

THIS REPORT is based primarily upon the large collection of dasyures from New Guinea now contained in the Archbold collection, also upon the Australian members of the family procured by H. C. Raven in 1921-1922 and by Miss Gabriele Neuhäuser in 1938.

I am indebted for the loan of comparative material to Dr. Remington Kellogg of the United States National Museum, Miss Barbara Lawrence of the Museum of Comparative Zoölogy, and Dr. Karl P. Schmidt of the Chicago Natural History Museum. My thanks are offered to Miss Lawrence for giving permission to describe *Myoictis melas wawicus*. Other new forms are *Antechinus mayeri misim* and *Antechinus wilhelmina*. It has been found necessary to define two new

genera, *Pseudantechinus* and *Parantechinus*. The collection of photographs of the skulls of type specimens that I was able to make in Europe in 1937 through the kindness of the curators of many European mammal collections has been of constant value to me in interpreting both my own notes and the published literature on the subject.

The present paper is divided into two parts. In the first part I have dealt with anatomical, evolutionary, phylogenetic, and distributional aspects of the family Dasyuridae. In the second part I have handled the purely taxonomic phase, together with records of material, notes on type specimens, and minor anatomical discussions.

PART 1. ANATOMICAL AND PHYLOGENETIC NOTES ON THE DASYURIDAE

THE BASIC PATTERN of the dasyurid dentition, as expressed in such relatively unspecialized genera as *Antechinus*, *Murexia*, and *Phascosorex*, is remarkably like that of *Didelphis*. The principal change found in the dasyures lies in the loss of an upper and a lower incisor, presumably the fourth, and the greater degree of simplification of the milk premolars. In *Didelphis*, these latter teeth are large and strongly molariform; in the dasyurids, on the contrary, they become both smaller and progressively less complex. The

molars in primitive dasyures are virtual counterparts of those of *Didelphis*.

I should like to offer the thought that *Murexia*, a comparatively newly discovered generic group native to New Guinea, unknown to Thomas (1888), Bensley (1903), Jones (1923), and other early workers on the marsupials, may be related to the ancestry of *Thylacinus*. *Thylacinus*, although divergent in many ways from the morphological pattern presented by *Murexia*, shows the same premolar gradient.

DENTAL CHARACTERS

INCISORS

In the Dasyuridae the upper incisors are of two kinds: a narrow, pointed, more or less proödont i^1 erupted late in the animals' developmental history; and blade-like, broadly pointed, cutting i^{2-4} erupted much earlier. The former tooth is usually set off by a space from i^2 . The first upper incisors are not only formed differently from the second, third, and fourth of the series; they are larger, function differently, and appear at a later stage in development. This fact of their late development was stated long ago by Thomas (1887a) for *Sarcophilus* and *Myoictis wallacei*.

Discussing a juvenal *Thylacinus*, Flower (1867) pointed out that the second and fourth incisors lay superficially to the first and third. In *Phalanger* (Tate, 1945, p. 24), i^2 was also shown to be the earliest developed of the incisors.

The distinguishing morphological characters of i^1 are suppressed in *Neophascogale*, *Sarcophilus*, and *Thylacinus*, and although they are plainly discernible in the northern genus *Satanellus* they can barely be recognized in *Dasyurus (sensu stricto)*. On the other hand, the very slow rate of eruption of i^1 is apparent in all these genera.

Contrary to the condition seen in many dasyurid genera, the upper and lower incisive toothrows in the insect-eating genus *Neophascogale* run almost parallel to the premolar rows, and the scarcely differentiated i^{1-1}

neither converge nor have strongly proödont lower incisors working between them. In *Phascosorex*, unlike *Neophascogale*, i^{1-1} are still well differentiated, but the incisive rows are more transverse. In occlusion the lower incisors set behind and inward from the upper set. In each of these two genera i^4 is a larger tooth than i^2 , though the lower incisors are still subequal in mass, even if shaped differently; and i_{2-3} , seen from above, are long triangular (table 7). In *Myoictis* substantially the same incisive picture as in *Phascosorex* is presented, but in *Dasyuroides* each of the innermost lower incisors has an elongated, raised cusp that works with the pointed cusp of i^{1-1} . *Satanellus*, the least modified of the "native cats," has the upper and lower incisors formed substantially as are those of *Dasyuroides*. In *Dasyurus (sensu stricto) quoll (=viverrinus)* differentiation of i^{1-1} is no longer conspicuous, although the incisive toothrows are strongly transverse. The climax of this change is reached in *Sarcophilus*. In that hyaena-like animal the incisive toothrows have become almost fully transverse, and i^{1-1} , although still delayed in eruption, are virtually undifferentiated. Throughout the series of genera just reviewed i^4 remain larger than i^2 .

In *Antechinus* and *Phascogale (sensu stricto)* i^2 are distinctly larger than i_{3-4}^2 . This condition, combined with other factors, is here interpreted to mean that these two dasyurid

genera have developed as a phyletic line distinct from the remaining genera (fig. 1).

PREMOLARS

Reduction in the size of the fourth premolars results from a latent trend present in more than one of the families of the marsupials. Onset of this condition is manifest in the lower jaw of all dasyures except *Murexia*, *Thylacinus*, and the *Sminthopsis rufigenis* group. Dominance of p_4^4 is seen also in macropodid genera such as *Dorcopsis* and *Hypsiprymnodon*, in which the crown of p_4^4 is either much elongated or much deepened. In many *Phalangeridae* p_4^4 are also dominant.

The assumption is here made that genera possessing large milk and permanent p_4^4 are primitive and that whenever the same teeth are reduced and simplified specialization has taken place. It is also assumed that a slight upward size gradient from p^1 through p^3 to p^4 is primitive, and that reduction of the size of p^4 to less than the size of p^3 is a specialization. The primitiveness of large size in p_4^4 is attested by analogy with the *Didelphidae*, the *Phalangeridae*, the *Peramelidae*, etc. Almost half of the genera of the *Dasyuridae* retain at least p_4^4 , and sometimes p_4 , as the dominant premolar. In the remainder those teeth are found in various stages of obsolescence, p_3^3 becoming the dominant premolars instead. In *Planigale*, while p_4^4 is larger than p_3^3 , p_4 is already reduced to a single-rooted peg. In both *Antechinus* and *Phascogale (sensu stricto)*, although the upper fourth premolar is still the largest of its series, the lower fourth premolar is already substantially smaller than p_3 .

In a few genera or sections of genera—*Myoictis*, *Sminthopsis crassicaudata*— p_1^1 may be secondarily enlarged so that they are virtually equal in size to p_3^3 .

MILK PREMOLARS

The milk premolars in *Murexia* (A.M.N.H. No. 101970) are well-formed, triple-rooted

organs and are retained behind the erupting p_3^3 until those teeth are at least halfway through. Flower (1867, pl. 30, fig. 6) showed in *Thylacinus* the unerupted p_4^4 directly above mp_4^4 . The milk teeth in *Thylacinus*, illustrated by him, agree with those of *Murexia* in being well-differentiated structures, although the number of roots cannot be determined. In *Sminthopsis rufigenis*, in which p_4^4 are considerably larger than p_3^3 , the lower milk tooth is still fairly large. The size of the corresponding upper tooth has not been determined for want of material. The milk teeth, much reduced in dimensions, may be seen in the upper jaw of *Antechinus melanurus* but have not been discovered in the lower jaw. In *A. flavipes* they have been found in the mandible but not yet in the upper jaw. Material with which to demonstrate these facts is very scarce.

In the milk premolars of typical *Antechinus*, as in *Murexia*, mp_4^4 is already a much smaller element than mp_4^4 . This advanced reduction of the lower milk tooth is shared by the lower permanent tooth (in *Murexia* p_4^4 are much larger than p_3^3 but mp_4^4 is very much smaller than mp_4^4). In true *Phascogale tapoatafa* and *P. calura*, reduction of permanent p_4 has progressed even further than in *Antechinus*. Thomas (1888, pl. 24) figured the two-rooted upper milk tooth of *P. penicillata* (= *tapoatafa*). I have seen no specimens with milk teeth.

In the most specialized members of the subfamily *Dasyurinae*, in which atrophy of the fourth permanent premolars has been attained in the upper jaw as well as in the lower, mp_4^4 can be found only in *Satanellus albomaculatus*. Woodward (1896, p. 285) demonstrated calcified, early deciduous mp_4^4 in "*Dasyurus*." In this group of genera, as in *Murexia* and *Sminthopsis*, i^4 is invariably the largest of i^{2-4} . Relative obsolescence, so far as known in the *Dasyuridae*, is shown (table 1) both for the permanent and the milk dentition.

CRANIAL CHARACTERS

Although the evolution of the dentition of the dasyures from a *Didelphis*-like origin appears relatively (perhaps deceptively) straightforward, the same cannot be said of

the skull. In the latter, because many characters seem to fluctuate between fairly wide limits, attribution of the phyletic significance may be open to grave doubt. Besides, most

of the more obvious distinctions are adaptive and so possess diminished phyletic values.

ROSTRUM

Lengthening of the rostrum, anterior palate, and lower jaw may cause spacing out of the premolars with little or no change in the size relationships of those teeth, as in *Neophascogale*, *Phascosorex*, and *Antechinomys*. Reduction in the size of p^4 has already begun in the two first named. A more advanced stage of reduction of the size of p^4 , in combination with corresponding shortening of the fore palate, is observable in *Dasyuroides*, *Dasyercus*, and *Myoictis*. This process culminates in *Dasyurus* with the total elimination of p^4 , after which p^3 gains contact with m^1 . At the same time as the rostrum and palate shorten, the whole skull becomes stronger and more massive, and the organism tends to shift from a chiefly insectivorous diet to a more carnivorous one.

In the lower jaw, in such cases, elongation or shortening of the premolar portion of the ramus takes place in unison with the lengthening or shortening of the rostrum. Reduction in the size of the fourth premolar is usually further advanced in the lower than in the upper jaw. In *Dasyurus*, p^4 are already obsolete; a peg-like tooth is all that remains in *Myoictis*. The remaining two premolars in these genera have become heavier. In *Neophascogale* and *Phascosorex*, in both of which the palate is elongate and reduction of the upper fourth premolar has barely commenced, reduction of the size of the corresponding lower tooth is well advanced. A diastema develops between p_1 and the canine in these genera.

POSTORBITAL CONSTRICTION AND PROCESS

A somewhat tubular braincase, accompanied by a pronounced postorbital constriction and slight postorbital bulges containing the olfactory portion of the brain, is present in adult *Murexia*. The extent of development of this character appears to be a function of age and of the size of the temporal muscles, modified slightly by sex. Adult or old males should therefore be used when making comparisons. Similar constriction of the mid-brain region, accompanied by an enlarged olfactory brain, recurs in *Thylacinus*. In that

animal the postorbital processes are even more strongly developed.

In *Sminthopsis* and *Antechinomys* the mid-brain is also somewhat constricted (much more so than in *Antechinus* and allies). Post-orbital processes are discernible only in *Sminthopsis rufigenis* and its allies.

Neophascogale, one of the seemingly primitive forerunners of *Dasyurus*, has neither postorbital processes, narrowed mid-brain region, nor unduly broadened fore-brain region. In *Phascosorex* and *Myoictis* post-orbital processes are incipient.

The several genera of marsupial cats, *Dasyurus* and its relatives, all have constricted mid-brain regions and broadened fore-brain regions with incipient or quite well-developed postorbital processes. *Dasyercus* shows substantially the same intertemporal conditions as *Dasyurus* and allies. In *Sarcophilus* those conditions reach optimum, the broadening of the olfactory fore-brain area increasing markedly and the post-orbital processes enclosing a substantial segment of the orbit.

In *Dasyuroides* the mid-brain and fore-brain regions, respectively, show neither intertemporal constriction nor development of postorbital processes. In these respects *Dasyuroides* resembles *Phascogale* (*sensu stricto*). *Antechinus* and *Planigale*, on the contrary, lack postorbital processes; moreover, these two genera have the mid-brain region exceptionally broad, instead of constricted. *Planigale* has diverged from *Antechinus* both by the extreme flattening of its skull and by the reduction of p_4 to a single-rooted organ.

HAMULAR PROCESS

In some old specimens of *Murexia* these bones are short, broad, truncate blades. In all other genera seen by me they are slender, hook-like processes. The skulls of *Dasyercus*, *Dasyuroides*, and *Thylacinus* that I have seen have invariably had the pterygoids broken.

PALATAL FORAMINA

The posterior fenestrae of the palate seem to be non-adaptive. The extent of their development varies in different genera or even between species of the same genus. The posterior palate is entire in *Satanellus* and *Dasyurus* (*sensu stricto*). It has a pair of

supplementary fenestrations placed behind the primary posterior openings in *Sminthopsis*, *Antechinomys*, *Dasyercus*, and *Dasyuroides*.

MASTOID, AUDITORY, AND OCCIPITAL REGIONS

The modifications found in the auditory area, consisting chiefly of varying degrees of inflation of the alisphenoid bulla, the petrosal, and the mastoid, are probably adaptive. In *Murexia* the basisphenoid and basioccipital regions form a broadly flattened expanse, the small, rounded bullae are widely separated, the mastoids wholly uninflated, the foramen magnum rather large, and the lambdoidal crests well developed. This condition is maintained essentially in *Thylacinus*, except that the basioccipital and mastoid widths are narrowed, bringing the bullae closer together, and the bullae themselves, bearing roughened processes, are proportionately even smaller. The foramen magnum is also relatively smaller in *Thylacinus*. The paroccipital processes in both genera, although well developed, are shorter than in most other dasyurids.

In *Sminthopsis*, widely varying degrees of inflation of the bullae, petrosals, and mastoids are seen. Much greater enlargement of these elements appears in *Antechinomys*. Varying degrees of enlargement show in *Antechinus*, in *Planigale*, and in *Phascogale* (*sensu stricto*).

Neophascogale, *Phascosorex*, and *Myoictis* have moderate-sized to small, rounded bullae and only slightly enlarged petrosals. Conversely, in *Dasyuroides* and *Dasyercus* the entire auditory region of the skull is very greatly inflated. Although the bullae of *Satanellus* and *Dasyurus* (*sensu stricto*) are moderately large and rounded, the petrosals and mastoids remain unenlarged; in *Dasyurops* the bullae are rather flat. *Sarcophilus*, following the pattern of *Dasyurus* (*sensu stricto*), has large, well-rounded bullae. All the foregoing genera differ from *Murexia* and *Thylacinus* by having much reduced paroccipital processes (slightly more developed in *Satanellus* and *Sarcophilus*).

NASAL AND PREMAXILLA

The nasals of the Dasyuridae, as in *Didelphis*, are normally well broadened at their proximal ends. They are comparatively unbroadened in the genera *Pseudantechinus*,

Sminthopsis, and *Antechinomys*, perhaps a non-adaptive but secondary condition.

Although the form of the rostral portion of the dasyurid premaxilla is conditional upon the length of the rostrum and palate, and to that extent is related to function, non-adaptive individuality often occurs in its relationship to the maxilla in various genera. The most usual form assumed by this part of the premaxilla is a narrow wedge that penetrates between the nasal and the maxilla. This condition is seen in the majority of the genera, but a tendency for the narrow wedge shape to become shortened and rounded, or even sharply truncate, is found in *Neophascogale*, *Dasyuroides*, and *Planigale*. In *Didelphis* the same process is extremely short, but this is not necessarily primitive.

LACRIMAL, JUGAL, AND ANTORBITAL CANAL

Exposure of a part of the lacrimal bone on the face outside the orbit is a characteristic of all marsupials. I have not observed that the proportion exposed varies very widely.

Normally the opening of the antorbital canal is contained wholly within the maxilla. In *Thylacinus* the opening of the short canal is placed so far back that its posterior margin becomes bounded by the jugal. This particular feature is seemingly unique.

SAGITTAL AND LAMBDOIDAL CRESTS

The sagittal crest developed in company with the temporal muscles, particularly in aging males, occurs as a rule in the more raptorial carnivorous genera but is usually absent in the more delicately built insectivorous genera. It is developed in *Murexia*, *Satanellus*, *Dasyurus*, and *Sminthopsis rufigenis* but not in the delicately formed *S. crassicaudata* and *Antechinomys*. It reaches optimum in *Thylacinus* and *Sarcophilus*. The lambdoidal crests become enlarged in unison with the sagittal crest, i.e., in genera with powerful neck muscles and strongly predaceous habits. Development of both crests is strongly adaptive.

MANDIBLE AND SYMPHYSIS

Most of the variable characters of the mandible are adaptive. They relate to the length and depth of the ramus, the form of the symphysis, the height of the articular

process, and the length and degree of inflection of the angular process.

The length of the mandibular ramus is correlated with the length of the muzzle. In skulls that have the anterior part of the palate elongate and the upper premolars spaced out, the premolar region of the ramus is correspondingly extended. Such conditions may accompany an insectivorous diet. *Murexia* furnishes an example.

The depth of the ramus is also likely to be purely a functional phenomenon. It may vary within a genus, as in *Sminthopsis*; it is pronounced in *S. rufigenis*, slight in *S. crassicaudata*. It appears to be correlated with the degree of development of the temporal muscles and consequently with the presence of the sagittal crest.

The symphysis varies both in regard to the length of the area of union and in the completeness of the fusion of the two rami. In long-jawed forms the symphysis is long and

may be weakly fused. The first condition is seen in *Antechinus swainsonii*, *Sminthopsis crassicaudata*, and *Dasyurus (sensu stricto)*. In those examples, the back of the symphysis is approximately level with p_3 ; in *Antechinus flavipes*, a species group with very short symphysis, it is only level with p_1 . The perfectly fused symphyseal condition is not found in the Dasyuridae. In *Sarcophilus*, which provides the nearest approach to it, fusion is fairly complete and the symphysis has become slightly arched, although its length is such that it only reaches the level of m_1 .

The degree of elevation of the articular process of the mandible is related to the degree of enlargement of the bulla and thus to auditory function. It is combined with increased length and slenderness of the angular process. Such elevation is well exemplified in *Antechinomys*, *Sminthopsis crassicaudata*, *Dasyuroides*, and *Dasyercus*.

EXTERNAL CHARACTERS

If the internal osteological features of the dasyurid skull are so greatly subject to influence by adaptation to habitus, how much greater plasticity can be expected of purely external structures. Almost all minor external characters must be regarded as adaptive and therefore without great significance as indicators of ancient phyletic history. The impact of relatively few kinds of environments on a number of old phyletic lines results in development of numerous cases of convergence of comparatively recent origin.

EXTERNAL EAR

I propose to discuss here only the size of the pinna in relation to habitus and habitat. An average-sized pinna may be considered as that which rises about as far above its junction with the crown of the head as the inferior portions of the superficial ear extend below that place. The ears of most Dasyuridae conform to this size. It is known that natatorial and fossorial mammals tend to have reduced external ears. None of the dasyures are swimmers, but a few may scratch out holes in the ground.

Enlargement of the pinna beyond the

"average" occurs in the predaceous, cursorial *Thylacinus*. As stated previously, this genus is distinctive for the fact that the audital bulla reaches minimum size for the family. In this case, enlargement of the ear conch may compensate for minuteness of the resonating chamber. A considerable degree of enlargement of the external ear occurs also in both species of the squirrel-like *Phascogale (sensu stricto)* and in the *crassicaudata* group of *Sminthopsis*, and much greater enlargement in the desert-dwelling, saltatorial *Antechinomys*. In both the last-named genera the audital parts of the skull are much inflated.

Reduction in the size of the pinna is seen in a few markedly terrestrial, perhaps partly fossorial groups. The ear conch has become exceptionally low in the tiny shrew-like *Planigale*. It is of only moderate size in the *Antechinus swainsonii* group and in *Neophascogale*. The bulla of neither one of these is specialized, although that of the latter, together with the petrosal, is slightly enlarged.

Dasyurus (sensu stricto) and *Dasyurops* are two closely related genera possessing moderate-sized ears. The first has the bulla

rounded and rather large, the second has it relatively inconspicuous and flat. All other things being equal, *Dasyurus* may be expected to be able to hear better than *Dasyurops*.

The pointed type of pinna seen in *Myrmecobius* is not duplicated in any dasyurid genus, although its analogue can be seen in *Lorentzimys* of the Muridae and in certain species of *Pteropus* among the Pteropodidae. It is perhaps a non-adaptive character.

FEET

The principal features requiring examination in the marsupial foot relate to the presence or absence of syndactyly; to striation in contrast to granulation of the pads; and to broadening of the foot, sometimes accompanied by elongation of claws, in contrast to narrowing of the foot, accompanied either by elongation or by obsolescence of digits or both. The normal, moderately broad dasyurid foot has striated pads. The narrowly elongated foot often has granular pads. The former may indicate scansorial, the latter terrestrial, habits.

The longest digit of the hand in the Dasyuridae is the third. This condition is found also in the Macropodidae and Peramelidae, but not in the Phalangeridae, where the fourth digit is dominant. In the Didelphidae of America the third and fourth digits are about equal, with the second digit but slightly smaller. From the didelphid hand either of the two could develop.

Syndactyly is not developed either in the Dasyuridae or in the American Didelphidae or Caenolestidae. The third and fourth digits of the dasyurid hind foot are neither reduced in size nor contained in a common web—the hall-marks of syndactylous marsupials.

Loss of digits is often associated with leaping, running, and fossorial habits. The hallux is reduced, and its claw is absent throughout the family. Atrophy of the first digit of the hind foot is found to be in an advanced stage throughout the family. Its total disappearance takes place at random in distantly related genera, seemingly in consonance with the development of cursorial or of hopping methods of locomotion: *Thylacinus*, *Antechinomys*, *Dasyuroides*, *Dasyurus* (*sensu stricto*), *Sarcophilus*.

One is prone to assume axiomatically that striated pads connote a primarily arboreal existence, and granulated pads a terrestrial life. Striated pads are prevalent in most dasyurid genera. They are otherwise seen almost solely in forest-dwelling placentals, such as tree shrews and primates, some other marsupials, and in rudimentary form in certain rodents, such as *Neotoma* (Whipple, 1904, p. 313). Whipple showed the relation of the "friction ridges" on hands, feet, and tail to prevention of slipping, particularly in arboreal mammals. On the basis of the intergeneric relationships indicated by other anatomical characters, it seems probable that lack of striations in living species in the orders named is an adaptive condition superimposed on ancestral lines that earlier had striated pads.

Almost half a century ago Dollo (1899) reached the conclusion that the ancestors of all marsupials were arboreal. He based his opinion upon various foot characters, including opposability of the hallux, syndactyly, and lengthening of the fourth toe; but he did not refer to the presence or absence of striae on the pads. Yet such striations are characteristic of many tree-living mammals—Primates and Tupaiaidae. In the Didelphidae, *Didelphis*, *Marmosa cinerea*, *M. noctivaga*, and *M. elegans* all have striated pads. In the totally arboreal family Phalangeridae, the pads of *Phalanger*, *Petaurus*, and *Pseudochairus* are striated. The burrowing Vombatidae, however, which perhaps are descended from the same ancestry as the Phalangeridae, have granular pads.

Most of the peramelid genera have wholly granular pads; yet the tiny mountain-dwelling genus *Microperoryctes* of New Guinea has the skin of the sole and pads soft and smooth and apparently quite without striae; and in the genus *Peroryctes*, subgenus *Ornoryctes*, tiny rounded striated or semi-striated areas, much like those of *Dasyurinus*, appear only on the hind feet among the coarse granulations. In the mainly terrestrial kangaroos, only the primitive *Hypsiprymnodon* and *Potorous* have striated pads, while the single arboreal genus, *Dendrolagus*, is without striae. *Dendrolagus*, however, appears to be arboreal in a secondary sense; it has reverted from terrestrial to arboreal life.

The pads of the two highly specialized families, the Myrmecobiidae and the Noto-ryctidae, both relatives of the Dasyuridae, are without striae. On the other hand, more than twice as many of the genera of true dasyurids have striae as lack them. Progressive diminution of the striated condition in dasyurid genera is shown (table 2) in contrast to the high degree of uniformity present in most other marsupial families.

Elongation of the claws has developed independently in three genera (*Neophascogale*, *Parantechinus*, and the *swainsonii* section of *Antechinus*). Both the front and the hind claws of *Neophascogale* are maintained unusually long, needle-sharp, and but slightly curved. The same applies to a slighter degree in *A. swainsonii* and to the very distinct *Parantechinus apicalis*. Probably all live in some type of environment where abrasive substances are virtually absent.

When dealing with broad-footed and narrow-footed Muridae (Tate, 1936, p. 544), I employed the percentage of the width of foot at the base of the fifth metatarsal to the length of foot, without claws. This percentage can also be used advantageously as an index of pedal function in the Dasyuridae. Extreme examples are found in the cases of the broad-footed terrestrial *Planigale novaeguineae*, 3.0:14.0, or 21.5 per cent, and the narrow-footed, leaping *Antechinomys laniger*, 3.0:30.0, or only 10 per cent. The same ratio in *Sminthopsis crassicaudata* is 14 per cent. The majority of the dasyurid genera have the same foot ratio near 20 per cent. In the scansorial genera *Phascogale (sensu stricto)* and *Myoictis* the corresponding figures are, respectively, 18 per cent and 20 per cent; in the striate-footed *Satanellus* of New Guinea, 20 per cent; in the granular-footed *Dasyurus quoll* of Tasmania, 25 per cent; in *Sarcophilus*, with granular feet, 22 per cent, and in *Thylacinus*, also with rough pads, 19 per cent (estimated).

Some sort of relationship may exist between body weight and breadth of foot in those genera that have cursorial habits and granular pads. Although the tiny *Sminthopsis crassicaudata* is narrow-footed and the heavier *Dasyurus*, *Sarcophilus*, and *Thylacinus* are relatively broad-footed, all have granular pads.

INGUINAL AREA

The structure of the pouch has been discussed by Pocock (1926). There is no likelihood that the scrotal pouch in *Thylacinus* (Pocock, 1926, fig. 40) is the homologue of the marsupium proper. In Pocock's figure (41, c) of *Didelphis azarae* a pouch-like glandular area is shown separate from, and in front of, the scrotum. Bolliger's work (1942) on experimental conversion of the scrotum in *Trichosurus* into a pouch-like structure presents evidence that development of such a secondary sexual structure may be controlled by hormones. It is also obvious that the marsupial scrotum is not the homologue of the placental scrotum.

In the family Didelphidae adult development of the pouch area is much more varied than is the case in the Dasyuridae. In *Didelphis*, *Metachirops*, and *Chironectes*, the pouch opens forward and is capacious and complete. In *Caluromys* and *Metachirus* it is represented by nothing more than slight lateral folds. In the *Marmosa cinerea*, *M. noctivaga*, and *M. murina* groups, it is obsolete, and the mammary region is confined to the abdomen. In the *Marmosa elegans* group and in *Monodelphis* the mammae are distributed in two rows beneath the body as far forward as the axillae, somewhat as in the case of *Sus* or *Canis*, and there likewise remains no trace of the pouch.

In the Dasyuridae the fact that the pouch, whenever present, opens backward instead of forward as in the Didelphidae, Phalangeridae, and Macropodidae, is perhaps not a distinction of very great importance. The pouch develops in young animals by a sinking of the skin through a gap in the cutaneous musculature (Bolliger, 1942). In the Didelphidae the cutaneous abdominal muscles posterior to the sunken area become highly functional to form the transverse lip of the complete pouch; while in the Dasyuridae, on the contrary, the anterior muscles perform that office, though less perfectly.

Incompleteness of the pouch may appear at first sight to signify primitiveness. On the other hand, it may indicate a retrogressive trend and thus can be viewed as a comparatively new development. Possibly those South American didelphids in which the

mammary area extends from the level of the fore limb to that of the pubic region are in that respect truly primitive. Bresslau (1920) believed that the pouched genera were the more advanced.

As shown by Pocock (1926, fig. 43) the pouches of some genera become conspicuous only during the period when young are attached to the nipples. In such cases (*Satanellus*, *Dasyurinus*, *Dasyurus* [sensu stricto] *quoll* = *viverrinus*, *Sminthopsis*) the superficial musculature seems wholly to encircle the rim of the pouch and to act as a sphincter ring. Before the mammary area becomes stimulated this muscular ring remains inactive within the cutaneous wall, leaving the area exposed on the ventral surface of the body. In other genera (*Thylacinus*, *Dasyurops*, *Antechinus* [part], *Phascosorex*, *Myoictis*, *Neophascogale*, *Antechinomys*) the muscular ring of the functioning pouch remains incomplete at the back, its fibers perhaps confluent with the circumanal musculature.

The arrangement of the nipples in the Dasyuridae differs from that of *Marmosa*, *Monodelphis*, and other didelphids by lack of an unpaired median nipple. The dasyurid nipples are arranged in two, three, or four, rarely five, pairs (table 3). Bresslau's table (1920, p. 45) indicates the degree of development of the pouch and the nipple count for several genera, specimens of which are not available to me.

Variation of the number of nipples in a given species may be due to one or more remaining functionless, as in some *Marmosa* (Tate, 1933, p. 34).

The two pairs of nipples in *Murexia* are large, exposed organs. The single pair of *Sminthopsis stalkerii* are partly retractable within the milk-secreting tissue, as are the two pairs of large nipples in *Antechinus melanurus* (A.M.N.H. No. 152739, alcoholic). Pocock shows (1926, fig. 44, E) in *A. flavipes* a total of eight nipples, four grouped on an udder-like structure on each side near the rear of the pouch, an arrangement that I have been unable to find in our material. Unlike those in *A. melanurus*, the nipples of *A. godmani*, comprising three pairs distributed along the pouch area, appear large and non-retractile. The nipples of *A. swainsonii*, even when it is nursing young, are small and very slender.

The paucity of information concerning the form of the pouch and the number and arrangement of the nipples in such genera as *Neophascogale* and the alteration in the size and shape of the pouch in accordance with the reproductive condition of the animal prevents our reaching sweeping conclusions. It is safe to say that these organs in the Dasyuridae appear to be highly plastic, highly adaptive, and consequently not of great significance in working out major phylogenetic trends in the family.

CRITERIA FOR CLASSIFICATION

As frequently happens, a review of the sum total of all the characters of all species of Dasyuridae leads to apparent confusion and conflict of evidence. Recent convergences must be distinguished from old, persistent homologies. One is faced with the perennial question whether environments act to induce mutations more effectively in external than in internal characters. For example, do environments act more readily upon the length of the claws or of the tarsus than upon the characters of the premolars, upon the structure of the tail than upon the degree of fenestration of the palate? Are internal characters less plastic than external ones?

We are prone to conclude that linkage of morphological modification with observable

function implies a more rapid rate of change than do quantitative alterations of structure that are seemingly valueless. This may be quite untrue. It is also difficult to imagine that significant difference in survival value for primitive phascogales can depend upon which one of the subequal p^3 and p^4 becomes dominant and which becomes subordinate. Such a choice of evolutionary courses, apparently originally of a random nature, nevertheless seems to have taken place. In *Murexia*, *Thylacinus*, *Sminthopsis*, and *Antechinomys*, p_4^4 are the largest premolars. In *Myoictis*, *Dasyrcus*, *Neophascogale*, *Dasyurus*, and *Sarcophilus*, the largest premolars are p_3^3 . Characters of this nature, which seem to indicate ancient dichotomy, are the ones I have

sought as guides in classification. On the contrary, I have held that those often very pronounced features that are strongly linked with modern function are less valuable as indicators of old evolutionary trends. Unfortunately, such old dichotomous characters are few and difficult to detect. It is doubtless theoretically possible that all modifications originated in company with functional significances now no longer detectable, and that later, owing to environmental shift, the functional elements fell into disuse, leaving their morphological team-mates still in course of development. Although many specializations have had functional significance, this is not invariably so in nature; too many peculiarities having no conceivable significance can be observed among living things. Even when we theoretically correlate a structure with a function of value to one organism, we are often confounded by discovering that a related species or genus succeeds equally well in life without either the structure or its supposed value.

Because many external characters pertaining to the pelage, to locomotion, and to food getting are adaptive, morphological similarities in those cases may be the result of convergences rather than indicators of real relationships, and so can be employed in phylogeny only with discretion. Some at least of the internal characters of animals also come under the same category and must likewise be used guardedly. Others, especially those that have originated in a seemingly causeless and random way, may well point to actual phyletic history. Among those last seem to belong such characters as the size relationships of the individual teeth of a given dental group (incisors, premolars, molars) to one another, or of the individual bones of the skull and skeleton to one another. But constant watch must be kept for functional significances. For instance, diastemata in the dasyurid premolar toothrow are probably of secondary functional significance. They appear in the adult with lengthening of the forepalate and the rostrum, and this in turn seems to go with insect-killing rather than vertebrate-killing habits. Many vertebrate killers, on the contrary, have short muzzles and palates, accompanying short, crowded, massive tooththrows and atrophy of certain dental elements.

In the same way, the incisive series presents minor features apparently unrelated to function. In most dasyurid genera the first upper incisors are set off from the rest as a nipping apparatus not very dissimilar functionally to the anterior cusps of the front incisors of *Sorex*. The second, third, and fourth upper incisors, essentially alike, appear to function together as a unit. Minor variations in any one of these three teeth may be of phyletic significance. In some genera (*Antechinus*) a gradient of increasing size is seen from i^2 to i^4 . In most others (*Sminthopsis*) it is reversed. Only in the genus *Phascogale* (*sensu stricto*), in which the tooth i^2 has become exceptionally heavy and now shares the nipping function of i^1 , is the state seen in *Antechinus* further modified.

Because i^2 becomes larger than i^4 in one branch of the Phascogalinae but remains smaller than i^4 in all other major divisions of the dasyurid family, the assumption is made that the latter condition represents the primitive one. The progressive diminution of p_4^4 from teeth much larger than p_3^3 to ultimate obsolescence likewise has led to the hypothesis that the large size in p_4^4 is primitive. Large p_4^4 are retained only in three widely diverse genera, while both a vestigial stage and complete absence are commonplace.

Combinations of these supposedly phyletic characters have resulted in definitions and limitations of the two dasyurid subfamilies somewhat at variance with the standard concept. Genera that show some degree of reduction of p_4^4 to a size less than that of p_3^3 , combined with i^2 smaller than i^4 , are now included with the subfamily Dasyurinae. This arrangement makes the Papuan genera *Neophascogale*, *Phascolosorex*, and *Myoictis* primitive members of that subfamily. It also serves to include the new genera *Pseudantechinus* and *Parantechinus*, formerly treated as *Antechinus*, in the same subfamily.

Only *Antechinus* and the nearly related (?) *Planigale*, and *Phascogale* (*sensu stricto*) remain typical of the original subfamily Phascogalinae. In those genera, although reduction of p_4^4 has commenced, enlargement of i^2 is a new feature, incipient in *Antechinus* and culminating in *Phascogale*. To these two genera are added *Thylacinus*, *Murexia*, *Sminthopsis*, and *Antechinomys* (tables 5, 6),

in which p^4 is as large as, or larger than, p^3 , even though i^{2-4} lack the special condition of *Antechinus* and *Phascogale* (*sensu stricto*).

Thylacinus, formerly the only genus in its subfamily, is now placed near *Murexia* of New Guinea on the evidence of certain homologies in the dentition and the skull. The ad-

dition to that pair of genera of *Sminthopsis* and the extremely specialized *Antechinomys* rests as yet upon evidence furnished mainly by the incisors and premolars. It also rests upon a lack of features allying either with the *Dasyurinae* or even very closely with the *Phascogalinae* (*sensu stricto*).

THE HYPOTHETICALLY PRIMITIVE DASYURE

Study of the genera shown in the phylogenetic diagram (fig. 1) suggests that the primitive dasyure from which the living members of the family originated must have had approximately the following characters: Size about equal to that of a small rat; skull long faced, with slight postorbital eminences, slightly constricted mid-brain area, and unreduced hind-brain area; bullae small, more or less hemispherical; periotic little inflated; paroccipital processes free from inflated area; pterygoids falcate; palate with short anterior foramina and small or perhaps no posterior openings; i^1 specialized, late in erupting, and set off from i^{2-4} by a diastema; i^4 larger than i^2 ; $p^{1,3,4}$ each successively larger than the pre-

ceding tooth, with simple subtriangular cusps; mp^4 molariform, not extremely small; m^{1-3} with complete primary tritubercular set of cusps and styles; m^4 reduced to accommodate its terminal position in the toothrow; i_{1-3} semi-recumbent, with i_1 the largest of the three; p_4 slightly smaller than p_3 . The pads were striated; the number of toes not reduced; the third anterior digit was slightly dominant; syndactyly did not occur; the tail, about as long as the head and body, was not capable of incrassation. The pouch was probably complete and opened posteriorly; the number of nipples ranged from eight to 10 (perhaps 12).

THE PHYLOGENY OF *THYLACINUS* AND THE DASYURIDAE

Bensley (1903) was so much impressed by the many special adaptive characters of *Thylacinus* that he separated it from all other *Dasyuridae* as the subfamily *Thylacinae*. This practice was followed by others, including Iredale and Troughton (1934). Pocock (1926) had expressed doubt concerning such an extreme point of view. The discovery during recent years of *Murexia* now leads me also to question Bensley's ideas.

It appears to me likely that *Murexia* and *Thylacinus*, *Sminthopsis* and *Antechinomys*, *Antechinus* and *Phascogale* (*sensu stricto*) are the survivors of three very old lines, all of which are referable to a single subfamily, the *Phascogalinae*.

Retention of unreduced p^4 in the first two groups and the only very slight degree of reduction of the corresponding milk premolars, which I assumed to be phyletic characters, serve to distinguish this entire group from the *Dasyurinae* in which both the milk and the permanent p^4 have either undergone con-

siderable degeneration or are already obsolete.

Of the six genera just listed, *Murexia* is believed to be the least specialized. Next to this comes the unprogressive species group *Sminthopsis rufigenis* and, distinguished chiefly by their reversed incisive gradients (i^2 larger than i^4), *Antechinus flavipes* and its closest allies. Very ancient forms relatively similar to these three modern lines (fig. 1) are held to have given rise (1) to *Thylacinus*, (2) to the more highly specialized species of *Sminthopsis* and to *Antechinomys*, and (3) to the divergent genera *Planigale* and *Phascogale* (*sensu stricto*).

The paucity of phyletic characters indicating the common origin of those three primary genera, and the numerous characters showing both recent and ancient adaptive changes suggest the great age of this perhaps once numerous and diversified group of marsupials.

Externally the evidence for primitiveness is chiefly negative. It comprises: a scampering type of locomotion; unreduced digital for-

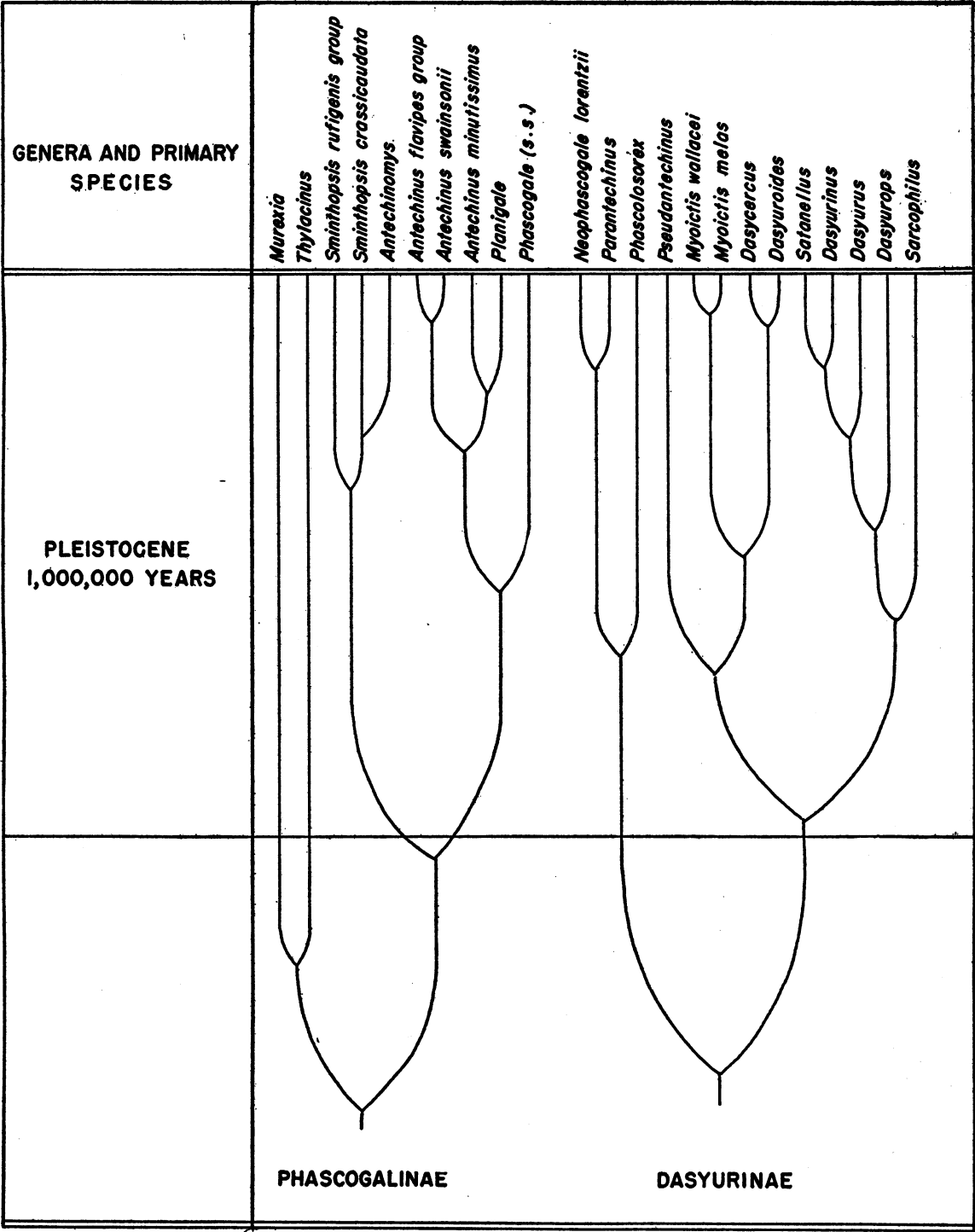


FIG. 1. Hypothetical phylogenetic tree of the Dasyuridae. In any dichotomous pair of branches, the more specialized forms have been placed to the right.

mulae; unmodified claws; pads with primitive striations; an unmodified tail. All the positive characters, including modifications of the ear pinna, of the pouch and mammae, of the quality and the color of the pelage, characters of the feet other than those mentioned above, have probably a recent and usually an adaptive significance.

Although *Thylacinus* is now far removed from my concept of its primitive ancestor, the small, generalized *Murexia*, p_4^4 in both are relatively very large, and the mid-brain region of the skull is narrow. In both, too, the hind brain region of the skull is both narrowed and shortened, and the audital region is reduced, especially in *Thylacinus*.

In the other two lines mentioned, *Sminthopsis-Antechnomys* and *Antechinus-Planigale-Phascogale*, I have regarded narrowing of the base of the nasals in the case of the former and reversal of the incisive gradient in the case of the latter as old characters that probably lacked original adaptive values, and I have employed them to distinguish the same two lines from one another and from the supposedly distinct *Murexia-Thylacinus* line.

As regards the *Sminthopsis* group of genera, it appears possible that *Antechnomys* is the result of a series of rapid evolutionary steps from a form like *S. crassicaudata*, which had already become separated from the *S. rufigenis* group with its tubular braincase, heavy skull, and striated foot pads.

Several minor groups are contained within the *Antechinus* group, including *Planigale* and *Phascogale* (*sensu stricto*), a strongly divergent offshoot. They show, either incipiently (*Antechinus*) or markedly (*Phascogale*), a reversal of the incisive gradient prevailing in the family when taken as a whole. Instead of the size of the lateral upper incisors ascending from i^2 to i^4 , the anterior incisor is slightly larger and the posterior one smaller. The gradient of the upper premolars is as in other Phascogalinae, p^1 less than p^3 and p^3 less than p^4 ; not as in the Dasyurinae, where p^1 is smaller than p^3 which is larger than p^4 —the last premolar in the dasyures being often rudimentary or obsolete. In general the interorbital region in the *Antechinus* group is broad (narrow in more typical Phascogalinae); the postorbital processes are absent (present in *Murexia*, *Thylacinus*, and most

Dasyurinae); the size of the audital bullae is small to medium (never much enlarged), and their form is hemispherical; the pads are usually striate (except some *Planigale*).

The Dasyurinae, those dasyurid genera in which the trend of p_4^4 toward obsolescence is either initiated or complete (fig. 1), include the rather weakly specialized genera *Neophascogale*, *Phascosorex*, and *Myoictis* in New Guinea. The Australian members of the subfamily are much more diversified, and most have p_4^4 markedly reduced or obsolete.

Parantechinus of Western Australia is in many respects very like *Neophascogale* and may be related to it, even though its premolars are much more reduced. *Pseudantechinus*, also with p_4^4 minute, has developed flattening of the skull analogous to that found in *Planigale*. *Dasycercus* and *Dasyuroides*, notable for extreme enlargement of the bullae, are otherwise not incompatible with *Myoictis*, even though obsolescence of p_4^4 in them is more advanced. Evolution of the whole *Dasyurus* and *Sarcophilus* complex from some form more or less like *Myoictis* (except the pattern of the pelage) is also by no means an impossible concept. *Satanellus*, a member of that complex, is held to be the most primitive, because of its differentiated i^1 and retained mp_4^4 ; *Sarcophilus* the most specialized. The places of *Dasyurinus*, *Dasyurus*, and *Dasyurops* are largely determined by the modifications exhibited in their feet.

It must be fully understood that the basic ancestral forms of the Phascogalinae and the Dasyurinae must have been remarkably similar. The points of differentiation between them were ill defined. In general, the Phascogalinae tended to maintain p_4^4 as the dominant element in the premolar series (an exception is seen in p_4 of *Planigale*); and in general the Dasyurinae tended to reduce p_4^4 and shift its dominance to p_3^3 .

It has been suggested to me recently that the one-million-year span of time covered by the Pleistocene was amply long enough for the evolution of the entire dasyurid family. That may be so. But such a rate of evolution was extremely rapid compared with certain bats of the genera *Rhinolophus* and *Hipposideros*, already fully developed in the middle Eocene of France. This last may represent a minimum rate of evolution for mammals.

There was opportunity for the dasyurid marsupials of Australia to spend much more

time than a million years on their development.

GEOGRAPHICAL AND ALTITUDINAL DISTRIBUTION

One or more members of the Dasyuridae occur between sea level and, where sufficient altitude exists, 11,000 feet in virtually every part of New Guinea and Australia. I have plotted (table 4) the distributional patterns of the primary species groups—20 Phascogalinae and 17 Dasyurinae. Twenty-five per cent of the former and 35 per cent of the latter occur in New Guinea. Of those that are found in New Guinea, 60 per cent of the Phascogalinae and 100 per cent of the Dasyurinae are indigenous. With the exception of the very widely dispersed *Antechinus flavipes* group (Phascogalinae), only dasyurine genera (three) are mountain dwellers. The majority of the dasyurine genera in New Guinea are of generalized type, and their frequent presence high in the mountains suggests that New Guinea may have served as a place of development for a considerable part of the dasyurine complex. On the contrary, the Australian Dasyurinae for the most part have produced numerous and varied adaptations and do not include forms peculiar to mountains. The greater part of the evolution of the Phascogalinae seems to have taken place in continental Australia, even though the unspecialized *Antechinus flavipes* group is distributed virtually throughout eastern and southern Australia and most of New Guinea.

The geographical divergence of *Murexia* and *Thylacinus*, which I have suggested may

be distant relatives, is compatible with their morphological differences. The presence of *Murexia* in New Guinea and Aru only may not indicate that it originated there.

Several characteristic faunal groups are revealed in table 4. The mountains of New Guinea are the only habitat of *Neophascogale* and *Phascolosorex*. Torresia appears to be the geographical center of *Planigale* and the *Sminthopsis rufigenis* group. Extending from west to east, south of Torresia, but not crossing the Strait are: *Sminthopsis macroura* and *S. larapinta*, *Planigale ingrami*, and *Satanelus hallucatus*. The dry center of Australia has cradled *Antechinomys*, *Pseudantechinus*, *Dasyercus*, *Dasyuroides*, and various groups of *Sminthopsis*. Southern Australia with its eucalypt woods is the home of several groups of *Antechinus*, of *Thylacinus* (even though it now survives only in Tasmania), of various genera related to *Dasyurus* (*sensu stricto*), and of that specialized genus *Sarcophilus* (also in Tasmania only). Western Australia contains the autochthonous groups *Sminthopsis granulipes*, *S. crassicaudata*, and *Parantechinus apicalis*. Finally, several groups very widely distributed, except in the arid center and Torresia, include the *Sminthopsis murina* group and *Phascogale tapoatafa* (*P. calura*, also found in the south of the continent from east to west, is not found in the northern parts of Western Australia).

PART 2. TAXONOMIC TREATMENT OF SUBFAMILIES, GENERA, AND SPECIES

AS SHOWN EARLIER, the Phascogalinae are reunited in this paper with the Thylacininae. *Thylacinus* is associated with the recent *Murexia* of New Guinea and Aru. The suggested phylogeny of the Dasyuridae is shown in a "tree" (fig. 1).

SUBFAMILY PHASCOGALINAE

Two main branches of this subfamily are here recognized: one branch, forking dichotomously far down at its base, gives rise, respectively, to *Murexia* and *Thylacinus*; a second branch, from which arise various generic associations, includes *Sminthopsis*, *Antechinus*, *Planigale*, and *Phascogale*.

The incisive and premolar gradients of the Phascogalinae, based on the crown lengths of those teeth, are shown separately—those of *Sminthopsis*, *Antechinomys*, *Murexia*, and *Thylacinus* in table 5, and those of *Antechinus*, *Planigale*, and *Phascogale* in table 6. The measurements in both tables should be compared with the dental dimensions of the Dasyurinae (table 7).

As shown earlier in this paper (table 1), the progressive or often total obsolescence in both the milk and permanent fourth premolars in the Dasyurinae, in contrast to that in the Phascogalinae, is strikingly apparent.

MUREXIA TATE AND ARCHBOLD

Murexia TATE AND ARCHBOLD, 1937, Bull. Amer. Mus. Nat. Hist., vol. 73, pp. 335 (footnote), 339.

TYPE: *Phascogale murex* Thomas = *longicaudata* Schlegel.

The following forms are also now referred to *Murexia*: *aspera* from the Utakwa River, *maxima* from Japen Island, *longicaudata* from Aru, and *rothschildi* from the headwaters of the Aroa River, Papua.

The Archbold collection contains the only extensive museum series of these animals known, most of them from the low-lying valley of the upper Idenburg River near Bernhardt Camp, 220 feet.

Distinctive cranial characteristics of old adult males include the elongate muzzle, the deep zygoma, low tubular mid-braincase,

postorbital swellings, narrow mastoid width, very small bullae, rectangular pterygoids (in old adults), and p_4^4 very tall and large and well separated by spaces from p_3^3 . The same characters are often imperfectly developed in younger males and in females.

Besides the elongation of the muzzle, the differentiation between the interorbital width and the least intertemporal width of the skull is emphasized in aged specimens. The mid-brain region in them becomes more narrowly tubular than in younger animals.

Actually there are but two full species of *Murexia*, the plain-colored *longicaudata* and the recently described black-striped *rothschildi*. The only difference of importance between *longicaudata*, *murex*, *aspera*, and *maxima*, after age and sex characters have been discounted, is the one of size. The smallest of the races is still represented by the unique type of *longicaudata* from Aru, in which the crown dimensions of m^1 are only 2.6 by 1.8 mm. The largest race is *maxima*, from Japen Island and Idenburg Valley, with the crown of m^1 reaching a maximum size of 3.7 by 2.7 mm.

Specimens from the Astrolabe Range behind Port Moresby collected in 1937 are somewhat smaller than *maxima*, with the greatest measurement of m^1 , 3.4 by 2.3 mm., although these dimensions overlap those of some of the Idenburg River specimens.

The still unique type of *murex* from the Huon Peninsula, although larger than *longicaudata*, is smaller than any other mainland race. The race *aspera*, based upon a young female from the Utakwa River, 2500 feet, is probably the same as the few specimens that Shaw Mayer collected in the Gebroeders Range at 5000 feet. Their dimensions are approximately equal to those of the Astrolabe Range series. Our single skin without skull from Mount Mabion, headwaters of the Fly River, is referable to *aspera*.

There may well exist racial continuity in *Murexia* from end to end of the southern slope of the Central Range of New Guinea, but the animals are still so rare that this hypothesis remains to be demonstrated. All

we know of such continuity is comprised of *aspera* (type only), our single specimen from Mount Mabion, the few individuals that I collected in the Astrolabe Range, and Thomas' earlier record (1897, p. 61) of a specimen of "*longicaudata*" from the same general area collected by Loria north of Port Moresby.

Murexia is suggested elsewhere in this paper as possibly the little-altered descendant of the early Tertiary marsupial that evolved also into *Thylacinus*.

Murexia longicaudata (Schlegel)

To this single species I now refer the several known forms of *Murexia* that lack the black dorsal stripe of *M. rothschildi*. Other characters separating *longicaudata* from *rothschildi* will be found under the remarks on the latter.

All *Murexia longicaudata* are colored dull grayish brown above, buffy white beneath. The tails are long and rat-like, with a few longer hairs at the tip.

Murexia longicaudata longicaudata (Schlegel)

Phascogale longicaudata SCHLEGEL, 1866, Nederlandsch Tijdschr. Dierk., Amsterdam, vol. 3, p. 356. SCHLEGEL, 1872, De Dierentuin, p. 162. THOMAS, 1888, Catalogue of . . . Marsupialia and Monotremata in the . . . British Museum, p. 293, (described skull).

TYPE: Leiden Museum, Spec. a, from Wonoumbai, Aru Island, collected by Rosenberg in 1865 (a mounted skin and skull). This animal, which I have reexamined, is a young adult male. Perhaps partly owing to the "make" of the skin, the tail appears disproportionately long. The fact that it is an unusually small-sized race of *Murexia* is attested by the small dimensions of the individual molars of the type in comparison with those of any of our mainland specimens. The back of the braincase is broken away and lost. The rostrum is somewhat narrowed and elongated. The nasals are but little widened at the base. The bullae, broken, are not measurable. The zygomata do not flare abruptly but are widest near the back. The mandible is strongly arched, and its ascending ramus is steep in front.

The proödont first upper incisor is sepa-

rated from the nearly equal i^{2-4} (i slightly larger than i^2) by a space; p^4 is much larger than p^1 or p^3 ; p^3 slightly larger than p^1 . In the lower jaw p_3 is larger than p_1 or p_4 , and the last is only slightly larger than p_1 . The lower incisors are crowded, normally three on each side; an anomalous (fourth) incisive tooth, possibly a milk tooth (?), appears on the left side.

The color of the skin, normal for the entire group except the striped *M. rothschildi*, is grayish brown above; buffy, with the hair bases gray, beneath.

I give some detailed measurements of the specimen, made by me in Leiden: head and body (dry), 145 mm.; tail (dry), 170; foot (s.u., dry), 26.5; zygomatic width, 21.0; least intertemporal width, 7.3; breadth of braincase, 14.6; length of nasals, 14.6; greatest breadth of nasals, 4.9; palatal length, 21.1; length of anterior palatal foramina, 4.1; width of mesopterygoid fossa, 3.9; width inside m^{1-1} , 4.9; length, m^{1-3} , 7.3; crown of m^1 , 2.6 by 1.8; m^2 , 2.5 by 2.3; m^3 , 2.2 by 2.7; m^4 , 1.8 by 2.5.

Murexia longicaudata murex (Thomas)

Phascogale murex THOMAS, 1913, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 80.

The type, B.M. No. 12.2.4.1, from Sattelberg, Huon Peninsula, collected by Fritsche, which Thomas believed an "adult male," is in my opinion a rather young animal. As in the type of *longicaudata* of Aru, the back of the skull is missing. The dorsal profile of the skull is very low and flat. There are slight diastemata in front of and behind p^3 . The hind claws measure 3 mm.

The dimensions of the teeth of the type are: m^{1-3} , 8.0 mm.; crown of m^1 , 2.9 by 2.0; m^2 , 2.75 by 2.4; m^3 , 2.5 by 2.6; m^4 , 2.0 by 2.6; length m_{1-3} , 7.7.

A very large male (unnumbered) in the Berlin Museum came from Ortzengebirg (forest), Netherlands New Guinea, collected in 1903 by Hoffman. Apparently the skull of this animal is Berlin Museum, No. A 60,08. It is not certain whether this individual is assignable to *murex* or to *maxima*.

Murexia longicaudata aspera (Thomas)

Phascogale murex aspera THOMAS, 1913, Ann. Mag. Nat. Hist., ser. 8, vol. 12, p. 211.

Phascogale maxima STEIN, 1932, Zeitschr. f. Säugetierk., vol. 7, p. 254.

TYPE LOCALITIES: *Aspera*, Utakwa River, south side of Orange-Nassau Range; *maxima*, Japen Island, Geelvink Bay.

The collection of a considerable series of this large-sized race from the valley of the Idenburg River by the Third Archbold Expedition illustrates development from youth to age in this rare genus, in western New Guinea. The Archbold collection, comprising in all 10 specimens from one station 220 feet above sea level, contains three very large old adult males closely similar to Stein's single male from Japen. The three represent an extreme of growth and age. The collection also contains three somewhat younger but sexually adult males and several fully adult reproducing females, in all of which, although the teeth are fully erupted, no very appreciable degree of spacing out of the premolars has yet begun; there are also some very young specimens. The morphological range of the smaller-sized group readily includes not only Thomas' type of *aspera* but also a series collected by Shaw Mayer at Mount Derimapa in the Gebroeders Range, east of Geelvink Bay. In this entire series two things are especially apparent: the teeth are actually very much larger and heavier (less so in females) than those of *murex* of the Huon Peninsula, and the males are capable of growing to a very large size, in which process some of the considerable changes in the skull come about that in part have led me to suggest remote relationship to *Thylacinus*.

There is as yet no evidence to show that the local strain of *Murexia longicaudata* found in the Astrolabe Mountains near Port Moresby also produces such very large males, although that evidence may later be uncovered. Meanwhile, at this stage of our knowledge, I can scarcely suggest subspecific separation of our Astrolabe series and our Idenburg series, although slightly smaller dimensions can be noted almost throughout the former.

Murexia rothschildi (Tate)

Phascogale (Murexia) rothschildi TATE, 1938, Novitates Zool., vol. 41, p. 58.

TYPE: Tring Museum, Field No. 1, male,

from the head of the Aroa River, collected by A. S. Meek, May 28, 1905. On the same day Meek collected a second male, A.M.N.H. No. 108106. The altitude is not known but is probably ± 4000 feet.

No new specimens representing this interesting species have come to light. From *longicaudata* and its various races, *rothschildi* can be distinguished by its broad, black, longitudinal dorsal stripe, by the light brown color of the ventral pelage; and in the skull, by the short rostrum and the rather sharply truncated bases of the nasals; also by the difference in the steepness of the gradient in the crown lengths of the lower incisors. Thus in *rothschildi*, i_1 , 0.9 mm., is larger than i_2 , 0.8, which is larger than i_3 , 0.7; i_1 in *longicaudata aspera*, 1.1, is larger than i_2 , 0.9, which is smaller than i_3 , 1.2. The much smaller size of i_3 in *rothschildi* is emphasized.

THYLACINUS TEMMINCK

Thylacinus TEMMINCK, 1824, 1827, Monographies de mammalogie, vol. 1, pp. xxiii, 23, 60, 267.

TYPE: *Didelphis cynocephala* Harris.

This genus is unique respecting the relationships of the antorbital canal, and the well-known specialization of the molars by obsolescence of the styles or outer line of cusps of the upper molars and the inner cusps of the lower molars. Another adaptive character appears in the identity of form of i^1 to i^{2-4} and absence of a diastema, instead of the usually pointed form of i^1 and the usual diastema setting it off from i^{2-4} .

The progressive reduction in size of the molars in *Thylacinus* from back to front is also presumably an adaptive character analogous to that of the canids; it is not found in *Murexia* or among the marsupial cats.

I wish especially to point to those features in which *Thylacinus* most nearly agrees with *Murexia* and tends to differ from other dasyurid genera. These include the essentially tubular character of the braincase; the extreme degree of reduction of the alisphenoid bullae and of the mastoid width; the great degree of telescoping of the hind-brain (the nearness of the paroccipitals to the bullae and of the mastoid processes to the glenoid processes), which scarcely seems to represent an adaptive condition and is incipient in

Murexia; the large size of the fourth premolars, both upper and lower, in proportion to p_1^1 and p_3^3 ; and the fact that i^4 is larger than i^2 . In the lower jaw of both *Thylacinus* and *Murexia longicaudata*, i_3 is larger than i_1 , whereas in *Antechinus flavipes* i_1 is larger than i_3 .

Not one of the few skulls of *Thylacinus* before me has the pterygoids unbroken. It will be interesting to discover whether the pterygoids are truly falcate, as in most dasyures, or rectangular, as in old specimens of *Murexia longicaudata*.

Thylacinus cynocephalus (Harris)

Didelphis cynocephala HARRIS, 1808, Trans. Linnean Soc., London, vol. 9, p. 174.

TYPE: Probably not in existence.

For use in the present study I have had one skin in rather poor condition and three skulls, A.M.N.H. Nos. 35866, 77701, and 144316, all from Tasmania.

SMINTHOPSIS THOMAS

Podabrus GOULD, 1845, The mammals of Australia, pt. 1 (letterpress to pl. 47, vol. 1). Homonym of *Podabrus* Westwood, 1840.

Sminthopsis THOMAS, 1888, Catalogue of . . . Marsupialia and Monotremata in the . . . British Museum, p. 298.

TYPE: *Podabrus crassicaudatus* Gould.

Gould placed two forms, *macrurus* from Darling Downs, south Queensland, and *crassicaudatus* from Williams River, Western Australia, in his genus *Podabrus*, subsequently shown to be preoccupied by a genus of insects.

Thomas' (1887b, 1888) definition of *Sminthopsis*, the name that he proposed to replace *Podabrus*, if strictly adhered to would exclude many species that are referred to it today. He admitted only the four species, *crassicaudata*, *murina*, *leucopus*, and *virginiae*, and designated *crassicaudata* the type. Since that time several other very distinct species and a number of races have tended further to broaden the generic concept.

Important key characters of *Sminthopsis*, set forth by Thomas, that should still be adhered to include the large size of p^4 in relation to the anterior premolars and to the molars; the relatively large size of mp^4 ; the

increase in size backward of the lateral upper incisors, i^{2-4} , the slight degree of lateral expansion of the back of the nasals; the comparatively narrow interorbital and intertemporal widths (compare with *Antechinus*); the presence of a pair of supplementary palatal openings between m^{4-4} lying behind the primary posterior palatal openings. Not all these characters are exclusive, nor can all be regarded as wholly non-adaptive.

The mainly adaptive characters used by Thomas further to delimit *Sminthopsis* are no longer applicable throughout that genus. They include caudal incrustation (not in *S. rufigenis*); granulation of the pads (some species have striated pads); mammae, 8 to 10 (in some species only 6; in one, only 2); bullae small, not swollen (some have them enlarged, e.g., *S. hirtipes*); weak postorbital processes and relatively high, massive skulls with well-formed low sagittal crests (in the *rufigenis* division only); marked reduction in size of the two anterior premolars in some groups, but not in the typical species.

The range of *Sminthopsis* now includes southern New Guinea and the Aru Islands, as well as Australia and Tasmania.

Two primary types of *Sminthopsis* can be distinguished: those species in which the pads have retained their primitive (?) striated pattern, which may be known collectively as the *rufigenis* division; and those in which the pads have lost their striae and become granulated, the *crassicaudata* division. This latter condition may be accompanied variously by partial coalescence of individual pads, by narrowing of the foot, by caudal incrustation, and by enlargement of the ears and bullae.

In the *rufigenis* division p^4 is very large and p^1 (and sometimes p^3) considerably reduced; but in the *crassicaudata* division such extreme enlargement of p^4 does not appear, even though, in special cases (*crassicaudata* proper), p^1 is secondarily sufficiently larger than usual to be virtually equal to p^3 . The status of mp^4 in *Sminthopsis* is touched upon under *S. crassicaudata*.

THE *rufigenis* DIVISION

The slightly specialized *rufigenis* division comprises animals with the feet moderately broad and strong, the pads striated, the ears

not enlarged, the skull strongly built and the bullae small, the teeth strong and relatively large, and p^4 much larger than either p^3 or p^1 . It is divisible into two sections.

The *Sminthopsis rufigenis* section is distinguished from the *S. murina* section by a distinctive dark median face stripe and the reddish color of the cheeks and sides of the head. The number of nipples is six in the *rufigenis* section; from six to 10 in the *murina* section.

Sminthopsis rufigenis Thomas

Sminthopsis rufigenis THOMAS, 1922, Ann. Mag. Nat. Hist., ser. 9, vol. 9, p. 265; 1922, Nova Guinea, vol. 13, p. 739.

Phascogale rona TATE AND ARCHBOLD, 1936, Amer. Mus. Novitates, no. 823, p. 2.

TYPE: B.M. No. 22.2.2.76, adult female, from Aru (*rufigenis*), obtained from Buitenzorg Museum, Java; A.M.N.H. No. 104005, adult female, from Rona Falls, Laloki River, Astrolabe Range, Papua (*rona*), collectors, Archbold and Rand.

I have seen both type specimens. In addition, I have available for study the more than 60 specimens from south New Guinea recorded earlier (Tate and Archbold, 1941).

Sminthopsis lumholtzi Iredale and Troughton

Phascogale virginiae COLLETT, 1887 (1886), Proc. Zool. Soc. London, p. 548; 1887, Zool. Jahrb., Jena, vol. 2, p. 866.

Sminthopsis lumholtzi IREDALE AND TROUGHTON, 1934, Mem. Australian Mus., Sydney, no. 6, p. 11 (renamed).

TYPE: Probably in Christiania Museum. Specimen, adult male, collected by Lumholtz. A cast of skull in British Museum (no number).

Pending observations of the actual type of this species, I suggest that it may be the Australian racial representative of the south Papuan *rufigenis*.

Collett first gave the length of the hind foot at 33 mm. (Proc. Zool. Soc. London), later as 23 mm. (Zool. Jahrb.). The latter is correct.

Sminthopsis (?) *virginiae* (Tarragon)

Phascogale virginiae TARRAGON, 1847, Rev. Zool., p. 177.

TYPE: Lost.

The brief description of this seemingly undeterminable form suggests *rufigenis*. Unless the type is discovered and its skull can be described, it should be discarded as undeterminable. Should such a discovery be made, both *rufigenis* and *lumholtzi* may become subordinate to *virginiae*.

Sminthopsis longicaudata Spencer

Sminthopsis longicaudata SPENCER, 1909, Proc. Roy. Soc. Victoria, new ser., vol. 21, p. 449.

TYPE: From Western Australia, collected by J. Kearland. (Not seen.)

Spencer's unique specimen, from an unknown locality, apparently represents a special, long-tailed development of the division of *Sminthopsis* having striated pads. As its describer pointed out, the tail is proportionally even longer than that of *Antechinomys*. There is no corresponding lengthening of the foot (18 mm.).

The *Sminthopsis murina* section of the *Sminthopsis rufigenis* division is distinguished at sight from the *rufigenis* section by lack of the narrow median facial stripe and of the strongly russet hairs on the sides of the face and head (except possibly in *ferruginifrons*). Apart from the presence of a race of *murina* in Queensland, the two groups seem to be well separated geographically. When the unknown factors in the *rufigenis* section have been cleared up, the present *rufigenis* and *murina* sections may be determined to be merely two full species. The nipple count in *rufigenis* is six. Krefft (1866) gives eight for *fuliginosa*; 10 for *albipes*.

Sminthopsis murina (Waterhouse)

Sminthopsis murina murina (Waterhouse)

Phascogale murina WATERHOUSE, 1838, Proc. Zool. Soc. London, p. 76.

TYPE: B.M. No. 55.12.24.95, young male, from Hunter's River, northern New South Wales.

Krefft (1866) believed *albipes* and *murina* to be alike. The general similarity of the skulls indicates that they are geographical representatives of the one species.

Two specimens, A.M.N.H. No. 65696, female, and M.C.Z. No. 29313, male, respectively from Atherton Tableland and Lake

Barrine, 2300 feet, central Queensland, are provisionally taken to represent the typical race, although they may be members of a northern race. In default of topotypes this point cannot now be determined. The specimens are brownish gray dorsally, much browner than our *S. m. leucopus*, and the pelage is short. The underparts have creamy hair tips and gray bases. The tail is gray above, buffy beneath. The hands and feet are white, much paler than those of our *leucopus*. The feet measure 20 and 21 mm. with the claws. The pouch region of the female is chestnut brown. There appear to be six nipples.

The Lake Barrine specimen alone has a skull. There is a weak sagittal crest. The bullae are moderately large (width, 3.2 mm.; width apart, 3.4 mm.). The two anterior premolars, subequal, have the length of the crowns ± 1.1 mm.; the crown length of the much larger p^4 , 1.3 mm. The length of m^{1-3} is 4.8 mm.

***Sminthopsis murina ferruginifrons* (Gould)**

Antechinus ferruginifrons GOULD, 1854, The mammals of Australia, vol. 1, pt. 6, p. 36.

TYPE: Two cotypes, B.M. Nos. 54.11.19.-3, 54.11.19.4, adult and young adult, males, marked only "New South Wales" (Troughton gives Sydney), collected by Pamplin.

This is the only race of *murina* that could conceivably be confused with *rufigenis*, the northern species of this division, and that only because of the slightly reddish coloration about the head. We have no specimens.

***Sminthopsis murina albipes* (Waterhouse)**

Phascogale albipes WATERHOUSE, 1842, Proc. Zool. Soc. London, p. 48. Waterhouse (1842) reported Port Adelaide as the locality.

TYPE: B.M. No. 1080C, a skull only (skin lost), marked "specimen g." Thomas (1888) listed it from "South" Australia. Iredale and Troughton (1934) suggested Port Adelaide and Port Lincoln as localities.

Krefft (1866) reported *albipes* from the plains of the Murray River, and recorded 10 mammae.

***Sminthopsis murina leucopus* (Gray)**

Phascogale leucopus GRAY, 1842, Ann. Mag. Nat. Hist., vol. 10, p. 261.

TYPE: B.M. No. 41.1812 (skin), 43.5.31.5 (skull), young adult male, from Tasmania, collected by Leadbeater. The type skull, in fragments, is glued to a tablet. Many of its teeth are missing.

Harry C. Raven obtained a skin and skull (the skull unfortunately lost) of this form from Arthur River Mill, Tasmania. The dorsal color is smoky brown, the hands and feet buffy white, the underparts light gray caused by blending of the dark gray bases and white tips of the hairs. The tail is dark above and below. The foot length (with claws) is 20 mm.

***Sminthopsis murina fuliginosa* (Gould)**

Antechinus fuliginosa GOULD, 1852, The mammals of Australia, vol. 1, pt. 4, pl. 41.

TYPE: B.M. No. 44.2.15.20, young adult male, from River Avon, King George's Sound, Western Australia, collected by Gilbert.

I have also seen M.C.Z. No. 218464, adult female, from Albany, King George's Sound (a virtual topotype), and M.C.Z. No. 218463, adult male, from Kojonup, a few miles to the north of Albany.

Compared with the Tasmanian *leucopus*, this race has, in general, whiter underparts; the ventral hairs, although also gray at their bases, have much longer white tips.

The range shown by Shortridge (1909) scarcely reaches as far north as Geraldton but extends eastward all along the south coast of Australia.

THE *crassicaudata* DIVISION

Of the *Sminthopsis crassicaudata* division, it is at once apparent that the longest-known species, true *crassicaudata*, is considerably more specialized than either *S. macrura* or *S. granulipes*. The most generalized of the species of *Sminthopsis* having granular pads is *S. macrura*. In this species the bullae have not yet become enlarged, the tail is not shortened, the feet are not especially narrowed.

Although lack of specimens of certain species prevents arrival at fully satisfactory conclusions, the following forms are held to be adaptively specialized in various ways that distinguish them from *macrura*: *lara-*

pinta, *stalkerii*, and *nitela* are distinguished by marked enlargement of the bullae; true *crassicaudata*, by its short tail, enlarged bullae and ears, and relatively enlarged p^{1-1} ; *hirtipes*, by greatly enlarged bullae and peculiarities of the pads. These forms are thus all variously discordant with *macrura*. In addition, *psammophila* is exceptionally large. The four remaining forms, *Sminthopsis granulipes*, *froggatti*, *centralis*, and *constricta*, of which we have no specimens and little data, must also be considered and ultimately placed. The few comparisons that can be made between *macrura*, *centralis*, *constricta*, and *froggatti* suggest that all four are close relatives. *Sminthopsis granulipes*, because of peculiarities of i^{1-1} and its exceptionally broad foot (see Troughton's illustration), is probably a distinct species. The status of *S. psammophila* remains vague. Pending a formal revision of *Sminthopsis*, I propose the following arrangement of the *crassicaudata* division, arranged from relatively less specialized to relatively more specialized species:

1. *macrura*
 constricta = *centralis*
 froggatti
 psammophila
2. *granulipes*
3. *larapinta*
 stalkerii
 nitela
4. *crassicaudata* (*sensu stricto*)
5. *hirtipes*

***Sminthopsis macrura* (Gould)**

***Sminthopsis macrura macrura* (Gould)**

Podabrus macrurus GOULD, 1845, Proc. Zool. Soc. London, p. 79.

TYPE: From Darling Downs, south Queensland, possibly in the Liverpool Museum (not seen). Two topotypes, B.M. Nos. 46.4.4.62 and 87.5.4.1, were examined by me.

A single fully adult male, A.M.N.H. No. 108934, from Malbon, west of Townsville, central Queensland, collected by Gabriele Neuhäuser in June is contained in the Archbold collection. The tail is very slightly swollen at the base. The skull, though its rostrum is pointed, is shorter and proportionately broader across the zygomata than is the case of *S. murina*, which also is found in that general region.

The tail in this northeastern race is considerably longer than in the two southern races—65 mm. in a British Museum topotype, about 80 mm. in our specimens from Malbon.

***Sminthopsis macrura constricta* Spencer**

Sminthopsis murina var. *constricta* SPENCER, 1896, Report on . . . the Horn scientific expedition to central Australia, Zoology, vol. 2, p. 33.

TYPE: From Oodnadatta, central Australia (not seen).

The facts that the pads of this form were stated to be unstriated and the tail distinctly incrassated serve to remove it from the *murina* section where Spencer placed it. The tail is longer than the head and body, the ears are of only moderate length, the foot is broad (therefore unlike true *crassicaudata*).

Sminthopsis constricta may equal *centralis*, the race next commented upon.

***Sminthopsis macrura centralis* Thomas**

Sminthopsis crassicaudata centralis THOMAS, 1902, Ann. Mag. Nat. Hist., ser. 7, vol. 10, p. 492.

TYPE: B.M. No. 2.9.8.7, adult male, from Killalpenina, east of Lake Eyre, South Australia, collected by H. J. Hillier, 1902.

I have seen only the type of this *Sminthopsis*. The length of the tail of the type specimen, 63 mm., lies between that of *crassicaudata* of south Western Australia and that of *macrura* of Queensland. Finlayson (1933), reporting upon a large series that he referred to *centralis*, indicated a considerably greater average body size than that of Thomas' type.

***Sminthopsis macrura froggatti* (Ramsay)**

Antechinus (Podabrus) froggatti RAMSAY, 1887, Proc. Linnean Soc. New South Wales, ser. 2, vol. 2, p. 552.

TYPE: In the Sydney Museum, female, from King Sound, near Derby, north Western Australia, collected by W. W. Froggatt (not seen by me).

Besides Ramsay's original description of the skin, Troughton (1932) has published a description of the type skull. These two descriptions in my opinion conform specifically to *S. macrura*. Ramsay's words "forehead and a narrow triangular stripe to the nose pencilled with black like the back," and "Manus and pes much more delicate [than

those of *crassicaudatus*],” added to Troughton’s “Tail much longer and more tapered than in *crassicaudata*, the definite incrassation being near the root” suggest no other species group. The granular character of the pads and the smaller ear further support this view. In fact, *S. froggatti* and *macrura* seem to be either synonymous or conspecific. Both are distinct from the shorter-tailed *crassicaudata*. In such case the name *macrura* takes precedence.

An example from Margaret River, inland from King Sound, M.C.Z. No. 21946, if indeed equal to *froggatti*, demonstrates conclusively the closeness of this species to *macrura* of Queensland. Its pads are granular, the bullae and ears are small, the tail is unshortened and unswollen, and the feet are un-narrowed. The distance m^{1-3} is 4.6 mm.; the crown lengths of p^1 , p^3 , and p^4 are, respectively, 0.95 mm., 1.05, and 1.15.

***Sminthopsis macrura psammophila* Spencer**

Sminthopsis psammophilus SPENCER, 1895, Proc. Roy. Soc. Victoria, new ser., vol. 7, p. 223.

TYPE: From Lake Amadeus, central Australia (not seen).

This is clearly a very much larger species than either *crassicaudata* or *murina*; the hind foot measures 25 mm. The pads are unstriated and granular; the ears rather large. The tail is longer than the combined length of head and body. This form is apparently known only by the type.

***Sminthopsis granulipes* Troughton**

Sminthopsis granulipes TROUGHTON, 1932, Rec. Australian Mus., vol. 18, p. 350.

TYPE: Sydney Mus. No. 669, adult female, from King George’s Sound, south Western Australia.

This species, although its pads are granular, has the feet considerably broader than those of *crassicaudata*. It comes from the same type locality as *fuliginosa*, a race of *murina*, which has striated pads.

A specimen, U.S.N.M. No. 218646, without skull, from Albany, marked “*murina fuliginosa*,” seems to be a topotype. Its pads are wholly granular.

***Sminthopsis larapinta* Spencer**

***Sminthopsis larapinta larapinta* Spencer**

Sminthopsis larapinta SPENCER, 1896, Report on . . . the Horn scientific expedition to central Australia, Zoology, vol. 2, p. 33; 1896, Proc. Roy. Soc. Victoria, new ser., vol. 8, p. 8.

TYPE: From Charlotte Waters, central Australia (not seen by me).

Finlayson (1933) has questioned the distinctness of *S. larapinta* from *S. crassicaudata centralis* Thomas. If the two were synonymous, they would in all likelihood have to be placed nearer to *froggatti* and *macrura* than to the short-tailed true *S. crassicaudata*, on account of the relatively great length of the tail.

Following the lead of Thomas, it has been a common practice for some time to place *S. nitela* Collett, from the Daly River, only 60 miles from the north coast of Australia, in the synonymy of *larapinta*. I suggest that the status of these two forms should be re-examined by those who may acquire topotypical series of both.

***Sminthopsis larapinta stalkerii* Thomas**

Sminthopsis stalkerii THOMAS, 1906, Proc. Zool. Soc. London, p. 543.

TYPE: B.M. No. 6.3.9.91, adult male from southwest of Alroy, 200 miles southwest of the Gulf of Carpenteria, Northern Territory, 800 feet, collected by Stalker.

Thomas compared *stalkerii* throughout with “*larapinta*.” Because he had earlier placed *nitela* Collett in the synonymy of *larapinta* Spencer, one cannot be sure to which of the two he later alluded, although it was almost certainly to *nitela*, the type of which he had in London.

A facial line is present in this form. Other characters include “low granulated cushions . . . three minute non-lineated pads . . . the center of the foot hairy to beyond the tip of the hallux. . . Tail incrassated at base. Bullae much smaller than in *S. hirtipes*.” The bullae are about equal to those of *nitela*.

A.M.N.H. No. 153413, a female in alcohol, the skull cleaned, collected at Dickaree, Birdville area, southwest Queensland, some 200 miles northeast of Lake Eyre, agrees in all

essential features with the type of *stalker*. Birdsville is not very remote from Alroy and the habitat in both places seems to be similar. The tail is strongly incrassated and pedunculate; the pads are wholly granular and without hairs; the ears are large; the bullae are small; anterior palatal foramina are short; p^4 is considerably larger than p^3 . The canine is short, premolariform, and has a posterior talon.

Measurements (some unpublished) of the type of *stalker* and of this specimen (the second in parentheses) are compared: head and body, 70 mm. (75); tail, 65 (68); hind foot, 15 (15); greatest length of skull, 23.3 (24); zygomatic breadth, 13 (13.1); interorbital breadth, 3.9 (4.2); breadth of braincase, 9.6 (9.9); mastoid breadth, 9 (9.5); nasals, 8.0 by 2.0 (9.0 by 2.3); palatal length, 11.2 (12.5); anterior palatal foramina, 2.3 (2.4); length of bulla, 3.4 (3.3); m^{1-3} , 4.7 (4.8); m_{1-3} , 4.4 (4.5); crown of m^1 , 1.6 by 1.3 (1.7 by 1.2).

This specimen is peculiar in that only a single pair of symmetrically placed nipples appears in the pouch.

Sminthopsis larapinta nitela Collett

Sminthopsis nitela COLLETT, 1897, Proc. Zool. Soc. London, p. 334.

TYPE: B.M. No. 97.4.12.6, young adult female (body in alcohol), from Daly River, Northern Territory, collected by Dahl.

The median facial stripe, "front and cheeks rufous orange," long canines, very large p^{4-4} are all reminiscent of *S. rufigenis*, but the "smooth (not striated)" pads are not in agreement. Unfortunately, my notes on the type specimen do not cover this last point. My photograph of the skull of the type is extremely like those of our many specimens of *rufigenis*, with the exception of the bulla, which is slightly larger (3.4:3.0 mm.).

Sminthopsis crassicaudata (Gould)

Podabrus crassicaudatus GOULD, 1844, Proc. Zool. Soc. London, p. 105.

TYPE: B.M. Nos. 44.7.9.10 (skin), 44.10.15.4 (skull), from Williams River, south Western Australia, from the Gould collection.

Besides the type, I have seen three specimens from Tambellup (M.C.Z. Nos. 34722,

34723, and 34724), one from Bridgetown (M.C.Z. No. 35181), both localities within a score or so of miles of the type locality; and four from Mulewa, east of Geraldton, latitude 29° S., some distance farther to the north (M.C.Z. Nos. 27943-27945, and 29807).

In true *crassicaudata* the tail is much shorter than in the Queensland *Sminthopsis macrura* (treated in this paper as a species), 40 to 60 mm. compared to 65 to 80 mm.

I have accepted the series of four specimens taken by P. J. Darlington at Mulewa as referable to true *crassicaudata*. Only one, M.C.Z. No. 27944, is adult; in the others the large, double-pointed mp^4 are still retained and m^4 are not quite in place. In all four specimens, p^1 is scarcely smaller than p^3 (compare with *S. rufigenis*); in the three juvenal specimens the somewhat molariform mp^4 is but slightly smaller than p^3 , while p^4 of the single adult is just a little larger than p^3 . Lower mp^4 is equally distinctive but smaller. Thus the premolar size gradient in *crassicaudata* is seen to be very slight. In all four specimens the unusually long anterior palatal foramina extend back level with the hind margin of p^1 .

The persistence of the large-sized mp^4 in *S. crassicaudata* almost to maturity is in marked contrast to the condition of that tooth in *S. rufigenis*. In the latter, mp^4 is shed very early in life, while its permanent successor develops correspondingly early. In quite immature individuals of *rufigenis*, p^4 is seen to be already partly erupted. The stage of development and relative size of mp^4 may furnish important evidence of the interrelationships of other species of *Sminthopsis* when sufficient material for that study can be assembled.

Sminthopsis hirtipes Thomas

Sminthopsis hirtipes THOMAS, 1898, Novitates Zool., vol. 5, p. 3.

TYPE: B.M. No. 97.12.17.1, adult male, from Station Point, Charlotte Waters, central Australia, purchased from Gerrard (body in alcohol).

A medium-sized species with specialized palms and soles, the metatarsal pads more or less united and hairy, and the ears and bullae very large (but the periotics only slightly inflated). The fourth upper premolar is exceptionally large; p^1 is considerably smaller

than p^3 . The tail is longer than the combined head and body.

Glauert (1934) records *hirtipes* from near the Warburton Range, some 500 miles west of its type locality.

With the possible exception of *S. psammophila*, of which almost nothing is known, I am inclined to consider the present species as the most specialized in the genus.

ANTECHINOMYS KREFFT

Antechinomys KREFFT, 1867, Proc. Zool. Soc. London, for 1866, p. 434.

TYPE: *Phascogale lanigera* Gould.

This genus, which shows numerous adaptations connected with its peculiar leaping habits and arid habitat, seems to be derived from the same ancestry as *Sminthopsis*, and from that section of *Sminthopsis* to which *S. crassicaudata* belongs.

Phyletic characters present also in *S. crassicaudata* include unbroadened nasals; long, slender, anterior palatal foramina; large primary posterior palatal foramina with a secondary pair behind them; anterior part of palate and rostrum narrow and elongate; bullae and periotics enlarged (less in *A. laniger*); foot very narrow; pads of hands and feet wholly granular.

From this basic habitus *Antechinomys* has developed a further range of peculiarities that include secondary alteration of the canine to the shape of a premolar; extremely procumbent lower incisors, coupled with its elongate and very completely fused mandibular symphysis; elongation of the ears (already rather large in *S. crassicaudata*); elongation and tufting of the tail, with probable suppression of the tendency towards incrassation found in *crassicaudata*; unusual development of the external carpal vibrissae (present in unenlarged form in many other genera); great elongation of the hind limb, joined with total obsolescence of the hallux, to form a leaping organ; and tendency for the pads of the sole to fuse into a single eminence and to be densely haired.

The degree of enlargement of the bulla is much greater in the deserticolous species *spenceri* than in the Victorian species *lanigera*. The angular process of the mandible is elongated in each species to a degree cor-

responding with the degree of enlargement of the bulla.

Antechinomys laniger (Gould)

Phascogale lanigera GOULD, 1856, The mammals of Australia, vol. 1, pt. 8, pl. 33.

TYPE: B.M. No. 47.8.14.22 (skin) and B.M. No. 47.12.4.5 (skull), an old adult male, collected by Sir T. Mitchell on the plains between the Murray and Darling rivers in New South Wales. The type skull has the back of the braincase missing.

The rostrum is pointed and short, the lacrimals are enlarged, the bullae are large and rounded, extending 3.5 mm. below the glenoid fossa, the periotics are much inflated, and the palate has supplementary posterior openings. Teeth: $p^{1,3,4}$ form an increasing size gradient; the lower canine tends to form part of the procumbent lower incisive series.

The skin is gray; the bases of the hairs are darker, the subterminal rings buff, and the tips of many hairs black. The underparts are dull whitish, with the hair bases gray. The terminal 40 mm. of the tail is clothed with a black pencil of hairs.

The range is given by Iredale and Troughton as northwest Victoria to southwest Queensland. I here record an adult male in the Tring collection collected by A. S. Meek at Cedar Bay, north Queensland.

Antechinomys spenceri Thomas

Antechinomys spenceri THOMAS, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 331.

TYPE: B.M. No. 97.11.3.12, adult female, collected at Charlotte Waters, central Australia, by Baldwin.

This is a somewhat larger species than *laniger*. In it most of the generic peculiarities are intensified. The ears and audital bullae are much larger, the tail is more heavily tufted, the muzzle is more slender.

The Department of Mammals of this Museum is fortunate to have one of Spencer's original specimens, A.M.N.H. No. 15012, received with a few other marsupials from the Horn Expedition about 1899. Several more recently collected specimens preserved in alcohol are kept in the Department of Comparative Anatomy.

ANTECHINUS MACLEAY

Antechinus MACLEAY, 1841, Ann. Mag. Nat. Hist., vol. 8, p. 242.

Phascogale (sic) (part) THOMAS, 1888, Catalogue of . . . Marsupialia and Monotremata in the . . . British Museum, p. 273.

TYPE: *Antechinus stuartii* Macleay = *Phascogale flavipes* Waterhouse.

All species of *Antechinus* are broad-footed; all have striated pads. In no species of the genus, as herein limited, does incrassation of the tail occur. All have i^2 larger than i^3 and i^4 , and all have p^4 slightly larger than p^3 , but in the lower jaw p_4 is considerably smaller than p_3 . The interorbital and intertemporal region is relatively broad in comparison with *Sminthopsis*.

Antechinus has evolved parallel in many respects to the genus *Sminthopsis*, but it has developed no offshoot with wholly granular and sometimes hairy pads corresponding to *S. crassicaudata*. It can be distinguished from *Sminthopsis* by the fact that i^2 is larger than i^3 , the size gradient in those incisors being reversed in the latter; by the greater breadth of the interorbital region and the total absence of postorbital processes (present in some *Sminthopsis*); by the much wider basal portions of the nasals, and by the lack of accessory openings behind the posterior palatal foramina. With one exception, *bellus*, the bullae in *Antechinus* never become greatly enlarged (the former species *mimulus*, *apicalis*, and *macdonnellensis*, all having large bullae, have now been placed in the Dasyurinae). The long-clawed, long-snouted *Antechinus swainsonii* and *minimus* form a very distinct group of *Antechinus*. *Antechinus bellus* and *A. maculatus* are distinct. Otherwise all remaining forms, whether found in Australia or in New Guinea, are very closely related to *A. flavipes*.

Viewed synoptically, the principal species groups of *Antechinus* are:

1. The *A. flavipes* group, comprising large to medium-sized species in which the snout and anterior palatal foramina are relatively short, i^{1-1} are strongly differentiated and separated from i^{2-2} , $p^{1,3}$ are only slightly smaller than p^4 , the claws are short, the bullae not enlarged.

2. The *A. maculatus* group, comprising

much smaller species with snout and anterior palatal foramina short; claws short, bullae small, i^{1-1} differentiated, $p^{1,3}$ much smaller than p^4 ; and p_4 incipiently single-rooted.

3. The *A. swainsonii* group, including large to medium-sized forms with long claws; long snout and anterior palatal foramina; i^{1-1} , although differentiated, placed much closer to i^{2-2} than is the case in the *flavipes* group.

4. The *A. bellus* group, containing but one species, large, short clawed, short snouted, with exceptionally large bullae for *Antechinus*. Somewhat resembling *Sminthopsis rufigenis*, *A. bellus* is distinguished by the reversed incisive gradient.

Antechinus flavipes GROUP

Besides the several widespread races of *flavipes* and the species (?) *godmani* of Australia, this group contains all the true *Antechinus* found in New Guinea. The group is arranged as follows:

- flavipes* (five races, all Australian)
- godmani* (possibly only a large-sized race of *flavipes*)
- melanurus* (lower mountains and lowlands of New Guinea)
- mayeri* (with *modestus*, *tafa*, *centralis*, all from the mountains of New Guinea)
- wilhelmina* (mountains of New Guinea)

When the *A. flavipes* group is considered throughout its arc-like total range, namely, from New Guinea through Queensland, southeast Australia, to south Western Australia, two distinct anatomical trends are noted. The first relates to the size of the teeth, the forms with the largest teeth occurring at the northern end of the distributional arc (except *A. wilhelmina*). The second trend relates to the relative size of the bullae, the largest bullae being found in *A. f. leucogaster* of south Western Australia, and the smallest in *A. melanurus* of New Guinea.

The bullae in the Papuan species *melanurus* are consistently smaller than those of the Australian *flavipes* and *godmani*. With one exception, *wilhelmina*, their widths are about one-half of their distance apart; in *wilhelmina*, owing to narrowness of the skull, the width of each bulla is nearly 60 per cent of the distance between them. The bullae of all Australian members of the group are larger

than the bullae of the Papuan members, those of the races of the south and west of the continent being larger than those of Queensland in the north. In *leucogaster* of south Western Australia, the form in which the bullae show maximum enlargement, the width of each bulla is approximately equal to the space between the two.

The crown length of the lower molars, m_{1-4} , has been taken as a "yard-stick" to compare the toothrows. The largest teeth (9.3–9.7 mm.) occur in the races of *melanurus* found near Morobe (north of the central range, in eastern Papua). The next largest are found in *centralis* of central Netherlands New Guinea, *tafa* from the higher levels (8000 feet) of the central range, north of Port Moresby, and in one specimen from the Cyclops Mountains (8.1–8.7 mm.). Those of true *melanurus* of the Port Moresby area below 5000 feet and west to the Fly River region of south New Guinea are still smaller (7.5–7.9 mm.). The smallest teeth appear in the little species *wilhelmina*, also from central Netherlands New Guinea but dwelling as high as 9000 feet.

This progressive diminution of the molars continues through Australia, where m_{1-4} in the otherwise large *A. godmani* is relatively short (± 8.0 mm.). In the forms of the small-sized *flavipes* living on the eastern side of the continent, the same molar teeth measure only 7.0 to 7.2 mm. In the isolated western race *leucogaster* they are reduced to 6.7 to 6.9 mm.

The premolars of specimens of *melanurus* from Morobe are very heavy, and those of *centralis* and the specimen from the Cyclops Mountains are nearly as large. But the premolars of *melanurus* and *tafa* are distinctly smaller, and those of *wilhelmina* are the smallest of any in New Guinea. In the Australian *godmani* the premolars are about as in *melanurus*, while in *adustus* of Queensland and true *flavipes* of New South Wales they are scarcely larger than those of *habbema*. Those in *leucogaster* are more compressed laterally than the same teeth in *flavipes*.

Antechinus flavipes (Waterhouse)

This species, which comprises several races, is but weakly separable from *A. godmani* and *A. melanurus*. From *godmani* it is

distinguished by smaller size, smaller teeth, and the absence of a distinct metaconic process at the back of m^4 . From *melanurus* it can be known by its larger audital bullae, smaller teeth, and brown instead of black (sometimes brownish black) tail.

Antechinus flavipes, as currently understood, is confined to Australia. It is present from Queensland to Victoria and west to the extreme southwestern corner of Western Australia.

Antechinus flavipes flavipes (Waterhouse)

Phascogale flavipes WATERHOUSE, 1838, Proc. Zool. Soc. London, p. 75.

Antechinus stuartii MACLEAY, 1841, Ann. Mag. Nat. Hist., vol. 8, p. 242.

Antechinus unicolor GOULD, 1854, The mammals of Australia, vol. 1, pt. 6, pl. 37.

Phascogale flavipes burrelli LE SOUEF AND BURRELL, 1926, Wild animals of . . . Australia, p. 334.

TYPES: B.M. No. 55.12.24.75, adult male (*flavipes*), and B.M. No. 54.11.19.2, adult female (*unicolor*).

TYPE LOCALITIES: *Flavipes*, north of Hunter River, New South Wales; *stuartii*, Manley, near Sydney; *unicolor*, Sydney; *burrelli*, Ebor, northern New South Wales. I can find no good reason for distinguishing *burrelli* from true *flavipes*.

The following specimens have also been studied: from Moseley's Ranch, 25; from Wandandian, four; from Milton, one; from Gloucester, one; from Salisbury, one; from Cascade, Dorriggo, one; from Mount Wilson, one; from Guy Fawkes district, one. All these localities are in New South Wales.

The dorsal color is dusty gray brown; the underparts are buffy to whitish, the bases of the hairs gray. The tail is brown.

Antechinus flavipes adustus (Thomas)

Phascogale flavipes adusta THOMAS, 1923, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 175.

TYPE: B.M. No. 22.12.18.54, adult male, from Dinner Creek, Ravenshoe, northern Queensland, 2900 feet.

Numerous specimens, mainly from near Ravenshoe, the type locality, have been examined.

Compared with the typical race of *flavipes*, *adustus* has the underparts touched with russet.

***Antechinus flavipes rufogaster* (Gray)**

Phascogale rufogaster GRAY, in Grey, 1841, Journals of two expeditions . . . in . . . Australia, vol. 2, App., pp. 401, 407.

TYPE: B.M. No. 41.1251 (318d) is an adult male, labeled "S. Australia."

This russet-bellied form is very like the similarly colored *A. f. adustus* of Queensland.

***Antechinus flavipes leucogaster* (Gray)**

Phascogale leucogaster GRAY, in Grey, 1841, Journals of two expeditions . . . in . . . Australia, vol. 2, App., pp. 401, 407.

TYPE: B.M. No. 41.1244 (317a), is a young adult of unascertained sex, from the Canning River, near Perth, Western Australia.

This is a thoroughly good race with larger bullae and smaller teeth than any of the east Australian races. The underparts are white (with gray bases) instead of buffy. The range is shown by Shortridge (1909).

***Antechinus godmani* (Thomas)**

Phascogale godmani THOMAS, 1923, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 174.

TYPE: B.M. No. 22.12.18.46, adult male, from Dinner Creek, Ravenshoe, northern Queensland, 2900 feet. A series from near the type locality has been examined.

This large-sized species, which comes from the same type locality as *A. flavipes adustus*, may be suspected of being based merely upon a selection of large, well-grown specimens. This seems not to be true, even though *godmani* and *adustus* are surprisingly alike externally, both having the tips of the hairs of the underparts light rusty brown. Young specimens of *godmani*, although exceedingly similar to fully grown *adustus*, can be distinguished by the rufescent instead of gray brown color of the sides of the face.

The teeth of *godmani* are very much larger in both sexes than those of *flavipes adustus*, and the metacone region of m^4 in *godmani* is less reduced.

THE MEMBERS OF THE *Antechinus flavipes* GROUP IN NEW GUINEA

Renewed study of the extensive series of Papuan *Antechinus* in our collections, of specimens lent by other museums, and of the types and other specimens in European

museums reveals a fairly clear picture of the interrelationships of this group and necessitates certain alterations in the classification and nomenclature.

The names hitherto applied to Papuan members of the genus are *melanurus* from the Astrolabe Range behind Port Moresby, *modestus* from the south slopes of the central range at the head of the Eilanden River, *mayeri* from the Arfak Mountains, *tafa* from Mount Tafa, *centralis* from the Bele River north of Mount Wilhelmina, and *habbema* from Lake Habbema, north of Mount Wilhelmina.

I now find three main types of *Antechinus* in New Guinea, having, respectively, the following characteristics:

1. First upper incisors very thick and heavy, other incisors broad and strong; mp^4 two-rooted; posterior palatal foramina small; bases of ears chestnut; tail black above and below. Here belong *melanurus* from the Moresby area, including also specimens from the lowlands of the Fly River area, 100 feet; a single individual from Mount Misim, near Morobe, 5700 feet; four specimens from the upper Idenburg River at altitudes between 150 and 5000 feet; one specimen from the Cyclops Mountains near Hollandia; specimens from the Weyland Mountains, ± 5000 feet.

2. First incisors proportionately small, other incisors broad; premolars large; mp^4 two-rooted; molars large; posterior palatal foramina large; bases of ears not chestnut, scarcely differentiated from body color; tail brown above, pale buffy beneath. Body color dark gray, barely touched with brown at the tips of the hairs. Rump not contrastingly reddish. In this group, the adults of which are slightly larger than *melanurus*, I now place *modestus*, *tafa*, *centralis*, and *mayeri*. The group is found in the hilly and mountainous parts of the island. Our large series of *centralis* comes from altitudes between 5000 and 8000 feet; *modestus* was from about 5000 feet, *tafa* from 7500 feet, *mayeri* from only 3500 feet.

3. First incisors very slender, other incisors narrow and slender; premolars small; mp^4 single-rooted; molars very small; posterior palatal foramina large; bases of ears faintly chestnut; tail black above and below. Body color gray brown, the hairs strongly washed with rufous.

These are mountain-living animals occurring in the central ranges at altitudes between 7000 and 9000 feet. They are smaller than either *melanurus* or *tafa*. (Young examples of both the last species may be smaller.)

The type specimen of *A. habbema* unfortunately seems to be compounded of a mismatched skin and skull. The skin agrees closely with the skins of our series of 21 *centralis*, while the small-toothed skull is similar to the skulls of our series of 11 specimens of the small reddish *Antechinus* referred to in 3 above. To remedy this situation I propose to restrict the use of the name *habbema* to the skin of the type, which then becomes a synonym of *centralis*, the skull being equal specifically to those of the series of small reddish *Antechinus* and in need of a specific name (supplied beyond).

***Antechinus melanurus* (Thomas)**

Phascogale melanura THOMAS, 1899, Ann. Mus. Civ. Genova, ser. 2, vol. 20, p. 191.

Phascogale melanura modesta THOMAS, 1912, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 92.

TYPES: The cotypes of *melanurus* are Genoa No. C.E. 3915, adult female, and B.M. No. 0.6.26.1, adult male, both from Moroka, headwaters of the Musgrave River, 1300 meters, collected by Loria. The type of *modestus*, B.M. No. 11.11.29.11, from Mount Goliath, is a skin without skull collected by A. S. Meek.

Other specimens examined include a series of near topotypes in the American Museum that I collected in the Astrolabe Range in 1937; a specimen in Tring Museum from the head of the Aroa River taken by A. S. Meek, and two others collected by Archbold on the Vanapa River; a young specimen taken by Stevens (in the Museum of Comparative Zoölogy) from near Morobe, "shot while running along branch 40 feet above the ground"; and the three individuals, mentioned above, from south New Guinea. All of these are distinguished from *wilhelmina* by their very heavy first upper incisors and relatively large molars.

Antechinus melanurus is distributed far more widely through New Guinea than has been previously reported, in fact it may be regarded as almost ubiquitous. Our records now show it to extend all along the central

chain from the Astrolabe Mountains through Mount Goliath to the Weyland Mountains and Arfak, at altitudes below 6000 feet. In south New Guinea, although rare, it is present along the banks of the Fly River (Lake Daviumbu and Sturt Island Camps) almost to sea level. North of the Central Range it occurs on Mount Misim near Morobe, on the mountains bordering the south side of the Idenburg River, and on the Cyclops Mountains.

***Antechinus mayeri* (Rothschild and Dollman)**

The rather large-sized brownish gray forms, *mayeri* of Arfak, *centralis* of the region about Mount Wilhelmina, *tafa* of the higher levels of Mount Tafa and the Albert Edward Range, and the large-toothed form occurring on Mount Misim near Morobe, are all referable to this species. In every case the first incisors have small cusps and are slender, i^{2-4} have broad cusps, and the molars are large, m^{1-3} exceeding 6.0 mm.

I have provisionally recognized four races of this large grayish species: typical *mayeri* of Arfak (probably distributed among the other high areas of the Vogelkop); *centralis* of the highlands of Netherlands New Guinea (its headquarters in the Wilhelmina area but extending west to the Weyland Mountains); *tafa* of the central chain in eastern New Guinea; and the large-toothed race on Mount Misim, near Morobe (see beyond). All four of these races stand so close to one another that later reviewers may decide that they should be merged together.

***Antechinus mayeri mayeri* (Rothschild and Dollman)**

Phascogale mayeri ROTHSCILD AND DOLLMAN, 1930, Proc. Zool. Soc. London, p. 433.

TYPE: B.M. No. 29.5.27.57, adult female from Boinosa, Arfak Mountains, 1000 meters, taken by Shaw Mayer.

The Weyland Mountains material (including Stein's from Kunupi and Shaw Mayer's from the Gebroeders) hitherto referred to this race, is now placed with *centralis*. A brown patch behind each ear is ill defined. There is a faint median face stripe in the type of *mayeri*. A good series is needed for comparison with *centralis*.

Antechinus mayeri centralis

Tate and Archbold

Antechinus tafa centralis TATE AND ARCHBOLD, 1941, Amer. Mus. Novitates, no. 1101, p. 8.

Antechinus habbema TATE AND ARCHBOLD, 1941, loc. cit. (skin). (See remarks on p. 129 of this article.)

TYPE: A.M.N.H. No. 109823, adult male. We have a series of 22 near topotypes—from Bele River Valley, 7000 feet, near Mount Wilhelmina, with total altitudinal range, 5000 to 8000 feet.

I have also seen Stein's and Shaw Mayer's specimens from the Kunupi and Weyland Mountains. Berlin (field) Nos. 474 and 475 taken at 6500 feet are referable to the present form, but No. 472 from the same place is a specimen of the smaller *wilhelmina*.

The general body color is brownish gray; the hairs of the underparts are white-tipped, their bases slate. The distinctive differences from *A. m. tafa* include the larger size of the posterior palatal foramina and the greater width of the mesopterygoid fossa.

***Antechinus mayeri tafa* (Tate and Archbold)**

Phascogale tafa TATE AND ARCHBOLD, 1936, Amer. Mus. Novitates, no. 823, p. 3.

TYPE: A.M.N.H. No. 104050, adult female from Mount Tafa, north of Port Moresby, 6500 feet.

This form was at first erroneously believed to be related to *Murexia longicaudata*. It is now recognized as an eastern race of *A. mayeri*. No additional specimens have been received. The teeth are larger than those of true *A. melanurus* from lower altitudes, and the tail is brownish rather than black.

***Antechinus mayeri misim*,
new subspecies**

TYPE: M.C.Z. No. 29924, adult male; Mount Misim, 5850 feet, near Morobe, Papua; collector, H. Stevens; April 24, 1933. The type is a skin with skull in good condition.

GENERAL CHARACTERS: Externally this race is indistinguishable from the races *centralis* and *tafa*. Internally it can be recognized by its much larger teeth.

DESCRIPTION: Gray, with the tips of the hairs touched with brown. No contrasting

brown ear patches. Underparts dull white, with the bases of the hairs gray. Tail dark gray above, slightly paler beneath. Hands and feet gray. Skull very similar to that of *tafa*; the posterior palatal foramina is, similarly, rather small, but the bullae are smaller, and the rostral process of the premaxilla is less elongated posteriorly, its distance from the frontal being 4.8 mm. (only 2.5 in *tafa*). The teeth are much heavier than those of *tafa*.

MEASUREMENTS: Length of head and body, 112 mm.¹; tail, 137; hind foot (c.u.), 25. Skull: condylobasal length, 32.8; zygomatic breadth, 17.5; palatal length, 17.8; length of posterior palatal foramina, 3.2; width of bulla, 2.9; width apart of bullae, 6.0. Teeth (measurements of type of *tafa* in parentheses): crown length of p¹, 1.35 (1.2); of p⁴, 1.7 (1.6); m¹⁻³, 7.4 (6.4); crown dimensions of m¹, 2.6 by 1.8 (2.2 by 1.7).

Stevens obtained a second specimen of *misim* at the same mountain two days later, a female, in which the teeth are equally large.

***Antechinus wilhelmina*, new species**

TYPE: A.M.N.H. No. 109811, adult male; 9 kilometers northeast of Lake Habbema, north of Mount Wilhelmina; 2800 meters; collector, W. B. Richardson, 1938 New Guinea Expedition. The type is a skin and skull in good condition.

GENERAL CHARACTERS: Externally a small replica of *A. melanurus*, but with much smaller incisors and molars. Much more rufescent than *mayeri*.

DESCRIPTION: Color of dorsal pelage gray at the bases but with the tips strongly yellowish rufous, becoming more russet on the rump. The base of the ear with a faint pale brown patch, less prominent than in *melanurus*. Underparts dull white, the hairs with gray bases. Hands and feet colored like the back. Tail black above and below, as in *melanurus*.

Skull smaller and more delicate than in either *melanurus* or *centralis*. The palatal foramina smaller than in *centralis*, larger than in *melanurus*. Incisors extremely slender and delicate, especially in comparison with *melanurus* (the first incisors of *centralis* are slen-

¹ Taken in the flesh.

der). Premolars very small and compressed. Molars much smaller than in either species.

MEASUREMENTS: Head and body, 108 mm.¹; tail, 130¹; foot (s.u.) 20¹. Skull: condylobasal length, 28.6; zygomatic breadth, 17.0; palatal length, 14.6; interorbital width, 7.2; intertemporal width, 7.0; width of bulla, 2.9 (2.7 in *melanurus*); width apart of bullae, 4.8 (5.4 in *melanurus*). Dental measurements, compared with those of *melanurus* in parentheses: thickness of *i*¹ at cingulum, 0.7 (0.8); length of crown of *i*⁴, 0.7 (0.8); crown dimensions of *m*¹, 1.9 by 1.4 (2.2 by 1.5); length of *m*¹⁻³, 5.4 (6.1).

In addition to the type specimen, we have 10 others from the general region, of which three more are from the type locality, six from the upper Bele River, 7000 feet, a few miles to the north of the type locality, and one from Lake Habbema, without recorded altitude. Furthermore the skull which was associated with the type skin of *A. habbema* exactly matches the skulls of *wilhelmina*.

Antechinus maculatus GROUP

Here are placed only the very small-sized *A. maculatus* and its race *sinualis*. The group is characterized by the very small size of almost equal-sized *p*¹ and *p*³ in comparison with the large *p*⁴, and by the small size of *p*⁴. The skull is as high as in other species of *Antechinus*, not low and flat as in the species of *Planigale*.

The lower fourth premolar of *sinualis*, according to T. C. S. Morrison-Scott of the British Museum (correspondence), although contained in a single alveolus, is incipiently double-rooted on one side, the outline of the single root insertion being like the figure 8; on the opposite side the tooth is single-rooted. The arrangement of the incisors, *i*² larger than *i*⁴, is in agreement with that of other species of *Antechinus*.

In the type of *A. m. sinualis*, a juvenal specimen, much disparity in size between *p*¹ and *p*³ is seen. The characters of *p*⁴ in *sinualis* cannot be distinguished because that tooth is only partly erupted, but the milk teeth in both jaws are seen to be substantially smaller than *p*³.

The feet, although proportionately broad,

are very small (only 10 to 11 mm. long) in contrast to 18 to 25 mm. in the *flavipes* group.

Thomas (1888) records eight mammae, but Pocock (1926, p. 1069) shows only six; the number in the *flavipes* group seems to be six, although again Pocock (1926, p. 1069) shows eight.

In view of the extreme paucity of material representing the *maculatus* group in collections, final judgment regarding its relationships must be deferred. It seems possible that the "spotted" character of the pelage of the little species may have a group significance and perhaps offer an analogy with *Dasyurus* and its allied genera. It is uncertain whether this group or the *flavipes* group has given rise to the several specialized, tiny, flat-skulled phascogales segregated as *Planigale*.

Antechinus maculatus maculatus Gould

Antechinus maculatus GOULD, 1851, The mammals of Australia, vol. 1, pt. 3, pl. 44.

Antechinus minutissimus GOULD, 1852, *op. cit.*, vol. 1, pt. 4, pl. 45.

TYPES: B.M. No. 53.10.22.21 (1079b), adult male from Clarence River, south of Moreton Bay, southern Queensland (*maculatus*); B.M. No. 53.10.22.20 (skin), B.M. No. 54.10.21.5 (skull), adult male from Cressbrook, Moreton Bay, southern Queensland (*minutissimus*). Both were collected by Strange.

The only other material representing this scarce little animal seems to have comprised two taken by Collett in 1881 and 1884, a female from Winton, 500 miles west of Rockhampton, and a male from Coomoboolaroo; "specimens" from Rockhampton were reported exhibited by Gunther to the Zoological Society, London, in 1876. Bresslau (1912) alluded to the mammary organs of this species. Chrisholm (1923) reported a specimen at Marrangaroo. Pocock (1926) had one or more to study when preparing his paper on the external characters of the dasyures.

Antechinus maculatus sinualis (Thomas)

Phascogale minutissima sinualis THOMAS, 1926, Ann. Mag. Nat. Hist., ser. 9, vol. 17, p. 634.

TYPE: B.M. No. 26.3.11.194, a juvenal male, from Groote Eylandt, Northern Ter-

¹ Taken in the flesh.

ritory, collected by Wilkins, January, 1925. In it the mp_4^1 are still present, m_3^3 are only partly erupted, and i^{1-1} and the canines are not completely in position. It is therefore very young. No other specimen is known.

Antechinus swainsonii GROUP

This strongly specialized division of *Antechinus*, having elongate snout and claws, is confined to the southeastern parts of Australia and to Tasmania. It contains the two species *swainsonii* and *minimus*.

The skulls in the *swainsonii* group are relatively elongate and narrow, and the first upper incisor, although differentiated from i^{2-4} morphologically, is not separated by a wide space from i^2 , as is the case in most phascogales.

Of the two species *swainsonii* and *minimus*, the former appears to be the more specialized. Its anterior palatal foramina and its mandibular symphysis are much longer. The less specialized *minimus* appears to be extremely rare; the more specialized *swainsonii* is common both in Tasmania and on the continent.

The number of nipples in those females of *swainsonii* that I have examined is eight. The nipples are observed to be very slim and small in comparison with the much thicker, heavier organs found in the *A. flavipes* group.

Antechinus minimus (Geoffroy)

Dasyurus minimus GEOFFROY, 1803, Bull. Sci. Soc. Philom., Paris, no. 81, p. 159; 1804, Ann. Mus. d'Hist. Nat., Paris, vol. 3, p. 362.

Phascogale affinis GRAY, in Grey, 1841, Journals of two expeditions . . . in . . . Australia, vol. 2, App., pp. 401, 406.

Antechinus rolandensis HIGGINS AND PETTERD, 1883, Proc. Roy. Soc. Tasmania, p. 171.

Antechinus concinnus HIGGINS AND PETTERD, 1884, *ibid.*, p. 184.

TYPES: Paris Museum, No. 381 (192a), adult male, a mounted skin, the skull taken out and cleaned in 1937; collected by Peron and Lesueur, on the voyage of "Le Naturaliste," in Tasmania; the back of the type skull is broken (*minimus*); B.M. No. 41.1241, adult, sex not determined, Gould collection, Tasman's Peninsula, Tasmania (*affinis*).

In the type of *A. minimus* the anterior palatal foramina and the symphysis are almost as short as in *flavipes*, but i^1 , although of

different shape, is placed close to i^2 (as in *swainsonii*). The pelage is rather dense; the claws are long as in *swainsonii*.

Antechinus swainsonii (Waterhouse)

Antechinus swainsonii differs from *A. minimus* in having much longer anterior palatal foramina, which extend back to the level of the back of p^1 , and very large posterior palatal foramina, extending from the front of m^1 to the back of m^3 . The mandibular symphysis extends almost to the back of p_2 . The talons of the lower premolars are strongly developed, and the protoconids and entoconids are extremely high. The premolars are compressed.

This species, which seems to be much more abundant than *A. minimus*, is found in southeastern Australia as well as in Tasmania.

Antechinus swainsonii swainsonii (Waterhouse)

Phascogale swainsonii WATERHOUSE, 1840, Mag. Nat. Hist. (Charlesworth), vol. 4, p. 299.

Antechinus niger HIGGINS AND PETTERD, 1883, Proc. Roy. Soc. Tasmania, p. 172.

Antechinus moorei HIGGINS AND PETTERD, 1884, *ibid.*, p. 182.

Antechinus moorei var. *assimilis* HIGGINS AND PETTERD, 1884, *ibid.*, p. 185.

TYPE: B.M. No. 60.1.5.18 (skin), B.M. No. 60.1.5.26 (skull), (Field No. 1348a), adult male, collected by Swainson in Tasmania.

I have seen 13 specimens in the collection of the American Museum from Arthur River, west of south from Smithton, Tasmania, collected by H. C. Raven, and two in the United States National Museum collection taken by Hoy.

These are long-clawed, dark gray brown phascogales, having the tips of the hairs along the middle of the underparts whitish (buffy in the Australian race). The bases of all ventral hairs are fuscous.

Antechinus swainsonii mimetes (Thomas)

Phascogale swainsonii mimetes THOMAS, 1924, Ann. Mag. Nat. Hist., ser. 9, vol. 14, p. 528.

TYPE: B.M. No. 24.10.1.1. adult female, collected by Wilkins "Under log in thick scrub," Guy Fawkes District, 5000 feet, latitude 30° S., longitude 152° 30' E., New South Wales.

I have also examined 12 collected by Raven and three by Hoy at Ebor, 52 miles east of Armidale, New South Wales.

This race, although very similar to true *swainsonii* of Tasmania, is rather larger and has the mid-ventral pelage washed with buffy instead of dull white.

Antechinus bellus GROUP

This group, marked by the single species *bellus*, is the most divergent of all the groups now assigned to *Antechinus*. The bullae are very much larger and the posterior palatal openings are smaller than those of any member of the *A. flavipes* group.

Antechinus bellus (Thomas)

Phascogale bella THOMAS, 1904, Novitates Zool., vol. 11, p. 229.

TYPE: B.M. No. 4.1.3.102, young adult male, collected by J. T. Tunney at South Alligator River, Northern Territory. At Tring Museum there is an adult male from 20 miles west of South Alligator River, also taken by Tunney.

This aberrant species combines features both of *Antechinus* and of *Sminthopsis*. It agrees with *Antechinus* and *S. crassicaudata* (but not the *S. rufigenis* group) in the reduction of p_4 to a size slightly smaller than p_3 , while maintaining p^4 larger than p^3 ; in i^2 being larger than i^4 ; and in the absence of secondary posterior palatal openings. It resembles *Sminthopsis* in the relative narrowness of the nasals at the base, and in the narrowed interorbital regions with slight post-orbital swellings (as in *S. rufigenis*).

The presence of a faint facial stripe is in agreement with certain species of *Sminthopsis* but not with *Antechinus*. The quite large alisphenoid bullae probably indicate affinities with neither genus, although this particular adaptive character can be seen in several *Sminthopsis* and is little developed in *Antechinus*. The body color is pale gray, made up of light buffy wool hairs and fuscous guard hairs. The underparts are buffy white with gray bases. The hands and feet are white. The tail is white, with a narrow stripe of dark body color dorsally.

I can find no statement as to whether the pads on the broad feet of this species have striations or are entirely granular.

PLANIGALE TROUGHTON

Planigale TROUGHTON, 1928, Rec. Australian Mus., vol. 16, p. 282.

TYPE: *Planigale ingrami brunnea* Troughton, 1928 = *Phascogale ingrami* Thomas. The type of a genus cannot be a subspecies.

Despite their general outer resemblance to the high-crowned *Antechinus maculatus* group, the several forms of *Planigale* form a distinct group. A slip in Troughton's diagnosis (p. 282) needs correction. The statement is made that *Planigale subtilissima* lacks the lower secutor. I have been permitted to examine the type skull and have photographs of it. Actually, the type is a young animal in which p^{3-3} are partly erupted, the lower left p_4 is not yet visible, but the tip of the lower right p_4 is just showing.

Unfortunately I have only one species of *Planigale* actually before me for study, the relatively large, newly described *P. novae-guineae*. In this species, although p^4 of the upper jaw is substantially larger than either p^3 or p^1 , degeneration of the corresponding tooth in the lower jaw, p_4 , has reached a decidedly more advanced stage than in *Antechinus flavipes*. The tooth is in my opinion a permanent one (not a milk tooth). Yet it has a single root instead of two and is much reduced in size. Troughton did not describe the characters of lower p_4 in the several species of his genus *Planigale*, but the comparative lengths of the crowns in *ingrami* are: p_1 , 0.5 mm.; p_3 , 0.65; p_4 , 0.4. Mr. T. C. S. Morrison-Scott, after kindly re-examining the lower premolars of certain types for me, reports that in *ingrami* p_4 is single rooted. It will be of interest to learn whether p_4 in *brunnea*, *tenuirostris*, and *subtilissima* is also minute and single-rooted. If such proves to be the case, the corresponding milk tooth will probably be a mere spicule.

The incisive gradient (i^{2-4}) in *P. novae-guineae* is the reverse of what appears in *Antechinus*; it resembles that of *Murexia* and *Sminthopsis*. This fact is significant and may indicate that my present tentative association of *Planigale* and *Antechinus* is erroneous.

The possession of six pairs of nipples by *P. tenuirostris* compared with three pairs by *brunnea* serves to separate the two completely. Its very much larger size and the

presence of striated pads distinguish *novae-guineae* at once from all Australian forms. Although the largest species of *Planigale*, it is easily the smallest dasyurid recorded from New Guinea.

Provided that generic relationship between *novae-guineae* and the two Australian species can be substantiated, the former may be regarded as the least progressive of the species of *Planigale* owing to its retention of striated pads, while *tenuirostris* may also be considered unspecialized because of its high mammary count. The second of these conclusions appears to be the weaker, on account of the well-known phenomenon of secondary multiplication of serial organs (e.g., the teeth of some whales, of armadillos, and of *Myrmecobius*).

***Planigale novae-guineae* Tate and Archbold**

Planigale novae-guineae TATE AND ARCHBOLD, 1941, Amer. Mus. Novitates, no. 1101, p. 7. —

TYPE: A.M.N.H. No. 108561, adult male, from Rona Falls, Astrolabe Range, Papua, 800 feet.

This is by far the largest of the several known forms of *Planigale* and the only one in which the foot pads are distinctly striated. The color above is brownish gray. The underparts are light tan, the scrotum vinaceous. The feet are strong and broad. No other specimen has been recorded.

***Planigale ingrami* (Thomas)**

The disposition of the three forms *subtilissima*, *ingrami*, and *brunnea* from west to east in the northern parts of Australia suggests that they may in fact be races of a single species. The supposed dental differences in *subtilissima*, as explained subsequently, are due to the juvenal condition of the type. *Planigale tenuirostris* is maintained as a full species on account of its narrower rostrum and interorbital region, much higher mammary formula, and geographical position.

***Planigale ingrami ingrami* (Thomas)**

Phascogale ingrami THOMAS, 1906, Proc. Zool. Soc. London, Abstr., no. 32, May 22, p. 6; 1906, Proc. Zool. Soc. London, p. 541.

TYPE: B.M. No. 6.3.9.77, old adult male, collected by Stalker at Buchanan, near

Alexandria, southwest of Gulf of Carpentaria, Northern Territory.

Dorsal color pale brownish gray, central color buffy white, the roots of the hairs gray. In the skull, p^3 slightly larger than p^1 ; both much smaller than p^4 ; p_4 single rooted. Bulla rather large and flat; periotic and part of mastoid inflated. No second specimen is known.

***Planigale ingrami subtilissima* (Lönnberg)**

Phascogale subtilissima LÖNNBERG, 1913, K. Svenska Vetensk. Akad. Handl., Stockholm, vol. 52, no. 1, p. 9.

TYPE: Stockholm Museum, No. 2482, a mounted skin, skull cleaned, young male, from Kimberly District, northern Western Australia.

The fourth upper premolar is not fully erupted, the exposed portion being about equal in extent to the totally erupted p^3 ; p_4 is not absent as claimed by Lönnberg; instead, the tip of the right p_4 is just showing, even though that of the left tooth is not yet visible; m_4^1 are in place.

The bullae are large and flattened; the periotic is somewhat inflated. The condyles exceed the occiput posteriorly as in true *ingrami*.

No other specimen is recorded.

***Planigale ingrami brunnea* Troughton**

Planigale ingrami brunneus TROUGHTON, 1928, Rec. Australian Mus., vol. 16, p. 282.

TYPE: Sydney Museum, No. M. 2174, female, body in alcohol, skull cleaned, from Wyangarie, Flinders River, Richmond District, northern Queensland; collected by F. L. Berney.

This Queensland form was distinguished from true *ingrami* of central north Australia by the brown color of the basal fur, the greater length of the tail and the anterior palatal foramina, and the greater degree of disparity between p^1 and p^3 .

Here again we are dealing essentially with a single specimen (a juvenal was recorded with the mother).

***Planigale tenuirostris* Troughton**

Planigale tenuirostris TROUGHTON, 1928, Rec. Australian Mus., vol. 16, p. 285.

TYPE: Sydney Museum, No. M. 3856, "apparently adult female," collected by R. Helms at Bourke or Wilcennia, near Darling River, New South Wales.

The anterior part of the palate is considerably narrowed. The interorbital area is also narrow, compared to the same parts in *ingrami*. Furthermore p^4 is stated to be shorter and higher and to lack the elongated talon.

Planigale tenuirostris is distinguished sharply from *ingrami* by having 12 nipples instead of six (a common number in *Antechinus*). The actual number of functional mammae was recorded by Troughton as 11. Some years ago I pointed out (Tate, 1933, pp. 34-35) that not all the nipples in the American marsupial genus *Marmosa* became functional. Bresslau (1920) had previously demonstrated the mechanism of eversion of the nipples in marsupials. It is thus possible to account for the odd number in *tenuirostris*.

PHASCOGALE TEMMINCK (RESTRICTED)

Phascogale TEMMINCK, 1824, Monographies de mammalogie, vol. 1, pp. xxiii, 23, 56.

Ascogale GLOGER, 1841, Hand- und Hilfsbuch der Naturgeschichte, vol. 1, p. 183.

Tapoa LESSON, 1842, Nouveau tableau du règne animal, p. 190.

Phascolicitis MATSCHIE, 1916, Mitt. Zool. Mus. Berlin, p. 263. (Type, *Phascogale calura* Gould.)

TYPE: *Didelphis penicillata* Shaw = *Viverra tapoatafa* Meyer.

A genus of squirrel-like and chipmunk-like species probably derived from an *Antechinus*-like ancestor and strongly modified for arboreal or at least scansorial life. Its primitive, unprogressive characters include retention of the large size of the upper fourth premolar even though the lower premolar is sharply reduced; the separation of i^1 from i^{2-4} ; the palmar and plantar striations on the hand and foot.

Characters now regarded as adaptive comprise the tendency to squirrel-like shortening and broadening of the skull; enlargement of the bullae and periotics; specialization of i_1^1 to form a strong nipping or clipping apparatus; unusual enlargement of i^2 (primitively only slightly larger than i^4 , as in *Antechinus*) in such a way as to supplement i^1 functionally and to work with it against i^1 . In addition,

the rather large size of the ear and the tufted distal half of the tail may be considered specializations related to a scansorial existence.

Phascogale tapoatafa (Meyer)

This is a gray, squirrel-like marsupial about the size of a red squirrel, with the ears broadly pointed and the tail chiefly black. The broad feet, with striated pads, are of distinctly scansorial type. One wonders whether they can be rotated as in true squirrels. Even the skull is "sciuromorphic," the cranium and zygomata being markedly broadened and the rostrum shortened.

The specialized enlargement of i^2 (generic character) is far more pronounced in the south Australian race than in *P. t. pirata* of the Northern Territory. The latter is therefore to be regarded as probably the primitive form from which *P. t. tapoatafa* has descended.

The range of *P. tapoatafa* extends across the extreme south of Australia from New South Wales to south Western Australia. In the far north the species occurs as the apparently isolated race *pirata*.

Phascogale tapoatafa tapoatafa (Meyer)

Viverra tapoatafa MEYER, 1793, Systematisch-summarische Uebersicht der neuesten zoologischen Entdeckungen in Neuhollland, pp. 28, 281.

Didelphis penicillata SHAW, 1800, General zoology (Mammalia), vol. 1, pt. 2, p. 502.

Dasyurus tafa GEOFFROY, 1803, Bull. Sci. Soc. Philom., Paris, no. 81, p. 159.

TYPE: Probably not in existence, but from Sydney, New South Wales.

A male specimen, A.M.N.H. No. 14445, of this interesting animal, obtained by exchange from the Sydney Museum, is in our possession. I have also examined a skull (M.C.Z. No. 37284) without skin from near Bridgetown, south Western Australia.

The general color is gray, with a mixture of numerous whitish hairs; the hands, feet, and base of the tail are a paler buffy gray; the underparts are white; the terminal two-thirds of the tail is clad in long black hairs.

Phascogale tapoatafa pirata Thomas

Phascogale penicillata pirata THOMAS, 1904, Novitates Zool., vol. 11, p. 228.

TYPE: B.M. No. 4.1.3.100, adult male,

collected by J. Tunney at South Alligator River, Northern Territory.

Thomas, although he pointed out that the specially large size of the incisors of *P. t. tapoatafa* was not developed in this northern race, drew no conclusions therefrom. The northern form, with its less specialized incisors and premolars, presents a closer likeness to *Antechinus* than does the southern form.

Phascogale calura Gould

Phascogale calura GOULD, 1844, Proc. Zool. Soc. London, p. 104.

TYPE: B.M. No. 44.10.15.1, adult male, collected by Gilbert at Williams River, near Perth, Western Australia.

This is a chipmunk-like little species with ears more rounded than those of *tapoatafa*. The dorsal color is brownish gray, the ventral hue white with the bases of the hairs gray. The basal half of the tail dorsally is light orange brown, giving place ventrally to black. The terminal half of the tail is black above as well as beneath. The hairs of the distal half become progressively longer to form a brush. The hands and feet are buffy white.

The skull, except for its smaller size, is remarkably like that of *tapoatafa*. The bullae are proportionally slightly larger and closer together, and the periotics are somewhat more inflated. The postorbital process of the zygoma is less pointed. The second upper incisor is likewise enlarged.

I have for study one specimen, C.N.H.M.¹ No. 36052, male, skin and skull, collected from Toolbrunup, south Western Australia.

SUBFAMILY DASYURINAE

The two principal systematic changes suggested for this subfamily consist, first, in inclusion of certain Papuan genera in which the characteristic reduction of p^4 is still in its initial stage,² and, second, in the transfer from *Antechinus* to the Dasyurinae of the species *macdonnellensis*, *mimulus*, and *api-*

calis, all three of which have p^4 sharply reduced. Thus, progressive obsolescence of p^4 is here made a prime criterion for membership in the subfamily. There is in the Dasyurinae no instance in which i^2 is larger than i^4 , as in *Antechinus*. The first upper incisor maintains its morphological distinctness from i^2 in most genera. The exceptions to the last statement are *Neophascogale*, *Dasyurinus*, *Dasyurus* (*sensu stricto*), and *Sarcophilus*, in all of which i^1 has taken on a close similitude to i^2 .

The incisive and premolar gradients in the Dasyurinae (table 7) are to be compared with those of the *Sminthopsis-Murexia-Thylacinus* and *Antechinus-Phascogale* branches of the Phascogalinae (tables 5 and 6).

NEOPHASCOGALE STEIN

Neophascogale STEIN, 1933, Zeitschr. f. Säugetierk., vol. 8, p. 87.

TYPE: *Phascogale venusta* Thomas = *Phascogale lorentzii* Jentink.

Neophascogale is a generally unprogressive member of the Dasyurinae, which, like the genera *Phascolosorex* and *Myoictis*, has the external appearance of a tree shrew. Its distinctive characters include identity in shape of i^1 to i^{2-4} (in most genera i^1 is both differently shaped and is set off by a space from i^{2-2}); long pale tips to the pelage; the backs of the ears white; long claws (compare the similarly long-clawed *Antechinus swainsonii*, *Pseudantechinus mimulus*, and *Parantechinus apicalis*).

Neophascogale lorentzii (Jentink)

Phascogale lorentzii JENTINK, 1911, Notes Leyden Mus., vol. 33, p. 234.

Phascogale nouhuysii JENTINK, 1911, *ibid.*, vol. 33, p. 235.

Phascogale lorentzii venusta THOMAS, 1921, Ann. Mag. Nat. Hist., ser. 9, vol. 8, p. 358.

Phascogale venusta rubrata THOMAS, 1922, Nova Guinea, vol. 13, p. 739.

TYPES: Leiden Museum, Field No. 329, young adult female, collected by Lorentz at the Hellwig Mountains; south of Mount Wilhelm, 2600 meters (*lorentzii*); Leiden Museum, Field No. 321, collected at Bivak Island (?),³ ± 1850 meters (*nouhuysii*); B.M.

³ This ? was on the original label. The altitude given may be right.

¹ Chicago Natural History Museum, formerly Field Museum.

² In the *Antechinus-Phascogale* branch of Phascogalinae diminution of the size of the fourth premolar, although incipient in the lower tooth, has not commenced in the upper tooth.

No. 21.8.1.11, old female, collected by the Pratt brothers on Mount Kunupi, Weyland Range, 6000 feet (*venusta*); B.M. No. 11.11.29.10, adult male, collected at Mount Goliath, 5800 feet, 70 miles east of the Hellwig Mountains (*rubrata*).

Now that I have seen the types of *lorentzii*, *venusta*, *nouhuysii*, and *rubrata*, I have no hesitation about referring them all to the genus *Neophascogale* and to the single species *lorentzii*.

In the large series of 96 specimens obtained by the Third Archbold Expedition in the neighborhood of Mount Wilhelmina and Lake Habbema, between altitudes of 8000 and 11,000 feet, are two specimens, both young females, that correspond closely to the young melanistic female earlier named by Jentink *nouhuysii*. The series includes nearly a dozen young animals of breeding age, only two of which are females. Possibly melanism in *Neophascogale* is confined to the female sex.

PARANTECHINUS, NEW GENUS

TYPE: *Phascogale apicalis* Gray.

Parantechinus, although superficially similar to *Antechinus* and *Sminthopsis* of the Phascogalinae, is readily distinguished by the extreme degree of reduction of p_4^1 . These teeth are reduced to single-rooted vestiges. The braincase is relatively high (the posterior part of the skull, destroyed in the type, is unknown to me). The long claws and the quality of the pelage are reminiscent of *Neophascogale*. The proödont condition of i^{1-1} , set off by diastemata from i^{2-2} , distinguishes *Parantechinus* from that genus.

Parantechinus apicalis (Gray)

Phascogale apicalis GRAY, 1842, Ann. Mag. Nat. Hist., vol. 9, p. 518.

TYPE: An adult female, with skin and skull respectively recorded as B.M. No. 42.8.18.3 and B.M. No. 44.6.15.8. It was procured from Brandt in Hamburg and the place of origin was unknown.

The rostrum, short and pointed, rises to the very high frontal region (contrast with *Pseudantechinus* and *Planigale*). The nasals are moderately broadened behind; the inter-orbital region is narrow, with traces of post-orbital processes. The anterior palatal foramina are short, the posterior ones large, and

the mesopterygoid fossa is narrow.

The crown length of i^2 equals that of i^4 (in my photograph of the skull, i^2 appears to have greater bulk than i^4), thus agreeing with *Antechinus* and *Phascogale* (*sensu stricto*); p^3 is one and a quarter times as high as p^1 ; p^4 , apparently not a milk tooth, is reduced to a single-rooted spicule one-half of the height of p^1 . The lower premolars are in the same proportion.

As I have been unable to find any supplementary descriptions of *apicalis* in the few papers that refer to it, I can say nothing regarding the relative size of the bullae and periotics.

Gray described the type as a female with well-developed pouch, short tapering tail "covered with elongate yellowish tipped hairs and a terminal pencil of black-tipped hair." The body had "long white tips to the dark brown and black hairs." Superficially it resembles *Neophascogale venusta*, both in the appearance of its pelage and the unusual length of its claws (4 mm.). The underparts are dull buffy, with gray bases. The tail is short and tapered. The width of the hind foot at the base of the metatarsals is 4.7 mm.

The species must be extraordinarily rare. Shortridge (1909, p. 840) records three specimens from southwest Australia.

PHASCOLOSOREX MATSCHIE

Phascolosorex MATSCHIE, 1916, Mitt. Zool. Mus. Berlin, vol. 8, p. 263.

TYPE: *Phascologale (sic) dorsalis* Peters and Doria.

Phascolosorex, like *Neophascogale*, is an unprogressive Papuan member of Dasyurinae. Although its first upper incisors are not secondarily specialized as are those of the latter, its last premolars show greater specialization in the direction of final obsolescence.

Externally *Phascolosorex* is distinguished by the presence of a slender black dorsal stripe (not to be confused with the broad stripe seen in *Murexia rothschildi*). Its claws are unlengthened. Hitherto *P. doriae* and races have been separated from *dorsalis* and its race chiefly by their smaller size. It is still to be demonstrated that this furnishes sufficient reason for retaining for them full specific rank. The larger species has apparent-

ly a more restricted range than the smaller, its bullae are proportionately slightly smaller and its paroccipital processes slightly larger. I shall continue provisionally to treat the two as full species.

***Phascolosorex doriae* (Thomas)**

Phascogale doriae THOMAS, 1886, Ann. Mus. Civ. Genova, ser. 2, vol. 4, p. 208.

Phascogale doriae umbrosa DOLLMAN, 1930, Proc. Zool. Soc. London, p. 434.

Phascogale pan STEIN, 1932, Zeitschr. f. Säugetierk., vol. 7, p. 255.

TYPES: Cotypes (*doriae*), Genoa Museum, Nos. C.E. 3907 (in alcohol), C.E. 589 (skull), young female, from Mori, Arfak Mountains, collected by Beccari in 1875; a second cotype, B.M. No. 87.8.17.5, juvenal male, with hind foot measuring only 29 mm., also from Mori, Arfak, is in the British Museum; (*umbrosa*), B.M. No. 29.5.27.55, young male (p⁴ not completely in place), from Arfak Mountains, 3000 feet, collected by Shaw Mayer; (*pan*), Berlin Museum, No. 44227, adult male, collected by Stein on Kunupi Mountain, Weyland Range.

The presence or absence of the white tail tip is apparently not significant, nor is the slightly darker hue of *umbrosa*.

An ample series of this large species from central Netherlands New Guinea at altitudes between 4000 and 6000 feet demonstrates that it is a mid-montane organism rather than a species of the high mountains. Therefore the relatively low hills lying between the Arfak and Weyland Mountains cannot be expected to form an important barrier, and *doriae*, with *umbrosa*, of Arfak will form a continuous population with *pan* of the Weyland Range, while these in their turn are doubtless continuous with our series from the upper Idenberg region.

***Phascolosorex dorsalis* (Peters and Doria)**

Aside from its much smaller size, *P. dorsalis* can be distinguished from *P. doriae* by astonishingly few characters. The bullae are proportionately a little larger and closer together; the paroccipital processes are shorter; the distribution of the species, although at a higher altitudinal level, is not restricted to western New Guinea but extends to eastern Papua. The species has not yet been recorded

in the mountains of the Huon Peninsula.

Because *dorsalis* is a species of the high mountains, it may be expected to cross the hilly country between Arfak and the Central Ranges less freely. The differential in the lengths of the tails in *dorsalis* of Arfak and *brevicaudata* of central Netherlands New Guinea is thus understandable.

***Phascolosorex dorsalis dorsalis*
(Peters and Doria)**

Phascogale dorsalis PETERS AND DORIA, 1876, Ann. Mus. Civ. Genova, ser. 1, vol. 8, p. 335.

TYPE: Genoa Museum, No. C.E. 3916, adult male, in alcohol, skull cleaned, collected by Beccari at Hatam, Arfak Mountains.

***Phascolosorex dorsalis brevicaudata*
(Rothschild and Dollman)**

Phascogale brevicaudata ROTHSCHILD AND DOLLMAN, 1932, Proc. Zool. Soc. London, p. 1084.

TYPE: Tring Museum, Field No. 139, adult male, collected by F. Shaw Mayer, at the Gebroeders, Weyland Range, 6000 feet.

The Archbold collection contains a series of 31 specimens of this animal from the neighborhood of Mount Wilhelmina, taken at altitudes between 5000 and 10,500 feet. It was especially plentiful at about 10,000 feet. A single specimen was taken as low as 5500 feet. It therefore appears that Shaw Mayer collected almost at the low limit of the range of the subspecies.

The Archbold specimens agree well with Dollman's description of *brevicaudata*. The tail length in adults varies from 95 to 120 mm.

Stein records this form from Japen Island, altitude unknown.

***Phascolosorex dorsalis whartoni*
(Tate and Archbold)**

Phascogale (Phascolosorex) dorsalis whartoni TATE AND ARCHBOLD, 1936, Amer. Mus. Novitates, no. 823, p. 4.

TYPE: A.M.N.H. No. 104046.

The tail in this race is longer than that of *brevicaudata*. In the type, the length of the tail is 131 mm.; in other specimens 127, 120, and 116 mm. The altitudes at which these four animals were collected range from 6000 to 7500 feet. Three other individuals secured

by Stevens (M.C.Z. Nos. 29921, 29922, 29925) are from Mount Misim, near Morobe, 6000 feet. Their tails measure about 130 mm.

PSEUDANTECHINUS, NEW GENUS

Similar in external appearance and size to *Sminthopsis* and *Antechinus*, but, as in the case of *Parantechinus*, the great reduction in the size of p_4 places the species of this genus with that line of dasyurids that leads to *Myoictis*, *Dasyurus*, and *Sarcophilus*.

TYPE: *Phascogale macdonnellensis* Spencer.

Distinguished from typical *Antechinus* by very great reduction of p_4 and total absence of the corresponding lower tooth; by i^2 being slightly smaller than i^4 (as in *Sminthopsis*); by the relatively narrow bases of the nasals (as in *Sminthopsis*); by the low broad skull (as in *Planigale*); and by the inflated character of the bulla and periotic.

From *Sminthopsis*, *Pseudantechinus* is distinguished by the aforesaid characters of p_4 (p_4 very small but not reduced to a spicule); by the relatively broad interorbital region (except *S. crassicaudata*); and by the enlarged nipper-like lower first incisors. To this genus I also refer *Phascogale mimulus* Thomas. The species occur respectively in central and northern Australia. Certain detailed measurements of these two rare marsupials are shown in table 8.

***Pseudantechinus macdonnellensis* (Spencer)**

Phascogale macdonnellensis SPENCER, 1896, Report on the . . . Horn scientific expedition to central Australia, Zoology, vol. 2, p. 27.

The American Museum of Natural History is fortunate to possess the skull of one of Mr. W. A. Horn's original specimens (A.M.N.H. No. 15011), marked "Alice Springs," one of seven marsupials preserved in alcohol received from Mr. Horn in 1899. This skull presents the features upon which I have based the new genus *Pseudantechinus*.

Horn notes that the pads are striated.

***Pseudantechinus mimulus* (Thomas)**

Phascogale mimulus Thomas, 1906, Proc. Zool. Soc. London, p. 540.

TYPE: B.M. No. 6.3.9.75, adult female, from Alexandria, Northern Territory, collected by Stalker, is apparently the only specimen of its kind in museums.

Besides the features given by Thomas the following are noted: hind foot moderately broad, its width at the base of the metatarsi 2.6 mm.; anterior claws short, 1.5 mm.

Skull rather flat as in *macdonnellensis*, muzzle flat; zygomata wide; i^{2-4} subequal (crown length of i^2 , 0.5 mm.; of i^4 , 0.6); $p^{1,3,4}$ subequal (but p^3 slightly larger than either p^1 or p^4); bullae large and rounded; periotic much swollen; nasals only slightly broadened at the base. In the lower jaw, i_1 about one and a quarter times as large as i_2 ; p_3 one-fourth as high again as p_1 ; p_4 obsolete.

MYOICTIS GRAY

Myoictis GRAY, 1858, Proc. Zool. Soc. London, p. 112; 1858, Ann. Mag. Nat. Hist., ser. 3, vol. 2, p. 222.

Myoictis STEIN, 1933, Zeitschr. f. Säugetierk., vol. 8, p. 87.

Myoictis TATE AND ARCHBOLD, 1937, Bull. Amer. Mus. Nat. Hist., vol. 73, p. 340.

TYPE: *Myoictis wallacei* Gray.

Myoictis is perhaps the most primitive member of that group of dasyurine genera of the family Dasyuridae that lead directly to *Dasyurus* and *Sarcophilus*. Its face is already somewhat shortened, and the fourth premolars, considerably reduced in the upper jaw, are all but obsolete in the lower, in which respect it compares with *Dasycercus* of Australia. *Myoictis* is sharply marked off from *Phascosorex* and *Neophascogale* by the above-mentioned shortening of the face and jaws. Externally it is characterized, except in occasional melanistic specimens, by three longitudinally placed dark dorsal stripes.

Two sharply distinct species of *Myoictis* occur: a more primitive species, *wallacei* (= *pilicauda*) of southern New Guinea and Aru Islands, in which p_4 is double rooted and the tail densely long haired; and a more specialized species, *melas*, found in Vogelkop and New Guinea north of the Central Range, in which p_4 is single rooted and very small, or even obsolete. The fourth premolar in the upper jaw, although always double rooted, is very much smaller in *melas* than in *wallacei*.

I have found milk premolars in only one specimen of *Myoictis*, A.M.N.H. No. 152009, from the Idenburg River. In this specimen m^2 is only partly erupted; the upper milk premolar is the merest pointed spicule and meas-

ures only 0.4 mm. in thickness. No corresponding tooth is visible in the lower jaw.

The number of nipples in both species of the genus *Myoictis* is six.

***Myoictis melas* (Müller and Schlegel)**

After taking into consideration the tendency towards melanism found in the *Myoictis* of the western part of New Guinea, and after examining virtually all the specimens in museums, I have felt obliged to synonymize several forms recently described by Stein.

An exception may exist in the form *burgersi* from just east of the great bend of the Sepik River, in which the bullae are almost as small as those of my new race from Wau, although I found the color differences to be not nearly so marked as Stein claimed. No example of *Myoictis* has been recorded between the Sepik area (*burgersi*) and the gold-mining region, Wau (*wavicus*).

Melanism in *melas* may not be at all common; the only recorded melanistic specimens are the type from Triton (= Lobo) Bay and a juvenal individual collected by A. S. Meek in the "Snow Mountains" (probably Mount Goliath).

Between our specimens from the Weyland area and those of our large series from the upper Idenburg, a small and inconstant difference may be noted which does not warrant subspecific recognition. In the Weyland animals the pale line on either side of the black median dorsal line is slightly whitened at the shoulders; it is less diversified in Idenburg material. The chestnut area at the base of the ears may be slightly more rufescent in Weyland than in Idenburg specimens. No cranial differences can be appreciated. In the new form from Wau there are very distinctive characters both of the skin and of the skull.

***Myoictis melas melas* (Müller and Schlegel)**

Phascogale melas MÜLLER AND SCHLEGEL, 1839-1844, in Temminck, C. J., *Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche overzeesche bezittingen*, p. 149, pl. 25.

Phascogale thorbeckiana SCHLEGEL, 1866, *Nederlandsch Tijdschr. Dierk.*, Amsterdam, vol. 3, p. 256.

Phascogale bruijnii PETERS, 1875, *Ann. Mus. Civ. Genova*, ser. 1, vol. 7, p. 420.

Phascogale melas senex STEIN, 1932, *Zeitschr. f. Säugetierk.*, vol. 7, p. 255.

Phascogale melas burgersi STEIN, 1932, *ibid.*, vol. 7, p. 256.

TYPES: Leiden Museum, Spec. a, young adult male, from Triton Bay, south coast of Vogelkop (*melas*); Leiden Museum, Spec. a-d, cotypes, from Salawatti, collected by von Bernstein (*thorbeckiana*); Genoa Museum, Nos. C.E. 590 and 3904, cotypes, collected by Beccari at Andai, east side of Geelvink Bay (*bruijnii*); Berlin Museum, No. 44226, adult male, from Kunupi Mountains in the Weyland Range, collected by Stein (*senex*); Berlin Museum, No. 20335, young adult, from Aprilfluss, Meanderberg, northward offshoot within the great bend of the Sepik, from the Central Range of New Guinea, longitude 141° 45' E., latitude 04° 00' 05" S. (*burgersi*).

In addition I have examined five more specimens from the Weyland Mountains collected by Stein, three by F. Shaw Mayer, and a series of 13 from the upper Idenburg Valley secured by the Third Archbold Expedition.

***Myoictis melas wavicus*, new subspecies**

TYPE: M.C.Z. No. 28082, adult male; from Wau, near Morobe, northeastern Papua; altitude 3800 feet; collected by H. Stevens, March 27, 1932. Skin and skull in good condition.

GENERAL CHARACTERS: A non-melanistic race of *M. melas* in which the red patch on each side of the head, neck, and shoulders is almost completely suppressed. The skull agrees with that of true *melas* in having p_4 single rooted and with that of *wallacei* in the more compressed form of the premolars and the much greater size of the posterior palatal foramina.

DESCRIPTION: General body color much as in *melas* of Netherlands New Guinea, the hairs gray based with the tips shining pale straw-colored, slightly browner on the head and more rufescent on the rump and tail. The median black line extends from the back of the head to the rump; the paired lateral lines are much shorter from the shoulders to the lumbar region. Hands and feet dark gray. The underparts are gray, the hairs, especially along the median line, tipped with white; the chin is pale brown.

Skull smaller than in either *melas* or *wal-*

lacei and with smaller bullae and teeth. The posterior palatal foramina occupy even more of the palate than in the case of *wallacei*. The talonid of m_4 is narrower than that of *melas* and almost as narrow as that of *wallacei*.

MEASUREMENTS: Head and body, 168 mm.¹; tail, 146¹; hind foot, 33¹; ear, 22.¹ Skull: condylobasal length, 43.0; zygomatic width, 24; interorbital width, 10.1; least intertemporal width, 9.0; breadth of braincase, 16.0; mastoid width, 16.8; nasals, 16 by 5.5; palatal length, 23.0; length anterior palatal foramina, 3.5; length posterior palatal foramina, 6.0; length of bulla, 4.0; distance apart of bullae, 7.0. Teeth: length of m^{1-3} , 8.2; crown length of p^1 , 1.5; p^3 , 1.8; p^4 , 1.5; crown dimensions of m^1 , 2.8 by 2.0; m_{1-4} , 10.5; crown length of p_1 , 2.0; p_3 , 2.0; p_4 , 0.7.

Stevens recorded that the animal was shot on a "recumbent, decayed log in undergrowth." He failed to secure a female that was with the male.

Myoictis wallacei Gray

Myoictis wallacei GRAY, 1858, Proc. Zool. Soc. London, p. 112.

Phascogale (Chaetocercus) pilicauda PETERS AND DORIA, 1881, Ann. Mus. Civ. Genova, vol. 16, p. 668.

TYPES: B.M. No. 58.2.20.1, juvenal male with m^2 only erupted, from Aru Islands, collected by A. R. Wallace in 1857 (*wallacei*); cotypes: Genoa Museum, C.E. 3922, adult female in alcohol, skull cleaned, collected up the Fly River by D'Albertis, and Berlin Museum, No. 5680, also adult female from the Fly River (*pilicauda*). There is a near topotype from Silokiloki, Aru, B.M. No. 1.6.5.21, in alcohol, also with the skull cleaned. Finally, A.M.N.H. No. 105976, from Lake Daviumbu, middle Fly River, is an adult male representing *pilicauda*. In all the adults p_4 is double rooted; in the type of *wallacei*, even though the permanent tooth is not yet visible, no trace of the milk tooth can be seen.

The black, median dorsal stripe of *melas* is not continued onto the head in this southern species. The crown is tawny brown, and the patches of clear color around and behind the ears are orange brown rather than red brown. The chin is white, and the gray ventral hairs

are white tipped. The caudal pelage is very full, whence probably the name *pilicauda*.

I cannot now decide whether to refer a British Museum specimen from the Vanapa River, near Port Moresby, to *wallacei* or to one of the two races of *melas*.

DASYCERCUS (PETERS)

Chaetocercus KREFFT, 1867, Proc. Zool. Soc. London, p. 434. Homonym of *Chaetocercus* R. G. Gray (a bird).

Dasyercus PETERS, 1875, Sitzber. Gesellsch. Naturf. Fr., Berlin, p. 73. New name for *Chaetocercus* Krefft.

Amperta CABRERA, 1919, Genera mammalian, Madrid, p. 65.

TYPE: *Chaetocercus cristicauda* Krefft.

Dasyercus is one of two rather closely interrelated Australian genera in which relatively enormous increase in the size of the bulla has taken place, perhaps in accordance with their desert habitats. Reduction of p_4 is well initiated and has reached the single-rooted stage seen in *Myoictis melas*. The tooth may likewise be absent. Shortening of the face has advanced somewhat further than in *Myoictis*.

The number of nipples may be eight (four pairs). F. W. Jones (1923) lists two specimens that carried seven young.

In this genus, as in *Parantechinus*, thickening of the tail occurs just beyond the pedunculate base. Such thickening is a commonplace adaptation among the mammals of the drier parts of Australia and is probably connected with food storage. The pads of the hind feet only have striations; those of the hands are entirely granulated.

Dasyercus cristicauda Krefft

Chaetocercus cristicauda KREFFT, 1867, Proc. Zool. Soc. London, p. 435.

Phascogale hillieri THOMAS, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 16, p. 427.

TYPES: Sydney Museum, No. 669 $\frac{1}{2}$, mounted specimen, skull extracted. Troughton gives "probably Lake Alexandrina" (*cristicauda*); B.M. No. 5.3.28.1, skin without skull, from Killalpanima, east of Lake Eyre, South Australia (*hillieri*).

As in *Dasyuroides byrnei*, this species is characterized by great enlargement of the bulla, periotic, and exoccipital. The skull is

¹ Field measurements.

broad and massive, with strongly developed supraorbital ridges and nasals moderately broad at their bases. The anterior palatal foramina are short; the posterior moderately large, with small accessory openings behind them. In the dentition p^3 is half as large again as p^1 ; p^4 , minute and peg-like, only just reaches the height of the cingulum of p^2 ; in the mandible, p_3 is slightly larger than p_1 ; p_4 is absent.

Other specimens I have examined were from Charlotte Waters and Alice Springs.

Dasyercus blythi (Waite)

Phascogale blythi WAITE, 1904, Rec. Australian Mus., vol. 5, p. 123.

Two cotypes, probably Sydney Museum, from Pilbarra, latitude 21° S., Western Australia.

Waite states that p^4 of this form is absent, and that the palms as well as the soles have striated areas.

Considering the close relationship of *Dasyercus* and *Dasyuroides*, the present animal may prove to be annectant.

DASYUROIDES SPENCER

Dasyuroides SPENCER, 1896, Proc. Roy. Soc. Victoria, new ser., vol. 8, p. 5; 1896, Report on . . . the Horn scientific expedition to central Australia, Zoology, vol. 2, p. 36.

TYPE: *Dasyuroides byrnei* Spencer.

In many respects similar to *Dasyercus*, *Dasyuroides* has gone a stage further in dental reduction; p_4 is absent. The bullae have also undergone great inflation.

The supraorbital ridges are less developed than in *Dasyercus cristicauda*, and the nasals are less broadened. Only four digits are present on the foot. The soles are hairy. In the teeth, p^4 is developed and only slightly smaller than p^1 .

Dasyuroides byrnei Spencer

Dasyuroides byrnei SPENCER, 1896, Report on . . . the Horn scientific expedition to central Australia, Zoology, vol. 2, p. 36.

Dasyuroides byrnei pallidior THOMAS, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 330.

TYPES: Probably in Sydney Museum (*byrnei* from Charlotte Waters); B.M. No. 5.8.9.7, adult male, from Killalpanima, east of Lake Eyre. Skinned from alcohol; skull

cleaned (*pallidior*). A topotype, B.M. No. 5.5.3.1, adult male; also A.M.N.H. No. 15009 is apparently one of Horn's original series.

SATANELLUS Pocock

Satanellus Pocock, 1926, Proc. Zool. Soc. London, p. 1083.

TYPE: *Dasyurus hallucatus* Gould.

In this, the least-specialized of the living genera of marsupial cats, the hallux is retained, and the first upper incisors are differentiated and moderately set off from i^{2-2} , a feature that I regard as primitive in the polyprotodonts. In *albopunctatus* i^4 is distinctly larger, in *hallucatus* slightly larger, than i^2 . The upper and lower fourth premolars are absent. The milk p^4 , however, can still be detected in very young specimens of *albopunctatus* (e.g., A.M.N.H. No. 151980 from New Guinea), a manifestation that I have not been able to find duplicated in the other *Dasyurus*-like genera, but see the work on pouch young by Woodward (1896). The extensively striated condition of the pads seems also to be a basic character widely developed in the family.

One cannot determine which of the two species, *hallucatus* or *albopunctatus*, is the more primitive. The rostrum and the anterior part of the palate of the former are less shortened and narrower than those of the latter, the posterior palate has larger fenestrae, and the dentition is decidedly less heavy. But the bullae are larger and p_3^3 have not commenced to undergo reduction in size as is the case in *albopunctatus*. The paroccipital processes are not so much reduced; they extend backward from the periotics for a considerably greater distance. The question of the presence or absence in *hallucatus* of the spicule-like mp^4 , present in *albopunctatus*, has yet to be settled.

Satanellus albopunctatus (Schlegel)

Dasyurus albopunctatus SCHLEGEL, 1880 (January), Notes Leyden Mus., vol. 2, p. 51.

Dasyurus fuscus MILNE EDWARDS, 1880 (June), Ann. Mag. Nat. Hist., ser. 5, vol. 6, p. 172.

Dasyurus daemonellus THOMAS, 1904, Ann. Mag. Nat. Hist., ser. 7, vol. 14, p. 402.

TYPES: Leiden Museum, Spec. a, old female from "Sapoea," Arfak Mountains, obtained through the animal dealer Frank in 1879

(*albopunctatus*); a mounted skin with skull, the back of the skull missing and the lower jaw diseased. Paris Museum, 1880, No. (1463), 371, juvenal adult male, collected by Laglaize in Arfak Mountains (*fuscus*); a mounted skin with skull cleaned (broken at the back). B.M. No. 3.12.1.24, adult male from Avera, Aroa River, Papua, collected by A. S. Meek (*daemonellus*).

Contrary to the opinion expressed earlier (Tate and Archbold, 1937), I now believe that the three forms synonymized above are alike. The seeming differences are due to differences of sex in the cases of *albopunctatus* (female) and *daemonellus* (male), or to youth (*fuscus*). The ample series from the Idenburg River now before me gives proof that adult males are very slightly larger than adult females. This difference is expressed in the lengths of the feet in adults, 10 males, 47–55 mm., seven females, 40–48, and in the rather variable teeth: m^{1-3} , 11.7–13.0 in males, 11.5–12.8 in females; crown dimensions of p^3 , 2.5–2.8 by 1.6–2.0 in males, 2.3–2.7 by 1.5–1.8 in females; crown dimensions of m^1 , 3.8–4.6 by 2.7–3.2 in males, 3.8–4.1 by 2.7–3.0 in females.

Satanellus hallucatus (Gould)

No important differences between the skulls of the types of the four races of this species occur. With the exception of slight difference in size, the skulls of *predator* (Queensland) and *exilis* (Kimberley), both adult males, are virtually inseparable; the characters further differentiating true *hallucatus* (female from Port Essington) and *nesaeus* (young male from Groote Eylandt) are those of sex and youth, respectively. Thomas' (1926) races seem to depend for their validity chiefly upon external characters. I have compared (table 9) three dental characters of a series of two males and six females from Queensland with the same characters in the four type specimens. The most noticeable fact shown is the virtual lack of dimensional differences between the sexes in respect to those characters, just as in the cast of the New Guinea species *albopunctatus*. The generally larger size of the Queensland form than either *nesaeus*, *hallucatus*, or *exilis* needs to be substantiated when ample series of those three races can be measured. An explanation of the alleged darker

coloring of Thomas' three specimens of *nesaeus* from Groote Eylandt may be found in their immaturity.

The number of nipples in all races is reported to be eight.

Satanellus hallucatus hallucatus (Gould)

Dasyurus hallucatus GOULD, 1842, Proc. Zool. Soc. London, p. 41.

TYPE: B.M. No. 42.5.26.10, young adult female from Port Essington, Northern Territory.

Satanellus hallucatus nesaeus (Thomas)

Dasyurus hallucatus nesaeus THOMAS, 1926, Ann. Mag. Nat. Hist., ser. 9, vol. 18, p. 544.

TYPE: B.M. No. 26.3.11.125, a young male with the last molar not fully in place, from Groote Eylandt, western part of Gulf of Carpentaria, Northern Territory; collector, G. H. Wilkins, 1925.

Satanellus hallucatus exilis (Thomas)

Dasyurus hallucatus exilis THOMAS, 1909, Ann. Mag. Nat. Hist., ser. 8, vol. 3, p. 152.

TYPE: B.M. No. 9.4.23.8, adult male, from Parry's Creek, east Kimberley, north Western Australia, 25 feet; collected by J. P. Rogers.

Satanellus hallucatus predator (Thomas)

Dasyurus hallucatus predator THOMAS, 1926, Ann. Mag. Nat. Hist., ser. 9, vol. 18, p. 543.

TYPE: B.M. No. 15.3.5.77, adult male, from Utingu, Cape York, Queensland, 10 meters; collected by R. Kemp.

A series of eight specimens representing this race, secured for the Archbold collection by Gabriele Neuhäuser, is available for study.

DASYURINUS MATSCHIE

Dasyurinus MATSCHIE, 1916, Mitt. Zool. Mus. Berlin, vol. 8, p. 262.

Notoconus Pocock, 1926, Proc. Zool. Soc. London, p. 1082.

TYPE: *Dasyurus geoffroyi* Gould.

The small hallux is retained in this genus as in *Satanellus* and *Dasyurops*, but the hallucal pad and metatarsal pads are virtually obsolete. The pads are granular with the exception of a very small central area, the skin of which is smooth, not striated. Thomas (1888) mentions the shortness of m^4 ("Nar-

rower antero-posteriorly"). The posterior palatal foramina are unusually large. The bulla is full and rounded as in *Satanellus*, not semi-flattened as in *Dasyurops*.

Matschie (1916) combined the species of *Satanellus* with *Dasyurinus*, but later Pocock (1926) separated the two on the basis of the structure of the pads.

Dasyurinus geoffroyi (Gould)

The degree of differentiation of i^1 from i^2 is very slight, and the diastema between those two teeth, present normally in most dasyures, is much reduced. The condition of incisor homology seen in *Neophascogale* and *Sarcophilus* is thus approached. The soles are granular and unstriated. This animal is considerably larger than either species of *Satanellus* of the north of Australia and New Guinea. The length of m^{1-3} is 16–16.5 mm. compared with 11–13 in *Satanellus*.

The first and third premolars of the race *fortis* are large and subequal, their crown lengths, 3.0:3.3; in the type of true *geoffroyi* the same tooth crowns measure 2.7 and 3.2 mm., respectively. The tail, which is darkened towards the tip, is much more densely hairy in the western than in the eastern race. No specimen of either race exists in the American Museum collection.

Dasyurinus geoffroyi geoffroyi (Gould)

Dasyurus geoffroyi GOULD, 1841, Proc. Zool. Soc. London, p. 151.

TYPE: B.M. No. 41.12.3, adult male from Liverpool Plains, New South Wales. The back of the type skull is broken.

This animal is considered by Troughton (1941) to be virtually extinct.

Dasyurinus geoffroyi fortis (Thomas)

Dasyurus geoffroyi fortis THOMAS, 1906, Proc. Zool. Soc. London, p. 476.

TYPE: B.M. No. 6.8.1.340, adult male, from Arthur River, south Western Australia, 840 feet, collected by G. C. Shortridge, 1905.

DASYURUS GEOFFROY (RESTRICTED)

Dasyurus GEOFFROY, 1796, Mag. Encyclop., ser. 2, vol. 3, p. 469.

Nasira HARVEY, 1841, South Australia Mag., vol. 1, p. 210.

TYPE: *Mustela quoll* Zimmerman = *Didelphis viverrina* Shaw.

This monotypic genus, used in the restricted sense, has in some ways attained a more advanced stage of specialization than the two foregoing genera of native cats; the hallux is obsolete, and with it the hallucal pad. The remaining pads are broadly granular, having completely lost their striated areas. These characters are adaptive and perhaps of rather recent origin.

The bulla is large and nearly spherical, as in *Satanellus*, but the face is considerably less shortened. The posterior palatal openings similarly are small to minute, and i^1 is only very slightly differentiated from i^{2-4} .

Melanism is occasionally recorded (Thomas, 1888).

Dasyurus quoll (Zimmermann)

Mustela quoll ZIMMERMANN, 1777, Specimen zoologiae geographicae, p. 489.

Didelphis viverrina SHAW, 1800, General zoology, vol. 1, pt. 2, p. 491.

Didelphis manglei GEOFFROY, 1803, Bull. Sci. Soc. Philom., Paris, no. 81, p. 159.

Dasyurus guttatus DESMAREST, 1804, Nouveau dictionnaire d'histoire naturelle, 1st ed., vol. 24, p. 10.

TYPES: Probably none in existence. Type localities: Sydney, New South Wales (*quoll* and *viverrinus*); southern Tasmania (*manglei*).

We have one very faded Australian specimen with skull. Several specimens of this species were collected in 1922 at Ruby Creek, Huon District, Tasmania, by the late H. C. Raven. They are slightly smaller than *geoffroyi*; m^{1-3} , ± 15 mm. The bullae are large and full. The palate is narrowed anteriorly as in *Satanellus hallucatus*. The undifferentiated character of i^1 is a conspicuous feature. The crown lengths of p^1 and p^3 are, respectively, 2.6 and 3.4 mm. The dental ramus of the mandible is shallow (5.6 mm. immediately in front of p_3).

DASYUOPS MATSCHIE

Dasyurops MATSCHIE, 1916, Mitt. Zool. Mus. Berlin, vol. 8, p. 262.

Stictophonus POCKOCK, 1926, Proc. Zool. Soc. London, p. 1083.

TYPE: *Viverra maculata* Kerr.

This genus retains the very small hallux, as

in *Satanellus* and *Dasyurinus*. It is specialized in regard to the granular character of the pads of the hands and feet, the striations having become wholly absent. This is perhaps to be regarded as an adaptive character associated with terrestrial habits. The bullae, contrary to what appears in the genera already mentioned, are little inflated, and the periotics are almost flat. In *Dasyurops* the protoconid is much larger and the metaconid is much lower than those cusps in *Satanellus* or *Dasyurus* (*sensu stricto*). The characters of the skull and dentition may reflect a more ancient deviation from the central dasyurid stem than do the strongly adaptive foot characters. The tail is spotted.

Dasyurops maculatus (Kerr)

Viverra maculata KERR, 1792, The animal kingdom . . . of . . . Linnaeus, p. 170.

Mustela novaehollandiae MEYER, 1793, Systematisch-summarische Uebersicht der neuesten zoologischen Entdeckungen in Neuholland, p. 27.

Dasyurus macrourus GEOFFROY, 1833, Bull. Sci. Soc. Philom., Paris, no. 81, p. 159.

TYPES: Those of *maculata* and *novaehollandiae* probably are not in existence. The type of *macrourus*, Paris Museum No. 355 (142), adult male without skull, was collected by "C^e. Baudin, an. 11, le V. Le Naturaliste," in Australia. A second specimen, Paris Museum No. 354 (141), adult male with skull inside, probably a paratype but labeled "*maculatus* Geoffroy," is marked "Exped. de l'an 11 de la Nouvelle Hollande par le capitaine Baudin." Iredale and Troughton list Port Jackson as the type locality for all three names.

The dorsal color in each Paris type is faded to yellow brown. The dorsal spots are large (15 mm. by 15), and the spots continue beneath the body. Crown lengths of the teeth of Paris Museum No. 354 (141) are: i^1 , 1.5; i^2 , 2.0; i^3 , 2.0; i^4 , 1.8; p^1 , 3.6; p^2 , 4.6. The length of the hind foot in the same specimen is ± 75 mm., while that of the smaller one, the type of *macrourus*, is only 55.

Seven skins without skulls, from Arthur River, Tasmania, collected in 1922, and two from Evelyn, northern Queensland, are in the collection of the American Museum of Natural History. All were secured by H. C. Raven.

The two last evidently correspond to that *maculatus*-like form inhabiting "the Rockingham Bay district and the Bellenden-Ker Ranges" alluded to by Ramsay (1888) under his remarks on *gracilis*.

The largest two male skins, A.M.N.H. No. 66162 from Tasmania and No. 65680 from Evelyn, Queensland, although obtained at places 1500 miles apart, are remarkably alike. They differ sharply from our specimen of *gracilis* by having a buffy color on the underparts, especially the throat and chin, a rather light brown color of the head and limbs, and buff inner sides of the limbs. The head, chin, and throat, contrary to the condition found in *gracilis*, are wholly unspotted. The sizes of the two northern and southern males are, respectively: head and body, 500 mm., 480; tail, 430, 435; hind foot, 80, 80. A female with functional pouch, also from Evelyn, is smaller, the length of its hind foot, 65 mm.

Dasyurops gracilis (Ramsay)

Dasyurus gracilis RAMSAY, 1888, Proc. Linn. Soc. New South Wales, ser. 2, vol. 3, p. 1296.

TYPE: Perhaps in Sydney. From the Bellenden Ker Range, northern Queensland.

A single, badly shot-up, subadult female of this almost mythical species was obtained by Gabriele Neuhäuser at Mount Spurgeon, northern Queensland, 3600 feet. The skin is in fairly good condition; the skull is badly broken, the paired mandibular rami being almost the only complete portions of it. A fragment containing left p^3 , m^3 , the alveolus for m^4 , and the interorbital area, and a second piece containing parts of right m^1 and m^3 are preserved. There is a third fragment that includes the left squamosal and squamosal root of the zygoma. A piece of a phalangerid skull has been accidentally mixed with the remains, as well as a detached bulla that I do not care to express an opinion on.

Excepting those of *D. maculatus*, the teeth are larger than any dasyurine I have hitherto described; m^{1-3} measure 17.5 mm. and m_{1-4} , 22. The crown dimensions of p^3 are 3.7 by 2.3; of m^1 , 6.9 by 3.9; of p_1 , 3.6 by 1.8; and of p_3 , 4.0 by 2.0.

The skin is as described by Ramsay, very dark brown throughout, except for the white spots, large and often confluent on the sides

and underparts. The spotted pattern extends onto the dark brown hands, throat, chin, and tail. The tip of the tail is white. The nearly bare under side of the tail, also described by Ramsay, can be observed. The hallux is present, and the under sides of the toes, excluding their striated tips, are granular and not provided with two rows of scales as in *Satanellus* (Pocock, 1926). The pads are strongly striated.

The field measurements made by Neu-häuser are: head and body, 302 mm.; tail, 270; hind foot, 59; ear, 38. That collector has done a great service by rediscovering this animal.

SARCOPHILUS GEOFFROY AND CUVIER

Sarcophilus GEOFFROY AND CUVIER, 1837, *Histoire naturelle des mammifères*, vol. 4 (pt. 60), p. 6.

Ursinus BOITARD, 1841, "1842," *Le Jardin des Plantes*, p. 290.

Diabolus GRAY, in Grey, 1841, *Journals of two expeditions . . . in . . . Australia*, vol. 2, App., p. 400.

TYPE: *Ursinus harrisii* Boitard.

A derivative of the Dasyurinae in which the skull and teeth have become extremely massive, and the habitus has come to include the crushing of resistant foods such as carrion and bones. A strong analogy with the skull and teeth of *Crocota* is observable.

The fundamentally dasyurine character of the skull is partly evident in the total obsolescence of p_4^4 , in i^4 being larger than i^2 , and in the full, well-rounded bulla.

Specializations correlated with the carnivorous feeding habits of *Sarcophilus*, superimposed upon the original dasyurine struc-

ture, include the heavy, massive dentition; lack of differentiation of i^1 from i^2 ; extreme reduction of m^4 and of all the molar talonids; almost total obsolescence of the outer styles of the upper molars and of the metaconids, somewhat as in *Thylacinus*; broadening of the olfactory braincase with incidental enlargement of the postorbital processes partly to encircle the orbit; development of high sagittal and lambdoidal crests; narrowing and shortening of the entire cerebellum region of the skull coincidentally with enlargement of the areas for insertion of the neck muscles. The large size of the posterior palatal foramina may not be especially significant. Only *Dasyurinus* among the close generic relatives of *Sarcophilus* has similarly enlarged palatal foramina. As in *Dasyurus* (*sensu stricto*) the hallux is absent and the wholly granular pads are without striations. *Sarcophilus* is thus to be regarded as completely cursorial.

Sarcophilus has developed a more or less bear-like color pattern. The skin generally is blackish brown, with a blotch of white on the throat, another on the rump, and sometimes one or two others scattered at random.

Sarcophilus harrisii (Boitard)

Ursinus harrisii BOITARD, 1841, "1842," *Le Jardin des Plantes*, p. 290.

Didelphis ursina HARRIS, 1808, *Trans. Linnean Soc.*, London, vol. 9, p. 176. Homonym of *Didelphis ursinus* Shaw, 1800, *General zoology*, vol. 1, pt. 2, p. 504 (a wombat).

TYPE: If in existence, probably at the Paris Museum.

In 1922, H. C. Raven obtained six specimens of this now rare animal at Arthur River Mill, northwest Tasmania.

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TABLE 1

PROGRESSIVE OBSOLESCENCE OF FOURTH PREMOLARS IN THE DASYURIDAE
(Crown lengths of p_4^1 expressed as percentages of p_3^1 .)

| Subfamily, Genus, Species | Permanent p_4^1 | | | | | | Milk p_4^1 | | | | | |
|---|-------------------|---------|-----|--------------------|---------|-----|------------------|---------|-----|---------------------|---------|----|
| | Upper | | | Lower | | | Upper | | | Lower | | |
| | p_4^1 | p_3^1 | % | p_4^1 | p_3^1 | % | mp_4^1 | p_3^1 | % | mp_4^1 | p_3^1 | % |
| <i>Didelphis</i> ^a <i>marsupialis</i> | 5.2 | 4.3 | 120 | 6.5 | 6.3 | 100 | 6.0 | 6.0 | 100 | 4.7 | 6.0 | 80 |
| Phascogalinae | | | | | | | | | | | | |
| <i>Murexia</i> <i>murex</i> | 1.8 | 1.3 | 138 | 2.4 | 1.8 | 130 | 1.2 | 1.3 | 92 | 0.8 | 1.8 | 44 |
| <i>Thylacinus</i> <i>cynocephalus</i> | 11.5 | 9.3 | 120 | 11.6 | 9.3 | 125 | 2.5 ^b | 9.5 | 26 | 2.8 ^b | 9.3 | 30 |
| <i>Sminthopsis</i> <i>rufigenis</i> | 1.5 | 1.3 | 115 | 1.3 | 1.4 | 93 | | | | 0.5 | 1.1 | 45 |
| <i>crassicaudata</i> | 1.0 | 1.0 | 100 | 1.0 | 1.1 | 91 | | | | | | |
| <i>Antechinomys</i> <i>spenceri</i> | 1.3 | 1.2 | 110 | 1.1 | 1.2 | 92 | | | | | | |
| <i>Antechinus</i> <i>flavipes</i> | 1.2 | 1.1 | 110 | 1.0 | 1.2 | 83 | 0.7 | 1.1 | 64 | 0.5 | 1.2 | 42 |
| <i>melanurus</i> | 1.6 | 1.5 | 107 | 1.5 | 1.6 | 94 | 0.7 | 1.1 | 64 | 0.5 | 1.4 | 36 |
| <i>Phascogale</i> (s.s.) <i>tapoatafa</i> | 1.9 | 1.7 | 112 | 1.3 | 2.0 | 65 | 1.1 ^c | 1.8 | 61 | | | |
| <i>calura</i> | 1.2 | 1.2 | 100 | 0.9 | 1.4 | 63 | | | | | | |
| Dasyurinae | | | | | | | | | | | | |
| <i>Myoictis</i> <i>wallacei</i> | 1.7 | 1.8 | 95 | 1.4 | 2.0 | 70 | | | | | | |
| <i>melas</i> | 1.5 | 1.9 | 80 | (p_4 not found) | | | 0.4 | 1.8 | 22 | (mp_4 not found) | | |
| <i>Neophascogale</i> <i>lorentzii</i> | 1.4 | 1.8 | 77 | 0.7 | 2.3 | 30 | 0.6 | 2.7 | 22 | (mp_4 not found) | | |
| <i>Phascosorex</i> <i>doriae</i> | 1.5 | 2.1 | 71 | 1.0 | 2.4 | 41 | | | | | | |
| <i>dorsalis</i> | 1.0 | 1.7 | 59 | 0.7 | 1.9 | 37 | | | | | | |
| <i>Pseudantechinus</i> <i>macdonnellensis</i> | 0.5 | 1.2 | 42 | (p_4 absent) | | | | | | | | |
| <i>Dasyuroides</i> <i>byrnei</i> | | 1.6 | | 1.6 | | | | | | | | |
| <i>Satanellus</i> <i>albomaculatus</i> | (p_4 absent) | | | (p_4 absent) | | | 0.6 | 2.5 | 24 | (mp_4 not found) | | |

^a *Didelphis* introduced to show the almost unreduced condition of the milk premolars in that genus.

^b From Flower's drawing (1867).

^c From Thomas' drawing (1888).

TABLE 2

PREVALENCE OF STRIATED AND GRANULATED FOOT PADS IN THE MARSUPIALS,
WITH SPECIAL REFERENCE TO THE DASYURIDAE

| Families and Genera | Pads Striated | Pads Intermediate, with Extremely Minute Areas of Striated Skin | Pads Granulated, Sometimes Smooth or Hairy |
|---|---|--|--|
| Didelphidae | Most genera | | <i>Chironectes</i> (pads soft) |
| Dasyuridae, with <i>Myrmecobius</i> and <i>Notoryctes</i> | <i>Murexia</i> <i>Antechinus</i> <i>Planigale novaeguineae</i> <i>Sminthopsis rufigenis</i> group <i>Neophascogale</i> <i>Phascosorex</i> <i>Myoictis</i> <i>Satanellus</i> <i>Dasyurops</i> <i>Antechinus</i> <i>Phascogale</i> (s.s.) | <i>Dasyercus</i> ^a <i>Dasyurinus</i> <i>Sarcophilus</i> | <i>Thylacinus</i> <i>Sminthopsis crassicaudata</i> group <i>Antechinomys</i> <i>Dasyuroides</i> ^b <i>Dasyurus</i> (s.s.) <i>Myrmecobius</i> <i>Notoryctes</i> <i>Planigale ingrami</i> |
| Peramelidae | | <i>Ornoryctes</i> | All genera except <i>Ornoryctes</i> |
| Phalangeridae, with Vombatidae | All except Vombatidae | | Vombatidae |
| Macropodidae | <i>Hypsiprymnodon</i> , <i>Potorous</i> | | All genera except <i>Hypsiprymnodon</i> and <i>Potorous</i> |

^a Foot striated, hand smooth (Jones, 1923).

^b "Soles hairy" (Jones, 1923).

TABLE 3

MAMMARY FORMULAE IN THE DASYURIDAE

| Number of Pairs of Nipples | Genus, or Species Group |
|----------------------------|---|
| 6 | <i>Planigale tenuirostris</i> |
| 5 | <i>Antechinus swainsonii</i> , <i>Sminthopsis crassicaudata</i> |
| 4 | <i>Satanellus albomaculatus</i> , <i>Antechinus flavipes</i> (fide Pocock, 1926) |
| 3 | <i>Sminthopsis rufigenis</i> group, <i>Antechinomys spenceri</i> , <i>Antechinus flavipes</i> group, <i>Dasyurinus</i> , <i>Dasyurops</i> , <i>Dasyurus</i> (s.s.), <i>Dasyuroides</i> , <i>Dasyercus</i> , <i>Myoictis</i> |
| 2 | <i>Murexia</i> , <i>Thylacinus</i> , <i>Sarcophilus</i> , <i>Phascosorex</i> |
| 1 | <i>Sminthopsis stalkerii</i> (A.M.N.H. No. 153413) |

TABLE 4
GEOGRAPHICAL DISTRIBUTION OF THE DASYURIDAE, WITH NOTES ON ALTITUDINAL DISTRIBUTION

| | New Guinea | | | | | | Australia and Tasmania | | | | | | | | |
|---|----------------------|------------------------------|--------------------------------|--------------------------------|------------------------|----------------------------------|------------------------|--------------------------------|------------|-------------------|----------|-------------------|-----------------|---------------------------|---------------------------|
| | Vogelkop and Islands | North New Guinea and Islands | Central Mountain System (west) | Central Mountain System (east) | East End of New Guinea | South New Guinea with Aru Island | Cape York Peninsula | Northern Territory and Islands | Queensland | Eastern Australia | Tasmania | Central Australia | South Australia | Western Australia (north) | Western Australia (south) |
| PHASCOGALINAE | | | | | | | | | | | | | | | |
| <i>Murexia longicaudata</i> | | | | | | | | | | | | | | | |
| <i>Murexia rothschildi</i> | | | | | | | | | | | | | | | |
| <i>Thylacinus cynocephalus</i> | | | | | a | | | | | | | | | | |
| <i>Sminthopsis rufigenis</i> section | | | | | | | | | | | | | | | |
| <i>Sminthopsis murina</i> section | | | | | | | | | | | | | | | |
| <i>Sminthopsis macrura</i> | | | | | | | | | | | | | | | |
| <i>Sminthopsis granulipes</i> | | | | | | | | | | | | | | | |
| <i>Sminthopsis larapinta</i> | | | | | | | | | | | | | | | |
| <i>Sminthopsis crassicaudata</i> (restricted) | | | | | | | | | | | | | | | |
| <i>Sminthopsis hirtipes</i> | | | | | | | | | | | | | | | |
| <i>Antechinomys laniger, spenceri</i> | | | | | | d | | | | b | | c | b | | |
| <i>Antechinus flavipes</i> group | | | | | | | | | | | | | | | |
| <i>Antechinus maculatus</i> group | | | | | | | | | | | | | | | |
| <i>Antechinus swainsonii</i> group | | | | | | | | | | | | | | | |
| <i>Antechinus bellus</i> | | | | | e | | | | | | | | | | |
| <i>Planigale novaeguineae</i> | | | | | | | | | | | | | | | |
| <i>Planigale ingrami</i> | | | | | | | | | | | | | | | |
| <i>Planigale tenuirostris</i> | | | | | | | | | | | | | | | |
| <i>Phascogale tapoatafa</i> | | | | | | | | | | | | | | | |
| <i>Phascogale calura</i> | | | | | | | | | | | | | | | |
| DASYURINAE | | | | | | | | | | | | | | | |
| <i>Neophascogale lorentzii</i> | | | | | | | | | | | | | | | |
| <i>Parantechinus apicalis</i> | | | f | | | | | | | | | | | | |
| <i>Phascosorex doriae</i> | | | g | | | | | | | | | | | | |
| <i>Phascosorex dorsalis</i> | | | | | | | | | | | | | | | |
| <i>Pseudantechinus macdonnellensis</i> | | | | | | | | | | | | | | | |
| <i>Pseudantechinus mimulus</i> | | | | | | | | | | | | | | | |
| <i>Myoictis wallacei</i> | | h | | | | | | | | | | | | | |
| <i>Myoictis melas</i> | | | | | | | | | | | | | | | |
| <i>Dasycercus cristicauda</i> | | | | | | | | | | | | | | | |
| <i>Dasyuroides byrnei</i> | | i | | | | | | | | | | | | | |
| <i>Satanellus albomaculatus</i> | | | | | | | | | | | | | | | |
| <i>Satanellus hallucatus</i> | | | | | | | | | | | | | | | |
| <i>Dasyurinus geoffroyi</i> | | | | | | | | | | | | | | | |
| <i>Dasyurus quoll</i> | | | | | | | | | | | | | | | |
| <i>Dasyurops maculatus</i> | | | | | | | | | | | | | | | |
| <i>Dasyurops gracilis</i> | | | | | | | | | | | | | | | |
| <i>Sarcophilus harrisii</i> | | | | | | | | | | | | | | | |

^a *S. rona*.

^b *S. laniger*.

^c *S. spenceri*.

^d Upper limit 9000 feet; rare in the lowlands, not on Aru.

^e Rona Falls, Port Moresby.

^f 3000 to 6000 feet.

^g 5000 to 11,000 feet.

^h Sea level to 5000 feet.

TABLE 5

CROWN LENGTHS (IN MILLIMETERS) OF INCISORS AND PREMOLARS IN TYPE SPECIMENS OF *Sminthopsis* AND *Antechinomys*, WITH DIMENSIONS OF *Murexia* AND *Thylacinus* (TYPE UNKNOWN) FOR COMPARISON

| | i ² | i ³ | i ⁴ | p ¹ | p ³ | p ⁴ | i ₁ | i ₂ | i ₃ | p ₁ | p ₃ | p ₄ |
|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <i>Sminthopsis rufigenis</i> section | | | | | | | | | | | | |
| <i>rufigenis</i> | 0.50 | 0.60 | 0.65 | 0.90 | 1.10 | 1.35 | 0.60 | 0.600 | 0.60 | 0.90 | 1.20 | 1.20 |
| <i>Sminthopsis murina</i> section | | | | | | | | | | | | |
| <i>murina</i> | 0.50 | 0.50 | 0.60 | 0.80 | 1.00 | 1.20 | 0.55 | 0.450 | 0.40 | 0.85 | 1.10 | — |
| <i>ferruginifrons</i> | 0.50 | 0.60 | 0.65 | 1.00 | 1.10 | 1.40 | 0.60 | 0.500 | — | 1.10 | 1.20 | 1.25 |
| <i>albipes</i> | 0.55 | 0.45 | 0.50 | 0.90 | 1.05 | 1.15 | 0.55 | 0.400 | 0.45 | 0.85 | 1.00 | 1.00 |
| <i>leucopus</i> | — | — | — | 1.00 | — | 1.20 | — | — | — | 1.00 | 1.15 | 1.10 |
| <i>fuliginosa</i> | 0.45 | 0.45 | 0.55 | 0.85 | 1.10 | 1.15 | 0.55 | 0.500 | 0.50 | 0.80 | 1.10 | 0.95 |
| <i>Sminthopsis crassicaudata</i> section | | | | | | | | | | | | |
| <i>macrura</i> ^a | 0.50 | 0.50 | 0.60 | 0.95 | 1.15 | 1.25 | — | — | — | — | — | — |
| <i>centralis</i> | 0.50 | 0.50 | 0.60 | 0.90 | 1.10 | 1.15 | 0.55 | 0.450 | 0.40 | 0.90 | 1.10 | 0.95 |
| <i>stalkeri</i> | 0.55 | 0.55 | 0.60 | 0.90 | 1.00 | 1.10 | 0.50 | 0.475 | 0.50 | 0.80 | 0.90 | 0.85 |
| <i>nitela</i> | 0.50 | 0.60 | 0.70 | 0.80 | 1.10 | 1.30 | 0.60 | 0.550 | 0.60 | 0.80 | 1.10 | 1.10 |
| <i>crassicaudata</i> | 0.45 | 0.50 | 0.60 | 1.00 | 1.10 | 1.20 | 0.50 | 0.450 | 0.45 | 0.90 | 1.05 | 0.90 |
| <i>Sminthopsis hirtipes</i> | 0.50 | 0.50 | 0.55 | 0.85 | 1.10 | 1.20 | 0.55 | 0.450 | 0.50 | 1.00 | 1.15 | 1.10 |
| <i>Antechinomys laniger</i> | 0.60 | 0.55 | 0.60 | 0.95 | 1.15 | 1.20 | 0.60 | 0.550 | 0.55 | 1.00 | 1.20 | 0.95 |
| <i>spenceri</i> | 0.60 | — | 0.75 | 1.05 | 1.25 | 1.35 | 0.70 | 0.550 | 0.50 | 1.15 | 1.35 | 1.25 |
| <i>Murexia maxima</i> ^b | 1.00 | 1.05 | 1.10 | 1.85 | 2.10 | 2.50 | 1.15 | 1.000 | 1.00 | 2.15 | 2.30 | 2.40 |
| <i>Thylacinus cynocephalus</i> ^b | 3.00 | 3.10 | 5.20 | 6.30 | 8.00 | 10.70 | 3.40 | 3.200 | 4.20 | 6.10 | 8.40 | 12.00 |

^a Topotype.

^b Not a type.

TABLE 6

CROWN LENGTHS (IN MILLIMETERS) OF INCISORS AND PREMOLARS IN TYPE SPECIMENS
OF *Antechinus* AND *Phascogale* (SENSU STRICTO)

| | i ² | i ³ | i ⁴ | p ¹ | p ³ | p ⁴ | i ₁ | i ₂ | i ₃ | p ₁ | p ₃ | p ₄ |
|---------------------------------------|----------------|----------------|----------------|----------------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|------------------|
| <i>Antechinus flavipes</i> group | | | | | | | | | | | | |
| <i>flavipes</i> | 0.75 | — | 0.65 | 0.95 | 1.10 | 1.20 | — | — | — | — | — | — |
| <i>unicolor</i> | 0.75 | 0.70 | 0.80 | 1.05 | 1.20 | 1.25 | 0.75 | 0.60 | 0.55 | 1.20 | 1.30 | 1.05 |
| <i>rufogaster</i> | 0.80 | 0.60 | 0.65 | 1.00 | 1.15 | 1.30 | 0.75 | 0.60 | 0.60 | 1.15 | 1.30 | 0.85 |
| <i>adustus</i> | 0.80 | 0.70 | 0.75 | 1.00 | 1.15 | 1.20 | 0.80 | 0.65 | 0.60 | 1.10 | 1.35 | 1.10 |
| <i>leucogaster</i> | 0.70 | 0.60 | 0.65 | 0.95 | 1.00 | 1.00 | 0.70 | 0.60 | 0.55 | 1.00 | 1.20 | 0.70 |
| <i>godmani</i> | 0.75 | 0.75 | 0.75 | 1.15 | 1.35 | 1.40 | 0.80 | 0.75 | 0.60 | 1.45 | 1.70 | 1.20 |
| <i>melanurus</i> ^a | 0.85 | 0.75 | 0.75 | 1.20 | 1.35 | 1.40 | 0.80 | 0.65 | 0.75 | 1.25 | 1.45 | 1.20 |
| <i>centralis</i> | 0.80 | 0.75 | 0.75 | 1.25 | 1.45 | 1.55 | 0.80 | 0.70 | 0.80 | 1.40 | 1.60 | 1.35 |
| <i>tafa</i> | 0.75 | 0.70 | 0.75 | 1.20 | 1.50 | 1.70 | 0.70 | 0.65 | 0.80 | 1.35 | 1.60 | 1.45 |
| <i>misim</i> | 0.85 | 0.80 | 0.85 | 1.30 | 1.65 | 1.75 | 0.85 | 0.75 | 0.90 | 1.45 | 1.65 | — |
| <i>wilhelmina</i> | 0.75 | 0.70 | 0.75 | 1.05 | 1.25 | 1.30 | 0.65 | 0.60 | 0.70 | 1.25 | 1.30 | 1.20 |
| <i>Antechinus maculatus</i> group | | | | | | | | | | | | |
| <i>maculatus</i> | 0.40 | 0.35 | 0.35 | 0.45 | 0.50 | 0.80 | 0.50 | 0.35 | 0.30 | 0.65 | 0.80 | 0.35 |
| <i>minutissimus</i> | 0.40 | 0.40 | 0.40 | 0.50 | 0.55 | 0.75 | 0.50 | 0.45 | 0.40 | 0.65 | 0.80 | 0.50 |
| <i>sinualis</i> | 0.45 | 0.40 | 0.40 | 0.50 | 0.75 | (^b) | 0.50 | 0.40 | 0.40 | 0.60 | 0.85 | (^b) |
| <i>Antechinus swainsonii</i> group | | | | | | | | | | | | |
| <i>swainsonii</i> | 0.80 | 0.80 | 0.75 | 1.30 | 1.40 | 1.15 | 0.75 | 0.70 | 0.60 | 1.40 | 1.50 | 1.15 |
| <i>mimetes</i> | 0.80 | 0.80 | 0.90 | 1.20 | 1.35 | 1.35 | 0.70 | 0.65 | 0.65 | 1.35 | 1.55 | 1.25 |
| <i>minimus</i> | 0.85 | 0.70 | 0.80 | 1.10 | 1.15 | 1.20 | — | — | — | 1.20 | 1.30 | 1.10 |
| <i>affinis</i> | 0.80 | 0.80 | 0.80 | 1.05 | 1.20 | 1.25 | 0.75 | 0.60 | 0.55 | 1.15 | 1.40 | 1.25 |
| <i>Antechinus bellus</i> | 0.75 | 0.70 | 0.65 | 0.90 | 1.15 | 1.20 | 0.80 | 0.60 | 0.50 | 1.10 | 1.30 | 1.15 |
| <i>Planigale ingrami</i> | 0.35 | 0.35 | 0.30 | 0.40 | 0.45 | 0.75 | 0.45 | 0.40 | 0.35 | 0.50 | 0.65 | 0.40 |
| <i>Phascogale</i> (s.s.) | | | | | | | | | | | | |
| <i>pirata</i> | 1.00 | 0.80 | 0.80 | 1.30 | 1.60 | 1.65 | 1.00 | 0.80 | 0.70 | 1.75 | 2.00 | 1.30 |
| <i>calura</i> | 0.85 | 0.65 | 0.65 | 1.10 | 1.25 | 1.25 | 0.90 | 0.70 | 0.55 | 1.25 | 1.45 | 0.90 |

^a Topotype.

^b Milk teeth, crown lengths, 0.50 mm., 0.35, respectively.

TABLE 7

CROWN LENGTHS (IN MILLIMETERS) OF INCISORS AND PREMOLARS IN (CHIEFLY) TYPE SPECIMENS OF BOTH PRIMITIVE AND SPECIALIZED DASYURINAE. NOTE PROGRESSIVE OBSOLESCENCE OF P_4^4

| | i^2 | i^3 | i^4 | p^1 | p^3 | p^4 | i_1 | i_2 | i_3 | p_1 | p_3 | p_4^4 |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| <i>Parantechinus lorentzii</i> ^a | 1.10 | 1.20 | 1.30 | 1.70 | 1.80 | 1.60 | 1.10 | 1.20 | 1.35 | 2.00 | 2.30 | 1.00 |
| <i>Neophascogale apicalis</i> | 0.70 | 0.70 | 0.70 | 1.10 | 1.45 | 0.70 | 0.80 | 0.70 | 0.70 | 1.20 | 1.50 | 0.50 |
| <i>Phascosorex doriae</i> ^a | 0.90 | 1.10 | 1.20 | 1.90 | 2.10 | 1.50 | 1.00 | 1.00 | 1.50 | 2.30 | 2.40 | 1.00 |
| <i>brevicaudata</i> | 0.70 | 0.70 | 0.80 | 1.30 | 1.50 | 1.00 | — | — | — | 1.60 | 1.80 | 0.65 |
| <i>whartoni</i> | 0.60 | 0.70 | 0.90 | 1.30 | 1.60 | 1.10 | 0.85 | 0.85 | 1.20 | 1.80 | 1.85 | 0.80 |
| <i>Pseudantechinus mimulus</i> | 0.50 | 0.45 | 0.60 | 0.80 | 0.90 | 0.80 | 0.60 | 0.45 | 0.45 | 1.00 | 1.25 | none |
| <i>Myoictis pilicauda</i> | 0.95 | 1.00 | 1.20 | 1.50 | 1.80 | 1.70 | 1.00 | 0.95 | 1.00 | 2.20 | 2.20 | 1.40 |
| <i>melas</i> ^a | 0.95 | 1.00 | 1.30 | 1.90 | 2.00 | 1.30 | 1.00 | 1.00 | 1.05 | 2.40 | 2.30 | none |
| <i>wavicus</i> | 1.00 | 1.10 | 1.20 | 1.40 | 1.80 | 1.40 | 1.00 | 1.00 | 1.10 | 2.00 | 2.00 | 0.70 |
| <i>Dasycercus cristicauda</i> ^b | 0.80 | 0.70 | 0.90 | 1.40 | 1.90 | 0.60 | 0.90 | 0.70 | 0.75 | 1.80 | 1.90 | none |
| <i>Dasyuroides byrnei</i> | 0.75 | 0.90 | 1.00 | 1.50 | 1.70 | 1.25 | 0.90 | 0.80 | 0.80 | 1.90 | 2.10 | none |
| <i>pallidior</i> | 0.70 | 0.85 | 0.85 | 1.45 | 1.55 | 1.10 | 0.80 | 0.70 | 0.70 | 1.75 | 2.10 | none |
| <i>Santanellus daemonellus</i> | — | — | — | 2.50 | 2.90 | none | — | — | — | — | — | none |
| <i>fuscus</i> | 1.05 | 1.15 | 1.30 | 1.80 | 2.40 | none | 1.20 | 1.00 | 1.15 | 2.00 | 3.15 | none |
| <i>hallucatus</i> | — | — | — | 1.90 | 2.90 | none | — | — | — | — | — | none |
| <i>exilis</i> | — | — | — | 1.90 | 2.70 | none | — | — | — | — | — | none |
| <i>predator</i> ^a | 1.00 | 1.05 | 1.15 | 2.40 | 2.90 | none | 1.15 | 1.00 | 1.15 | 2.70 | 3.00 | none |
| <i>nesaeus</i> | — | — | — | 2.20 | 3.00 | none | — | — | — | — | — | none |
| <i>Dasyurinus geoffroyi</i> | — | — | — | 2.70 | 3.20 | none | — | — | — | — | — | none |
| <i>fortis</i> | — | — | — | 3.00 | 3.30 | none | — | — | — | — | — | none |
| <i>Dasyurus (s.s.) quoll (=viverinus)</i> ^a | 1.30 | 1.40 | 1.30 | 3.30 | 3.70 | none | — | — | — | — | — | none |
| <i>Dasyurops maculatus</i> ^a | 2.00 | 2.00 | 1.80 | 3.60 | 4.60 | none | 2.00 | 1.80 | 1.70 | 3.80 | 4.40 | none |
| <i>gracilis</i> | — | — | — | — | 3.70 | none | 1.80 | 1.60 | 1.80 | 3.60 | 3.70 | none |
| <i>Sarcophilus harrisii</i> ^a | 3.00 | 2.50 | 3.70 | 4.20 | 6.30 | none | 3.00 | 2.80 | 3.30 | 4.50 | 5.60 | none |

^a Not a type.

^b Teeth larger in males than in females.

TABLE 8

COMPARATIVE MEASUREMENTS (IN MILLIMETERS) OF *Pseudantechinus macdonnellensis* AND *P. mimulus*

| | <i>macdonnellensis</i> Topotype, A.M.N.H. No. 15011 (skull) | <i>mimulus</i> Type, Female B.M. No. 6.3.9.75 |
|--|---|---|
| Number of mammae | 6 | ? |
| Length of head and body | ± 105 ^a | 76.0 |
| Length of tail | ± 73 ^a | 74.0 |
| Length of hind foot (s.u.) | ± 14.5 ^a | 13.5 |
| Greatest length of skull | 27.0 | 24.7 |
| Basal length | 25.5 | 22.0 |
| Zygomatic breadth | 15.5 | 14.6 |
| Length of nasals | 9.5 | 9.0 |
| Greatest breadth of nasals | 2.8 | 3.1 |
| Least interorbital breadth | 5.7 | 5.3 |
| Height of crown above basion | 6.4 | 5.6 |
| Palatal length | 13.8 | 13.0 |
| Anterior palatal foramina | 2.4 | 2.0 |
| Breadth at outer corners of penultimate molars | 9.0 | 8.8 |
| Anteroposterior length of bullae: | | |
| With periotic | 6.8 ^b | 5.8 |
| Without periotic | 3.8 | 3.8 |
| Length of three anterior molariform teeth | 5.8 | 5.2 |
| Breadth of braincase | 11.8 | 11.2 |
| Mastoid breadth | 13.2 | 11.0 |
| p ₁ ¹ , crown lengths | 1.0 | 0.8 |
| | 1.2 | 1.0 |
| p ₂ ³ , crown lengths | 1.2 | 0.9 |
| | 1.3 | 1.25 |
| p ₄ ⁴ , crown lengths | 0.5 | 0.8 |
| | 0.0 | 0.0 |

^a Figures taken from Horn's report.

^b Thomas' figure.

TABLE 9
CROWN LENGTHS (IN MILLIMETERS) OF THE PREMOLARS AND LENGTH
OF m^{1-3} IN THE RACES OF *Satanellus hallucatus*

| | Males | | | Females | | |
|--------------------------|-------|-------|-----------|---------|-------|-----------|
| | p^1 | p^3 | m^{1-3} | p^1 | p^3 | m^{1-3} |
| <i>hallucatus</i> (type) | | | | 1.9 | 2.9 | 12.5 |
| <i>predator</i> (type) | 2.4 | 3.0 | 13.1 | | | |
| A.M.N.H. No. 108872 | 2.4 | 3.0 | 11.0 | | | |
| A.M.N.H. No. 108875 | 2.7 | 3.1 | 12.7 | | | |
| A.M.N.H. No. 108771 | | | | 2.4 | 3.2 | 13.4 |
| A.M.N.H. No. 108773 | | | | 2.4 | 3.2 | 13.0 |
| A.M.N.H. No. 108774 | | | | 2.3 | 3.0 | 13.3 |
| A.M.N.H. No. 108776 | | | | 2.3 | 3.2 | 12.1 |
| A.M.N.H. No. 108777 | | | | 2.5 | 3.0 | 12.7 |
| A.M.N.H. No. 108778 | | | | 2.1 | 2.9 | 12.9 |
| <i>nesaeus</i> (type) | 2.2 | 3.0 | 12.3 | | | |
| <i>exilis</i> (type) | 1.9 | 2.7 | 11.0 | | | |

