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## RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 55

### NOTES ON THE SQUIRREL-LIKE AND MOUSE-LIKE POSSUMS (MARSUPIALIA)

By G. H. H. TATE

Due to the indefatigable work of the Archbold New Guinea Expeditions, good series of many rare species hitherto lacking from, or scarcely represented in, the collections of the American Museum have been obtained. Notable among them is the fine representation of the New Guinea dormouse possum, *Eudromicia caudata*. Other material reported on includes the Australian collections made by the late Henry C. Raven and by Gabriele Neuhäuser.

One new form of *Dactylopsila trivirgata* is described.

All but one of the members of the two phalangerid subfamilies included in this paper are referable to the Phalangerinae; *Schoinobates*, the greater possum glider, belongs to the Phascolarctinae.

#### Subfamily Phalangerinae

Eight genera, excluding *Phalanger*, recently reviewed (Tate, 1945a), and *Trichosurus* (not treated here) are included in this family. Three, *Dactylopsila*, *Dactylonax*, and *Gymnobelideus*, are squirrel-like; *Petaurus* and *Acrobates* function like flying squirrels; *Eudromicia*, *Cercartetus*, and *Distoechurus* are mouse-like.

Jones (1923), perhaps as a matter of convenience, based his two primary divisions of the Phalangerinae upon the form of the tail—whether distichous or not. The presence or absence of gliding membranes was obviously held to be secondary. Yet both are interrelated functionally and are undoubtedly highly plastic characters. Other external characters dwelt upon by him included the degree of development of the toe pads and again the character of the pelage of the tail. The

form of the teeth was employed only to distinguish between *Dactylopsila* and *Phalanger*. It seems better now to attempt a classification based upon apparently less readily modified characters such as those of the teeth and the skull.

The basic phalangerine pattern of dentition comprises three well-developed incisors, a canine, three premolars, the last (fourth) by far the largest ( $p_2^2$  never developed), and four molars. The opposing lower teeth are one large central, chisel-shaped incisor, one large premolar (the fourth), between which stand a varying number of minute, nearly obsolete teeth, and four lower molars. To this pattern *Phalanger*, *Trichosurus*, *Dactylopsila*, *Dactylonax*, *Petaurus*, *Gymnobelideus*, and *Eudromicia* conform. *Acrobates*, *Distoechurus*, and *Cercartetus* are aberrant in various ways. In *Acrobates* the two upper premolars anterior to  $p^4$  are double-rooted and quite as large as that tooth, and  $p_3$  is as large as or larger than  $p_4$ . This condition may be secondary or it may demonstrate retention of a primitive state lost in other genera. In *Distoechurus*, as pointed out earlier (Tate and Archbold, 1937, pp. 388–390),  $p^3$  is the dominant premolar,  $p^1$  being only slightly smaller, but  $p^4$  very much smaller. In the lower jaw a single premolar, probably  $p_3$ , is set off from the molars by a diastema that perhaps formerly accommodated a minute  $p_4$ . In addition,  $m_1^1$  are absent. In *Cercartetus* the premolar system does not differ much from the supposedly typical pattern,  $p^4$  being somewhat reduced but neither  $p^1$  nor  $p^3$  enlarged, but  $m_1^1$  are obsolete. Of the three, *Cercartetus* is the least aberrant. *Distoechurus* and

*Acrobates* are not only markedly differentiated; they have taken quite different evolutionary courses. The distichous characters of the tails of *Distoechurus* and *Acrobates* are actually widely different, the fringe of hairs of the former being stiff, like the webs of a feather, while those of *Acrobates* are relatively soft (Jones, 1923, pp. 188-189). Moreover, though *Acrobates* has gliding membranes, *Distoechurus*, contrary to published statements, has none. I determined this point in New Guinea by examining a fresh-killed specimen (A.M. N.H. No. 105938). A final marked difference is to be noted in the mammary arrangement. Jones gives the nipple count as four in *Acrobates*; in *Distoechurus* there is a single nipple, median in position. *Cercartetus*, in which  $m_4^+$  are absent, is derived directly from *Eudromicia*.

Turning next to the remaining phalangerine genera, *Eudromicia*, *Dactylopsila*, and *Phalanger* can be taken as relatively generalized types. Only the extreme tip of the tail is prehensile in the first two. The first is mouse-like, the second squirrel-like, the third lemur-like. *Dactylopsila*, by specialization of the fourth finger, produced *Dactylonax* but is also a close relative of *Trichosurus* (which has fewer premolars) and, probably, of the rare *Gymnobelideus*. It also gave rise to the flying phalanger, *Petaurus*, by the development of gliding membranes. The genus *Phalanger* has carried scansorial adaptations to an extreme by great development of the prehensile function of the tail, enlargement of the claws, and a general slow-down of its rate of movement. The number of young is reduced in *Phalanger* to one or two.

It may be worth while to note that taxonomic balance is still far out of adjustment in the marsupials. On the one hand the scale-tailed flying squirrels, *Anomalurus*, of Africa, and the true flying squirrels are both treated as subfamilies (or families) of the Sciuromorpha. On the other hand *Petaurus*, in which analogous specialization has occurred, is still held in a subordinate position as a genus of the Phalangerinae. The same thing holds with *Schoinobates* in the Phascolarctinae. It has still to be

sufficiently recognized that the Australian marsupials include many single relicts of extremely ancient lines.

#### THE PYGMY POSSUMS OR POSSUM MICE

Of the two genera of naked-tailed pygmy possums, *Cercartetus* (= *Dromicia*) and *Eudromicia*, recognized by Iredale and Troughton (1934), the first is typified by *C. nanus* of Tasmania, the second by *E. macrura* of Queensland. A few years ago I studied the type specimens of both in London as well as those of most other species and forms.

Iredale and Troughton have established the fact that *Dromicia* Gray is antedated by *Cercartetus* Gloger. The type of each is *Phalangista nana*. In January, 1916, Mjöberg proposed *Eudromicia* for his *macrura*, a Queensland species in which  $m_4^+$  were present. The retention of these teeth was adduced by him as a character distinguishing *Eudromicia* from *Cercartetus* (= *Dromicia*). In April of the same year Matschie proposed *Dromiciola*, with type *lepida* of Tasmania, which Iredale and Troughton consider equal to *Eudromicia*, and *Dromiciella* with type *nana*, a pure synonym of *Cercartetus*.

Of the two genera, *Eudromicia*, in which the number of molar teeth is  $\frac{4}{4}$ , is the less specialized, while *Cercartetus* (= *Dromicia*) in which  $m_4^+$  is not developed, is the more specialized. Apparently *Cercartetus* is derived from *Eudromicia*. The geographical range of *Cercartetus* includes the southern parts of eastern and western Australia, and Tasmania, of *Eudromicia* the whole of New Guinea, the northeastern coastal strip of Australia, and Tasmania. *Cercartetus nanus* has developed the ability to store fat during the southern winter months in the temporarily swollen basal portion of the tail, in the same way as do some species of *Sminthopsis* and the South American *Marmosa elegans* group.

#### GENUS EUDROMICIA

*Eudromicia* Mjöberg, 1916 (January), K. Svenska Vetensk. Akad. Handl., vol. 52, no. 2, p. 13.

*Dromiciola* Matschie, 1916 (April), Mitt. Zool. Mus., Berlin, vol. 8, no. 2, p. 260.

Mjöberg based *Eudromicia* upon *E. macrura* of northern Queensland; Matschie founded *Dromiciola* upon *Dromicia lepida* from Tasmania. In both generic diagnoses the presence of  $m_4^4$  is mentioned; the relatively large size of  $p_4$  is pointed out by Matschie. I believe, with Iredale and Troughton, that *macrura* and *lepidus* are congeneric. *Dromicia caudata* of New Guinea, in which  $m_4^4$  are present also, must be regarded as a third member of the genus.

#### ***Eudromicia caudata* (Milne Edwards)**

*Dromicia caudata* MILNE EDWARDS, 1877, Compt. Rendus Acad. Sci., Paris, vol. 85, pp. 1079-1080.

Material studied since publishing earlier (Tate and Archbold, 1937, p. 385) includes the type specimen in Paris, the skull of which was cleaned for me the same year; several other specimens in the Berlin Museum from the Huon Peninsula (Saruwaged); four from the Angabunga River in the Tring Museum; one in the British Museum brought by Shaw Mayer from Fergusson Island; also a series of 30 specimens from the Mount Wilhelm-Lake Habbema area of Netherlands New Guinea, 5000-13,000 feet, collected by W. B. Richardson and now in the Archbold collection. These last include 19 specimens of a paler form from the Balim River, 5000 feet, and the Bele River, 7000 feet, and 11 of a very dark form from Mount Wilhelm, 10,000-13,000 feet. The former series is colored much as typical *caudata*. The latter, though easily distinguishable by its smoky color, has the skull and dimensions of the body identical to those from lower altitudes.

#### ***Eudromicia macrura* Mjöberg**

*Eudromicia macrura* MJÖBERG, 1916, K. Svenska Vetensk. Akad. Handl., vol. 52, no. 2, p. 4.

Two specimens, Stockholm 5255 and 5256, were kindly sent me for study while I was in London. Compared with *caudata* (A.M.N.H. No. 104054), from Matsika, *macrura* is smaller, and has larger bullae and larger anterior and posterior palatal foramina. The dental characters and dimensions of the teeth are substantially

the same. In other respects it is very similar, being clearly more closely related to the New Guinea specimen than to *lepidus* of Tasmania.

#### ***Eudromicia lepida* (Thomas)**

*Dromicia lepida* THOMAS, 1888, Catalogue... Marsupialia and Monotremata, p. 142.

The type of this species, an adult female from Tasmania, is B.M. No. 52.1.15.11, the body in alcohol, the skull cleaned. The species is very much smaller than *E. macrura*, *E. caudata*, or *Cercartetus nanus*. The teeth are approximately equal in size to those of *C. concinnus*. There is as yet no evidence that *E. lepida* is able to store fat in the basal portion of the tail as *C. nanus* can.

#### **GENUS CERCARTETUS**

*Cercartetus* GLOGER, 1841 (before May), Hand- und Hilfsbuch der Naturgeschichte, vol. 1, p. 85.

*Dromicia* GRAY, 1841 (November), in Grey, Journals of two expeditions... in... Australia, vol. 2, pp. 401, 407.

*Dromiciella* MATSCHIE, 1916, Mitt. Zool. Mus., Berlin, vol. 8, no. 2, p. 260.

*Phalangista nana* Desmarest is type for both *Cercartetus* and *Dromicia*; *Dromicia concinna* Gould for *Dromiciella*.

*Cercartetus* is chiefly distinguished from *Eudromicia* by its lack of  $m_4^4$ . The sizes of  $p_4^1$ , employed by Jones (1925, p. 97) in his key, serve only to separate *concinna* from *nana*, *gliriformis*, *britta*, and *unicolor*.

#### ***Cercartetus nanus* (Desmarest)**

*Phalangista nana* DESMAREST, 1818, Nouv. Dict. d'Hist. Nat., nouv. ed., vol. 25, p. 477.

The type specimen of *C. nanus* from Maria Island, Tasmania, collected by Perron and Lesueur, Paris No. 160 (192), is a juvenal male, so young that  $m_2^2$  are only partly erupted. The skull was extracted from the mounted skull and cleaned for me to study, in 1937.

The upper fourth premolar is a comparatively large tooth with anterior and posterior cusps; the two anterior premolars are quite small. The bullae are unusually large.

The present color of the badly faded skin is brownish gray, the underparts dirty white, with the bases of the hairs gray.

Subspecies of *C. nanus* have been named in South Australia, New South Wales, and Victoria. This obviates the need to assume that *gliriformis*, stated by Bell (1829) to have come from "Australia," was a mislabeled Tasmanian specimen. More probably *gliriformis* will supersede either *unicolor* from Sydney, New South Wales, or *britta* from South Australia.

Although the type of *nanus* has the dentition so little advanced that the status of  $m_1^4$  cannot be determined, Iredale and Troughton have synonymized *Dromiciella* with *Cercartetus*, thus indicating their belief in the absence of  $m_1^4$  in *nanus*. Besides this Thomas (1888, p. 146) had before him a number of other Tasmanian specimens that must have satisfactorily substantiated the molar tooth count for *nanus*. In the cases of *britta* and *unicolor* the describers specifically refer to the molar formula,  $m_1^{1-3}$ . The skull of the type of *gliriformis* has the posterior ends of the tooththrows broken off, but has the large-sized teeth of *nanus* and *uniformis*. Otherwise the presence of  $m_1^4$  in *gliriformis* is not proved. Probably the races of *nanus* should be written *nanus nanus*, Tasmania; *nanus gliriformis* = *unicolor*, New South Wales and Victoria; *nanus britta*, South Australia.

The name *nanus* is a misnomer; the teeth of *nanus* are almost as large as those of *Eudromicia caudata* and *E. macrura*. They are much larger than those of either *C. concinnus* or *E. lepidus*.

*Cercartetus nanus* alone of the mouse opossums is recorded as storing fat in its tail during the southern winter.

#### *Cercartetus concinnus* (Gould)

*Dromicia concinna* GOULD, 1845, Proc. Zool. Soc. London, p. 2.

*Phalangista (Dromicia) neillii* WATERHOUSE, 1846, Natural history...mammals, vol. 1, p. 315.

This is the only one of the pygmy possums that has pure white underparts. The molars are three only in number, the teeth about as long as, but more compressed than, those of *E. lepidus*. Besides giving its well-known distribution in Western Australia, Jones (1925, p. 96) records it from South Australia.

I have examined the cotypes from the Swan River in the British Museum and one at the Tring Museum from Preston, southwest Western Australia; also the type of *neillii*.

#### THE SQUIRREL-LIKE POSSUMS

##### *Dactylopsila trivirgata*

The following specimens have been either studied in European museums or added to the Archbold collections since 1937. The types of *trivirgata*, *albertisii* (= *angustivittis*), *occidentalis*, *arfakensis*, *kataui*, *picata*, *biedermanni*, *melampus*, *hindenburgi*, and *megalura* have been examined. New material representing known races in the Archbold collection comprises one *kataui* from upper Fly River, four *kataui* from south New Guinea, two *melampus* from the Kokoda Road, north of Port Moresby, and one specimen from Hollandia (?), three specimens of *picata* from north Queensland. Specimens previously studied include American Museum and Archbold material from Weyland Mountains, a large series of *D. t. kataui*, and several *melampus*.

It now appears that the specimens from the Weyland Mountains, formerly referred by me to *D. t. trivirgata*, are better considered as *D. t. arfakensis*. Although both *trivirgata* and *arfakensis* have the hands white, the black chin patch is undivided in the latter and in the Weyland Mountains series. In the type of *trivirgata* from the Aru Islands the black chin patch is divided longitudinally by a broad white line.

##### *Dactylopsila trivirgata infumata*, new subspecies

TYPE: A.M.N.H. No. 107203, adult male; Lake Barrine, near Cairns, Queensland, 2400 feet; collected by Gabriele Neuhäuser, December 12, 1937. The type, a skin with skull in good condition.

GENERAL CHARACTERS: A much darker race of *D. trivirgata* than *D. t. picata*, with the pale lines of the back greatly narrowed by the broadened dark areas, the blackish mark of the chin divided by a narrow pale line running from the throat to the middle of the lower lip (duplicated only in typical

*trivirgata* from Aru Islands); the hands and feet white, the underside of the tail, excluding the buff-colored tip, blackish brown, washed with buffy.

**DESCRIPTION OF THE TYPE:** The dark, lined areas of head, back, and limbs are blackish brown, less intensely black than in *D. t. picata*, the pale stripes grayish buff, not white as *picata* and not continued onto the tail (in true *picata* the buffy white sides and underside of the tail are continuous with the white dorsal stripes). The underparts are cream buff, the hairs of the median area self-colored along a width of 10 mm., wider at the chest and inguinal area and extending down the insides of the arms and legs. On either side of that median area the ventral pelage has gray bases and buff tips which combine to give a light buffy gray effect. In true *picata*, on the contrary, the area of self-colored hairs may be 30 mm. in width and the margining gray band hairs have much larger and whiter tips. The hairs of the metacarpal and metatarsal areas are white as in typical *trivirgata*, not blackish as in *picata*.

The skull appears similar to skulls of *D. t. picata* except in one small character which may not prove to be constant: the form of  $m^4$ . In the new race the posterior half of  $m^4$  is wider proportionately than in *picata*, *kataui*, or *melampus*, giving it a subrectangular instead of a subtriangular outline.

**MEASUREMENTS OF THE TYPE:** Length of head and body, 273 mm.<sup>1</sup>; tail, 347<sup>1</sup>; hind foot (s. u.), 46<sup>1</sup>; width of pale dorsal line at shoulders, 5 mm. ( $\approx$  10 mm. in *picata*); skull, condylobasal length, 55.5; zygomatic width, 42.3; mastoid width, 33.6; length of nasals, 19.5; least intertemporal width, 8.9; depth of zygoma behind postorbital process, 5.0; teeth,  $p^4$ - $m^4$ , 14.4; crown dimensions of  $p^4$ , 2.5 by 2.0; of  $m^1$ , 3.9 by 3.3; width of anterior loph of  $m^4$ , 2.2; of posterior loph, 1.9 (in *picata* 2.1, 1.6, respectively).

**REMARKS:** A second specimen of this smoky-colored striped phalanger, A.M. N.H. No. 107204, from Evelyn near Lake Barrine, was collected by Miss Neuhausser.

<sup>1</sup> Made in the flesh.

Unfortunately it has no skull. The skin is colored almost precisely like the type; the white chin stripe is even wider. For comparison three typical individuals of *picata*, two from Coen, one from Rocky Scrub, are available. These agree with Thomas's description (1908) and with Troughton's plate (1941). *Dactylopsila t. infumata* appears to be as closely related to the Aru Islands *trivirgata* as *picata* is to *kataui*.

#### **Dactylonax palpator** (Milne Edwards)

*Dactylopsila palpator* MILNE EDWARDS, 1888, Mem. Soc. Philom., Centenaire, Paris, pp. 173-177.

Since writing my notes on *Dactylonax* (Tate and Archbold, 1937) I have had the privilege of examining the following material in European museums: the type of *D. palpator* (Paris Nos. 188, 257c, collected by Laglaize); Berlin No. A22,01, Aroa River; five specimens taken by Stein in the Weyland Mountains; and the type of *D. p. ernstmayri* (Berlin No. 42418, from Jungsaing, Huon Peninsula). The 1938 Archbold New Guinea Expedition obtained seven specimens of *Dactylonax* near Lake Habbema and two south of the Idenburg River.

The Archbold series from Lake Habbema, 2200-2800 meters, consists of four adult males, two adult females, and one juvenal (pouch?) female; that from south of the Idenburg River, 850-1200 meters, of two adult males. The tails of the former are much more densely haired than those of the latter, the width of the caudal pelage being 2½ inches in the former, 1½ inches in the latter. The Idenburg specimens match the Stein series from Weyland Mountains,  $\approx$  6000 feet. The caudal pelage of the juvenal specimen is closely appressed to the tail instead of being erect and spreading as in adults. A sex character is perceived in the zygoma; its depth just behind the postorbital process in the males is from 5.5 to 7 mm., depending upon the degree of maturity, in the females from 4.8 to 5.3.

The minute middle upper premolar, usually present in *Dactylopsila*, is a fluctuating character in *Dactylonax*. It is present

on both sides in five males and one female, absent on both sides in one male and one female.

The number of minute lower teeth between the large incisor and  $p_4$  is five in one male, four in all the other specimens.

The juvenile (A.M.N.H. No. 109415) has the flat-crowned  $i^2$ , the smallest of the three upper incisors in the adult state, fully erupted. The canine is partly functional, and the minute  $p^3$  is fully in place. The teeth that are partly through are  $i^1$ ,  $i^3$ ,  $p^2$ ,  $p^4$ , and  $m^1$ . In the mandible,  $i_1$  and  $p_4$  are partly functional. The four tiny intervening teeth, fully functional and polished, are probably used to hold the mamma. The first two lower molars are just showing behind  $p_4$ . Both upper and lower milk premolars have already been shed.

Elongation of the fourth anterior digit of the juvenile is fully as complete proportionally as in the adults. This is obvious if comparison is made with a juvenile *Dactylopsila*. The two basal phalanges (excluding the claw-bearing phalanx) measure together 14 mm. in *Dactylonax*, 11.5 in *Dactylopsila*. The basal phalanx of the same digit shows even greater contrast, 8.2:6.2 mm.

In the two juvenals of *Dactylonax* and *Dactylopsila* the color pattern shows essential differences. In the former the paired white dorsal lines terminate at the rump, their margining black areas converging at the tail to make the tail wholly black, above and below, except its white tip. In *Dactylopsila* the paired white dorsal lines are continued onto the sides of the tail to within about an inch of its black tip. These two lines are separated dorsally and ventrally by black lines. The dorsal black line is a continuation of the median dorsal black line and is merged distally with the black tail tip. The ventral line begins very narrow, 1 inch behind the vent and, gradually broadening, also joins the black terminal area of the tail. The ventral surface of the extreme tip of the tail appears not to be prehensile in *Dactylonax*. In all species of *Dactylopsila* except *D. megalura* the tactile area is perfectly obvious.

The white ring around the wrist in *D. p. ernstmayri* is not important. One of our Habbema specimens has the entire lower leg white.

### **Gymnobelideus leadbeateri** M'Coy

*Gymnobelideus leadbeateri* M'Coy, 1867, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 287.

Originally from the Bass River, Victoria. The little that is known about this probably extinct species was well discussed by Brazenor (1933). The generic name is not suitable; Brazenor states that there are no flying membranes.

### GENUS **PETAURUS**

*Petaurus* SHAW AND NODDER, 1791, The naturalist's miscellany, vol. 2, pl. 60.

Three species are currently placed in *Petaurus*: *P. australis*, the large, broad-headed *Petaurus* or "Yellow-bellied Possum-Glider" (Troughton, 1941), *P. norfolcensis*, the apparently rare, medium-sized "squirrel-glider," and *P. breviceps*, the small, rather common "sugar-glider." To the last the Australian forms *longicaudatus* and *ariel* and all the flying phalangiers described from New Guinea and its outlier islands appear to be sub-specifically related. *Petaurus norfolcensis* and *P. breviceps* are much more closely related than either is to *P. australis*; perhaps their differences are also only sub-specific.

Aside from differences of size and the not very easily appreciable differences in the external characters of these flying phalangiers, certain absolute characters perceivable in the skulls are shown in table 1.

### **Petaurus australis**

*Petaurus australis* is sharply differentiated from all other species of *Petaurus* by the great breadth of the palate; the unusually great outer width across the canines is approximately equal to the length  $p^4-m^4$ , and the outer width across  $m^1-1$  exceeds it substantially. The back of the skull is correspondingly wide. The paroccipital processes descend almost twice as far as do the rather well-inflated alisphenoid bullae. The audital meatus is much

shorter (from the bulla to the opening of the tube) than in either *P. norfolcensis* or *P. breviceps*. Of the teeth,  $p_3^3$  are less reduced, and the molars are broad and massive. The coronoid process of the mandible seen from the side is broad and somewhat hooked compared with the narrow, unhooked, almost pointed coronoid in *norfolcensis* and *breviceps*.

**Petaurus australis australis**  
Shaw and Nodder

*Petaurus australis* SHAW AND NODDER, 1791, The naturalist's miscellany, vol. 2, pl. 60.

Typical *P. australis* is shown by Iredale and Troughton (1934) to have come from

Neuhäuser from Mount Spurgeon, north-east of Coen, Queensland.

**Petaurus norfolcensis**

This rare "flying-squirrel" is represented in the American Museum of Natural History by only three specimens, formerly on exhibition, from which the skulls have lately been removed and cleaned. They differ from *P. australis* by the characters already mentioned, but from *P. breviceps* their differences, other than those of size and the length and fullness of the tail, are less appreciable. The principal feature of anatomy by which they can be distinguished from *breviceps* is the propor-

TABLE 1

	<i>P. australis</i>	<i>P. norfolcensis</i>	<i>P. breviceps</i>
Mastoid width			
Zygomatic width	± 76	80-85	± 85
Depth of paroccipital process			
Depth of bulla	± 108	± 97	± 100
Length of meatus			
Zygomatic breadth	± 13	± 20	± 17
Outer width across c-c			
Length $p^4-m^4$	± 107	± 78	± 85
Width $m^1$			
Outer width $m^{1-1}$	± 45	± 20	± 20
Length crown $p^3$			
Length $p^4-m^4$	± 19	± 14	± 12
Length crown $p^3$			
Length crown $p^4$	± 79	± 76	± 67
Length crown $p_2$			
Length crown $p_4$	± 100	± 70	± 55

Sydney, New South Wales. Troughton (1941) gives the range as from southern Victoria to southern Queensland, eastern Australia. The American Museum collections include no specimens referable with certainty to this race. Strangely enough the late H. C. Raven, although he obtained a fine series of both northern and southern *Schoinobates*, failed to secure a single specimen of *Petaurus australis*.

**Petaurus australis reginae** Thomas

*Petaurus australis reginae* THOMAS, 1923, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 249.

Six specimens of this northern Queensland race of the yellow-bellied flying phalanger were assembled by Miss Gabriele

tionately smaller degree of reduction of  $p_4$  and the greater degree of inflation of the bullae. The close similarity of the proportions of the skulls and teeth of these flying phalangers to those of *P. breviceps* and the marked and important differences from those of *P. australis* and its northern race *reginae* can scarcely be overemphasized.

**Petaurus norfolcensis norfolcensis**  
(Kerr)

*Sciurus (Petaurus) norfolcensis* KERR, 1792, Animal kingdom . . . of Linnaeus, pt. 1, p. 270.

The type locality of *norfolcensis*, according to Iredale and Troughton (1934), is Sydney, New South Wales, not Norfolk

Island. Its range, Troughton (1941) signifies, includes Victoria, New South Wales, and at least southern Queensland. In northern Queensland the race *P. n. gracilis* replaces it.

We have no specimens of this southern race in the collections of the American Museum of Natural History.

#### ***Petaurus norfolcensis gracilis* De Vis**

*Petaurus norfolcensis gracilis* DE VIS, 1883, Proc. Linnean Soc. New South Wales, vol. 7, p. 619.

The type locality of this form is "north of Cardwell," northern Queensland.

In the American Museum of Natural History are two very faded specimens of this animal, withdrawn from exhibition, which are labeled Rockhampton, Dawson River. A third specimen, without exact locality, remains undetermined for geographical race. The skulls of all three have recently been taken out of the skins and cleaned.

#### ***Petaurus breviceps***

Since *P. breviceps*, the smallest of the flying phalangers except the tiny *Acrobates*, was described in 1839, several additional forms have been made known in Australia and New Guinea. My present study of the species of *Petaurus* makes me feel reasonably certain that all of these are very closely related to *breviceps*; it demonstrates that *breviceps* alone of the three species of *Petaurus* has reached New Guinea.

The named forms of *breviceps* and their type localities and ranges, so far as ascertained, are:

NAME	TYPE LOCALITY	RANGE
<i>breviceps</i> = <i>notatus</i>	New South Wales and Victoria	Southeastern Australia
<i>longicaudatus</i>	Mapoon Mission, Gulf of Carpentaria	Northern Queensland
<i>ariel</i>	Port Essington	Northern Territory, Australia
<i>flavidus</i>	Oriomo River	South New Guinea
<i>papuanus</i>	Huon Gulf	Forested New Guinea lowlands, and New Britain, etc.
<i>tafa</i>	Mt. Tafa, 2000 meters	Central mountain system of New Guinea
<i>biacensis</i>	Biak Island	?

Besides occurring about everywhere on the mainland of New Guinea between sea level and 6000 feet, the short-headed

flying phalangers are present on many outlying islands, including New Britain, Goodenough, Aru, Kei, Halmahera. Jentink records specimens from Soek and Mafool in the Geelvink Bay (possibly equal to *biacensis* from Biak), and from Misol, Bachian, Gilolo and Ternate.

#### ***Petaurus breviceps breviceps* Waterhouse**

*Petaurus breviceps* WATERHOUSE, 1839, Proc. Zool. Soc. London, (for 1838), p. 152.

*Petaurus (Belideus) notatus* PETERS, 1859, Monatsber. Akad. Wiss. Berlin, p. 14.

Unfortunately the American Museum of Natural History still lacks material referable to this southern flying phalanger. I have examined and measured the skin of the type (there is no skull), B.M. No. 55.12.24.78, and the skull of another specimen from Paramatta, New South Wales, B.M. No. 10.7.16.6, male. The type is a short-tailed animal (125 mm.), its hind foot measuring 26 mm. (c. u., 28 mm.). The skull is generally larger than those of either the type of *papuanus*, or of *flavidus* or *ariel*.

Concerning the type skin my notes are: "specimen dirty. Dorsal stripe faintly visible, slightly more distinct on head. Body color darker gray than in *ariel*. Underparts dirty white with gray bases. Tail smoky gray, its distal 40 mm. fuscous. Hands and feet dark gray. The skull is reputed to be no. 361 of the collection in the Zoological Society of London."

#### ***Petaurus breviceps longicaudatus* Longman**

*Petaurus breviceps longicaudatus* LONGMAN, 1924, Mem. Queensland Mus., vol. 8, abstr., p. ix.

This form is established by such a brief description that it barely passes the requirements of the International Commis-



sion on Zoological Nomenclature. I have examined two of Longman's cotypes, preserved in alcohol, at Brisbane. No skulls had been cleaned. They were numbered 4291, male, and 4292, female. The head and body measured 153 mm. and 115 mm., respectively, the tails 187 and 190. The hind foot of the male was 24 mm. This race is thus distinctly longer-tailed than either *papuanus* or *breviceps*.

We have in New York a short series from several parts of northern Queensland collected by Miss Gabriele Neuhäuser. Several have the tail even longer than Longman's cotypes, in others it measures  $\pm 160$  mm., or even as short as in *flavidus* or *ariel*, though not so short as in the type specimen of *breviceps*. Moreover, the tails are much more heavily haired than in *flavidus*, and all three of our specimens from the region west of Coen differ by having the tip of the tail colored perfectly white beyond the place where the basal gray gives place to fuscous. Whether our material from near Coen and from Rocky Scrub and Somerset farther north can be truly referred to *longicaudatus* is still problematical.

#### ***Petaurus breviceps ariel* (Gould)**

*Belideus ariel* GOULD, 1842, Proc. Zool. Soc. London, p. 11.

The type specimen of this form, B.M. 42.5.26.1, an adult female from Port Essington, Northern Territory, has been examined. Other material from the Northern Territory seen includes three specimens from the South Alligator River and one from Katherine River (all at Tring Museum).

The dorsal color of the type is light gray, almost devoid of the yellow-brown wash often seen in *flavidus* of south New Guinea. The underparts are pale self-colored buff. The pouch hairs are russet. The middle one of the three upper premolars is peg-like and single-rooted. The crowns of the third and fourth minute lower teeth between the large lower incisor and  $p_4$  are also much reduced—to 0.3 or 0.35 mm. in length.

#### ***Petaurus breviceps papuanus* Thomas**

*Petaurus breviceps* var. *papuanus* THOMAS, 1888, Catalogue... Marsupialia and Monotremata, p. 158.

*Petaurus (Petaurella) papuanus papuanus* TATE AND ARCHBOLD, 1937, Bull. Amer. Mus. Nat. Hist., vol. 73, p. 387.

In addition to our records given in 1937, several specimens referable to this lowlands race, collected by L. A. Willis, have been received from near the mouth of the Kemp Welch River, Papua.

The provisional assumption is made on the basis of incomplete data that the flying phalangers of the southeast coast of New Guinea are equal systematically to those of the northeast coast (true *papuanus*). This may be true for the whole of the New Guinea lowlands that receive heavy rainfall during most of the year. As pointed out under *P. b. flavidus* the yellowish color of the flying phalangers of the monsoon grass country may be seasonally induced.

#### ***Petaurus breviceps flavidus* Tate and Archbold**

*Petaurus (Petaurella) papuanus flavidus* TATE AND ARCHBOLD, 1935, Amer. Mus. Novitates, no. 810, p. 25; 1937, Bull. Amer. Mus. Nat. Hist., vol. 73, p. 387.

Since the original series from the Oriomo River was reported, a second series of 20 specimens from the neighborhood of the Wassi Kussa, on the south coast of New Guinea, has been obtained. These skins merely confirm previous conclusions that the majority of the individuals are marked with yellow brown above and have buffy white underparts. A few, however, are grayer.

It seems probable that material from the Aru Islands (recorded by Jentink), which were probably connected with south New Guinea during the last glacial period, should be referred to *flavidus*. It is an interesting fact that the few specimens obtained by the Archbold Expeditions in the extensive low-altitude grasslands near Hollandia, the Cyclops Mountains, and Lake Sentani, all near the north coast of New Guinea and totally cut off from the south New Guinea grasslands, are also washed with pale brownish and have

buffy underparts. This condition may then be somatic, the result of exposure to intense sunlight or some other environmental factor. The material from the northern area mentioned, though indistinguishable from *flavidus* on the basis of color above, is all longer-tailed and to that extent is more in agreement with *papuanus* of the Huon area, New Britain, and the D'Entrecasteaux Islands. I question whether these animals are sufficiently distinct to merit a subspecific name. In any case, Ulmer's *biacensis*, based upon a single skin without skull, may be available for them.

### ***Petaurus breviceps tafa***

Tate and Archbold

*Petaurus (Petaurella) papuanus tafa* TATE AND ARCHBOLD, 1935, Amer. Mus. Novitates, no. 810, p. 1; 1937, Bull. Amer. Mus. Nat. Hist., vol. 73, p. 387.

Additional material representing this dark-colored mountain race was obtained by me at Kagi, 5000 feet, on the trail from Port Moresby to Kokoda; Kagi is on the south slope of the Owen Stanley Range. No specimens were taken by Richardson in the Balim Valley near Mount Wilhelm. In western New Guinea Stein took *Petaurus* only in the lowlands, while Shaw Mayer's specimens from the Weyland Mountains, reported by Rothschild and Dollman without altitude, may also have been lowlands specimens. Evidence is still needed to show that the smoky-hued mountain form occurs at all in Netherlands New Guinea.

### **GENUS ACROBATES**

*Acrobates* DESMAREST, 1818, Nouv. Dict. d'Hist. Nat., nouv. ed., vol. 25, p. 405.

Troughton (1941) follows the example of Jones (1923) in inserting *Cercartetus* (= *Dromicia*) and *Gymnobelideus*, both of which lack flying membranes, between *Acrobates* and *Petaurus*. All are shown by the form of their molar teeth to be phalangerine, not phascolarctine marsupials. Jones places *Acrobates* next to *Distoechurus* of New Guinea, which also has the caudal pelage markedly distichous. I have already pointed out (Tate and Archbold, 1937) that *Acrobates* is not a very close relative of *Distoechurus*, but differs by certain char-

acters of its premolar dentition. Later I had the opportunity to examine and remark upon types or topotypes of all *Acrobates* (Tate, 1938).

From the fact that in *Acrobates* the last molar is obsolete, it follows that this genus cannot be directly ancestral to *Petaurus*. Other specializations in *Acrobates* include the subequal sizes of  $p^2$  and  $p^4$  (in most phalangerines  $p^4$  is much the larger, but in *Distoechurus*  $p^4$  is extremely small); the only slightly inflated mastoid bulla; the very large posterior palatal openings; the greatly broadened interorbital region (incipient in *Petaurus australis*).

The relative narrowness of the gliding membrane of *Acrobates* is not necessarily a mark of incomplete development; it may be correlated instead with the small size and insignificant weight of the animals.

### ***Distoechurus pennatus* Peters**

*Distoechurus pennatus* PETERS, 1874, Ann. Mus. Civ. Genova, ser. 1, vol. 6, p. 303.

Two additional specimens of the feather-tailed mouse possum have rather recently been added to the Archbold collection: a female from Kurasimari, Sepik River, 2000 feet, December, 1929; and a second female from Sturt Island, Fly River, western Papua, 50 feet, October, 1936. The former is referable to the race *neuhäussi*, the latter to *dryas*.

The Fly River specimen was interesting for the reproductive condition noted: a single mamma in the forward-opening pouch, placed medially, and a single pouch juvenal. The central position is analogous to the centrally placed nipples in the South American didelphids *Marmosa* and *Momodelfis*; the absence of paired mammae may be either fortuitous or constant.

The following is quoted from my notes on the same specimen: "Ears small and naked; the interior of the conch bearing tufts of long, very soft hair which projects laterally. The single juvenal was carried in the pouch parallel with the mother's body. The mammary gland converged upon the single median teat placed at the bottom of the pouch near the pubic arch. The epipubic bones seem to be absent. Only 5 mm. of the tip of the tail are pre-

hensile. No trace of flying membranes. Eyes large, probably luminous at night. The young, with the head very large, becoming downy on head and neck; the tail and the hind feet near the fifth metatarsal pigmented. Length of head and body of pouch young, 45 mm."

The lack of genera closely related to *Distoechurus* has been indicated earlier in this paper.

### Subfamily Phascolarctinae

#### GENUS *SCHOINOBATES*

*Didelphis volans* KERR, 1792, The animal kingdom... of Linnaeus, pt. 1, p. 199.

*Schoinobates* LESSON, 1842, Nouveau tableau du règne animal, p. 190.

*Petauroides* THOMAS, 1888, Catalogue... Marsupialia and Monotremata, p. 163.

The American Museum collection now contains two forms of *Schoinobates*, the phascolarctine flying phalangiers, currently known as *S. v. volans* and *S. v. minor*. Of the former we have 10 specimens collected by the late H. C. Raven in New South Wales, of the latter 23 taken by the same collector on Atherton Tableland, northern Queensland, and seven by Miss Gabriele Neuhäuser at various stations in northern Queensland (Evelyn, Dimboola, and Mount Spurgeon). There are two more recorded races of these mammals, *S. v. armillatus* from "southern mid-Queensland" (Iredale and Troughton, 1934), and *S. v. incanus* from "South-eastern Queensland."

The skulls of *minor* and of true *volans* differ from each other to a greater degree than do the skulls of *Pseudocheirus peregrinus* and *laniginosus* which I recently

(Tate, 1945b) united as subspecies of a single species. The geographical analogy between the distributional patterns of *S. volans* and *P. peregrinus* is also close. It is therefore preferable at this time to retain the conspecific status of *volans* and *minor*, while pointing out their distinctive characters.

From *S. v. volans*, *S. v. minor* differs sharply by its much smaller size including the tooththrows ( $m^{-4}$ , 12.2/14.2 mm.; width of  $m^1$ , 2.6/2.9); by the lack of a pronounced groove on the inferior surface of the bulla exteroposteriorly from the eustachian opening; by its relatively larger, more slender paroccipital processes; by the much less massive posterior margin of the palate; and by the truncation of the nasal bones posteriorly. In the mandibles the lighter weight of the teeth is similarly marked (the length of the crown of  $p_4$ , 2.2/2.9).

The skins of the two races differ chiefly by the ashy gray body color, brownish limbs and ears, and pure white underparts of *minor* in contrast to the blackish brown body color, tipped with pale gray, blackish limbs and ears, and partly gray-based white ventral hairs in *volans*. In two specimens of *S. v. volans* taken by Raven at Ebor, New South Wales, the backs and bases of the ears are white instead of smoky, the white extending to, and confluent with, the white of the throat. There is no indication of such white areas in the account and plate of the "Black Flying Opossum," published by Governor Phillips, from which Kerr's (1792) technical description was taken.

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