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A REVISION OF THE GENERA TAPHOZOUS AND SACCOLAIMUS (CHIROPTERA) IN AUSTRALIA AND NEW GUINEA, INCLUDING A NEW SPECIES, AND A NOTE ON TWO MALAYAN FORMS.

By

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(Plates xlvii-xlviii.)

When recently compiling a popular work upon the bats of Australia and New Guinea, I found it impossible either to differentiate or discredit certain species hitherto included in the genus *Taphozous*.

The type of Ramsay's *hargravei* was known to be in the Australian Museum collection, and a review of all the material yielded other interesting specimens, most important of these being the type of *T. flaviventris* Peters. This type has not been examined or commented upon since Gould returned it to Waterhouse, after its description in 1866, when the author failed to remark upon the absence of wing pouches; this omission, coupled with his likening the species to *australis*, led to a Taphozoan tangle which this paper endeavours to unravel. Also in the Museum collection are two specimens from Port Moresby, Papua, whose characters and colouration apparently warrant their description as a new species.

Upon appealing to the Director of the Queensland Museum, Mr. H. A. Longman, F.L.S., as to the validity of De Vis' species, *nudicluniatus* and *fumosus*, he promptly forwarded me typical material of the two species for examination, and has since very kindly forwarded four *flaviventris* from Queensland. In the same liberal manner the Committee of the Macleay Museum has kindly placed the bats of that collection at my disposal.

I am, therefore, very favourably equipped with material for the purposes of this paper, which endeavours to reorganise the New Guinea and Australian species previously relegated to *Taphozous* in its unrestricted form; the seven species hitherto recorded for the above area are reduced to three, their characters being reviewed and more clearly defined. The addition of one new species, and the elevation of *T. a. georgianus* to specific rank, makes five species in all for the area under review.

To the authorities of both the above institutions my most sincere thanks are due for their generous response to an appeal for material; also to Mr. John Shewan, Curator of the Macleay Museum, for his help in selecting specimens. I also desire to express very sincere thanks to my friends, Messrs. Allan R. McCulloch and Tom Iredale, for their helpful comment and advice, and to Miss Joyce K. Allan and Mr. J. R. Kinghorn, for their help in preparing several illustrations.

The genera TAPHOZOUS and SACCOLAIMUS.

Dobson (1875) divided *Taphozous* into two subgenera, *Taphozous* and *Taphonycteris*, and Hollister (1913) later regarded the two as distinct genera. Thomas (1915) also admitted their generic status, but pointed out that the name *Saccolaimus* antedated that of *Taphonycteris* by many years. He also (1922) synoptically arranged the genera of the *Taphozous* group. An examination of all the material available to me, however, shows that an important character used to separate *Taphozous* and *Saccolaimus* is not constant.

Though the absence of wing pouches has been considered typical of *Saccolaimus*, De Vis wrote that they were either very small or absent in his *nudicluniatus*, which has the complete bullae typical of *Saccolaimus*. Further, upon examination of a new species described below, I find the complete bullae typical of *Saccolaimus*, and the clearly developed wing pouches of *Taphozous*. In view of these conflicting characters it is necessary to modify Thomas' synopsis, and, as I consider the character of the bullae alone insufficient to distinguish the genera, it appears to me probable that additional material may prove the generic distinction untenable. Meanwhile the two genera may be synoptically arranged thus:—

A. Bullae perfect, the antero-internal sides complete. Upper anterior premolar proportionately larger, and acutely cusped. Radio-metacarpal pouch rudimentary or absent (well developed in *mixtus* only). Inner margin of ear not papillate. Lower outline of mandible convex beneath premolars in the Australian and New Guinea species ..... *Saccolaimus.*

B. Bullae imperfect, the antero-internal sides incomplete. Upper anterior premolar proportionately very small and simple, not acutely cusped. Radio-metacarpal pouch always well developed. Inner margin of ear papillate. Lower outline of mandible markedly concave beneath premolars in the Australian and New Guinea forms ..... *Taphozous.*

Genus SACCOLAIMUS *Temminck.*

Saccolaimus (Kuhl MS.) Temminck, Monogr. Mamm., ii, 1841, pp. 277, 279 (Type by tautonomy *T. saccolaimus* Temm., *Ibid.*, p. 285). *Id.*, Lesson, Nouv. Tabl. Regn. Anim., 1842, Mamm., p. 19 (published as a synonym of *Taphozous* from Kuhl MS.). *Id.*, Miller, U.S. Nat. Mus. Bull. 57, 1907, p. 93. *Id.*, Thomas, Journ. Bombay Nat. Hist. Soc., xxiv, 1915, p. 57, and Ann Mag. Nat. Hist. (9) ix, 1922, p. 266.

Taphonycteris Dobson, Proc. Zool. Soc. 1875, p. 548, and Cat. Chir. B.M., 1878, p. 379 (subgenus for *T. saccolaimus, affinis,* and *peli*). *Id.*, Monticelli, Ann. Mag. Nat. Hist. (6) iii, 1889, pp. 487-9. *Id.*, Hollister, Proc. U.S. Nat. Mus., xlvi, 1913, p. 308. *Id.*, Thomas, Journ. Bombay Nat. Hist. Soc., xxiv, 1915, p. 57.

Diagnosis.—Bullae complete antero-internally, there being a total lack of the emargination of their inner sides such as found in *Taphozous*. Radio-metacarpal pouch absent except in *nudicluniatus* (very small or absent), and in *mixtus* (clearly developed). Lower lip divided in front by a deep groove which varies in depth, but is always more clearly marked than in *Taphozous*. Inner margin of ear not papillate. Small anterior upper premolar proportionately much larger, and with a longer and more acutely pointed cusp than is found in the allied genus. Lower outline of the mandible convex beneath the premolars, in the three Australian and New Guinea species.

Genotype.—*S. saccolaimus* (*T. saccolaimus* Temminck).

Range.—India, Ceylon, Burma, Philippines, Austro-Malaysia, New Guinea to Australia.

Synonymy and history.—*Saccolaimus* was omitted by Dobson but is quoted by Miller as of Lesson in such a manner that the name could have been regarded as a pure synonym of *Taphozous*, as Lesson's work is unavailable to me. The name was revived by Thomas (1915) without any information concerning its history, and its validity was therefore in doubt according to the records given by the two authors. I have, however, traced the original introduction by Temminck as above, definitely establishing the validity of *Saccolaimus*.

Key to the species occurring in Australia and New Guinea:—

A. Undersurface conspicuously lighter than upper. Posterior floor of mesopterygoid fossa deeply grooved. Sphenoid pits deep, their median ridge high, rising to the level of the floor of the mesopterygoid fossa.

a. Forearm 70 - 80 mm. Wing pouches absent. Small secondary gular sac present. Undersurface creamy white. Basal length of skull 22 - 23.5 mm. ..... *flaviventris.*

b. Forearm 61.5 - 62.5 mm. Wing pouches present. Secondary gular sac absent. Undersurface pale buff-brown. Basal length of skull 18.5 - 19 mm. ..... *mixtus*

B. Undersurface not conspicuously lighter than upper. Posterior floor of mesopterygoid fossa smooth, without a deep groove. Sphenoid pits shallow, their median ridge low, not rising nearly as high as the floor of the mesopterygoid fossa ..... *nudicluniatus.*

SACCOLAIMUS FLAVIVENTRIS *Peters.*

(Pl. xlvii-xlviii.)

Taphozous flaviventris Peters, Proc. Zool. Soc. 1866 (1867), p. 430. *Id.*, Waterhouse in Harcus, South Austr., 1876, p. 192 (record only). *Id.*, Dobson, Cat. Chir. B.M., 1878, p. 382. *Id.*, Ogilby, Cat. Mamm. Austr., 1892, p. 96. Id., De Vis, Ann. Q'land Mus. No. 6, 1905, p. 37, and 38 (footnote). *Id.*, Lönnberg, Kungl. Svensk. Vet. Ak. Handl., lii, 2, 1916, p. 3 (record only).

Taphozous australis, var. *flaviventris* Dobson, Proc. Zool. Soc. 1875, p. 551.

Taphozous hargravei Ramsay, Proc. Linn. Soc. N.S. Wales, i, 1, 1876, p. 81. *Id.*, Dobson, Cat. Chir. B.M., 1878, pp. 382-3. *Id.*, Ogilby, *loc. cit.* *Id.*, De Vis, *loc. cit.*

Taphozous affinis, var. *insignis* Leche, Proc. Zool. Soc., 1884, pp. 51-53, fig. 4 a-c. *Id.*, Ogilby, *loc. cit.*, pp. 96-97.

Diagnosis.—Forearm 70-80 mm. Size large, females slighter in form and skull dimensions. Male with a large gular sac, (Pl. xlvii, fig. 1) upon the ventral wall of which is situated a small secondary sac; gular sac absent in females. Wing pouches absent in both sexes. Outer base of ear commencing exactly midway between the corner of the mouth and the rear base of the tragus. Lower lip grooved in front. Colour above auburn to blackish brown; creamy white below. Basal length of skull 22-23.5 mm. *Hab.* Australia.

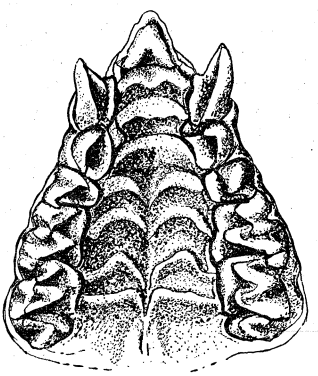


Fig. 1. Palatal ridges of *S. flaviventris.*

External characters.—Inner margin of ear commencing above the eye, slightly convex to the tip; the outer margin is slightly concave below the tip, followed by an even convexity, ending opposite the tragus where the margin is thickened and emarginate, thence convex to the outer base situated midway between the angle of the mouth and the tragus base. Outside of ear almost naked except for a sparse edging of hairs at the base; inside sparsely but evenly haired. Tragus (Pl. xlvii, fig. 1e) with inner edge evenly concave, rounded but somewhat uneven above, a deep notch just below the top on the outer edge. The groove in the centre of the lower lip is not so sharply incised, nor the ridges on each side so clearly defined as in Dobson's figure of *affinis* or my specimen of *saccolaimus*, the borders of the groove being broadly and smoothly rounded. The width between the nostrils is also greater than in the figure of *affinis*, in which they are shown as barely separated. Palatal ridges (Fig. 1) with the four hindmost divided into double arches. Measurements on p. 321.

Pelage.—Head well furred to between the eyes, thence the snout is sparsely covered with short hairs to its tip. Fur of back extending a short distance onto the wing membrane, to a line drawn between the upper thirds of the humerus and femur; the long fur barely extends onto the interfemoral, ending in a straight line slightly beyond the tail-root, rest of membrane very slightly haired. Below the wing membranes are lightly furred as above.

Skull (Pl. xlviii, fig. 1a-d).—Palation slightly posterior to the lateral palatal edges. Posterior floor of mesopterygoid fossa deeply grooved. Sphenoid pits smaller but deeper than in *nudicluniatus,* and, unlike the condition in that species, the median dividing ridge rises as high as the floor of the mesopterygoid fossa. Saggital crest well defined and extending to the occiput. Lower outline of the mandible roundly convex beneath the canine and anterior premolar, thence almost straight posteriorly, there being no trace of the marked concavity found in *T. australis.*

A careful comparison of the crania of the types of *hargravei* and *flaviventris,* and the male from Moree with the secondary pouch, as well as crania from Queensland localities, shows them to agree in all characters and in general contour. The skull of the type of *hargravei,* in my opinion an adult female, is slightly more slender in general proportions, the frontal region is not so broad or the forehead so deeply excavated, and the brain-case is not quite so inflated as in males. There is a skull of a female from Eidsvold, Queensland, exactly the same length as the *hargravei* skull, with which it agrees in all details, the conclusion therefore being that the slightly shorter length and more slender build is typical of the skulls of females of *flaviventris* over a wide range. Correspondingly three males, including the type of *flaviventris,* the Moree specimen, and one from Queensland, have skulls of the same length, and very consistent in having the same dimensions and general contour.

Small upper anterior premolar proportionately very large, equal to half, or more than half, the size of the posterior premolar; the cusp long and sharply pointed.

Variation.—A series of twelve specimens indicates that the colour of the back is decidedly variable, ranging from a darkish auburn brown to blackish brown with black tips. Hitherto *flaviventris* has been regarded as a yellow-bellied form as opposed to the white-bellied *affinis,* but it appears that the under surface of specimens of *flaviventris* is somewhat variable in colour. This conclusion is supported by statements contained in letters from Miss Florence M. Irby, of Casino, New South Wales, who presented two specimens to the Museum, and who wrote of the under surface colour:—"My brothers found five in a hollow tree . . . two are creamy white, others yellowish and one a pure white. I have now examined nine of these bats and can see absolutely no difference in them beyond that of the colours underneath. I really think it is merely a difference of age. The first four examined were pure white." The fur is unicoloured, though somewhat lighter basally above and below.

The large gular sac and small secondary sac on its ventral wall are present in the spiritous males from Moree, New South Wales, and Eidsvold, Queensland, and, in my opinion, the secondary sac is faintly discernible in Peters' mutilated type. In the nine dried and spiritous females examined there is no trace of the development of rudimentary edges of a gular sac, though in several specimens there is a slight difference in the integument, or sparseness of the fur, which indicates the area of the gular sac.

Leche described and figured the tragi of the type of his var. *insignis* as being differently shaped on each side, but each tragus in all my specimens of *flaviventris* is similar in shape to the right hand tragus of *insignis* (fig. 4 b.), the left tragus of Leche's type apparently being distorted.

History and characters of type.—Waterhouse forwarded the type specimen, a male, to Gould, and the species was described by Peters in 1867, who stated that it was "represented by a single male submitted to my examination by Mr. Gould." The type was returned to Waterhouse, who forwarded it to the Australian Museum as part of an exchange in 1871, the specimen being listed in a letter headed "South Australian Institute, Museum, Adelaide, 5 July, 1871," with the following note in Waterhouse's handwriting: "separate 1. *Taphozous flaviventris.* Bad but *only* duplicate at present. This specimen was sent to Gould and is described in Proc. Z. Soc., Nov., 1866." From the foregoing it appears that Waterhouse sent the type, which was in very bad condition and whose value was not then so apparent, preferring to keep the better but far less interesting duplicate.

In describing the type of *flaviventris,* which is a male, Peters traced the existence of the "large fossa" or gular sac common to many species of the genus but, owing to the mutilated condition of the type, failed to observe any traces of the small secondary sac, whose presence he probably did not even suspect. However, in spite of the rough incision through the centre of the gular region, it is still possible to discern the edges of the large gular sac. I also consider that with care, under strong binoculars, one can trace the edges of a small secondary sac such as is figured for *insignis.* The mutilation of the specimen doubtless took place with the original skinning, Waterhouse having referred to the "bad" condition of the specimen in 1871, and it was doubtless in this damaged and poorly preserved state when examined by Peters. Though unable to discern any very certain signs of the secondary pouch in the type, I infer that Peters' specimen possessed this feature in common with Leche's type of the variety *insignis,* as the Moree and Queensland males, which both possess the secondary pouch, agree with the type of *flaviventris* in every other plastic and cranial character.

After careful examination I can definitely state that there are no traces of wing pouches in Peters' type, and therefore *flaviventris* is distinguished from *australis* by the total absence of the wing

pouches which are so well developed in the latter, and not only by size and colour as hitherto understood. Unfortunately Peters overlooked mentioning that *flaviventris* lacked wing pouches, therefore his statement that it was "nearly related" to *australis,* being "different in colour and its superior size" misled subsequent authors, who believed that *flaviventris* also possessed wing pouches. Much confusion has resulted from this belief, and Dobson, being unable to examine Peters' type, stored in the Australian Museum since 1871, placed the species next *australis* in the wing-pouched section of the genus. Consequently De Vis, supposing that *flaviventris* possessed wing pouches, erroneously maintained that "*hargravei* is a sound species and a fine one," because the latter lacked them.

Discussion of Synonyms.

T. hargravei.—A detailed examination of Ramsay's type satisfies me that Dobson was correct in regarding *hargravei* as synonymous with *flaviventris,* though in spite of Ramsay's definite statement that "There is no sign of a gular pouch," Dobson cast doubt upon its absence which he regarded as "the only difference of importance." Indeed, were the type of *hargravei* a male, the absence of the pouch would have served to separate the two species, all the males of *flaviventris,* possessing well developed pouches. However, I cannot agree with Dobson's suggestion that Ramsay might have failed to observe the presence of a gular pouch, after having "examined it carefully in water." Examination of the type of *hargravei,* whose measurements, colour and plastic characters agree in detail with a female *flaviventris* from Moree, convinces me that no gular pouch existed in Ramsay's type. A feasible explanation is that owing to the remarkable prolongation of the female genitalia anteriorly, Ramsay mistook the sex of his type, which is really a female and not a male as stated by him. As in several other species of the *Taphozous* group, there is no trace of even the rudimentary edges of a gular pouch in females of *flaviventris;* the absence of the gular pouch in Ramsay's type therefore confirms the identity of the two species.

T. affinis insignis.—In describing his South Australian specimen as a variety of the Malayan *affinis,* Leche was apparently unaware of the existence of *flaviventris* as he wrote that "up to this time only one Australian species belonging to this genus is known, viz., *T. australis,* Gould."

There is a male in the Australian Museum collection from Moree, N.S.W., which has the large gular sac with a small secondary sac on its ventral wall, as described and figured by Leche for *affinis insignis.* A detailed comparison of this specimen with Peters' type of *flaviventris* shows them to agree exactly in their colour and cranial characters, their measurements and plastic characters also being quite in accord, excepting only the uncertainty regarding the presence of the secondary pouch in Peters' type.

Summary.—Just as the Moree male agrees in detail with Peters' type and Leche's description, so a female in the collection, which is also from Moree, agrees in every external detail, including colour and dimensions, with Ramsay's type of *hargravei* from Bulli, New South Wales. The association of the male and female forms in the same district at Moree further confirms the conclusion, of which I have no doubt, that *affinis insignis* represents the male, and *hargravei* the female of *flaviventris*. Contributing factors in the general confusion were that Peters was unable to discern traces of a secondary pouch and also failed to note the absence of wing pouches in his type; another factor being that both Leche and Ramsay overlooked the existence of *flaviventris* in describing their types, the latter author apparently being unaware that Peters' type was actually in the Museum collection.

Type.—An adult male, in the "old collection" of the Australian Museum. Received in exchange from F. G. Waterhouse in 1871, and entered as No. 137 in the Museum's earliest register compiled by Secretary Palmer about the year 1877. Tied to the type is an old label reading "*Taphozous flaviventris*, Gould, Proc. Zool. Soc., 1866, Male—Type." In view of this label and Waterhouse's letter noted above, I have no doubt that this specimen is the type of the species.

Other specimens examined.—A series of eleven males and females including the type of *hargravei* registered No. M.2349 in the collection of the Australian Museum, also four specimens lent by the Queensland, and one by the Macleay Museum.

Localities.—Bulli, Moree, and Casino, N.S. Wales; Woody Point, Eidsvold, Moreton Island, Charters Towers, and Cairns, Queensland; Port Darwin, Northern Territory.

Distribution.—South Australia (Leche), and northern South Australia (Waterhouse): Northern Territory; Queensland; New South Wales.

Conclusion and comparison with ally.—Upon reviewing a large series of specimens, including the type and that of a synonym, from a wide range of localities, I have no hesitation in concluding that *T. hargravei* and *T. affinis* var. *insignis* are synonymous with *flaviventris*.

Apparently most nearly allied to the *affinis-saccolaimus* form of India and Malaysia, *flaviventris* is readily distinguished by having a small secondary pouch situated on the ventral wall of the large gular sac in males, and by the females lacking even the rudiments of a gular sac such as is found in females of the allied form. The possession of the secondary pouch in males is apparently unique amongst Australasian members of the *Taphozous* group, being absent in the new species described herein, and doubtless lacking in *nudicluniatus* too, though males of the latter are not yet known. The simple flattened form of the tragus also serves to distinguish *flaviventris* from the two local allies.

Measurements of eleven examples of *Taphozous flaviventris* from Australia.

	137. Peters' type. Male. South Australia	M. 2349. *hargravei* type. Bulli, N.S.W.	M. 918. Male. Moree, N.S.W.	M. 3228. Female. Moree, N.S.W.	*affinis insignis*. Leche. South Australia	J. 1945. Male, Woody Pt,. Queensland	J. 3082-3. Eidsvold, Queensland		J. 4069. Female. Moreton Island. Queensland	M. 1667. Female. West of Charters Towers, Queensland	Macleay Museum. Female. Port Darwin
							Male.	Female.			
Forearm	76	77	80	76	70	76.5	79	75	74	70	73
Pollex—total length, c.u.	12	11.5	11.5	11.5	.....	11	12	11.5	11.5	11	10
2nd Digit—metacarpal ...	74	73.5	79.5	75.5	.....	73.5	76	70	73	73.5	70
3rd Digit—											
Metacarpal	80	80.5	84	80	68	79	82	76.5	77.5	70	76
1st phalanx	33.5	34.5	34.5	34.5	.....	34	38.5	33	34	30.5	32.5
2nd phalanx	35	38	39	39	.....	36	39	37	36	32.5	35
4th Digit—											
Metacarpal	63	63	67.5	64.5	.....	60	64,5	61	60	53	59
1st phalanx	20	20	20	18.5	.....	19.5	21	19	20	17	19
2nd phalanx	7	7.5	7.5	8	.....	7	8	7.2	8.5	6.5	6.5
5th Digit—											
Metacarpal	48.5	50.5	52	51	41	49.5	52.5	47	48.5	44	46
1st phalanx	16·5	17	18.5	16.5	.....	16	18.5	17	18.5	16.5	16
2nd phalanx	10	9.5-11	11.5	11.8	.....	11	11.5	11	11.5	10	10.2
Tragus—											
Length from middle of base.	5	5	5.5	5	7 (*vide* Leche)	5.5	5.2	5	5	4.6–5	5.8
Width of top	5	4	4.7	4.8	.....	5	5	4.8	4.5 & 5	.....	5.5
Ear—											
Length from outer base	22	20	23.5	21	25	24	23	21	23	20	23.5
Max. breadth flattened	14.5	13	15	15	.....	15	14	14	14.5	14.5	15
Tail—											
Free portion	9	5 –|–	7.5	10	9	12	15	10.5	11	7.5	10
Total length	25 –|–	23	28	24.5 –|–	23	27	31.5	28.5	31.5	17.5 –|–	27
Tibia	28	28	28.5	28	26	27.5	30.5	27.5	27	25	27.5
Foot—c.u.	15	14·5	14.5	14.5	.....	14	15	14.5	15.5	14	13.5
Corner of mouth to external base of ear.	6	.....	6	6	.....	6	5	6	.....	6	5

SACCOLAIMUS MIXTUS *sp. nov.*

(Plates xlvii-xlviii.)

Taphozous sp., Ramsay, Proc. Linn. Soc. N.S. Wales, iii, 1878 (1879), p. 243.

A much smaller form than *flaviventris* or *nudicluniatus*, possessing the complete inner sides of the bullae, proportionately large upper anterior premolar and grooved lip typical of *Saccolaimus*, combined with clearly developed wing pouches such as are invariably found in *Taphozous*.

Description.—Radio-metacarpal pouch present. Gular sac in the male (Pl. xlvii, fig. 3) forming a shallow but well defined pocket, the centre of the lip being considerably posterior to the points of origin of the ventral wall, the margins therefore enclosing a considerable area not covered by the pocket wall; from between the points of origin of the sac margins there projects into the gular region a furred area in the centre of which is a wart-like prominence, but posteriorly the enclosed gular region, as well as the shallow pocket, is naked. Though I am unable to decide the sex with certainty, there is a second specimen which I conclude to be a female, in which the gular sac is of similar shape and character, though enclosing a smaller area. Inner margin of ear arising above the eye, not papillate, and comparatively straight to the broadly rounded tip; upper half of outer margin broadly convex, the margin thickened and emarginate opposite the tragus, ending in a convexity which originates opposite, and about 3.5 mm. from the corner of the mouth. Tragus (Pl. xlvii, fig. 3e) differently shaped to that of *flaviventris* or *nudicluniatus*, not so simply flattened as in the former, and, though somewhat resembling that of the latter, it is proportionately longer and not so curiously thickened or rounded. Lower inner margin of the tragus concave, the convexity of the upper half sloping gradually backward to form the obliquely rounded top; upper half of the outer margin slightly serrated and twisted inward to form a fleshy ridge with its base situated on the front surface of the tragus, inward from the posterior edge of the outer lower half, which is convex.

Colour and pelage.—Fur unicoloured above and below, though above it is somewhat lighter at the base and some hairs are entirely grey. Above near Prout's brown (Ridgway), darkest on the head and shoulders, washed with buff-brown on the back owing to the lighter tips of the fur. Under surface evenly coloured, conspicuously lighter than the upper, and of a peculiar light shade of grayish buff-brown. According to Ramsay, who examined the specimens in a comparatively fresh state, the colour was "Under surface ashy white, back brown, wings and face black."

There is a thick tuft of dark brown fur behind the eyes which is continued in a sparser band up the inside of the ear; outside of ear naked for the upper two thirds. Front edge and top of tragus

fringed with hairs on each side. Face sparsely haired from in front of the eyes. Above, the fur does not extend far onto the membranes, reaching to a line drawn between the upper half of the humerus and the upper fourth of the femur; the long fur does not extend onto the interfemoral membrane beyond a line level with the vent, the rest of the membrane being very sparsely haired. Below, the antebrachial membrane is covered with light hairs, which also extend along the radius and form a thickish patch in the radio-metacarpal angle; wing membranes furred as above, the anal region and interfemoral membrane along the tail base being lightly haired. Fur above and below about 6 mm. long, and about 8 mm. on the sides of the neck. Membranes dark brown, lighter between the digits and along the hind border of the wing between the ankle and the fifth digit. Ear conch medium brown.

Skull (Pl. xlviii, fig. 3a-c).—Much smaller, and forehead more excavated than in *flaviventris* or *nudicluniatus*, but not so deeply excavated as in *T. australis*. Interorbital region very broad, the edges markedly concave, the breadth within 0.5 mm. of that of females of *flaviventris* and *nudicluniatus* in much larger skulls. The whole skull is broader and considerably more inflated than a skull of *T. australis* of equal length. The saggital crest does not reach backward to the occiput as in *flaviventris* and *nudicluniatus*. Palation level with, or slightly posterior to the lateral palatal edges. Posterior floor of mesopterygoid fossa deeply grooved. Sphenoid pits much as in *flaviventris*, the median dividing ridge barely reaching as high as the floor of the fossa, as it does in that species, but much higher than in *nudicluniatus*. Constriction very broad, much more so than in *T. australis* of the same size, as broad as in much larger skulls of *flaviventris* and *nudicluniatus*. The brain-case is remarkably inflated anteriorly, equalling the width above the attachment of the zygomata in the two allied but larger forms. Bullae proportionately large, almost as large as in the two allied forms. The lower outline of the mandible broadly convex, or almost straight, beneath the premolars, the convexity reaching its maximum beneath the posterior premolar; there is no trace of the concavity found in this position in *T. australis*.

Dimensions.—The type, a complete spirit specimen:—

Forearm, 61.5 mm.

Head and body 79; tail 23; tibia 23.5; ear, from outer base, 20; tragus 5; width across origin of gular margins 7; head, rear of tragus-base to nose tip, 20.5; 2nd digit, metacarpus, 56.5; 3rd digit, metacarpus, 60.5, first phalanx 23; 4th digit, metacarpus, 45, first phalanx 16.5; 5th digit, metacarpus, 31, first phalanx 14.5.

Dimensions of the skull of an adult, female?:—Basal length 18.5; condylo-basal length 20.5; palatal length 9; interorbital breadth 8; width of braincase at zygomata 10.5; intertemporal constriction 5.5; bulla length 4.8; front of canine to back of m^3, 9 mm.

Regarding these dimensions it should be noted that the measurements of a dried skin agree perfectly, to within a mm., with the spiritous type, excepting only in those features obviously subject to distortion in skinning, and in the 2nd phalanges of the 4th and 5th digits, which vary considerably in the same specimen. A duplicate skull also agrees perfectly in contour and measurements (within 0.5 mm.) with those given above. For additional measurements see pages 340-341.

Hab.—Port Moresby, Papua.

Type.—Adult male, number A.3257 in the Australian Museum collection. Other specimens, a dried skin and skull, A.3258, and an odd skull, A.3256, all from Port Moresby, and purchased from Kendal Broadbent in November, 1878.

Note on the typical series.—It is worthy of comment that Ramsay appreciated the differences exhibited by the specimens which are registered in the Australian Museum collection as "M.3256-8, *Taphozous australis,* Port Moresby, Purchased Kendal Broadbent, Nov., 1878." Under the reference quoted above Ramsay wrote: "Specimens from Broadbent's collection. Under surface ashy white, back brown, wings and face black, otherwise the same as the Cape York examples, from which it may prove to be specifically different."

Comparison with allies.—A small form distinguished from *flaviventris* and *saccolaimus* by the possession of wing pouches, and its much shorter forearm and skull. It may be further distinguished from the former by the shallow gular sac whose ventral wall is without the small secondary sac found in the male *flaviventris;* also, if the sex of the dried skin is correctly identified, the females of the new form possess a definite gular sac, which is entirely absent in the female *flaviventris.* From *nudicluniatus,* which according to De Vis may develop very small wing pouches, it differs in having a much shorter forearm and skull, and by having a conspicuously lighter under surface, instead of the almost uniform colouration found in the latter ally. The shape of the tragus also distinguishes this species, being thicker and more fleshy than the flattened, comparatively simple tragus of *flaviventris,* while it is proportionately longer and not nearly so rounded and thickened as in *nudicluniatus.* Cranially it is distinguished from De Vis' species by having the posterior floor of the mesopterygoid fossa deeply grooved instead of smooth, and by its deeper sphenoid pits with their dividing ridge rising almost to the level of the fossa floor, instead of being much below it as in *nudicluniatus.*

It is readily distinguished from all other forms with wing pouches typical of the genus *Taphozous* by its complete bullae typical of all *Saccolaimus.* Though of about the same size, it differs markedly from the local *T. australis* in the darker colouration of the fur of the back, which is not parti-coloured but brown from base to tip; below the fur is also unicoloured, not being tipped with brown as in *australis.* The

shape of the tragus, and more deeply grooved lip, also serve to distinguish the two forms externally, an additional feature being the larger anterior upper premolar, typical of all *Saccolaimus*.

SACCOLAIMUS NUDICLUNIATUS *De Vis.*

(Plates xlvii-xlviii.)

Saccolaimus nudicluniatus De Vis, Ann. Q'land Mus., No. 6, 1905, pp. 39-40.

Taphozous granti Thomas, Ann. Mag. Nat. Hist. (8) viii, 1911, pp. 378-9.

Diagnosis.—Forearm 71-75 mm. Form stout; digits short and heavy. Gular sac represented in females (Pl. xlvii, fig. 2) by a well defined almost naked area encircled posteriorly by rudimentary pouch edges; no doubt there is a gular sac present in males. Wing pouches absent, or very small (De Vis). Outer base of ear commencing much nearer the tragus base than the corner of the mouth. Lower lip thickened in front, slightly emarginate above, deeply grooved below. Colour above reddish brown, below paler brown. Condylo-basal length of skull 21-23 mm. Hab. North-eastern Queensland and S. Dutch New Guinea.

External characters.—Inner margin of ear commencing above the eye, its lower third concave, thence evenly convex to the tip, not papillate. The upper three-quarters of the outer margin forms a wide-angled convexity, in the lower part of which the ear margin is bent inwards to form a flattened ledge, which is deeply emarginate opposite the tragus, followed by a convex lobe which terminates the outer margin; the outer base reaches to about one-third of the distance between the outer tragus base and the mouth corner. Tragus (Pl. xlvii, fig. 2e) quite circular in its upper outline, peculiarly bulbous above, the front surface of this rounded upper portion concave, the hind surface very convex; covered with minute papillae and scattered hairs. There is a distinct notch at the middle of the outer margin, the rounded upper part of this margin curving inward and downward and ending in a ledge attached to the front surface of the tragus at the middle of its height; the notch is followed by a slight convexity, in its turn followed by a shallow concavity. Other characters as in the diagnosis.

Pelage.—Face in front of the eyes sparsely covered with short hairs; a vertical band of fur behind the eye. External basal third of ear conch furred, the rest naked; inside evenly but sparsely haired. Tragus hairy. Fur of the back extending onto the wing to a line between the proximal thirds of the humerus and femur; posteriorly the long fur does not extend past the femora but ends in a definite line drawn between their proximal ends, about 8 mm. from the tail base. Rest of back and interfemoral membrane sparsely haired. Below the fur is short and thin, the chin is sparsely haired to a level

with the outer ear bases; antebrachial membrane sparsely furred, a post-radial band also present and forming a thickish patch in the radio-metacarpal angle. Proximal third of the humerus covered with dark fur similar to that of the chest; wing membranes covered with lighter longish hairs to a line between the upper halves of the humerus and femur. Fur of the under surface not extending beyond the tail root.

Regarding the colour and external characters of their respective species as given by De Vis and Thomas, the striking similarity is best indicated by tabulating excerpts from each description as follows:—

nudicluniatus.	*granti.*
Colour—	
"back, rich red brown" with "scattered white spots" . . . "hairs white at the extreme base . . . beneath, pale greyish brown."	"above deep reddish brown" . . . mottled with a number of irregular whitish patches; bases of hairs paler. Under surface paler brown."
Gular sac in adult female—	
"represented by a fold of integument and nearly bare skin within its compass."	"represented in female by a sharply defined naked space on the throat, with distinct edges."
Radio-metacarpal pouch—	
"very small or absent . . . minute."	"No radio-metacarpal pouch."

The following table shows the important external and cranial measurements of *granti* to be very much in accord with those given by De Vis, and taken by myself, of specimens of the type series of *nudicluniatus*.

	granti.	*nudicluniatus.*	
	Type.	Female cotype.	De Vis' description.
Forearm	71	73.5	75
Head and body	89	92	93.5
Tail	24	26	26.5
Ear	18	19	16
Tragus	5	5	5
3rd Digit—			
metacarpus	67	72	—
1st phalanx	27.5	29.5	29
Skull—			
greatest length	21.7	25.8	—
condylo-basal length..	21	23	—
zygomatic breadth ..	16	17	—
interorbital breadth..	7.8	8.5	—
front of canine to back of m^3	10.1	10.8	—

The most important points of disagreement in these dimensions occur in the metacarpus length of the third digit, and greatest length of the skull. The disparity in the metacarpus lengths may quite conceivably be accounted for by variation, measurements of twelve *flaviventris* having shown the phalanges to be very variable at times, even in the same specimen. Regarding the greatest length of the skulls one can only assume there may have been an error in the printing of this measurement in Thomas' description, or else his specimen must be almost devoid of the comparatively strong and overhanging occipital helmet developed in the cranium of the female *nudicluniatus* examined by me. It is difficult to explain how the greatest length of the skull of the *granti* type should be given as only 0.7 mm. longer than its condylo-basal length, unless there was some discrepancy in the taking of the measurement; the measurement taken by myself is from the front of the canines to the posterior end of the occipital helmet. For additional measurements see pp. 340-1.

Skull.—Comparison of the skull (Pl. xlviii, fig. 2a-c) of a female cotype of *nudicluniatus* with Thomas' description of the skull of *granti* shows agreement in every detail, with the exception of the discrepancy noted above. As in *granti,* the forehead is not deeply excavated and the postorbital processes are unusually long, being 1 mm. longer than in the largest skull of *flaviventris.* The median palatal notch (palation) is decidedly posterior to the lateral palatal edges. The posterior part of the floor of the mesopterygoid fossa is smooth, without the deep, sharp, median groove found in *saccolaimus, flaviventris,* and *mixtus.* The sphenoid pits are large and not very deep, and their median dividing ridge is comparatively low, not rising nearly as high as the floor of the mesopterygoid fossa. Bullae about as in *flaviventris,* 5.3 mm. long. Lower outline of the mandible decidedly convex beneath the premolars, there being no concavity such as is found in *T. australis.*

Variation.—Thomas described the wing pouches as absent in the type of *granti,* whereas De Vis mentioned that they were either very small or absent; in the latter's cotype examined by me there are very faint but definite traces of rudimentary wing pouches. Otherwise, with the exception of the discrepancy in the skull lengths and the length of the 3rd metacarpus referred to above, the characters of *granti* are strikingly in accord with those of *nudicluniatus.* Regarding any differences which may be apparent, allowance should be made for the fact that the specimens of the latter are somewhat larger than the single specimen of *granti,* and also for variation in the methods of authors in taking measurements, as well as the considerable natural variation of individual specimens. Thomas having failed to mention the extent of the pelage in his type, it is impossible to state whether there is a comparative bareness of the extreme lower back of *granti* as is found in De Vis' specimens.

Localities.—Gowrie Creek, Cardwell, Queensland (De Vis); Paramau, Mimika R., S. Dutch New Guinea, low country (Thomas).

Comparison with allies.—As De Vis pointed out, the nudity of the lower back appears to indicate a slight affinity with *nudiventris,* to which might be added the development of a decided occipital helmet. However, the complete inner sides of the bullae, the hairy abdomen and tragus, and non-papillate ear, and the extension of the fur onto the wing membranes above, definitely distinguishes this form from *nudiventris;* these differences also being maintained by the respective ranges of the two forms. This species is distinguished from *saccolaimus, flaviventris,* and *mixtus* by the absence of the deep groove in the posterior floor of the mesopterygoid fossa and by other cranial characters detailed above, and by its colouration. The peculiarly rounded outline of the tragus and marked thickening of its upper part, also distinguishes this species from its allies, the tragus of *flaviventris* being flattened and comparatively simple, while in *mixtus* though more fleshy, it is not markedly rounded or nearly so thickened above as in *nudicluniatus.*

Conclusion.—When describing his New Guinea species, Thomas was apparently unaware of De Vis' *nudicluniatus,* failing to refer to it in any way, and regarding *saccolaimus* as most nearly allied to *granti.* He stressed certain cranial characters as distinguishing his species from *saccolaimus,* all of which I find to be present in a cotype of De Vis' species. In view of the foregoing, as well as the similarity of the external characters as indicated by the cotype, and De Vis' description, I have no hesitation in regarding *granti* as synonymous with *nudicluniatus.* Additional specimens from New Guinea may show *granti* to be subspecifically distinct and representative of a slightly smaller form, but a large series would be required, and then might only tend further to unite the two forms.

The geographical range of the two might appear to support their distinction, at least subspecifically, were it not for the fact, pointed out by Iredale, that the same species of birds are known to range over both areas. Such evidence of affinity between the birds of the Mimika River and Cardwell areas, considering the strongly volant habits of bats, tends to confirm my conclusion that the species are synonymous.

SACCOLAIMUS SACCOLAIMUS *Temminck.*

Taphozous saccolaimus Temminck, Monogr. Mamm. ii, 1841, p. 285, pl. lx. *Id.,* Dobson, Proc. Zool. Soc. 1875, p. 554, and Monogr. Asiat. Chiropt., 1876, p. 172. *Id.,* Leche, Proc. Zool. Soc. 1884, pp. 52-3. *Id.,* Monticelli, Ann. Mag. Nat. Hist., (6) iii., 1889, p. 489 (synopsis).

Taphozous affinis Dobson, Ann. Mag. Nat. Hist., (4) xvi., 1875, p. 232; Proc. Zool. Soc. 1875, p. 555; Monogr. Asiat. Chiropt., 1876, p. 173. *Id.,* Leche, *loc. cit. Id.,* Monticelli, *loc. cit.*

Dobson wrote that *affinis* was closely allied to *saccolaimus,* which it resembles in general structure and measurements, being distinguished only by its colour and the rudimentary condition of the gular sac in females in which only the margins are developed. The colour of *affinis* was described as black above and white below, as opposed to the dark brown back mottled with irregular white patches, and reddish-brown under surface of *saccolaimus.*

There is a dried skin of a female *Saccolaimus* from North Borneo in the Australian Museum collection which combines the upper surface colouration of *saccolaimus* with the rudimentary gular sac of the female *affinis,* in which only the margins are developed to surround a bare area devoid of any cavity. The fur is dark brown mottled with white above as in *saccolaimus,* while the under surface is creamy white, more nearly approaching the "pure silky white" of the under surface of *affinis;* it is noteworthy that the median line of the under surface is washed with a faint buffy tinge, strongest on the chest and lower abdomen, suggesting a faint tendency to the reddish-brown of the typical *saccolaimus* under surface.

Specimen examined.—Adult female, Australian Museum collection no. M. 45. Purchased from E. Gerrard in 1886.

Variation.—As the specimen from the northernmost range of *affinis* possesses the upper surface colouration of *saccolaimus,* it is possible that the structural character said to separate the two forms may also be variable. In describing *affinis,* Dobson referred to the variability of colour in bats rendering it unreliable alone as a specific difference, but he regarded the rudimentary gular sac of the female as a good specific character. Examination of other species of the group indicates that both the neck and wing pouches may vary considerably, for *T. georgianus* is without the sign of a neck pouch, and the two *S. mixtus* from Port Moresby have small wing pouches typical of the genus *Taphozous.*

Commenting upon the variability of certain characters used to differentiate members of the *Taphozous* group Monticelli (1889) suggested that the size of the feet offered a more consistent diagnostic character. He then presented a modified synopsis of the group and, in addition to the characters I have already discussed, showed *saccolaimus* as having the forearm ranging from 71-73, and the foot from 14-16 mm., contrasted with 65-67 and 17-18 in *affinis.* These figures would seem convincing, suggesting that *affinis* possessed the shortest forearm and the longest foot, were it not that Monticelli appears to have made an error either in taking or arranging his measurements, as shown hereunder. In his catalogue Dobson does not give the forearm length of *saccolaimus,* but that of *affinis* is given as 2.9 ins. = 73.5 mm., and thus the latter would appear to have a maximum forearm length just half a millimeter in excess of that given for *saccolaimus* by Monticelli. Therefore, unless Dobson was in error, Monticelli's key characters break down, *affinis* having both a slightly larger

foot and forearm, and the forearm lengths of the two forms overlapping in a range of only 8.5 mm., which is not excessive for individuals of the one species, as evidenced by the range of 10 mm. in the forearms of my series of ten *flaviventris*. Accepting the forearm lengths as similar, the foot lengths cease to be significant, as Monticelli gives a range of only 5 mm. for the two species, as opposed to 8.5 for the forearms, and again his measurements conflict with those given by Dobson. Therefore, excluding the colour, already shown to be variable, there remains only the rudimentary nature of the female gular sac in *affinis* to distinguish that form, Dobson having stated that the male gular sac of the latter is as large as in *saccolaimus;* he also stated that the female gular sac of the latter is much smaller than in the male, and it therefore seems that *affinis* may prove to be merely a variation of *saccolaimus*.

Range.—Leche (1884) regarded *saccolaimus, affinis,* and his *affinis* var. *insignis* as "direct descendants of the same type, which through geographical separation have perhaps gained a certain permanence." He also wrote that "The geographical range of the three above-named forms seems only partly coincident." I have already demonstrated that Leche's *affinis* var. *insignis* is synonymous with *flaviventris,* a species which cannot be confused with *saccolaimus,* or the *affinis* form as hitherto accepted. Regarding the latter two forms, I cannot agree with Leche's conclusion that their ranges are only partly coincident, as the locality of the specimen with the conflicting characters described above, in association with those hitherto recorded for the two forms, indicates that their ranges overlap very considerably.

Dobson recorded *saccolaimus* from Lower Bengal, through Ceylon, Malay Peninsula and Sumatra to Java, and *affinis* from Sumatra. Dobson's other locality for *affinis* was Labuan Island, North Borneo, to which I add the specimen from North Borneo combining features typical of either form.

Conclusion.—In view of the conflicting features of the specimen noted above, and the fact that the dimensions and ranges of the two forms evidently overlap, the variability of colouration in these bats, and the inference that plastic characters may also vary, I consider it advisable to regard *affinis* as synonymous with *saccolaimus,* pending the establishment of cranial characters separating the two forms. Possibly examination of a large series from various localities might serve to distinguish *affinis,* meanwhile the only alternative would be to regard it as a variety characterised by the rudimentary condition of the female gular sac, though it is noteworthy that the females of *saccolaimus* have a smaller sac than the males, and therefore the rudimentary condition in the female *affinis* may be merely a matter of degree.

Genus TAPHOZOUS *Geoffroy.*

Taphozous Geoffroy, Descr. de l'Egypte, ii., 1818, pp. 113, 126 (not 1812 as cited by Dobson, or 1813 as given by Miller, proofs only, vide Sherborn, P.Z.S. 1897, p. 285). *Id.*, Monticelli, Ann. Mag. Nat. Hist., (6) iii., 1889, pp. 487-8. *Id.*, Thomas, Journ. Bombay Nat. Hist. Soc., xxiv., 1, 1915, p. 57, and Ann. Mag. Nat. Hist., (9) ix., 1922, p. 266.

Diagnosis.—Bullae incomplete antero-internally, being conspicuously emarginate on the inner sides. Radio-metacarpal pouch always present and well developed. Lower lip scarcely grooved in front. Inner margin of ear papillate. The small anterior upper premolar is proportionately much smaller and its main cusp much lower than in *Saccolaimus,* its crown barely or not reaching the level of the cingulum of canine and large premolar. Lower outline of the mandible markedly concave beneath the anterior premolar in the Australian species.

Genotype.—T. perforatus Geoffroy.

Range.—Africa (except north-western portion), southern Asia, East Indies, Philippine Islands, east to New Guinea and Australia.

The Australian species.—The limited number of specimens available, together with details recorded by various authors, enables me to tabulate several striking characters by which *georgianus* may be distinguished from *australis.* Though doubtless somewhat variable, the characters of each form are apparently constant within the limits tabulated in my key, and the available evidence leads to the conclusion that they do not intergrade. So far as one may judge from the meagre details published by Collett, his specimen from Coomooboolaroo, 80 miles south-west of Rockhampton, which he identified as *australis,* presents both the characters and larger dimensions of *georgianus* rather than those of *australis.* Furthermore, though my male of *georgianus* is merely labelled "Dunrobin," the dimensions agree with those of Collett's female, and as there is a Dunrobin 300 miles north-west of Rockhampton, only about 200 miles from Collett's locality, it is very probably the Dunrobin of my specimen. As both Collett's female and the Dunrobin male are evidently referable to *georgianus* rather than *australis,* I am led to the conclusion that the two forms must be regarded as distinct species and not as sub-species, which Thomas considered them to be; *australis* being restricted to the north-eastern coastal regions of Queensland southward to Cardwell, while *georgianus* ranges from about Rockhampton in south-eastern Queensland to the Northern Territory and Western Australia.

The characters of the two species may be synoptically arranged thus:—

A. Gular sac present in male; represented by a naked area with a rudimentary edge in the female. Intertemporal constriction broad, 4.8 — 5 mm., Sphenoid pits short, 3.5 — 3.8. Forearm 61.5 — 66. Tibia 22.8 — 24.5 mm. ..... *australis*

B. Gular sac absent in male; no trace of naked area or rudimentary edge in female. Intertemporal constriction narrow, 4 — 4.1. Sphenoid pits long, 4.1—5. Forearm[1] 65—70. Tibia 26—28 mm. ..... *georgianus.*

TAPHOZOUS AUSTRALIS *Gould.*

(Plates xlvii.—xlviii.)

Taphozous australis Gould, Mamm. Austr., iii., 1863 (pt. 6, 1854), p. 32, pl. xxxii. *Id.*, Wagner, Suppl. Schreb. Saugeth., v., p. 690 *Id.*, Dobson, Proc. Zool. Soc. 1875, p. 550, and Cat. Chir. B.M., 1878, p. 382. *Id.*, Ogilby, Cat. Mamm. Austr., 1892, p. 96. *Id.*, Thomas, Journ. Bombay Nat. Hist. Soc., xxiv., 1, 1915, p. 62.

Taphozous fumosus De Vis, Ann. Queensland Mus., No. 6, 1905, p. 37.

Diagnosis.—Forearm 61.5 — 66 mm., averaging smaller than in *georgianus.* Gular sac (Pl. xlvii., fig. 4 a-b.) : in males forming a small but distinct pocket enclosing a naked area in front; in females there is a naked area with a rudimentary edge posteriorly. Intertemporal constriction broader and sphenoid pits shorter than in *georgianus* (see synopsis). Fur bi-coloured; the colour of the tips, in old spirit specimens, of a lighter brown than in *georgianus.* Condylo-basal length of skull 20.2 — 20.5 mm.

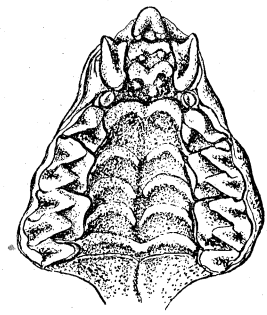


Fig. 2. Palatal ridges of *T. australis.*

External characters.—Ear large, the inner margin papillate and arising above the eye; the outer margin arising opposite, or somewhat below the level of the mouth corner, and nearer the mouth than the tragus base. Tragus (Pl. xlvii., fig. 4e.) large, spatulate and thin, appearing naked to the eye but the microscope shows it to be covered with tiny papillations and short sparse hairs; expanded above, the top

[1] Ostensibly measuring the same specimen, Thomas gives the forearm and metacarpal of the 3rd finger lengths as 3.5 mm. shorter than Dobson's measurements of these parts of the King George Sound female, the forearm according to Dobson being 2.7 in. = 68.5 mm.

is evenly curved and much broader than the base, giving the appearance of a marked concavity of the inner edge. The upper half of its outer margin is almost straight, instead of decidedly concave as in *georgianus;* lower third of outer margin of tragus thickened to form a slight ridge or convexity which does not constitute a lobule. The frontal depression is strongly marked and there is a groove under the eye. Lower lip not grooved in front, but terminating anteriorly in a naked triangular area on each side of the centre, separated by a sparsely haired area. Palatal ridges (Fig. 2) five, the first and last complete arches, the others divided by a central depression; the hindmost ridge is more complete than in *georgianus.* Measurements on pages 340-341.

Colour and variation.—Lack of fresh skins obviates a satisfactory colour description, but in wet or dried old spirit specimens the bicoloured nature of the pelage of both surfaces is always discernible. Gould, quoting MacGillivray, described the basal half of the fur as white, and it is certainly whitish, though in old spirit specimens, wet or dried, I consider the basal half of the fur creamy, rather than pure white, on both surfaces. Dobson, doubtless describing the somewhat darker coloured female *georgianus,* gave the terminal half of the fur as dark brown above, and paler below. In a dried old spirit skin from Cape York, the general colour of the back is a light sayal brown with a fawny tinge, the head being much lighter; under surface a pale shade of fawny brown.

Lacking fresh material, I am permitted to follow Gould's example in quoting MacGillivray's notes "taken on the spot":—"Colour (there are two varieties): above, ferruginous brown; light brown in the centre of the back and across the abdomen; or entirely brownish grey; basal half of the fur white; below, ash-grey, with sometimes a slight reddish tinge; muzzle black." The two varieties of colour refer to the upper half of the fur, the whitish basal half being quite consistent on both surfaces.

Pelage.—Fore part of head sparsely haired to a convex line drawn between the eyes, as is the chin to a line drawn between the mouth corners. A slight tuft of fur behind the eyes. Inner margin of ear fringed with hair within; fur extending onto lower quarter of base externally, the remainder of the ear either naked or very faintly haired inside and out. Fur extending onto the wing membranes above and below to a line drawn between the proximal thirds of the humerus and femur. Above, the interfemoral membrane is furred to a line with its perforation by the tail; below, the dense fur does not extend beyond the anus and femora, the membrane being but sparsely furred posteriorly. Antebrachial membrane naked on both surfaces, excepting close to the shoulder.

Skull (Pl. xlviii., fig. 4 a-c.).—Frontal area deeply excavate, decidedly more so than in the three species of *Saccolaimus;* interorbital region flattened, the outline of its edges markedly concave. Palation about level with the lateral palatal edges, within 0.5 of a mm. Posterior floor of mesopterygoid fossa deeply grooved. Sphenoid pits deep, their median dividing plate rising as high as the floor of the mesopterygoid fossa. Intertemporal constriction markedly broader, and sphenoid pits shorter than in *georgianus* (see synopsis), though subject to slight variation in individuals. Thomas has recorded the width of the constriction as uniformly just 5 mm., and the length of the sphenoid pits as 3.5 mm., whereas in a specimen from Cape York and one of De Vis' *fumosus* the measurements are 4.8-4.9, and 3.7-3.8 respectively. Owing to the greater constriction width, and the width of the brain case at the zygomata being equal to that of the larger *georgianus,* the cranium appears more inflated than in the allied species. Anteriorly the sphenoid pits are rounded and do not reach the level of the large vacuities outside the nasal cavities, but end about a millimeter from them, whereas, in *georgianus* the sphenoid pits are narrowed anteriorly and reach forward to the level of the vacuities. Saggital crest weak, not reaching to the occiput as in *georgianus.*

Synonymy.—Thomas has shown that Gould's specimens from Cape York are the cotypes of *australis,* and not the King George Sound female, regarded as the type by Dobson and which Thomas made the type of his subspecies *georgianus.*

In 1905 De Vis described *T. fumosus* based upon four specimens from Cardwell, Queensland, which he distinguished from *australis* by various characters. After analysing these characters, and comparing his typical material with topotypical and definite *australis,* I have no doubt that the two species are synonymous. Dobson listed only the one adult female, from Western Australia, and it was doubtless this specimen which prompted him to state that there was no trace of the gular pouch in females of *australis,* and that the chin was covered with hairs in the position of the gular sac in males. Misled by Dobson's description of this character, typical of the *georgianus* form, De Vis regarded the presence of a rudimentary gular sac in his Cardwell females as a specific character separating them from *australis;* however, an examination of five topotypical *australis* females shows them to have the rudiments of the gular sac equally as well developed as in the female co-types of *fumosus.*

Other characters relied upon by De Vis to distinguish *fumosus* were:—(1) a lobule on the tragus; (2) a much shorter forearm and tail; (3) colour. Upon examining De Vis' material, in comparison with a series of twelve *australis* from Cape York and Cooktown, and two *georgianus* from Derby, W.A., I find none of the characters sufficient to confirm the identity of *fumosus,* for the following reasons:—

(1) The tragi of De Vis' specimens conform in detail to those of *australis,* the "shallow lobule" described by him being merely a thickening of the lower outer margin, equally well developed in all my specimens of *australis.* This thickened convexity is slightly less marked in my specimens of *georgianus,* and Dobson was apparently describing this form when he stated that there was no lobule at the tragus base. The structure does not constitute a lobule as usually accepted by Dobson, and being exactly similar in the typical *fumosus* and Cape York *australis,* cannot be regarded as a distinctive character.

(2) Dobson apparently quoted a large specimen of *georgianus* in giving the forearm length of *australis* as (2.7 ins.) 68.5 mm., leading De Vis to suppose that his specimen with a forearm of 63.5 mm. represented a species with "a much shorter forearm." However, my series of *australis* have forearms ranging from 61.5-66 mm., and the four *fumosus* forearms, as taken by myself, measure within these limits.

Dobson gave the tail length as (1.3 ins.) 33 mm., and De Vis concluded that his specimen with a tail length of 25.5 mm. represented a species with a "much shorter" tail. Apparently measuring the same specimen as Dobson, Thomas gives the tail length of the female type of *georgianus* as 25 mm., so that allowance must be made for individual methods of measurement, and for the variable nature of the character. However, the tails of my series of *australis* range from 25.5 to 28.5 mm., and the tail lengths of *fumosus* fall within this range.

(3) De Vis' colour description of *fumosus* recognizes the bi-coloured nature of the fur, but he apparently regarded his species as darker than *australis.* The fur of the *fumosus* series is almost black in alcohol, but the uniformly bad condition of the specimens suggests that the colouration has been affected by delayed, faulty, or over strong preservation. The membranes are perished, splitting or peeling in parts, and are not uniform black as De Vis described them, nor are the ears, both showing definite traces of the yellowish colour typical of the integument of spirit specimens of *australis.* In view of the similarity in all the plastic characters, I do not consider the apparently abnormal colouration of De Vis' specimens of specific significance.

A detailed comparison of the skull of one of De Vis' cotypes with a skull from Cape York shows them to agree in all their characters, m^3 and the palatal ridges also being exactly as described by De Vis.

Locality and history of cotypes.—Gould's specimens were from "the maritime caves in the sandstone cliffs of Albany Island, Cape York. In great numbers in three of the caves. Specimens obtained October, 1848." Collected by John MacGillivray, the naturalist attached to H.M.S. "Rattlesnake" during a survey of the northern coast of Australia.

Specimens examined.—A series of eleven specimens from Cape York (Macleay Museum); De Vis' type series of *fumosus* (Queensland Museum); also a male from Cooktown, no. M.876 in the Australian Museum collection, presented in 1893 by the late Dudley Le Souëf.

Localities.—Albany Island, Cape York; Cooktown and Cardwell, northern Queensland, New Guinea (Dobson).

Distribution.—In his catalogue Dobson lists an adult male from New Guinea presented by Mrs. Stanley, which Thomas did not refer to in describing his subspecies. This specimen is of interest regarding the range, and the specific identity of the New Guinea form, as it occurs to me that it may prove to be an example of the *Saccolaimus mixtus* described above. The known range of *australis*, in Australia, is the coastal region of northern Queensland from Albany Island, Cape York, to Cardwell, and the species therefore appears to inhabit the Cape York Peninsula, extending only about fifty miles southward of that area to Cardwell.

Conclusion and comparison with allied species.—I consider that none of the characters used to distinguish *fumosus* are maintained, and have no hesitation in regarding it as synonymous with *australis*.

This species may be readily distinguished from *georgianus* by the possession of a gular sac in males, and a naked area and rudimentary edge in the gular region of females, whereas there is no trace of a gular sac in either sex of *georgianus*, the region being sparsely covered with hair. The broad intertemporal constriction (4.8-5 mm.), and the shorter sphenoid pits, which are broadly rounded anteriorly, serve to distinguish skulls of *australis*.

TAPHOZOUS GEORGIANUS *Thomas*.

(Plates xlvii-xlviii.)

Taphozous australis Collett, Zool. Jahrb. (Syst.), ii, 1887, p. 849.

Taphozous australis georgianus Thomas, Journ. Bombay Nat. Hist. Soc., xxiv, 1, 1915, p. 62.

Diagnosis.—Forearm 65-70 mm., averaging larger than in *australis*. Gular sac absent in both sexes (Pl. xlvii, fig. 5 a-b.), the gular region being sparsely haired. Intertemporal constriction narrower, and sphenoid pits longer than in *australis* (see synopsis). Fur bicoloured, the upper half, as far as discernible in old spirit specimens, of a darker brown than in *australis*. Condylo-basal length of skull 21-21.4 mm.

External characters.—Other than those in diagnosis, apparently as in *australis,* excepting that the outer margin of the tragus (Pl. xlvii, 5e.) is not so straight, being decidedly concave in its upper half, and the hindmost palatal ridge tends to a division in the centre like the three intermediate ones, instead of being complete, as in the typical form. Under microscopic examination the location of the gular sac, in the largest female, is but faintly indicated by the texture of the skin and sparseness of the hair. Measurements on pages 340-341.

Colour.—Lack of fresh skins renders a satisfactory description impossible. In three old spirit specimens the bicoloured nature of the pelage is clearly discernible on the upper surface, but not so well defined below; these specimens also indicate that the general colour is somewhat darker than in *australis.* Probably describing the King George Sound female, Dobson gave the terminal half of the fur as dark brown above, paler below, and the basal half as "above and beneath pure white." According to Collett his specimen was "a light greyish brown, the base of the fur whitish, but not pure white as in Dobson's specimen. The lower surface is coloured as the upper." Though my old spiritous material may be considerably stained, I consider the basal half of the fur yellowish-white or creamy, rather than pure white, thus conforming more to Collett's description.

Cranial characters.—Intertemporal constriction (Pl. xlviii, fig. 5a-c.) markedly narrower (4-4.1 mm.), and sphenoid pits longer (4.1-5) than in *australis;* owing to the noticeably narrower constriction width, and the width of the brain case at the zygomata being barely equal to that of smaller skulls of *australis,* the cranium appears less inflated than in the allied form, producing a material difference in the general aspect of the skull. Sphenoid pits pear-shaped, their narrowed anterior ends reaching forward to the hind level of the large vacuities outside the nasal cavities, whereas in *australis* the pits are broadly rounded anteriorly and end about a millimeter from the vacuities. The length of the pits appears to be subject to considerable variation, ranging from 4.1-5 mm. in one male and two female crania which are of equal size to within a millimeter. Saggital crest weak but reaching to the occiput, instead of fading out as in *australis.*

Variation in authors' descriptions of type.—Though they were apparently reviewing the same specimen there are discrepancies in the dimensions given by Thomas and Dobson which may be due to individual methods of measurement. Thomas gives the forearm length as 65 mm., and that of the 3rd finger metacarpal as 60, which according to Dobson are 68.5 and 63.5 respectively. The tail length according to Thomas is 25, Dobson giving it as 33 mm. However, in two specimens from Derby, W.A., the tails measure 28.5-32 mm., showing that the length of the tail varies considerably. The forearms of the two latter measure 66-69.5 mm.

SPECIMENS EXAMINED.

In describing the female type of his subspecies, Thomas stated that the rudimentary indications of a gular sac are less perceptible than in females of the typical *australis*. Two female *georgianus* from Derby, W.A., have the gular region covered with hair as described by Dobson, who was evidently describing the King George Sound specimen as it was the only female listed by him; the sex of the cotypes of the species was apparently not determinable as Dobson listed them merely as "ad. sks."

Collett's specimen.—Collett gave only a brief colour note and a few dimensions of the female from about 80 miles south-west of Rockhampton which he recorded as *australis*, but all the dimensions conform to those of the larger Western Australian form as represented by my Derby females, and the Dunrobin male. He gives the forearm length as 70 mm., which is half a millimeter in excess of the forearm of my largest female from Derby, and one millimeter longer than the forearm of the Dunrobin male; it also exceeds the longest *australis* forearms by 4 mm. The length of the tibia 28 mm., agrees with the dimensions (26-27) of *georgianus*, rather than with those of the tibiæ of *australis* (22.8-24.5). The length of the tail, though evidently subject to variation and differences in measuring methods, is compatible with that of *georgianus*. The zygomatic breadth of the skull (14) is 0.2 mm. larger than my largest *georgianus* (13.6-13.8), thus emphasising the disparity between it and *australis* (13). The length of the skull (24) given by Collett is in excess of the length from the occipital helmet to the front of the canine (22-22.3) of my largest *georgianus*, but this is accounted for by the fact that the author probably took his measurement to the extreme tips of the canines, as by so doing the skull length of my largest Derby female is also 24; in any event the larger dimension indicates affinity with *georgianus*.

The Dunrobin male.—According to Thomas, a male which originally accompanied the type disappeared afterwards, and therefore the characters of the male have not hitherto been described. I have recently discovered an adult spiritous male in the unregistered old collection of the Australian Museum (now M.3509) on the label of which is written "Dunrobin, 2.6.'67"; unfortunately the place is not localised, and would remain in doubt save for indications set out below tending to associate it with the Queensland Dunrobin. Of the identity of the specimen, however, I have no doubt, as careful comparison of it with the Derby females shows them to agree in all cranial and external characters. Furthermore, in the male, unlike in *australis*, there is no trace of even the rudimentary edge of a gular sac or a naked area, such as is found in females of the latter form, instead the gular region is sparsely but evenly covered with short hairs as in the *georgianus* females. The dimensions of this male with a forearm length of 69 mm. are in close accord with those of a Derby female with a 69.5 forearm, while both are reconcilable with

Collett's female from near Rockhampton with a 70 mm. forearm. In fact so well do the dimensions of the Dunrobin male accord with Collett's female, that I consider it reasonable to assume that the locality is identical with the Dunrobin situated about 300 miles north-west of Rockhampton, and approximately 200 miles from Collett's locality.

Locality and history of type.—Thomas founded his subspecies primarily on specimen *d* of Dobson's Catalogue, an adult female in spirit, from King George Sound, Western Australia, presented to the British Museum by Sir John Richardson. This specimen was regarded by Dobson as the type of Gould's species but, as Thomas pointed out, *australis* was founded on two specimens from Albany Island, Cape York, which are Dobson's *b* and *c*, the cotypes of the species.

Localities.—King George Sound (type) and Derby, Western Australia; Mary River, Northern Territory; Coomooboolaroo, 80 miles south-west of Rockhampton, Queensland. The male from "Dunrobin," the location doubtful, but believed to be the Dunrobin 300 miles north-west of Rockhampton.

Distribution.—In view of the above the species range is from King George Sound, Western Australia, to the Mary River in the Northern Territory, and eastward to near Rockhampton in Queensland.

It is regrettable that the locality of the only male of the species so far retained should be in any doubt. However, though there is a Dunrobin in both Victoria and South Australia, the complete agreement of the dimensions of the Dunrobin male with Collett's female from the Rockhampton area, renders it reasonable to suppose that the locality is the Dunrobin situated between the Great Dividing Range and one of its spurs, about 80 miles west of Clermont and 300 miles inland from Rockhampton, Queensland. Iredale has pointed out to me the dissimilarity of the species of birds inhabiting the Cape York Peninsula and the Rockhampton regions, and the ranges of the two species of *Taphozous* appear to support his contention. Though widely distributed, *georgianus* does not seem to extend far north of Rockhampton, and there are no records of *australis* south of Cardwell so that, pending further records, we have two forms representing two well defined geographical areas.

Comparison with allied species.—The species is readily distinguished from *australis* by the absence of any trace of a rudimentary gular sac in either sex, even the naked area and rudimentary edge found in females of *australis* is absent, the gular area being evenly but sparsely covered with hairs. The narrower intertemporal constriction (4-4.1 mm.) and the longer sphenoid pits, which are narrowed anteriorly, serve to distinguish skulls of *georgianus*.

Table of measurements of *S. mixtus* and *nudicluniatus*, and *T. australis* and *georgianus*.

	mixtus.		*nudicluniatus*.	*T. australis*.					*T. georgianus*.			
	A. 3257-8. Port Moresby.		J. 1947. Cardwell.	M. 876. Cooktown.	Cape York, Q. In Macleay Museum.		*fum. sus* cotypes. Cardwell, Q.		Dunrobin.	Derby, W.A.		*australis*, *vide* Dobson, = *georgianus*.
	Type, Male.	Allotype, Female.	Cotype, Female.	Male.	Male.	Females.	Male.	Female.	Male.	Females.		
Forearm	61.5	62.5	73.5	61.5	64	63.5—66	63.5	65	69	66	69.5	68.5
2nd Digit—Metacarpal ...	56.5	56.5	66	52.5	54	52.5—55	53	54.5	58	54.5	57.5	.....
3rd Digit—												
Metacarpal	60.5	60.5	72	56.5	58	56.5—60	56	58.5	62.5	60	63	63.5
1st phalanx	23	23	29.5	19	19	19.5—21	18.5	19.5	22	20.5	22	20.5
2nd phalanx	23.5	23	30	22.5	22.5	22.5—23	21.5	22	25	24.5	28	28
4th Digit—												
Metacarpal	45	46	52	44.5	45	44 —47	43.5	46.5	50	48.5	50.5	.....
1st phalanx	16.5	17.5	21.5	12.5	13.5	13.5—14	12.5	13.5	15	14.5	15	.....
2nd phalanx	4	6.5	7.5	9.2	9.5	9 —10	9.3	9.5	11	9	10.3	.....
5th Digit—												
Metacarpal	31	32	37.5	35.5	36	35.5—37.5	36	37.5	42	40	40.5	62.5
1st phalanx	14.5	15	18	13	13.5	13 —13.5	13	13.2	15	14.5	14.3	
2nd phalanx	8.5	7 & 10	12	7.5	8	7.7— 8.5	8	7.5	9	8.2	9	
Tragus—												
Length from base ...	4.5	.....	5	5.8	5.5	5.8— 6.5	5.3	5.5	6.5	5.8	6.5	7
Width of top	3.2	.....	4	5	5	5.2— 5.4	.....	4.9	5.2	5.3	5.5	.....
Ear—												
Length from outer base	20	.....	19–20	23	22	22 —22.5	21	22	23	21.5	23	24.2
Max. breadth flattened	14.3	.....	14	.....	16	16 —15	13.5	15.5	.....	16.5	15	.....
Tail—												
Total length	23	? 26	26	27	25.5	25.5—28.5	26.5	26.5	.....	28.5	32	33
Free portion	9	11	13	12	13	14.5—13.5	11.7	12	12	15	12.5	.....
Tibia	23.5	23	27.5	23	23	22.8—24.5	24	24	27	26	26.5	26.5
Foot—c.u.	12	11	16	10	10.2	9.8—10	9.9	9.8	11	10.3	10.5	11.5
Corner of mouth to outer ear-base.	3.5	4	7.5	3.3	3	3.2— 3.8	4	4	5	4 8	4.3	.....
Head, from outer tragus-base to nose-tip ...	20.5	.....	.....	19	19	18.5—19	18.5	19.5	.....	21	20	.....

Table of cranial measurements of *Saccolaimus* and *Taphozous*.

	S. flaviventris.			*S. mixtus.*		*S. nudicluniatus.*	*T. australis.*		*T. georgianus.*	
	No. 137. Type. Male.	M. 918. Moree. Male.	*hargravei.* Type. Female.	Two Skulls. Port Moresby.		Female. Cotype. Cardwell, Queensland.	Cape York. Male.	*fumosus.* J. 1950. Female. Cotype. Cardwell.	Male. Dunrobin. Australian Museum.	Female. Derby. Macleay Museum.
Basal length	23.5	23	22.5	18.3	18.5	21	18.5	18.2	19.5	19.5
Condylo-basal length	25	25.4	24.5	20.5	20.5	23	20.5	20.2	.....	21.4
Occip. helmet to front of canine	26.6	26.5	25.4	22	21.9	25.8	21.4	21.4	22	22.3
Zygomatic breadth	17.8	17.6	16.5	.....	.....	17	13	13	13.8	13.6
Palatal length	11.5	11	10.5	9	9	10.5	8.5	8.5	9	9.1
Interorbital breadth	9.5	9.1	8	7.7	8	8.5	6.4	6	6.4	6.5
Postorbital process	5	4.9	.....	.....	.....	6	3.7	.....	3.8	3.7
Sphenoid pit length	3.8	3.9	3.4	4.2	4.2	4.2	3.8	3.7	4.6	5
Brain-case at zygomata—width	12	12	11.3	10.5	10.5	12	10	9.8	9.8	9.5
Intertemporal constriction ...	6	5.7	5	5.7	5.5	5.3	4.9	4.8	4.1	4
Bulla length	5.5	5.5	5.2	4.7	4.8	5.2	4.6	5	5	5.3
Maxillary tooth-row	11.8	11.8	11.5	9.2	9	10.8	9.3	9.1	9.8	9.5

EXPLANATION OF PLATE XLVII.

Fig. 1. *Saccolaimus flaviventris* Peters. Male. Moree, N.S.W. Showing secondary gular sac.

„ 2. „ *nudicluniatis* De Vis. Cotype, female.

„ 3. „ *mixtus sp. nov.* Type, male.

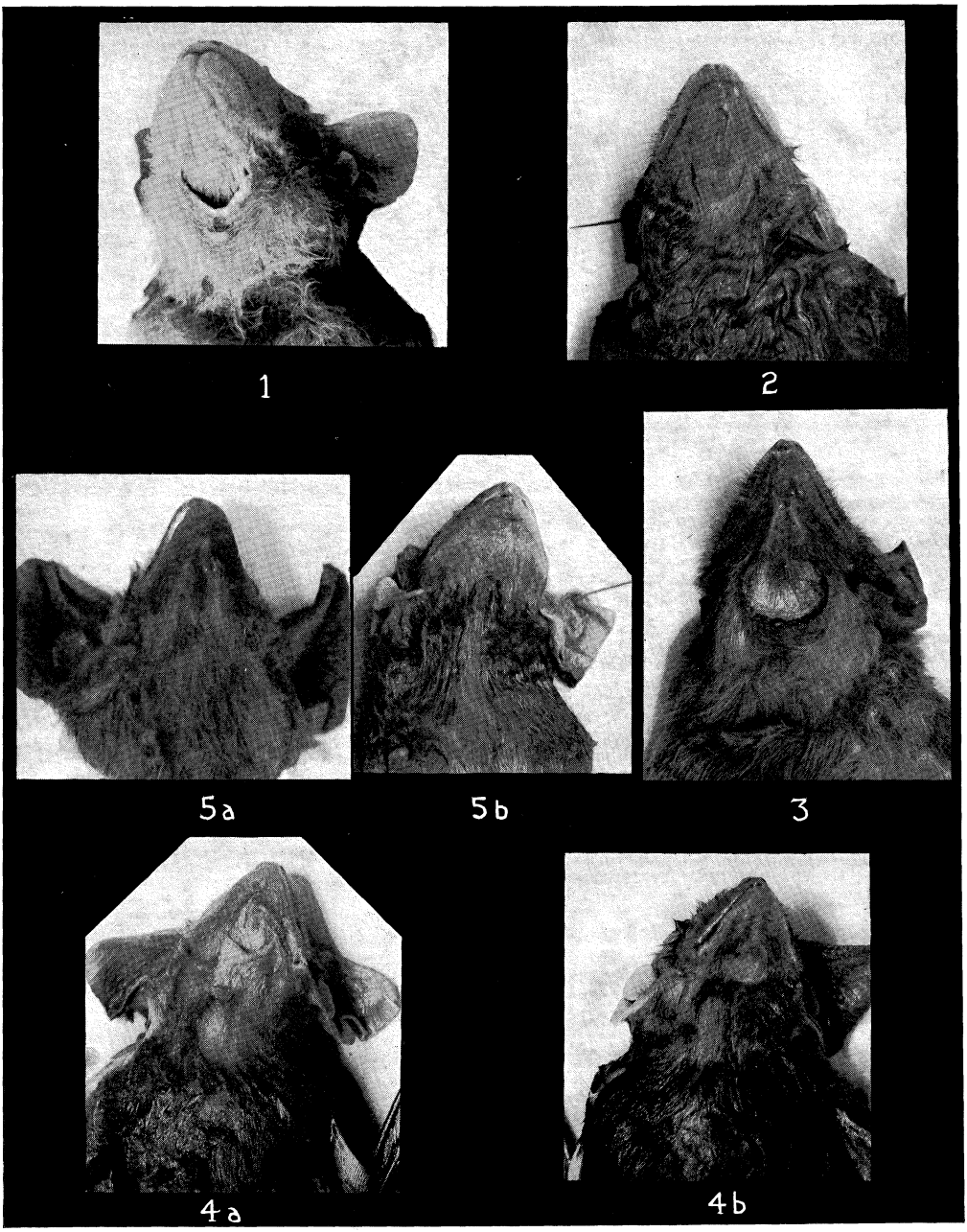
„ 4. a. *Taphozous australis* Gould. Male, showing definite gular sac.

b. „ „ Gould. Female, showing rudiments of sac.

„ 5. a. „ *georgianus* Thomas. Male. } Showing absence of gular sac or its rudiments.

b. „ „ „ Female. }

e. Tragus.

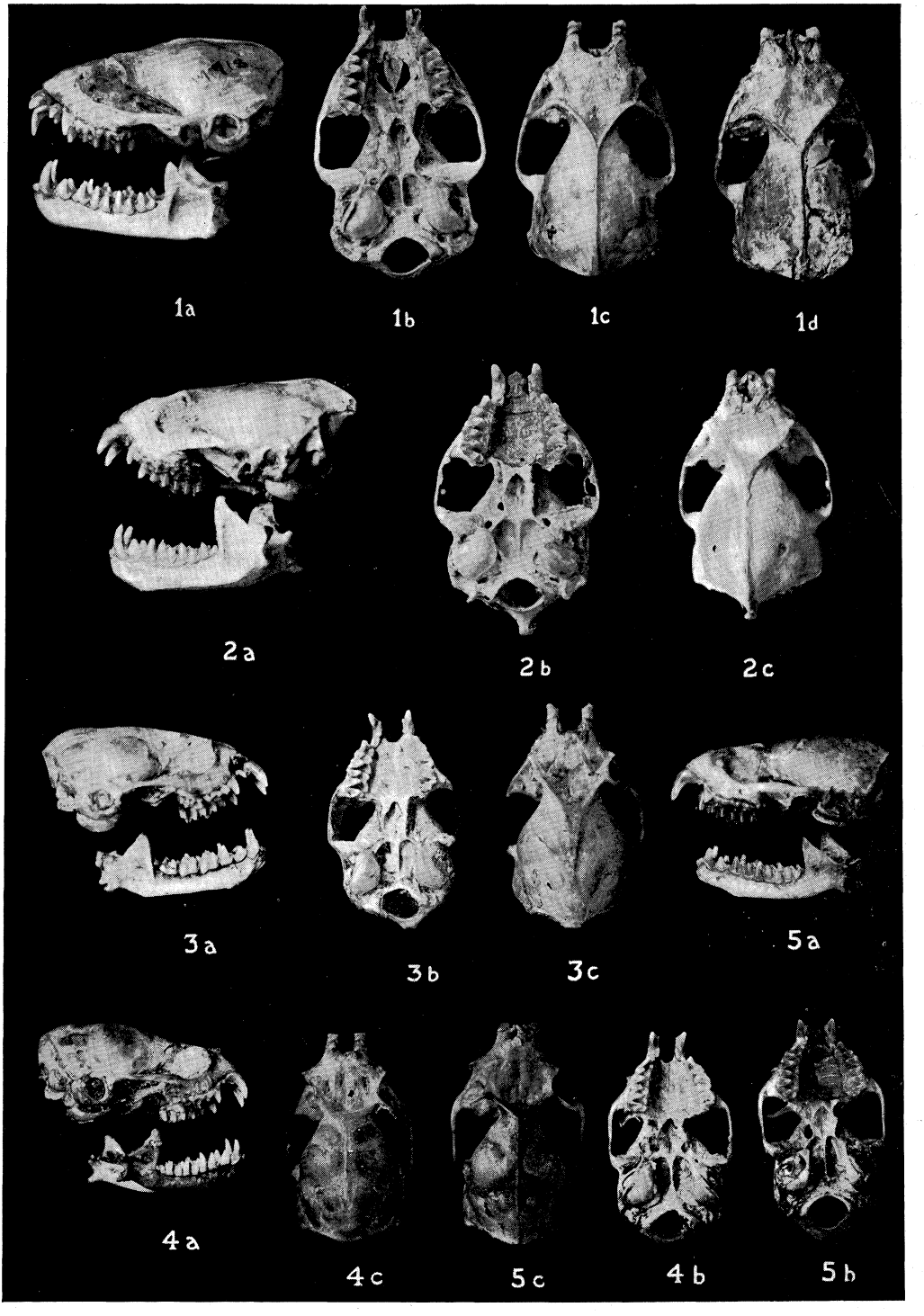


G. C. CLUTTON, photo.
J. R. KINGHORN, del.

EXPLANATION OF PLATE XLVIII.

Fig. 1. *Saccolaimus flaviventris* Peters. Male, Moree, N.S. Wales.
„ 1d. „ „ „ Type skull, upper view.
„ 2. „ *nudicluniatus* De Vis. Cotype, female.
„ 3. „ *mixtus sp. nov.* Type, male.
„ 4. *Taphozous australis* Gould. Male.
„ 5. „ *georgianus* Thomas. Female.

a. Side view of skull and mandible.
b. Under surface of skull.
c. Upper surface of skull.



G. C. CLUTTON, photo.