

peduncle $\frac{3}{4}$ as long as deep. Olivaceous with 5 or 6 dark brown cross-bars; light blue spots on the body and soft vertical fins.

The types from Colombia measure from 115 to 200 mm. in total length.

37. *Cichlosoma rostratum*.

Heros rostratus, Gill & Bransford, Proc. Ac. Philad. 1877, p. 481.

Cichlasoma rostratum, Jord. & Everm. Bull. U.S. Nat. Mus. xlvii. 1898, p. 1529.

Depth of body $2\frac{1}{4}$ in the length, length of head $2\frac{3}{5}$. Snout longer than postorbital part of head. Diameter of eye 4 in the length of head, interorbital width $3\frac{3}{5}$. Depth of præorbital $1\frac{1}{4}$ the diameter of eye. Maxillary extending to midway between nostril and eye; præmaxillary processes not extending to above the eye; jaws equal anteriorly; fold of the lower lip not continuous; cheek with 5 or 6 series of scales; 12 or 13 gill-rakers on the lower part of the anterior arch. Scales $33\frac{6}{13}$, $3\frac{1}{2}$ between lateral line and base of anterior rays of soft dorsal. Dorsal XVI 11, commencing above the opercular cleft, the spines subequal from the sixth to the fourteenth, the last $\frac{2}{5}$ the length of head. Anal VII 8. Pectoral as long as the head, extending to above the last anal spine; ventral extending beyond the origin of anal. Caudal subtruncate. Caudal peduncle $\frac{5}{7}$ as long as deep. A blackish blotch below the fourteenth to the seventeenth scales of the lateral line; a dark spot at the base of caudal; soft dorsal, anal, and caudal with alternate light and dark bars or series of spots.

Lake Nicaragua.

1. (186 mm.) one of the types L. Nicaragua. Smithsonian Inst. of the species.

This species is very closely allied to *C. altifrons*.

[To be continued.]

XXVIII.—*On the Bats of the Rhinolophus philippinensis Group, with Descriptions of Five new Species.* By KNUD ANDERSEN.

THE conclusions recorded in the present paper are based on the material in the British Museum, together with some specimens from the United States National Museum. The latter were sent for inspection and identification by Mr. Gerrit S. Miller, Jr., Washington.

General Characters of the Rh. philippinensis Group.

Diagnosis.—Median anterior nasal swellings large. Palatal bridge long, on an average more than, and generally considerably more than, $\frac{1}{3}$ the length of the maxillar tooth-row; median anterior point opposite the front (or anterior half) of p^4 . Posterior connecting-process extremely low and rounded off, starting from a point considerably below the summit of the sella. Base of central nose-leaf forming cup-like or wing-like expansions.

Remarks.—So far as my material goes, the above diagnosis holds good for all members of the group, the most primitive (*philippinensis*, *achilles*), as well as the highest developed (*trifoliatus*, *luctus*, and all their allies). In these latter the skull is rather modified, and some of the modifications are obviously correlated to the enormous enlargement of the nose-leaves and ears. The postnasal depression is deeply hollowed out, more than in other *Rhinolophi*. In front of the median anterior swellings is formed a narrow, thin brim of bone, the object of which is evidently to increase the surface of the facial part of the skull (which supports the large nose-leaves); in *Rhinolophi* with nose-leaves of normal size there is no such brim of bone, the median anterior swellings partaking immediately in the formation of the margin of the nasal openings. The interorbital constriction is narrower than in other *Rhinolophi*. The cochleæ are, proportionately, *slightly* larger, the basioccipital, between them, consequently slightly narrower; but neither are the cochleæ as large nor the basioccipital as narrow (linear) as in *Rh. hipposiderus* and its allies.

In most, if not all, species the position of the lower p_3 is *individually* variable (as in other primitive *Rhinolophi*): in the tooth-row, or more or less external to the row. The upper p^2 is invariably in the row.

Subdivision of the Group.

The group may conveniently be divided into three sections:—the *philippinensis* section, the *sedulus* section, and the *trifoliatus* section. The first of these sections is represented by *Rh. philippinensis* and *achilles* *; the second by *Rh. sedulus* and *lanosus*; the third by *Rh. trifoliatus*, *solitarius*, *luctus*, *perniger*, *geminus*, and *Beddomei*. They differ as follows:—

* On *Rh. mitratus* and *Maclaudi*, see the "General Remarks" on p. 254.

(1) In the *philippinensis* section the sagittal crest is low in front, gently sloping towards the postnasal depression (fig. 1). In the *trifoliatus* section the crest is high in front, and abruptly descending towards the postnasal depression (fig. 2): this causes a very different side view of the skull.

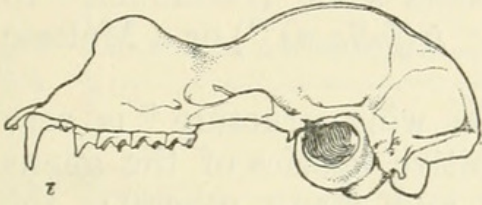


Fig. 1.

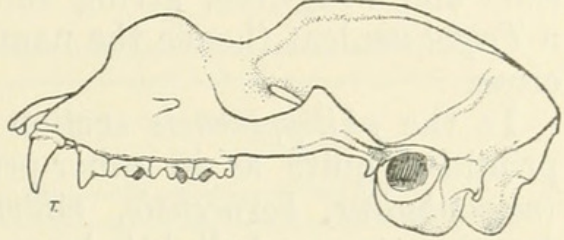


Fig. 2.

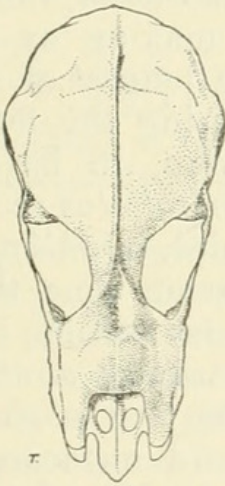


Fig. 1 a.

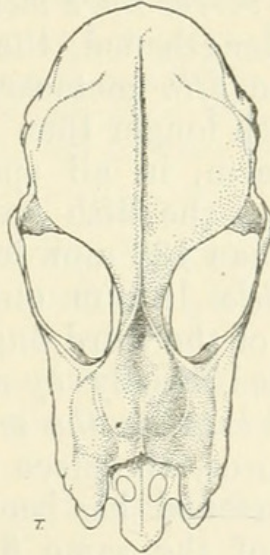


Fig. 2 a.

Fig. 1. Skull of *Rh. philippinensis*, side view. 1 a. The same skull, upper view. 2. Skull of *Rh. trifoliatus*, side view. 2 a. The same skull, upper view. The specimens figured are of the same age (teeth unworn). $\frac{2}{3}$.

In the *philippinensis* section the teeth are smaller, the maxillar width narrower, the coronoid process of the mandible somewhat lower, the temporal fossa narrower, the zygomatic arches, therefore, very slightly projecting laterally, making the zygomatic width of the skull but very slightly, or not at all, larger than the mastoid width (fig. 1 a). In the *trifoliatus* section the teeth are larger, the maxillar width broader; the stronger teeth involve an increase in size of the temporal muscle, this again a slight heightening of the coronoid process, a considerable widening out of the temporal

fossa, a projecting of the hinder part of the zygomatic arches, making the zygomatic width of the skull considerably larger than the mastoid width (fig. 2 a).

In the *philippinensis* section the base of the sella forms, together with the internasal lobes, a cup-like expansion. In the *trifolius* section the internasal lobes are quite, or almost quite, normal, the lateral expansions confined to the sella and wing-like, giving the sella some resemblance to a *Trifolium* leaf (hence the name "*trifolius*") or a Maltese cross.

In the *philippinensis* section the wing-structure* is very primitive, quite as in other primitive species of the genus (*megaphyllus*, *borneensis*, *minor*, and many others): the fourth metacarpal slightly longer than the fifth and the third; IV.²† and V.² but slightly longer than IV.¹ and V.¹. In the *trifolius* section the wing-structure is considerably modified:—the third metacarpal is much shortened, the fourth slightly lengthened, the fifth more so, making as a final result the fifth metacarpal decidedly the longest of all, and very much longer than the third (supposing the length of the forearm, in all species of the group, to be exactly 1000 mm., the fifth metacarpal, in the *trifolius* section, is no less than 133 mm. longer than the third, in *philippinensis* and *achilles* 18 mm. only)‡. At the same time the first phalanx of the third finger, in the *trifolius* section, is much lengthened, chiefly by a removing, in proximal direction, of the joint between the metacarpal and the first phalanx; in other words, the piece by which the third metacarpal has been shortened has been added to the length of the first phalanx of the same finger. Thirdly, III.², IV.², and V.², in the *trifolius* section, are considerably lengthened.

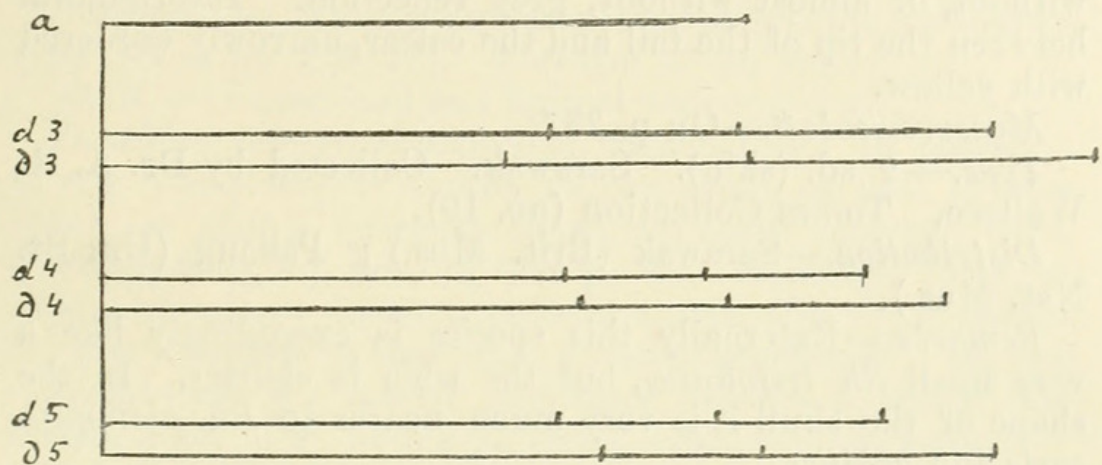
The mechanical reason for this modification of the wing is, probably, the following:—A lengthening of the distal phalanges gives a broader wing, consequently an increased power of flight; the third finger, as being the longest of all and the nearest to the front margin of the wing (when expanded), has to sustain the heaviest pressure of the air;

* The remarks on the wing-structure to be compared, point for point, with the diagram on p. 247 and the wing-indices on p. 257.

† For brevity's sake I call the distal phalanges of the 3rd, 4th, and 5th fingers III.², IV.², and V.², the proximal phalanges of the same fingers III.¹, IV.¹, and V.¹.

‡ An almost exact parallel to this modification of the wing-structure is seen in *Rh. ferrum-equinum* compared with the primitive forms of the group to which that species belongs (f. i. *Rh. megaphyllus*, *borneensis*, &c.).

a considerable increase in the length of III.² involves, therefore, an increase in the length of the phalanx which supports III.², viz. III.¹, and this increase is effected not by a lengthening of III.¹ in *distal* direction (which would make an unproportionately long third finger), but by a lengthening



a. Forearm. *d3, d4, d5*. Third, fourth, and fifth fingers in the *philippinensis* section. *δ3, δ4, δ5*. The same fingers in the *trifoliatus* section, reduced to the same length in proportion to the forearm. Subdivisions of *d* and *δ*, in direction from left to right, indicate the metacarpal, first and second phalanx.

in *proximal* direction, *i. e.* by a removing backwards of the joint between the third metacarpal and III.¹, which again makes a shorter third metacarpal.

(2) The *sedulus* section has the skull and the teeth *essentially* as in *philippinensis*, but the nose-leaves and the wing-structure as in *trifoliatus*.

Only the species of the *sedulus* and *trifoliatus* sections will be described below.

1. *Rhinolophus sedulus*, sp. n.

Diagnosis.—Cranial characters much as in *Rh. philippinensis*, but postnasal depression considerably deeper. Nose-leaves and wing-structure: the *trifoliatus* type. Forearm 43.5–49.2 mm.

Skull.—Sagittal crest and maxillar width very much as in *philippinensis*; temporal fossa but slightly larger; postnasal depression deeply hollowed out as in *trifoliatus*.

Dentition (two skulls).—*p*₃ external; *p*₂ and *p*₄ almost or quite in contact; *p*² in row, cusp so minute as to be scarcely observable.

Colour.—♀ ad., Sarawak; distal epiphyses of metacarpals ossified; teeth unworn; skin: General impression a shade of dark brown, slightly varied with greyish tips to the hairs.

Analysis of colour: the tips of the hairs of the upperside have a grey iridescence; when keeping the skin so that the reflections disappear, the true colour proves to be a deep brown shade of "drab"; base of hairs scarcely lighter. Underside of the same general colour as the upperside, but without, or almost without, grey reflection. Interfemoral between the tip of the tail and the calcar, narrowly bordered with yellow.

Measurements *.—On p. 257.

Type.—♀ ad. (skin). Sarawak. Collected by Dr. A. R. Wallace. Tomes Collection (no. 19).

Distribution.—Sarawak (Brit. Mus.); Pahang (Un. St. Nat. Mus.).

Remarks.—Externally this species is exceedingly like a very small *Rh. trifolius*, but the tibia is shorter. In the shape of the skull it is very much nearer to *Rh. philippinensis* and *achilles*.

2. *Rhinolophus lanosus*, sp. n.

Diagnosis.—Similar to *Rh. sedulus*, but very much larger. Forearm 71.5 mm.

Skull.—In the shape of the sagittal crest, the small temporal fossa, the narrow maxillar width, and the small teeth, this very large species bears much resemblance to *Rh. philippinensis*. But the postnasal depression is deeply hollowed out as in the *sedulus* and *trifolius* type (corresponding to the enormously developed nose-leaves).

Dentition (one skull).— p_3 in row; p_2 and p_4 well separated; p^2 in row, cusp extremely small.

Colour.—♀ ad.; teeth slightly worn; skin: as in *Rh. sedulus*.

Type.—♀ ad. (skin). Kuatun †, N.W. Fokien, China; April 4th, 1898. Presented by J. D. La Touche, Esq. Brit. Mus. no. 98. 11. 1. 1.

Remarks.—As proved by the skull, this fine species is an

* Only the following measurements require some explanation:—*Ears*, length from base of inner margin to tip. *Second phalanx*, exclusive of the cartilaginous terminal rod. *Skull, total length*, inion to front of canines. *Width of brain-case*, above root of zygomata. *Maxillar width*, across antero-external corner of m^3 . *Supraorbital length*, from posterior point of postnasal depression to median anterior point of nasals. *Mandible*, condylus to front of incisors. *Upper and lower teeth*, exclusive of incisors.

† An excellent characteristic of this Chinese village and its surroundings was contributed by Mr. La Touche to the Proc. Zool. Soc. for 1898 (pp. 769–70).

offshoot of the *sedulus*-type, differing in all important cranial characters from the species of the *trifolius* section. But externally it is exceedingly like a small *Rh. perniger*.

3. *Rhinolophus trifolius*, Temm.

Diagnosis.—Cranial and external characters: the *trifolius*-type (above pp. 245–47). Forearm 47–55 mm.

Skull.—As described and figured above (p. 245).

Dentition (eleven skulls).— p_3 “vacillating” in position: in row (one skull), or almost in row (one), or half in row (two), or almost external (one), or quite external (six). Corresponding to this, p_2 and p_4 well separated (five), or almost in contact (one), or quite in contact (five). p^2 always in row. Upper canine and p^4 well separated. In one example there is a *marked interspace between p^2 and p^4* (the former place of p^3 , lost in all recent species of the genus).

Colour.—Five skins; ad.; teeth unworn or slightly worn: Very light-coloured. Upperside, a “wood-brown” shade of “drab,” somewhat darker on the hinder back; base of hairs more distinctly light “drab.” Underside “drab,” somewhat varying in the intensity of the colour, and washed with “ecru-drab” on the throat and breast. Interfemoral, between the tip of the tail and the calcar, narrowly bordered with yellow.

Size.—The great variation in the size of this species (forearm 47–55 mm.) is independent of the geographical habitat and of the sex:—(1) The shape of the skull is identically the same in all the individuals examined; (2) the size of the skull is much less subject to variation than the external dimensions (*cf.* the measurements); (3) the smallest and the largest individuals examined are both from N. Borneo; (4) the smallest individual in the series (forearm 47 mm., teeth slightly worn) and one of the very largest (54.3 mm., teeth unworn) are, both of them, males. All the specimens are full-grown (distal epiphyses of metacarpals ankylosed).

Distribution.—N. Borneo (Paitan, Kina Balu, Mt. Dulit, Mt. Mulu, Sarawak); Singapore; Lower Siam (Trong); Tenasserim (Mergui). ? Java (*cf.* below).

Technical name.—The type specimen of *Rh. trifolius*, as described by Temminck*, is stated to be from Bantam, W. Java. I have seen no specimen of this Bat from Java. It is rather easy indeed to point out some discrepancies between Temminck’s figure (natural size) and the series

* Temminck, Mon. Mamm. ii. 8^e monogr. (1835) pp. 27–28, pl. xxxi.
Ann. & Mag. N. Hist. Ser. 7. Vol. xvi. 17

here under consideration:—The horseshoe is very narrow (9 mm., as against 10·5–12·4 in the series examined by me); the tail extremely short (about 21–23 mm., as against 29–36); also in the letterpress the tail is stated to be only “de la longueur du tibia,” whereas in all the individuals I have seen it is from $\frac{1}{5}$ to $\frac{1}{3}$ longer than the tibia. On the other hand, the length of the forearm of the type (“1 pouce 10 lignes” = about 50 mm.) and of the metacarpals, phalanges, and tibia (on the figure) are quite as in several Bornean specimens. Also it should be remembered that the type is a mounted specimen and, according to Jentink *, only “à-peu-près adulte”; the differences pointed out above are of such kind that they may *perhaps* be due to shrinkage. At all events, in the absence of more conclusive evidence, I think it advisable to retain the name *trifolius* for the species described above. If not identically the same as the Bornean and Malaccan bat, the Java form is probably extremely closely related †.

4. *Rhinolophus solitarius*, sp. n.

Diagnosis.—Allied to *Rh. trifolius*, but slightly smaller, with very short tail and tibia. Forearm 46·5 mm.

Skull.—Smaller than in *trifolius*, but *proportionately* broader (compare *maxillary*, zygomatic, mastoid breadth, and breadth of brain-case with the measurements of the *trifolius* skulls, p. 257).

Dentition (one skull).— p_3 *completely wanting*, without any trace of the alveoli (teeth but very slightly worn); p_2 and p_4 in contact. This is the only instance, within the present group, of a complete obliteration of the middle lower premolar; the aberration from the general rule ‡ is rather surprising, and I must leave it open to question if it is, really, a constant (or almost constant) peculiarity of the present species.

* Jentink, “Cat. syst. Mamm.,” Mus. d’Hist. nat. Pays-Bas, xii. (1888) p. 160.

† The following statements in the original description of *Rh. trifolius* are, evidently, accidental errors only:—“Deux grosses verrues triangulaires à la mâchoire supérieure”; must be “inférieure.” “Dans l’adulte point d’incisives supérieures”; they must have been overlooked. “Point de petite dent anormale entre la canine et la première molaire de la mâchoire supérieure”; it is extremely improbable that p^2 , which is present in all species of this group and always situated in the tooth-row, should be wanting in the type of *trifolius*.

‡ As a *general* rule, in the genus, the lower p_3 does not completely disappear until the dentition has arrived at the stage that the upper p^2 is external, and even then it is still very often present. In all species of the present group p^2 is quite in the tooth row.

Also the upper p^2 is slightly smaller than in *trifolius*, and consequently the interspace between the canine and p^4 a little narrower.

External characters.—In all important respects as *Rh. trifolius*, but a trifle smaller than the smallest individuals I have seen of that species; tail and tibia extremely short. Colour (of a spirit-specimen) much as in *trifolius*.

Type.—♂ ad. (in alcohol). Tanjong Pamuja, Banka; June 18th, 1904. Collected by Dr. W. L. Abbott. Un. St. Nat. Mus. no. 124767.

5. *Rhinolophus luctus*, Temm.

Diagnosis.—*Trifolius* type. Forearm 65.3–68 mm.

Skull.—As in *trifolius*, but very much larger.

Dentition (five skulls).— p_3 generally external (four skulls), sometimes almost in row (one). p_2 and p_4 separated (two), or almost or quite in contact (three). p^2 always in row, cusp rudimentary or altogether wanting. Interspace between the upper canine and p^4 rather narrow.

Colour.—(1) ♀, rather young, but quite full-grown; distal epiphyses of metacarpals ossified; teeth almost unworn; Selangor, November; skin: Above and below, an exceedingly dark shade of “drab,” *approaching* blackish; grey iridescence on the hairs of the upperside.

(2) Aged individuals; teeth slightly worn or well worn; N. Borneo; four skins: Same style of colour, but decidedly browner. Details as in *Rh. sedulus*.

Distribution—N. Borneo (Mt. Dulit, Baram, Lawas); Singapore; Selangor (Semangton). ? Java (*cf.* below).

Temminck's Rh. luctus *.—The type specimen † of *Rh. luctus* is stated to be from Tapos, Java. I have seen no example of this species from Java, but the original description of *luctus*, the measurements (forearm and tail only), and the figure (natural size) agree very closely ‡ with the species

* Temminck, Mon. Mamm. ii. 8^e monogr. (1835) pp. 24–26, pl. xxx.

† According to Dr. Jentink (“Cat. syst. Mamm.,” Mus. d’Hist. nat. Pays-Bas, xii. (1888) p. 160) there are two type specimens of *Rh. luctus* in the Leiden Museum. Technically only one of these examples is the “type,” viz. no. “b” (the adult female); *cf.* Temminck (*l. c.*): “mesure et description d’une adulte femelle” (p. 25); “nos voyageurs n’en trouvèrent qu’une femelle” (p. 26). The specimens “a” and “c” in Jentink’s Catalogue are, perhaps, those referred to by Temminck in a later appendix to the description (*op. cit.* pp. 30, c, d).

‡ The measurements given by Temminck are: forearm 63 mm. (“2 pouces 4 lignes”), tail 45 mm. (“1 pouce 8 lignes”). Dr. Jentink has kindly re-examined the type, and found the length of the forearm as stated by Temminck.

here under consideration. If by further examination Java specimens should prove to differ from the Borneo-Malacca form, the former will have to stand as *Rh. luctus*, the latter as *Rh. morio*, Gray.

Gray's *Rh. morio* *.—The type (adult, Singapore; sent to Gray in alcohol, subsequently mounted) is in the British Museum. The light colour, approaching that of *Rh. trifolius* (and which caused Gray to give it a new name), is probably due to fading in alcohol; the colour of all the species of the present group seems to be unusually liable to fading; in every other respect *Rh. morio* is indistinguishable from Selangor and Borneo specimens.

Alleged occurrence on the Philippine Islands.—Eydoux and Gervais's "*Rh. luctus*, varietas *rufa*," from Manila, is characterized by the authors as follows:—"Dans la variété que nous décrivons, quoique la feuille soit parfaitement la même [as in Temminck's *Rh. luctus*], le pelage est généralement roussâtre" †. No further description, no measurements, no figure. By subsequent writers ‡, none of whom seem to have seen the specimen, the name proposed by Eydoux and Gervais has been referred as a synonym to "*Rh. luctus*." I very much doubt that this is correct. Neither before 1839 nor since has any bat of the *luctus* type been recorded from any of the Philippine Islands. Considering the time at which Eydoux and Gervais wrote, I should find it very hazardous to lay much stress on the statement that the nose-leaves were "parfaitement" as in *luctus*. Of much more importance is, I think, the fact that in 1839 *Rh. philippinensis* was not yet described. Perhaps "*Rh. luctus*, var. *rufa*" is nothing but *Rh. philippinensis*; and, if so, the name "*rufus*" (1839) unfortunately antedates "*philippinensis*" (1843). An examination of the type (presumably in the Paris Museum) would decide the matter.

6. *Rhinolophus perniger*, Hodgs.

Diagnosis.—Allied to *Rh. luctus*, but much larger. Fore-arm 71·5–78 mm.

Skull.—Quite of the *luctus* shape, but considerably larger and with markedly broader nasal swellings.

* J. E. Gray, Ann. & Mag. Nat. Hist. (1) x. (Dec. 1842) p. 257.

† Eydoux and Gervais, 'Voyage autour du monde . . . la Favorite,' v. pt. ii. (1839) p. 9.

‡ In his "Kritische Durchsicht der Ordnung der Flatterthiere" (SB. Akad. Wien, Bd. lxi. Abth. i., Feb. 1870, p. 194) Dr. Fitzinger, without having seen the example here under consideration, gives it a new name—*Aquias Eydouxii*—on account of "die durchaus verschiedene Heimath, so wie auch der grosse Unterschied in der Färbung."

Dentition (five skulls).— p_3 generally external (four skulls), sometimes almost in row (one); p_2 and p_4 separated (three), or almost in contact (two); p^2 in row, cusp rudimentary and soon worn down. Interspace between the upper canine and p^4 generally rather narrow.

External characters.—Considerably larger than *Rh. luctus*, with, also proportionately, much longer ears and tibia. It is in every respect the extreme of the “*trifolius* type” and the largest species in the genus. Colour as in *Rh. luctus*.

Distribution.—The Himalayas: Sikkim, Nepal, Masuri.

Technical name.—The types of Hodgson’s *Rh. perniger** (three adult specimens, Nepal) are in the British Museum.

Remarks.—This species has hitherto wrongly been confounded with *Rh. luctus*.

7. *Rhinolophus geminus*, sp. n.

Diagnosis.—Similar to *Rh. perniger*, but with shorter ears and much shorter tail. Forearm 73 mm.

Skull.—Much as in *perniger*, but with markedly narrower nasal swellings.

Dentition (one skull).— p_3 almost in row; p_2 and p_4 well separated; p^2 in row, cusp extremely small. Interspace between the upper canine and p^4 rather wide.

Colour.—The *luctus* style.

Type.—♀, slightly immature (in alcohol). Kediri, E. Java, 2000–3000 feet, between March and May, 1878. Presented by Baron v. Hügel. Brit. Mus. no. 79. 11. 15. 10.

Remarks.—As might be expected, from the general character of the mammalian fauna of Java, this species is much more closely related to the Himalayan form (*perniger*) than to *Rh. luctus* from Borneo and the Malay Peninsula.

8. *Rhinolophus Beddomei*, sp. n.

Diagnosis.—Allied to *Rh. luctus*, but rather smaller, with excessively short metacarpals and tail. Forearm 63.8 mm.

Skull.—Of the *luctus* type, but extremely small.

Dentition (one skull).— p_3 external; p_2 and p_4 almost in contact; p^2 in row, cusp almost imperceptible (teeth unworn).

External characters.—This species is almost of the same size as *Rh. luctus*, but the metacarpals and tail are much shorter.

Type.—♂ ad. (in alcohol). Wynaad, Mysore, S. India. Collected and presented by Colonel Beddome. Brit. Mus. no. 82. 3. 3. 1.

* Hodgson, J. A. S. B. xii. pt. 1, no. 137 (May 1843), p. 414.

General Remarks on the Rh. philippinensis Group *.

In the Philippine Islands and the Austro-Malayan Sub-region we find preserved the most primitive members of the whole group.

In all the more important points, cranial and external, *Rh. philippinensis* (Luzon) and *achilles* † (Key Islands) are either much like or quite on the same level as other primitive *Rhinolophi*:—In the general shape of the skull; in the narrow temporal fossa and low sagittal crest; in the long palatal bridge; in the dentition— p^2 less reduced in size, its cusp well developed, the interspace between the canine and p^4 very wide; in the wing-structure—the ratio between the metacarpals, as well as the proportional length of the distal phalanges, practically *quite* as in *Rh. megaphyllus* (and its closer allies) or *Rh. lepidus* (and its modifications); in the number of mental grooves—three, as in *all* primitive species of the genus; in the general shape of the ears—very blunt, emargination of outer margin below the tip very shallow, the ear therefore not attenuated below the tip. But the nose-leaves are peculiarly modified ‡ and the ears unusually large.

This type of bat has found its way to N. India: *Rh. mitratus* (Chaibassa, on the border of Orissa and Bengal). The same cup-like expansion of the central nose-leaf, formed by the base of the sella *and the internasal lobes*; the same shape and proportionate size of the ears. But the wing-structure seems to be more advanced § and the lateral mental grooves are obliterated. The skull and dentition are unknown.

We find the *philippinensis*-type so far away as Conakry Island, off the coast of Senegambia: *Rh. Maclaudi* ||. Identically the same cup-like (not wing-like) expansion of the central nose-leaf; the same shape of the upper (not expanded) part of the sella—very broad, parallel-margined, the summit

* To be compared with the diagram on p. 247.

† Thomas, Ann. & Mag. Nat. Hist. (7) v. (1900) p. 145.

‡ It is worth noticing that the connecting-process in *Rh. philippinensis* and *achilles*, although quite of the same style as in the other members of the group, is slightly less reduced in size, consequently nearer to the "normal" type.

§ Detailed measurements of the wing of *Rh. mitratus* are unknown. According to Blyth (J. A. S. B. xiii. (1844) p. 483) the length of the forearm is 57 mm., the length of the third finger, as a whole, 84.5 mm.; this is sufficient to convince me that there must be a considerable lengthening of III.².

|| E. de Pousargues, Bull. Mus. d'Hist. nat. 1897, no. 8, pp. 358–361 (Feb. 1898).

broadly rounded off, almost truncated; the same connecting-process; the same lancet—peculiarly long, narrow, cuneate; the same size and shape of the horseshoe; the enormously enlarged ears—proportionately of the same size as in *achilles* and essentially of the same shape; *the same ratio between the metacarpals* (third metacarpal not shortened). But the distal phalanges are much lengthened*; the lateral mental grooves are obliterated (as in *Rh. mitratus*); and the general size of the animal is much increased. The dentition of *Rh. Maclaudi* is more highly developed than in *philippinensis* and *achilles*, and on the same level as in the *sedulus* and *trifolius* section— p^2 in the tooth-row, very small, the interspace between the canine and p^4 narrow†. The skull is unknown.—In short: *Rh. Maclaudi* is an Ethiopian offshoot of the *philippinensis*-type, more highly developed than that species *at least* in the dentition, the wing-structure, and the mental grooves.

The bats of the *sedulus* section have retained, in all important respects, the cranial characters of *philippinensis* and *achilles*. But the postnasal depression is deeply hollowed out (as in the *trifolius* type), and externally, *i. e.* in the nose-leaves (wing-like expansions of the sella), in the wing-structure, in the mental grooves (one only), and in the more pointed ears, they are like *trifolius* and *luctus*. Two species only are known—*Rh. sedulus* from N. Borneo and the Malay Peninsula, and *Rh. lanosus* from S. China.

The series of evolution culminates in the *trifolius* section: also the skull is modified. The six species known are distributed from N. Borneo to S. India, from Banka and Java to the Himalayas.

* In the *trifolius* section the lengthening of III.² (as pointed out above) has involved a lengthening of III.¹ in *proximal* direction, and consequently a shortening of the metacarpal. In *Rh. Maclaudi* the lengthening of III.² has involved a lengthening of III.¹ in *distal* direction; consequently the metacarpal retains its original length. The great increase in the total length of the third finger resulting herefrom seems to have been counterbalanced by a lengthening *also* of the first phalanx of the other (fourth and fifth) fingers. These remarks are based on Pousargues's measurements of the third and fifth fingers (those of the fourth finger are unknown).

† I am indebted to M. A. Ménégaux, Paris Museum, for the above details on the dentition of *Rh. Maclaudi*, as well as for the following information:—"M. de Pousargues s'est trompé en disant qu'il y a un espace entre la canine supérieure et la p^2 [p^4 in this paper]; à leur base la première prémolaire [p^2] touche en avant la canine, en arrière la p^2 [p^4]." By this important correction the dentition of *Rh. Maclaudi* is shown to be *perfectly* in accordance with the usual scheme in the present group.

One of these modifications of the skull, in the *trifoliatus* section, is very instructive. When, as is the case in other *Rhinolophi* beyond a certain low level of development, the temporal muscle increases in size, the sagittal crest creeps more *forwards* (as in many other Mammalia), reducing the length of the supraorbital crests, consequently also the length of the postnasal depression, which is bordered laterally by the supraorbital crests. In the *trifoliatus*-type the shape and size of the nose-leaves seem to require a rather long and very deep postnasal depression; therefore the temporal muscle, when growing larger, cannot very well push the sagittal crest much farther *forwards*; instead of that it pushes the crest *upwards*, making it unusually high in front. This accounts for the peculiar shape of the sagittal crest, as figured on p. 245 (fig. 2).

The subjoined diagram gives a view of the probable inter-relations of the species :—

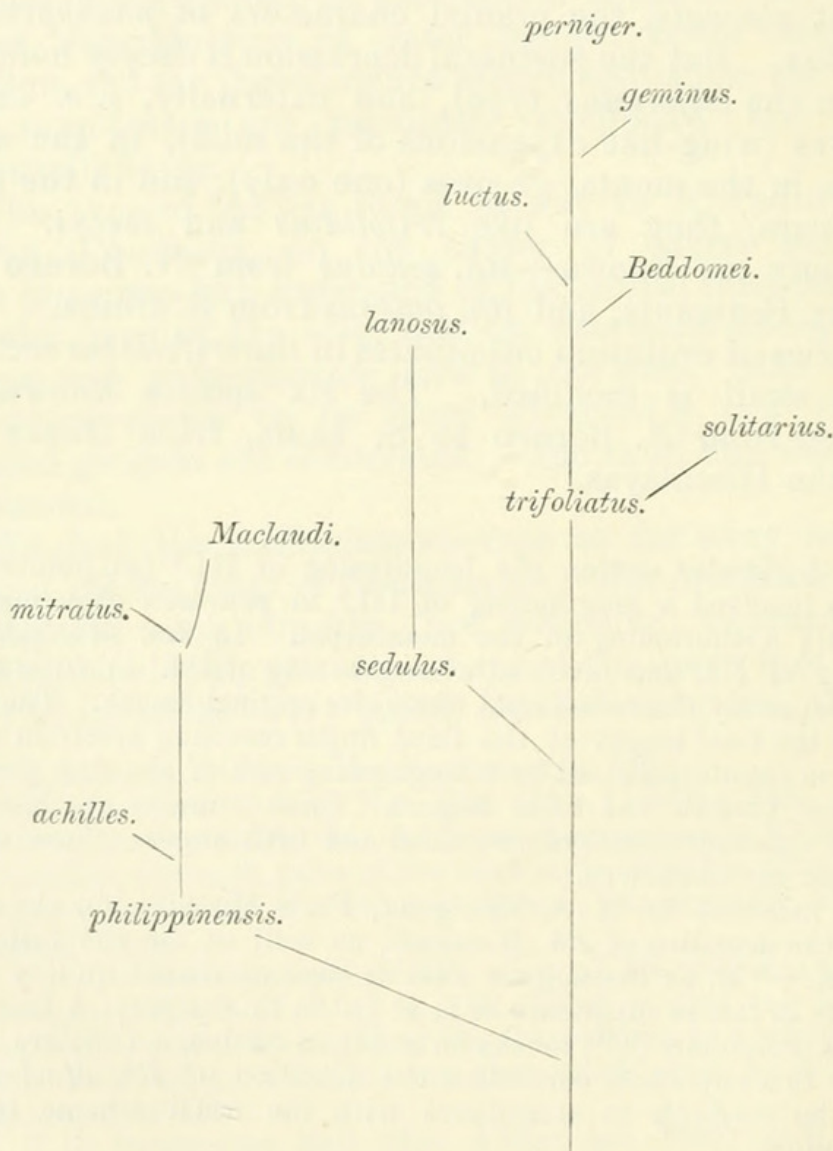


Table of Measurements.

	<i>Rh. sedulus.</i>		<i>Rh. lanosus.</i>	<i>Rh. trifolius.</i>		<i>Rh. solitarius.</i>	<i>Rh. luctus.</i>		<i>Rh. perniger.</i>	<i>Rh. geminus.</i>	<i>Rh. Beddomei.</i>
	2 spems., 2 skulls.		♀ ad. Type.	15 spems., 11 skulls.		♂ ad. Type.	7 spems., 5 skulls.		6 spems., 5 skulls.	♀ imm. Type.	♂ ad. Type.
	Min.	Max.	mm.	Min.	Max.	mm.	Min.	Max.	mm.	mm.	mm.
Ears, length	...	22.5	...	22	25	24.2	...	30.5	36.7	34.5	29
" greatest breadth	...	16	...	17	19	17.8	...	25	26	25	21
Nose-leaves, length	...	18.8	...	18.2	20.8	19.5	...	25	26	28	23.5
" breadth of horseshoe	...	10.3	...	10.5	12.4	11.3	...	14.2	14.5	15.5	14
Forearm.....	43.5	49.2	71.5	47	55	46.5	65.3	68	71.5	73	63.8
3rd metacarpal	27	30.5	45	30.5	37	29.8	40.2	46	45.5	46.2	37.5
III. ¹	15.2	18	26.3	17.8	22.3	16.2	24.7	26.8	25.7	26	22.9
III. ²	21.5	23.8	37	25	31	24	33	36.2	35.5	35	31.2
4th metacarpal	31.7	34.5	53	35.5	42	33.5	47.2	53	52.2	57	45
IV. ¹	9	11.8	16	10.5	13	9.5	13.2	15	13.2	15	12.7
IV. ²	14.2	15.8	23.2	14.8	20	15	20.5	23.2	22.8	23	20.3
5th metacarpal	32.3	35.8	54.3	37	43.8	35.8	48.2	55.2	55.5	53.5	46.2
V. ¹	10	11.7	17	11	13.7	10.2	14.2	16	15	17.5	14.8
V. ²	15.2	15.5	25	15	19.7	16.5	21.5	26	24.7	24	22.1
Tail	...	31	51	29.3	36	25.7	43	50	50	44.2	35
Lower leg	22.8	22.9	37.5	23.2	27.8	21.2	32.5	34.2	35.2	36.2	31.2
Skull, total length	...	21.1	30.2	22.6	24.9	21.7	28.7	30	31.2	31	27.7
" mastoid width	...	10	13.2	10.7	11.6	10.8	12.9	13.2	13.5	14	12.5
" width of brain-case	8.5	8.8	11.9	9.5	10.3	9.8	12.2	12.8	13	12.6	11.7
" zygomatic width	10	10.1	14.2	11.4	12.7	12	14.8	16.2	15.5	15.8	14.8
" maxillar width	7.5	7.8	9.8	8.2	9.1	9	11	11.8	11	10.8	10.5
" supraorbital length	6.8	7.6	10.8	7.2	8.2	8.2	9.2	10.8	11	10.5	8.7
" width of nasal swellings	5.7	5.7	8.2	6.1	6.5	6	7.8	8.2	8.8	8.2	7.5
Mandible	14	14.8	22	15.7	17.6	15	20.8	22.5	22.7	...	19.7
Upper teeth	7.8	8.4	11.1	8.7	9.7	8.7	11.1	12.1	12	12	10.5
Lower teeth	8.2	9	11.8	9.2	10.3	9.2	12	13	13	12.8	11.3

Wing-indices.

	Forearm.	3rd metac.	III. ¹ .	III. ² .	4th metac.	IV. ¹ .	IV. ² .	5th metac.	V. ¹ .	V. ² .
<i>Rh. philippinensis</i> and <i>achilles</i> ...	1000	694	290	386	716	205	248	712	221	248
<i>The sedulus</i> and <i>trifolius</i> sections.	1000	629	371	525	734	211	325	762	232	343



Andersen, Knud. 1905. "XXVIII.—On the Bats of the *Rhinolophus philippinensis* Group, with Descriptions of Five new Species." *The Annals and magazine of natural history; zoology, botany, and geology* 16, 243–257.

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