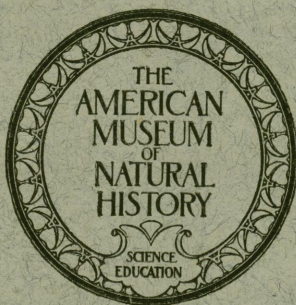


RESULTS OF THE ARCHBOLD EXPEDITIONS. No. 47

REVIEW OF THE VESPERTILIONINE BATS, WITH
SPECIAL ATTENTION TO GENERA AND SPECIES
OF THE ARCHBOLD COLLECTIONS

BY G. H. H. TATE



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Article VII.—RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 47

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INTRODUCTION

This paper is the eighth and last of a series of publications devoted to the study and determination of a large number of Microchiroptera assembled by Mr. Richard Archbold, which are deposited in The American Museum of Natural History, New York.

The bats in question form a part of a large collection of mammals assembled by Mr. Archbold during the decade 1930-1940, mainly by means of his own expeditions to Madagascar, New Guinea and Australia, but also through the work of collectors whom he sent from time to time to Celebes, Borneo, Java and Sumatra.

Our interest in the oriental region has centered upon the mammal fauna of the island of New Guinea. But in order properly to study the mammals of that island it has been necessary to work intensively with those of Australia on the one hand and of southeastern Asia and the East Indian islands on the other.

Reports based upon the fruits of Mr. Archbold's tireless collecting have been published with considerable regularity, the field of research extending far beyond mammalogy to ornithology and other zoological departments. Numerous papers on the bo-

tanical material assembled have also appeared.

The present work on the Vespertilioninae has been facilitated by the use of specimens generously lent by the curators at the museums at Chicago, Cambridge and Washington. In addition, numerous photographs of types, made by the kind permission of the authorities at various European and Australian museums, have aided materially in establishing the exact characteristics of species inadequately described.

One new species, *Pipistrellus anthonyi*, is described.

Preliminary papers relating to the Vespertilionidae have been published in which the subfamilies Miniopterinae, Murinae, Kerivoulinae and Nyctophilinae were successively dealt with.¹ *Myotis*, the most primitive genus of the remaining subfamily, the Vespertilioninae, had been previously reviewed.² But it was found in practice that the remaining vespertilionine genera were often too closely integrated one with another to permit satisfactory treatment

¹ 1941, Bull. Amer. Mus. Nat. Hist., LXXXVIII, Art. 9.

² 1941, Bull. Amer. Mus. Nat. Hist., LXXXVIII, Art. 8.

one by one. Instead, a procedure is here adopted under which the subfamily is reviewed as a whole, and the interrelationships of the genera are pointed out, as far as understood. In many instances the data upon which certain species or races have been founded are so vague that it has not been possible to reach a conclusion regarding their status. I do not hesitate to assert that many of the names will go into synonymy. This action should occur, however, only after ample facts have been marshaled in proof. As much evidence is needed to prove synonymy of a species as to demonstrate the distinctness of a new one. It was with the above mentioned idea of an inclusive review of this very complex subfamily that the work following was undertaken.

Despite the modern concept of "the

species," based upon populations relatively homogeneous both morphologically and functionally, whose individuals normally interbreed freely and breed rarely or never with other species even when they inhabit the same environment—despite this knowledge and theory and the understanding that one should deal with large samples statistically, in practice the museum student is still compelled to found his assumptions or "conclusions" upon quite small samples or often upon random individuals taken from different localities. To a great extent also he must rely upon other men's observations. Thus he still builds "species" upon morphological distinctions seen in single specimens (types). But he is nevertheless aware of his handicaps and awake to the shortcomings of methods which he must use.¹

ALPHABETICAL LIST OF GENERA DISCUSSED

Particular Attention Has Been Paid Those Printed in Bold-faced Type

<i>Baeodon</i>	283	<i>Mimetillus</i>	265
<i>Barbastella</i>	263	<i>Myotis</i>	229
<i>Chalinolobus</i>	260	<i>Nyctalus</i>	254
<i>Corynorhinus</i>	231	<i>Nycticeius</i>	283
<i>Dasypterus</i>	290	<i>Otonycteris</i>	289
<i>Discopus</i>	233	<i>Philetor</i>	265
<i>Eptesicus</i>	271	<i>Pipistrellus</i>	233
<i>Euderma</i>	232	<i>Plecotus</i>	229
<i>Glauconycteris</i>	263	<i>Rhinopterus</i>	279
<i>Glischropus</i>	253	<i>Rhogeessa</i>	283
<i>Hesperoptenus</i>	268	<i>Scoteinus</i>	280
<i>Histiotes</i>	279	<i>Scotoecus</i>	283
<i>Ia</i>	259	<i>Scotomanes</i>	288
<i>Idionycteris</i>	231	<i>Scotophilus</i>	283
<i>Laephotis</i>	279	<i>Scotozous</i>	259
<i>Lasionycteris</i>	229	<i>Tylonycteris</i>	266
<i>Lasiurus</i>	290	<i>Vespertilio</i>	270

THE PRIMITIVE VESPERTILIONID

Cases are numerous in the Vespertilionidae of parallel or convergent development from relatively independent genetic lines. The primitive, unspecialized vespertilionid skull may be considered to have possessed the following characteristics: moderately full braincase; zygomatic arches strongly built and bearing small postorbital processes; rostrum fairly slender, elongate, not especially broadened at lacrimal level and without pronounced supraorbital tubercles. Palate rather narrow, weakly arched or

domed, with postpalatal spine; basicranial region with cochleae and bullae only moderately large, without basial pits. Dentition: upper incisors, two each side, bifid; lower incisors, three each side, trifid, not at all or weakly imbricated; canines not approximated, without accessory cusps; upper and lower premolars three in each jaw, subequal in height and in cingulum

¹ Reference: The symposium on species held at the joint meeting of the Amer. Societies of Ichthyologists, Herpetologists, Vertebrate Paleontologists, April, 1942.

lengths, except p_4^1 which were less blade-like and more molariform; m^3 with Z-pattern complete; m_3 with posterior triangle scarcely reduced.

In the skin one may expect none of the special adaptations of ears, feet and wings which have been developed by certain of the genera and subfamilies. The ears were simple, separate and of moderate size. The

tragus was simple, unnotched and probably much like that of simple types of *Pipistrellus*. The wing was probably attached to the terminal part of the metatarsus. This type of attachment is common throughout the Chiroptera. Attachment to the wrist (some *Myotis*) or to one of the phalanges of the fifth digit (*Murina*) may be considered new modifications.

PRINCIPAL ADAPTIVE CHARACTERS OF THE VESPERTILIONINAE

Upon the basic pattern above described certain modifications have been imposed, not once only, but so often that it is difficult to avoid the idea that hidden trends or tendencies are present.

One of the earliest, most widespread of these modifications came in connection with seizing and masticating food: most vespertilionid bats tend to shorten the face, jaws, palate and toothrows. This process comes about by shortening of the bones of the face with the result that the fronts of the orbits continually approach the roots of the canines. In extreme cases the anteorbital foramen may reach a position almost over the canine.

At the same time shortening of the toothrow takes place by reduction and elimination of p_3^3 and p^2 , the corresponding teeth of the upper jaw being lost before those of the lower jaw. A further point where shortening of the toothrow takes place is at m_3^3 . This is accomplished by reduction of the posterior limb of the Z-pattern and by shortening of the body of the tooth longitudinally in the toothrow.

THIRD MOLARS

Modification of the regions of the premolars and of m^3 may take place independently. The alteration of m^3 appears to be a more advanced, more recent specialization and one occurring at random in many genera. For example, in *Eptesicus*, *nilssonii* m^3 is entire, while in *E. serotinus* m^3 is markedly shortened. This fact is apparent too in *Pipistrellus* and other genera. But it must not be thought that m^3 in unmodified condition necessarily indicates that the bats showing it are primitive. It may be merely one unmodified feature in a

bat otherwise considerably specialized, e.g., in *Histiotus*.

PREMOLARS

The customary change in the premolars happens through the sharp reduction in size of the third and second teeth; here the teeth of the upper jaw precede those of the lower. The upper third premolar disappears, then the lower third; next the upper second tooth goes. Although the lower second premolar remains in many genera fairly large, in the Nycticeini and others it may become exceedingly small.

INCISORS

The incisor teeth undergo modifications also. In part at least the changes in the incisors are connected with approximation of the canines. Thus imbrication of the lower incisor teeth, often accompanied by thickening of the crowns, is seen when the lower canines stand close together.

In the upper incisor teeth reduction takes place in the secondary, or lateral (sometimes posterior), cusp of each tooth, leaving a peg-like unicuspid tooth. It also occurs by displacement outward (*Ia*, some *Pipistrellus*, etc.), inward (*Hesperoptenus*) or by obsolescence (many genera) of the outer incisor (i^2), permitting i^1 ultimately to come in contact with the cingulum of the canine (*Scotophilus*).

The lower incisors, primitively tricuspid (as are the milk incisors of the upper jaw), show slight changes in addition to imbrication. The outermost lobe of the three is separated by a deeper sulcus than is the inside one. In *Rhogeessa* this outer lobe becomes obsolescent, and i_3 is reduced.

CANINES

The chief changes in the canines, apart from size, relate to development of accessory cusps (a) on the posterior cutting edge, (b) on the cingulum.

An accessory cusp is present in *Tylonycteris* and sometimes in *Pipistrellus*, but only in certain groups of species. It is absent in *Ia*, *Nyctalus*, *Chalinolobus*, *Hesperoptenus*, *Lasiurus*, *Scotophilus*, *Scotomanes*, *Otonycteris*, *Nycticeius* and allies, *Eptesicus*, *Scoteinus* (Australia). A strongly developed posterior cingulum cusp is seen in *Philetor* and *Mimetillus*.

BRAINCASE

The braincase and intertemporal region in primitive forms were described earlier as "moderately full." Broadening of the braincase had been indicated in the Nycticeini, *Tylonycteris* and allies. It appears also in *Hesperoptenus* and in less pronounced form in *Nyctalus*, *Ia* and some groups of *Pipistrellus*. Extreme flattening in combination with such broadening is seen only in *Tylonycteris* and in *Discopus*.

The reverse condition, excessive fullness of the braincase, occurs twice, namely, in the Lasiurini and in *Chalinolobus* and *Glauconycteris*, in each case combined with extreme shortening of the face.

In some bats the intertemporal area appears much constricted by contrast with the secondarily broadened rostrum. In the case of *Histiotus* the intertemporal region appears definitely expanded both laterally and upward.

Osseous crests, the sagittal and lambdoid crests, are obsolescent in the majority of the vespertilionine genera. They are present in advanced Nycticeini (especially in *Scotophilus kuhlii*, in which a "helmet" is developed), also in Australian *Scoteinus*, the *serotinus* group of *Eptesicus*, in *Ia*, *Hesperoptenus* and *Nyctalus*. It will be recalled that weak crests are present in the *myotis* section of the genus *Myotis*, in certain Nyctophilinae and Miniopterinae. In general, crests are present in large bats, absent in small ones. They are correlated with strong temporal muscles and heavy mandibles.

ROSTRUM

The height and breadth of the rostrum may go with that of the braincase, as in *Nyctalus* and *Histiotus*; also in species with broad, flat braincases the rostrum may be broad and flat, as in *Scoteinus*, *Tylonycteris* and *Scotophilus*. In the case of the primitive, little modified rostrum (unbroadened) there is often a weak median sulcus, as in *Myotis*, some *Pipistrellus* and many other genera. Quite marked depressed areas may appear on either side of the muzzle just anterior to and behind the canine and in front of the anteorbital foramina (*Eptesicus fuscus* group, etc.). In *Barbastella* a markedly depressed dorsal area is seen on the rostrum and a median spine in the anterior narial sinus.

Coupled with such expansion of the rostrum and in certain cases possibly with a supplementary process comes the enlargement laterally of the supraorbital tubercles. This condition occurs in the *joffrei* group of *Pipistrellus* and is found at its optimum in *Mimetillus* and *Philetor*. In *Tylonycteris* it is less well developed. In *Scotomanes*, although the lacrimal region is much widened, the tubercles are limited to narrow bony ridges placed directly above the eyes.

The anteorbital foramen normally is a small, pore-like opening placed just in front of the orbital fossa. In *Scotophilus* (less in *Scotomanes* and not at all in *Otonycteris*) the pore becomes considerably enlarged, so that its externally bounding wall is reduced to a slender bar separating the foramen from the orbital fossa. Considerable enlargement of the anteorbital foramen may be perceived also in *Histiotus*, an offshoot from *Eptesicus*, and in *Scotoecus*. In the Lasiurini, on the other hand, the foramen is represented by minute pores on each side, which because of extreme shortening of that part of the maxilla lie almost directly above the canine.

ZYGOMATA

Perhaps as a secondary effect of the modifying of biting, the zygomata become altered. In a great many genera the post-orbital processes of the zygomata have disappeared, following which the zygomata

themselves have become so weak and slender as to appear almost functionless.

PALATE

The anterior palatal sinus is normally about half as wide as the canine width (outer). In *Nyctalus*, *Vespertilio* and *Lasiurus* this sinusal width is greatly increased. Usually it is smoothly rounded, or slightly squarish in outline. In *Tylonycteris* a trace of a median projection appears, which in *Philetor* may become a spine definitely projecting forward. The posterior palatal spine is normally either finely pointed or triangular, projecting backward beneath the nasal canal. In *Scotophilus*, especially *S. kuhlii*, the spine projects downward from the palatal surface.

BASISPHENOID PITS

"Basial pits" (Thomas) must be regarded as indications of specialization, although I do not know their function. They usually adjoin the inner sides of the cochleae and may be observed in a number of genera. Possibly those of *Eptesicus dimissus* are not homologous with the pits customarily seen (e.g., in *Hesperoptenus tickelli*).

AUDITAL ORGANS

Extreme enlargement of the pinnae of the ears has appeared among the Vespertilioninae three times. The plecotine bats, *Plecotus*, *Corynorhinus*, *Idionycteris* and *Euderma*, represent a compact group derived, if one may judge from skull characters and dentition, from the parent stem leading to *Myotis* and *Lasionycteris*. Reduce the size of the ears and audital bullae of *Plecotus*, eliminate the myotine p^3 , and what is left is almost identical to *Lasionycteris*. The second large-eared group, the Histiotini, including *Histiotus* (tropical America) and *Laephotis* (Africa), derived probably from *Eptesicus*, obviously has progressed farther from the ancient line. In both of these genera an *Eptesicus* stage of dentition has been achieved. Both braincase and rostrum are high and full in *Histiotus*, rather less so in *Laephotis*. The third group of big-eared vespertilionine bats is represented by *Otonycteris*. The affinities of this genus appear to be with the

Nycticeini; the heavily built skull (less broadened, however, than in *Scotophilus* and *Scotomanes*), the well developed supra-orbital tubercles, the massive character of the teeth, with reduction of i^1 to peg-like form, the elimination of i^2 and p^2 , the narrowing of the canine width and small size of p_2 emphasize the relationship.

Emphasis was laid by early writers upon the shapes of the tragus. Dobson in particular based much of his specific classification upon minute differences of degree of curvature of the margins of the tragi.

THUMB-PADS AND FOOT-PADS

Just as enlargement of the ear appears to have come about more than once, so development of thickened pads or adhesive disks on thumbs or feet in the Vespertilioninae has taken place repeatedly. The two best known genera in this category are *Glischropus* and *Tylonycteris*. *Glischropus* is virtually a *Pipistrellus* in which the pad of the metacarpal of the thumb is much enlarged, though by no means a pedunculate disk as in *Thyroptera* (tropical America). The feet also are broadened and thickened. The relation of *Glischropus* to *Pipistrellus* is best seen in the *P. tenuis* group, in which the features mentioned are weakly developed. The premaxillae of *Glischropus* are shortened much as in *P. tenuis*.

The pads of *Tylonycteris*, on the other hand, are strongly divergent. *Tylonycteris* possesses wing- and foot-pads, similar to, but better developed than, those of *Glischropus*. But the extremely specialized flattened skull permits no close affiliation of the two. Taking into account the widening of the lacrimal area, the loss of p^2 and the reduction of the crown length of p_4 in the toothrow, *Tylonycteris* appears distantly associated with *Mimetillus* (Africa) and *Philetor* (New Guinea). In these latter genera the dentitions, as well as the broadening of the skulls and palates and development of supraorbital tubercles, show close correspondence to *Tylonycteris*. The flattening of the skull so conspicuous in *Tylonycteris* is far less obvious in *Mimetillus* and is not found in *Philetor*.

Discopus, recently described from Indo-

China by Osgood, evidently became separated from the pipistrelline stem far back in time, because, like *Lasionycteris*, it retains p_3 and has the rostrum relatively unshortened. In it the braincase is depressed nearly as in *Tylonycteris* but shows no orbital processes. This bat, with ear rather long and narrow, has pads developed on the hind feet "even more extreme than in *Tylonycteris* and *Ghiischropus*." Pads were also described in the poorly known *Hesperoptenus blanfordi*.

OTHER STRUCTURES

The interfemoral membrane is constantly extended between the *tuber calcanei* and the cartilaginous spur which is attached thereto, and the tip of the tail. In certain species of *Myotis* and other genera the last caudal vertebra may project beyond the membrane. Again, in *Lasiurus* and in the subfamily Murinae the dorsal surface of the membrane may be quite densely covered with hair. In certain groups the calcar

bears a small, lobe-like, flattened projection, the calcareal lobe. This structure may be present or absent in the same genus (example, *Myotis*). It seems to have no systematic value when groups of higher order than species are under consideration.

The baculum has been used extensively as a basis of classification in the Rodentia. It seems probable that study of this structure in the Microchiroptera would yield valuable results. Beginnings have been made in certain groups: Thomas studied the bacula of the genus *Nyctophilus*; the late Dr. G. M. Allen had gathered together a number of bacula representing many of the species of *Pipistrellus* which he intended to employ in revising the genus. In general, very few of the bacula of the Vespertilionidae are known, so it will be necessary, before any extensive work based on them can be attempted, to assemble adequate representation from the collections of bats in alcohol and perhaps anew from the field.

EXTRA-FAMILIAL RELATIONSHIPS AND THE AFFINITIES OF VESPERTILIONID SUBFAMILIES

Vespertilionid bats with premolar dentition of least specialized type occur in the New World among the Thyropteridae and Natalidae¹ (part). The Old World Kerivoulinae, in respect of their premolar arrangement, show indications of reducing p_{2-3}^{2-3} and thus suggest the method of approach to the present condition in *Myotis*.

In most other respects those families of ancient lineage have pursued independent pathways. The Kerivoulinae, Furipteridae and Thyropteridae have developed greatly inflated braincases and low, tip-tilted rostra, and the Thyropteridae have produced the well known modifications of the pads of thumbs and feet. But the two families have diverged markedly in the structure of the pterygoid region and *basis cranii*.

The Furipteridae (*Furipterus* and *Amorophochilus*) have pursued the above mentioned course of cranial and rostral specialization to an even greater extreme but have

evolved yet a third pattern of pharyngeal anatomy while also eliminating completely one of the two anterior upper premolars—probably p_2 , since p_2 is considerably reduced in size.

In the Natalidae a special type of *basis cranii* is present whereby that part of the mesopterygoid fossa which lies between the wings of the pterygoids is separated from the posterior area, in which basisphenoid pits are present in certain chiropteran genera, by a strongly developed transverse ridge aligned with the two glenoids. The anterior portion is the more pitted, and the pterygoid palate extends far backward, partly covering it. Mesially it is divided in two by a thin wall of bone (the vomer?). The greatly enlarged Eustachian tubes, ossified only externally, open on this pharyngeal region.

Natalus, *Nyctiellus* and *Chilonatalus* all show this character of the pterygoid area, *Phodotes* to a less extent. A homologous, though in detail slightly different, development of the bony framework of the pharynx

¹ Separated by H. Allen, 1893, Bull. U. S. Nat. Mus., XLIII, p. 55.

is seen in *Thyroptera*. The structure taken as a whole appears to be a specialization peculiar to American bats.¹

Natalus and *Phodotes* are more closely allied to each other than to either of the other two genera, *Chilonatalus* and *Nyctielus*, in which smaller size and reduction in size of p^2 are apparent. In *Nyctiellus* p^2 is already minute, reaching only to the depth of the cingulum of the canine. This type of premolar modification is wholly different from that pursued in the vespertilionine bats in which, though both p^2 and p^3 are obsolescent, p^3 is always the first to grow smaller and disappear.

In all of the Natalidae exceptional lengthening of the low, flattened rostrum has taken place. This is somewhat analogous to what has occurred in the subfamily Glossophaginae of the family Phyllostomidae. Such lengthening of the jaws, with accompanying spacing of the teeth and modification of the premolars into compressed elongate blades, is the antithesis of the tendency to shorten the face and mandible, visible throughout the Vespertilioninae.

It can be concluded that, although the Vespertilionidae, Thyropteridae, Furipteridae and Natalidae have had a common origin, they have since diverged steadily. It is also apparent that the Thyropteridae alone among the last three families show some slight resemblance to the vespertilionid subfamily Kerivoulinae, though they differ so greatly in the pterygoid and rostral regions of the skull and in the ears, wings and feet that the similarity between the two is better regarded as fortuitous.

Considering next the relationships be-

tween the Vespertilioninae and those other groups currently considered subfamilies, the Murinae, Miniopterinae, Nyctophilinae and Kerivoulinae,² only the last can be regarded as at all nearly related to the Vespertilioninae. The dentition of the first three subfamilies mentioned is already so specialized that no obvious clue to the path of divergence followed by them remains. In the cases of the Murinae and Miniopterinae there is no way of knowing whether the missing premolar is p^2 or p^3 , except doubtfully in *Miniopterus* by analogy with the lower premolars.

The Nyctophilinae are, however, a little different. They have reached the *Nycticeius* stage of dental reduction, though they may have arrived there by a path different from that taken by the Nycticeini. In addition they have developed their characteristic nyctophiline modifications (noseleaves, etc.). No matter whether they are regarded as Vespertilionids separated in remote times from the vespertilionine, which independently achieved nyctophiline dentition, or whether they are considered as hyperspecialized Nycticeini, they can have played no part in the ancestry of those lower Vespertilioninae with relatively complete dentition, the Myotini.

That leaves only the Kerivoulinae, which, as I stated in my earlier paper, show incipient reduction of p_2^{2-3} , as possible relatives of the less progressive genera of Vespertilioninae. The relationship cannot be very close, for the Kerivoulinae demonstrate skeletal peculiarities not shared with the Myotini. Nevertheless the affinity seems to be real.

SUGGESTED PRIMARY GENERIC GROUPS AND TREATMENT OF GENERA AND SPECIES

The more than thirty vespertilionine genera of bats fall chiefly into four main divisions which may be named Myotini, Pipistrellini, Nycticeini and Lasiurini:

1.—The first are long-faced genera coterived with *Myotis*, in which p_3^2 are both present, or p^3 is absent. The upper incisors

have undergone no important modification; p_2^{2-3} are reduced in size; m_3^3 is generally complete.

2.—Genera coterived with *Pipistrellus*. In this division, too, the upper incisors are little or not at all altered, but p_3^2 are absent (except in *Discopus*), and to a greater or

¹ A slightly similar development can be seen in *Nyctalus velutinus*.

² Reviewed in Bull. Amer. Mus. Nat. Hist., LXXXVIII, Art. 9, 1941.

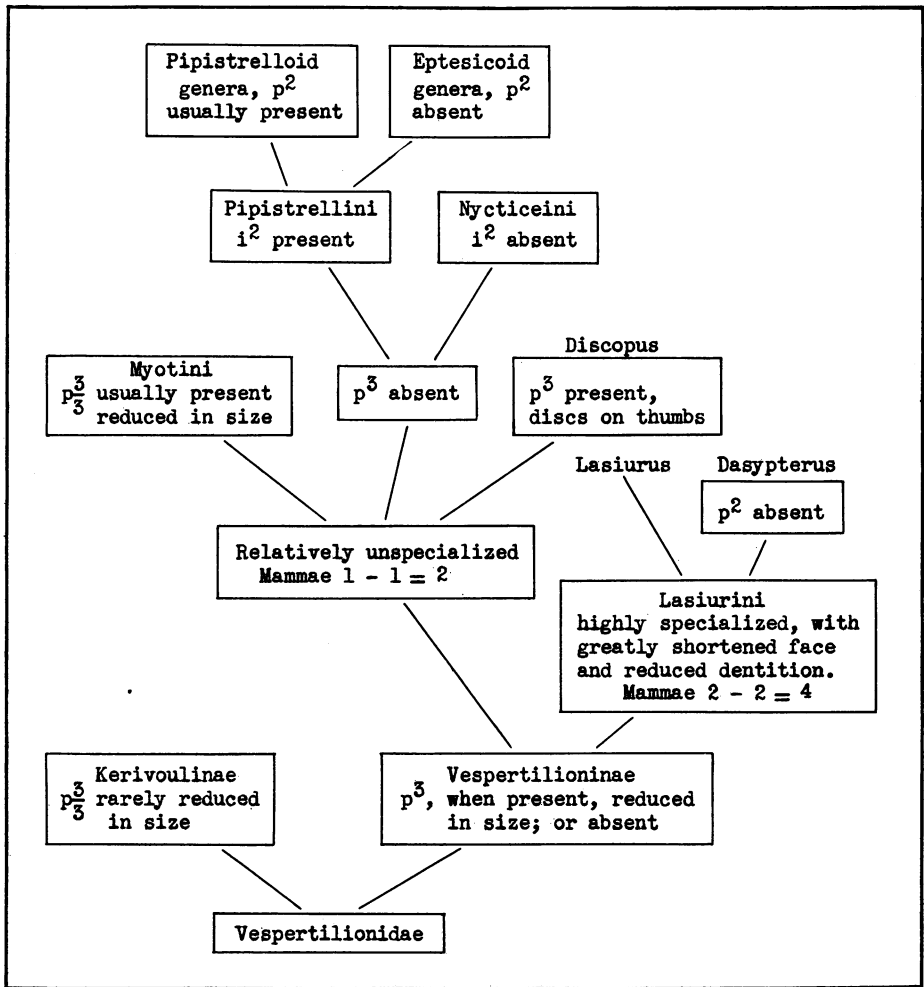


Fig. 1. Suggested phylogeny of the Vespertilioninae. See also Figs. 2, 3, 4, 5.

less degree the face has undergone shortening; in the *Eptesicus* subdivision p^2 has also disappeared, and in many genera related to *Pipistrellus* p^2 is very greatly reduced and often displaced inward from the toothrow; m_3 is complete or incomplete.

3.—Genera of the general type of *Nycticeius*, *Scoteinus* and *Scotophilus*, in which the incisors as well as the premolars are much modified, and m^3 is frequently reduced. In this division i^2 and the accessory cusp of i^1 are almost always obsolete, i^1 becoming a peg-like tooth often closely in contact with the canine. In all three of

these divisions quite profound specializations of various sorts have obscured the basic pattern first indicated. In many instances the same kind of specialization occurs in two or even three of the divisions. One example is the independent development of large ears in *Plecotus*, *Histiotus* and *Otonycteris*.

4.—The highly specialized American *Lasiurus* and *Dasypterus* stand apart from the divisions just defined. These remarkable bats, confused by some early authors with the Murinae in which also the uropatagium is densely pilose, diverged unques-

tionably very far down the vespertilionine trunk. The incisors, perhaps independently, and m^3 have reached the *Nycticeius* stage of reduction; the premolars are in the *Pipistrellus* stage. In the skull, extreme shortening of the face is evident, coupled with enlargement of the braincase, broadening of the rostrum, broadening of the nasal and anterior palatal sinuses (as in *Nyctalus*) and weakness of the zygomata. Except the trifold nature of the lower incisors almost no primitive characters remain. Possibly the mammary formula

2-2 may indicate primitiveness, but even that is open to question.

The Lasiurini may be regarded as having diverged farthest of all from the early vespertilionine bats. It is indeed possible that they should be accorded equal rank with the subfamilies Kerivoulineae, Miniopterinae, etc.

The tree shown above serves to outline roughly the phyletic relationships of the bats treated in this paper and to indicate their relationships to related subfamilies (Fig. 1).

Myotini

In regard to the extent of their dental evolution and shortening of the face the bats of this division are less progressive than any others discussed hereafter. The basic types of the division are represented by *Myotis* and its near relatives, *Pizomyx*, *Cistugo* and *Rickettia*. The American genus *Lasionycteris*, essentially a *Myotis*, has become specialized through the loss of p^3 , without yet greatly shortening the face and jaws. The corresponding lower tooth and p_2 still agree closely with the lower premolars of less specialized species of *Myotis*, not only in relation to each other but in their proportional sizes relative to p_4 . There is no indication of displacement of p_3 in *Lasionycteris*.

One hesitates to assume derivation of *Plecotus* and *Corynorhinus* from the *Myotis* stock, principally because of the enormous degree of specialization of the audital region in those genera of bats. Yet their dental pattern, showing absence of p^3 combined with retention of *Myotis*-like incisors, is almost precisely equivalent to the tooth arrangement of *Lasionycteris*. If the four plecotine genera are gathered together under the collective term Plecotini, with rank equal to the Myotini, undue notice is accorded an admittedly important modification which affects only the auditory areas. It seems preferable that the Plecotini be regarded instead as a specialized offshoot of the *Myotis* line. The fact that *Euderma* has gone a stage farther than *Plecotus* and has lost p_3 as well as p^3 does not alter this view (Fig. 2).

MYOTIS KAUP

A preliminary study of *Myotis* has already been made.¹

LASIONYCTERIS PETERS

Lasionycteris PETERS, 1865, Monatsber. Akad. Wiss. Berlin, p. 648.

GENOTYPE.—*Vespertilio noctivagans* Le Conte.

This monotypic genus has been compared above to *Myotis*. Its characters, apart from the loss of p^3 , are essentially primitive myotine. In the teeth i^2 , though it lacks a posterior cusp, is not reduced in crown height; c is simple; p^2 , completely in the tooththrow, and m^3 , unreduced. The lower incisors are incipiently imbricated; p_2-3 , as in *Myotis*, much smaller than p_4 ; p_3 is completely within the tooththrow.

In the skull the zygomata are fairly deep, with well developed postorbital processes; the rostral area is somewhat broadened, with lateral depressions similar to those in some *Myotis* and *Eptesicus*. There are no peculiarities.

PLECOTUS GEOFFROY

Plecotus GEOFFROY, 1818, Descrip. del l'Egypte, II, p. 112.

GENOTYPE.—*Vespertilio auritus* Linnaeus.

Geoffroy's original concept was broader than the present plecotine section, "les trois espèces de ce genre sont, l'oreillard de Daubenton [*Plecotus*], la barbastelle [*Barbastella*] et une nouvelle espèce de Timor [*Nyctophilus*]."

A highly specialized genus closely re-

¹ 1941, Bull. Amer. Mus. Nat. Hist., LXXVIII, Art. 8, pp. 537-565.

lated to the American *Corynorhinus*, *Idionycteris* and *Euderma*. Formerly *Plecotus* was considered to be also a near relative of *Barbastella*. But though it and allies may be closer to *Barbastella* than to most other vespertilionine genera and betray certain characters in common, they show, according to Miller,¹ numerous important differences in the ear, rostrum, anterior part of the skull, zygomata, bullae and teeth,

Himalaya region, but members of the genus extend to western Europe and eastward to Japan.

A brief comparative study of the genus was made by Thomas,³ which I quote, "Of the genus *Plecotus*, *P. homochrous* (Nepal) and *puck* (Murree), doubtfully distinct from each other, stand apart from the rest owing to the narrowness of the braincase; *auritus* (Europe) has rounder

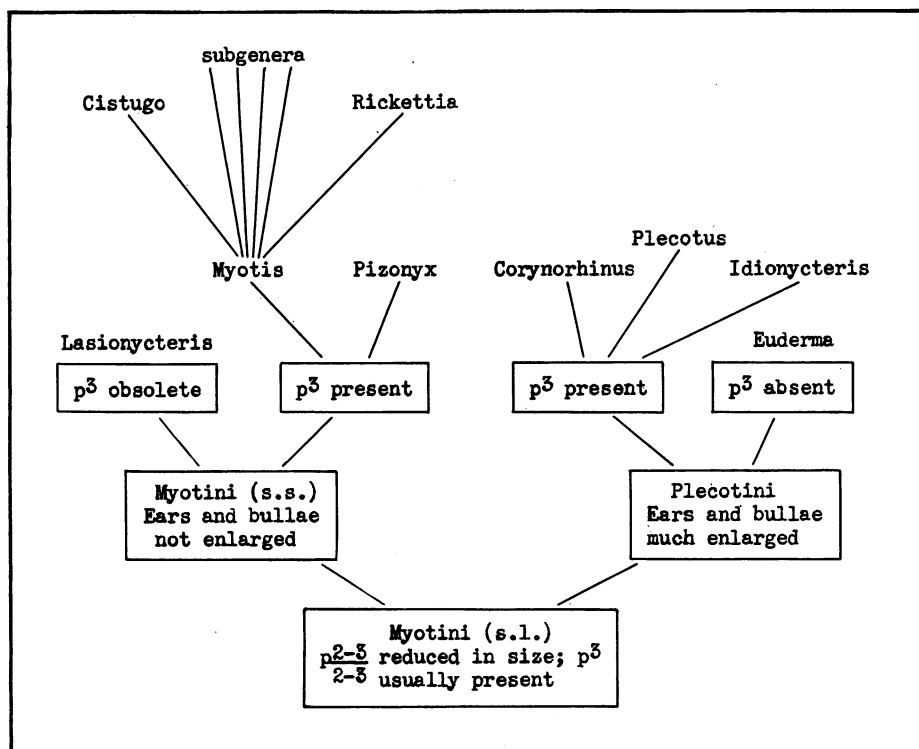


Fig. 2. Suggested phylogeny of the myotine and plecotine genera of Vespertilioninae. See also Fig. 1.

and are related only distantly to the South American big-eared bats of the genus *Histiotus*.

Less than a dozen forms of *Plecotus* have received names. G. M. Allen², in his African list, shows only two races of *P. auritus*, reaching across northern Africa to Teneriffe. The Eurasian forms come chiefly from the uplands adjoining the

skull, small bullae, and short thumbs; *christiei* (Egypt) a large braincase and very large bullae; *wardi* (Ladak and Kashmir) a large skull, rather small bullae, long thumbs, and very pale color; *sacrimontis* (Japan) a large skull, rather small bullae and long thumbs; and finally the present species [*ariel*] has a large rounded skull, large bullae, long thumbs

¹ 1907, Bull. U. S. Nat. Mus., LVII, p. 224.

² 1939, Bull. Mus. Comp. Zool., LXXXIII, p. 96.

³ 1911, Proc. Zool. Soc. London, p. 160.

and dark color. No doubt it is nearly allied to *wardi* but the colors of the two are nearly at the opposite ends of the scale."

Ognev¹ reviewed the northern forms, making *wardi* and *sacrimontis* subspecies of *auritus*. It is quite possible that all are subspecies, though one gathers from Thomas's description of *mordax* that it is a well marked species.

Recently Kishida (1927) has renamed *sacrimontis* Ognev (not *sacrimontis* Allen) *P. ognevi*. It is unlikely that this can stand since Ognev himself (1938) places *sacrimontis* Ognev in the synonymy of *sacrimontis* Allen.

I have photographs of the type skulls of *homochrous*, *puck*, *wardi* and *mordax* and specimens of *auritus auritus* from England. An outstandingly different species is indicated by the skull of *mordax*. In it the posterior part of the mastoid area is broadened and prominent, and the relatively great size of the molars, mentioned by Thomas, can be discerned.

The following named forms of *Plecotus* have been proposed:

NAMED FORM	LOCALITY	FORE- ARM IN MM.
<i>ariel</i> Thomas	Szechwan	44
<i>auritus</i> Geoffroy	Egypt(England)	38
<i>homochrous</i> Horsfield (Hodgson)	India	38
<i>kozlovi</i> Bobrinskoj	Eastern Tibet	44-46
<i>leucophaeus</i> Swertsoff	Tashkent	—
<i>mordax</i> Thomas	Kashgar	44
<i>ognevi</i> Kishida	Japan	—
<i>puck</i> Barrett- Hamilton	Punjab	38
<i>sacrimontis</i> Allen	Japan	38-40.7
<i>teneriffae</i> Barrett- Hamilton	Teneriffe	44
<i>wardi</i> Thomas	Ladak	45.5

It is suggested that the Eurasian *Plecotus*, which in this paper are primarily of interest, comprise actually only three species with races and synonyms as follows:

¹ 1928, Mammals of Eastern Europe and Northern Asia, I, pp. 593-607.

FORM	LOCALITY	FORE- ARM IN MM.
1. <i>auritus auritus</i>	Europe	38
<i>auritus homochrous</i>	Himalaya	38
= <i>puck</i> ?	Punjab	38
<i>auritus sacrimontis</i>	Japan	39
= <i>ognevi</i>	Japan	39
2. <i>ariel ariel</i>	Szechwan	44
<i>ariel wardi</i>	Ladak	45
= <i>kozlovi</i> ?	Tibet	45
3. <i>mordax</i>	Kashgar	44
= <i>leucophaeus</i> ?	Tashkent	—

CORYNORHINUS H. ALLEN

Corynorhinus H. ALLEN, 1865, Proc. Acad. Nat. Sci. Philadelphia, p. 173.

GENOTYPE.—*Plecotus macrotis* Le Conte.

Corynorhinus is slightly more specialized than *Plecotus*. The braincase is higher and fuller; the strong zygoma of *Plecotus* shows indications of reduction, and the postorbital process is placed nearer the glenoid; the postpalatal spine is more accentuated; and p^2 is more reduced. On the other hand p^4 in *Plecotus* is the more specialized, being narrowed, and compressed and modified by obsolescence of its hypocone region into a shearing blade. In the lower jaw a corresponding change of shape is seen in p_4 , whose crown area in *Corynorhinus* is wider than long and in *Plecotus* is longer than wide.

Three full species of *Corynorhinus* have been named, all from the United States or Mexico.

IDIONYCTERIS ANTHONY

Idionycteris ANTHONY, 1923, Amer. Mus. Novitates, No. 54, p. 1.

GENOTYPE.—*Idionycteris mexicanus* Anthony.

This monotypic genus was distinguished by two fleshy lappets rising from the band uniting the ears. No generic description of the skull was made. Under the specific description the small anterior premolar was said to be "crowded" between c and p^4 .

The type is not easily available now for study, for it has been put away for safety during the war.

Idionycteris was regarded as more nearly related to Old World *Plecotus* than to New World *Corynorhinus*.

EUDERMA H. ALLEN

Euderma H. ALLEN, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 467.

GENOTYPE.—*Histiotus maculatus* J. A. Allen.

Related to *Plecotus* and *Corynorhinus*. Distinguished by its remarkable color

pattern in combination with wide spacing of c and p^4 in front of and behind the minute p^2 , but especially by the obsolescence of p_3 (present in *Plecotus*, *Corynorhinus* and *Idionycteris*).

Pipistrellini

In this division the anterior upper premolar (p^2) is unstable. Reduced in size and in process of obsolescence, it is present in some genera, absent in others. In *Scotoecus* it may be present in some species, absent in others, and rarely single specimens occur with p^2 present on one side only.

Although the distinction based on the presence or absence of this disappearing structure seems of doubtful validity in distinguishing *Pipistrellus*-like genera from *Eptesicus*-like genera, I have nevertheless adhered to the accepted practice. It will be seen that two major sections are thus treated. The two sections, in contrast to the Nycticeiini and Lasiurini, have complete incisive dentition, subject only to minor modifications in a few genera. In all of them the face is considerably shortened, in comparison with the Myotini, and all have lost p_3 .

The division Pipistrellini is by far the largest and most complex in the Vespertilioninae. Below I have traced out the scheme of classification of its many branches, which, it is hoped, will assist in explaining the order in which the genera are arranged.

- 1.—Middle lower premolar retained, showing primitive origin. Genus otherwise with pronounced specializations of wings and feet. Face elongate.....*Discopus*.¹
Middle lower premolar obsolete, a specialization. All species showing greater or less shortening of the face. Various special adaptations in certain of the genera.....2.
- 2.—The large assemblage *Pipistrellus*, comprising a dozen major species groups, of quite wide morphological variability, is assumed to be the complex from which most, perhaps all, succeeding genera

¹ One may ask why *Discopus* is not placed with *Lasiomyotis* in the Myotini. I have been influenced by the fact that wing and foot disks have hitherto been found only in the Pipistrellini, except, of course, the family Thyropteridae.

- were given off. In one group or another trends leading to many of the recognized genera can be observed. Inclusive and exclusive definition is difficult, perhaps not possible. P^2 present....*Pipistrellus*.
Non-pipistrelles.....3.
- 3.—Pipistrelle-like bats with pipistrelle skull and dentition, but with the pads of the feet and the metacarpal pad of the thumb greatly thickened and enlarged. (Unlike *Tylonycteris* in which the skull is flat and broadened. See also *Hesperoptenus blanfordi*.).....*Glischropus*.
 - 4.—Pipistrelle-like bats of unusually large size with i^2 - 2 carried forward, rostrum not broadened or raised.....*Ia*.
 - 5.—Medium to large bats, the more specialized and best known species of which have high, broad rostra. Dentition as pipistrelles, wings generally narrow. Smaller species scarcely separable from pipistrelles.....*Nyctalus*.
 - 6.—Medium to small bats with very high, full braincases and short, low rostra, the African members (*Glauconycteris*) lacking p^2 , which is retained in Australian species (except *C. rogersi*)...*Chalinolobus*.
 - 7.—Medium sized bats with ear unusually short, rostrum with markedly depressed median area, p^2 present...*Barbastella*.
 - 8.—Bats with moderately broad rostra, p^2 obsolete, strongly developed supraorbital tubercles.....9.
Very small bats with broad, very flat skulls and weak tubercles, but p^2 present....10.
 - 9.—Braincase full, rounded.....*Philetor*.
Braincase depressed (African)...*Mimetillus*.
 - 10.—Enlarged pads on feet and base of thumbs...*Tylonycteris*.
 - 11.—Braincase full as in *Philetor*; no supraorbital tubercles, i^2 placed directly behind i^1*Hesperoptenus*.
 - 12.—Skull with full rostrum and wide anterior palatal sinus very much as in *Nyctalus*, but p^2 obsolete. Otherwise much as *Eptesicus fuscus*.....*Vespertilio*.
 - 13.—Small species, *Pipistrellus*-like but lacking p^2 ; and large species with skulls somewhat resembling *Myotis myotis* in outline but with reduced dentition (premolars, $\frac{5}{2}$).....*Eptesicus*.
 - 14.—Small African bats with somewhat elevated *Eptesicus*-like skulls and enlarged ears...*Laephotis*.

15.—Larger South American bats with enormous ears, skulls with high rostrum and braincase, and *Eptesicus*-like dentition.
.....*Histiotus*.

DISCOPUS OSGOOD

Discopus OSGOOD, 1932, Publ. Field Mus. Nat. Hist., Zool. Ser., XVIII, p. 236.

GENOTYPE.—*Discopus denticulus* Osgood.

“ . . . Hind feet with highly developed disk-like pads even more extreme than in

ment of wing and foot disks, leads me to place *Discopus* far back along the phyletic line leading to *Pipistrellus* and allies. Its dental formula equals that of *Lasionycteris* which I regard as derived from *Myotis*, specialized through the loss of p^3 .

Discopus denticulus Osgood

Discopus denticulus OSGOOD, 1932, Publ. Field Mus. Nat. Hist., Zool. Ser., XVIII, p. 236.

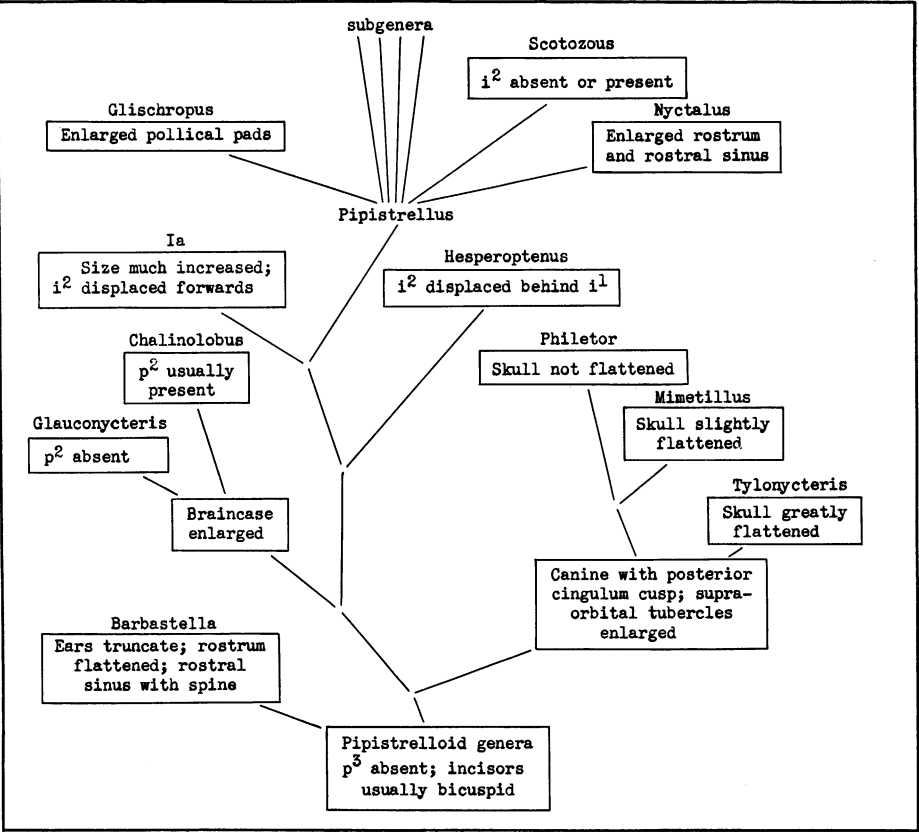


Fig. 3. Suggested phylogeny of the pipistrelloid genera. See also Fig. 1.

Tylonycteris and *Glischropus*. . . . Skull with broad, greatly flattened braincase, somewhat as in *Tylonycteris* but with a longer, narrower rostrum; dentition with two upper and three lower premolars on each side, the middle lower pair small and somewhat internal to the toothrow.”

A single primitive character, retention of p_3 , in combination with marked specializations, flattening of the skull and develop-

TYPE LOCALITY.—Phong Saly, Laos, Indo-China.

Osgood described the color as “Cinnamon Brown, the hairs unicolored from base to tip; underparts near Amber Brown, the hairs with darker bases.” Forearm, 37.8; c-m³, 5.4 mm.

PIPISTRELLUS KAUP

Pipistrellus KAUP, 1829, Skizzirte Entwickl.-Gesch. u. natürl. Syst. d. europ. Thierw., I, p. 98.

Romicia GRAY, 1838, Mag. Zool. Bot., II, p. 495.

Vesperugo KEYSERLING AND BLASIUS, 1839, Archiv. f. Naturg., V, Part 1, p. 312 (part, with *Eptesicus*).

Hypsugo KOLENATI, 1856, Allg. deutsch. naturh. Zeitung, (n.f.) II, p. 131.

Nannugo KOLENATI, 1856, loc. cit.

Megapipistrellus BIANCHI, 1916, Annuaire Mus. Zool. Acad. Sci. Petrograd, XXI, pp. lxxiii-lxxxi.

GENOTYPES OR REPRESENTATIVE SPECIES.—

Pipistrellus, *Vespertilio pipistrellus* Schreber. *Romicia*, *calcarata* Gray = *kuhlii* Kuhl. *Vesperugo*, several species of *Pipistrellus* and *Eptesicus* were included. *Hypsugo*, *maurus* (= *savii*) and *kracheninikowii* listed. *Nannugo*, *nathusii*, *pipistrellus*, *kuhlii* included.

Kaup's brief characterization of *Pipistrellus* reads as follows, "Bats with short, simple ears with bases far apart, short tragus arched inwards, and 34 teeth." When Kaup set up *Pipistrellus*, only two species, *pipistrellus* and *Vespertilio kuhlii* Kuhl, 1819, had been described. The two are very easily distinguished, as shown by Miller's (1912) key and figures of dentitions. Subsequently *savii* Bonaparte and *nathusii* Keyserling and Blasius were described from Europe, a few species from America, and a wealth of species and races from the Old World tropics and subtropics.

Pipistrellus is a genus of short-faced Vespertilioninae in which the dental formula is i_2^1, p_2^2 . This number of incisors and premolars it shares in common with *Ia*, *Nyctalus* and *Glischropus*; also *Barbastella*, *Euderma* and *Chalinolobus*. The first three mentioned are probably descended from common ancestry with *Pipistrellus*; the last three are different in various ways. The African forms of "*Scotozous*" have been treated by Hollister as a group of *Pipistrellus*. *Glischropus* is separable chiefly through its specialized thumbs and foot-pads. *Ia* and *Nyctalus* evince minor peculiarities of size, teeth, rostrum and ears.

No uniformly unspecialized pipistrelle exists. Either the incisors or the canines or the premolars have in every species acquired peculiarities. Ideally the upper incisors should be subequal in size, and each should have its accessory cusps well set off; the lower incisors should be scarcely thickened and in linear arrangement; the

canines should lack accessory cusps; p^2 should not be smaller than i^2 , and it should be slightly or not at all displaced inward from the tooth row, leaving an obvious diastema between c and p^4 ; p_2 should be only slightly smaller than p_4 and retained in the tooththrow. In all species of *Pipistrellus*, m_3^2 remain unmodified. In reality one or more of these characters is changed.

Various partial treatments of the pipistrelles have been published. The following is an incomplete list of papers in which *Pipistrellus* has been treated in some detail:

1866, Gray, Ann. Mag. Nat. Hist., (3) XVII, p. 90. Diagnosis of "*Vesperugo*."

1878, Dobson, Cat. Chiropt. Brit. Mus., pp. 183-246. Under "*Vesperugo*" Dobson included both *Pipistrellus* and its close allies, and under his subgenus *Vesperugo* came *Nyctalus*, *Pipistrellus* and *Glischropus*. He dealt with about twenty-five species.

1897, Miller, North American Fauna, XIII, pp. 87-95. Revision of North American *Pipistrellus*.

1907, Miller, Families and Genera of Bats, pp. 204-205. *Pipistrellus* was characterized in detail, and a few of the species were mentioned. 1912, Miller, Mammals of Western Europe, pp. 202-224. The genus *Pipistrellus* and its four European species were treated at length.

1916, Bianchi, Annuaire Mus. Zool. Acad. Sci. Petrograd, XXI, pp. lxxiii-lxxxii. *Megapipistrellus*, with type *V. annectans* Dobson, was proposed.

1917, Wroughton, J. Bombay Nat. Hist. Soc., XXV, pp. 588-592. A synoptic list of the Indian pipistrelles.

1928, Ognev, Mammals of Eastern Europe and Northern Asia, I, pp. 480-502. Much detailed information concerning the boreal species of *Pipistrellus*.

1928, Thomas, Proc. Zool. Soc. London, p. 144. Discussion of "*Pipistrellus*" *tralatitius* and *P. imbricatus*.

1934, Iredale and Troughton, Mem. Australian Mus., VI, p. 96. Check list of Australian *Pipistrellus*.

1934, Taylor, Philippine Land Mammals, pp. 294-301. Four Philippine pipistrelles are recognized in this manual.

1935, Phillips, Manual of Mammals of Ceylon, pp. 109-118. A manual which includes four species of *Pipistrellus* occurring on the island of Ceylon.

1938, Allen, G. M., Mammals of China and Mongolia, Part 1, pp. 226-231.

1940, Chasen, Bull. Raffles Mus., XV, pp. 50-51. Synoptic list of twelve Malayan *Pipistrellus*.

Somewhat arbitrarily I have condensed the many "species" of *Pipistrellus* into

fourteen species groups.¹ These groups cannot be arranged in simple gradient from primitive to modified, but instead present a complex of archaic and specialized structures which makes their arrangement at best unsatisfactory. Thus species with strong zygomata and with traces of post-orbital processes on the zygomata, and with p_2^2 not specially reduced, have been regarded as relatively primitive. But other species occur in which one or the other of those characters has remained primitive, while the other has been strongly modified. For example, *P. macrotis* with the zygoma deep, strong, and provided with a strong postorbital process, yet with p^2 reduced to a mere spicule, or *P. abramus* in which the zygoma is almost obsolete, but p^2 is still fully as large as i^2 . Other such independently fluctuating characters are numerous. Therefore, though it has been hoped that the species groups might be arranged progressively from unspecialized to specialized, in practice exceptions will be numerous. The groups dealt with are shown synoptically:

Pipistrellus abramus group. Forearm, 32-35; skull broad; p^2 unreduced; zygoma weak.

Pipistrellus pipistrellus group. Forearm, 30-32; skull slender; p^2 unreduced; frons depressed; zygoma weak.

Pipistrellus coromandra group. Forearm, 30-32; skull slender; p^2 unreduced but displaced inward; zygoma weak.

Pipistrellus tenuis group. Forearm, 27-30; skull broadened; face short; premaxilla short; p^2 unreduced; zygoma weak.

Pipistrellus affinis group. Forearm, 35-38; skull long, low; p^2 unreduced; zygoma strong, with postorbital process present.

Pipistrellus ceylonicus group. Bats chiefly of the Indian peninsula, much like the *affinis* group but with weak zygomata which lack the postorbital processes.

Pipistrellus kuhlii group. Forearm, 33-35; skull long, low; p^2 slightly reduced; zygoma weak; wings often pale.

Pipistrellus savii group. Forearm, 32-34; skull typically long; p^2 greatly reduced; zygomata strong, with processes. Also oriental species in which braincase is rounded and face shorter.

Pipistrellus circumdatus group. Forearm, 40; braincase rounded; p^2 reduced; zygomata strong but without process. One species.

Pipistrellus tasmaniensis group. Forearm, 47; braincase and skull low; zygomata weak; p^2 much reduced; i^1 unicuspid. One species.

Pipistrellus annectens group. A single large species, characters unknown. Forearm, 45. Subgeneric name, *Megapipistrellus* Bianchi.

Pipistrellus minahassae group. Forearm, 35; braincase full, with weak sagittal crest; p_2 as large as p_1 . One species.

Pipistrellus rüppellii group. Chiefly African. Braincase very full; zygomata weak; underparts white. These are the African "*Scotozous*."

Pipistrellus joffrei group. Specialized pipistrelles with markedly developed supraorbital tubercles and very minute p^2 . Formerly referred to *Nyctalus*. Improbably truly annectant between *Pipistrellus* and *Nyctalus*.

Under each group I have gathered various named forms which I believe are referable to it. In some, perhaps many, instances the names should go into synonymy.

Pipistrellus abramus Group

The bats of this group have the skull with profile sloping uniformly from braincase to rostrum; wide, smooth, flat rostrum; very weak zygomata; braincase wide and smooth; no basial pits; unshortened premaxillae. Anterior upper premolar, though displaced inward, not reduced in size, its area about equal to that of i^2 ; i^1 distinctly bifid; canine with posterior cusp; c and p^4 not in contact; lower incisors somewhat imbricated. Baculum very large. Forearm usually 33-35 mm. Color of dorsal pelage grayish brown.

The group extends from Japan and China south to Malay, Banka, Java, Sumatra, the Nicobar Islands, and thence west to Burma and (?) northern India. Taylor (1934) recorded it from the Philippines.

Forms referred to the *abramus* group are: *abramus*, *akokomuli* (= *abramus*?) *irretitus*, *pumiloides*, *bancanus*, *camortae*.

P. abramus, with type locality at the northern edge of the geographical range of the group taken as a whole, may not be wholly representative.

It seems probable that ultimately the forms now named as species of this group will be in part synonymized and in part reduced to subspecies of *abramus*.

¹ This excludes African groups, unstudied. One of them is probably represented by *Eptesicops* Roberts (type, *rusticus*), another by *Scotozous* (African only).

Pipistrellus abramus (Temminck)

Vespertilio abramus TEMMINCK, 1835, Monogr. Mamm., II, p. 232.

TYPE LOCALITY.—Nagasaki, Japan.

Temminck gave the size of *abramus* as "a little smaller than the pipistrelle . . ." and the forearm length as 1 inch 2 lines (= 29.6 mm.). On the other hand Dobson recorded the forearm as 1.35 inches (34.5 mm.). The animals we treat today as *abramus* have dimensions much as Dobson stated.

In Leyden in 1937, I examined and photographed the cotype, specimen "d" of the Jentink catalogue, an adult male whose skull Dr. Junge had extracted for me. From notes made then, "Profile of skull nearly flat; palate strongly domed; rostrum broad and flattened on top; i^2 three-quarters of height of i^1 ; p^2 at inner edge of tooththrow between canine and p^4 , its height about one-half that of p^3 ; canine with posterior cusp; p_2 three-quarters of height of p_4 ." The forearm of that specimen measured 33 mm. For skull measurements see table.

Two topotypes (U.S.N.M. 140923, 140935) agree substantially with the type, Leyden "d," in all characters, as do the considerable series of specimens from many of the eastern and southern Chinese provinces which were listed by G. M. Allen in "The Mammals of China and Mongolia"; also three specimens from Chiunglung, upper Salween River. The specimen from the Philippines referred to by Taylor is still in our collections.

The animals from North China (Weisien), the Salween River and the Philippine Islands have very slightly larger skulls than have those from Japan. Otherwise no appreciable difference can be detected.

[Pipistrellus akokomuli (Temminck)]

Vespertilio akokomuli TEMMINCK, 1835, Monogr. Mamm., II, p. 233.

TYPE LOCALITY.—Japan.

Temminck's description hardly suffices to separate *akokomuli* from *abramus*, and by Dobson and others it has been treated as a synonym. Jentink so regarded it and catalogued each of specimens "b," and

"o" to "s" of the *abramus* series¹ as "un des types du *Vespertilio akokomuli*." Specimens "o" to "r" of the same series were entire in alcohol.

Of specimen "b" I noted, "Ears rather narrow; tragus round-tipped; skull moderately deep; profile almost flat from rostrum to occiput; interorbital region broad. . . ." But subsequently study of the skull reputed to belong with the skin and of measurements made of it shows that it is not a *Pipistrellus* but a *Nyctalus* skull. The size of skull "b" is very nearly equal to that of *N. velutinus* of China, whose forearm attains a length of 52 mm. It is obvious therefore that the skull in question had nothing to do with *akokomuli* Temminck. The skin, on the contrary, may well be correctly marked, in which case *akokomuli* should still come within the synonymy of *abramus*.

Pipistrellus irretitus (Cantor)

Vespertilio irretitus CANTOR, 1842, Ann. Mag. Nat. Hist., IX, p. 481.

TYPE LOCALITY.—Chusan, eastern China.

Cantor gave very little data. Color "gray-brown, beneath dust-colored . . . forearm 1.3 inches" (= 33 mm.).

The type was a male. Our photograph of the type skull shows the rather large bullae in place and the characteristically broad rostrum and braincase of the *abramus* group. The approximation of canines (see table) and of i^{1-1} may be due to crushing, although no sign of bad treatment shows in the photograph.

Irretitus is apparently the mainland representative of the Japanese *abramus*. The type, as shown in the table of measurements, is slightly smaller than the type of *abramus*.

Pipistrellus pumiloides (Tomes)

Scotophilus pumiloides TOMES, 1857, Proc. Zool. Soc. London, p. 51.

TYPE REGION.—China.

Dobson made this form from "China" a synonym of *abramus*, but the skull, though closely related, is uniformly smaller. A considerable series from Hainan Island,

¹ 1888, Cat. Systematique des Mammifères, Mus. d'Hist. Nat. des Pays-Bas, XII, p. 180.

identified as "*tralatitius pumiloides*," is without much question referable to the *abramus* group. Forearm of type, 34 mm.

The skull measurements of the type, shown in the table, suggest that *pumiloides* was slightly smaller than the type of *irretitus* and *abramus*. But on the other hand the animal is virtually inseparable from topotypes of *abramus*. In A.M.N.H. 84842 of the type series, the large size of the baculum, which seems to characterize the entire group, can be observed easily.

Pipistrellus paterculus Thomas

Pipistrellus paterculus THOMAS, 1915, J. Bombay Nat. Hist. Soc., XXIV, p. 32.

TYPE LOCALITY.—Mt. Popa, Upper Burma.

A small representative of the *abramus* group, with the baculum proportionally as long. The rostral width broad, as with *abramus*. The canine width, however, is less, reminding one of the Chinese *irretitus*. P^2 equals i^2 in area, is half internal and visible externally. Possibly the specimens from the Salween River, mentioned under *abramus*, belong here.

Pipistrellus camortae Miller

Pipistrellus camortae MILLER, 1902, Proc. U. S. Nat. Mus., XXIV, p. 779.

TYPE LOCALITY.—Nicobar Islands.

Miller contrasted this species with "*abramus*" of Java, showing that it had a broader rostrum. It may be a relatively unspecialized member (as suggested by the size of the baculum—very large in true *abramus*) of the *abramus* group.

Pipistrellus bancanus Sody

Pipistrellus tralatitius bancanus SODY, 1937, Temminckia, II, p. 233.

TYPE LOCALITY.—Banka, Dutch East Indies.

The photographs before me of Sody's type skull marked "39 BK" leave no room for doubt that it belongs with the *abramus* group. It has the same uniformly shelving profile, the same breadth of rostrum and of braincase, with substantially wide mastoids and weak zygomata.

[Horsfield's dental formula for *tralatitius*, molars $\frac{5-5}{6-6}$ (p^3 doubtless minute and concealed), seems to indicate that *tralatitius* was a *Myotis*.]

It is not possible to learn from Chasen's Handlist¹ which of his pipistrelles he considers the representative of *P. abramus* in Java, but we may limit the possibilities to three: *brachypterus*, "*imbricatus*" and "*tralatitius*." I have pointed out beyond that due to a mix-up of the type skull at Leyden the status of *brachypterus* is unsatisfactory; *imbricatus*, based on measurements of the type skull, I believe allied to *coromandra*, *subulidens*, *vordermanni*, etc.; and I believe *tralatitius*, with its "sooty" pelage and "six" lower molars (Horsfield) to be a *Myotis*. There remains then actually no named form of *abramus* with type locality in Java, the nearest being *bancanus* from Banka, whose type I have studied and photographed and which I am thoroughly satisfied represents *abramus*. (It may be synonymous.) A series of twelve skins and skulls in the Archbold Collections from Cheribon, Java, is therefore referred to *P. abramus bancanus* (Sody).

Sody gave the length of upper tooththrow in his series as 4.4–4.7 mm.

Pipistrellus pipistrellus Group

Relatively unspecialized as to dentition; zygoma weak and without indication of postorbital process. Braincase full, rostrum but little shortened as shown by the considerable diastema between canine and p^4 ; posterior canine cuspule present but weak; p^2 equal in area to i^2 , placed inward from diastema but in contact with canine and p^4 . Lower incisors very little imbricated; p_2 three-quarters of height of p_4 .

Here belong the common pipistrelle of Europe and its subspecies; also *P. nathusii*, distinguished by its longer canines and slightly compressed p_2^2 .

Compared with *abramus*, the type species of the genus, *P. pipistrellus* of Europe is generally smaller (forearm, 31 mm.), and has the basal phalanx of the thumb shorter, 2.2 mm., and the calcareal lobe better developed. The dentition differs slightly in that the canines are less widespread, p^2 is considerably smaller and its cusp only two-thirds the height of i^2 , and the tooththrows

¹ 1940, Bull. Raffles Mus., XV, pp. 50–51.

are convergent in front; $\frac{c-c}{m^{3-3}} = \frac{3.9}{5.1}$; $c-m^3$,

4.4.

Pipistrellus pipistrellus (Schreber)

Vespertilio pipistrellus SCHREBER, 1774, Säugethiere, I, Pl. LIV; description, 1775, I, p. 167, under name *Zwergfledermaus*.

TYPE REGION.—France.

A rather small species, with forearm, 29–32 mm. Color brown, near Snuff Brown (bases fuscous), underparts slightly paler.

Skull with narrow but rather high braincase and low rostrum, a distinct frontal depression, in profile. Zygomata weak and without traces of postorbital processes; rostrum unwidened; no basial pits. Dentition: i^1 with distinct posterior cusp; i^2 as long as posterior cusp of i^1 ; canine with trace of posterior cuspule; area of p^2 equal to that of i^2 ; p^2 partly displaced inward but diastema between c and p^4 not closed. Lower incisors but slightly imbricated; lower canine slightly exceeding p_4 in height; p_2 three-quarters the height of p_4 and almost in toothrow.

Various European races have been set up, but Miller (1912) placed all in the synonymy of *pipistrellus*.

Pipistrellus pipistrellus bactrianus

Satunin

Pipistrellus bactrianus SATUNIN, 1905, Mitt. Kaukasus Mus., II, pp. 67, 85.

TYPE LOCALITY.—Oasis of Tedzen, Transcaspia.

Satunin regarded this bat as closely related to *P. pipistrellus*, but his statement that the margin of the wing and parts of the phalanges are whitish causes one to remember that in the *kuhlii* group whitening of the wings is prevalent. Ognev (1928), however, who reported obtaining more material from Turkestan, retains *bactrianus* with *pipistrellus*. Forearm, 34 mm.

We have no specimens.

Pipistrellus nathusii (Keyserling and Blasius)

Vespertilio nathusii KEYSERLING AND BLASIUS, 1839, Archiv. f. Naturg., V, Part 1, p. 320.

TYPE LOCALITY.—Berlin, Germany.

Slightly larger than *P. pipistrellus* (fore-

arm, 33–35 mm.). Skull with frontal region slightly depressed. Dentition very similar to that of *pipistrellus* but with height of lower canine to height of p_4 about as 5:4; p_2 compressed and slightly displaced.

This species appears to be restricted to central and southern Europe (Miller, 1912). Ognev (1928) showed that it extended across Russia to the Ural Mountains. Whether records from Japan and Baluchistan are valid is uncertain.

The European races *P. n. unicolor* Fatio and *mediterraneus* Cabrera have been described.

Pipistrellus coromandra Group

This group comprises a number of small species, perhaps nearest to the *P. pipistrellus* group of the west but with less depressed rostrum and less full braincase. The moderately expanded zygomata are weak as in the *pipistrellus* and *abramus* groups. Dentition virtually as in *pipistrellus*, i.e., with p_2^2 little reduced and the lower incisors scarcely imbricated. The approximation of the canines and the small expanse of the lacrimal region give these bats somewhat pointed muzzles (compare with *tenuis* or *abramus* group). A posterior canine cusp is usually present.

These bats are distinguished from characteristic members of the *tenuis* group by their unshortened premaxillae, relatively narrower palates and less globular braincases. But the New Guinea forms *papuanus*, *angulatus* and *collinus* bridge the gap. They are apparently annectant between the *coromandra* and *tenuis* groups of *Pipistrellus*.

Typically *coromandra* and allies are quite small bats (forearm, 30–32 mm.) with unreduced p_2^2 , premaxillae not especially shortened, weak zygomata without postorbital processes. The skull, which shows the frontal step from rostrum to braincase less abrupt than in the *P. pipistrellus* group, is thinly ossified as in *pipistrellus*. On the other hand the bats of this group show some relationship to the *abramus* group. The latter has the skull much more heavily constructed, the rostrum broader and flatter and the zygomata more expanded.

P. regulus, in which the braincase is extraordinarily flattened and low, is a specialized Australian offshoot of the *coromandra* group. Perhaps it should be separated as a wholly distinct group.

The *coromandra* group has a very extensive distribution, reaching from Persia (and perhaps farther west), through India to South China and east to the Bonin group of islands, the East Indies, Philippines and New Guinea.

A number of species have received names, many of them perhaps being synonyms. Arranged from west to east and north to south they are listed as follows:

<i>aladdin</i> Thomas, 1905	Persia
<i>micropus</i> Peters, 1872	Northwest India
<i>coromandra</i> Gray, 1838	South India
<i>tramatus</i> Thomas, 1928	Tonkin
<i>portensis</i> J. A. Allen, 1906	Hainan
<i>sturdiei</i> Thomas, 1915	Bonin, southeast of Japan
<i>ridleyi</i> Thomas, 1898	Selangor, Malaya
<i>subulidens</i> Miller, 1901	Natuna Islands
<i>murrayi</i> Andrews, 1900	Christmas Island
<i>imbricatus</i> Horsfield, 1824	Java
<i>meyeni</i> Waterhouse, 1845	Philippines
<i>collinus</i> Thomas, 1920	New Guinea
<i>angulatus</i> Peters, 1880	Duke of York Island
<i>ponceleti</i> Troughton, 1936	Bougainville Island

Pipistrellus aladdin Thomas

Pipistrellus aladdin THOMAS, 1905, Proc. Zool. Soc. London, p. 521.

TYPE LOCALITY.—Derbeuch, Persia.

Thomas compared *aladdin* with *mimus* of the *tenuis* group and with the African *nanus*. The skull is delicate, with the premaxillae normal as in others of the *coromandra* group, not shortened as in *mimus*. P², though small, remains in the toothrow. Forearm, 31 mm.

Pipistrellus micropus (Peters)

Vesperugo micropus PETERS, 1872, Proc. Zool. Soc. London, pp. 707-708.

TYPE LOCALITY.—Dehra Doon, near Simla, northwest India.

Peters gave very little information on this bat. "Brown above, gray-brown beneath; tibia $\frac{7}{16}$ (14 mm.); forearm length not indicated.

Dobson treated it as a synonym of *abramus*. It is now placed provisionally next to *aladdin*, as I am not convinced that

the *abramus* group extends as far as western India.

Pipistrellus coromandra (Gray)

Vespertilio de Coromandel F. CUVIER, 1832, Nouv. Ann. Mus. Paris, I, p. 21.

Scotophilus coromandra GRAY, 1838, Mag. Zool. Bot., II, p. 498.

TYPE LOCALITY.—Pondicherry, Coromandel Coast, South India.

Cuvier described a "noctuloid" skull (with full braincase and lower rostrum), ears "échancrées," tragi "en couteau" (as in *Pipistrellus*); upperparts "brown-gray-yellowish," lower parts whitish, the hairs dark for three-quarters of their length, and pale yellow at the extremities. Body length, 34 mm., tail length, 27 mm.

Gray merely replaced Cuvier's *Vespertilio de Coromandel* with the name *coromandra*.

Wroughton¹ set weak definitions for the species. According to him the forearm is 29-33 mm., tragus less than 4 mm. broad, outer margin of ear below tip straight, p² entirely inside toothrow, outer incisor as high as outer cusp of inner incisor and skull relatively long (12.5 mm.). The last two characters were used to separate *coromandra* from members of the short-faced *tenuis* group.

By elimination, *coromandra* can be applied only to the species for which it is now used or to *mimus*. Wroughton has already made the selection. Phillips² has followed Wroughton's lead and lists only two small species, *coromandra* and *mimus*, from Ceylon.

I cannot agree with Wroughton (*ibid.*, p. 588) that "the Indian representative of *abramus* Temminck (from Japan) is *coromandra*." As shown under the *abramus* group those bats are larger and stronger, with the top of the rostrum broad and flat.

Pipistrellus tramatus Thomas

Pipistrellus coromandra tramatus THOMAS, 1928, Proc. Zool. Soc. London, p. 144.

TYPE LOCALITY.—Tonkin, French Indo-China.

It is very possible that *tramatus*, and *portensis* from Hainan, are identical.

¹ 1918, J. Bombay Nat. Hist. Soc., XXV, pp. 589, 592.

² 1935, Manual of Mammals of Ceylon, p. 113.

Tramatus is now treated as a species merely because of my uncertainty about it. Perhaps all of the forms in this group should be regarded as subspecies of *coromandra*. Forearm, 29.5 mm.

Pipistrellus portensis J. A. Allen

Pipistrellus portensis J. A. ALLEN, 1906, Bull. Amer. Mus. Nat. Hist., XXII, p. 487.

TYPE LOCALITY.—Porten, Hainan, China.

Allen stated that *portensis* was "similar in form of ear and structure of incisors and premolars" to *tenuis* Temminck, as described by Dobson, but much larger. "Quite different from *ridleyi* Thomas, which . . . is much smaller . . . and has quite different ears and dentition It differs from *P. abramus* in smaller size . . ."

We have a good series of paratypes as well as the type specimen. Forearm, 32 mm.

Pipistrellus sturdeeii Thomas

Pipistrellus sturdeeii THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 230.

TYPE LOCALITY.—Hillsboro Island, Bonin Islands, southeast of Japan.

Skull narrow and delicate. Teeth "as in *abramus* but smaller"; p^2 equal in area to i^2 ; p_2 three-quarters height of p_4 ; forearm, 30 mm.; $c-m^3$, 4.2; diastema between c and p^4 .

My photographs of the type of *P. sturdeeii* indicate its near relationship not to *abramus* but to *coromandra*, *portensis* and *tramatus*. It thus marks the extreme north-eastern limit of range of its group. Representatives of the *coromandra* group should be present on the Liu Kiu Islands. *P. meyeri* probably represents it in Luzon.

Pipistrellus meyeri (Waterhouse)

Vespertilio meyeri WATERHOUSE, 1845, Proc. Zool. Soc. London, p. 7.

TYPE LOCALITY.—Luzon, Philippine Islands.

Very little data can be drawn from Waterhouse's description: forearm, 28 mm.; color rufous-fuscous, hairs white at base, beneath grayish; foot short and broad.

The original description could serve equally well for a member of the *tenuis* group and perhaps does so. Dobson treated *meyeri* as a synonym of "*abramus*, var.

'a.,' *irretitus* Cantor." However, *irretitus* really belongs with *abramus* and is decidedly larger than *meyeni*. Taylor treats "*irretitus*" (= *meyeni* ?) as a full species with forearm 27.5 mm. and places *meyeni* in its synonymy. I measured the skull of a cotype of *irretitus* (see table) which is a much larger animal than is shown in Taylor's measurements of the type of *meyeni*.

Pipistrellus subulidens Miller

Pipistrellus subulidens MILLER, 1901, Proc. Wash. Acad. Sci., III, p. 134.

TYPE LOCALITY.—Sirhassen, Natuna Islands.

Miller wrote "inner upper incisor without supplemental cusp." He compared *subulidens* chiefly with *P. pipistrellus*. Forearm of type, 32.4 mm.

Mr. Miller kindly lent me paratypes of *subulidens* to study. In one of them (U.S.N.M. 104756) the accessory cusp of i^1 is present. In every other way the skull and teeth appear to me characteristic of the concept of the *coromandra* group which I have tried to express. The zygomata are proportionately a little deeper than in *pipistrellus* and *abramus*. P^2 is unreduced.

Pipistrellus ridleyi Thomas

Pipistrellus ridleyi THOMAS, 1898, Ann. Mag. Nat. Hist., (7) I, p. 361.

TYPE LOCALITY.—Selangor, Malaya.

Thomas compared this bat with *abramus* but remarked upon the markedly shorter forearm (28 mm.), muzzle narrower and less flattened above, and short upper incisors. P^2 in tooththrow, unreduced.

My photographs of the type skull clearly show the low narrow rostrum, narrow canine width and narrow lacrimal width. Detailed measurements are given in the table.

Pipistrellus murrayi Andrews

Pipistrellus murrayi ANDREWS, 1900, Monogr. Christmas Island, I, p. 26.

TYPE LOCALITY.—Christmas Island, 250 miles south of Java.

Type specimen not seen. Smaller than *abramus*, near size of *tenuis*. Andrews states that the muzzle is less obtuse than that of *abramus*. The muzzle in *tenuis*

is distinctly obtuse. Forearm, 30-32.5 mm.; p^2 visible between c and p^4 , therefore probably un-reduced. Color brown with yellowish tips.

Pipistrellus imbricatus (Horsfield) .

Vespertilio imbricatus HORSFIELD, 1824, Zool. Researches in Java.

TYPE REGION.—Java.

Horsfield described *V. tralatitius* and *V. imbricatus*, comparing them. *V. tralatitius*, with "molares $\frac{5-5}{6-6}$," appears to have been a species of *Myotis*¹; *V. imbricatus*, with "molares $\frac{4-4}{5-5}$," to have been a *Pipistrellus*. There exists in the British Museum collections the supposed type of *imbricatus*, B.M. 79.11.21.108, the skull in poor condition. From photographs of it the measurements are: canine width, 4.0; $c-m^3$, 4.4; m^1-3 , 3.0; breadth of braincase, 6.5 can be taken. These measurements agree closely with those of the *coromandra* group but do not agree with either the *abramus* or the *tenuis* group. It seems probable that *imbricatus* was the Javanese representative of the *coromandra* group. If so, *imbricatus* would have to replace *coromandra* as the group name, a step which I hesitate to take until an opportunity for further close comparison of the several type specimens arises. In case it can be shown that *imbricatus* and *coromandra* really belong in the same species-group, it will probably be found that one of the species nearby geographically is a synonym of *imbricatus*.

Horsfield stated that the pelage of *imbricatus* was "brown with a fulvous luster."

Pipistrellus angulatus (Peters)

Vesperugo angulatus PETERS, 1880, Sitzungsber. Ges. Naturf. Freunde, p. 122.

TYPE LOCALITY.—Duke of York Island, between New Britain and New Ireland.

Peters gave the pelage color as red-brown; forearm, 34; ear "rounded as in *maurus* (= *savii*). I have not seen the type. It seems likely that the subsequently described *collinus* and *ponceleti* must be closely related, perhaps are subspecies. I do not believe that any one of them can

be races of *papuanus*, which appears, on account of its shorter rostrum and palate and smaller size, to belong in the *tenuis* group.

Pipistrellus collinus Thomas

Pipistrellus papuanus collinus THOMAS, 1920, Ann. Mag. Nat. Hist., (6) IX, p. 533.

TYPE LOCALITY.—Bihagi, head of Mambari River, Papua.

This species, with forearm reaching 36 mm., is the largest member of the group. The canine width and lacrimal width are unusually great and suggest transition to the *abramus* group.

Pipistrellus ponceleti Troughton

Pipistrellus ponceleti TROUGHTON, 1926, Records Australian Mus., XIX, 5, p. 351.

TYPE LOCALITY.—Bougainville Island, Solomon Islands.

Troughton compared *ponceleti* with *papuanus*, *abramus* and *angulatus* from Duke of York Island. He gave the forearm length of *ponceleti* as 32-33.8 mm.; $c-m^3$, 4.3-4.4.

Pipistrellus regulus Thomas

Pipistrellus regulus THOMAS, 1906, Proc. Zool. Soc. London, p. 470.

TYPE LOCALITY.—King River, King George's Sound, southwest Australia.

This strongly specialized species seems to have no very close allies. It is distinguished by its extremely low flattened skull. The zygoma is weak and without postorbital process. P^2 about one-fourth of the area of i^2 ; canine with supplementary cusp. No basal pits.

Pipistrellus tenuis Group

The bats of this group include the smallest of the species of *Pipistrellus*. Pre-maxillae exceptionally short. Zygomata weak, the braincase full and rather short, with rather steep frontal region and low rostrum, somewhat as in *pipistrellus*. Some degree of broadening of the muzzle contributes to give the palate an appearance of unusual wideness and shortness. Forearm length, from 27 to 30 mm.; p^2 somewhat reduced, about one-half of area of i^2 .

It seems possible that *V. tylopus* Dobson,

¹ Thomas disregarded Horsfield's published molar formula for *tralatitius* and accepted the "type" as valid. See Proc. Zool. Soc. London, 1928, p. 144. See also this paper under *P. bancanus* and again under *P. tenuis*.

separated by Peters to form the genus *Glischropus*, was derived from ancestry common to it and to the *P. tenuis* group. It differs chiefly from *P. tenuis* by the unusual development of thumb-pads and foot-pads.

The following named forms, arranged geographically from west to east, are here referred to the *P. tenuis* group:

<i>glaukillus</i> Wroughton, 1912	Northwest India
<i>minus</i> Wroughton, 1899	Near Bombay, western India
<i>principulus</i> Thomas, 1915	Assam
<i>tenuis</i> Temminck, 1835	Sumatra
<i>nitidus</i> Tomes, 1858	Labuan, northwest Borneo
<i>papuanus</i> Peters and Doria, 1881	Salawatti, Nether- lands New Guinea
<i>orientalis</i> Meyer, 1899	Papua

The more typical members of the *tenuis* group (*tenuis*, *principulus* and *nitidus* of the Malay-Sunda region) seem to be connected morphologically with the *coromandra* group through the Papuan form *papuanus* (= *orientalis*?).

On the other hand the specialized (as regards shortening of face and palate) western Indian forms *minus* and *glaukillus* represent a special offshoot.

It should be noted that the North American *P. hesperus* group, recently revised by Hatfield,¹ and the African *P. musciculus* appear to find nearest relatives in the *tenuis* group. *P. subflavus* of the eastern United States is quite unlike any member of this group. It has the height of crown of p^2 one-third of height of p^4 , and the lower incisors spaced, not imbricated.

Pipistrellus tenuis (Temminck)

Vespertilio tenuis TEMMINCK, 1835, Monogr. Mamm., II, p. 229.

TYPE LOCALITY.—Sumatra.

Temminck compared *tenuis* with "*tralatitius*" (not with *V. tralatitius* of Horsfield which was a species of *Myotis*, but with a pipistrelle apparently closely related to *P. coromandra*). *Tenuis*, he wrote, had "shorter muzzle, . . . ears shorter, less broad, more pointed, . . . braincase smaller and less inflated, . . . only one false molar."

During my visit to Leyden Museum in

1937, Dr. Junge kindly had a number of skulls cleaned for me to study. Among them were the two cotypes of *V. tenuis* from Sumatra mentioned by Jentink² as specimens "a," "b," "types de l'espèce."

These specimens proved to belong to two different genera. Specimen "a," with three upper and lower premolar teeth, was a *Myotis*, close to *M. macellus*, of which I also examined cotypes. Specimen "b," premolars $\frac{2}{2}$, was a *Pipistrellus*.

In the past *V. tenuis* has been regarded as one of the pipistrelles. Jentink (*tom. cit.*) placed it in *Vesperugo*, and Thomas has treated it as a species of *Pipistrellus*. It becomes necessary therefore to restrict the basis of the specific concept of *V. tenuis* Temminck to specimen "b" of Leyden Museum.

My photograph of the type (skull "b," Leyden) is poor. The skull was in fragments when cleaned for me. Nevertheless the few measurements made it possible for me to indicate its relationships.

In my notes I find, " p^2 in contact with inner margins of c and p^4 , half of height of p^4 ; p_4 slightly higher than p_2 ; canine scarcely higher than p_4 ." Measurements: forearm, 30 mm.; hind foot (s.u.), 6.1; $c-m^3$, 2.5; crown areas, m^1 , 1.0×1.0 ; m^2 , 0.9×1.1 ; m^3 , 0.6×1.1 ; m_{1-3} , 3.0.

In addition, in the British Museum are two more specimens marked "cotypes"³ obtained by Tomes from Leyden Museum: B.M.7.1.1.407-408, the former without braincase, the latter in quite good condition. Both are from Sumatra. Their forearms measure, respectively, 26 and 27 mm. I have no further notes concerning them. But their photographs are fairly clear. Distinctive features are: shortness of the premaxillae, which places the upper incisors only slightly in advance of the canines; peculiarly narrowed U-shaped notch, whose width is only 0.7 mm., at base of narial sinus; canine width, $c-m^3 = 3.3:3.8$ (measured on photograph, in which millimeter scale was included); width across supraorbital processes, 4.0; breadth of braincase, 6.6. In both the Leyden and

² 1888, Cat. Systematique des Mammifères, Mus. d'Hist. Nat. des Pays-Bas, XII, p. 179.

³ But see Thomas's remark, 1898, Ann. Mag. Nat. Hist., (7) I, p. 361.

¹ 1936, J. Mamm., XVII, pp. 257-262.

London photographs a distinct canine cusp can be seen, and p^4 is almost in contact with canine. The infraorbital foramen is very close to the edge of the orbit (0.5 mm.).

In view of the close tally of the characters of the British Museum animals with the Leyden specimens and their history, I am inclined to believe that they may be true cotypes of *tenuis* Temminck.

Finally there is a specimen in the Archbold Collection from Bali, not in good condition (the canines have been lost), which I am persuaded is also a specimen of *tenuis*.

The dimensions of the type and two topotypes in the table of measurements give a good idea of the proportions of the skulls in *P. tenuis*.

Pipistrellus nitidus (Tomes)

Scotophilus nitidus TOMES, 1858, Proc. Zool. Soc. London, p. 538.

TYPE LOCALITY.—Northwest Borneo.

Tomes wrote, "head somewhat elevated . . . p^2 in line with other teeth, visible from the outside . . . , i^2 in advance of i^1 ."

My photograph of the type skull shows the frontal region steep, the braincase quite high and the rostrum relatively low, p^2 scarcely reduced, palate fairly short and broad.

It is necessary to compare this species with *Glischropus tylopus* from the same general region. They are much alike, apart from the character of the thumb. Of the thumb of *nitidus* Tomes wrote, "Free portion of thumb longer than that enclosed in the membrane." Surely he would have noted the pads, had they been enlarged.

Pipistrellus principulus Thomas

Pipistrellus principulus THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 231.

TYPE LOCALITY.—Gauhati, Assam.

In this bat the inflation of the braincase, common to this group as a whole, is stated to be accentuated. The comparison with "*tenuis*" is doubtful. Under description of *P. ridleyi*, Thomas wrote, "no authentic specimens of *tenuis* in Museum collection." Probably, however, he had the two "topotypes" with which to make comparisons (see under *tenuis*).

The photograph of the type of *principulus* shows the braincase a little higher and broader than in *mimus*. Zygomata weak. Basial pits at least visible.

Pipistrellus mimus glaucillus Wroughton

Pipistrellus mimus glaucillus WROUGHTON, 1912, J. Bombay Nat. Hist. Soc., XXI, p. 769.

TYPE LOCALITY.—Multan, Indus River, Punjab, northwest India.

Apparently a "mouse-gray" race of *mimus*, whose color Wroughton states is near "bistre." Only skin measurements were given. Forearm, 29 mm.

A photograph of the type skull shows: a small-sized, short, muzzled skull with steeply sloping frontal region, braincase very slightly higher than in *mimus*. For skull measurements (made from photograph) see table.

Pipistrellus mimus mimus Wroughton

Pipistrellus mimus mimus WROUGHTON, 1899, J. Bombay Nat. Hist. Soc., XII, p. 722.

TYPE LOCALITY.—Konkan (coast), near Bombay, western India.

Wroughton compared *mimus* with his "*abramus*" (not from its type region, Japan, but from near Bombay). "Inner and outer incisor [of *mimus*] close together . . . linear; forearm 27–28."

He gave the following skull measurements: greatest length, 11.5; greatest breadth, 6.5–7.0.

Our photograph of the skull of the type indicates a palate rather broad and short and braincase moderately full; zygomata apparently weak; p^2 three-quarters of height of p^4 . Measurements made from photograph of skull.

Pipistrellus papuanus (Peters and Doria)

Vesperugo papuanus PETERS AND DORIA, 1881, Ann. Mus. Civ. Genova, XVI, p. 696.

TYPE LOCALITY.—Salawatti, west New Guinea.

This little species, found all over New Guinea, is apparently annectant between the *tenuis* and *coromandra* groups. The face is slightly less shortened than in *tenuis*, considerably less than in *mimus*. A number of specimens of the species are present in the Archbold Collections from Papua and Netherlands New Guinea. It may be expected in northeast Australia.

Pipistrellus papuanus orientalis (Meyer)

Vesperugo papuanus orientalis MEYER, 1899, Abh. Ber. K. Zool. Anthr. Ethn. Mus., Dresden, VII, 7, p. 14.

TYPE LOCALITY.—Bongu, Astrolabe Bay, north New Guinea.

I have been unable to distinguish valid differences between descriptions of *P. p. orientalis* and true *papuanus*.

Pipistrellus affinis Group

Typical *P. affinis* and *P. pulveratus* are possibly the most primitive members of the genus *Pipistrellus*. The second upper premolar is still as large as i^2 . The zygomatics are deep and strong and possess postorbital processes. The skulls are long and rather low, and the molar rows are almost parallel. No basal pits are developed.

The species *affinis*, *pulveratus* and *petersi* appear more nearly related to each other than to others. I have no facts on the size of p^2 in *lophurus* and *kitcheneri*. Both species have strongly developed basal pits just as in the case of *P. circumdatus*. They are included provisionally.

Pipistrellus affinis (Dobson)

Vesperugo affinis DOBSON, 1871, Proc. Asiatic Soc. Bengal, p. 213.

TYPE LOCALITY.—"Bhamo, Yunnan."

The present interpretation of *affinis* is founded upon a male specimen of *P. affinis* from Li Chiang, Yunnan, China, 9000 feet, A.M.N.H. 44565, formerly marked "*P. pulveratus*." The identification with Dobson's *affinis* is made chiefly by skin characters, which are very distinctive, the hairs fuscous, with hoary tips, and (most striking) the hairs of the pubic region dull white to the bases. Forearm, 38 mm.

The skull of our specimen is remarkable for its low braincase, unbroadened rostrum, fairly substantial zygomatics bearing low but distinct postorbital processes, narrow palate. In the dentition, p^2 is not smaller than i^2 but is placed internally, and p^4 nearly makes contact with canine. The lower incisors are moderately imbricated; canine is not large; p_2 stands uncrowded in the tooththrow, its crown height about one-half of that of p_4 .

The type of *affinis* is probably at the Indian Museum, Calcutta.

Pipistrellus pulveratus (Peters)

Vesperugo pulveratus PETERS, in Swinhoe, 1870, Proc. Zool. Soc. London, pp. 618-619.

TYPE LOCALITY.—Amoy, Fukien, China.

The skull of a near topotype (from Chungan Hsien, Fukien), A.M.N.H. 84844, male, shows characters which recall those of *P. affinis*. The skull is low, but the braincase is rather fuller than in *affinis*; the supraorbital ridges are similarly developed; the zygoma and its postorbital process are both stoutly developed; p^2 , though displaced inward, has approximately the same area as i^2 ; the palate is rather narrow, and the tooththrows converge slightly in front; no basal pits.

P. pulveratus is, however, considerably smaller than *affinis* (forearm, 33-34.5 mm.; *affinis*, 38) and lacks the area of dull white hairs on upper thighs and pubic area beneath. The pelage is blackish, grizzled with pale gray above, with buffy beneath.

The strongly developed zygoma is reminiscent of the *savii* group. But p^2 in the present species shows no sign of reduction, whereas in *savii* it is markedly reduced in size.

We have a second topotype and a specimen from Yunnan Province.

Pipistrellus petersi (Meyer)

Vesperugo petersi MEYER, 1899, Abh. Ber. K. Zool. Anthr. Ethn. Mus., Dresden, VII, 7, pp. 13-14.

TYPE LOCALITY.—Minahassa, north Celebes.

The type specimen of this species was not seen. Two individuals lent by the U. S. National Museum, U.S.N.M. 219409, 219413, agree very closely with the little which has been written about the dentition, for apparently the skull had not been cleaned when Meyer wrote.

The skulls of both of the Washington specimens are clean and in good condition. They can be referred without hesitation to the *affinis* group. Elongate, low, with low braincase, no basal pits, unbroadened rostrum, subparallel molar series, narrow palate, zygoma deep and strong and provided with postorbital process.

Teeth: upper incisors heavy, not in contact with canine; canine with heavy posterior blade but without posterior cusp;

p^2 as large in area as p^4 , wholly out of line, and canine in contact with p^4 ; inner face of molars (protocones plus hypocones) longer than in true *affinis* (1.0 mm.: 0.8 mm.); lower incisors well imbricated; p_2 slightly displaced, about three-quarters of height of p_4 .

Meyer described the dorsal color as Vandyke Brown. The Washington specimens are in alcohol. The animals are from Celebes but without precise locality.

Pipistrellus lophurus Thomas

Pipistrellus lophurus THOMAS, 1915, J. Bombay Nat. Hist. Soc., XXIII, p. 413.

TYPE LOCALITY.—Maliwun, Victoria Province, Tenasserim.

The photograph of the type shows a braincase fairly high at the occiput; slight frontal depression in profile; a deep zygoma with well developed postorbital process; the postpalatal spine obsolescent. Dentition: p^2 , twice as large as in *imbricatus*, is as great in crown area as i^2 . Forearm, 35 mm.

Thomas emphasized a dorsal tuft of hairs at the base of the tail which he supposed marked the position of a gland.

The dorsal color was described as "warm bister-brown, below paler than Prout's Brown."

Pipistrellus kitcheneri Thomas

Pipistrellus kitcheneri THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 229.

TYPE LOCALITY.—Boentok, Barito River, south central Borneo.

My photograph of the type skull shows a deep zygoma with a small postorbital ossification; the general appearance of skull very like that of *lophurus*. If the supposed caudal gland of *lophurus* were shown to be individual, or in reality a wound or ulcer peculiar to the single specimen, we might well conclude that *lophurus* and *kitcheneri* were subspecies.

Forearm, 37 mm. Color, brown.

Thomas compared *kitcheneri* with *imbricatus*. Length of palate indicated by "muzzle less conspicuously shortened as compared with braincase."

Pipistrellus ceylonicus Group

Bats of moderate size (forearm, 36–41 mm.), their skulls with low braincases, no frontal groove. The zygomata are weak and unprovided with postorbital processes.

Compared with species of the *affinis* group, the facial part of the skull (rostrum and palate) is shorter and broader; the palatal length and tooththrows are shorter, and the lacrimal width greater. Basial pits weak.

Dentition: the canine bears a strong supplemental cusp placed a little below the cingulum; p^2 equal in area to i^2 .

Forms referable to the group are *ceylonicus*, *indicus*, *subcanus* and *chrysothrix*, and, tentatively referred, *shanorum* and *raptor*. The first four are from the Indian peninsula; the others, from the Burma-Indo-China region.

Pipistrellus ceylonicus (Kelaart)

Scotophilus ceylonicus KELAART, 1852, Prodr. Fauna Zeylanica, p. 22.

TYPE LOCALITY.—Ceylon.

I have before me specimens from Ceylon (M.C.Z. 27525–26). The color is dark brown, slightly paler beneath. No trace of pale tips of hairs as in *affinis* group. Forearm, 37–42 mm. (Phillips). The thumb appears large and strong; its basal phalanx, 3.5 mm. The skull is as described under the "group" heading.

Dobson (1878, pp. 222–223) pointed out that the type had been lost and that *ceylonicus* might, because of discrepancies in Kelaart's description, remain unrecognizable. However, we may perhaps accept the decisions of Wroughton, of Thomas and of Phillips that the name belongs to the present kind of bat.

Pipistrellus ceylonicus indicus (Dobson)

Vesperugo indicus DOBSON, 1878, Cat. Chiropt. Brit. Mus., p. 222.

TYPE LOCALITY.—Mangalore, Malabar Coast, Madras.

The type of this species is probably at the Indian Museum, Calcutta.

Dobson gave no data on the skull, and of the teeth he wrote, "... first upper premolar quite internal to tooththrow, not visible from without; second upper premolar al-

most touching canine; lower incisors in the direction of the jaws" (indicating a V-shaped symphysis).

He mentioned possible relationship to *ceylonicus*.

Pipistrellus ceylonicus subcanus Thomas

Pipistrellus ceylonicus subcanus THOMAS, 1915, J. Bombay Nat. Hist. Soc., XXIV, p. 30.

TYPE LOCALITY.—Yalala, Junagadh State, Kathiawar, western India.

"Grayer than *ceylonicus*." Forearm, 38 mm.

The photograph of the skull of the type is very similar to that of our *ceylonicus*. The tooththrow appears a little longer and the braincase slightly wider. Probably *subcanus*, *indicus*, *ceylonicus* and *chrysothrix* are races of a single species. Thomas suggested that *chrysothrix* "was founded on a specimen of *P. ceylonicus* with abnormal incisors."

Pipistrellus ceylonicus chrysothrix

Wroughton

Pipistrellus chrysothrix WROUGHTON, 1899, J. Bombay Nat. Hist. Soc., XII, p. 720.

TYPE LOCALITY.—Konkan, near Bombay, western India.

Thomas, when writing of *subcanus*, referred *chrysothrix* as a subspecies of *ceylonicus*.

Our photograph of the type skull indicates the reasonableness of this association: the rather broad rostrum, weak zygoma, etc.

The dorsal color was described by Wroughton as "golden brown"; i^1 with secondary cusp "posterior."

Pipistrellus shanorum Thomas

Pipistrellus shanorum THOMAS, 1915, J. Bombay Nat. Hist. Soc., XXIV, p. 29.

TYPE LOCALITY.—Pyaung-gaung, North Shan States, Burma.

The character of the zygoma, broken, cannot be seen in the photograph of the type. Otherwise the skull agrees well with those of the *ceylonicus* group. Thomas wrote, "closely allied to *ceylonicus* but smaller"; p^2 smaller than in *ceylonicus*, its area two-thirds of that of i^2 . Forearm, 37 mm.

Color "dark, warm brown, tipped with dark buffy or cinnamon."

Pipistrellus raptor Thomas

Pipistrellus raptor THOMAS, 1904, Ann. Mag. Nat. Hist., (7) XIII, p. 387.

TYPE LOCALITY.—Tonkin, French Indo-China.

Zygoma weak, without process. Skull of type essentially as in *shanorum* but p^2 unreduced. Muzzle slightly broadened and smooth as in *ceylonicus*.

Measurements show the lacrimal width, zygomatic width and skull length somewhat greater than in other species of this group.

Our photograph of the type skull suggests relationship with *shanorum* and *ceylonicus* rather than with *circumdatus* or *mordax*.

Pipistrellus kuhlii Group

Chiefly bats of Europe, western Asia and Africa, reaching central India. Skull low and broad, the zygoma weak, p^2 small but less reduced than in *savii* group, and the lower incisors thickened and strongly imbricated.

Named forms besides *kuhlii* are: *canus*, *ikhwanius*, *lepidus*, *leucotis* and *lobatus*. Several have been treated as synonyms of *kuhlii*; others are races. I have been able to examine only European *kuhlii*, and the type of *babu*, which is referred here provisionally.

The group badly needs revisional treatment, but many of the types must be in India. The obsolescence of the secondary cusp of i^1 in *babu* is also to be noted in *kuhlii*.

Pipistrellus kuhlii (Kuhl)

Vespertilio kuhlii KÜHL, 1819, Ann. Wetterau. Gesellsch. Naturk., IV, p. 199.

Romicia calcarata GRAY, 1838, Mag. Zool. Bot., II, p. 495.

TYPE LOCALITY.—Trieste, Adriatic Sea.

Miller separated *kuhlii* from *savii* by the less reduced p^2 and by the tragus being longer and narrower, and from *pipistrellus* and *nathusii* by the shorter outer upper incisor and closure of the diastema between c and p^4 .

The skull of one before me (U.S.N.M. 172128) shows only a slight frontal depression in profile; a slight tendency to an occipital "helmet"; zygomata weak, basal pits almost undeveloped; no trace of pos-

terior cusp on canine; posterior cusp of i^1 obsolete; area of p^2 about one-half that of p^4 . Lower incisors very markedly imbricated; height and cingulum length of p_2 about two-thirds of same measurements of p_4 . The wings of *kuhlui* are frequently margined with whitish.

Pipistrellus kuhlui lepidus Blyth

Pipistrellus lepidus BLYTH, 1845, J. Asiatic Soc. Bengal, XIV, p. 340.

TYPE LOCALITY.—Kandahar, Hyderabad, central India.

Not mentioned in Dobson (1878). Wroughton (1917, p. 591) treated it as a subspecies of *kuhlui*, but the type was unknown, so it is not probable that he had more than descriptive information to support his decision.

"General color a light yellowish-clay, pale sandy or isabella brown; underneath paler . . . forearm 1 inch and three-eighths or a trifle less. . ." (34 mm.).

Pipistrellus kuhlui ikhwanus Cheeseman and Hinton

Pipistrellus kuhlui ikhwanus CHEESEMAN AND HINTON, 1924, Ann. Mag. Nat. Hist., (9) XIV, p. 549.

TYPE LOCALITY.—Arabia.

"Near *kuhlui*"; color pale, light buff; forearm, 33–34 mm.; $c-m^3$, 4.6 mm.

Pipistrellus babu Thomas

Pipistrellus babu THOMAS, 1915, J. Bombay Nat. Hist. Soc., XXIV, p. 30.

TYPE LOCALITY.—Murree, near upper River Indus, northern India.

Thomas called *babu* the north Indian representative of "*tralatitius*." As pointed out elsewhere in this paper, he regarded *tralatitius* Horsfield as *Pipistrellus*, not a *Myotis*.¹ The species does not readily fit into one of the groups here arranged. It appears to be too large for the *coromandra* group and a little small for the *affinis* group. Perhaps it is best regarded as a member of the *kuhlui* group.

Forearm, 33–35 mm.; a distinct rostral sulcus; i^1 with only a trace of supplemental cusp (see *kuhlui*); p^2 wholly internal but

visible, its area about equaling that of i^2 ; $c-m^3$, 5.0 mm.

I have seen only the type and photographed its skull.

Pipistrellus leucotis (Dobson)

Vesperugo leucotis DOBSON, 1872, J. Asiatic Soc. Bengal, XLI, p. 222.

TYPE LOCALITY.—Kachh, near Quetta, northwest India.

Wing membrane near body white; rest of wing traversed by white reticulations.

Dobson (1878) placed this bat in the synonymy of *kuhlui*. Wroughton (1917) followed Dobson's views. He gave the number of the type: 154 p. India Museum, Calcutta.

Pipistrellus canus (Blyth)

Nycticejus canus BLYTH, 1863, Cat. Mamm. Mus. Asiatic Soc. Bengal, p. 32.

TYPE REGION.—India.

Dobson (1878, p. 230) placed *canus* in the synonymy of *kuhlui*. Wroughton (1917, p. 591) agreed. He mentioned two cotypes, Nos. 154a, b, in the collection of the Indian Museum, Calcutta.

This would give to *kuhlui* a remarkably extended range, if true. Probably *canus* should be considered a geographical race.

Pipistrellus lobatus (Jerdon)

Scotophilus lobatus JERDON, 1867, Mammals of India, p. 35.

TYPE LOCALITY.—Madras, India.

"Ears small, ovoid, ends rounded, scarcely emarginate, with a lobe at the base; tragus short, of nearly uniform breadth . . . muzzle very short, pointed. Fur, above, black.sh-yellow, ashy, beneath. . ."

Jerdon (1874 edition) queried whether *lobatus* might not equal *abramus* Temminck. Forearm length was published as $1\frac{2}{12}$ inches (30 mm.). Jerdon's broad concept of *Scotophilus* included *Eptesicus serotinus* and *Pipistrellus*.

Dobson, however, considered *lobatus* a synonym of *kuhlui*. Wroughton ignored the name.

Pipistrellus minahassae Group

Pipistrellus minahassae Meyer

Pipistrellus minahassae MEYER, 1899, Abh. Ber. K. Zool. Ethn. Mus., Dresden, VII, 7, pp. 14–16.

¹ Horsfield gives the molar formula of *tralatitius* as $\frac{5-5}{6-6}$. With three lower premolars and three lower molars, *tralatitius* could not have been a *Pipistrellus*.

TYPE LOCALITY.—Tomohon, Minahassa, north Celebes.

A single specimen contained in the Archbold Collections, from Roeroekan, north Celebes, is provisionally referred to Meyer's species. Unfortunately no description of the type skull of *minahassae* has been published, so identity cannot be guaranteed.

The skull of the animal from Roeroekan (A.M.N.H. 102359, ♂) presents novel characters sufficient in themselves to set it off from other *Pipistrelli* as a distinct group.

The distinctive characters are: the short, high braincase with rudiments of sagittal crest; the prominent supraorbital tubercles suggestive of the *joffrei* group but less developed than those of *Philetor*; the fact that p_2 is scarcely, if at all, smaller than p_4 . This last is perhaps a primitive character harking back to the period before p_2^2 became markedly reduced in size.

Other features of the skull include: zygoma slender, as in *abramus* group; deep basal pits; p^2 but little moved inward from the toothrow, its area slightly exceeding that of i^2 ; i^1 long, with well developed posterior accessory cusp; canine slender without extra cusp; lower incisors scarcely imbricated.

This bat is wholly different from *P. petersi*, described by Meyer from the same island (see under that species). Its affinities appear to be with the more primitive pipistrelles.

Pipistrellus rüppellii Group

African bats, with one putative representative in Mesopotamia. These bats were referred by Dobson (1876) to *Scotozous*, but Hollister regarded them as specialized *Pipistrellus*. Read under *Scotozous*.

P. rüppellii, of which we have specimens, is unlike any of the Asiatic *Pipistrellus* groups. Braincase very full, interorbital area broad, rostrum short, unwidened and slightly flattened above. Zygoma very weak and delicate. Palate narrow. No basal pits.

Dentition: i^1 with accessory cusp almost as big as primary cusp; i^2 slender, small, its tip reaching only one-half way down supplementary cusp of i^1 ; canine slender, long, without cusp; p^2 small, its cusp only one-

fifth of that of p^4 , but p^2 retained either in toothrow or but slightly moved inward; lower incisors not imbricated; i_1 and i_2 with crowns unthickened, i_3 with crown distinctly thickened; canine slightly higher than p_4 ; p_2 crown one-half height of p_4 crown.

Wings pale gray; dorsal pelage pale gray with slightly darker bases; ventral pelage pure white to roots.

Reference of *coxi* to this group is provisional.

Pipistrellus coxi Thomas

Pipistrellus coxi THOMAS, 1919, J. Bombay Nat. Hist. Soc., XXVI, p. 747.

TYPE LOCALITY.—Amara, Mesopotamia.

Compared with the African *rüppellii*, under surface whitish.

"This bat . . . seems to mark the northern limit of a series beginning with the Uganda *P. fuscipes*, which has a large and much inflated braincase, etc. . . Egyptian and Sudanese *P. rüppellii*, in which the braincase is more normal, while in *coxi* it is distinctly smaller than usual."

Pipistrellus savii Group

Comprising rather smaller bats than those of the *affinis* and *circumdatus* groups, but the well built skull with its strong zygomata suggests relationship. There are traces of postorbital processes on the zygomata. *P. savii* has, however, become specialized by the great degree of reduction of p^2 to only about one-fourth of the area of i^2 . The braincase is relatively low as in the more typical bats of the *affinis* group.

The group apparently is considerably developed in Africa: *ariel* from Egypt, *darwinii* from Canary Islands, *maderensis* from Madeira. Present inclusion of several oriental species with *savii* may not be tenable. It is based upon one character common to all, the extreme degree of reduction of p^2 . Otherwise the eastern forms *curtatus* and *cadornae* (and possibly *austenianus*) differ rather sharply from *savii* by their full, rounded braincases and short muzzles. The braincase of *savii* is low and flat and the muzzle less shortened. The only other species known to me which has p^2 much reduced is *circumdatus*, a much larger form

with forearm 40 mm., possibly related to *mordax*, also with forearm 40 mm.

Pipistrellus savii (Bonaparte)

Vespertilio savii BONAPARTE, 1837, Iconogr. Fauna Ital., I, fasc. 20.

Vespertilio maurus BLASIUS, 1853, Archiv. f. Naturg., XIX, Part 1, p. 35.

TYPE LOCALITIES.—Pisa, Italy (*savii*); central chain of Alps (*maurus*).

Miller separated this species from the remaining three European pipistrelles by the extremely small size of p^2 measured in terms of the area of i^2 , and by the widened ear and extremely broad tragus.

The skull of a specimen of *savii* (U.S. N.M. 103322) before me is low, without frontal depression between braincase and rostrum. Rostrum depressed just in front of supraorbital ridges. Zygoma strong but without postorbital process. Basial pits almost undeveloped. Area of p^2 about one-sixth of area of i^2 . Lower incisors markedly imbricated, lower canines short, height and cingulum length of p_2 respectively one-half of height and cingulum length of p_4 .

Pipistrellus macrotis (Temminck)

Vespertilio macrotis TEMMINCK, 1835, Monogr. Mamm., II, p. 218.

TYPE LOCALITY.—Padang, Sumatra.

At Leyden I found the following cotypes: mounted skins "n" and "o," both with skulls inside, both from Padang, also skull "m" from Padang.

The skull of "m" had the frontal region slightly raised; bullae rather large; p^2 minute, included on inside between c and p^4 ; p_2 about one-half of height of p_4 . My photograph of skull "m" shows a skull very similar to that of *P. vordermanni*.

The forearm length of specimen "n" was 34.5 mm. Temminck published the length for *macrotis* as 1 inch 2 lines (29.5 mm.).

A series of three specimens in the Archbold Collection from Koeta, Bali, belongs without doubt to the assemblage which included *curtatus*, *cadornae* and *macrotis*.

It has the characteristic deep zygoma with well developed postorbital process of the zygoma, full rounded braincase, short rostrum and palate, deep basial pits and extremely reduced p^2 . The color of the

pelage agrees quite closely with the description of Temminck, "brown-bister or onion-color," a light brown near Sayal Brown or Tawny. The ears are large and the tragus broad, deeply notched near the base of its posterior margin, narrowed toward its tip, and with the posterior margin strongly curved while the anterior margin is slightly excavated. The thumb is slender, its basal phalanx 3.2 mm. A small pollical pad covers the joint between the metacarpal and the phalanx.

Pipistrellus vordermanni (Jentink)

Vesperugo vordermanni JENTINK, 1890, Notes Leyden Museum, XII, p. 152.

TYPE LOCALITY.—Billiton Island, Dutch East Indies.

Jentink referred to the white wing membranes of *vordermanni*. Dentition: i^2 equal in height to external cusp of i^1 ; p^2 very small, hardly visible without lens, placed inside the toothrow. Forearm, 33 mm.

The braincase is full and rounded, rostrum and palate rather short, somewhat as in the *tenuis* group, but the skull is much larger. Well marked basial pits can be seen in the photograph of the type. The zygomata are deepened, and traces of postorbital processes are present.

Pipistrellus cadornae Thomas

Pipistrellus cadornae THOMAS, 1916, J. Bombay Nat. Hist. Soc., XXIV, p. 415.

TYPE LOCALITY.—Darjiling, Assam.

Forearm, 33 mm.; p^2 very small; basial pits developed. Thomas compared *cadornae* with *kitcheneri* and *ceylonicus*. But it is even more closely related to *curtatus* Miller from Engano Island and to a specimen (U.S.N.M. 141097) labeled "*macrotis*."

These bats are distinguished by their full braincase, minute p^2 , deepened zygomata bearing distinct postorbital processes and short rostra and palates. Their association with *savii* comes from the similar reduction of p^2 in that species.

Pipistrellus curtatus Miller

Pipistrellus curtatus MILLER, 1911, Proc. Biol. Soc. Washington, XXIV, p. 25.

TYPE LOCALITY.—Engano Island, west of Sumatra.

Forearm, 33.6 mm. Crown area of lower premolar much reduced. Rostrum and palate short. Basial pits well defined.

Pipistrellus austenianus (Dobson)

Vesperugo austenianus DOBSON, 1871, Proc. Asiatic Soc. Bengal, p. 213.

TYPE LOCALITY.—Cherrapunji, Assam.

In his 1878 "Catalogue" Dobson synonymized *austenianus* with *savii* of Europe. Wroughton¹ treated it as distinct in his key: forearm, 33 mm. or less; tragus broad, above 4 mm.; color black, hoary. The type is No. 150b of the Indian Museum at Calcutta.

Dobson states: forearm, 1.4 inches (35 mm.); p^2 "may be distinguished from without."

P. austenianus is here placed in the *savii* group solely because Dobson once synonymized it with *savii*. The skull of the type should be critically reexamined and described.

Pipistrellus circumdatus Group

The only species definitely known to belong here, *circumdatus*, shows several special characters: short, broad outline of skull; short permaxillae, as in *tenuis* group; strong zygomata without any trace of postorbital processes; distinct basial pits somewhat as in *Ia*; supraorbital region short, unbroadened; a deep frontal depression; i^1 heavy, virtually unicuspid; i^2 placed well forward; canine width markedly less than lacrimal width; p_2^2 much reduced, area of p^2 about one-fourth of that of i^2 .

Inclusion of *mordax* with *circumdatus* may not be permissible. The forearm lengths are approximately the same.

Pipistrellus circumdatus (Temminck)

Vespertilio circumdatus TEMMINCK, 1835, Monogr. Mamm., II, p. 214.

TYPE LOCALITY.—Tapos, Java.

Forearm, according to Temminck, 40 mm. (1 inch 7 lines); 38 (1.5 inches) according to Dobson. In a specimen from north Burma (A.M.N.H. 114850) the forearm measured 41 mm.

The pelage of this relatively large pipis-

trelle is characterized by the distinctly bronzy tips to the hairs, the basal and sub-terminal portions being fuscous. The color scheme of the hairs is somewhat like that of *Myotis sicarius*.

Pipistrellus mordax (Peters)

Vesperugo mordax PETERS, 1866, Monatsb. Akad. Wiss. Berlin, p. 402.

TYPE LOCALITY.—Java.

"Color above red-brown . . . with paler tips . . . forearm 40 mm." No mention of cranial or dental characters.

Peters compared this species with the European *maurus* (= *savii*), but in 1866 he was just beginning his remarkable work on the Chiroptera and probably was unacquainted with many species. Later Dobson, Trouessart and others included *mordax* as a race of *savii*, which clearly it is not.

The type of *mordax* should be compared with *P. circumdatus* which has a forearm of similar length.

Sody² gives measurements of five specimens, with forearms 40–42 mm., which he believes referable to *mordax*. He gives no cranial or dental dimensions.

Pipistrellus tasmaniensis Group

Represented by a single large species, *tasmaniensis*, of which *krefftii* is commonly held to be a synonym. Distinguished from most pipistrelles by the unicuspid i^1 and by the "helmeted" form of the back of the skull. In it p_2^2 are much reduced. The zygoma is weak and slender as in many other pipistrelles. *Tasmaniensis* is slightly reminiscent of *Nyctalus*, both having p^2 much reduced, but it differs in the relative narrowness of its rostrum. The group is distinctly aberrant.

Iredale and Troughton³ placed *tasmaniensis* in *Glischropus*. It is quite unrelated to that genus, lacking all trace of the enlarged pad on the basal joint of the thumb. The Archbold Collection contains a large series of *G. tylopus*, the type species of *Glischropus*, in which the character above mentioned is clearly discernible. *Tasmaniensis* is further separable from *Glischro-*

¹ 1917, J. Bombay Nat. Hist. Soc., XXV, pp. 589, 591.

² 1937, Temminckia, II, p. 215.

³ 1934, Mem. Australian Mus., VI, p. 96.

pus by its large size (forearm, 48 mm.), the form of i^1 and its greatly reduced p^2 .

Pipistrellus tasmaniensis (Gould)

Vespertilio tasmaniensis GOULD, 1858¹ (1863), Mammals Australia, III, Pl. XLVIII (with text).

TYPE REGION.—Tasmania.

The photograph of Gould's type specimen, B.M. 43.2.22.6, shows only the front of the skull preserved (muzzle and tooth-rows). The unicuspid i^1 ; i^2 in virtual contact with canine; no space between c and p^4 ; p^2 not visible (actually extremely minute); palate narrow; lacrimal width small.

The bats of the Australian mainland (*krefftii*) mentioned next are in all probability not separable from those of Tasmania. It is customary to place them in the synonymy of *tasmaniensis*.

Pipistrellus tasmaniensis krefftii (Peters)

Vesperugo krefftii PETERS, 1869, Monatsber. Akad. Wiss. Berlin, p. 404.

TYPE LOCALITY.—New South Wales.

Peters described "i¹ large, single-cusped; . . . p^2 very small. . . ." The forearm was given as 48 mm. and the tibia, 19.

In two specimens from Ebor, New South Wales, i^1 is long and without trace of accessory cusp; i^2 is very small, its crown only one-fourth of height of crown of i^1 ; canine long; without supplemental cusp; p^2 excessively small, about one-third of crown area of already reduced i^2 ; c and p^4 contiguous; lower incisors very strongly imbricated; canine strong, curved, considerably higher than p_4 ; p_2 small, completely in tooththrow, but its cusp less than one-third of height of cusp of p_4 .

The skull is low and rather flat; the zygoma, though weak, shows a trace of postorbital process; posterior part of sagittal crest developed to form slight "helmet"; palate long, little domed; no basal pits.

Pipistrellus annectens Group (= *Alobus* Peters? = *Megapipistrellus* Bianchi)

A single species, *annectens* Dobson, for which Bianchi has proposed the subgenus *Megapipistrellus*, differs sharply from all

other known species by its greater size (forearm, 45 mm.). It may, in fact, belong to a different genus—to *Ia* or *Nyctalus*, both of which agree in dental formula with *Pipistrellus*. The type in the Indian Museum is still the only specimen known, and knowledge of the species still depends upon Dobson's description of it.

Bianchi's name *Megapipistrellus* may be invalidated by *Alobus* Peters,² which was proposed to contain the small African species *temminckii* Cretzschmar, which lacks the calcareal lobe, has the ear pinna much like *Myotis dasycneme*, and the rostrum relatively low and short. Dobson (1876) employed *Alobus* for *annectens* and *pulcher* Dobson, as well as for *temminckii*. Thus, if *temminckii* and *annectens* are con-subgeneric, *Megapipistrellus* becomes a synonym of *Alobus*.

Pipistrellus annectens (Dobson)

Vesperugo annectens DOBSON, 1871, Proc. Asiatic Soc. Bengal, p. 213; 1876, Monogr. Asiatic Chiroptera, p. 116; 1878, Cat. Chiropt. Brit. Mus., p. 234.

TYPE LOCALITY.—Naga Hills, Assam.

"Upper incisors nearly equal . . . canine small, scarcely exceeding the second premolar in the upper jaw [p^4] in vertical extent; in the lower jaw the second premolar [p_4] slightly exceeds the canine; first upper molar minute, placed slightly inside the tooththrow, but distinctly visible from without."

Forearm, 45 mm. (1.8 inches).

No other specimen is known.

In his 1876 article Dobson wrote ". . . this species unites the external appearance of a *Vespertilio* [*Myotis*] to the dentition of *Vesperugo* [*Pipistrellus*]. In the form of the ears, and tragus, and the elevation of the roof of the skull above the face, it very closely resembles some species of the former genus." Two woodcuts of the head were shown with the same text.

Pipistrellus joffrei Group

A special Burmese-Malaya group which in some ways connects *Pipistrellus* to *Nyctalus* but is distinguished by peculiari-

¹ Fide Iredale and Troughton, 1934, Mem. Australian Museum, VI, p. 96.

² 1867, Monatsber. Akad. Wiss. Berlin, p. 707. But see also this paper under *Glischropus*.

ties. It is characterized by its strongly specialized upper canine (see beyond), minute p^2 and small i^2 ; subequal p_2 and p_4 ; short, broad rostrum, in which the width across prominent supraorbital tubercles exceeds the lacrimal width. A small descending process from the zygoma external to m^3 .

Included are *Nyctalus joffrei* Thomas, type of the group, *P. anthonyi*, new species, described beyond, *P. stenopterus* and *P. brachypterus*.

The species *joffrei*, according to Thomas, has a "build suggesting a large pipistrelle rather than a noctule but the proportions of the digits quite as in *Nyctalus* Skull of a somewhat different shape from that of other species of the genus (*Nyctalus*), particularly in regard to the broadened rostrum and expanded supraorbital tubercles."

I do not feel that it is proper to include *joffrei* with *Nyctalus* as heretofore. The special nature of the canine, the shortened cingulum length of p_4 , the pronounced tubercles above the eyes are repeated almost exactly in *Philetor*. The *P. joffrei* group approaches oriental members of the *P. savii* group. In the latter, p^2 is minute and the palate short, but supraorbital tubercles are undeveloped. For the present the *joffrei* group is treated as an offshoot of *Pipistrellus*. It may later be accorded subgeneric rank.

P. stenopterus and *P. brachypterus* are seemingly slightly less advanced members of the *joffrei* group. *Stenopterus* possesses the specialized canines and broad rostrum but has less developed supraorbital tubercles; in *brachypterus* the canine cusp is low and weak and the rostrum less broadened.

Pipistrellus joffrei (Thomas)

Nyctalus joffrei THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 225.

TYPE LOCALITY.—Kachin Hills, Upper Burma.

Forearm, 39 mm. Our photograph of the type skull clearly shows the great expanse across the supraorbital tubercles in combination with relatively narrow canine width (a character not shown in *Nyctalus*). The anterior palatal sinus is narrow, and i^{1-1} are more approximated than in true

Nyctalus. The remarkable accessory canine cusp is clearly visible. Rostrum much lower than in *Nyctalus*. Basial pits present but weak.

The skin was described as "uniform pale brown above and below."

Pipistrellus anthonyi, new species

Pipistrellus affinis (?) ANTHONY, 1941, Publ. Field Mus. Nat. Hist., Zool. Ser., XXVII, p. 81.

TYPE.—No. 114849, Amer. Mus. Nat. Hist., ad. ♂, Changyinku, northern Burma; 7000 feet; collector, H. E. Anthony, Vernay-Cutting Burma Expedition; March 13, 1939. The type is a skin with skull, the latter in bad condition.

GENERAL CHARACTERS.—A dark brown pipistrelline bat structurally close to *joffrei* but colored very dark brown instead of "pale brown."

DESCRIPTION OF TYPE.—Pelage firm, glossy and velvety. Dorsal color near Bone Brown; hairs of underparts tipped with Wood Brown, their bases fuscous. Thumb short, its basal phalanx 3.4 mm. (heavier than in *affinis*) and provided with a small basal pad (smaller than in *Glischropus*); claw short and blunt. Feet heavy; a moderately developed calcareal lobe.

Skull (lacking cranial portion): rather wide and only moderately high, with exceptionally wide lacrimal region and even wider space across well developed supraorbital tubercles, but narrower muzzle and canine width. Zygoma flaring from maxilla, provided with a small but distinct descending process, 0.5 mm. in depth, external to m^3 . Sagittal suture very faintly crested and continued as faintly defined paired crests curving outward to meet the supraorbital tubercles. Face short, the narial sinus level with a line drawn through the fronts of the orbits. Palate short, domed.

Dentition: upper incisors missing (alveolus of i^1 larger than that of i^2); canine with very strongly defined posterior cusp which descends from the posteriorly extended cingulum and is partly fused with the main cusp; p^2 quite as small as in *P. savii* or *P. macrotis*, its crown diameter about one-fourth of crown diameter of i^2 , that of its alveolus about one-third of diameter of alveolus of i^2 ; p^4 a large tooth, the cusp descending to midway between the main and posterior cusps of canine, but the body of the tooth is much shortened (in the tooththrow), and a diastema exists between the front of the protocone area of m^1 and what represents the area of the hypocone of p^4 (actually the hypocone is obsolete); lower incisors also missing; canine about as tall as p_4 ; p_2 and p_4 both rather small, p_4 only slightly taller than p_2 but almost as much compressed longitudinally (in tooththrow) as it is in the case of *Philetor*.

MEASUREMENTS OF THE TYPE.—Skin: forearm, 38 mm.; tibia, 12; total length, 96 $\frac{1}{2}$; tail

¹ Made in field.

vertebrae, 41¹; hind foot (c.u.), 10¹. Skull: lacrimal width, 7.0; width across supraorbital tubercles, 7.8; intertemporal width, 4.9; width across canines, 5.1; width across m^3 -³, 7.2; palate length, 4.8; $c-m^3$, 5.3; cingulum length of lower canine, 1.0; p_2 , 0.55; p_4 , 0.45.

REMARKS.—At first sight the characters of this interesting bat suggested the genus *Philetor* more than *Pipistrellus*, particularly in the development of supraorbital tubercles and the modification of p_4 . But in *Philetor* p^2 is no longer present.

The species is named for Dr. H. E. Anthony, Curator of the Department of Mammals, The American Museum of Natural History, who collected it.

Pipistrellus brachypterus (Temminck)

Vespertilio brachypterus TEMMINCK, 1835, Monogr. Mamm., II, p. 215.

TYPE LOCALITY.—Padang, Sumatra.

Temminck's published forearm length of *brachypterus* was 1 inch 3 lines (32 mm.) but the cotype, Leyden "a," measured by me gave 35 mm. "Pelage short, smooth . . . brown, approaching blackish, beneath umber."

The type skin seen by me in Leyden was a mounted skin, specimen "a" of Jentink's catalogue. The skull (only the short, broad, high rostrum and the palate remain) had lacrimal width, 7 mm.; canine width, 5.5; $c-m^3$, 5.5.

It is open to question whether the measurements given for *brachypterus* by Dobson can be relied upon. They were taken not from the type at Leyden but from a specimen in Berlin.

The only data on the type skin appearing in my notes are, "ear rather broad and rounded, with small posterior basal lobe; tragus a rather broad, short lobe . . . tail, 30 mm.; forearm, 35; ear from crown, 7.

A specimen from the Philippines, U.S. N.M. 125313, though labeled *stenopterus*, appears to agree more with *brachypterus*.

Pipistrellus stenopterus (Dobson)

Vesperugo stenopterus DOBSON, 1875, Proc. Zool. Soc. London, p. 470.

TYPE LOCALITY.—Sarawak Island, Borneo.

Forearm, 39 mm.

Fur "very short, dark brown throughout."

¹ Made in field.

The photograph of the type skull indicates a bat near *joffrei*, with the rostrum short and broad in comparison with *Nyctalus*. The canines are less approximated than in *joffrei* and *anthonyi*, the first upper incisors project farther forward, and the supraorbital tubercles are less prominent.

GLISCHROPUS DOBSON

Glischropus (subgenus of *Vesperugo*) DOBSON, 1875, Proc. Zool. Soc. London, p. 472.

GENOTYPE.—As restricted by Miller,² *Vesperugo tylopus* Dobson.

Glischropus contained originally *Vesperugo nanus* Peters from Africa, and *Vesperugo tylopus* Dobson from North Borneo. *V. nanus* Peters is placed by G. M. Allen³ under *Pipistrellus*. Another species formerly and erroneously referred to *Glischropus* is *Pipistrellus tasmaniensis* (Gray, 1843). *Batjanus* Matschie, 1901, and *javanus* Chasen, 1939, are probably correctly assigned.

I have pointed out earlier in this paper the close resemblance of the skull of the type species, *G. tylopus*, to those of the *Pipistrellus tenuis* and *Pipistrellus coromandra* groups. *P. nanus*, which formed the basis of *Alobus* Peters,⁴ is, I think, unquestionably a *Pipistrellus* and lacks any trace of the modifications of the thumb- and foot-pads visible in *G. tylopus*. *Glischropus* must then be restricted to the three named forms, *tylopus* Dobson, *batjanus* Matschie and *javanus* Chasen.

The genus may be thought of as a direct offshoot of *Pipistrellus* in which the apparatus for grasping has undergone modification. The enlarged pads covering the metatarsal-phalangeal joints of the thumb are clearly to be seen, as well as thickening and broadening of the entire plantar surfaces of the feet. Presumably they improve prehension.

The African species *nanus*, which Dobson included in *Glischropus* with *tylopus*, has quite differently proportioned incisors, i^2 being elongate and its position as in normal *Pipistrellus*. Also, enlargement of the pads

² 1907, Families and Genera of Bats, p. 205.

³ 1939, Bull. Mus. Comp. Zool., LXXXIII, p. 95.

⁴ *Alobus* Peters, 1867, Monatsber. Akad. Wiss. Berlin, p. 707, is homonym of *Alobus* Le Conte, 1856, J. Acad. Nat. Sci. Philadelphia, (2) III, p. 273 (Coloptera).

seems to be rudimentary in comparison to those of *tylopus*. The zygoma of *nanus*, too, is a far more heavily built structure than that of *tylopus* and bears traces of a postorbital process.

Glischropus tylopus (Dobson)

Vesperugo tylopus DOBSON, 1875, Proc. Zool. Soc. London, p. 473; 1876, Monogr. Asiatic. Chiroptera, p. 114; 1878, Cat. Chiropt. Brit. Mus., p. 236.

TYPE LOCALITY.—North Borneo.

The skull of the type, photographed by me in 1938, fails to show the *Ia*-like arrangement of the upper incisors, whereby i^2 is thrust so far forward that a straight line will pass through the bodies of the four teeth, i^2 , i^1 , i^1 , i^2 . In addition, the cusp of i^2 is very short, while the supplementary cusp of i^1 is placed posteriorly and descends almost as far as the main cusp. Canine short, its cingulum extended posteriorly but without distinct posterior cuspule. P^2 only slightly reduced, its crown area slightly less than that of i^2 , but its cusp only one-fifth of height of cusp of p^4 . Lower incisors moderately imbricated; p_2 partly displaced, its cingulum length equal to, its cusp height one-half of, that of p_4 .

Skull and rostrum somewhat lower. Zygoma extremely weak, broken in all but two or three specimens of our large series; no basial pits.

The pads of thumb and feet are prominently swollen, as described by Dobson. The color of the pelage is dark brown above, light orange-brown beneath, with dark gray bases.

Of the large series in the Archbold Collection, probably all from Perboewa, north-west Borneo, may be considered topotypes. Those from south Borneo may grade over into *javanus*.

Glischropus batjanus Matschie

Glischropus batjanus MATSCHIE, 1901, Abh. Senck. Gesellsch., XXV, p. 277.

TYPE LOCALITY.—Batchian Island, Moluccas.

Matschie had five specimens in alcohol. He distinguished them from *tylopus* by their average slightly smaller ear. However, the forearm length given by Matschie fits perfectly into the pattern shown by measurements of six Bornean animals. I think

it probable that *batjanus* will have to be placed in synonymy.

Glischropus javanus Chasen

Glischropus javanus CHASEN, 1929, Treubia, XVII, p. 189.

TYPE LOCALITY.—Pangeango, west Java.

Chasen, comparing *javanus* with *tylopus*, found the forearm and lower leg longer, the braincase flatter, p^2 more displaced and p_2 smaller. Certain of the measurements given by Chasen for *javanus*, of which he had apparently only the type, when compared with the series of six of our Bornean specimens appear markedly larger. This greater size, coupled with what must be differences of proportion in the skull, suggests that *javanus* may well be a good species.

NYCTALUS BOWDICH

Nyctalus BOWDICH, 1825, Excursions in Madeira and Porto Santo, p. 36.

Pterygistes KAUP, 1829, Skizzirte Entwickl.-Gesch. u. natürl. Syst. d. europ. Thierw., I, p. 99.

Noctulinia GRAY, 1842, Ann. Mag. Nat. Hist., X, p. 258.

Panugo KOLENATI, 1856, Allg. deutsch. naturh. Zeitung, (n.f.) II, p. 131.

GENOTYPE.—(*Nyctalus*) *verrucosus*; (*Pterygistes*) *noctula*; (*Noctulinia*) *proterus* and *fulvus*, representatives; (*Panugo*) representatives, *noctula*, *leisleri*.

The genus *Nyctalus* has had a peculiar history. Bowdich wrote of *N. verrucosus* from Madeira, the type, "It forms a new subgenus between *pharopus* (*Pteropus*, *fide* Palmer, 1904) and *cephalotes*." Therefore one would assume it to be one of the Megachiroptera rather than a noctule. The name *Nyctalus* was ignored by Dobson, 1878, and by Miller, 1907. But next year Andersen¹ analyzed Bowdich's description of *verrucosus* in considerable detail and reached the conclusion that it was equal to *Pterygistes madeirae* Barrett-Hamilton, 1906, and had nothing to do with the Pteropodidae. The type may not be in existence.

Pterygistes Kaup, 1829, was based upon *Vespertilio noctula* Schreber. This name was employed by Miller (1912) for bats of the genus *Nyctalus*. By Dobson they were considered merely a section of "*Vesperugo*."

¹ 1908, Ann. Mag. Nat. Hist., (8) I, pp. 434-435.

With the exception of *N. joffrei* Thomas and *N. stenopterus* Dobson, removed in this paper to a special section of *Pipistrellus*, the structure of the rather numerous named forms of *Nyctalus* is remarkably uniform. Distinctions are based chiefly upon differences of size. The largest known species is *N. maximus* Fatio (= *lasiopterus*) from Switzerland and Italy; the smallest, *N. azureum*.

Miller (1912) distinguished *Nyctalus* from *Pipistrellus* and *Barbastella* by "length (of fifth finger) only a little more than that of metacarpal of fourth or third" compared with "length greater than metacarpal and first phalanx of fourth or third." In "remarks" he wrote, "This genus is well differentiated from allied groups by the peculiar narrowing of the wing due to the shortness of the fifth finger."

Thomas had already pointed out¹ that the difference (breadth of wing) between *Nyctalus* and *Pipistrellus* was more or less bridged over by oriental forms of *Pipistrellus* like *P. ceylonicus* and *P. chrysothrix*.

Earlier (1907) Miller wrote, "skull with nares extending unusually far back, half way to interorbital constriction, and with very large palatal emargination . . . outer upper incisor very deeply concave and with a large anterior and small posterior secondary cusp; canine and p⁴ always strongly in contact; pm³ [p²] very small, quite invisible from the outside; canines without trace of secondary cusps; first and second molars with small but distinct hypocones. . . ."

To these characters may be added the convexity of the frontal area in profile; the generally rather high rostrum; prominence of the lambdoid crests; very weak zygoma, narrowed anterior part of basioccipital; well developed basal pits; and great breadth of the rostrum (almost as broad as the braincase), swollen in the supraorbital region but not produced as supraorbital tubercles (as in *Philetor*, *Tylonycteris*, *Mimetillus* and the *joffrei* group of *Pipistrellus*). The posterior cusp of i¹ is usually obsolete. The body of p₂ is much shortened in the toothrow as in *Philetor*, etc.

With the removal of the short-faced Malayan *stenopterus-joffrei* group to form a special group of *Pipistrellus*, *Nyctalus* becomes virtually a temperate-subtropical zone genus. Taken from west to east there are four European forms, *noctula*, *leisleri*, *lasiopterus* = *maximus*, *princeps*; in West Africa and islands, *verrucosus*, *azureum* = *madeirae*; in Transcaspiia, *meklenburzevi*; in the Himalayas, *montanus*, *labiatus* (?); in China, *plancei*, *velutinus*; in Japan occur three names, *aviator* = *molossus*, *montanus* and *motoyoshii*.

Miller's (1912) key to the European species of *Nyctalus* is built almost solely upon differences of size, but he also employs a hair character (with or without dark bases). The division with dark hair bases includes only the two smallest species of the genus, *L. leisleri* and *L. azureum*.

The measurements of the species of *Nyctalus*, as far as known to me, are compared beyond. Obviously *azureum* and *leisleri* are thoroughly distinct species, markedly smaller also than any others. The group of very large forms, *maximus*, *molossus*, *aviator*, is also sharply marked off. The remaining forms, though they show considerable variability in size, conform to a broad pattern which transgresses neither the large nor the small species mentioned above.

The large forms may be grouped as two geographical races: *lasiopterus aviator* = *molossus*, and its European representative, *lasiopterus* = *maximus*.

A slightly smaller species, *noctula*, has been made to include several races, *N. princeps*, *N. meklenburzevi* and possibly *N. motoyoshii*. It appears to be primarily boreal in distribution. *N. lasiopterus* and *N. noctula* are without secondary basal pits and lack dark-colored bases to the pelage.

Following these largest *Nyctalus* comes an oriental group centered upon China which includes *N. plancei* = *sinensis* and *N. velutinus*. As pointed out by G. M. Allen² these bats may be synonyms. Probably at least they are conspecific. Both have distinct secondary basal pits and dark brown pelage with lighter tips.

¹ 1901, Ann. Mag. Nat. Hist., (7) VIII, p. 34.

² 1938, Mammals of China and Mongolia, Part 1, p. 235.

These special characters are present also in the supposed type specimens of *labiatus* Hodgson, B.M. 43.1.12.146, which is rather larger (see under *Nyctalus, incertae sedis*). Hodgson described the molar formula as " $\frac{6-6}{6-6}$ " i.e., as in *Myotis*, so there is doubt whether the specimen is truly the type, though I do not question that it was sent by Hodgson from Nepal.

With one exception (that of *montanus* Barrett-Hamilton, to be mentioned later) the remaining species are markedly smaller and more *Pipistrellus*-like. They have dark-based pelage with paler tips, and the rostra of the skulls are less inflated. They are *leisleri*, *verrucosus* = *madeirae*, and *azoreum*. Probably they differ specifically from each other. Compared with the groups previously dealt with they are less specialized, or closer to the basic *Pipistrellus*-pattern.

The remaining form, *montanus*, from the Himalayas, is unusual in possessing the short forearm of *verrucosus* conjoined with the much larger skull of *velutinus*.

The measurements, chiefly made from type specimens, shown in the table beyond, demonstrate and support the species groups just suggested.

Nyctalus verrucosus Bowdich

Nyctalus verrucosus BOWDICH, 1825, Excursions in Madeira and Porto Santo, p. 36, and footnote.

Nyctalus madeirae BARRETT-HAMILTON, 1906, Ann. Mag. Nat. Hist., (7) XVII, p. 98.

Nyctalus verrucosus ANDERSEN, 1908, Ann. Mag. Nat. Hist., (8) I, p. 434 (discussion of identity of Bowdich's bat).

TYPE LOCALITY.—Madeira.

Forearm, 43 mm. Barrett-Hamilton stated that *madeirae* had a quite different skull from that of *N. leisleri*, "smaller, less massive, relatively longer and narrower . . . not at all like the much smaller *azoreum* . . ." This appears to be true of the zygomatic width but untrue of the lacrimal width (see table). I have had no specimen from Madeira to study.

Nyctalus leisleri (Kuhl)

Vespertilio leisleri KÜHL, 1819, Ann. Wetterau. Gesellsch. Naturk., IV, pp. 46-49.

TYPE LOCALITY.—Hanau, Hessen-Nassau, Germany.

Forearm, 40-42 mm. No specimen seen, but the small size, the color of the dark pelage (Prout's Brown), the less imbricated lower incisors, less reduced p^2 , the subequal crown-areas of the upper incisors combine to set the species off sharply from the larger species of *Nyctalus*.

Nyctalus montanus (Barrett-Hamilton)

Pterygistes montanus BARRETT-HAMILTON, 1906, Ann. Mag. Nat. Hist., (7) XVII, p. 99.

TYPE LOCALITY.—Mussooree (= Masuri), northern India.

" . . . Size, color, characters . . . very similar to *leisleri* . . . skull well built, massive, lambdoid crests well developed . . . teeth very large, except small anterior upper premolar . . ." Forearm, 42.5 mm.

The photograph shows the type skull of *montanus*, B.M. 79.11.21.164, to be of the same general dimensions as that of *velutinus* but shorter and wider and wholly lacking the secondary basal pits of *velutinus*. On the other hand the skull of *montanus* exceeds considerably the measurements given by Miller for *leisleri* of Europe.

Nyctalus azoreum (Thomas)

Pterygistes azoreum THOMAS, 1901, Ann. Mag. Nat. Hist., (7) VIII, p. 33.

TYPE LOCALITY.—Azores.

This species is the most *Pipistrellus*-like of all *Nyctalus* seen by me. It is unique in having preserved the posterior cusp of i^1 ; and the crown area of p^2 , although somewhat reduced, is still two-thirds of the area of i^2 , while the canine is less enlarged and bears a distinct rudiment of a posterior cuspule. The $c-p^4$ diastema is not completely closed, and the basal pits are but weakly developed. The zygoma is weak. The profile of the dorsal surface of the skull at the frontal region is slightly convex. The rostrum is broad, without supraorbital tubercles, and is thus typical for *Nyctalus*.

The general appearance of the skin is that of a pipistrelle rather than of a noctule. The pelage dorsally and ventrally has dark bases.

The species may be regarded as an unprogressive offshoot from the primitive line leading from *Pipistrellus* to *Nyctalus*.

Nyctalus plancei (Gerbe)

Vesperugo plancei GERBE, 1880, Bull. Soc. Zool. France, V, p. 71.

Vesperus sinensis PETERS, 1880, Monatsber. Akad. Wiss. Berlin, p. 258.

TYPE LOCALITY.—Peking, China (*plancei* and *sinensis*).

Gerbe's description is almost valueless. Fortunately, however, I obtained a photograph of the type skull, B.M. 82.7.29.2. Only the rostrum remains, the braincase having been destroyed.

Color (Peters) "brown, the individual hairs dark brown with their tips paler."

Gerbe gave the forearm length as 47 mm.; Peters, as 49. This, combined with the characters of the teeth, palate, rostrum and color pattern, indicates relationship to the medium-sized group with dark hair-bases to which *velutinus* belongs.

Nyctalus velutinus Allen

Nyctalus velutinus G. M. ALLEN, 1923, Amer. Mus. Novitates, No. 85, p. 7.

TYPE LOCALITY.—Futsin, Fukien, China.

A form about the size of *noctula*, but with dark bases to the ventral hairs. Forearm of type, 49 mm.; c-m³, 7.3. Allen had previously referred his material to *labiatus* Hodgson.

The skull is rather readily distinguished from that of *noctula* by the secondary set of basal pits placed anterior to the primary ones. These secondary pits are placed virtually in a vertical plane with the glenoid fossae and are separated from the primary pits by a low ridge. Both p² and i² are decidedly smaller.

Closely related to or a synonym of *plancei*. See also remarks by Osgood.¹

Nyctalus noctula (Schreber)

Vespertilio noctula SCHREBER, 1775, Säugethiere, Pl. LI, pp. 166-167.

TYPE LOCALITY.—France.

Forearm, 51-54 mm. (Miller). Pelage "rather dark, yellowish brown near Wood Brown and Cinnamon." The hairs are without dark bases.

Skull with the distinctive character of the noctules, with high, broad rostrum, frontal depression absent in profile, strong lamb-

doid crests, weak zygomata. The secondary basal pits described in *velutinus* are absent or rarely faintly suggested. Crown area of i² larger than i¹; diameter of p² about one-half that of i². Lower incisors strongly imbricated.

This is the characteristic race of *Nyctalus* of northwestern Europe.

Nyctalus noctula princeps Ognev and Worobiev

Nyctalus noctula princeps OGNEV AND WOROBIEV, 1923, Fauna Vertebr. Mamm., Gov't Moscou, p. 97.

TYPE LOCALITY.—Voronesh, Russia.

A slightly larger, strongly reddish representative of the true noctule. The distribution seems to be over eastern Russia and Transcaspia to Turkestan.

The dimensional range shown by Ognev is extraordinarily wide, even for a species of *Nyctalus*.

Nyctalus noctula mекlenburzevi Kuzjakin

Nyctalus noctula mекlenburzevi KUZJAKIN, 1934, Bull. Soc. Nat. Moscou, XLIII, 2, pp. 323-329.

TYPE LOCALITY.—Tashkent, central Asia.

This race was compared by Kuzjakin directly with *noctula*. It must, however, be even closer to the race *princeps* Ognev from eastern Russia and Turkestan, or even synonymous. The measurements average very slightly smaller.

Nyctalus noctula motoyoshii Kuroda

Nyctalus noctula motoyoshii KURODA, 1934, in Siebold, Fauna Japonica (Jap. ed.), III, p. 3.

TYPE LOCALITY.—Hondo, Japan.

This form was also referred to in Kuroda, 1938 (A List of the Japanese Mammals, Tokyo, p. 99-100) in which the citation of Kuroda, 1934, is marked "*nom. nov.*" The work was published in Japanese, and I have not seen a copy.

Nyctalus lasiopterus aviator Thomas

Vespertilio molossus TEMMINCK, 1835, Monogr. Mamm., II, p. 269.

Vespertilio molossus TEMMINCK, 1850, Fauna Japonica.

Nyctalus aviator THOMAS, 1911, Ann. Mag. Nat. Hist., (8) VIII, p. 380.

TYPE LOCALITY.—Japan.

¹ 1932, Publ. Field Mus. Nat. Hist., Zool. Ser., XVIII, pp. 229-230.

Thomas correctly pointed out that *Vespertilio molossus* Temminck, 1850 (and 1835), was a homonym of *Vespertilio molossus* Pallas, 1767,¹ a name applied to an American free-tailed bat described by Buffon, but he had no excuse for designating one of the British Museum specimens, B.M. 5.1.4.5, "type." Cotypes of *molossus* Temminck, e.g., Leyden "b," of whose skull I have a photograph, exist. Actually Jentink² listed four cotypes, skins "a," "b," and "c," and skeleton "a."

The forearm lengths of skins "a" and "b" and of skeleton "a" are, respectively, 60.5, 59.5 and 61 mm. That of skin "c" is 56 and may represent a smaller species, *princeps*. The forearm of Thomas's "type" was 62 mm.

The skull of Leyden "b" is very large and shows some tendency to the formation of a "helmet," the posterior part of the sagittal crest as well as the lambdoid crests being appreciably raised. No trace appears of secondary basal pits. Upper incisors: i¹ long and pointed, i² much shorter and hollowed to receive the tip of lower canine.

Nyctalus lasiopterus (Schreber)

Vespertilio lasiopterus SCHREBER, 1781, Säugethiere, Pl. LVIII B.

Vesperugo noctula var. *maxima* FATIO, 1869, Fauna Vert. Suisse, I, p. 57.

The forearm of *lasiopterus* in Schreber's plate measures 67 mm. The forearm length given by Miller (1912) for *maximus* is 64–68, while Thomas's dimension for the Japanese *aviator* is 62 mm.

The Schreber plate is a relatively excellent portrayal of *N. lasiopterus*. There seems to be no reason to suppose it represented the smaller Japanese *N. aviator*.

This identity of *lasiopterus* and *maximus* seems genuine, despite the work of "first revisers,"³ Fischer and Wagner, who had erroneously placed the name *lasiopterus* as a synonym of *noctula*.

The area of distribution of this largest of the noctules is Switzerland, Sicily and

Italy. Ognev (1928) records it under the name "*siculus*" from Bessarabia, Caucasus and Ural. *Siculus*, according to Miller (1912), equals *Vespertilio murinus*.

Nyctalus, incertae sedis

Nyctalus labiatus (Hodgson)

Vespertilio labiata HODGSON, 1835, J. Asiatic Soc. Bengal, IV, p. 700.

TYPE LOCALITY.—Nepal.

"Thick-lipped bat . . . ears shorter than the head, remote, erect, spheroidal; auricle of the same form, directed towards the conch of the ear; posterior margin of the helix folded outward and carried forward to the gape . . . saturate brown throughout. . . . Teeth $\frac{2.2}{6}$, $\frac{1.1}{1.1}$, $\frac{6.6}{6.6}$. . . *Labiata* is closely affined to M. Geoffroy's *Noctula*. . ."

An obvious discrepancy exists here. It is hard to believe that anyone could describe the molar formula of the British Museum specimen marked type as " $\frac{6-6}{6-6}$ " for it is unmistakably a species of *Nyctalus*. Yet Hodgson so wrote. But he also mentioned its close relationship to *noctula* Geoffroy,⁴ which equals *noctula* Schreber.

We are faced with the alternatives of (1) an error in observation by Hodgson (the molar formula given by him being that of *Myotis* or *Kerivoula*), or (2) substitution of a skull of a large *Nyctalus* for the real type skull with six teeth in each molar-premolar series. Unfortunately I have no record of having seen the skin of B.M. 43.1.12.146, the alleged type of *Vespertilio labiata*. Our photograph of the skull of the same, marked "type" shows not only p₂², m₃³ but p₂² greatly reduced, the typical broad, high rostrum of *N. noctula* and allies, and the same kind of secondary basal pits in line with the glenoid fossae which I have described earlier from paratypes of *velutinus*. The measurements of the *labiatus* skull given beyond are larger than those of *velutinus* and about equal to those of *noctula* or *princeps*. The color, "saturate brown," suggests again *velutinus*.

Elsewhere (*V. tralatitius* Horsfield) I accepted the author's statement of "molars, $\frac{6-6}{6-6}$ " as proof that the bat in question was a *Myotis*, or at least not a *Pipistrellus*.

⁴ 1809, Ann. Mus. Hist. Nat., Paris, VIII, pp. 193–194.

¹ 1767, Spicilegium Zool., Fasc. 3, p. 8.

² 1887, Cat. Ostéologique des Mammifères, Mus. Hist. Nat. Pays-Bas, IX, p. 276.

³ See Thomas, 1911, Ann. Mag. Nat. Hist., (8) VIII, p. 379.

IA THOMAS

Ia THOMAS, 1902, Ann. Mag. Nat. Hist., (7) X, p. 163.

GENOTYPE.—*Ia io* Thomas.

Here is a case of relative gigantism among the pipistrelline bats. The only other large-sized species in that aggregate are *Nyctalus* and the *tasmaniensis* group of *Pipistrellus*. Neither of these approaches *Ia* in body size.

In *Ia* the arrangement of the upper incisors surpasses that seen in *Glischropus*, in that i^2 is carried so far forward that the four incisive teeth are virtually in a row. Similarly, too, i^2 is much reduced in size. But in the case of *Ia* reduction of i^2 is far greater, for its cusp does not attain the cingulum level of i^1 . The first upper incisor is relatively massive and unicuspid (in *Glischropus* bicuspid, the posterior cusp almost as long as the anterior), in this respect resembling *Pipistrellus tasmaniensis*. P^2 is greatly reduced, its area less than that of i^2 , in spite of the small size of the latter. Canine very heavy, half as long again as p^4 , and without enlargement of cingulum or accessory cuspule. Diastema, c- p^4 closed. Molars very heavy, with hypocone weakly present (in m^{1-2}) on commissure running backward from protocone. Lower incisors profoundly imbricated and canines rather close together; p_2 with large crown area but low cusp, the latter one-half as high as cusp of p^4 , the tooth wholly within the tooththrow.

Skull strongly formed: a suggestion of a "helmet," lacrimal width and width of braincase moderate; zygoma moderately deep, with merely a trace of postorbital process; palate narrow, the anterior palatal sinus also narrow. Rostrum not shortened. In the basicranial area well developed basial pits may be observed.

In many respects *Ia* is merely a very large *Pipistrellus*. It could be considered as representing one of the more specialized species groups of that genus.

Ia, as far as known, is monotypic.

Ia io Thomas

Ia io THOMAS, 1902, Ann. Mag. Nat. Hist., (7) X, p. 164.

TYPE LOCALITY.—Chung Yang, south Hupeh, China.

Forearm, 72 mm. Color of pelage very dark, blackish brown, with a trace of ashy tips on some of the hairs; beneath Hair Brown, with the bases fuscous. Terminal point of tail free. No trace of a calcareal lobe. Ear subtriangular with rounded tip; tragus broad, falcate, with tip rounded.

Photographs of the type skull, B.M. 2.6.10.2, ♂, agree closely with our specimen from Szechwan, A.M.N.H. 56873. In the type specimen, however, the basicranial area is destroyed, the description of the basial pits being drawn from our specimen.

SCOTOZOUS DOBSON

Scotozous DOBSON, 1875, Proc. Zool. Soc. London, p. 372; 1876, Monogr. Asiatic Chiroptera, p. 118; 1878, Cat. Chiropt. Brit. Mus., p. 243.

GENOTYPE.—*Scotozous dormeri* Dobson of India.

Africa is obviously the geographical headquarters of this genus, provided that the numerous described species from that continent are correctly referable to *Scotozous*. Hollister¹ believed the African forms to be a special group of *Pipistrellus*. They have been so treated in this paper and will be found under the *P. rüppellii* group of *Pipistrellus*.

The possibility that African and Indian species should not be placed in the same genus was indicated unwittingly by Dobson, 1876, when he wrote, "To the subgenus [*Scotozous*] belongs *Vesperugo schlieffenii* . . . from Egypt. In that species the upper incisors are much smaller than in *V. dormeri*, the first upper premolar is deciduous, and the lower incisors are not crowded."

The incisors of African *Scotozous* are modified from the *Pipistrellus* pattern, i^2 being minute (by Dobson's original definition of *S. dormeri*, i^2 was absent) and, according to Miller (1907), external to the line between canine and i^1 (as in *P. tenuis* group, *Ia*, etc.). Miller wrote that i^1 was bicuspid in the African *rüppellii*, simple in the Indian *dormeri* (the genotype). Thomas (1915) referred to the variable presence of i^2 when writing of *S. dormeri caurinus*.

Elsewhere in this present paper an attempt is made to show that the Nycticeini,

¹ 1918, Bull. U. S. Nat. Mus., XC, p. 89. Allen (1939) included them as *Pipistrellus*.

in which i^1 is unicuspid and i^2 obsolete, represent a stage of incisive evolution in advance of that signaled by the Pipistrellini, with i^1 bicuspid and i^2 present.

However, i^1 in the unicuspid condition with i^2 still present has been noted occasionally in the Pipistrellini, for example, in *P. tasmaniensis* and in *Ia*.

It is possible that *Scotozous dormeri* represents a stage in the transition from the less specialized pipistrelles to the more specialized Asiatic members of the Nycticeini. This idea is supported by the presence of a "helmet," and by the elongate, slender form of the canines, almost as in *Scotophilus*. In *Scotozous dormeri* m^3 remains unreduced, the rostrum and mastoid regions are unbroadened and the skull (rostrum and braincase) is relatively less depressed. P^2 is present in *dormeri* but may be absent in some African species.

Scotozous dormeri Dobson

Scotozous dormeri DOBSON, 1875, Proc. Zool. Soc. London, p. 373.

TYPE LOCALITY.—Bellary Hills, Assam.

The photograph of the skull of the type specimen shows the premaxillaries broken away, so that the incisive arrangement cannot be determined directly. But in the picture of the subspecies *S. d. caurinus* the appearance of i^1 (i^2 obsolete) conforms closely to that of *Scotophilus*.

"Fur above brown, the extreme tips ash; beneath darker brown, the terminal third of the hairs white." Forearm, 33 mm.

According to Kuroda, *S. dormeri* is present in Formosa.

Scotozous dormeri caurinus Thomas

Scotozous dormeri caurinus THOMAS, 1915, J. Bombay Nat. Hist. Soc., XXIV, p. 33.

TYPE LOCALITY.—Junagadh, Kathiawar, western India.

Our photograph of the type skull of this race shows no anatomical characters different from those of *dormeri*, except slightly greater width of rostrum. As pointed out by Thomas the western race is larger, with the forearm 36 mm.

Thomas admitted that *caurinus* was a name of convenience, intended to describe the larger western race of *dormeri*. He re-

marked that forms "in the intermediate area will need further investigation. . . ."

Chalinolobus PETERS

Chalinolobus PETERS, 1866, Monatsber. Akad. Wiss. Berlin, p. 680.

GENOTYPE.—*Vespertilio tuberculatus* Forster.

Discovery, since Dobson wrote,¹ of *Chalinolobus rogersi* has weakened the main distinction made between *Chalinolobus* and *Glauconycteris*, namely, the presence or absence of the small upper premolar (p^2).

The skull of *Chalinolobus* has a rather high, broad rostrum and braincase, weak zygomata without trace of postorbital process, supraorbital area more or less swollen, moderately large bullae, very short rostrum and palate, and large postpalatal spine.

In the dentition, i^1 may have a posterior notch or cusp; i^2 is very small, sometimes minute; p^2 very small, set in angle between c and p^4 , or (in *rogersi*) absent; m^3 never reduced.

In the skins the lobe at the angle of the mouth accounts for the popular Australian name, "lobe-lipped bat"; the ear is broad and low, somewhat like the ear of *Miniotus*; the basal phalanx of the thumb large; the attachment of wing to tip of metacarpal.

The forms of *Chalinolobus* can be grouped in four principal groups, perhaps four species. These are: (a) the *gouldi* group, containing the largest bats of the genus, *gouldi* and its subspecies *venatoris*; (b) the *tuberculatus* group, of which *tuberculatus*, *picatus* and *nigrogriseus* are members; (c) the *morio* group, which includes besides *morio*, *signifer* and *microdon* (and perhaps *australis*); and (d) the *rogersi* group, with only the small-sized *rogersi*.

The four groups are distinguished by color: *gouldi*, with the anterior two-thirds of the body black, the posterior third with the hairs brown-tipped; *tuberculatus*, blackish gray; *morio*, chocolate brown; *rogersi*, hoary (with dark gray bases).

The distinctness of the four groups of *Chalinolobus* is further supported by skull characters; the *gouldi* group has moder-

¹ 1875, Proc. Zool. Soc. London, pp. 381-388; 1878, Cat. Chiropt. Brit. Mus., pp. 246-248.

ately inflated supraorbital swellings, a trace of a posterior cusp behind i^1 ; i^2 about one-third height of i^1 above cingulum, an incipient anterointernal cingulum cusp on p^4 . In the *tuberculatus* group the interorbital area is broadened and the intertemporal constriction accentuated; no trace of a posterior cusp appears on i^1 ; i^2 about as large as in *gouldi*, the cingulum cusp on p^4 accentuated. The *morio* group shows the interorbital width scarcely greater than the intertemporal, a well defined posterior cusp of i^1 , i^2 greatly reduced both in height and diameter, no cusp on p^4 cingulum. *Rogersi* has the intertemporal region much as in *tuberculatus*, i^1 lacking accessory cusp, i^2 small as in *morio*, p^4 with trace of cingulum cusp; but the special peculiarity of *rogersi* (at least in U.S.N.M. 237822) is the fact that p^2 is absent and that p_2 is so much reduced that its breadth and length in the

much larger than *tuberculatus* and *morio* and exhibits distinctive characters: i^1 has a weak posterior cusp; i^2 is proportionately (to i^1) smaller but actually equal in size to i^2 of *tuberculatus*; it is very much larger than i^2 of *morio*; a weak internal cingulum cusp appears in p^4 (as in *tuberculatus*); the degree of development of the supraorbital swellings is less than in *tuberculatus*, greater than in *morio*. The subspecies *C. g. venatoris* differs but very slightly from *gouldi* in dentition, not at all in externals.

The Archbold Collections contain five specimens of *C. gouldi venatoris* from north Queensland, four from Pentland, on the railroad about 100 miles southwest of Townville, and one from Malbon, farther west. The table well shows the range of measurements of forearm and skull and demonstrates that Thomas's type was a small individual of its kind.

SERIES OF *C. g. venatoris*, NORTH CENTRAL QUEENSLAND, COMPARED WITH *C. g. gouldi*

	107764 ♀	107800 ♂	107765 ♂	109275 ♀	109274 ♂	U.S.N.M. 221242, ♂ Gloucester, N.S. W.
Forearm	41.0	43.0	43.0	39.0	38.0	44.00
Skull total length	14.6	—	14.3	14.4	14.0	—
Zygomatic breadth	10.1	10.4	10.1	10.5	10.5	11.00
Interorbital breadth	6.1	6.0	5.9	6.4	6.2	6.30
Least intertemporal breadth	4.6	4.8	4.5	4.7	4.6	4.50
Breadth braincase	7.8	8.0	7.7	7.9	7.9	8.40
Mastoid breadth	8.7	—	8.8	8.8	9.0	9.40
Diameter tympanic ring	3.4	3.5	3.5	3.6	3.4	3.70
C-m ³	5.7	6.0	5.8	5.7	5.4	5.70
M ¹ { Length of crown	1.5	1.6	1.5	1.4	1.4	1.60
{ Breadth of crown	1.7	1.6	1.5	1.6	1.5	1.50
M ² { Length of crown	1.5	1.6	1.4	1.5	1.5	1.60
{ Breadth of crown	1.8	1.8	1.7	1.7	1.7	1.70
M ³ Breadth	1.8	1.8	1.8	1.8	1.8	1.75

toothrow to those of p^4 are as 0.5:0.8 and 0.4:0.6, respectively, and the height of the two cusps above cingula, 0.4:1.0.

Neocaledonicus may represent a fifth group. It was compared with *nigrogriseus*, but, although the forearm length is approximately the same, the teeth are very much larger, c-m³, 5.7, being approximately the same as in *gouldi* (in *nigrogriseus*, 4.9).

Chalinolobus gouldi Group

Chalinolobus gouldi is a distinctive species with blackish pelage shading rather suddenly to brown on the rump. The skull is

The only way in which the specimen from New South Wales differs from our *venatoris* is in p^4 . This tooth is decidedly smaller and presents shorter internal and external faces in the toothrow: external face, 1.0 (*gouldi*), 1.15 (*venatoris*); internal face, 0.8 (*gouldi*), 0.9 (*venatoris*). The space between p^4 and m^1 internally is closed in *venatoris*, open in *gouldi*.

Chalinolobus tuberculatus Group

This group contains the two species *pictatus* (= *nigrogriseus*, fide Iredale and Troughton) and the genotype *tuberculatus*

from New Zealand. Not only the scheme of coloring but the skulls of these animals are singularly alike, particularly in regard to the lack of the cusp on the posterior face of i^1 and in the relatively broad interorbital and narrow intertemporal widths.

C. tuberculatus is a species of medium size (forearm, 39 mm.). Contrary to the view expressed by Thomas¹ in 1889, *tuberculatus* is not precisely equal to *morio*. The following comparison shows the distinction between the two: *tuberculatus* (U.S.N.M. 38031/14003 from New Zealand) is wider than *morio* across the canines, 4.6:4.0; i^1 in *tuberculatus* is single, in *morio* with posterior cusp; height of cusp of i^2 above cingulum, 0.5:0.3; intertemporal width, 4.1:4.7; interorbital width, 5.4:5.1 (note the change of proportions in the last two items); diameter of tympanic ring in *tuberculatus*, 3.0, of *morio*, 2.8; p^4 in *tuberculatus* with anterointernal cingulum cusp, in *morio* without such cusp; length of lower tooth-row ($c-m_3$), 5.4:5.0.

Chalinolobus morio Group

C. morio, U.S.N.M. 236766, from Kangaroo Island, South Australia, has forearm 38.5 mm. In the skull the interorbital width (5.2) scarcely exceeds the intertemporal width (4.7); the zygomatic breadth only slightly exceeds the mastoid width (8.7:8.5). The first incisor has a well developed internal secondary cusp, while i^2 is exceedingly minute (height of its cusp above cingulum, 0.3 to 0.4; in *tuberculatus*, 0.6); $c-m^3$, 4.6.

Closely related or perhaps identical to *morio* is a specimen, M.C.Z. 14927 (in alcohol, skull cleaned), from Broome Hill, Western Australia, previously identified as "*C. signifer*." Forearm, 38 mm.; basal phalanx of thumb, 3.8; skull, greatest length, 12.7; zygomatic breadth, 8.8; mastoid breadth, 8.1; interorbital width, 5.1; intertemporal width, 4.6; $c-m^3$, 4.6; m^{1-3} , 3.15. Iredale and Troughton regard *signifer* as equal to *morio*.

C. microdon (forearm, 37 mm.), concerning which I have little data (photograph of the mandible only), is currently con-

sidered synonymous with *morio*. It also has brown pelage.

C. australis, type locality not known (Tasmania, *vide* Iredale and Troughton), is also regarded as equal to *morio*.

Alphabetical list of named forms of *Chalinolobus*:

australis Gray, 1841, in Grey, Journals Two Exped. Australia, II, pp. 400, 406.

No type locality (Australia).

Described as *Scotophilus*. Regarded as synonymous with *morio*.

gouldii Gray, 1841, in Grey, Journals Two Exped. Australia, II, pp. 400, 405.

TYPE LOCALITY.—Australia (restricted to Launceston, Tasmania, by Thomas).

MATERIAL.—Photograph of type, B.M. 41.1516 (*sic*).

Coloring almost exactly as in *venatoris*. The largest species of *Chalinolobus*.

microdon Tomes, 1860, Ann. Mag. Nat. Hist., (3) V, pp. 51-53.

TYPE REGION.—Tasmania.

MATERIAL.—Photograph of mandible only of type, B.M. 41.1513.

Described as *Scotophilus*.

Dorsal color near brown, ventral color slightly paler, with gray bases. Considered synonym of *morio*.

morio Gray, 1841, in Grey, Journals Two Exped. Australia, II, pp. 400, 405.

TYPE REGION.—South Australia according to Dobson (restricted by Iredale and Troughton to Tasmania).

MATERIAL.—Photograph of type skull, B.M. 37.4.8.118 (90a).

Erroneously made a synonym of *tuberculatus* (Thomas, 1889), but nearest ally appears to be *picatus* (see discussion above).

Dorsal color chocolate brown. A strongly marked post-calcareal lobe, which itself is supported by a minute offshoot of the calcar.

neocaledonicus Revilliod, 1914, in Sarsain and Roux, Nova Caledonica, Zoologie, I, p. 355.

TYPE REGION.—New Caledonia.

"... Above pelage uniform brown-black, a light brown tuft of hairs behind each ear ... forearm, 35.3 ... skull, basilar length, 10.5; mastoid breadth, 8.8; zygomatic breadth, 10; $c-m^3$, 5.7."

¹ Ann. Mag. Nat. Hist., (6) IV, p. 462.

Compared by Revilliod principally with *nigrogriseus*.

nigrogriseus Gould, 1852¹ (1863), Mammals Australia, III, Pl. XLIV (with text).

TYPE LOCALITY.—Moreton Bay, south Queensland.

MATERIAL.—Photograph of type skull, B.M. 56.10.28.3.

Color dorsally fuscous; beneath fuscous, with tips of hairs gray. Forearm, 36 mm. This species apparently equal to *picatus*.

picatus Gould, 1852¹ (1863), Mammals Australia, III, Pl. XLIII (with text).

TYPE REGION.—Northwestern New South Wales.

MATERIAL.—Photograph of skull of type, B.M. 53.10.22.33.

Described as *Scotophilus*.

Color black above and beneath. Forearm, 32 mm. Currently believed equal to *nigrogriseus*. *Picatus* appears to be the closest of the Australian species to *tuberculatus* of New Zealand.

rogersi Thomas, 1909, Ann. Mag. Nat. Hist., (8) III, p. 150.

TYPE LOCALITY.—Wyndham, northwestern Australia.

MATERIAL.—Photograph of type skull, B.M. 9.4.23.1.

"A small species, black, with hoary tips to the hairs. Most nearly allied to *C. nigrogriseus* . . . a well-marked postcalcareal lobe . . . forearm, 34.5; condylobasal length, 12.2; zygomatic breadth, 8.6; c-m³, 4.5. . ."

signifer Dobson, 1876, Ann. Mag. Nat. Hist., (4) XVII, p. 289.

TYPE LOCALITY. Peak Downs, Queensland.

MATERIAL.—Photograph of type skull, B.M. 76.3.29.11.

Treated by Iredale and Troughton as equal to *morio*. I am unable to separate a specimen from northwest Australia (M.C.Z. 14927) from specimens from South Australia and Kangaroo Island.

tuberculatus Forster, 1844, Descript. Anim. Itin. ad Maris Austral. Terres, p. 62.

TYPE REGION.—New Zealand.

MATERIAL.—For purposes of this

study I have had before me a specimen from Dunedin (U.S.N.M. 38031/14003).

Nearest Australian relative, *picatus*, not *morio*.

vagans Dobson, 1879, Ann. Mag. Nat. Hist., (5) IV, p. 135.

TYPE LOCALITY.—"Bermuda."

MATERIAL.—Photograph of type skull, B.M. 79.1.7.1.

Described as *Vesperugo*. Synonym of *Chalinolobus tuberculatus* (Thomas, 1915, Proc. Biol. Soc. Washington, XXVIII, p. 69).

venatoris Thomas, 1908, Ann. Mag. Nat. Hist., (8) II, p. 372.

TYPE REGION.—Northern Territory, Australia.

MATERIAL.—Photograph of skull, B.M. 6.3.9.4.

Described as race of *gouldi*. "... Forearm, 40 mm., skull, greatest length, 14; braincase breadth, 7.6. . ."

Dorsal color blackish brown with brown rump; ventrally very dark brown anteriorly, and light brownish buff posteriorly. External appearance exactly as *gouldi*.

GLAUCONYCTERIS DOBSON

Glauconycteris DOBSON, 1875, Proc. Zool. Soc. London, p. 383.

GENOTYPE.—*Kerivoula poensis* Gray.

This wholly African genus was originally proposed as a subgenus of *Chalinolobus*, now limited to the Australian region.

In 1906 Miller² recognized that *G. floweri*, which he separated under the generic term *Rhinopterus*, had nothing to do with *Glauconycteris* but was actually closer to *Eptesicus*.

Seven species of *Glauconycteris* are given by Allen in the "Checklist of African Mammals" (1939).

BARBASTELLA GRAY

Barbastella GRAY, 1821, London Medical Repository, XV, p. 300.

Synotus KEYSERLING AND BLASIUS, 1839, Archiv. f. Naturg., V, Part 1, p. 305.

GENOTYPE.—*Vespertilio barbastellus* Schreber.

The teeth of *Barbastella* are in virtually the same stage of modification as the teeth of *Pipistrellus*, i.e., i¹ is bifurcate, i² slightly

¹ Fide Iredale and Troughton, 1934, Mem. Australian Museum, VI, p. 97.

² Proc. Biol. Soc. Washington, XIX, p. 85.

reduced; p^2 exceedingly minute and displaced inward by the already contiguous c and p^4 ; m^3 unreduced; lower incisors imbricated, trifid, with additional internal cusp on i_3 ; crown of p_2 one-third of height of cusp of p_4 . Special characters of teeth and skull are seen in the anterointernal cingulum cusp on p_2 ; the broadly depressed rostrum and median sinual spine; the extreme weakness of the zygomata. The ears are proportionately shorter than those of *Pipistrellus*, and the bullae are uninflated.

In quite early times¹ *Barbastella* was regarded as a close relative of *Plecotus*. Perhaps because of this confusion, Horsfield² published his description of *darjelingensis*, collected by Hodgson in Nepal, under *Plecotus*. I have a photograph of the type skull, B.M. 54.9.1.3., which shows distinctly the median spine of the much broadened narial sinus and thus allocates *darjelingensis* Horsfield (Hodgson) definitely within *Barbastella*. Dobson³ placed "*darjelingensis*" and *barbastellus* in *Synotus* Keyserling and Blasius, 1839 (genotype *V. barbastellus* Schreber). His description of the ear states "the outer margin has no projecting lobe at the junction of its upper and middle third. . . ." Bianchi⁴ assumed, on the basis of the wording of Horsfield's description, that *darjelingensis* Horsfield (Hodgson) was in reality a *Plecotus* and suggested a mix-up of labels, whereby Dobson (in Bianchi's opinion) was writing, as he was, of a *Barbastella*. Just why *Synotus darjelingensis* Dobson, which Bianchi renamed *Barbastella blanfordi*, should be considered a synonym of *Plecotus darjelingensis* Horsfield, assuming for the moment that Bianchi was right in his surmise, that author did not explain.

Bianchi (*tom. cit.*) recognized two divisions of *Barbastella*, one, typified by *barbastellus*, with projecting lobe from the base of the ear; the other, without such lobe, represented by "*darjelingensis* Hodgson." He must have meant instead *dar-*

jelingensis Dobson (= *blanfordi*), because he believed *darjelingensis* Hodgson to be a *Plecotus*.

But there is little actual reason for so complex an explanation of the problem. *Homochrous*, with which Horsfield compared his *darjelingensis*, is a *Plecotus*; I have a good picture of the type skull. Bianchi's chief stumbling-block in Horsfield's description of *darjelingensis* lies in the words "the dimensions are the same [as *homochrous*] in all points." Horsfield continued, "the color is deeper, inclining to blackish ['uniform obscure brown' in *homochrous*]. The lobes of the ear are spreading with a small appendicule at the bases ['Ears enormous, $2\frac{1}{2}$ of head, elliptic, nude, transversally striolate']. The tragus is narrow [Inner ear narrow, pointed, erect, with a small basal process for tragus, answering which is a small internal anti-tragus]. . . ." The matter in single quotes refers to *Plecotus homochrous*. Apart from the implication that the dimensions of the ear of *darjelingensis* Horsfield are as great as those of *homochrous*, the description quoted above of the former is perfectly suited to *Barbastella*. I do not think the "small appendicule at the base" (Horsfield) equivalent to the "small well-defined circular projecting lobe at the junction of the upper and middle third" of the outer margin of the ear (Dobson). But if it were, *darjelingensis* Horsfield would be a representative of the *barbastellus* group and the lobeless specimens before me, as I write, from United Provinces, northern India, would have to bear some other name.

Ognev⁵ accepted Bianchi's conclusions.

The following forms of *Barbastella* have received names:

barbastellus Schreber from Burgundy, France (synonyms: *daubentonii* Bell, *communis* Gray)
b. caspica Satunin from Caucasia
b. walteri Bianchi from Transcaspia
leucomelas Cretschmar from Arabia Petraea
darjelingensis Horsfield from Nepal (synonym: *blanfordi* Bianchi)

Ognev (*tom. cit.*) placed *darjelingensis* Dobson, *caspica* and *walteri* together under *caspica* Satunin, 1908. Even if these races were synonymous they should have been

¹ 1838, MacGillivray, Naturalist's Library, XVII, pp. 83-84.

² 1855, Ann. Mag. Nat. Hist., (2) XVI, p. 103.

³ 1878, Cat. Chiropt. Brit. Mus., p. 177.

⁴ 1916, Annuaire Mus. Zool. Acad. Sci. Petrograd, XXI, p. lxxiii.

⁵ 1928, Mammals of Eastern Europe and Northern Asia, I, p. 588.

named *darjelingensis*, the oldest name. According to Ognev's key (*tom. cit.*, p. 584) none of them has the supplementary lobe on the outside of the ear. *Leucomelas*, as illustrated (*tom. cit.*, Pl. XXVIII, figs. b, 3, 4), has rather larger ears than typical *Barbastella*; it lacks the accessory lobe, and the bullae are small (not large as in *Plecotus*). Height given for ear, 7 lines (= 14 mm.). Hairs of lower body with white tips. The description supports the view that *Vespertilio leucomelas* is a *Barbastella*. The ears, as illustrated, are considerably larger than those of the type species.

Provisionally the following arrangement of the forms of *Barbastella* is suggested:

B. barbastellus

B. darjelingensis (= *caspica* = *walteri* = *blanfordi*)

B. d. leucomelas

The following comparison is drawn from *barbastella* (M.C.Z. 37000) from Berlin and *darjelingensis* (F.M.N.H. 48571, 48573 [young]) from Mussoorie, United Provinces, northern India. These species differ chiefly, as stated earlier, by the presence or absence of the supplemental lobe on the outer margin of the ear. In addition the pinna of *darjelingensis* is larger and less abruptly truncated or "broadly rounded off" (Dobson). No significant color differences appear; both are blackish gray with the tips whitish. In the young specimen the grizzled tips have not developed. In both, the membrane attaches to the end of the metatarsal; a calcareal lobe is present.

In spite of the quite significant difference in the ears, the skulls show few distinguishing characters: the premaxillae and incisors are slightly more projecting in the case of *darjelingensis* and the diameter of the tympanic ring is greater (3.1:2.9).

PHILETOR THOMAS

Philetor THOMAS, 1902, Ann. Mag. Nat. Hist., (7) IX, p. 220.

GENOTYPE.—*Philetor rohui*.

Thomas compared *Philetor* with "*Pterygistes*" = *Nyctalus*, showing that it had one less upper premolar.

In many ways *Philetor* resembles the *Pipistrellus joffrei* group (*joffrei* was originally described as a *Nyctalus*): the uni-

form dark brown coloration, the heavy thumbs and large ears; also in the skull, the short, broad rostrum and very strongly developed supraorbital tubercles, as well as the remarkable posterior basal cusp on the canine, the much shortened bodies of the premolars, p_4^4 , and the scarcely reduced p_2 , which is virtually as high as p_4 . Almost the only point of difference in *Philetor* is the disappearance of p^2 . That tooth in all of the *Pipistrellus*-like genera is a vanishing structure.

Philetor rohui Thomas

Philetor rohui THOMAS, 1902, Ann. Mag. Nat. Hist., (7) IX, p. 220.

TYPE LOCALITY.—Albert Edward Range, New Guinea, 6000 feet.

Forearm, 34.5 mm.

I have excellent pictures of the type skull of this species, B.M. 1.11.24.11, ♂. The zygomata are weak as in *Nyctalus*. The posterior process of the palate, in place of being spine-like, is broadly ligulate in form. No secondary basial pits. Expanse across supraorbital tubercles, 8.2 mm.

B.M. 3.3.5.3-4 are two specimens from the Owen Stanley Range, both of which have forearm 32 mm.; B.M. 8.10.8.60, inland from Port Moresby, has forearm 35 mm. It appears that the forearm in this species varies at least from 32 to 35 mm.

A male specimen, A.M.N.H. 152466, from the Idenburg River in the Archbold Collection is slightly larger than the type, its forearm, 37, and $c-m^3$, 5.0 mm. It looks conspicuously different from other pipistrelloid bats recently examined, by possessing a prominent, pointed, palatal spine projecting forward 1 mm. in the center of the anterior palatal sinus, which appears to be the counterpart of the generally present posterior palatal spine (ligulate in *Philetor*). I hesitate to make this spine the basis of a new race (in company with the larger measurements of our specimen) because in the type the spine may have been present and been broken off.

MIMETILLUS THOMAS

Mimetillus THOMAS, 1904, Proc. Zool. Soc. London, II, p. 188.

GENOTYPE.—*Vesperugo moloneyi* Thomas.

This peculiar African genus has been regarded as related to the oriental *Tylonycteris*. It has achieved a relative degree of flatness of the skull. It has also developed large orbital swellings¹ and the obsolescence of p^2 . But certain characteristics about it suggest its independent origin from some branch of *Pipistrellus* other than the line which led to *Philetor* and *Tylonycteris*. In *Mimetillus* the zygoma is deep and strong and exhibits distinct signs of a postorbital enlargement. The canine is long and slender with no lengthening of the cingulum posteriorly to accommodate the posterior accessory cusps of *Philetor* and *Tylonycteris*; the lower incisors are scarcely imbricated and are arranged in an open transverse arc around the broadened symphyseal portion of the mandibles; p_2 and p_4 are not arranged as in the genera mentioned, instead p_2 becomes much reduced in size, while p_4 remains unshortened in the axis of the jaw.

In the skin the large ears, less reduced thumb, the lack of tumescence in the foot and thumb-pads, and the whitening of the wings are characters foreign to *Tylonycteris*.

In this paper no attempt can be made to place the origin of *Mimetillus*. No African groups of *Pipistrellus* have been studied. It may come from a specialized African group, or it may be derived from *Eptesicus* ancestry in which p^2 was already lost.

TYLONYCTERIS PETERS

Tylonycteris PETERS, 1872, Monatsber. Akad. Wiss. Berlin, p. 703.

GENOTYPE.—*Vespertilio pachypus* Temminck.

If the extraordinary flattening of the skull of *Tylonycteris* is for the moment disregarded, its similarity to *Philetor* becomes apparent. The upper incisors are much the same, the canine has developed a strong accessory cingulum cusp; p^2 is absent; the lower premolars have much the same character, p_4 much shortened longitudinally in the toothrow, and the height of p_3 only slightly inferior to that of p_4 . In the skull supraorbital tubercles are more weakly

developed; the canine width remains unexaggerated; the zygoma is weak.

Perhaps we may regard *Tylonycteris* and *Philetor* as independently derived from near the *Pipistrellus joffrei* group, and as having lost p^2 independently.

The flattening of the skull is an attribute of *Tylonycteris* only. It is not to be traced in *Philetor*.

A considerable number of forms of *Tylonycteris* have received names:

pachypus GROUP

<i>pachypus</i>	Java
<i>fulvidus</i> (= <i>rubidus</i> ?)	Sittang River, Burma
<i>meyeri</i>	Philippines
<i>aurex</i>	Western India

robustula GROUP

<i>robustula</i>	Sarawak, Borneo
<i>malayana</i>	Perak, Malaya

Thomas was right in part in 1915³ when he recognized three types of *Tylonycteris*, but only two main divisions actually occur. His attempt to partition this genus was held later to have failed⁴ until Osgood⁵ concluded that two distinct types existed. Even so, G. M. Allen⁶ again expressed doubt.

I am able, I believe, to point to two anatomically *proportional* characters, in addition to absolute differences of size and color, which place any species of *Tylonycteris* definitely in one of two groups. The first of these characters relates to the degree of development of the supraorbital tubercles, extreme in the larger *robustula*, minimal in *fulvidus*, *aurex*, etc. The character is expressed clearly in the table beyond by setting "width across supraorbital tubercles" against "lacrimal width," this latter being the minimum interorbital width taken across the orbits *in front of* the supraorbital tubercles. In the larger forms with dark pelage this differential appears as 0.5 mm. and upward; in the smaller fulvous forms

¹ This name (*nomen nudum*) apparently used erroneously by authors for *fulvidus*. It was attributed to the same type locality as *fulvidus* by Thomas and by Gyldestolpe.

² Ann. Mag. Nat. Hist., (8) XV, p. 226.

³ Wroughton, 1917, J. Bombay Nat. Hist. Soc., XXV, p. 586.

⁴ 1932, Publ. Field Mus. Nat. Hist., Zool. Ser., XVIII, p. 235.

⁵ 1938, Mammals of China and Mongolia, Part 1, pp. 247-249.

¹ These swellings are not strictly the homologues of the supraorbital tubercles in *Tylonycteris* but are swellings of the area anterior to that part of the orbit which incloses the anteorbital foramen, but posterior to the foramen.

as 0.1–0.2 mm. In the small species the tubercles are minute, in the large species substantial.

The second distinct difference lies in the degree of enlargement of the lambdoid crests. In the small species these crests are strongly developed and on each side just above the condyle are drawn strongly backward so that, seen from above, the two backwardly projecting lambdoid crests and the bulge of the supraoccipital form almost a straight line. In the large species, on the contrary, the crests are poorly developed, are scarcely drawn backward and do not form a straight line with the bulge of the supraoccipital.

The type species of the genus, *pachypus*, is a member of the smaller group. This is shown by the small toothrow of the cotype, Leyden "e," and the narrowness of the measurement across the supraorbital tubercles, as well as by Temminck's statement about the color of the skin, "... bi-color . . . above more or less lustrous maroon . . . with bases more or less golden red; chest red, brown at the ends of the hairs. . . ." Specimen "e" came from Bantam, Java.

To this group can be referred *fulvida*, *aurex* and probably *meyeri*, a considerably smaller bat.

The *robustula* group should probably include *malayana*, which Chasen shows to be even larger than typical *robustula*.

Tylonycteris pachypus Group

Tylonycteris pachypus (Temminck)

Vespertilio pachypus TEMMINCK, 1835, Monogr. Mamm., II, p. 217.

TYPE LOCALITY.—Bantam, Java.

The only specimens at Leyden marked by Jentink as types were mounted specimens "a–c" and alcoholic specimen "e." Of skeletal material, "a–h" were stated to be types. All were from Bantam, Java.

Dr. Junge was good enough to have the skull of specimen "e" (alcohol) taken out and cleaned. My notes on skull and dentition were derived from that skull. The following are forearm lengths of seven cotypes: skin "a," 27 mm.; skin "b," 26; skin "c," 25; alcoholic "e," 26; skeleton "a," 26.5; skeleton "b," 25; skeleton

"c," 27. In the specimen in the British Museum (44.4.4.24), which Thomas stated was a cotype received from Leyden, the forearm measures 26.4.

The foregoing dimensions alone make it reasonably sure that *pachypus* was a "small" *Tylonycteris*. The skull of specimen "e," which I studied, fully confirms that view, possessing relatively slight rostral tubercles and prominent lambdoid ridges.

I am unable to distinguish between Balinese and Sumatran skulls in the Archbold Collections and skulls from Laos, Indo-China, which represent *fulvidus*. At best *fulvidus* (= *rubidus*) can be but a slightly more rufescent race of *pachypus*.

T. aurex, the form from western India, may differ very slightly; *T. meyeri* from the Philippines appears much smaller.

In the Archbold Collections are series from Palembang, Sumatra (17); Selat, Bali (5).

Tylonycteris pachypus fulvidus (Blyth)

Scotophilus fulvidus BLYTH, 1859, J. Asiatic Soc. Bengal, XXVIII, p. 293.

Tylonycteris rubidus THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 227.

TYPE LOCALITY.—"From Schwe Gyeen," Sit-tang River, Burma.

I have not found an earlier usage of *rubidus* (used also by Gyldenstolpe, 1916). The name seems to have been substituted inadvertently for *fulvidus*.

"A small *Scotophilus* . . . of a pale fulvous color throughout, with black membranes. Length, $2\frac{3}{4}$ inches, of which tail 1 inch; . . . forearm, $1\frac{1}{16}$ inches [27 mm.]; . . . 4 females."

The type is probably at Calcutta.

Thomas, Gyldenstolpe, Osgood and G. M. Allen have at various times referred bats from Burma and Indo-China to this race.

Tylonycteris pachypus aurex Thomas

Tylonycteris aurex THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 228.

TYPE LOCALITY.—Astoli, Belgaum, south of Bombay, western India.

My photograph of the skull of *aurex* and the measurements taken therefrom offer no point of differentiation from *pachypus*. *Aurex* is maintained a geographical

race upon Thomas's authority. We have no specimens.

***Tylonycteris pachypus meyeri* Peters**

Tylonycteris meyeri PETERS, 1872, Monatsber. Akad. Wiss. Berlin, p. 705.

TYPE LOCALITY.—South Luzon, Philippines.

This little bat, forearm, 22.3–24 mm., is retained as a distinct race of *pachypus* on

***Tylonycteris malayana* Chasen**

Tylonycteris malayana CHASEN, 1940, Bull. Raffles Mus., XV, p. 52.

TYPE LOCALITY.—Jor, Batang Padang, Perak, Malay States.

There is only Dr. Chasen's description of this bat to go upon. He was disinclined to regard it as a race of *robustula*. Forearm, 28.5 mm.

RATIO OF LACRIMAL WIDTH TO WIDTH ACROSS SUPRAORBITAL TUBERCLES IN *Tylonycteris*

	Lacrimal Width	Tubercle Width	Differential
<i>T. robustula</i> group			
A.M.N.H. 109144 Peleng	6.0	6.9	0.9
A.M.N.H. 109145 "	5.9	6.8	0.9
F.M.N.H. 32158 Laos	5.7	6.2	0.5
F.M.N.H. 32157 "	5.6	6.1	0.5
M.C.Z. 27067 Tonkin	5.6	6.3	0.7
A.M.N.H. 102641 South Sumatra	5.9	6.7	0.8
A.M.N.H. 102642 " "	5.6	6.8	1.2
<i>T. pachypus</i> group			
F.M.N.H. 32160 Laos	4.8	5.0	0.2
F.M.N.H. 32189 "	5.1	5.2	0.1
M.C.Z. 27066 "	5.0	5.2	0.2

account of its smaller size. Peters had three cotypes. I have a photograph of the skull of B.M. 75.11.3.12, ♀. As shown in the table, its dimensions are generally smaller than those taken from the cotype of *pachypus*.

***Tylonycteris robustula* Group**

***Tylonycteris robustula* Thomas**

Tylonycteris robustula THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 227.

TYPE LOCALITY.—Sarawak, Borneo.

Thomas pointed out the larger size and dark brown coloring by which this species could be distinguished from *T. pachypus* and allies, and earlier in this paper I have indicated two additional cranial differences.

Thomas gave the range of this species as Malay Peninsula, Borneo, Java, Celebes and Timor. Osgood (1932) recorded it from Indo-China, and G. M. Allen (1938) recorded three specimens from Yunnan, China. There is no indication that it reaches India.

The Archbold Collections contain good series from Palembang, Sumatra (5); Selat, Bali (8); and Peleng Island, east of Celebes (13).

HESPEROPTENUS PETERS

Hesperoptenus (subgenus of *Vesperugo*) PETERS, 1868, Monatsber. Akad. Wiss. Berlin, p. 626.

To Peters' genotype, *Vesperus doriae* from Sarawak, Dobson¹ added *Nycticejus tickelli* Blyth, 1851 (with its supposed synonym *N. isabellinus* Horsfield, 1851) from India and Ceylon, and *Vesperugo* (*H.*) *blanfordi* Dobson, 1877, from Tenasserim.

Contrary to the conditions in *Scotomanes*, in which the three "races" are doubtfully separable, *Hesperoptenus*, if not polyphyletic, contains very strongly differentiated species. Miller² rightly suggested that more than one generic group might be involved. Thus in *doriae*, the type species, Peters makes no mention of any unusual position of i², merely calling it "low and small." Had it stood behind i¹ as in the mainland species *tickelli* he would scarcely have failed to notice the fact. Again the relationships of the anteorbital foramina to the supraorbital ridges in *tickelli* and *tomesi* show them to be "good" species. The remarkably small size and specialized

¹ 1878, Cat. Chiroptera Brit. Mus., p. 240.

² 1907, Families and Genera of Bats, pp. 211–212.

thumb of *blanfordi* make one suspect that it, too, differs widely.

I have seen specimens of *tickelli* and *tomesi* only, but it is probable that, when the skull of the type of *doriae* has been studied, these larger bats may require reconsideration from the generic standpoint.

Peters gave virtually no generic characters with *doriae*, and Miller's definition of *Hesperoptenus*, based chiefly upon *tickelli*, may have to be recast.

In *H. tickelli* an interesting condition of the upper incisors exists (in addition to the position of i^2), namely, the unicuspid condition of i^1 . In most *Pipistrellus*-like genera i^1 remains bicuspid, and in the *Scotophilus*-like genera obsolescence of the posterior cusp is accompanied by loss of i^2 . In *tickelli* an intermediate condition is seen, whereby the unicuspid state is achieved in i^1 before obsolescence of i^2 .

Hesperoptenus doriae Peters

Hesperoptenus doriae PETERS, 1868, Monatsber. Akad. Wiss. Berlin, p. 626.

TYPE LOCALITY.—Sarawak, Borneo.

"... Trilobed lower incisors stand oblique to edge of jaw . . . second upper incisor low and small . . . Light brown, dorsal hairs darker at bases. . . Forearm, 36.5."

Apparently Dobson (1876, p. 112) was responsible for the association of *tickelli*, and other forms in which i^2 stands behind i^1 , with *doriae*. He wrote, "Most probably . . . it will be found that they can both [*doriae* and *tickelli*] be included in the subgenus *Hesperoptenus*." He went so far in the "Catalogue" (1878, p. 239) as to contrast *doriae* "outer incisors in the toothrow," with all other species, "outer incisors quite posterior to the toothrow." The first of those statements remains, I believe, yet to be proved.

Hesperoptenus tickelli (Blyth)

Nycticejus tickelli BLYTH, 1851, J. Asiatic Soc. Bengal, XX, p. 157.

TYPE REGION.—"Central India, Ceylon, and doubtless the intervening country."

"... Forearm, $2\frac{3}{8}$ inches (61 mm.) . . . fur . . . pale fulvescent or whitish fulvous . . . considerable growth of hair upon basal half of interfemoral membrane above . . .

dentition . . . short, flat, obtusely trilobate or quadrilobate second pair of upper incisors, situate posterior to the usual large pair, and immediately behind the contact of each of the latter and the canine of the same side. . ."

Herewith a few notes made on M.C.Z. 27514-15 from Ceylon: A "helmeted" skull with high mandibular coronoid; i^1 without trace of secondary cusp; i^2 inward from i^1 , the reverse of condition in *Ia*; crown area of i^2 about equal to i^1 ; p^2 absent; m^3 , though short, with nearly complete pattern; lower incisors much thickened, strongly imbricated; p_2 wider than long (in jaw), height of its cusp two-fifths of p_4 . Supraorbital processes angular, without conjunction with anteorbital foramina as in *tomesi*.

[*Hesperoptenus isabellinus* (Horsfield)]

Nycticejus isabellinus HORSFIELD, 1851, Cat. Mamm. Mus. East India Comp., p. 38.

"... Size of *N. temminckii* [= *Scotophilus temminckii*], clearly characterized by a uniform isabellina tint both above and underneath."

Dobson (1876) treated *isabellinus* as a synonym of *tickelli*. No locality was given.

Hesperoptenus tomesi Thomas

Hesperoptenus tomesi THOMAS, 1905, Ann. Mag. Nat. Hist., (7) XVI, p. 575.

TYPE LOCALITY.—Malacca.

Our picture of the type skull, B.M. 7.1.1. 428, shows a moderately short rostrum with wide supraorbital area which is, however, pinched in sharply at the level of the anteorbital foramina; back of skull raised and back part of sagittal crest moderately developed into a "helmet"; mastoid area slightly expanded as in *Scotomanes*. Canines very long; i^2 strongly displaced inwardly; p_2 not compressed in toothrow; lower incisors well imbricated.

"General color . . . burnt umber but darker . . . under surface uniform brown (almost matching Ridgway's Burnt Umber) throughout. . . i^2 , which is also very large, placed quite behind i^1 . . . premolar much extended transversely . . . forearm, 51 mm. . . only near ally *H. tickelli*."

Hesperoptenus blanfordi Dobson

Vesperugo (*H.*) *blanfordi* DOBSON, 1877, J. Asiatic Soc. Bengal, XVI, p. 312.

TYPE REGION.—Tenasserim.

"... A broad adhesive cushion occupies the base of the inferior surface of the metacarpal bone [of the thumb], and extends outward and backward upon the base of the metacarpal of the second finger.

"Forearm, 1.1 inches (27 mm.).

"Fur reddish-brown above, slightly paler beneath Dentition almost similar to that of *V. tickelli*, the outer incisors even smaller and placed more behind the inner incisors. . . ."

Here is a digital adaptation similar to that of *Glischropus*.

pertilio and *Eptesicus* as synonymous. Ten years later, following the views of Méhely,² Miller,³ recognizing *Eptesicus*, restricted *Vespertilio* to contain only *murinus* and *superans*.

The formation of the skull, especially the massive rostrum, and the dental formula indicate that the bats of this genus are allied on the one hand with *Nyctalus* and on the other with *Eptesicus*. The tricuspid condition of *i*¹ is a specialization, while the cusp of the outer incisor is less reduced than in *Eptesicus*. The canines are unusually broad at the cingulum level. Last upper molar unreduced.

The size of the type species, *murinus*, is

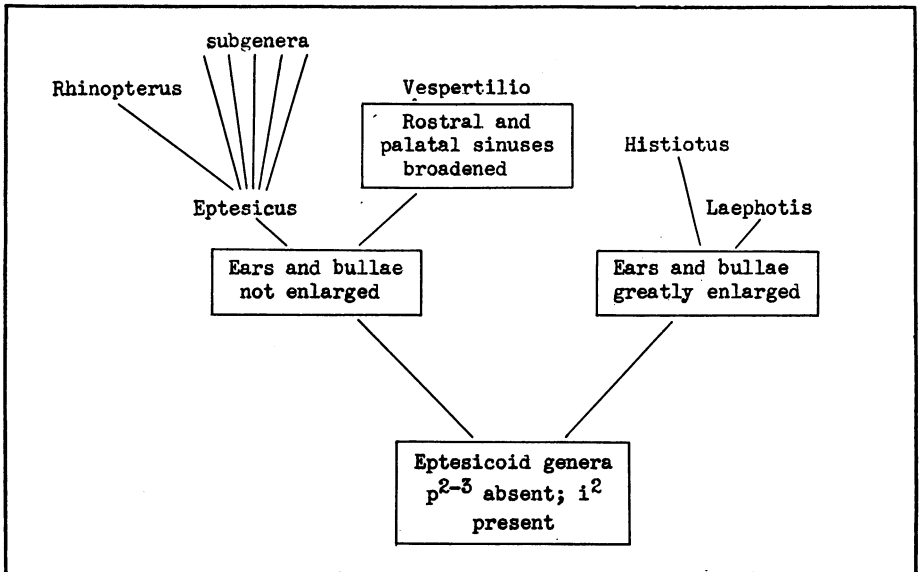


Fig. 4. Suggested phylogeny of the eptesicoid genera. See also Fig. 1.

VESPERTILIO LINNAEUS

Vespertilio LINNAEUS, 1758, Syst. Nat., I, 10th ed., p. 31.

GENOTYPE.—*Vespertilio murinus* Linnaeus.

Vespertilio Linnaeus, 1758, contained all of the seven bats described by him, of which two only, *auritus* [*Plecotus*] and *murinus*, belonged in the present family Vespertilionidae. The type was fixed in 1897 by Miller,¹ who at that time regarded *Ves-*

about equal to that of *Eptesicus nilssonii*, the forearm, 43–45 mm.

Vespertilio is placed next to *Eptesicus* only provisionally, on account of the loss of *p*². However, the broadened rostrum and especially the width of the anterior narial and palatal sinuses make it equally probable that it has a co-origin with *Nyctalus* and has since lost *p*².

¹ 1897, North American Fauna, XIII, pp. 18–19, 95–103.

² 1900, Monogr. Chiropt. Hungariae, p. 219.

³ 1907, Families and Genera of Bats, pp. 207, 209.

Until recently only *V. murinus* and its geographical race *superans* were known. In 1920 Kuroda described *namiyei*. *V. discolor* is a synonym of *murinus*, and *siculus* has also been used for that species.

Vespertilio murinus Linnaeus

Vespertilio murinus LINNAEUS, 1758, Syst. Nat., I, 10th ed., p. 31.

Vespertilio discolor KUHL, 1819, Ann. Wetterau. Gesellsch. Naturk., IV, p. 187.

Vesperus siculus DADAY, 1885, Orvos-Termesztudományi, X, p. 275.

TYPE LOCALITY.—Upsala, Sweden (*discolor*, Vienna; *siculus*, Homorod-Almas Cave, Hungary).

Forearm, 43–45 mm.¹

Vespertilio murinus superans Thomas

Vespertilio murinus superans THOMAS, 1898, Proc. Zool. Soc. London, p. 770.

TYPE LOCALITY.—Se-sa-lin, Ichang, Yang-tse, China.

Consistently larger than the European *murinus*. Forearm, 50 mm.

Vespertilio namiyei (Kuroda)

Nyctalus namiyei KURODA, 1920, Annot. Zool. Japon., IX, Pt. 5, p. 601.

TYPE LOCALITY.—Otsukuejima, coast of Chikuzen Province, Kiusiu, Japan.

Writing in 1938,² Kuroda shows how he first placed *namiyei* in *Nyctalus*, next (1934) in *Eptesicus*, and finally in *Vespertilio*. Forearm given as 45–48 mm. No description of skull (in 1938). "Color of both sides of body much deeper [than *superans*] and without a distinct 'frosted' area on back."

Kuroda's reference of *namiyei* to *Vespertilio* is accepted provisionally.

EPTESICUS RAFINESQUE

Eptesicus RAFINESQUE, 1820, Annals of Nature, p. 2.

Adelonycteris H. ALLEN, 1892, Proc. Acad. Nat. Sci. Philadelphia, for 1891, p. 466. New name for *Vesperus*, preoccupied.

The basic concept of the genus *Eptesicus* is founded upon Rafinesque's genotype, *E. melanops* = *Vespertila* [sic] *fuscus* Beauvois and *V. mydas*, both North American bats, and Kaup's *Cnephaeus*, 1829, with type *Vespertilio serotinus* Schreber. The other two European species admitted to the

genus by Miller,³ *nilssonii* Keyserling and Blasius, 1839, from Sweden, and *sodalis* Barrett-Hamilton from Roumania, were described later. The American *fuscus* and European *serotinus* are unquestionably con-subgeneric. They are rather large, with c-m³ approximately 7 mm. In both, m³ is strongly modified, and the skull is drawn back into an occipital "helmet."

Since Rafinesque originated the genus, the addition of numerous species, including tropical forms from Africa, Australia and South America, has necessitated such broadening of the generic scope of *Eptesicus* that, apart from the similar dental formula, many species are found to have little in common with *melanops* Rafinesque.

This dental formula differs from that of *Pipistrellus* only by the absence of the anterior upper premolar, an obsolescent tooth which varies in size in *Pipistrellus* but is always reduced. Moreover, certain species groups of *Eptesicus* resemble given species groups of *Pipistrellus* in the form of their skulls, so that one asks one's self whether obsolescence of p², with consequent transformation of a pipistrelle into an *Eptesicus*, may not have taken place more than once. In the present paper, however, the conventional assumption will be upheld, that all species of *Eptesicus* are more closely related to one another than to any species of *Pipistrellus*.

Study of a representative assemblage of the species of *Eptesicus* has resulted in their provisional segregation into a number of species groups whose number and scope are shown synoptically:

SPECIES GROUPS OF EURASIAN *Eptesicus*

Eptesicus nilssonii group (subgenus *Amblyotus* Kolenati).

This is perhaps the least modified group. Old World. Numerous forms.

Eptesicus nasutus group (subgenus *Rhyneptesicus* Bianchi.)

Subgeneric characters imperfectly known. India. See text beyond.

Eptesicus fuscus group (subgenus *Eptesicus* Rafinesque).⁴

Exceptionally large. Postorbital process developed on strong zygoma; m³ reduced. Cir-

¹ For full description see Miller, 1912, Cat. Mammals of Western Europe, pp. 238–242.

² 1938, A List of the Japanese Mammals.

³ 1912, Cat. Mammals of Western Europe, pp. 224–237.

⁴ *Pachyomys* Gray, as revived by Bianchi, synonym of *Eptesicus* subgenus.

cumpolar, with tropical representatives. Numerous forms.

Eptesicus pachyotis group (subgenus *Paraepstesicus* Bianchi).

Subgeneric characters not studied. India.

Eptesicus demissus group.

Much resembling *fuscus* group, but skull with basial pits.

Eptesicus pumilus group.

A group of very small species with reduced zygomata and unmodified m^3 . Australia.

Besides the groups indicated above, others in Africa or South America may later be segregated, e.g., *Neoromicia* Roberts.

It appears that the headquarters of *Eptesicus* in regard to numbers of species lies in lower temperate and subtropical Asia and Africa, while rather meager offshoots are present in Europe, America and Australia. In southern Asia only two species, *dimissus* and *verecundus*, are present in the Malay States. Taylor¹ shows no record of *Eptesicus* from the Philippines. None is known from the East India islands west or north of New Guinea and Australia. Thus the Australian *pusillus* group is separated from mainland *Eptesicus* by a distance of some 2000 miles.

Africa is quite rich in species of *Eptesicus*. Allen² shows twenty-six species which between them extend over most of the continent.

In Africa is found a series of species or races conspicuous because of their nearly translucent flying membranes; also there are many quite small species which possibly find their nearest allies not with northern *Eptesicus* but with the Australian *pumilus* group. Possibly some of those, including the *pumilus* group, are referable to *Neoromicia* Roberts (type, *zuluensis*).

Those African species with "white" or translucent membranes include *phasma*, *rendalli*, *faradjius* and *tenuipes*. They are characterized by completeness of m^3 and extreme weakness and delicacy of the zygoma, as in the Australian *pusillus* group, but they differ from *pusillus* and allies by broadening of the supraorbital area and development of small supraorbital tubercles.

Of African dark-winged forms I have seen *flavescens*, a moderate-sized species

with full braincase, deep zygoma, weak basial pits and unreduced m^3 ; *minutus*,³ a species nearly as small as *pusillus*, whose skull shows strong general likeness but has stronger zygomatic arches and larger ante-orbital foramina; and *somalicus*, which is of the size of *pusillus* but differs in numerous small details which need not be enumerated here.

In spite of the differences pointed out it seems very likely that the closest relatives of the Australian group of *Eptesicus* occur in Africa and not in Eurasia.

In South America *Eptesicus* is not well represented. Apart from members of the *serotinus-fuscus* group, the species are small to medium-sized, dark brown in color: *andinus*, forearm, 45 mm. (size of *nilssonii*), has the braincase high and full, zygoma with slight postorbital process, well defined basial pits, muzzle narrow, m^3 unreduced; the skull of *cubensis* is almost a replica of *hingstoni* (Persia) but has the postorbital processes higher and bullae smaller; in *chapmani*, forearm 40 mm., the zygoma is strong and deep, a weak "helmet" appears, muzzle narrow, m^3 somewhat shortened in the tooththrow, anteorbital foramen unusually large; in *doriae*, forearm 37 mm., the characters of *chapmani* are repeated but the size is in every way less, and the anteorbital foramen is not enlarged; *hilarii* appears virtually equal to *chapmani*.

This short survey, although incomplete, suggests that no close relatives of the *pusillus* group will be found in the neotropical region. The South American forms (other than the allies of *serotinus*) appear on the whole to be unspecialized species derived from early *Eptesicus* stock. *Hilarii* and *chapmani*, in which m^3 is slightly shortened, may be distantly allied to *serotinus* and *fuscus*.

Eptesicus nilssonii Group (Subgenus **Amblyotus**)

In *Amblyotus*,⁴ typified by *Vespertilio nilssonii*, the skull is relatively delicate and tapered, the braincase low. A definite

¹ 1934, Philippine Land Mammals, p. 115.

² 1939, Bull. Mus. Comp. Zool., LXXXIII, pp. 83-87.

³ Our series, identified as "*minutus*," may be in reality *capensis*.

⁴ Ognev, 1928, Mammals of Eastern Europe and Northern Asia, I, p. 543, treats *Amblyotus* as a full genus.

postorbital deepening of the zygoma at the jugal succeeds the anterior, slender zygomatic process of the maxilla. The supra-orbital ridges are weak and play no part in forming the anteorbital foramen. Rostrum, palate and zygomata rather narrow.

Incisors slender, elongate, i^1 with posterior accessory cusp; i^2 slightly shorter than accessory cusp of i^1 ; canine slender, with sharp posterior cutting edge; m^3 complete, the two posterior commissures relative to the anterior one, 0.7, 0.7 : 1.0, and length of m^3 (in tooththrow) 1.0 mm. Lower incisors delicate, moderately imbricated, incisor slightly thickened; p_2 slender, compressed, its blade about one-third of height of blade of p_4 .

The numerous named forms referable to this group are apparently confined to the Eurasian continental mass and to the northern parts of Africa.

I have been able to see only a few representatives of the group: *nilssonii*, *walli* and "*jobiensis*." The last has forearm 38–42 mm. and $c-m^3$, 5.6–5.9.

Of those forms described by various authors but not seen by me *caucasicus* from Tiflis, *pallascens* from the River Moldja, *tamerlani* from east Turkestan, and *velox* from Vladivostok, all with forearm 35 mm., seem closest to *nilssonii*.

Larger bats (forearms near 40 mm.) include *kashgaricus* from near Kashgar, *centrasiaticus* from Tibet, and *gobiensis* from Mongolia.

The small *tauricus* may not belong with *nilssonii* at all but to one of the African groups of small-sized *Eptesicus*.

Walli, which I have described beyond (from a supposedly identical specimen) in company with *matschei* and *pellucens*, may represent a wholly distinct species.

E. alashanicus from Mongolia was distinguished by Bobrinskoj by special characters of the upper incisors.

Eptesicus nilssonii (Keyserling and Blasius)

Vespertilio nilssonii KEYSERLING AND BLASIUS, 1839, Archiv. f. Naturg., V, Part 1, p. 315.

TYPE REGION.—Sweden.

This bat has been described by many authors. One of the best descriptions ap-

pears in Miller, 1912.¹ Pelage dark brown with tips whitish; forearm, 38–40 mm. The details of the skull have been described under the group heading. Measurements are shown in the table.

Eptesicus nilssonii caucasicus (Satunin)

Vesperugo (Vesperus) caucasicus SATUNIN, 1901, Zool. Anz., XXIV, p. 649.

TYPE LOCALITY.—Tiflis.

By Satunin in 1896 this bat was regarded as a "variety" of *nilssonii* (= *borealis*). Forearm, 35 mm., according to Ognev, 1928 (not given by Satunin). Color dark brown, washed with yellowish, beneath gray brown, with silvery tips.

Eptesicus nilssonii pallascens Bobrinskoj

Eptesicus caucasicus pallascens BOBRINSKOJ, 1926, Comptes Rendus Acad. Sci. U.R.S.S., ser. A, pp. 97–98.

TYPE LOCALITY.—River Moldja (Maldj), mountain ridge of Russki.

The description indicates a pallid form of *caucasicus* Satunin.

Forearm, 35.0–35.5 mm.

Eptesicus nilssonii tamerlani Bobrinskoj

Eptesicus tamerlani BOBRINSKOJ, 1918, Fauna and Flora of Russia, XV, pp. 13–16.

TYPE LOCALITY.—Baisunski Bay, Bucharia, east Turkestan.

Forearm, 33.5–35 mm. Ognev (1928) considered *tamerlani* a race of *caucasicus* but somewhat paler in color.

Eptesicus nilssonii velox Ognev

Eptesicus velox OGNEV, 1927, J. Mamm., VIII, p. 154.

TYPE LOCALITY.—Vladivostok.

Forearm, 35 mm.; $c-m^3$, 4.8.

Eptesicus nilssonii kashgaricus Bobrinskoj

Eptesicus nilssonii kashgaricus BOBRINSKOJ, 1926, Comptes Rendus Acad. Sci. U.R.S.S., ser. A, p. 97.

TYPE LOCALITY.—Khotan-Tagh, mountains of Russki, Asiatic Russia (near Kashgar).

Forearm, 40.5–41.7 mm.; $c-m^3$, 6.0.

Lighter in color than typical *nilssonii*—dorsally straw yellow, with bases of hairs dark brown, ventrally buffy white.

¹ Cat. Mammals of Western Europe, p. 234.

***Eptesicus nilssonii centrasiaticus* Bobrinskoj**

Eptesicus nilssonii centrasiaticus BOBRINSKOJ, 1926, Comptes Rendus Acad. Sci. U.R.S.S., ser. A, p. 96.

TYPE REGION.—Tibet.

Forearm, 40.5 mm.; $c-m^3$, 5.9.

***Eptesicus nilssonii gobiensis* Bobrinskoj**

Eptesicus nilssonii gobiensis BOBRINSKOJ, 1926, Comptes Rendus Acad. Sci. U.R.S.S., ser. A, p. 96.

TYPE REGION.—Mongolia.

Forearm, 38.5 mm.; $c-m^3$, 5.5

***Eptesicus tauricus* (Ognev)**

Amblyotus tauricus OGNEV, 1927, J. Mamm., VIII, p. 152.

TYPE REGION.—Crimea, Russia.

This is one of the unusually small members of the *nilssonii* group, according to Ognev. Forearm, 30 mm.; $c-m^3$, 4.5. Ognev contrasted it with *tamerlani*.

***Eptesicus walli* Thomas**

Eptesicus walli THOMAS, 1919, J. Bombay Nat. Hist. Soc., XXVI, p. 746.

TYPE LOCALITY.—Basra, Mesopotamia.

"... Allied to *E. pellucens* and *matschiei*. Size rather larger . . . [forearm, 40 mm., against 35.7 and 35.0] . . . $c-m^3$, 5.3."

In a specimen from Nasiriyah, Iraq, F.M.N.H. 43767, the foregoing dimensions are exactly duplicated. This skull, compared with topotypical *nilssonii*, shows several outstanding differences which must be considered to set *walli* off as a full species; the zygoma is *weak* and without any sign of postorbital process, much as in the Australian *pumilus* group. The bullae are so large that they cover the cochleae; no basal pits are developed (they are well developed in *nilssonii*); the internal cingulum of the canine and the regions of protocone and hypocone are more heavily developed than in *nilssonii*. The length in the tooththrow of m^3 is considerably greater (0.95 : 0.8). In the lower jaw p_2 is slightly smaller and slightly moved outward from the dental alignment.

***Eptesicus matschiei* (Thomas)**

Vespertilio matschiei THOMAS, 1905, Ann. Mag. Nat. Hist., (7) XVI, p. 573.

TYPE LOCALITY.—Aden, Arabia.

Forearm, 35 mm.; "... uniform sandy buffy above, rather paler below . . . skull slender, with small braincase, widely expanded zygomata. Muzzle remarkably flattened . . ."

No specimens of *matschiei* and *pellucens* are available. They seem from the descriptions most nearly referable to the *nilssonii* group, but like many other mammals from that part of the world (the southeastern arid belt of Asia) they may have closer relatives in Africa.

***Eptesicus matschiei pellucens* (Thomas)**

Vespertilio matschiei pellucens THOMAS, 1905, Proc. Zool. Soc. London, p. 520.

TYPE LOCALITY.—Ahwaz, Karun River, southwest Persia.

This form was described as a race of *matschiei* but larger and paler. However, its forearm measured only 35.7 mm. against 35.0 of *matschiei*.

***Eptesicus bobrinskoi* Kusjakin**

Eptesicus bobrinskoi KUSJAKIN, 1935, Bull. Soc. Nat. Moscou, XLIV, 7-8, pp. 435, 437.

TYPE LOCALITY.—Brunnen Tjulek in the Aral Sea, Kaza Kum desert (65 km. east of City Aralskoje More), Central Asia.

Forearm, 35; $c-m^3$, 5.4 mm. Fur long, dark brownish black, with tips olive yellow; "underparts whitish." Kusjakin states that this species is nearest *alashanicus*, differing "by greater size and more flattened skull, by the smaller outer and upper incisor . . ."

***Eptesicus alashanicus* Bobrinskoj**

Eptesicus alashanicus BOBRINSKOJ, 1926, Comptes Rendus Acad. Sci. U.R.S.S., ser. A, p. 98.

TYPE REGION.—Mongolia.

Upper outer incisor said to equal upper inner incisor in extent. This indicates a peculiar form, if so, since in all groups of *Eptesicus* seen i^2 is markedly shorter than i^1 . Forearm, 37 mm.

***Eptesicus nasutus* Group (Subgenus *Rhyneptesicus*)**

This group apparently contains only *nasutus* of the Himalayas. Bianchi (1916) erected *Rhyneptesicus* with type species *nasutus* Dobson. No subgeneric description was offered.

Eptesicus nasutus (Dobson)

Vesperugo (*Vesperus*) *nasutus* DOBSON, 1877, J. Asiatic Soc. Bengal, XVI, p. 311.

TYPE LOCALITY.—Sinde, western India.

"Upper inner incisors moderately long and unicuspidate. Outer incisors very short . . . forearm, 1.45 inches (37–38 mm.) . . . no postcalcareal lobes; wings from base of toes . . ."

The "unicuspidate" i^1 , if substantiated, would suggest relationship to *Scoteinus* and allies.

A specimen, M.C.Z. 5147, from Amballa, in the Siwalik Hills, is of moderate size (the forearm, 37 mm.), the skull without "helmet," rostrum broad, supraorbital ridges prominent, and the large rostral depressions anterior to the orbits and one either side of the midline of the rostrum emphasized. Zygoma with anterior portion deep, no sign of postorbital process. Paroccipital processes proportionately short (much shorter than in the *fuscus* group). Incisors and canines greatly worn; m^3 complete, the posterior, middle and anterior commissures measuring 0.8, 0.7, 1.0 mm., respectively; the length of m^3 in the tooth-row, 0.9–1.0 mm.

Lower incisors with i_2 and i_3 slightly and progressively thickened; cusp of p_2 one-third of height of cusp of p_4 .

Eptesicus fuscus Group (Subgenus *Eptesicus*)

Although this group includes the type species of the genus, *fuscus*,¹ it is in reality rather specialized. Besides comprising species of unusually large size, it is characterized by its broad, flat skull and strong development of an occipital "helmet," formed by confluence of lambdoid and sagittal crests, by rather pronounced development of the supraorbital ridges, and by moderate depressions on the rostrum at either side of the midline anterior to the orbits. The teeth are large and strong; i^1 has its posterior cusps almost as well developed as the main cusps; the main cusp of i^2 is about one-half as deep as the posterior cusp of i^1 ; in m^3 the posterior com-

missure is much shorter than the middle commissure, which in turn is very much shorter than the anterior one; their proportions (in *serotinus*) are 0.4 : 0.7 : 1.2 mm. The body of the tooth in the toothrow is correspondingly shortened. In *serotinus* it measures 0.7–0.8 mm. One primitive character retained by members of this group is the well defined postorbital process of the zygoma.

The lower incisors are strongly imbricated, i_2 and i_3 each with a small low posterior cusp set directly behind the middle cusp of the three which form the cutting blade of the tooth.

A number of forms of the large, conspicuous bats of this group have received names. Mainly temperate and subtropical in latitudinal range, the group is circumpolar in distribution. In America it has also representatives in the tropics. It is possible that the entire group represents only one species. The skulls of *fuscus* of the eastern United States and *serotinus* of Europe, as stated earlier, greatly resemble each other.

In the Old World members of the *serotinus* group (or *fuscus* group?) there appear to be two lots of named forms distinguishable by no morphological differences other than size. The larger ones are primarily northern, reaching from Europe through to India, China and Japan. The smaller ones are southern and extend from Roumania to Tripoli, Arabia, Persia and southern Russia.

"LARGE" SECTION

Form	Locality	Forearm in mm.,
<i>serotinus</i>	Western Europe	49–53
<i>turcomanus</i>	Asia Minor	47–54 (Ognev)
<i>mirza</i>	Persia	—
<i>shirazensis</i>	Shiraz, Persia	54
<i>intermedius</i>	Russia	—
<i>pachyomus</i>	India	54
<i>andersoni</i>	Yunnan	53
<i>sinensis</i>	Peking	49
<i>pallens</i>	Kansu	49
<i>brachydigitus</i>	Korea	47.5

"SMALLER" SECTION

<i>sodalis</i>	Roumania	45–48
<i>ognevi</i>	Bucharia	45–46 (Ognev)
<i>isabellinus</i>	Tripoli	42
<i>bottae</i>	Botta, Arabia	40
<i>hingstoni</i>	Bagdad	45

¹ The American members of the group treated by G. M. Allen, 1933, J. Mamm., XIV, p. 150; and by Engels, 1936, Amer. Midl. Nat., XVII, pp. 653–660.

Thomas suggested that *turcomanus* and *mirza* may be synonymous. I can offer no evidence on the matter. *Pachyomus* of India and *andersoni* of Yunnan and Szechwan have skulls which are indistinguishable, though the tips of the hairs in the former (U.S.N.M. 37792 and 37306 from Kashmir) are more strongly marked with whitish than in our good series of *andersoni*. *Pallens* from Kansu appears to be equal or very closely related to *sinensis* from Peking. Possibly *brachydigitus* of Korea belongs here too.

Of the "smaller" bats *isabellinus* and *botatae* should be compared for possible identity. *Hingstoni* is the smallest of the species available to me for examination.

The American species (or races) *fuscus*, *bernardinus*, *miradorensis* and *wetmorei* are members of the *serotinus* group, possibly only subspecies. None of the "small" members is represented in America.

Eptesicus serotinus Section

Eptesicus serotinus (Schreber)

Vespertilio serotinus SCHREBER, 1774, Säugethiere, I, Pl. III; description, *op. cit.*, I, p. 167, 1775.

TYPE REGION.—France.

Miller (1912) gives the forearm as 49–53 mm., c-m³, 7.6–8.2. The species has been described frequently.

Eptesicus serotinus intermedius Ognev

Eptesicus serotinus intermedius OGNEV, 1927, J. Mamm., VIII, p. 152.

TYPE LOCALITY.—Terek region, near Vladikavkaz, Murtasovo Sta., Russia.

Intermediate (in color) between *serotinus* and *turcomanus*.

Eptesicus serotinus turcomanus (Eversmann)

Vespertilio turcomanus EVERS-MANN, 1840, Bull. Soc. Imp. Nat. Moscou, I, p. 21.

TYPE REGION.—". . . Between Caspian and Aral Seas."

" . . . Ashy ferruginous . . . whitish beneath . . . front and sides of muzzle nearly bare . . . teeth quite large . . . ears exceeding half length of head, nearly as broad as long . . . " Length of forearm not given by Eversmann, but Ognev (1927) gives it as 47–54.2 mm.

Eptesicus serotinus mirza (Filippi)

Vesperus mirza FILIPPI, 1865, Note di un Viaggio in Persia nel 1862, p. 342.

I have not seen this work but Filippi is stated in the Zoological Record (II, Mamm., p. 3) to have visited Tiflis and worked along the south shore of the Caspian Sea. Thomas (1919) has suggested that *mirza* is probably synonymous with *turcomanus*.

Eptesicus serotinus shirazensis (Dobson)

Vesperugo shirazensis DOBSON, 1871, J. Asiatic Soc. Bengal, XL, p. 459.

TYPE LOCALITY.—Shiraz, east of Persian Gulf.

Another large form (forearm, 54 mm.), perhaps also close to *turcomanus* and *mirza* but equally likely to belong with *pachyomus* of northwest India.

Eptesicus serotinus pachyomus (Tomes)

Vespertilio pachyomus TOMES, 1857, Proc. Zool. Soc. London, p. 50.

TYPE REGION.—India.

Gray (1866) made of this bat the genus *Pachyomus*, recognized recently (1916) as a subgenus by Bianchi. Dobson (1878) referred *pachyomus* to the synonymy of *serotinus*. I am unable to distinguish generic or even specific characters to separate *pachyomus* from *serotinus*. The bat is larger and heavier than true *serotinus* of western Europe and should be considered a geographical race. It is closely allied to *shirazensis* and *andersoni*.

Forearm, 55 mm.

Eptesicus serotinus andersoni (Dobson)

Vesperugo andersoni DOBSON, 1871, Proc. Asiatic Soc. Bengal, p. 211.

TYPE REGION.—Yunnan.

Forearm, 53 mm. A rather dark-colored serotine with pale tips to hairs, related to but darker than *pachyomus*.

Eptesicus serotinus sinensis (Peters)

Vesperus sinensis PETERS, 1880, Monatsber. Akad. Wiss. Berlin, p. 258.

TYPE LOCALITY.—Peking, China.

Forearm, 49 mm. More nearly the size of true *serotinus*; smaller than the southern races *shirazensis*, *pachyomus* and *andersoni*. Peters gave an illustration of the ear of this race.

Eptesicus serotinus pallens Miller

Eptesicus serotinus pallens MILLER, 1911, Proc. Biol. Soc. Washington, XXIV, p. 53.

TYPE REGION.—Kansu, China.

Miller did not compare *pallens* with *sinensis*. The forearm lengths are identical. But the type region is 500 miles west of Peking, so some racial differences may be discernible.

Eptesicus serotinus brachydigitus Mori

Eptesicus brachydigitus MORI, 1928, Zool. Soc. Japan, p. 291.

TYPE REGION.—Korea.

"Allied to *serotinus* but smaller . . . forearm, 47.5, c-m³, 7.3 mm."

Eptesicus sodalis Section**Eptesicus sodalis** (Barrett-Hamilton)

Vespertilio sodalis BARRETT-HAMILTON, 1910, Ann. Mag. Nat. Hist., (8) V, p. 291.

TYPE REGION.—Roumania.

A small species very like *serotinus*; forearm, 45–48 mm.; c-m³, 7.2 (Miller, 1912).

Eptesicus sodalis ognevi Bobrinskoy

Eptesicus ognevi BOBRINSKOJ, 1918, Fauna and Flora of Russia, XV, p. 12.

I have not seen Bobrinskoy's paper. Ognev (1927) made *ognevi* a race of *sodalis*, giving forearm length as 45–46.6 mm.; c-m³, 6.4–6.7; ". . . color very pale, the back sandy-gray, sometimes with a chestnut tint; below white."

Eptesicus bottae (Peters)

Vesperus bottae PETERS, 1869, Monatsber. Akad. Wiss. Berlin, p. 406.

TYPE LOCALITY.—Botta, Arabia.

Forearm, 40 mm., too short to be related to *serotinus* as indicated by Trouessart. More probably either near *sodalis* and *ognevi* or else derived from an African group.

Eptesicus hingstoni Thomas

Eptesicus hingstoni THOMAS, 1919, J. Bombay Nat. Hist. Soc., XXVI, p. 745.

TYPE LOCALITY.—Bagdad.

Forearm, 45 mm.; ". . . intermediate in size between the small *E. innesi* of Egypt and *E. s. turcomanus* of Persia . . ."

Eptesicus demissus Group

Eptesicus demissus is distinguished by its moderate size and its "helmet" and broad zygomata like those of the *fuscus* group. The zygomata are broken in the type. The basicranial region is conspicuous by having a pair of deep basal pits between the bullae. (In *fuscus* and *serotinus* the pits, though present, are very weak.) In addition, the photograph of the type skull of *demissus* shows the roof of the posterior narial canal and anterior part of the mesopterygoid fossa to be raised high in the skull. M³ is also complete, its length (in the toothrow) being almost 1 mm.

Eptesicus demissus Thomas

Eptesicus demissus THOMAS, 1916, J. Fed. Malay States Mus., VII, p. 1.

TYPE REGION.—Malaya.

". . . Related to *E. pachyotis* [see under *incertae sedis*] . . . color chestnut brown above, lighter below . . . skull with well marked occipital helmet . . . forearm, 42, c-m³, 6.2."

Zygomata very wide; basal pits very deep.

Eptesicus pachyotis Group (Subgenus *Paraepptesicus* Bianchi)

Seemingly only *Vesperugo pachyotis* Dobson is referable to this group. The only descriptive matter related to the thickened basal part of the ear pinna posteriorly, a character of perhaps only specific value. However, Chasen compared *verecundus* with "*pachyotis*" and "*demissus*."

Eptesicus pachyotis (Dobson)

Vesperugo (Vesperus) pachyotis DOBSON, 1871, Proc. Asiatic Soc. Bengal, p. 213.

TYPE LOCALITY.—Khasia Hills, Assam.

Forearm, "1.6 inches" (38–39 mm.). Color dark brown, a lighter shade beneath.

". . . Readily distinguished by the peculiar thickness of the lower half of the outer side of the ear conch . . . minute upper premolar . . . absent. . ."

Most of the additional general characters given by Dobson apply to any species of *Eptesicus*. The type is supposedly

in the Indian Museum, Calcutta, and should be examined carefully for further characters.

Eptesicus pumilus Group¹

The Australian forms of *Eptesicus* are typified by *E. pumilus*. Compared with the conservatively built *E. (Amblyotus) nilssonii*, the braincase is unflattened, the rostrum shorter and palate wider, but the zygomata have been reduced to slender shallow rods with scarcely a sign of post-orbital enlargement. In *i*¹ a well formed posterior cusp can be observed, but *i*² is much reduced, its depth less than half of that of the accessory cusp of *i*¹. Lower teeth much as in *E. (Amblyotus)* but height of crown of *p*₂ about one-half of height of crown of *p*₄.

These tiny bats include several races and are the only representatives of *Eptesicus* in Australia.

Eptesicus pumilus (Gray)

Scotophilus pumilus GRAY, 1841, in Grey, Journals Two Exped. Australia, II, pp. 400, 406.

TYPE LOCALITY.—Yarrundi, New South Wales.

I have photographs and notes of the type skull, B.M. 41.1523 (119c). Back of skull of type broken. Forearm, 31 mm.; c-m³, 4.2.

Eptesicus pumilus caurinus Thomas

Eptesicus pumilus caurinus THOMAS, 1914, Ann. Mag. Nat. Hist., (8) XIII, p. 439.

TYPE REGION.—Kimberley, Western Australia.

Here also we have a photograph of the type skull, B.M. 14.3.9.1 (10473).

This western form is considerably smaller than *pumilus*, with forearm, 30 mm.; c-m³, 3.9.

Eptesicus pumilus darlingtoni G. M. Allen

Eptesicus darlingtoni G. M. ALLEN, 1933, J. Mamm., XIV, p. 150.

TYPE REGION.—Queensland.

¹ *Vespadellus* Iredale and Troughton, 1934, Mem. Australian Mus., VI, p. 95, was proposed without description to include the Australian species of *Eptesicus*. According to the "International Congress, Budapest," p. 1589, it is invalid. Troughton employed the name again in his recent book "Furred Animals of Australia," still without generic description. I am not aware that a description has been published elsewhere.

A paratype, M.C.Z. 29113, is dark brown, above and below, with blackish hair bases. C-m³, 4.9 mm.; forearm, 34. This makes *darlingtoni* the largest of the weakly differentiated races of *pumilus*.

Eptesicus pumilus vulturinus Thomas

Eptesicus pumilus vulturinus THOMAS, 1914, Ann. Mag. Nat. Hist., (8) XIII, p. 440.

TYPE REGION.—Tasmania.

The photograph of the type skull, B.M. 7.1.1.375, shows an animal decidedly larger than either *pumilus* or *caurinus*. Forearm, 33 mm.; c-m³, 4.6.

Eptesicus pygmaeus (Becker)

Vespertilio pygmaeus BECKER, 1858, Trans. Phil. Inst. Victoria, III, pp. 38-40, Pl.

TYPE LOCALITY.—Oakleigh, Danegong ranges, 30 miles north of Melbourne, Victoria.

Becker's plate shows unmistakably the skin, skull and dentition of an *Eptesicus* of the *pumilus* group. The form may be merely a synonym of *pumilus* from New South Wales or it may equal *vulturinus* of Tasmania. Becker did not give the length of the forearm.

Eptesicus, incertae sedis

Besides the three species first treated, *platyrhinus* Dobson, *atratus* Blyth and *verecundus* Chasen, there are a number of names which have been proposed by Japanese authors: *aurijuncus* Mori, *hori-kawai* Kishida, *kobayashii* Mori, *parvus* Kishida, *renanensis* Kishida and Mori (*nomen nudum*) concerning which I have little or no information valuable for the purpose of referring the forms to species groups.

Eptesicus platyrhinus (Dobson)

Vesperugo platyrhinus DOBSON, 1875, Ann. Mag. Nat. Hist., (4) XVI, p. 262.

TYPE LOCALITY.—Unknown.

Marked by "absence of the first minute upper premolar." Apparently an *Eptesicus*.

[Eptesicus atratus (Blyth)]

Nycticejus atratus BLYTH, 1863, Cat. Mamm. Mus. Asiatic Soc. Bengal, No. 96.

TYPE LOCALITY.—Darjeling, India.

Forearm, 1.7 inches (43-44 mm.).

This name is a homonym of *Amblyotus*

atratus Kolenati, 1858, a synonym of *E. nilssonii*. Dobson placed *atratus* Blyth between *discolor* Kuhl (true *Vespertilio*, because a synonym of *V. murinus*) and *pachyotis*.

***Eptesicus verecundus* Chasen**

Eptesicus verecundus CHASEN, 1940, Bull. Raffles Mus., XV, p. 53.

TYPE LOCALITY.—Perak, Malaya.

" . . . General characters of *E. pachyotis* Dobson (not studied) and *E. demissus* Thomas (photograph of skull of type studied) but smaller than both . . . inner incisor much larger [than in *pachyotis*] and tricuspid. Upper canine with small secondary cusp . . . forearm, 34.5 . . . c-m³, 4.8 mm."

Verecundus obviously has peculiarities not seen elsewhere in *Eptesicus*. The type was kept at Singapore.

The following references apply to Japanese names concerning which sufficient data are not available:

E. horikawai Kishida, 1924, Zool. Mag., Tokyo, XXXVI, p. 127; Dobuts. Zasshi, XXXVI, No. 425. Formosa.

E. kobayashii Mori, 1928, Zool. Soc. Japan, p. 292; Annot. Zool. Japon., XI, 4, p. 392 (English). Korea.

E. parvus Kishida, 1932, Lansania, IV, No. 31, p. 2. North Korea.

E. aurijuncus Mori, 1928, Annot. Zool. Japon., XI, 4, p. 393. Korea.

" . . . Ears firmly joined by dermal ridge between their inner margins on forehead . . . forearm, 49; c-m³, 6.8." This description seems inapplicable to *Eptesicus*.

RHINOPTERUS MILLER

Rhinopterus MILLER, 1906, Proc. Biol. Soc. Washington, XIX, p. 85.

Scabrifer G. M. ALLEN, 1908, Bull. Mus. Comp. Zool., LII, p. 46.

GENOTYPE.—*Glauconycteris floweri* DeWinton.

The rostrum is rather flat and broad; the braincase shows no increase in depth such as appears in *Glauconycteris* and *Chalinolobus*; the zygoma is moderately deep but apparently without postorbital processes. In the dentition, i¹ is bifid, the secondary cusp lateral from the primary one; i² is quite small; p² is absent as in *Eptesicus* (and *Glauconycteris*). The lower incisors

are well imbricated, with their outer lobes reduced as in *Rhogeessa*; p₂ is in the tooth-row but much compressed and reduced.

The ears appear much as *Eptesicus*, and the pelage is a pale straw color with dark bases.

Allen lists three species, two from Anglo-Egyptian Sudan, one from South Africa.

LAEPHOTIS THOMAS

Laephotis THOMAS, 1901, Ann. Mag. Nat. Hist., (7) VII, p. 460.

GENOTYPE.—*Laephotis wintoni* Thomas.

This genus is in many respects a smaller copy of *Histiotus*. It is less specialized. The ears and bullae, although larger than those of *Eptesicus*, do not attain the extreme size seen in *Histiotus*. In the teeth i¹ is bifid as in both *Eptesicus* and *Histiotus*; m³ is unreduced. The dorsal profile of the skull is high as in *Histiotus*. The palate is very strongly domed.

Laephotis is known only from Africa.

HISTIOTUS GERVAIS

Histiotus GERVAIS, 1855, Exped. Comte de Castelnau, Zool. Mamm., p. 77.

GENOTYPE.—*Plecotus velatus* I. Geoffroy.

Derived from the line leading to *Eptesicus* and showing the same dental formula, but with i² even more reduced. The last molar is unreduced.

In the skull the rostrum and temporal regions are rather high, combining to form a gently arching profile leading to the braincase.

The outstanding specialization of *Histiotus* occurs in the ears. Both external and skeletal parts are greatly enlarged. The very large, forward projecting pinnae are united by a lower frontal band. The width of each bulla is more than twice their distance apart.

Further distinctive characters of *Histiotus* are the large size of the anteorbital foramina and of the eyes.

Histiotus is a purely American offshoot of the *Eptesicus* stem and is found chiefly in the warmer latitudes. I have taken it in Ecuador at 8000 feet. Several species have been named.

Nycticeini

All genera¹ of this division, named after *Nycticeius*, possess the common character that their upper incisor tooththrows are strongly modified from the bicuspid condition of *Myotis*, *Pipistrellus* and *Eptesicus*. The outer incisor is obsolete; the inner one usually lacks the supplementary cusp and is simply conical. There

are *Nycticeius* in America and *Scoteinus* in Asia. A small American offshoot culminates in *Rhogeessa* and *Baeodon*. In Asia and Africa considerable specialization has resulted in the production of *Scotophilus* and allies, and *Otonycteris*. The nycticeine genera are shown in relation to each other diagrammatically (Fig. 5).

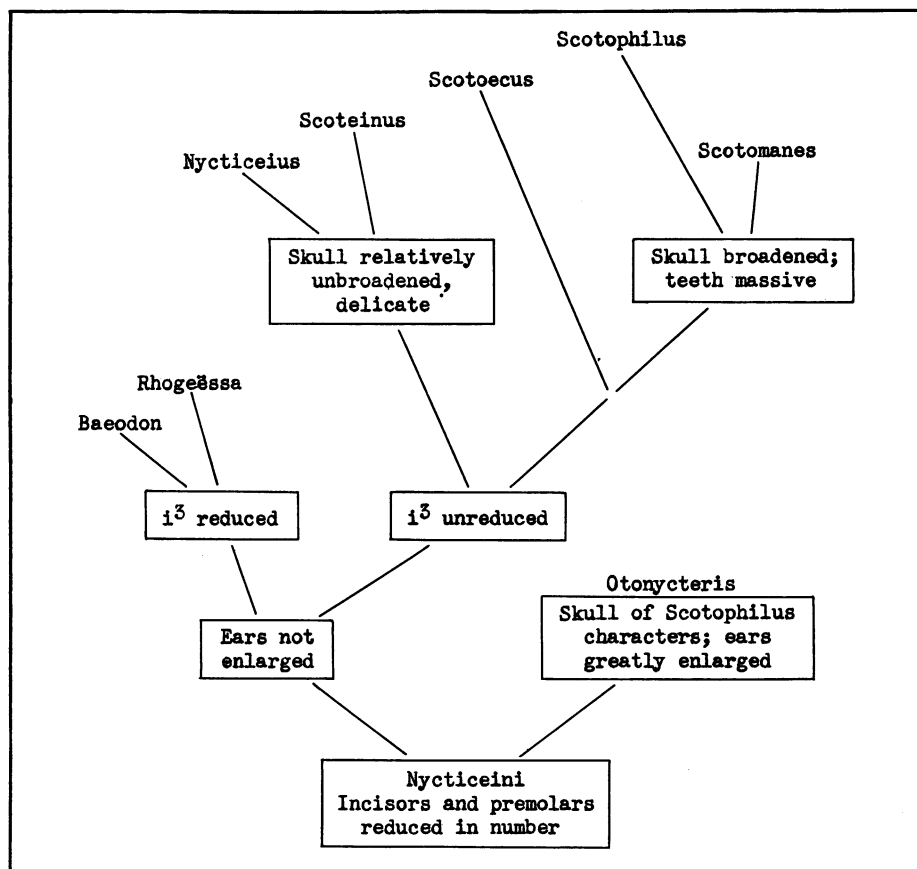


Fig. 5. Suggested phylogeny of the nycticeine genera. See also Fig. 1.

is a strong resemblance between the incisor teeth of Australian *Scoteinus* and those of the nyctophiline bats of that country. P_2^2 are invariably absent; m^3 often much reduced.

Less specialized members of this division

¹ Except *Scoteinus pallidus*. The status of *Scoteinus*, which may be diphyletic, needs clarifying.

SCOTEINUS DOBSON

Scoteinus DOBSON, 1875, Proc. Zool. Soc. London, p. 371; 1876, Monogr. Asiatic Chiroptera, pp. 120, 123-124; 1878, Cat. Chiropt. Brit. Mus., pp. 257, 262-264.

GENOTYPE.—*Nycticeius emarginatus* Dobson (designated by Miller, 1907; Palmer, 1904, indicated no previous selection of the type species).

In this genus, as in *Hesperoptenus*, we may be dealing with a polyphyletic group. Unfortunately there appears to be no Indian material in our collections which is undisputably referable to *S. emarginatus*, the type. One skull from India, A.M.N.H. 54420, labeled *S. pallidus*, has m^3 unreduced and so does not come within Miller's (1907) definition. But that definition, it will be noted, was based upon the Australian *balstoni* and *greyii* and the African *schlieffenii*. Actually, until we have a good description of the skull of the genotype *emarginatus* we cannot correctly understand *Scoteinus*.

Provisionally *Scoteinus* may be considered a less specialized genus coming from the stem which also produced the more specialized *Scotophilus*. Indication of affinities between the two genera is shown by the character of the upper incisors.

Of the Australian species one, *rüppellii*, is strongly divergent. It is a large species (as large as the Indian *emarginatus*) with forearm, 52–53 mm. It offers only one special character, the unusual length of the postpalatal spine. The remaining Australian species fall into three groups: larger species with broadened mastoid processes and prominent supraorbital ridges, *inflatus* and *orion*; smaller forms with mastoids less prominent and the supraorbital eminences virtually obsolete, so that the margin of the orbital fossa passes back smoothly from the lacrimal region to the intertemporal constriction, *balstoni*, *aquilo*, *caprenus*; and a considerably smaller series from Papua and north Queensland, *sanborni* and *greyii*.

All of these *Scoteinus*, including *rüppellii*, are distinguished from the Indian *pallidus* by the fact that in them m^3 is more reduced, though far from reaching the extreme condition seen in *Scotophilus*. The lengths of the two posterior commissures of the Z-pattern (in *orion*) compared to that of the anterior one is approximately 0.6, 0.7 : 1.1; whereas in *pallidus* m^3 is scarcely reduced at all, and the commissures measure 0.8, 0.8 : 1.0. The length of the body of the tooth (m^3) in the tooththrow is 0.7 mm. in *orion* and in *pallidus* 1.0. It becomes clear that, in this respect, all Australia-

lian species are more specialized than is the Indian *pallidus*. Whether *emarginatus*, the genotype, conforms to this situation may be shown eventually, when the skull of the type specimen has been studied.

Scoteinus emarginatus (Dobson)

Nycticejus emarginatus DOBSON, 1871, Proc. Asiatic Soc. Bengal, p. 211.

Scotophilus emarginatus DOBSON, 1875, Proc. Zool. Soc. London, p. 371; 1876, Monogr. Asiatic Chiroptera, pp. 123–124; 1878, Cat. Chiropt. Brit. Mus., p. 262.

TYPE LOCALITY.—“India, precise locality unknown. Type in the collection of the Indian Museum, Calcutta.”

Dobson accompanied his first description of *emarginatus* with the words “subgenus *Nycticejus*: premolars, $\frac{1-1}{2-2}$, wing membranes attached to base of toes.” His description of *N. emarginatus* was based otherwise upon external characters. The hair “above, tricolored, at the base dark ferruginous brown, then buff, the tips light yellowish brown; beneath, dark ferruginous brown at the base, the remaining portion buff . . . forearm, 2.2 inches (54 mm.).”

In his monograph (1876) he added a line drawing of the head of *emarginatus*. His remarks in the “Catalogue” (1878) added nothing new.

Actually the skull of *emarginatus* remains undescribed. We must accept Dobson's indirect statement that p^2 is absent. Nevertheless it is desirable that the type be restudied so that the characters of the type skull may be clearly defined.

Scoteinus rüppellii (Peters)

Nycticejus rüppellii PETERS, 1866, Monatsber. Akad. Wiss. Berlin, p. 21.

TYPE LOCALITY.—Sydney, New South Wales (by Peters stated “Sydney, West Australia”).

“ . . . Color dark rust red, beneath paler . . . Forearm, 52 mm. . . ” This large Australian species is wholly unlike any other species of that continent. Forearm, 52 mm.

Scoteinus pallidus (Dobson)

Scotophilus pallidus DOBSON, 1876, Monogr. Asiatic Chiroptera, Appendix D, p. 186.

TYPE LOCALITY.—Mian Mir, near Lahore, Punjab, northwest India.

"... Teeth as in *S(cotophilus) temminckii* [i.e., with i^2 and p^2 absent] . . . Fur, integuments of the body, wings and interfemoral membrane pale buff throughout. . . . Forearm, 1.4 inches (35–36 mm.)."

Specimens from Kooloo Valley, India, exist in American museums (M.C.Z. 5337, 5341; A.M.N.H. 54419–20) which agree well with the description of *pallidus*. Forearm, 34–36 mm.; rostrum broad, supraorbital tubercles small; zygomata weak; anteorbital foramina not enlarged; sagittal crest undeveloped (back of braincase broken away); dentition of type of *Scotophilus*, i^2 and p^2 obsolete, but differing in (1) unreduced pattern of m_3^3 , (2) lower incisors unimbricated and almost equally thin, and (3) p_2 , though the height of its crown is only one-third of that of p_4 , is completely in the toothrow, uncrowded, and shows the crown outline very slightly compressed laterally.

Before we can feel sure of the identification the type skull (in Indian Museum) must be examined.

Obviously, from its much smaller size, *pallidus* must be entirely different from *emarginatus*.

Scoteinus noctulinus (I. Geoffroy)

Vespertilio noctulinus I. GEOFFROY, in Belanger, 1834, Voyage aux Indes-Orientales . . . Zoologie, p. 92, Pl. III.

TYPE REGION.—Bengal.

"... Head and body above reddish fawn, beneath clear fawn . . . interfemoral membrane partly hairy . . . forearm, 1 inch, 4 lines (34 mm.) . . . muzzle naked. . . ."

It appears probable that *noctulinus* is related to *pallidus*. It is far too small to equal *Scotophilus temminckii*, in whose synonymy it has usually been placed.

Scoteinus influatus Thomas

Scoteinus influatus THOMAS, 1924, Ann. Mag. Nat. Hist., (9) XIII, p. 540.

TYPE LOCALITY.—Prairie, central south Queensland.

"... More nearly approaching . . . *balstoni* . . . forearm, 39 mm.; condylo-canine length, 15; zygomatic breadth, 11.5; mastoid breadth, 9.4; maxillary toothrow, 6 . . .

perhaps the eastern representative of *S. balstoni*. . . ."

Scoteinus orion Troughton

Scoteinus orion TROUGHTON, 1937, Austral. Zool., VIII, 4, p. 277.

TYPE LOCALITY.—Sydney, New South Wales.

"Allied to *balstoni* . . . forearm, 34.5–36.3 . . . ear definitely smaller than in *balstoni*."

Scoteinus balstoni Thomas

Scoteinus balstoni THOMAS, 1906, Proc. Zool. Soc. London, p. 472.

TYPE LOCALITY.—Hawknest, Laverton, southwest Australia.

"Allied to *greyii*, hair bicolor instead of unicolor . . . pale brown . . . Below, hairs dark at base . . . tips pale pinkish buff . . . upper incisors standing rather farther from canines (than in *greyii*) . . . forearm, 36 mm. (4 others 34–35) . . . zyg. br., 10.1; $c-m^3$, 5.2 . . ."

Scoteinus orion aquilo Troughton

Scoteinus orion aquilo TROUGHTON, 1937, Austral. Zool., VIII, 4, p. 278.

TYPE REGION.—East coast of Queensland, Bowen to Rockhampton.

Compared with *orion*, "size generally smaller . . . skull of similar outline but smaller proportions . . . cheek-teeth rows decidedly shorter . . . forearm (holotype), 34.5; zygomatic breadth, 10.4 . . . $c-m^3$, 5.1 . . . the longer ear, larger dimensions and more robust skull leave no doubt of its distinction from *greyii*. . . ."

Scoteinus balstoni caprenus Troughton

Scoteinus balstoni caprenus TROUGHTON, 1937, Austral. Zool., VIII, 4, p. 279.

TYPE LOCALITY.—Roebuck Bay, Kimberley region, northwest Australia.

"Size smaller generally than southern *balstoni* . . . fur not strongly bicolored . . . forearm, 32.5–34 mm. . . color . . . apparently a dull drabby or more olivaceous brown (than *balstoni*) . . . lower incisors more crowded, distorted, and less distinctly trilobate than in true *balstoni* or *greyii*; first lower premolar smaller and more rounded. . . ."

Scoteinus greyii (Gray)

Scotophilus greyii GRAY, 1843, List Mamm. Brit. Mus., p. 30; 1844, Voyage Erebus and Terror, Pl. xx.

TYPE LOCALITY.—Port Essington, Northern Territory, Australia.

"... Back and beneath brighter chestnut..." (1843).

The forearm length of the female depicted on Pl. xx (1844) is 34 mm. However, no statement is made that the picture is of natural size. I have not seen the text which this plate accompanies.

Thomas (1906) designated specimen "b" of Pl. xx type of *S. greyii*.

The skull of the type, B.M. 42.8.17.12, is badly smashed, but its toothrows are intact and measurable (c-m³, 5.2 mm.).

Scoteinus sanborni Troughton

Scoteinus sanborni TROUGHTON, 1937, Austral. Zool., VIII, p. 280.

TYPE LOCALITY.—East Cape, Papua.

Compared chiefly with *greyii*, "ear decidedly smaller and forearm and pes longer... forearm, 32–33.3 mm...."

NYCTICEIUS RAFINESQUE

Nycticeius RAFINESQUE, 1819, Journ. de Physique, LXXXVIII, p. 417.

GENOTYPE.—*Vespertilio humeralis* Rafinesque.

The American *Nycticeius* was the first of the vespertilionid group of genera characterized by simplified first upper incisors to be recognized. Immediately afterward came *Scotophilus* of the oriental tropics. It was long usual for writers describing bats of this group in India and adjoining areas to refer them to Rafinesque's genus.

Nycticeius, though its relationship to *Scotophilus* and allies is demonstrated by the loss of i² and by reduction of i¹ by loss of the posterior cusp to a simple, peg-like tooth, is far less specialized. The skull shows none of the extreme broadening of the rostrum and lacrimal region or the enlargement of the supraorbital tubercles usually found in the oriental representatives of the group of species. The zygoma is weak.

Compared with Australian *Scoteinus* less dissimilarity may be noted than in the case of *Scotophilus*. The skull of *Nycticeius* is unbroaderened across the rostrum and lacks

all trace of the posterior sagittal crest of Australian *Scoteinus*.

Nycticeius is represented by the single American species *humeralis*.

RHOGESSA H. ALLEN

Rhogeessa H. ALLEN, 1866, Proc. Acad. Nat. Sci. Philadelphia, p. 285.

GENOTYPE.—*Rhogeessa tumida* H. Allen.

"Like *Nycticeius*, but outer lobe of all three lower incisors obsolete and inner lobe practically absent also in outer tooth...."

Known only from tropical America.

Rhogeessa and its derivative *Baeodon* constitute a primitive, isolated American offshoot of the nycticeine bats of Asia. Contrary to the usual trend in the Vespertilioninae, i₃ in this genus and the next becomes progressively smaller.

BAEODON MILLER

Baeodon MILLER, 1906, Proc. Biol. Soc. Washington, XIX, p. 85.

GENOTYPE.—*Rhogeessa allenii* Thomas.

Specialized offshoot of the line leading to *Rhogeessa*; "... reduction of the outer lower incisor carried so far that the tooth has become a mere functionless spicule less than one-twentieth as large as the first or second incisor, nearly concealed beneath cingulum of canine...."

R. allenii was taken first in Mexico.

SCOTOECUS THOMAS

Scotoecus THOMAS, 1901, Ann. Mag. Nat. Hist., (7) VII, p. 263.

GENOTYPE.—*Scotophilus albofuscus* Thomas.

Exclusively African in distribution. Intermediate between *Nycticeius* and *Scoteinus* on the one hand and *Scotophilus* and *Scotomanes* on the other. Zygomatic and rostral widths exaggerated. Anteorbital foramen enlarged as in *Scotophilus*. Teeth much as in *Nyctophilus*.

G. M. Allen listed eight species.

SCOTOPHILUS LEACH

Scotophilus LEACH, 1821, Trans. Linn. Soc. London, XIII, pp. 69, 71–72.

Pachyotus GRAY, 1831, Zool. Miscellany, I, p. 38 (part); 1838, Mag. Zool. Bot., II, p. 498.

GENOTYPE.—*S. kuhlii* Leach (for both generic names). See remarks on status of *kuhlii*.

Name *Scotophilus* not preoccupied by

Scotophila Hübner.¹ *Nycticeius*, now restricted to American bats, was used commonly for Asiatic species by authors during the 19th century. *Scotophilus* has been restricted since Dobson wrote in 1878. At that time it included as subgenera, *Scotophilus*, *Scoteinus* and *Scotomanes*.

Pachyotus Gray included *Nycticeius* Rafinesque, 1819, with type *N. humeralis* from the United States, and *Scotophilus* Leach, 1821, with type *S. kuhlii*. Gray (1831) wrote, "The bats, the Vespertiliones of Geoffroy, might for convenience be divided into three genera, the true bats, *Vespertilio*, with thin ears and membranes and a hairy face, the *Pachyotus* with thick ears and membranes and bald swollen cheeks, including the genera *Nycticejus* and *Scotophilus*, and the hairy-tailed species of America (*Lasiurus*)."² And again (1838) under *Scotophilus*, "upper surface of interfemoral membrane slightly covered with hair (*Pachyotus*)," followed by two species *Vespertilio polythrix* I. Geoffroy and *Scotophilus levis* I. Geoffroy from Brazil.³ The descriptions of these bats form part of a paper on the Vespertilionidae of Brazil. *Polythrix* was apparently a species of *Dasypterus*; *levis* perhaps a *Myotis*.

Dobson, when writing his monograph,⁴ divided *Scotophilus* into three subgenera: *Scotophilus*, *Scoteinus* and *Scotomanes*. All have since been given generic standing. In the restricted *Scotophilus* Dobson included only *temminckii* (Java) and *borbonicus* (Africa).

The next year⁴ he dealt with *temminckii* and "subspecies *heathii*," showing woodcuts of the heads of both. Two years later⁵ he treated *temminckii*, with variety *heathii*, *borbonicus* (Africa) and *gigas* (Africa). Under *temminckii* he grouped a number of alleged synonyms: *kuhlii*, *belangeri*, *castaneus*, *luteus*, *flaveolus* and *fulvus*.

Scotophilus is specialized in regard to certain characters of the skull. In addition

to the shortened face, present in *Pipistrellus*-like bats, it has developed the posterior part of the sagittal crest, together with the lambdoid crests, to form a distinct helmet such as one seen in *Taphozous*; the zygomata are weak; the anteorbital foramen on the face is unusually large—larger than any other Vespertilionid known to me except *Scotoecus*.

The dentition is massive and crowded: i^1 unicuspid; i^2 and p^2 obsolete; m^3 greatly modified by shortening in the toothrow and comprise only protocone, paracone and parastyle.

Lower incisors thickened, much imbricated, i_{1-2} trilobate, the inner and middle lobes higher than the outer, i_3 as i_2 but with small anterior and posterior cusps added which rise only slightly above the cingulum; lower canine with large cingulum heel extending backward, tending to embrace the inner wall of p_2 and touch p_4 ; p_2 compressed between c and p_4 ; talonid of m_3 much reduced in conformity with condition of m^3 .

Status of *Scotophilus kuhlii* Leach

Scotophilus kuhlii LEACH, 1822, Trans. Linn. Soc. London, XIII, p. 72.

TYPE LOCALITY.—Unknown.

Peters and Dobson have explained that the incisive formula $\frac{4}{5}$ given by Leach related to milk dentition in the extremely young type specimen. Presumably the molar (plus premolar) formula $\frac{8}{6}$, instead of $\frac{8}{10}$, and the canine peculiarities are explainable in the same way.

The only specific character (and one without value in systematic work on this species) given by Leach was the color, "ferruginous, ears, nose and wings fuscous."

Dobson, in the monograph cited, claimed that the specific identity of the animal which Leach named *Scotophilus kuhlii* could not be determined. Peters had written earlier⁶ that he regarded the type as equal to *temminckii* Horsfield, that it retained the milk incisives, and its forearm measured only 41 mm. I have seen the types of neither.

In more recent times, and in spite of Peters' expressed opinion, authors have

¹ G. M. Allen, 1939, Bull. Mus. Comp. Zool., LXXXIII, p. 99.

² 1824, Annales des Sciences Naturelles, (1) III, pp. 440-447.

³ 1875, "On the Genus *Scotophilus* . . .," Proc. Zool. Soc. London, pp. 368-373.

⁴ 1876, Monogr. Asiatic Chiroptera, pp. 119-125.

⁵ 1878, Cat. Chiropt. Brit. Mus., pp. 256-266.

⁶ 1866, Monatsber. Akad. Wiss. Berlin, p. 679.

come to apply *kuhlii* to the larger forms in which the forearm exceeds 54 mm. I can find no more justification for this than I can for Peters' conclusion, and until someone has measured the size of the teeth in the juvenal type and checked the results against teeth of known "large" or "small" *Scotophilus*, it will be best to pass by *kuhlii* and use the names *heathii* and *temminckii*.

In the list following the *heathii* and *temminckii* groups are separated. It will be seen that the smaller forms appear to have a slightly different total range from the larger. A bat of the *temminckii* group occurs on Formosa.

LIST OF NAMED FORMS OF ASIATIC *Scotophilus*
Forearm
in mm.

Form	Locality	Forearm in mm.
<i>temminckii</i>		
<i>wroughtoni</i>	Peninsular India	50
<i>gairdneri</i>	Central Siam	48
<i>consobrinus</i>	Hainan	52
<i>castaneus</i>	Malacca	50
<i>temminckii</i>	West Java	51
= <i>fulvus</i>		
<i>solutatus</i>	East Java	54-55
<i>collinus</i>	Bali	48-54
<i>panayensis</i>	Philippines	48
<i>heathii</i>		
<i>heathii</i>	South peninsular India	64-69
<i>belangeri</i>	South peninsular India	54
<i>luteus</i>	Coromandel- Bengal	59
<i>flaveolus</i>	Continental India	54-56.5
<i>insularis</i>	Hainan, South China	64-67
<i>celebensis</i>	Celebes	62½-64

***Scotophilus temminckii* Horsfield¹**

(References under subspecies.)

A term used here to include a number of named races and color forms of "small" *Scotophilus* with forearm 54 mm. or less. Anatomically almost identical to *heathii* (which by Dobson was considered a subspecies of *temminckii*) but with the occipital "helmet" less developed. Anterior lower premolar invariably compressed longitudinally.

Distribution from Bombay to Formosa, Philippine Islands, Java and Bali. Seemingly absent from Celebes.

¹ See Sody, 1928, *Natuurk. Tijdschr. Ned. Ind.*, XC, pp. 271-272, in which he reviewed *Pachyotus temminckii*.

The races and synonyms are presented from west to east and north to south, beginning at India and ending at Philippines.

Scotophilus temminckii wroughtoni

Thomas

Scotophilus wroughtoni THOMAS, 1897, J. Bombay Nat. Hist. Soc., XI, p. 275.

TYPE LOCALITY.—Kim, Surat District, north of Bombay, western India.

"Fur . . . uniform brownish above, without any tinge of yellowish, the hairs white at their bases and gradually darkening to brownish tips . . . under surface very pale fawn, almost white . . . forearm, 50 mm. . ."

This bat was compared with "*kuhlii*" and *emarginatus* (a *Scoteinus*).

The photograph of the type skull shows a slightly narrower zygomatic expanse than that of true *temminckii*. Pelage paler brown dorsally, and ventrally buffy white. All over peninsular India and common on Ceylon where Phillips² records it from the drier parts of the island. Its pallid tones give it the appearance of an arid country bat.

***Scotophilus temminckii gairdneri* Kloss**

Scotophilus gairdneri KLOSS, 1917, J. Nat. Hist. Soc., Siam, II, p. 284.

TYPE LOCALITY.—Paknambo, central Siam.

"About size of *S. castaneus* and *wroughtoni* . . . rostrum narrower than in *S. castaneus* . . . above bister, the head darker. . . Below pale drab, the base of the fur whitish. . . In its pale underparts this bat bears some resemblance to *S. wroughtoni* . . . but it has the upper pelage much darker. . ."

This a small species with forearm only 48 mm. I have seen no undoubted specimens.

Scotophilus temminckii consobrinus

(Allen)

Scotophilus castaneus consobrinus J. A. ALLEN, 1906, Bull. Amer. Mus. Nat. Hist., XXII, p. 485.

TYPE LOCALITY.—Hainan Island, South China.

Of this form we have the type and numerous paratypes. I find myself unable to distinguish between these bats and the

² 1935, *Manual of Mammals of Ceylon*, p. 124.

large series we now have of true *temminckii* from Java. This similarity supports to some extent my idea that intervening forms, *gairdneri*, *castaneus*, *panayensis*, are merely weak variant races or even individual variants from a single widely dispersed species.

Scotophilus temminckii castaneus
(Horsfield)

Nycticejus castaneus HORSFIELD, 1851, Cat. Mamm. Mus. East India Comp., p. 38.

TYPE REGION.—"Singapore, Penang, Malay Peninsula and Islands."

"... Characteristic feature . . . a uniform deep chestnut color of the body, above and beneath . . . head blackish. Size of *temminckii*."

A cotype of *castaneus*, a female, labeled "Malacca," B.M. 79.11.21.11b, has the forearm 50.5 mm. in length.

In this case too I am constrained to the belief that *castaneus* of the Malacca region is merely a rufescent phase of *temminckii*.

Bonhote,¹ comparing *castaneus* of Malaya with "*kuhlui*," gave the "average length of forearm . . . 50.7 (49–52)." These measurements correspond exactly with those of *temminckii* given by Sody in 1936 and measured on our series of specimens from Cheribon, Java.

Scotophilus temminckii temminckii
(Horsfield)

Vespertilio temminckii HORSFIELD, 1824, Zool. Researches in Java.

TYPE LOCALITY.—Java.

Color "pure dark brown above, grayish brown, somewhat dusky beneath, with a rufous tint extending laterally from the nose to the tail."

No significant measurements were offered by Horsfield.

Temminck² recognized under "*Nycticejus temminckii*" five varieties in more than 100 specimens taken from "Java, Sumatra, Borneo, Banda and Timor."

In the Archbold Collections is a series of twenty-three specimens of *temminckii*, all from Cheribon, Java. Our forearm measurements extend from 47–51 mm.

[*Scotophilus fulvus* Gray]

Scotophilus fulvus GRAY, 1843, List Mamm. Col. Brit. Mus., p. 31.

TYPE LOCALITY.—Java.

Gray's terse description serves little except to validate the name *fulvus*:

- "The Foxy Noctule. *Scotophilus fulvus*:
a. Yellowish brown beneath. Java.
b. Yellowish beneath. Java. . . .
c. India, Madras."

Since descriptive matter is provided only for Javanese specimens, the type locality may be restricted to Java. *Fulvus* then becomes a probable synonym of *temminckii*.

***Scotophilus temminckii collinus* Sody**

Scotophilus temminckii collinus SODY, 1936, Natuurk. Tijdschr. Ned. Ind., XCVI, p. 48.

TYPE LOCALITY.—Bali.

"Balinese (and East Javanese) . . . average slightly smaller than the typical race [*temminckii*]. . . ."

Sody gave: forearm, 48–54 mm.; greatest length of skull, 18.4–19.3; upper tooththrow (+ c), 6.5–6.9. He compared *collinus* from east Java and Bali with *temminckii* from west Java, giving for the latter the measurements: forearm, 50–56 mm.; greatest length of skull, 18.0–19.7; upper tooththrow, 6.6–7.2.

In the Archbold Collections is a series of fourteen specimens from Bali. I cannot agree with Sody that they average smaller than our material from Cheribon, Java.

***Scotophilus temminckii solutatus* Sody**

Scotophilus castaneus solutatus SODY, 1936, Natuurk. Tijdschr. Ned. Ind., XCVI, p. 49.

TYPE LOCALITY.—Tjandiroto, east Java.

In this race Sody claimed superior size over *castaneus* of Malacca and true *temminckii*. He showed (with rather few specimens) that whereas size gradient ran upward in *temminckii* from west to east, it ran downward from west to east in *solutatus*. On this somewhat tenuous basis he claimed specific rank for *castaneus*.

In two strongly rufescent specimens, M.C.Z. 12909 and 12919, from Pelahoean Ratoe, Java, the forearm lengths are 55 mm.

¹ 1900, Proc. Zool. Soc. London, pp. 191–192.

² 1835, Monogr. Mamm., II, p. 149.

Scotophilus temminckii panayensis Sody

Scotophilus panayensis SODY, 1928, *Natuurk. Tijdschr. Ned. Ind.*, LXXXVIII, p. 90.

TYPE LOCALITY.—Panay Island, Philippines.

Forearm only 48 mm. Virtually no description offered. I have no Philippine specimens. Taylor referred such material to *temminckii*, but he seems not to have come across Sody's name *panayensis*, which was applied to four animals which the latter had never seen, said by Elliot to have forearms only 48 mm. in length. Those animals were females. The low limit for length of forearm in Javanese *temminckii*, according to Sody,¹ is 50 mm.

Miss Lawrence² mentioned specimens of larger size than the type of *panayensis*. She gave the forearm length as 48 to 50 mm. The unusual shortness of the caudal vertebrae, mentioned by her, may prove to be a useful character.

Scotophilus heathii (Horsfield)

Nycticeus heathii HORSFIELD, 1831, *Proc. Zool. Soc. London*, p. 113.

TYPE LOCALITY.—Madras, India.

" . . . Considerably larger than the Javanese species [*temminckii*], from which it differs also remarkably in its coloring . . . covered with short . . . silky hair . . . color . . . above is brown with a tawny hue; underneath fulvous with a slight tendency to gray . . ."

Larger bats (forearm, 64–69 mm.) of the Indian peninsula, generally colored yellowish brown, slightly paler beneath. In the skulls I can find no difference from the skulls of *temminckii*, other than those caused by their greater size. In both species p_2 is compressed longitudinally in the lower toothrow. Specimens from Ceylon appear to be consistently darker colored than those from the mainland. Phillips (1935) states of the Ceylonese race "color exceedingly variable, commonly dark yellowish bronze-brown above . . . another variety . . . deep chestnut Between these extremes all variations of color are to be found."

This large species is apparently unpre-

sented in Sumatra, Java, Borneo and Philippines.

Scotophilus heathii belangeri

(I. Geoffroy)

Vespertilio belangeri I. GEOFFROY, in Belanger, 1834, *Voyage aux Indes-Orientales . . . Zoologie*, pp. 87–92.

TYPE LOCALITY.—Found commonly in the towns near Pondicherry, Coromandel Coast, India.

"Body fawn or white, yellowish beneath, maroon olive or brown above. . . . Length of forearm, 2 inches (54–55 mm.)." This form appears to be annectant in size between *heathii* and *temminckii*. The description almost fits that of *wroughtoni*. The type skull is probably lost.

[Scotophilus luteus (Blyth)]

Nycticeus luteus BLYTH, 1851, *J. Asiatic Soc. Bengal*, XX, p. 157; 1852, *J. Asiatic Soc. Bengal*, XXI, p. 345.

TYPE REGION.—"Bengal: Coromandel" (eastern peninsular India).

"Length (of a large male) $5\frac{5}{8}$ inches . . . tail . . . $2\frac{1}{4}$ inches . . . forearm, $2\frac{1}{4}$ in. (57 mm.) . . . entire length of skull is barely 1 in., inclusive of the greatly developed sagittal crest" (1851, p. 157).

" . . . Underparts of *luteus* being of a much more rufescent hue than those of . . . *temminckii*. The length of forearm in *temminckii* is very regularly 2 inches (51 mm.), in *luteus* $2\frac{3}{8}$ inches (58 mm.), in *heathii* $2\frac{3}{4}$ inches (69 mm.)." (1852, p. 346).

Luteus appears to be a synonym of *belangeri* I. Geoffroy.

[Scotophilus flaveolus (Horsfield)]

Nycticeus flaveolus HORSFIELD, 1851, *Cat. Mamm. Mus. East India Comp.*, p. 37.

TYPE REGION.—"Many parts of Continental India."

Horsfield listed five specimens: A, "bright rufous beneath"; B, yellowish gray beneath; C, pale. D and E were not described. "This species represents the former [*temminckii* of Java] on the continent of India, being fully one-third larger. The color varies considerably in different individuals, being dark brown above, in different shades, and rufous or yellowish underneath."

¹ 1936, *Natuurk. Tijdschr. Ned. Ind.*, XCVI, p. 48.
² 1939, *Bull. Mus. Comp. Zool.*, LXXXVI, pp. 58–59.

We have photographs of the skulls of two of Horsfield's cotypes, B.M. 60.5.4.31-32. Both are marked "India." In both, p_2 is strongly compressed longitudinally in the tooththrow. The forearm length of two cotypes, B.M. 60.5.4.30 and 32, is 56.5 and 54 mm., respectively.

The type locality of *flaveolus* should be restricted. Provisionally I treat it as synonymous with *belangeri* and *luteus*. As in *belangeri*, the relative shortness of the forearm suggests the *temminckii* group, but the large size of the teeth (see table) indicates *heathii*.

than those from South India." The rostral sinus in *insularis* is deeper than the sinus in Ceylonese specimens of *heathii*.

Forearm, 60-62 mm.

Scotophilus heathii celebensis Sody

Scotophilus celebensis SODY, 1928, Natuurk. Tijdschr. Ned. Ind., LXXXVIII, p. 90.

TYPE LOCALITY.—Toli-toli, Celebes.

Forearms of three specimens, $62\frac{1}{2}$ -64 mm. Very weak description.

I have included *celebensis* with the *heathii* division chiefly because of its great size compared with *temminckii* of nearby

DETAILED MEASUREMENTS OF DENTITION IN *Scotophilus*, TENDING TO SHOW DISTINCTION BETWEEN *heathii* (= *kuhlii*?) GROUP AND *temminckii* GROUP

	Forearm	C-m ³	Cingulum length lower canine	Distance apart of lower canines	Width, m ⁴	Width, m ³	Crown dimensions, p ₂
A.M.N.H. 83449 Kashmir	58	8.0	1.0	1.5	2.5	2.5	0.9 × 1.0
A.M.N.H. 44544 Salween River	61	7.8	1.2		2.3	2.6	0.6 × 1.2
A.M.N.H. 54796 Burma (red)		7.6	1.3	1.7	2.3	2.5	0.7 × 1.0
26787 Hainan (<i>insularis</i>)	61	8.4	1.5	1.5	2.7	2.8	0.7 × 1.4
26784 Hainan (<i>insularis</i>)	66	8.7	1.6	1.9	2.9	2.9	0.8 × 1.3
M.C.Z. 27519 Ceylon (<i>heathii</i>)	63	8.0	1.4		2.4	2.6	0.7 × 1.2
M.C.Z. 27518 Ceylon (<i>heathii</i>)	63	8.0	1.4	1.9	2.5	2.7	0.6 × 1.2
M.C.Z. 12909 Java (<i>solutatus</i>) (red)	55	7.1	1.1	1.4	2.2	2.2	0.5 × 1.0
A.M.N.H. 101869 Java (<i>temminckii</i>) (brown)	48	6.5	1.2	1.3	2.1	2.1	0.6 × 0.9
A.M.N.H. 107452 Bali (<i>collinus</i>) (brown)	49	6.9	1.3	1.5	2.2	2.2	0.7 × 1.0
U.S.N.M. 144817 Luzon (<i>panayensis</i>) (brown)	50	6.5	1.2	1.6	2.3	2.1	0.5 × 0.9
U.S.N.M. 144819 Luzon (<i>panayensis</i>) (brown)	50	6.6	1.2	1.7	2.1	2.1	0.5 × 0.8
U.S.N.M. 199596 Hainan (<i>consobrinus</i>) (brown)	53	6.7	1.3	1.7	2.2	2.1	0.5 × 0.9
F.M.N.H. 45998 Formosa (brown)		6.5	1.2	1.8	2.1	2.1	0.6 × 1.0

Scotophilus heathii insularis Allen

Scotophilus kuhlii insularis J. A. ALLEN, 1906, Bull. Amer. Mus. Nat. Hist., XXII, p. 485.

TYPE LOCALITY.—Hainan Island, South China.

"Color above uniform olive brown; below pale brownish buff. . . ."

These large bats are apparently the northeastern representatives of the Indian *heathii*. They are essentially similar to the continental form rather than to the Ceylonese race which latter, as Blyth remarked (1852), "are a good deal darker

islands. There exists, however, a geographical hiatus since, according to Bonhote and Chasen,¹ "*kuhlii*" (meaning *heathii*) has not been recorded south of Patani, Malay Peninsula.

SCOTOMANES DOBSON

Scotomanes (subgenus of *Scotophilus*) DOBSON, 1875, Proc. Zool. Soc. London, p. 37.

GENOTYPE.—*Nycticejus ornatu* Blyth.

This is a monotypic genus with one

¹ 1940, Bull. Raffles Mus., XV, p. 54.

species, *ornatus*, and two named forms, *imbrensis* and *sinensis*, both weak races which perhaps cannot be sustained.

Its relationships seem to be with the same line which gave rise to *Scotophilus*. The skin is less specialized as regards the ear, in which the tragus is of simple *Pipistrellus* form instead of being elongate pointed and broadened in the middle as in *Scotophilus*. The ornate white pattern may be considered as specialization.

In the skull, shortening of the rostrum has gone farther than in *Scotophilus*, similar broadening of the supraorbital area has occurred, but widening across the anterior margins of the orbits in the region of the anteorbital foramen (circular instead of oval) has taken place. The rostral sinus is relatively small. The palatal sinus, too, is little developed. The posterior part of the skull remains low, and the sagittal and lambdoid crests weak. Mastoid processes comparatively unexpanded.

Dentition much as in *Scotophilus* but m^3 slightly less reduced, lower incisors simply trilobate as in *Pipistrellus*. P_2 proportionately as small, but less compressed between c and p_4 .

Scotomanes ornatus (Blyth)

Nycticejus ornatus BLYTH, 1851, J. Asiatic Soc. Bengal, XX, p. 517.

TYPE LOCALITY.—Cherrapunji, Burmese India.

"... Bright pale rusty isabelline-brown above (the piles black for the basal fourth, then whitish, with rusty extremities) less vivid on the lower half of back, and somewhat paler below; a pure silky white spot on the center of forehead, others on each shoulder and axilla above, and a narrow stripe of the same along the middle of the back... forearm $2\frac{1}{2}$ inches [57 mm.]."

Scotomanes ornatus imbrensis Thomas

Scotomanes ornatus imbrensis THOMAS, 1921, J. Bombay Nat. Hist. Soc., XXVII, p. 772.

TYPE LOCALITY.—Konshnong, Jaintia Hills, Assam.

"Size... as in *ornatus* or rather smaller. Color distinctly darker and browner... dark collar on throat blackish, strongly

contrasted with rest of under-surface... Forearm of type 56 mm...."

The type locality of this "race" is only a few miles from Cherrapunji, type locality of true *ornatus*.

Scotomanes ornatus sinensis Thomas

Scotomanes ornatus sinensis THOMAS, 1921, J. Bombay Nat. Hist. Soc., XXVII, p. 772.

TYPE LOCALITY.—Kuatun, northwest Fukien, China.

"Size smaller, forearm 50-55, rarely reaching 60. Color deeper... forearm of type 55 mm...."

It is very doubtful whether the "smaller" size of this Chinese race can be sustained.

A.M.N.H. 84847 from Fukien has the forearm 59 mm. A second specimen measures 54 and a third 56 mm.

OTONYCTERIS PETERS

Otonycteris PETERS, 1859, Monatsber. Akad. Wiss. Berlin, p. 223.

GENOTYPE.—*Otonycteris hemprichii* Peters.

In this genus we see the third independent evolution of "big-eared-ness" in the Vespertilioninae. The other cases were *Plecotus* and allies, derived from the *Myotis* stem, in which little reduction of the dentition is evident, and *Histiotus* (with *Laephotis*), an offshoot of the *Eptesicus* line, showing specialization of the premolar area but none of the incisors. *Otonycteris* demonstrates enlargement of the auditory apparatus in the nycticeine bats, where already marked modification of the upper incisors is an established fact.

Divergence probably took place at or before the *Nycticeius-Scoteinus* stage, because marked broadening of the rostrum is not evident, and the occipital helmet is merely incipient. Moreover, the zygomata are still fairly strongly developed.

Otonycteris inhabits the arid regions of north and east Africa, Arabia and adjoining territories.

In Asiatic regions the names *petersi* (Persian Gulf), *jin* (Hasa, Arabia), *cinereus* (Baluchistan) and *cheesemani* (Arabia) have been applied. I am not in a position to attempt to evaluate these names. Probably some, at least, are synonyms or races,

Lasiurini

American vespertilionid bats, specialized to an extraordinary degree. The elevated braincase provides a superficial likeness to *Chalinobus* of Australia and Africa.

The densely pilose uropatagia resemble those of the Murininae of southeastern Asia. Two genera (which perhaps should be subgenera) only are distinguished: *Lasiurus* and *Dasypterus*. Within *Lasiurus* two chief divisions appear, the *cinereus* group, large bats with greatly elongated basal pollical phalanx, under surface of wing adjoining forearm densely pilose, etc., and the *borealis* group, smaller bats with basal phalanx of thumb less elongated and wing near forearm thinly haired beneath. This latter group extends to South America as far south as Chile, where it is represented by a somewhat larger form (*varius*).

Dasypterus, although it is distinguished from *Lasiurus* by the absence of p^2 , resembles *L. cinerea* otherwise in many respects.

The bats of this supergeneric group together form a very distinct offshoot of the Vespertilionidae. They are set apart by the broad, very short, elevated rostrum and braincase, which is illustrated by the proximity of the orbital fossa to the canine, by the great breadth of the anterior rostral and palatal sinuses, reduction of incisors to

i^1 , obsolete or vestigial state of p^2 , great reduction of m^3 (longitudinally). In the lower incisors i^1 is the major functioning tooth, i^2 and i^3 being smaller, a condition wholly different from *Myotis*. Imbrication occurs.

LASIURUS GRAY

Lasiurus GRAY, 1831, Zool. Miscellany, I, p. 38.

GENOTYPE.—*Vespertilio borealis* Müller (Palmer, 1904).

"The hairy-tailed species of America" (Gray). Only two species, *cinereus* and *borealis*, are listed by Miller for North and Central America. Several others related to *borealis* occur in South America.

DASYPTERUS PETERS

Dasypterus PETERS, 1871, Monatsber. Akad. Wiss. Berlin, p. 912.

GENOTYPE.—*Lasiurus intermedius* H. Allen.

Miller lists three species of *Dasypterus* north of the Isthmus of Panama. The genus is represented in tropical South America. *Dasypterus* differs from *Lasiurus* obviously by the loss of p^2 . This distinction, although perfectly definite, is less important than may be suspected, because p^2 in *Lasiurus* is a disappearing structure already greatly reduced in size.

TABLES OF MEASUREMENTS OF VESPERTILIONINE BATS

The tables which follow are made up for the most part of the measurements of type specimens and cotypes. A great many of the sets of measurements were made on actual specimens in European museums during the summer of 1937, but a large number also have been taken from photographs of the types with which a millimeter scale had been included. Slight lenticular aberration has introduced errors in these latter groups of measurements. In certain instances, *Pipistrellus abramus*, *P. bancanus*, *P. regulus*, *P. tasmaniensis*, *Nyctalus molossus* and some members of the *Eptesi-*

cus pumilus group, both measurements are shown. In each case an apparent increase in the size of skull varying from 2 per cent to 10 per cent results from the use of photography. This means that in photographs made with my Contax camera and enlarged with a commercial enlarger, tooth-row lengths of 5 mm. usually require a corrective of -0.4 mm. In a few instances measurements are quoted from publications. Forearm lengths are generally taken from actual type specimens. A few are copied from text or transposed into millimeters from inches.

Name	Museum number	Forearm	Total length skull	Zygomatic width	Breath braincase	Mastoid width	Lacrimal width	Canine width	C-m ³	Source of measurements
<i>Pipistrellus abramus</i> group										
<i>Pipistrellus abramus</i>	Cotype, Leyden, "d"	{ 33	13.3	8.5	7.0	7.1			4.7	Specimen
"	Topotype, U.S.N.M. 14093 ;	34	13.7	9.0	7.3	7.7	5.4	4.5	4.9	Photo
"	Cotype, Leyden "b"	33	12.5	8.7	7.4	7.6	5.2	4.4	4.8	Specimen
"	Type ♂, B.M., no number	33			8.7				5.7	Specimen
"	Type, B.M. 46.11.11.87	34		8.2	7.1		5.0	3.6	4.8	Cantor
"	Type, ♂, B.M. 14.7.19.242	31	11.6	8.2	6.8	7.1	5.1	4.3	4.7	Photo
"	Type, ♂, B.M. 14.7.19.242	{ 32		8.0	7.2	7.2	4.9	3.8	4.5	Photo
"	Type, Sody 39BK		13.3	8.3		7.1	4.8	4.2	4.6	Specimen
"									4.4	Photo
<i>Pipistrellus pipistrellus</i> group										
<i>Pipistrellus pipistrellus</i>	A.M.N.H. 70616, England	31	11.8	7.2	6.4	6.8	4.2	3.6	4.2	Specimen
"	U.S.N.M. 105299	33	12.8	7.7	6.7	7.0	4.5	3.7	4.5	Specimen
<i>Pipistrellus coromandra</i> group										
<i>Pipistrellus aladdin</i>	Type, ♂, B.M. 5.10.4.13	30	11.8	7.3	6.3	6.5		3.4	4.3	Photo
"	♂, F.M.N.H. 34779, Bengal	29	12.3	8.2	6.5	7.2	4.8	4.1	4.5	Specimen
"	Type, ♂, B.M. 25.1.1.120	30	12.1	7.3	6.4	6.7	4.4	3.7	4.4	Photo
"	Paratype, A.M.N.H. 26796	33			6.1		4.7	3.6	4.4	Specimen
"	Type, ♀, B.M. 91.2.2.3		11.1	7.0	6.2	6.3	4.1	3.6	4.2	Photo
"	Topotype, U.S.N.M. 104756	32	11.5	7.5	6.4	6.5	4.6	3.5	4.3	Specimen
"	Type, ♂, B.M. 93.3.13.5	28	12.3	8.0	6.8	6.9	5.3	4.1	4.8	Photo
"	Type, B.M. 79.11.21.108				6.5			4.0	4.1	Photo
"	Type, ♂, B.M. 13.11.7.4	36		8.3	7.0	7.2	5.7	5.0	4.7	Specimen
"	Type, B.M. 6.8.1.8	{ 38	13.0	8.0	7.2	8.0		4.1	4.7	Specimen
"			13.8	8.8	7.3		4.9		5.1	Photo
<i>Pipistrellus tenuis</i> group										
<i>Pipistrellus tenuis</i>	Cotype, Leyden "b"	30							4.0	Specimen
"	Topotype, B.M. 7.1.1.407	26					4.1	3.4	3.9	Photo
"	Topotype, B.M. 7.1.1.408	27	11.3	7.2	6.2	6.9	4.4	3.9	4.1	Photo
"	Type, B.M. 7.1.1.403	31	10.8	7.5	6.7		4.6	3.6	4.2	Photo
"	Type, ♀, B.M. 5.10.4.13	30	11.2	8.0	6.2	6.8	4.4	3.8	3.8	Photo
"	Type, ♂, B.M. 10.1.18.15	29	10.2	7.4	5.4	6.5	3.9	3.7	4.0	Photo
"	Type, ♂, B.M. 98.5.5.6	26	11.6	7.8	6.2	6.4	4.2	3.5	4.0	Photo
"	Type, Genoa, C.E. 11660	27	12.2	7.9	6.5	7.0	4.7	3.9	4.1	Specimen
<i>Pipistrellus affinis</i> group										
<i>Pipistrellus affinis</i>	Topotype, A.M.N.H. 44565	38	15.5	9.6	7.4	7.9	5.2	4.8	5.8	Specimen
"	Topotype (near), A.M.N.H. 84844	34	13.3	8.5	6.8	7.3	4.9	4.1	4.9	Specimen
"	U.S.N.M. 219409, Celebes	36	15.2	9.6	7.5	8.1	5.8	4.7	5.6	Specimen
"	Type, ♂, B.M. 14.12.1.6	35	14.1	9.0	7.2	7.8	5.0	5.0	5.0	Photo
"	Type, ♀, B.M. 10.4.5.55	37	14.0	9.1	7.0	7.9	5.2	5.2	4.8	Photo

Name	Museum number	Forearm	Total length skull	Zygomatic width	Breadth braincase	Mastoid width	Laeral width	Canine width	Coma	Source of measurements
<i>Pipistrellus ceylonicus</i> group										
<i>Pipistrellus ceylonicus</i>	Topotype M.C.Z. 27525	38	14.8	10.0	7.6	8.7	6.2	5.1	5.5	Specimen
"	Type, ♀, B.M. 13.8.8.30	38	14.9	10.0	8.1	8.4	6.2	5.1	5.6	Photo
"	Type, ♂, B.M. 98.5.5.3	38	15.2	10.1	7.8	8.2	6.0	5.0	5.9	Photo
"	Type, ♀, B.M. 14.7.8.6	36	14.6	10.2	8.0	8.2	5.8	5.1	5.5	Photo
"	Type, ♂, B.M. 4.6.8.7	37	14.7	10.8	8.0	8.3	6.6	5.2	5.8	Photo
<i>Pipistrellus kuhlii</i> group										
<i>Pipistrellus kuhlii</i>	U.S.N.M. 172128	33	13.8	8.8	6.6	7.5	4.7	4.4	5.0	Specimen
"	Type, ♀, B.M. 7.11.21.2	34	13.6	8.5	6.8	7.4	5.0	4.7	5.1	Photo
<i>Pipistrellus savii</i> group										
<i>Pipistrellus savii</i>	U.S.N.M. 103322	32	13.5	9.0	6.7	7.4	5.2	4.4	4.9	Specimen
"	Cotype, Leyden "m"	34	12.6	8.8	6.9	7.1	5.4	4.5	4.1	Specimen
"	Type, Leyden, "a"	33	12.2	8.5	6.7	7.0	5.0	4.5	4.0	Specimen
"	Type, ♂, B.M. 16.3.25.6	32	13.5	9.0	6.7	7.4	5.0	4.5	4.9	Photo
<i>Pipistrellus circumdatus</i> group										
<i>Pipistrellus circumdatus</i>	Type, Leyden "a"	42		11.2	8.2		7.2	5.0	6.3	Specimen
"	♀, A.M.N.H. 114850, Burma	41	15.4	10.8	8.1	8.6			6.0	Specimen
<i>Pipistrellus tasmaniensis</i> group										
<i>Pipistrellus tasmaniensis</i>	Type, B.M. 43.2.22.6	{ 45							6.7	Specimen
"	U.S.N.M. 237824, N. S. Wales	52	18.5	12.5	9.3	10.3	6.9	6.1	7.3	Photo
"	A.M.N.H. 102359, Celebes	35	13.5	9.6	7.5	8.7	6.0	4.6	5.1	Specimen
<i>Pipistrellus minahassae</i> group										
<i>Pipistrellus minahassae</i> ?	Type, ♂, B.M. 88.12.1.37	39	15.0	10.8	8.0	8.8	7.0	5.0	5.2	Photo
<i>Pipistrellus joffrei</i> group	Type, ♂, A.M.N.H. 114849	38					7.0	5.1	5.3	Specimen
"	Cotype, Leyden "a"	35					7.0	5.6	4.8	Specimen
"	Type, B.M. 72.8.19.17	39	16.0	12.0	8.7	9.8	7.5	6.0	6.0	Photo
<i>Scotozous</i>										
<i>Scotozous dormeri</i>	Type, ♀, B.M. 65.5.20.3	33	12.5	9.0	7.8		5.0	4.1	5.0	Photo
"	Type, ♀, B.M. 13.8.8.32	36	13.7	10.3	8.5	10.2	6.7	4.8	5.6	Photo
<i>Glischropus</i>										
<i>Glischropus tylopus</i>	Type, ♀, B.M. 70.2.10.2	30	12.2	8.2	6.8	7.0	5.0	4.1	4.7	Photo
"	♂, A.M.N.H. 106858, N. Borneo	29	11.7	7.8	6.5	6.8	4.5	3.7	4.6	Specimen
"	♂, A.M.N.H. 106964, N. Borneo	28.5	11.4	7.2	6.2	6.6	4.1	3.7	4.4	Specimen
"	Type	32.7	12.6	8.0	6.5	7.0			4.7	Chasen
"	Type	28-29								Matschie
<i>Ia</i>										
<i>Ia io</i>	Type, ♀, B.M. 2.6.10.2	71.5	27	17	12.2	14.0	10.0	8.6	10.4	Photo
"	♂, A.M.N.H. 56873	74								Specimen

Name	Museum number	Forearm	Condylobasal length skull	Zygomatic width	Breadth braincase	Mastoid width	Laeral width	Canine width	C-m's	Source of measurements
<i>Nyctalus</i>										
<i>Nyctalus azoreum</i>		37-42	13.8-14.2	9.0-9.8	7.8-8.4		5.8-6.4		5.0-5.4	Miller, 1912
" <i>maderae</i>		43	15	9.5			8.0		5.2	Hamilton
" <i>leisleri</i>		40-42	15-16	10-11	8.2-8.6		6.4-7.0		5.8-6.0	Miller, 1912
" <i>montanus</i>	Type ♂, B.M. 79.11.21.164	42	16.0	12.2	9.0		7.5	6.0	6.9	Photo
" <i>planci</i>	Type, B.M. 82.7.29.2	47					7.5	6.4	7.0	Photo
" <i>velutinus</i>	Topotype, A.M.N.H. 44774	49	17.0	11.6	9.0		7.5	6.6	6.8	Specimen
" <i>labiatus</i>	Type, B.M. 43.1.12.146		18.5	13.5	10.0		8.5	7.5	7.5	Photo
" <i>meklenburzevi</i>		51	18.3-19.3	13.1-13.6					7.1-7.4	Text
" <i>noctula</i>		51-54	17.8-19.2	12.4-13.8	9.6-10.4		7.6-8.8		6.8-7.4	Miller, 1912
" <i>princeps</i>		52-58	19.1-20.1	13-14.5					7.4-8.3	Ognev
" <i>aridor</i>	Type, ♂, B.M. 5.1.4.5	62	21.8	14.7	11.6		9.5	8.6	8.9	Photo
" <i>molossus</i>	Type, Leyden "b"	{ 61	22.0	15.5	12.0	13.8		8.4		Specimen
" <i>lasiopterus</i>		67	22.5	15.5	11.5		9.7	8.5	8.8	Photo
" <i>maximus</i>		64-68	22-22.8	14.6-15.6	11.2-11.6		9.6-10		8.8-9.2	Schreber
<i>Philetor</i>										Miller, 1912
<i>Philetor rohui</i>	Type, ♂, B.M. 1.11.24.11	34	13.5	10.9	8.3	9.0	*	5.4	4.7	Specimen
" "	A.M. 152466	37	14.8	10.9	8.0	9.1	†	5.5	5.0	Specimen
<i>Tylonycteris</i>										
<i>Tylonycteris aurax</i>	Type, ♂, B.M. 0.4.2.15	27	11.5	9.1	6.8	7.5		4.0	4.1	Photo
" <i>fulvida</i>	Cotype, ♀, B.M. 15.4.29.1		11.1	9.0	7.2	7.3		4.2	4.1	Photo
" "	Cotype, ♀, B.M. 15.4.29.2		11.2	9.1	7.3	7.5		4.1	4.2	Photo
" <i>pachypus</i>	Cotype, Leyden "e"	25-27	11.6	8.7	6.7	7.4		4.1	3.9	Specimen
" <i>meyers</i>	Cotype ♀, B.M. 75.11.3.12	22-24	10.2	7.8	6.7	7.0		3.8	3.7	Photo
" <i>robustula</i>	Type ♀, B.M. 11.1.18.8		11.8	9.6	7.5	8.0		4.3	4.2	Photo
" <i>malayana</i>	Type	28.5	13.2	10.0	8.0			4.5		Chasen, 1940
<i>Hesperoptenus</i>										
<i>Hesperoptenus doriae</i>	Type	36.5								Peters
" <i>tickelli</i>		61								Text
" <i>tomesi</i>	Type, ♂, B.M. 7.1.1.428	51		16.0	11.0	9.8		8.0	8.8	Photo
" <i>blanfordi</i>		27								Text

* Width across rostral tubercles, 8.2.
† " " " 9.0.

Name	Museum number	Forearm	Condyllobasal length skull	Zygomatic breadth	Breadth braincase	Mastoid width	Lacrimal width	Canine width	C-m ³	Source of measurement
<i>Eplesiscus nilssonii</i> group										
<i>Eplesiscus nilssonii</i>	Sweden	39	14	9.6	7.7	8.5	5.8	4.8	5.2	Miller, 1912
" <i>n. gobiensis</i>	A.M.N.H. 60424, Mongolia	42	15	9.6	7.9	8.7	5.9	4.5	5.6	Specimen
" <i>pallascens</i>		35-35.5	13	8.5	6.8-6.9				4.7-4.8	Text
" <i>tauricus</i>		38.9	12.7						4.5	Text
" <i>turcomanus</i>		42								Text
" <i>isabellinus</i>		35								Text
" <i>caucasicus</i>		40	13.7	10.4	7.0			4.8	5.3	Photo
" <i>walli</i>		35							4.5	Text
" <i>matschiei</i>		36								Text
" <i>m. pellucens</i>	Type, ♂, B.M. 5.10.4.4	33.5-34.9	12.4-13	8.6-8.9					4.7-4.9	Ognev
" <i>tamerlani</i>		40.5							5.9	Text
" <i>centrasiaticus</i>		37								Text
" <i>alashanicus</i>		35	13.1	8.3					4.8	Text
" <i>velox</i>										
<i>Eplesiscus nasutus</i> group		36								Dobson
<i>Eplesiscus nasutus</i>										
<i>Eplesiscus fuscus-serotinus</i> group										
<i>Eplesiscus fuscus</i>	A.M.N.H. 35082, New York	47-49	17.9	12.5	8.8	9.5	7.4	6.1	7.2	Specimen
" <i>bernardinus</i>	A.M.N.H. 68688, California	47	17.5	12.1	8.0	9.3	6.7	5.6	6.8	Specimen
" <i>serotinus</i>	U.S.N.M. 152588, Germany	49-53	18.7	13.8	9.3	11.0	7.6	6.8	7.6-8.2	Miller, 1912, and speci-
										men
" <i>andersoni</i>	A.M.N.H. 44646, Fukien	52-53	19.8	14.0	10.0	11.0	7.9	7.0	7.8	Specimen
" <i>shirazensis</i>		54								Text
" <i>kashgaricus</i>		45							7.8	Text
" <i>pachyomus</i>	Type, B.M. 48.8.18.7†	54								Specimen
" "	U.S.N.M. 37306/21684, Kashmir	51	20.4	14.8	10.0	11.5	8.7	7.0	8.5	Specimen
" <i>hingstoni</i>		45								Text
" <i>pallens</i>		49								Text
" <i>intermedius</i>										Text
" <i>sodalis</i>		46								Text
									7.1-7.3	Miller, 1912
									7.2	

† Note: Skull still in skin.

Name	Museum number	Forearm	Condylolbasal length skull	Zygomatic width	Breadth braincase	Mastoid width	Lacrimal width	Canine width	C-m ³	Source of measurement
<i>Eptesicus sinensis</i>	A.M.N.H. 33135, N. China	49	19.5	12.9	9.5	10.8	8.0	6.5	8.0	Specimen
" <i>brachydigitus</i>		47.5							7.3	Text
" <i>ogneti</i>		45-46								Text
" <i>miradorensis</i>	A.M.N.H. 18745, Colombia	50	18.4	12.9	8.3	9.7	7.0	6.3	7.7	Specimen
" <i>vetmorei</i>	A.M.N.H. 39191, Porto Rico	50	16.7	12.3	8.5	9.6	6.9	5.8	7.3	Specimen
<i>Eptesicus dimissus</i> group										
<i>Eptesicus dimissus</i>	Type, B.M. 16.4.21.1		16.0	13.0	8.3	10.0	4.8		6.5	Photo
<i>Eptesicus pachyotis</i> group										
<i>Eptesicus pachyotis</i>										
<i>Eptesicus pumilus</i> group										
<i>Eptesicus pumilus</i>	Type, B.M. 41.1523 (119c)	38			6.8					Dobson
" <i>p. caurinus</i>	Type, B.M. 14.3.9.1(10473)	{ 31	10.5	7.5+	7.0	6.4	4.9	4.0	4.2	Specimen
" <i>p. darlingtoni</i>	Type, M.C.Z. 29113	{ 30	11.0	7.1	5.9					Photo
" <i>p. vulturnus</i>	Type, B.M. 7.1.1.375	{ 34	12.7	7.9	6.1	6.8	4.6	3.9	4.2	Specimen
" <i>pygmaeus</i>		{ 33	12.0	8.8	7.0	7.8	5.0	4.2	4.9	Specimen
<i>Eptesicus incertae sedis</i>			13.0	8.3	6.9	7.0	4.5	4.0	4.6	Specimen
<i>Eptesicus platyrrhinus</i>				8.4	7.1	7.3				Photo
" <i>verecundus</i>										Text
" <i>horikawai</i>										
" <i>kobayashii</i>										
" <i>n. parvus</i>										
<i>Scoletinus</i>										
<i>Scoletinus emarginatus</i>										
" <i>rüppellii</i>	M.C.Z. 29090	54	18.7	14.1	10.0	12.0	7.7	6.6	7.7	Text
" <i>pallidus</i>	M.C.Z. 5337, Kooloo Valley, India	53		11.1	7.8		6.6	5.5	5.9	Specimen
" <i>inflatus</i>	Type, B.M. 24.3.7.4, N. Queensland	38	14.9	11.3	7.9	9.2	6.2	5.5	6.0	Specimen
" <i>orion</i>	Paratype, Sydney	35.8-36								
" "	M.C.Z. 29114, N.S. Wales	37	14.3	10.8-11.1	7.5-7.8	9.0-9.2	5.8-6.1		5.6-5.8	Troughton
" "	M.C.Z. 29110, Cape York	34	14.1	11.3	7.7	9.4	6.3	5.3	5.7	Specimen
			295	10.5	7.5	8.8	5.7	5.1	5.7	Specimen

Name	Museum number	Forearm	Condylobasal length skull	Zygomatic width	Breadth of alveolae	Mastoid width	Lacrimal width	Canine width	Source of measurement
<i>Scoteinus greyii</i>	Type, B.M. 42.8.17.12	36.5	14.3	10.5	7.5	8.8	5.7	5.2	Specimen
"	M.C.Z. 29355, N. Terr., Australia							5.5	Specimen
"	Type, B.M. 6.8.1.41	35	14.1	10.0	7.2	8.6	5.4	4.7	Specimen
"	Type, E. Queensland	34.5		10.4	7.4	8.6	5.3	5.1	Troughon
"	Paratype, Kimberley	32.5-34			6.8	8.5	5.3	5.1	Specimen
"	A.M.N.H. 105317, S. Papua	34	14.0	10.7	7.0	8.8	5.7	4.7	Specimen
"	Paratype, E. Papua	32-33.3			7.1	8.1	5.5	4.8	Troughon
"	F.M.N.H. 33781, P. Moresby	33	12.2	9.5	7.0	7.9	4.8	4.0	Specimen
"	A.M.N.H. 109278, Pentland, Queensland	30	12.0	8.7	6.5	7.4	4.7	4.0	Specimen
<i>Scotophilus</i>									
<i>Scotophilus temminckii</i>	Cotype, ♀, B.M. 79.11.21.213	51	17.5	12.8	9.4	11.1	7.9	6.8	Text
"	Type, Sody, 213e	50						6.7	Specimen
"	Type, ♀, B.M. 79.11.21.11b	50.5							Text
"	Type	48						4.9	Kloss
"	Paratype, A.M. 58432	50	17.5	13.3	9.2	11.2	7.7	6.1	Specimen
"		48						6.6	Sody
"	Type, B.M. 97.6.8.12	50	18.3	12.0	9.2	11.4	8.4	6.0	Photo
"	Cotype, B.M. 60.5.4.30	56		15.5	11.0		9.5	7.8	Photo
"	Cotype, B.M. 60.5.4.32	54		14.2	11.0	12.8	8.5	7.7	Photo
"		57-59							Text
"		54							Geoffroy
"									Text
"	{Cotype, ♀, B.M. 71.1.1.446	63							Text
"	{Cotype, ♂, B.M. 71.1.1.447	64							Text
"	Type, Sody, 16b	55	19.4	15.0	10.4	12.6		7.5	Specimen
"	Type	62-64							Sody
"	Paratype	61					9.6	7.6	Specimen

SYNOPTIC LIST OF VESPERTILIONINAE (EXCEPT *MYOTIS*) IN THE ARCHBOLD COLLECTIONS

SPECIES OR SUBSPECIES	LOCALITY	SKIN AND SKULL	ALCO- HOLIC
<i>Pipistrellus imbricatus</i>	South Celebes	15	
" "	Bali	6	
" <i>imbricatus collinus</i>	Balim River, Netherlands New Guinea	2	
" " "	Idenburg River, Netherlands New Guinea	1	
" " "	Mt. Tafa, Papua	1	
" " "	Lake Habbema, Netherlands New Guinea	1	
" <i>abramus bancanus</i>	Cheribon, Java	12	
" <i>papuanus</i>	Sogeri, Papua	13	
" "	Kemp Welch River, Papua	1	
" "	Hollandia, Netherlands New Guinea	1	
" "	Idenburg River, Netherlands New Guinea	10	5
" "	Wassi Kussa, western Papua	7	
" "	Daru, western Papua	2	4
" "	Dogwa, western Papua		25
" "	Mabaduane, western Papua	1	
" "	Madiri, Fly River, western Papua	2	
" <i>tenuis</i>	Bratan, Bali	1	
" <i>macrotis</i>	Koeta, Bali	3	
" <i>minahassae</i>	Roeroeken, north Celebes	1	
<i>Glischropus tylopus</i>	Southwest Borneo	19	
" "	Northwest Borneo	18	
" "	South Borneo	14	
<i>Philetor rohui</i>	Idenburg River, Netherlands New Guinea	1	
" "	Papua		4
<i>Tylonycteris pachypus</i>	Palembang, Sumatra	16	
" "	Bali	4	
" <i>robustula</i>	Peleng, east Celebes	15	
" "	Palembang, Sumatra	6	
<i>Eptesicus pumilus</i>	Quamby, Queensland	23	
" "	Pentland, Queensland	7	
<i>Scoteinus influatus</i>	Wassi Kussa, Papua	6	
" "	Mabaduane, Papua	1	
" "	Madiri, Papua	1	
" "	Dogwa, Papua		12
" "	Daru, Papua		1
" <i>greyii</i>	Pentland, Queensland	4	
" "	Malbon, Queensland	1	
<i>Scotophilus temminckii temminckii</i>	Cheribon, Java	22	
" " <i>collinus</i>	Bali	15	

