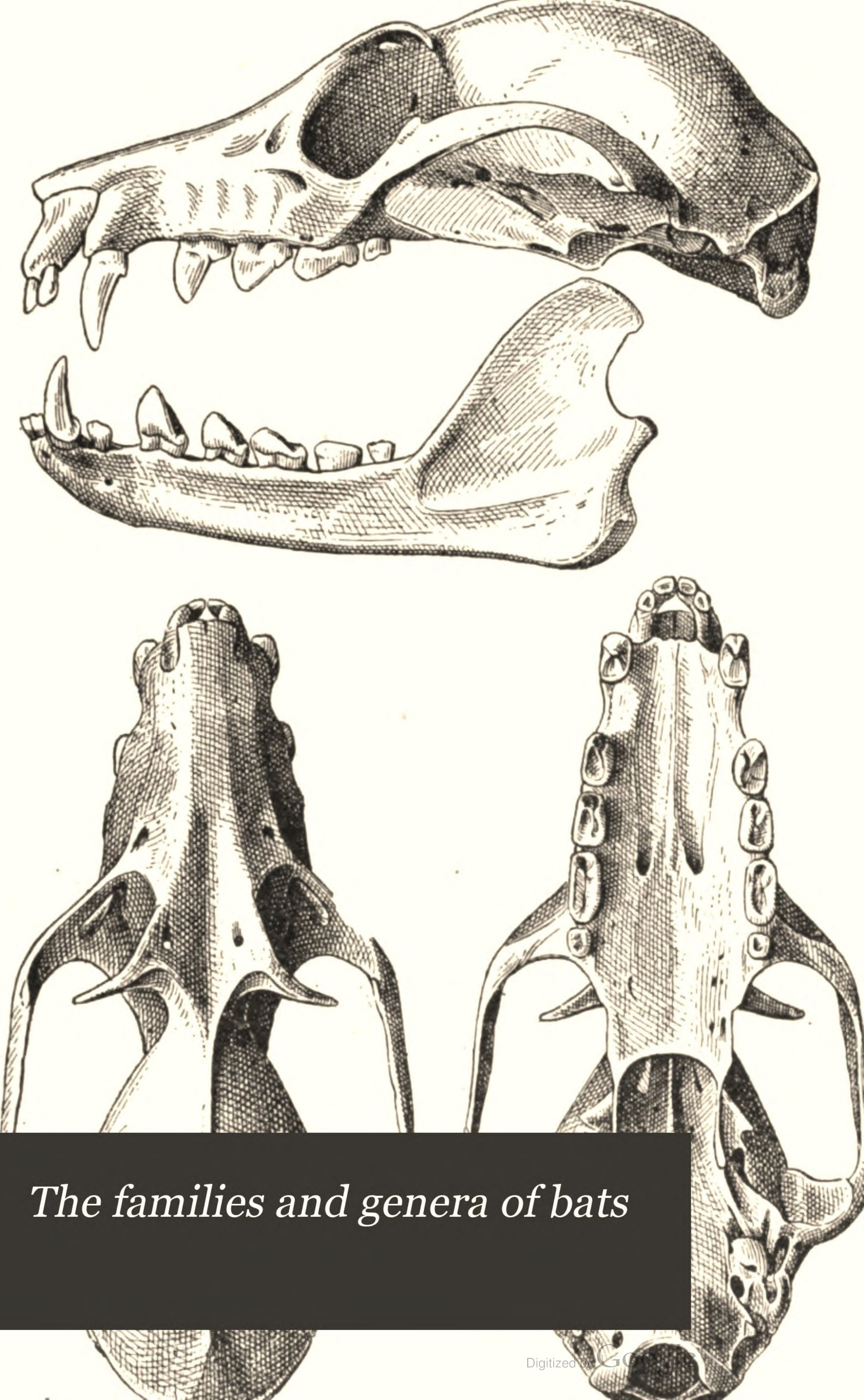

The families and genera of bats

SMITHSONIAN INSTITUTION

UNITED STATES NATIONAL MUSEUM

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THE FAMILIES AND GENERA OF BATS

BY

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CHARLES D. WALCOTT,
Secretary of the Smithsonian Institution.

WASHINGTON, U. S. A., *June 15, 1907.*

PREFACE.

This classification of the families and genera of bats, primarily based on skeletal and dental characters, is chiefly the result of my studies of the collections in the United States National Museum. During two visits to Europe I have, however, been permitted with the utmost liberality to examine the material in the museums of London, Paris, Leiden, and Berlin, with the result that members of practically all the known genera of Chiroptera have passed through my hands.[a] To the authorities of these institutions I take pleasure in acknowledging my indebtedness. I am also under special obligations to Mr. Oldfield Thomas for the unique facilities that I have enjoyed for working in the British Museum, and to Mr. Knud Andersen for his unfailing kindness in verifying special characters in the specimens in London. Finally, to my assistant, Dr. Marcus W. Lyon, jr., acknowledgment is due for his care in superintending the drawing of some of the illustrations and assistance in reading proof during my absence from Washington.

The pen drawings in the text are mostly by Miss Mary Mason Mitchell and the late Dr. J. C. McConnell; those in Plates XI to XIV are also by Doctor McConnell. The wash drawings of the teeth, forming Plates I to X, were made under my supervision by the late Mr. F. van Iterson. They should be regarded as semidiagrammatic.

Owing to the fragmentary condition of the remains by which they are known, it has not seemed expedient to attempt to introduce the extinct genera in a system based on characters which the fossils have for the most part lost. It has also seemed inexpedient to deal with subgenera at a time when the species of bats are still very imperfectly known.

All questions of nomenclature have been decided in accordance with the Code of Nomenclature of the American Ornithologists' Union, pending the final adoption of an international code.

GERRIT S. MILLER, Jr.

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[a] *Cormura*, *Stenoderma*, and *Amorphochilus* are the only genera among the 173 here recognized that I have not seen.

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THE FAMILIES AND GENERA OF BATS,

BY GERRIT S. MILLER.

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On page XIII, line 6 from bottom, for *trintatis* read *trinitatis*.

On page XV, lines 8 and 18 from top, for Genoa read Geneva.

On page XV, line 24 from top, for *Harpiocephlus* read *Harpiocephalus*.

On page XVII, line 7 from bottom, for *Molussus* read *Molossus*.

On page 47, line 14 from top, for *Acerdon* read *Acerodon*.

On page 93, line 12 from top, for *Taphonycteries* read *Taphonycteris*.

On page 151, line 12 from bottom, for effecting read affecting.

On page 158, line 12 from top, for *macconelli* read *macconnelli*.

On page 200, line 7 from bottom, for *Myotus* read *Myotis*.

On page 206, between lines 1 and 2, insert:

1867. *Alobus* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 707 (*temminckii=rüppellii*), not *Alobus* Le Conte, 1856.

On page 208, line 12 from bottom, for *Vespertilio* read *Eptesicus*.

On page 208, line 17 from bottom, for Hungarlæ read Hungariæ.

On page 228, line 3 from bottom, for *fucas* read *fuscus*.

On page 268, line 27 from bottom, strike out fucas, Miniopterus.... 228.

On page 268, between lines 9 and 10 from bottom, under fuscus, insert Miniopterus.... 228.

On page 272, line 4 from bottom, for fucas read fuscus.

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THE FAMILIES AND GENERA OF BATS.

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INTRODUCTION.

In 1758, Linnæus knew seven bats, all of which he placed in *Vespertilio*, the fourth and last genus of the order Primates. The work of the next fifty years, as recorded by Tiedemann in 1808, though it had resulted in the recognition of the order Chiroptera, had not increased the species beyond 14, while the number of genera, even with the addition of the flying lemur, was still only seven. The first subdivision of the order into families appears to be due to Goldfuss, who, in 1820, arranged the genera in four groups, one of which still comprised the flying lemur. To each group he definitely applied the name "Familie." The real foundation for the current classification was, however, not laid by Goldfuss, but by Gray, who published the first of his many papers on bats in 1821. Gray excluded the flying lemur, recognized the two main subdivisions of the order, and applied to the names of families the system of nomenclature now in use. According to this scheme there were two suborders, the Fructivoræ and Insectivoræ, the former containing the families Pteropidæ and Cephalotidæ, the latter the Noctilionidæ and Vespertilionidæ. Though Gray's system was not followed very closely during the succeeding fifty years, it was finally given definite form by Gill in 1872 and Dobson in 1875, and since then has been almost universally adopted. The new classification now presented is, in fact, little more than an amplification of that founded by Gray. The increase in our knowledge of the Chiroptera since 1821 has been, however, very great. As we have seen, Linnæus recognized only one genus of bats; Gray placed the number comprised in his four families at about 14. In 1865 Peters divided the group into 10 families and subfamilies, containing, in all, 59 genera. When Dobson published his Catalogue of the Chiroptera in the British Museum, in 1878, he described 401 species, 80 genera, and 14 families and subfamilies. As might have been anticipated, this work, the only complete special monograph of the order, was such a stimulus to the study of bats that since it appeared these animals have received more attention than ever before. In 1904 Trouessart recorded no less than 851 species, 122 genera, and 18 families and subfamilies. It appears, however, that even these numbers are much too small. Detailed study of the skeleton, particularly of the wing and shoulder girdle and of the structure of the tooth cusps, leads me to the conclusion that among the known species at least 173 genera and 36 families and subfamilies should be recognized. With regard to the species, recent work [a] shows that an enormous increase is to be expected as the characters on which distinctions are based come to be better understood. It seems highly probable that the total number of recognized bats will eventually exceed 2,000 named forms.

HISTORY.

The following summaries are intended to give somewhat in detail the more important facts in the development of the classification of bats. The list, though incomplete, gives a sufficiently clear idea of the course that this work has followed.

1758. **Linnæus,** Systema Naturæ, I, 10th ed. *Vespertilio*, the only genus of bats recognized, appears as the fourth genus of Primates (p. 31.) The other genera are *Homo*, *Simia*, and *Lemur*. In the twelfth edition, 1766, *Noctilio* is separated from *Vespertilio* and placed among the Glires. This is apparently the only instance of one genus of bats being referred to a different order from the others.

1772. **Brünnich,** Zoologia Fundamenta. *Vespertilio* is here one of the genera of Feræ; the others are *Hystrix*, *Lepus*, *Cavia*, *Castor*, *Mus*, *Sciurus*, *Erinaceus*, *Sorex*, *Phoca*, *Lutra*, *Hyæna*, *Felis*, *Canis*, *Cercopithecus*, and *Lemur*. The orders recognized are: Bruta, Feræ, Pecora, Bellua, and Cetacea.

1777. **Scopoli,** Introductio ad Historiam Naturalem. The genus *Vespertilio* is placed between *Bradypus* and *Lemur* in the Unguiculata. The position of this order in the system is as follows:

Tribus XII. Mammalia.
  Gens I. Cetacea.
  Gens II. Quadrupedia.
    Divisio I. Aquatilia.
    Divisio II. Terrestria.
      Ordo I. Ungulata.
      Ordo II. Unguiculata.

[a] See especially the papers (Proc. Zool. Soc. London, 1905, II, pp. 75–145, October 17, 1905, and Ann. Mag. Nat. Hist., 7th ser., XVI, pp. 648–662, December, 1905) by Mr. Knud Andersen on the Old World leaf-nosed groups.

1777. **Erxleben,** Systema Regni Animalis. Two genera of bats are recognized, *Pteropus* and *Vespertilio*, both placed in the Linnæan order Primates.

1779. **Blumenbach,** Handbuch der Naturgeschichte. The Mammalia are divided into 12 orders: I, Inermis; II, Pitheci; III, Bradypoda; IV, Sclerodermata; V, Chiroptera; VI, Glires; VII, Feræ; VIII, Solidungua; IX, Bisulca; X, Belluæ; XI, Palmatæ, and XII, Cetacea (pp. 57–59). *Vespertilio*, with 5 species, is the only genus of bats.

1800. **Cuvier,** Leçons d'Anatomie Comparée. The Cheiroptères are placed as a subdivision of the Carnivora.

1806. **Dumeril,** Zoologie Analytique. The Mammalia are divided into 14 families, the first three of which are Bimanes, Quadrumanes, and Chiroptères. Six genera of bats are recognized.

1808. **Tiedemann,** Zoologie. The bats form the "X Ordnung, Vögelartige Säugthiere, Fliegende Säugthiere, Chiroptera (Chiropteres, Alipédes.)" There are 7 genera, one of which is *Galeopithecus*.

1816. **Oken,** Lehrbuch der Naturgeschichte, dritter Theil, Zoologie. The bats (17 genera) form the first division of "III Ordnung, Vogelsuke—Klauer," thus:

III Ordnung, Vogelsuke—Klauer.
- A. Haltklauer.
  - 1 S. Finkenklauer—Flere; Fledermäuse.
  - 2 S. Rabenklauer—Tatzer.; Spitzm., Igel.
  - 3 S. Spechtenklauer—Kraller; Zahnerlose, Ameisenbären, Gurtelth., Schnabelth.
- B. Reissklauer.
  - 4 S. Aukenklauer—Robben.
  - 5 S. Reiherklauer—Ilke; Marder.
  - 6 S. Hühnerklauer—Köter; Hunde, Katzen.
  - 7 S. Trappenklauer—Bären.

1817. **Cuvier, G.,** Le Règne Animal, I. In this work the "Cheiroptères" form the first family of "Carnassiers." They are all placed in the genus *Vespertilio*, but this is divided into two main groups, the Rousettes (*Pteropus*) and the true bats. Among the latter, 12 subdivisions or subgenera are recognized. Essentially the same plan is followed in the second edition, published in 1829.

1820. **Desmarest,** Mammalogie. The classification is the same as that of Cuvier:

Ord. Carnassiers.
- Première Famille, Cheiroptères.
  - Première Tribu, Galéopithèques.
  - Seconde Tribu, Chauve-souris.

The minor groups of the former author are, however, recognized as 16 genera, while no less than 95 species are described.

1820. **Goldfuss**, Handbuch der Zoologie. The arrangement of the bats is as follows:

13[te] Ord., Chiroptera.

1 Familie, Noctiliones (*Taphozous*, *Dysopes*, *Noctilio*, *Nyctinomous*, *Myopterus*, *Plecotus*, *Vespertilio*, *Stenoderma*.)

2 Familie, Harpyiæ (*Harpyia*, *Pteropus*).

3 Familie, Phyllostomata (*Megaderma*, *Rhinolophus*, *Rhinopoma*, *Nycteris*, *Phyllostoma*).

4 Familie, Galeopitheci.

1821. **Gray**, On the natural arrangement of Vertebrose Animals, London Medical Repository, XV, pp. 296–310, April 1, 1821. In this little known work, Gray subdivided the vertebrates as follows:

Sub-kingdom I. Vertebrosa.

Class I. Bimanes.

Order I. Primates.

Class II. Quadrumanes.

Order I. Platyonychæ.

Order II. Gampstonychæ.

Order III. Heteronychæ.

Class III. Cheiroptera.

Order I. Fructivoræ.

Family I. Pteropidæ (*Pteropus*, *Rousettus*).

Family II. Cephalotidæ (*Cephalotes*).

Order II. Insectivoræ.

Family I. Noctilionidæ (Molosses, Nyctinomes, Stenodermes, *Noctilio*, Vampyre, *Phyllostoma*).

Family II. Vespertilionidæ (Megadermes, *Rhynolophus*, *Nycterus*, *Rhynopoma*, *Thaphosores*, *Vespertilio*, *Plecotus*, *Barbastella*).

Class IV. Quadrupedes.

Subclass I. Unguiculata.

Order I. Pterophoræ.

Order II. Plantigradæ.

Order III. Digitigradæ.

Order IV. Amphibiæ.

Order V. Rosores.

Order VI. Tardigradæ.

Order VII. Oligodontæ.

Order VIII. Edentulæ.

Order IX. Proboscidiæ.

Order X. Tesserachenæ.

Order XI. Trichenæ.

Order XII. Monochenæ.

Order XIII. Hydrophoræ.

Order XIV. Ruminantes.

1821. **Gray**—Continued.

Sub-kingdom I. Vertebrosa—Continued.

Class V. Pedimanes.

Order I. Feræ.

Order II. Brutæ.

Order III. Glires.

Order IV. Rosores.

Class VI. Cetaceæ.

Order I. Herbivoræ.

Order II. Carnivoræ.

1823. **Spix**, Simiarum et Vespertilionum Brasiliensium Species Novæ. Though dealing especially with the bats of Brazil the author proposed a general classification that influenced many subsequent writers. It was as follows:

Fam. I. Anistiophori.

Genus I. *Noctilio.*

II. *Molossus.*

III. *Thyroptera.*

IV. *Proboscidea.*

V. *Vespertilio.*

Fam. II. Istiophori.

Genus VI. *Vampyrus.*

VII. *Phyllostoma.*

VIII. *Glossophaga.*

IX. *Diphylla.*

1827. **Lesson**, Manuel de Mammalogie. The flying lemur is once more associated with the bats, and the group thus formed is made a division of the carnivores:

Ordre Carnassiers.

Division Cheiroptères.

Tribu Galeopithèques.

Tribu Chauve-souris.

The true bats are subdivided into two sections, the Istiophori containing the groups Phyllostomes and Rhinolophina, and the Anistiophori, with the groups Vespertilionina, Noctilionina, and Pteropina. Twenty-three genera are recognized.

1829. **Fischer**, Synopsis Mammalium. The bats are placed as the second order, Chiroptera, without subdivision into secondary groups.

1831. **Bonaparte**, Saggio di una Distribuzione metodica degli Animali Vertebrati. The bats form the second order, Chiroptera. They are all placed in the single family "Vespertiliones (Vespertilionidæ)," but this group is subdivided into five sections or subfamilies.

Ord. 2. Chiroptera.

Fam. 4. Vespertiliones (Vespertilionidæ).

Noctilionina (*Cheiromeles Dysopes*, *Thyropterus Stenoderma*, ?*Myopteris*, *Aëllo Taphozous* ("*Taphagous*") *Noctilio*, *Cœlano*).

1831. **Bonaparte**—Continued.

Ord. 2. Chiroptera—Continued.

Fam. 4. Vespertiliones (Vespertilionidæ)—Continued.

Vespertilionina (*Proboscidea*, *Diclidurus*, *Vespertilio*, *Furia*, *Plecotus*, *Barbastellus*).

Pteropina (*Pteropus*, *Cynopterus*, *Macroglossus*, *Harpyia*, *Cephalotes*).

Phyllostomina (*Phyllostoma*, *Vampyrus*, *Desmodus*, *Glossophaga*, *Rhinopoma*, *Mormops*, *Megaderma*, *Nyctophilus*, *Nyctinomus*).

Rhinolophina (*Rhinolophus Phyllorrhina*).

1838. **Bonaparte,** Synopsis Vertebratorum Systematis. (Nuovi Annali delli Scienze Naturali, Bologna, Anno I, Tomo II, pp. 105–113.) The subdivisions of the Chiroptera are now as follows:

Pteropodidæ.

Pteropodina.

Vespertilionidæ.

Noctilionina.

Vespertilionina.

Rhionolophina.

Rhinopomina.

Vampiridæ.

Vampirina.

1838. **Gray,** A revision of the genera of bats (Vespertilionidæ), and the description of some new genera and species. (Mag. Zool. and Bot., II, pp. 486–505, December, 1838.) In again dealing with the classification of bats Gray abandoned his earlier plan and adopted the main divisions introduced by Spix. As thus modified the arrangement of the group was as follows. The number of genera had now been increased to 47:

Family Vespertilionidæ.

A. Istiophori.

Tribe I. Phyllostomina.

Tribe II. Rhinolophina.

B. Anistiophori.

Tribe III. Vespertilionina.

Tribe IV. Noctilionina.

Tribe V. Pteropina.

1840. **Wagner,** Schreber's Säugthiere. (Supplement, I.) The flying lemurs are again associated with the bats.

Ord. Volitantia.

I. Unterord. Dermoptera.

II. Unterord. Chiroptera.

1840. **Wagner**—Continued.

Ord. Volitantia—Continued.

II. Unterord. Chiroptera—Continued.

I. Fam. Frugivora.

II. Fam. Istiophora.

I. Sippe. Desmodina.

II. Sippe. Phyllostomata.

III. Fam. Gymnorhina.

I. Sippe. Brachyura.

II. Sippe. Gymnura.

III. Sippe. Vespertilionina.

1842. **Lesson,** Nouveau Tableau du Règne Animal, Mammifères. The classification adopted by Lesson differs in many respects from those of previous writers.

I. Classe. Mammifères.

I. Sous-Classe Mammifères Normaux.

I. Ordre Mastomonadelphie.

I. Tribu Bimana.

II. Tribu Quadrumana.

III. Tribu Chiroptera.

VI. Famille Pteropusideæ.

VII. Famille Noctilionineæ.

VIII. Famille Vespertilioneæ.

IX. Famille Phyllostomineæ.

X. Famille Rhinolophineæ.

1854. **Gervais,** Histoire Naturelle des Mammifères. The order Cheiroptères is divided into the four families Ptéropodés, Phyllostomidés, Rhinolophidés, and Vespertilionidés.

1855. **Gervais,** Documents Zoologiques pour servir a la Monographie des Chéiroptères Sud-Américains. Animaux Nouveaux ou Rares receuillis dans l'Amérique du Sud sous la direction du Comte de Castelnau, pp. 25–88. Only two families are dealt with, but these are subdivided into groups that have been recognized by most subsequent writers.

Chéiroptéres Phyllostomidés.

Tribu Desmodina.

Tribu Stenodermina.

Tribu Glossophagina.

Tribu Vampyrina.

Chéiroptéres Vespertilionidés.

Tribu Noctilionina.

Tribu Molossina.

Tribu Emballonurina.

Tribu Nycticeina.

Tribu Vespertilionina.

1865. **Peters**, Vorlage von Abbildungen zu einer Monographie der Chiropteren, und Übersicht der von ihm befolgten systematischen Ordnung der hieher gehörigen Gattungen. (Monatsber. k. preuss. Akad. Wissensch., Berlin, 1865, pp. 256–258.) The following groups are recognized:

I. Fam. Pteropi with 10 genera.
II. Fam. Megadermata with 4 genera.
III. Fam. Rhinolophi with 3 genera.
IV. Fam. Phyllostomata.
  I. Subfam. Vampyri with 5 genera.
  II. Subfam. Glossophagæ with 5 genera.
  III. Subfam. Stenodermata with 5 genera.
  IV. Subfam. Desmodi with 2 genera.
  V. Subfam. Mormopes with 3 genera.
V. Fam. Brachyura with 6 genera.
VI. Fam. Molossi with 2 genera.
VII. Fam. Vespertiliones with 14 genera.

1866. **Gray**, I. Synopsis of the genera of Vespertilionidæ and Noctilionidæ. (Ann. and Mag. Nat. Hist., 3d ser., XVII, pp. 89–93.) II. A revision of the genera of Pteropine Bats (Pteropidæ) and descriptions of some apparently undescribed species. (Proc. Zool. Soc. London, 1866, pp. 62–67.) III. A revision of the genera of Rhinolophidæ, or Horseshoe Bats. (Proc. Zool. Soc. London, 1866, pp. 81–83.) IV. Revision of the genera of Phyllostomidæ, or Leaf-nosed Bats. (Proc. Zool. Soc. London, 1866, pp. 111–118.) In these four papers Gray again revised his classification of the bats. He recognized 5 families and 37 subfamilies or "tribes," but no larger groups.

Family Pteropidæ.
  Pteropina, 2 genera.
  Macroglossina, 4 genera.
  Cephalotina, 1 genus.
  Harpyiana, 1 genus.
  Cynopterina, 2 genera.
  Epomophorina, 3 genera.
Family Rhinolophidæ.
  Rhinolophina, 3 genera.
  Rhinonycterina, 1 genus.
  [Phyllorhinina], 8 genera.
  Rhinopomina, 1 genus.
  Megadermina, 2 genera.
  Nycterina, 3 genera.
Family Phyllostomidæ.
  Lonchorhinina, 1 genus.
  Macrophyllina, 1 genus.

1866. **Gray**—Continued.

Family Phyllostomidæ—Continued.

Vampyrina, 6 genera.
Phyllostomina, 8 genera.
Trachyopina, 1 genus.
Brachyphyllina, 1 genus.
Glossophagina, 3 genera.
Stenodermina, 8 genera.
Desmodina, 2 genera.
Centurionina, 2 genera.

Family Vespertilionidæ.

Scotophilina, 4 genera.
Romiciana, 1 genus.
Vespertilionina, 5 genera.
Natalinia, 4 genera.
? Nycticellina, 1 genus.
Plecotina, 2 genera.
Nyctophilina, 1 genus.
Nyctericina, 2 genera. Afterwards removed to the Rhinolophidæ.
Furipterina, 1 genus.
Emballonurina, 7 genera.
Diclidurina, 1 genus.

Family Noctilionidæ.

Noctilionina, 2 genera.
Mormopsina, 1 genus.
Phyllodiana, 3 genera.
? Spectrellina, 1 genus.
Molossina, 4 genera.

1872. **Gill**, Arrangement of the Families of Mammals. (Smithsonian Miscellaneous Collections, No. 230.) The bats are arranged as follows:

Order Chiroptera.

Suborder Animalivora.

Family Desmodidæ.
Family Phyllostomidæ.
Family Mormopidæ.
Family Rhinolophidæ.
Family Megadermidæ.

a. Vampyrinæ.
b. Glossophaginæ.
c. Stenoderminæ.

Family Vespertilionidæ.

a. Vespertilioninæ.
b. Nycticejinæ.

1872. **Gill**—Continued.

Order Chiroptera—Continued.

Suborder Animalivora—Continued.

Family Molossidæ.

Family Noctilionidæ.

a. Noctilioninæ.

b. Emballonurinæ.

c. Furiinæ.

Suborder Frugivora.

Family Pteropodidæ.

1875. **Dobson,** Conspectus of the suborders, families and genera of Chiroptera arranged according to their natural affinities. (Ann. and Mag. Nat. Hist., 4th ser., XVI, pp. 345–357, November, 1875.) Dobson's classification has been the standard, little departed from except in minor details, during the past thirty years.

Order Chiroptera.

Suborder I. Megachiroptera.

Family I. Pteropidæ.

Group I. Pteropi, 6 genera.

Group II. Macroglossi, 3 genera.

Suborder II. Microchiroptera.

Family II. Rhinolophidæ.

Subfamily I. Rhinolophinæ, 1 genus.

Subfamily II. Phyllorhininæ, 4 genera.

Family III. Nycteridæ.

Subfamily I. Megaderminæ, 1 genus.

Subfamily II. Nycterinæ, 1 genus.

Family IV. Vespertilionidæ.

Group I. Plecoti, 7 genera.

Group II. Vespertiliones, 8 genera.

Group III. Miniopteri, 3 genera.

Family V. Emballonuridæ.

Subfamily I. Emballonurinæ.

Group I. Emballonuræ, 4 genera.

Group II. Taphozoi, 3 genera.

Group III. Rhinopoma, 1 genus.

Group IV. Noctiliones, 1 genus.

Subfamily II. Molossinæ.

Group V. Molossi, 4 genera.

Group VI. Mystacinæ, 1 genus.

Family VI. Phyllostomidæ.

Subfamily I. Lobostominæ.

Group I. Mormopes, 3 genera.

Subfamily II. Phyllostominæ.

Group II. Vampyri, 10 genera.

Group III. Glossophagæ, 6 genera.

Group IV. Stenodermata, 10 genera.

Group V. Desmodontes, 2 genera.

1886. **Gill**, Standard Natural History, V, pp. 159–177

Suborder Frugivora.
- Family Pteropodidæ.

Suborder Animalivora.
- Family Rhinolophidæ.
  - Subfamily Rhinolophinæ.
  - Subfamily Phyllorhininæ.
- Family Megadermidæ.
  - Subfamily Megaderminæ.
  - Subfamily Nycterinæ.
- Family Vespertilionidæ.
  - Group Plecoti.
  - Group Vespertiliones.
  - Group Miniopteri.
- Family Emballonuridæ.
  - Group Furiæ.
  - Group Emballonuræ.
  - Group Dicliduri.
  - Group Rhinopomata.
- Family Molossidæ.
- Family Noctilionidæ.
- Family Phyllostomidæ.
  - Subfamily Phyllostomines.
  - Subfamily Glossophagines.
  - Subfamily Stenodermines.
- Family Mormopidæ.
- Family Desmodontidæ.

1892. **Winge,** Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien. The classification adopted by Winge is the only recent one that differs notably from that of Dobson. It is as follows (p. 24):

- Pteropodidæ.
  - Pteropodes.
  - Macroglossi.
- Rhinolophidæ.
  - Megadermatini.
    - Nycterides.
    - Megadermata.
  - Rhinolophini.
    - Phyllorhinæ.
    - Rhinolophi.
- Phyllostomatidæ.
  - Phyllostomatini.
    - Phyllostomata.
    - Glossophagæ.

1892. **Winge**—Continued.

Phyllostomatidæ—Continued.

Phyllostomatini—Continued.

Stenodermata.

Desmodontes.

Mormopini.

Emballonuridæ.

Rhinopomatini.

Emballonurini.

Emballonuræ.

Taphozoi.

Vespertilionidæ.

Natalini.

Vespertilionini.

Molossini.

1904. **Weber,** Die Säugethiere. By a combination of Winge's results with those of earlier writers the following scheme is produced (pp. 400–401):

Megachiroptera.

Pteropodidæ.

Pteropodinæ.

Macroglossinæ.

Microchiroptera.

Rhinolophidæ.

Megadermatinæ.

Rhinolophinæ.

Phyllostomatidæ.

Lobostominæ.

Phyllostominæ.

Desmodontinæ.

Emballonuridæ.

Rhinopomatinæ.

Emballonurinæ.

Vespertilionidæ.

Natalinæ.

Vespertilioninæ.

Molossinæ.

ANATOMY.

Though a general study of Chiropterine anatomy is still much needed, it is not my purpose in the present paper to undertake this work. Certain special parts, as the wing, shoulder girdle, sternum, and the cusps of the teeth, which have not hitherto been adequately described, but which appear to be of particular taxonomic importance, will, however, be treated in some detail.

Wing.

The general structure of the wing in bats has been so frequently described that no detailed account is necessary here. Two special parts of the flying apparatus need, however, a few words.

HUMERUS, SHOULDER, AND ELBOW.

As might be anticipated from its modification to serve as a wing, the anterior limb of the bats differs considerably from that of mammals that do not fly. The most obvious peculiarity is the great lengthening of the fingers to support the flying membrane, but the long bones and their two principal joints have also undergone considerable changes. The humerus, though in general without special modifications in form or unusual development of ridges for muscular attachment, is peculiar in the large size of the trochiter (tuberculum majus) and trochin (tuberculum minus), the former in some families being so greatly developed as to extend beyond the head and form a definite secondary articulation with the scapula, thus giving the shoulder joint a very unusual strength, while limiting its motion strictly to a single plane. The bicipital groove is usually deep and well defined, especially in the larger Pteropidæ. Shaft slender, mostly subterete, though somewhat flattened distally, varying in form from distinctly sigmoid in the lower groups to nearly straight in the higher, its deltoid crest always present, low and broad in the Megachiroptera, high and flangelike in the Microchiroptera. Except for this crest the shaft is never marked by distinct ridges, though a faint trace of the supinator ridge is sometimes present. No supracondylar foramen or supratrochlear perforation. Internal condyle usually large, though in the most specialized groups reduced to a mere base for the long spinous process. External condyle obliterated by the displacement outward of the articular surface. Capitellum large, with a well-developed external ridge and groove; trochlea reduced to a mere ridge scarcely more prominent than that on outer side of capitellum. The whole distal articular surface is in most bats so displaced outward as to be partly or in extreme cases almost wholly beyond axis of shaft. The elbow joint is formed almost exclusively by the humerus and radius, since the ulna is so reduced as to be nearly functionless. At its distal end the ulna is incomplete; among the Megachiroptera it is continued as a threadlike cartilaginous strand to wrist, though in old age it may become fused with radius; in the Microchiroptera this fusion with radius is invariable, though the point at which it takes place is not always the same. Occasionally the proximal extremity also is anchylosed. Olecranon scarcely extending beyond radius and forming no definite part of joint, succeeded by a sesamoid ossicle nearly equaling it in size.

Among recent mammals the nearest approach to the conditions just described is found in the Colugidæ. Here the trochiter and trochin, though less developed than in the Pteropidæ, strongly suggests the form characteristic of the bats as compared with their much more rudimentary condition in *Tupaia*. Of the two processes the trochin is distinctly the larger, and it is obvious at a glance that the distal extremity of the humerus in *Cynocephalus* more nearly resembles that of *Pteropus* than it does that of *Tupaia* or than that of *Pteropus* does the most highly developed type in the Microchiroptera. This resemblance is further heightened by the size and form of the deltoid crest, which is rather closely alike in *Cynocephalus* and *Pteropus*, while in both *Tupaia* and the Microchiroptera it is noticeably different. At the distal extremity of the humerus the resemblance between *Cynocephalus* and the bats is less exclusive. In the Colugidæ both supracondylar foramen and supratrochlear perforation are present and the supinator ridge is well developed, characters all of which are in common with the Insectivora. The actual surface of articulation, however, resembles that of the bats in the reduction of the trochlea and the large size of the capitellum, the outer edge of which shows the first suggestion of the groove and ridge which is so prominent a feature in the Chiroptera. As would be expected from the reduced condition of the trochlea, the ulna is much reduced from its normal form. It is throughout very slender, the distal half flattened against radius, into which it blends near wrist. Proximally it is slightly larger than in *Pteropus*, though very greatly reduced as compared with *Tupaia*, and the small, abruptly curved olecranon forms a definite part of the joint, its extremity fitting into the supratrochlear perforation.

It seems, therefore, that without touching on the question of the general relationships of the Dermoptera, it may safely be said that the long bones and two principal joints of the anterior limb in this group are intermediate in structure between those of Insectivores and Bats, but distinctly nearer the latter, and that in this respect at least *Cynocephalus* represents a stage that was passed through by the near ancestors of *Pteropus*.

In 1892, Winge [a] first called attention to the striking differences, already alluded to, in the humerus and shoulder joint of the Megachiroptera and of the more highly specialized Microchiroptera. A fact not mentioned by Winge is that, while the Microchiroptera, as a whole, show a much more specialized condition of the humerus than the Megachiroptera, different members of the group show different degrees of this modification, and these degrees are very largely charac-

[a] Jordfundne og Nulevende Flagermus (Chiroptera) fra Lagou Santa, Minas Geraes, Brasilien, p. 24.

teristic of families. In a group like the bats, where divergence from ordinary mammals has been chiefly in the direction of changing the front limbs from legs to wings, it seems necessary to give special weight in classification to such characters as these.

Pteropidæ.—The very characteristic structure of the humerus in this group shows no important variation in the numerous genera that I have examined. The head is broadly rounded, slightly oval in outline, well defined everywhere, except on the side next the trochiter, into which it merges. Trochiter ill-defined, low and broad, scarcely rising above base of head, to which it is joined by a level, smoothly rounded surface. Trochin slightly higher and narrower than trochiter, and much better defined, a well-developed groove, about as wide as its lateral diameter, separating it from head, and a similar though even more strongly defined groove isolating it dorsally from the low, broad, deltoid crest. Shaft somewhat triangular proximally, flattened distally, its sigmoid flexure distinct. Capitellum moved outward slightly beyond line of shaft and entirely obliterating epicondyle. Epitrochlea large, its lateral diameter more than half that of capitellum, its spinous process distinct, though short.

Microchiroptera.—The least specialized type of humerus in the Microchiroptera is found in the Rhinopomidæ and Emballonuridæ. In these families both trochin and trochiter have risen about to level of upper surface of head of humerus, a development which causes little change in the form of either tubercle as compared with its condition in the Pteropidæ. The alteration in form is most noticeable in the trochiter, which is now well defined throughout, and separated from head by a distinct groove over which the smooth surface of the head is extended. This groove is narrower and better defined than that dividing the head from the trochin. Though so distinctly increased in size the trochiter is not large enough to reach the edge of the glenoid fossa of the scapula, the shoulder joint remaining therefore strictly single. Head globular in *Rhinopoma*, somewhat compressed in the Emballonuridæ. As in all other Microchiroptera the deltoid crest is high and knifelike, very different from the low, rounded form in the Megachiroptera. The shaft of the bone is nearly terete throughout, except where distorted by the deltoid crest, and a little flattened distally. It has a slight single curvature. Capitellum essentially as in the Pteropidæ.

A slight modification of this type is found in the Noctilionidæ. Here the head of the humerus is greatly compressed and strikingly ridgelike. The well-defined trochiter is very small and narrow, though rising fully as high as in the related groups, while the trochin is greatly increased in size, being nearly as large as the head. The groove separating the trochin from the well-developed though rather small deltoid crest is ill-defined.

Another stage is represented by the Old World leaf-nosed groups, the Nycteridæ, Megadermidæ, Rhinolophidæ, and Hipposideridæ. In the first two of these the shoulder joint is still single, and the shaft of the humerus shows a slight though evident sigmoid flexure; the trochin and trochiter are as in the Emballonuridæ, neither rising distinctly above head. In the Rhinolophidæ and Hipposideridæ the shaft of the humerus is nearly straight, with merely a slight upward curve in distal third, while the trochiter has increased in length sufficiently to exceed the head slightly and to form a definite secondary articulation with the scapula by a surface about half as large as glenoid fossa. In size the trochiter is still distinctly exceeded by the trochin, which, however, barely rises above head. At its distal extremity the humerus in all four families is peculiar in the lengthened epitrochlea, bearing near middle a well-developed peg-like process, and the very conspicuous displacement outward of the capitellum and consequent widening of the entire distal region. This displacement is greatest in the Megadermidæ, where the articular surface is almost wholly exterior to the axis, and the width of the distal extremity is nearly one-fourth length of humerus. In the Nycteridæ the displacement is rather less, though the proportion of width of extremity to length of bone remains about the same. In the Rhinolophidæ and Hipposideridæ it is still less, and the proportion of width to length is normal—that is, about as one to six. The displacement of the articular surface remains very evident, and the epitrochlea and its spinous process are of the same character as in the Nycteridæ and Megadermidæ, though less elongated.

In the American leaf-nosed bats the shoulder joint is essentially like that of the Rhinolophidæ and Hipposideridæ, except that in the Chilonycterinæ the trochiter is so shortened as to form no articulation with the scapula. In this subfamily the shaft of the humerus has a slight single curvature, while in the others the bend is often, though not invariably, double. Throughout the family the capitellum is slightly displaced outward and the epitrochlea is small or moderately developed, the spinous process, when present, at its distal extremity. A similar type of humerus occurs in the Desmodontidæ, but both trochiter and trochin rise somewhat higher beyond head.

The Natalidæ, Furipteridæ, Thyropteridæ, and Myzopodidæ agree with each other in the form of the humerus. This differs from the Phyllostomine type merely in the somewhat enlarged trochiter, which now about equals the trochin in size and slightly exceeds it in height; distal extremity as in the Phyllostomidæ; flexure single or faintly double.

From the last type as best shown in the Thyropteridæ to the highly specialized form characteristic of the Vespertilionidæ, Mystacopidæ, and Molossidæ the transition is rather abrupt. In these families the trochiter slightly exceeds the somewhat reduced trochin in actual size, while in height it extends conspicuously beyond it as well as beyond the head of the humerus. The double articulation with the scapula is now complete, and the surface on which the flangelike trochiter acts is nearly as large as the glenoid fossa. The shaft of the humerus is nearly straight, or with a moderate single curvature; distal extremity scarcely wider than shaft, the articular surface not displaced outward, the short epitrochlea scarcely more than the base to the high spinous process, which projects beyond distal extremity in much the same manner as the trochiter beyond head.[a]

PHALANGES.

The first digit contains two phalanges, the distal of which bears a claw, functional in all bats except the two genera of Furipteridæ.

In the second digit the metacarpal alone is present in the Emballonuridæ, Nycteridæ, Rhinolophidæ, Hipposideridæ, Natalidæ, Furipteridæ, and Thyropteridæ. One distinct bony phalanx is present in all other families of Microchiroptera except the Rhinopomidæ, in which there are two. Three phalanges are present in this finger in all of the Megachiroptera, the terminal bone in most genera provided with a claw.

Three is the usual number of phalanges in the third, fourth, and fifth digits. The distal phalanx is always cartilaginous in the fourth and fifth, though in carefully prepared material its joint with the second phalanx may be detected when both are present.

In the third digit the terminal phalanx is ossified in the Phyllostomidæ, Desmodontidæ, Thyropteridæ, Myzopodidæ, and Mystacopidæ. When not completely ossified its joint with the second phalanx is at least clearly indicated and partially of bone, a condition readily observed in the Vespertilionidæ and Molossidæ. No distinct third phalanx is present in the third, fourth, and fifth fingers of any Megachiroptera, or among the Rhinopomidæ, Emballonuridæ, Noctilionidæ, Nycteridæ, Megadermidæ, Rhinolophidæ, Hipposideridæ, Natalidæ, and Furipteridæ, though it is probable that the terminal cartilage, when present, usually, if not always, represents this bone.

STERNUM AND SHOULDER GIRDLE.

The general characteristics of the sternum and shoulder girdle (Plate XI, fig. 1; Plate XII, fig. 3; Plate XIII, fig. 2; Plate XIV, fig. 1) are as follows:

Sternum.—The presternum is large, strongly keeled, and with three anterior lobes, one of which is vertical and continuous with the keel (from which it is often scarcely to be distinguished), the two others

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[a] In the genus *Eptesicus* both processes are unusually short.

horizontal, their substance thickened and strengthened to receive the articulation of the clavicles,[a] and their combined length equal to or greater than longitudinal diameter of presternum. Mesosternum with a longitudinal median ridge, occasionally rising to a distinct keel, the segments of the bone always fused in adults, and their boundaries usually obliterated. In cross section the depth of this part of the sternum is usually greater than the width, but to this rule there are conspicuous exceptions. Xiphisternum short, tapering or somewhat expanded posteriorly, its length usually greater than its width, its terminal cartilage well developed. The distinction between the presternum and mesosternum is usually evident, but that between the mesosternum and xiphisternum seldom persists except in the Megachiroptera.

Shoulder girdle.—The scapula is large, oval in form, the postscapular fossa much larger than the anterior fossa, its surface divided into three secondary surfaces set at slight angles with each other. The spine is short and moderately high, with a large, strong acromion. Coracoid large, usually curved outward, but occasionally straight and directed inward; rarely bifid at tip. Clavicle curved, its length about equal to that of scapula or of longest ribs, its shaft somewhat compressed, in one genus (*Diclidurus*) (Plate XII, fig. 3) conspicuously expanded. The articulation of the clavicle with the enlarged horizontal anterior lobe of the presternum is by a broad, unusually definite surface, from which the clavicles project upward and outward over the thorax nearly at right angles with each other.

Ribs.—The ribs decrease gradually in length from the longest to the second; between the second and the unusually shortened, thickened first, the reduction is much more noticeable, producing a break in the otherwise uniform series. Both portions of the first rib are shortened, but the modification, as compared with the others, is most noticeable in the sternal part, which is usually much expanded laterally. The vertebra to which this rib is attached is usually free, both anteriorly and posteriorly, but not infrequently it becomes fused with the last cervical vertebra, even when, as in the Molossidæ, no special modification of the shoulder girdle has taken place. These two vertebræ, together with the first rib, are so intimately associated with the shoulder girdle in the changes which it undergoes that they may conveniently be treated as forming part of it.

Modifications of the shoulder girdle and sternum.—The modifications presented by the shoulder girdle and sternum of bats are, as might be anticipated, mostly connected with the mechanical problems of furnishing surfaces of attachment for the very large pectoral

[a]For the homologies of the elements included in this region see Leche, Bihang Svensk. Akad Handl., V, No. 15; also, Flower, Introduction to the Osteology of the Mammalia, 1885, p. 253.

muscles and strengthening the arch by which the body is suspended to the wings during flight. Somewhat remarkably, however, the largest species, the great Pteropines,[a] in which the mechanical difficulties would be expected to be greatest, show little specialization except for the rather unusual development of the keel, particularly on mesosternum, a peculiarity which is most pronounced in the larger members of the group. The elements of the first rib and its attachments remain distinct, and except for the usual Chiropterine peculiarities show no characters worthy of note. Essentially the same conditions, though with much less development of the keel, are found in most of the Microchiroptera. So far as my observations go it is constant in the Rhinopomidæ, Emballonuridæ, Noctilionidæ, Phyllostomidæ, Desmodontidæ, Myzopodidæ, and in most of the Vespertilionidæ. The first stage in the strengthening process is found in the Molossidæ, the Mystacopidæ and in one subfamily of Vespertilionidæ, the Tomopeatinæ. It consists in the slightly greater thickening of the first rib, and the fusing of the last cervical and first dorsal vertebræ into a solid ring. There is no appreciable change in the form of any of the bones, and the keel of the mesosternum remains very slightly indicated. A peculiar modification of this process occurs in the Thyropteridæ where the fusion takes place between the first and second dorsals, the last cervical remaining free. In the Natalidæ it is again the last cervical and first dorsal that fuse; but in this family the supporting arch is further strengthened by a noticeable widening of the horizontal lobes of the presternum, so that the greatest anterior width exceeds the length of presternum and mesosternum together. The first rib is also thickened and its sternal segment is greatly reduced in length. Keel of mesosternum relatively as high as in the Pteropodidæ, and a slight keel on xiphisternum.

The most remarkable series of changes occurs in the four related families Nycteridæ, Megadermidæ, Rhinolophidæ, and Hipposideridæ. In the Nycteridæ the conditions are not very different from those in the Natalidæ. The keel is equally high and it extends similarly on the short, wide xiphisternum. The presternum is, however, less broadened and strengthened, and the last cervical vertebra is not fused with the first dorsal. In the Megadermidæ the mesosternum and xiphisternum are of the ordinary type, but the presternum is greatly widened, so that it is essentially a heavy transverse bar with a slight median backward projection. Laterally it is fused with the first rib, so that the only break in the continuity of the ring is at the point of articulation of the ribs with the vertebræ. As in the Nycte-

[a] The weight of an alcoholic specimen of *Pteropus* from Tenasserim (Cat. No. 104451, U. S. N. M.) is 739.5 grams, while that of a *Rhinolophus ferrumequinum* from Genoa, Italy (Cat. No. 18472, U. S. N. M.), is only 16.8 grams. Yet in the smaller animal the strengthening process is carried to the extreme.

ridæ the first dorsal vertebra is fused with the last cervical. In the Rhinolophidæ the seventh cervical vertebra and first dorsal are so completely fused that their boundaries can not be detected; this compound vertebra is fused with the first rib, which in turn is fused with presternum. The second rib fuses with first at about its point of attachment with presternum, to which it is joined throughout the rest of its course by a thin sheet of bone. At first sight, therefore, the presternum appears to be enlarged to a broadly crescentic plate applied to mesosternum at middle of its convex posterior border. The original elements of this mass, though perfectly fused, can still be distinguished. In the Hipposideridæ the strengthening process attains its highest degree of perfection. Here the general structure is as in the Rhinolophidæ, but the fusion of the first and second ribs involves the entire bone to and including the corresponding dorsal vertebræ. A solid ring is thus formed, including three vertebræ, two ribs, and the presternum, the elements indicated by a slit-like vacuity between the upper halves of the ribs, a small median space between the two dorsal vertebræ, and two minute roundish apertures in the region corresponding to space between horizontal arm of presternum and sternal portion of second rib. The mechanical need for this remarkable strengthening in bats of this size is by no means apparent.

TEETH.

Though much has been published concerning the teeth of bats, particularly by Winge,[a] the subject is still by no means exhausted. This is especially true of the modifications of the various cusps of the permanent cheek teeth, which have hitherto received little attention. Before passing to this more important aspect of the dentition, however, a few words on the milk teeth and the tooth formula may not be out of place.

MILK DENTITION.

The peculiar and very highly specialized milk dentition of bats has long been known in a general way, but the material has not yet been brought together for a complete study of its variations. The largest number of milk teeth that has been observed is 22, with the formula: $\frac{-\ 2\ 3.\ 1.\ 1\ 2}{1\ 2\ 3.\ 1.\ 1\ 2}$ ($mi.\ \frac{2-2}{3-3}$, $mc\ \frac{1-1}{1-1}$, $mp\ \frac{2-2}{2-2}=22$). As this is present in *Myotis*, a genus with the maximum number of permanent teeth, it probably represents the complete set. It also occurs in *Eptesicus*, in which the corresponding portion of the permanent dentition is $\frac{-\ 2\ 3.\ 1.\ -\ -\ -\ 4}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4}$, and in *Lasiurus* with the permanent teeth

[a] Jorfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes Brasilien, 1892, pp. 56–58.

$\frac{-\ 2\ -.\ 1.\ -\ 2\ -\ 4}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4}$. In *Nyctinomus brasiliensis*, with corresponding part of permanent formula the same as in *Lasiurus*, it also appears to be present, though I have been unable to verify the occurrence of mi_3. A slightly reduced formula $\frac{-\ 2\ 3.\ 1.\ 1\ 2}{1\ 2\ -.\ 1.\ 1\ 2}=20$, appears to be characteristic of the Desmodontidæ and Phyllostomidæ, though the posterior tooth both above and below is occasionally so small that its presence can not be positively determined. In *Desmodus* the doubtful tooth is mp^2, while in *Phyllostomus* it is mp_2. In two specimens of *Artibeus* (Nos. 38309 and 38310, U. S. Nat. Mus., Old Providence Island, Carribbean Sea), on the other hand, I can find no trace of mp_1. For the Megachiroptera the complete milk dentition is probably the same as that of the Phyllostomidæ. At least, I have verified the formula $\frac{-\ 2\ 3.\ 1.\ 1\ 2}{1\ 2\ -.\ 1.\ 1\ 2}=20$ in *Cynopterus* and *Pterocyon*. In both of these the posterior tooth above and below corresponds with pm^4, and pm_4, respectively, pm^3 and pm_3 being conspicuously without a preceding functional deciduous tooth.

In form the milk teeth are for the most part quite unlike those of the permanent dentition. They are usually slender, minute spicules, with straight or recurved tips, and their only function is probably, as has been frequently suggested, to aid the young in clinging to the mother during flight. In size they are so insignificant that one may not infrequently persist in the edge of an alveolus until the permanent tooth is nearly grown. These peculiarities of size and form, together with the very early development of the permanent dentition, preclude all possibility that the milk teeth can be used in mastication, and indicate that, whatever may be the case with other mammals, in bats the deciduous teeth can have had little if any influence on the modifications of the permanent set.

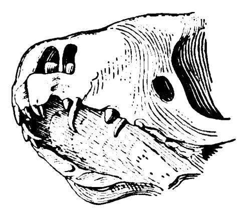

FIG. 1.—MILK DENTITION OF CYNOPTERUS MINUTUS, NIAS ISLAND. NO. 141271. × ABOUT 3.

The simplest form of milk tooth is a straight terete spicule, tapering to a sharp point, and with no evident differentiation between root and crown. This is found in the lower cheek teeth of *Cynopterus*. The next and more usual type differs in the definite recurving of the point. This curve may be slight and gradual (canines and cheek teeth of *Cynopterus* (fig. 1) and *Pterocyon*, upper canine of *Myotis yumanensis*) or strong and abrupt, sometimes almost angular (canines and cheek teeth of Phyllostomidæ, canines and incisors of *Nyctinomus brasiliensis*). Occasionally this type is further modified by a slight but evident shortening and thickening of the crown, or the faint indication of incipient secondary cusps (*mp* ² of *Pteroycon*, cheek teeth of *Phyllonycteris*). The presence of a definite secondary cusp below and behind the main cusp is probably characteristic of the lower cheek teeth in the Vespertilionidæ. It is very noticeable in *Eptesicus fuscus*, less so in *Myotis albescens*. Similar cusps occasionally, though less frequently, occur in the upper teeth and in both upper and lower canine (*Eptesicus* (fig. 2), *Myotis*). In *Nyctinomus brasiliensis* the canine has an additional secondary cusp situated on the anterior edge of the tooth somewhat nearer the tip. Contrary to what might be expected, the milk incisors present more variations of form than any of the other deciduous teeth. The simplest incisors are perhaps those of *Desmodus*, in which the upper teeth are of the primitive recurved type, without trace of secondary curvature or extra cusps, while the lower teeth are widened above, the outer slightly bifid. In *Nyctinomus brasiliensis* the upper incisors are simple and terete, but with a distinct double curve inward and backward, like those of *Promops fosteri* (fig. 3). The lower incisors are, however, much like those of the permanent set, with well differentiated, flattened, bifid crowns, the inner lobe distinctly the larger. In *Eptesicus* and *Myotis* both upper and lower incisors are trifid, those of the lower jaw scarcely recurved and very closely resembling the teeth of the permanent set, those of the upper jaw strongly recurved and with the cusps longer and more distinct than in the mandibular teeth. In the three genera of Phyllostomidæ at hand, *Phyllostomus*, *Artibeus*, and *Phyllonycteris*, there is evident differentiation between the inner and outer incisor of the upper jaw. This is slightest in *Phyllostomus*, where the outer tooth is longer than the inner, its point bent forward and then back, the concavity directed outward and backward; inner tooth with crown flattened but tapering to a fine recurved point below which there is a slight concavity on outer side. Lower incisors not seen. In *Arbiteus* the upper teeth are of much the same form, but the inner is distinctly notched at apex, much as in its successor; lower incisor faintly trifid, the middle lobe highest. Upper incisors of somewhat the same type are found in *Phyllonycteris*, though the differentiation is less evident. Inner tooth with a distinct secondary cusp on outer side considerably below level of main cusp. The lower teeth are so minute that the details of their form can not be determined. The upper incisors of *Cynopterus* and the

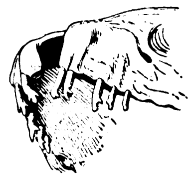

FIG. 2.—MILK DENTITION OF EPTESICUS FUSCUS. NO. 84550. × ABOUT 4.

FIG. 3.—MILK DENTITION OF PROMOPS FOSTERI, VILLA RICA, PARAGUAY. NO. 105681. × ABOUT 3.

lower incisors or *Pterocyon* are of the simple, little recurved type; the lower incisors of the former are straight, with bluntly rounded, slightly thickened crowns. Upper incisors of *Pterocyon* not seen.

DENTAL FORMULA.

The nearest approach in bats to the typical complete dentition of higher mammals—that is, a set of 44 teeth—as expressed by the formula $\frac{1\ 2\ 3.\ 1.\ 1\ 2\ 3\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ 1\ 2\ 3\ 4\ 5\ 6\ 7};\ i\,\frac{3-3}{3-3},\ c\,\frac{1-1}{1-1},\ pm\,\frac{4-4}{4-4},\ m\,\frac{3-3}{3-3}=44$, is a set of 38, lacking one upper incisor and one upper and one lower premolar: $\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}=38$. The smallest number known is 20, represented by the formula $\frac{-\ 2\ -.\ 1.\ -\ -\ -\ 4\ 5\ -\ -}{-\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ -\ -}=20$. Between these extremes occur no less than 50 formulas, representing totals of 24, 26, 28, 30, 32, 34, and 36. No bat is yet known with 22 teeth. The following table shows the distribution of the various total numbers of teeth among the 173 genera now recognized:

The genera of bats arranged according to the total number of teeth.

20.	24.	26.	28.	30.	32.	34.	36.	38.
Desmodus.	Nyctymene.	Macroderma.	Ptenochirus.	Harpyionycteris.	Boneia.	Rousettus.	Odontonycteris.	Natalus.
Diæmus.		Lavia.	Megærops.	Cynopterus.	Callinycteris.	Pterocyon.	Furipterus.	Chilonatalus.
		Cardioderma.	Dobsonia.	Niadius.	Nesonycteris.	Pteropus.	Amorphochilus.	Phodotes.
		Lichonycteris.	Scotonycteris.	Thoopterus.	Coleura.	Acerodon.	Lasionycteris.	Nyctiellus.
		Vampyriscus.	Epomophorus.	Balionycteris.	Rhynchiscus.	Desmalopex.	Plecotus.	Thyroptera.
		Diphylla.	Hypsignathus.	Sphærias.	Saccopteryx.	Pteralopex.	Corynorhinus.	Myzopoda.
		Eomops.	Notopteris.	Styloctenium.	Cormura.	Eonycteris.	Miniopterus.	Myotis.
		Molossops (part).	Rhinopoma.	Myropteryx.	Peropteryx.	Kiodotus.		Pizonyx.
		Cheiromeles.	Noctilio.	Taphozous.	Peronymus.	Syconycteris.		Kerivoula.
		Molossus.	Dirias.	Hipposideros.	Myropteryx.	Trygenycteris.		Phoniscus.
			Megaderma.	Anthops.	Centronycteris.	Melonycteris.		
			Lyroderma.	Cœlops.	Balantiopteryx.	Emballonura.		
			Asellia.	Triænops.	Diclidurus.	Chilonycteris.		
			Clœotis.	Mimon.	Nycteris.	Pteronotus.		
			Rhinonycteris.	Anthorhina.	Rhinolophus.	Mormoops.		
			Artibeus (part).	Chæronycteris.	Tonatia.	Micronycteris.		
			Vampyressa.	Leptonycteris.	Phyllostomus.	Xenoctenes.		
			Chiroderma.	Hylonycteris.	Chrotopterus.	Glyphonycteris.		
			Ectophylla.	Artibeus (part).	Lonchoglossa.	Otopterus.		
			Pygoderma.	Vampyrodes.	Anoura.	Lonchorhina.		
			Centurio.	Mesophylla.	Hemiderma.	Dolichsphyllum.		
			Sphæronycteris.	Ariteus.	Rhinophylla.	Phylloderma.		
			Antrozous.	Nycticeius.	Brachyphylla.	Trachops.		
			Tomopeas.	Scotæcus.	Artibeus (part).	Vampyrus.		
			Mystacops.	Scoteinus.	Enchisthenes.	Glossophaga.		
			Mormopterus (pt.).	Scotomanes.	Uroderma.	Lonchophylla		
			Molossops (part).	Otonycteris.	Vampyrops.	Monophyllus.		
			Platymops.	Rhogeessa.	Ardops.	Pipistrellus.		
				Bæodon.	Phyllops.	Glischropus.		
				Pachyotus.	Stenoderma.	Scotozous.		
				Dasypterus.	Sturnira.	Ia.		
				Nyctophilus.	Phyllonycteris.	Pterygistes.		
				Chærephon.	Reithronycteris.	Chalinolobus.		
				Nyctinomus (part).	Erophylla.	Barbastella.		
				Mormopterus (pt.).	Eptesicus.	Euderma.		
				Eumops.	Vespertilio.	Murina.		
				Promops.	Rhinopterus.	Harpiocephalus.		
					Hesperoptenus.			
					Tylonycteris.			
					Mimetillus.			
					Philetor.			
					Histiotus.			
					Læphotis.			
					Glauconycteris.			
					Lasiurus.			
					Nyctinomus (part).			

The different formulas, with the genera by which they are represented, are as follows:

$$\frac{\text{- 2 3. 1. - 2 3 4 5 6 7}}{\text{1 2 3. 1. - 2 3 4 5 6 7}}=38.$$ *Nyctiellus, Natalus, Chilonatalus, Phodotes, Thyroptera, Myzopoda, Myotis, Pizonyx, Kerivoula, Phoniscus.*

$$\frac{\text{- 2 3. 1. - - 3 4 5 6 7}}{\text{1 2 3. 1. - 2 3 4 5 6 7}}=36.$$ *Furipterus, Amorphochilus.*

$$\frac{\text{- 2 3. 1. - 2 - 4 5 6 7}}{\text{1 2 3. 1. - 2 3 4 5 6 7}}=36.$$ *Lasionycteris, Plecotus, Corynorhinus, Miniopterus.*

$$\frac{\text{- 2 3. 1. - 2 3 4 5 6 7}}{\text{1 2 -. 1. - 2 3 4 5 6 7}}=36.$$ *Odontonycteris.*

$$\frac{\text{- 2 3. 1. - 2 3 4 5 6 -}}{\text{1 2 -. 1. - 2 3 4 5 6 7}}=34.$$ *Rousettus, Pterocyon, Pteropus, Acerodon, Desmalopex, Pteralopex, Eonycteris, Kiodotus, Syconycteris, Trygenycteris, Melonycteris.*

$$\frac{\text{- 2 3. 1. - - 3 4 5 6 7}}{\text{1 2 -. 1. - 2 3 4 5 6 7}}=34.$$ *Chilonycteris, Pteronotus, Mormoops, Micronycteris, Xenoctenes, Glyphonycteris, Otopterus, Lonchorhina, Dolichophyllum, Phylloderma, Trachops, Vampyrus, Glossophaga, Lonchophylla, Monophyllus.*

$$\frac{\text{- 2 3. 1. - 2 - 4 5 6 7}}{\text{1 2 3. 1. - 2 - 4 5 6 7}}=34.$$ *Pipistrellus, Glischropus, Scotozous, Ia, Pterygistes, Chalinolobus, Barbastella, Euderma, Murina, Harpiocephalus.*

$$\frac{\text{- 2 3. 1. - 2 - 4 5 6 7}}{\text{1 2 3. 1. - 2 - 4 5 6 7}}=34.$$ *Emballonura.*

$$\frac{\text{- 2 -. 1. - 2 3 4 5 6 -}}{\text{1 2 -. 1. - 2 3 4 5 6 7}}=32.$$ *Boneia.*

$$\frac{\text{- 2 3. 1. - 2 3 4 5 6 -}}{\text{1 2 -. 1. - 2 3 4 5 6 -}}=32.$$ *Callinycteris.*

$$\frac{\text{- 2 3. 1. - 2 3 4 5 6 -}}{\text{- 2 -. 1. - 2 3 4 5 6 7}}=32.$$ *Nesonycteris.*

$$\frac{\text{- 2 -. 1. - 2 - 4 5 6 7}}{\text{1 2 3. 1. - 2 - 4 5 6 7}}=32.$$ *Coleura, Rhynchiscus, Saccopteryx, Cormura, Peropteryx, Peronymus, Centronycteris, Balantiopteryx, Diclidurus.*

$$\frac{\text{- 2 3. 1. - - - 4 5 6 7}}{\text{1 2 3. 1. - 2 - 4 5 6 7}}=32.$$ *Nycteris.*

$$\frac{\text{- 2 -. 1. - 2 - 4 5 6 7}}{\text{1 2 -. 1. - 2 3 4 5 6 7}}=32.$$ *Rhinolophus.*

$$\frac{\text{- 2 3. 1. - - 3 4 5 6 7}}{\text{1 - -. 1. - 2 3 4 5 6 7}}=32.$$ *Tonatia, Chrotopterus.*

$$\frac{\text{- 2 3. 1. - 2 3 4 5 6 7}}{\text{- - -. 1. - 2 3 4 5 6 7}}=32.$$ *Lonchoglossa, Anoura.*

$$\frac{\text{- 2 3. 1. - - 3 4 5 6 7}}{\text{1 2 -. 1. - 2 - 4 5 6 7}}=32.$$ *Phyllostomus, Hemiderma, Rhinophylla, Brachyphylla, Artibeus* (part), *Enchisthenes, Uroderma, Vampyrops, Ardops, Phyllops, Stenoderma, Sturnira, Phyllonycteris, Reithronycteris, Erophylla.*

$$\frac{\text{- 2 3. 1. - - - 4 5 6 7}}{\text{1 2 3. 1. - 2 - 4 5 6 7}}=32.$$ *Eptesicus, Vespertilio, Rhinopterus, Hesperoptenus, Tylonycteris, Mimetillus, Philetor, Histiotus, Læphotis, Glauconycteris.*

$$\frac{\text{- 2 -. 1. - 2 - 4 5 6 7}}{\text{1 2 3. 1. - 2 - 4 5 6 7}}=32.$$ *Lasiurus, Nyctinomus* (part).

$$\frac{\text{- 2 -. 1. - 2 3 4 5 6 -}}{\text{- (2) -. 1. - 2 3 4 5 6 7}}=30.$$ *Harpyionycteris.*

$\frac{-23.\;1.\;-2345--}{12-.\;1.\;-23456-}=30.$ *Cynopterus, Niadius, Thoopterus, Sphærias.*

$\frac{-23.\;1.\;-23456-}{-2-.\;1.\;-23456-}=30.$ *Balionycteris, Styloctenium.*

$\frac{-2-.\;1.\;-2-4567}{12-.\;1.\;-2-4567}=30.$ *Hipposideros, Anthops, Cœlops, Triænops.*

$\frac{---.\;1.\;-2-4567}{123.\;1.\;-2-4567}=30.$ *Myropteryx.*

$\frac{-2-.\;1.\;-2-4567}{12-.\;1.\;-2-4567}=30.$ *Taphozous.*

$\frac{-23.\;1.\;--34567}{1--.\;1.\;-2-4567}=30.$ *Mimon, Anthorhina.*

$\frac{-23.\;1.\;--34567}{---.\;1.\;-234567}=30.$ *Chœronycteris, Hylonycteris.*

$\frac{-23.\;1.\;--3456-}{12-.\;1.\;-23456-}=30.$ *Leptonycteris.*

$\frac{-23.\;1.\;--3456-}{12-.\;1.\;-2-4567}=30.$ *Artibeus* (part).

$\frac{-23.\;1.\;--3456-}{12-.\;1.\;-2-4567}=30.$ *Vampyrodes, Mesophylla, Ariteus.*

$\frac{-2-.\;1.\;---4567}{123.\;1.\;-2-4567}=30.$ *Otonycteris, Nycticeius, Scoteinus, Scotœcus, Scotomanes, Rhogeëssa, Bæodon, Pachyotus, Dasypterus, Nyctophilus, Mormopterus* (part).

$\frac{-2-.\;1.\;-2-4567}{12-.\;1.\;-2-4567}=30.$ *Chærephon, Nyctinomus* (part) *Eumops* (part), *Promops.*

$\frac{-23.\;1.\;-2345--}{-2-.\;1.\;-23456-}=28.$ *Ptenochirus, Megærops.*

$\frac{-23.\;1.\;--345--}{12-.\;1.\;-23456-}=28.$ *Scotonycteris, Epomophorus, Hypsignathus.*

$\frac{-2-.\;1.\;--3456-}{-2-.\;1.\;-234567}=28.$ *Dobsonia.*

$\frac{-23.\;1.\;-2345--}{-2-.\;1.\;-23456-}=28.$ *Notopteris.*

$\frac{-2-.\;1.\;---4567}{12-.\;1.\;-2-4567}=28.$ *Rhinopoma.*

$\frac{-23.\;1.\;---4567}{1--.\;1.\;-2-4567}=28.$ *Noctilio, Dirias.*

$\frac{---.\;1.\;-2-4567}{12-.\;1.\;-2-4567}=28.$ *Megaderma, Lyroderma.*

$\frac{-2-.\;1.\;---4567}{12-.\;1.\;-2-4567}=28.$ *Asellia, Rhinonycteris, Clœotis.*

$\frac{-23.\;1.\;--3456-}{12-.\;1.\;-2-456-}=28.$ *Artibeus* (part), *Vampyressa, Chiroderma, Ectophylla, Pygoderma, Centurio, Sphæronycteris, Ametrida.*

$\frac{-2-.\;1.\;---4567}{12-.\;1.\;-2-4567}=28.$ *Antrozous, Tomopeas, Molossops* (part), *Mormopterus* (part), *Platymops, Eumops* (part).

$\frac{-2-.\;1.\;-2-4567}{1--.\;1.\;-2-4567}=28.$ *Mystacops.*

$\frac{---.\;1.\;---4567}{12-.\;1.\;-2-4567}=26.$ *Macroderma, Lavia, Cardioderma.*

$\frac{-23.\;1.\;--3456-}{---.\;1.\;-23456-}=26.$ *Lichonycteris.*

$\frac{-23.\;1.\;--3456-}{1--.\;1.\;-2-456-}=26.$ *Vampyriscus.*

$\frac{-\,2\,3.\ 1.\ -\,-\,-\,4\,5\,6\,-}{1\,2\,-.\ 1.\ -\,2\,-\,4\,5\,6\,-}=26.$ *Diphylla.*

$\frac{-\,2\,-.\ 1.\ -\,-\,-\,4\,5\,6\,7}{1\,-\,-.\ 1.\ -\,2\,-\,4\,5\,6\,7}=26.$ *Eomops*, *Molossops*, (part), *Cheiromeles*, *Molossus.*

$\frac{-\,2\,-.\ 1.\ -\,2\,3\,4\,5\,-\,-}{-\,-\,-.\ 1.\ -\,2\,3\,4\,5\,6\,-}=24.$ *Nyctymene.*

$\frac{-\,2\,-.\ 1.\ -\,-\,-\,4\,5\,-\,-}{1\,2\,-.\ 1.\ -\,2\,-\,4\,5\,-\,-}=20.$ *Desmodus*, *Diæmus.*

It will be noticed at once that certain formulas are characteristic of particular groups, or rather that a given formula never occurs in widely separated families. Thus, among the genera with 34 teeth the formula $\frac{-\,2\,3.\ 1.\ -\,2\,3\,4\,5\,6\,-}{1\,2\,-.\ 1.\ -\,2\,3\,4\,5\,6\,7}$ is confined to the Pteropidæ, $\frac{-\,2\,3.\ 1.\ -\,-\,3\,4\,5\,6\,7}{1\,2\,-.\ 1.\ -\,2\,3\,4\,5\,6\,7}$ to the Phyllostomidæ, and $\frac{-\,2\,3.\ 1.\ -\,2\,-\,4\,5\,6\,7}{1\,2\,3.\ 1.\ -\,2\,-\,4\,5\,6\,7}$ to the Vespertilionidæ. Similarly among the 32-toothed genera the formula $\frac{-\,2\,-.\ 1.\ -\,2\,-\,4\,5\,6\,7}{1\,2\,3.\ 1.\ -\,2\,-\,4\,5\,6\,7}$ is peculiar to the Emballonuridæ, $\frac{-\,2\,3.\ 1.\ -\,-\,3\,4\,5\,6\,7}{1\,2\,-.\ 1.\ -\,2\,-\,4\,5\,6\,7}$ to the Phyllostomidæ, and $\frac{-\,2\,3.\ 1.\ -\,-\,-\,4\,5\,6\,7}{1\,2\,3.\ 1.\ -\,2\,-\,4\,5\,6\,7}$ to the Vespertilionidæ. The only formulas that occur in two or more families are $\frac{-\,2\,3.\ 1.\ -\,2\,3\,4\,5\,6\,7}{1\,2\,3.\ 1.\ -\,2\,3\,4\,5\,6\,7}=38$, found in the Natalidæ, Thyropteridæ, Myzopodidæ, and Vespertilionidæ, $\frac{-\,2\,-.\ 1.\ -\,-\,-\,4\,5\,6\,7}{1\,2\,3.\ 1.\ -\,2\,-\,4\,5\,6\,7}=30$ found in 9 genera of Vespertilionidæ and 1 of Molossidæ (*Mormopterus*), and $\frac{-\,2\,-.\ 1.\ -\,-\,-\,4\,5\,6\,7}{1\,2\,-.\ 1.\ -\,2\,-\,4\,5\,6\,7}=28$, found in two aberrant genera each of Vespertilionidæ (*Antrozous* and *Tomopeas*) and Molossidæ (*Molossops*, part, and *Mormopterus*, part). Even in these exceptional cases, however, the families involved are not distantly allied.

The only teeth that are never absent are the canines, the last premolar and the first molar, $\frac{-\,-\,-.\ 1.\ -\,-\,-\,4\,5\,-\,-}{-\,-\,-.\ 1.\ -\,-\,-\,4\,5\,-\,-}$ those never present the first upper incisor and the first upper and lower premolar, $\frac{-\,2\,3.\ 1.\ -\,2\,3\,4\,5\,6\,7}{1\,3\,3.\ 1.\ -\,2\,3\,4\,5\,6\,7}$. The reductions by which the various formulas have been produced appear to be as follows:

Incisors.—In the upper jaw the permanently missing incisor is without much doubt the first. This is indicated, as shown by Winge, by the correspondence of the two upper teeth with the two outer of the lower jaw when the maximum set is present, and also, even more strongly, by the general tendency throughout the group for the premaxillaries to become reduced, particularly along the inner edge. This would inevitably result in eliminating that part of the bone in which the first incisor grows. Of the remaining upper incisors it is invariably the outer that disappears first. This tooth may be seen in every stage of degeneration among the genera with 2–2 upper incisors, while in none is it distinctly more developed than its fellow, though in some of the long-tongued Pteropidæ and in certain genera of Glossophaginæ it is slightly the larger.

In the lower jaw the incisors become reduced from the outer side, a process mostly associated with narrowing of the anterior portion of the mandible. This process is especially well illustrated in the Molossidæ. The third incisor exists in some species of *Nyctinomus* and in *Mormopterus*, though reduced in size and crowded beneath the cingulum of the canine, the prominent cusp of which has assumed its function. In *Chærephon*, *Eumops*, *Promops*, and most species of *Nyctinomus* it has disappeared. In some species of *Molossops* the narrowing of the mandible has reduced and distorted the second incisor, the cingulum cusp of the canine in turn taking the functions of this tooth, while in other species of *Molossops*, in *Eomops*, *Cheiromeles*, and *Molossus* the second incisor has disappeared. There is little doubt that a similar course has been followed throughout the Microchiroptera. In the Megachiroptera no genera are known with 3–3 lower incisors, and it has been assumed by Winge that the first tooth is absent, a conclusion based chiefly on the correspondence in position of these teeth with the second and third of the upper jaw. The probability of this view seems heightened by the almost universally larger size of the outer tooth as compared with the inner, while in the Microchiroptera the reverse is normally the case. In the fruit-eating Phyllostomidæ, however, there is a similar reduction in the size of the inner incisor as compared with the outer, probably due to the action of the tongue, and I prefer to assume that the frugivorous habits of the Pteropidæ account for the relative size of these teeth also, and that the course of reduction in this group forms no exception to the rule, so far at least as regards the disappearance of the outer tooth first. The next incisor to disappear is, however, probably i_1, acted upon, as it must have been, by the tongue. In the genera *Dobsonia*, *Nesonycteris*, and *Notopteris* i_2 is therefore the remaining tooth.

Premolars.—Both above and below it is probably the first premolar that is permanently absent, though of this there is no proof. In the upper jaw the next to disappear is either pm^2 or pm^3. Three premolars are present in members of the families Pteropidæ, Phyllostomidæ, Natalidæ, Thyropteridæ, Myzopodidæ, and Vespertilionidæ. The anterior tooth (pm^2) is the more reduced in four of these, the Pteropidæ, Phyllostomidæ, Natalidæ, and Thyropteridæ, while the median (pm^3) is the smaller in the two others, the Myzopodidæ and Vespertilionidæ. While the evidence is therefore not conclusive for any of the other families, it appears safe to assume, from general considerations of relationship, that the small upper premolar is pm^3 in the Furipteridæ and pm^2 in the Nycteridæ, Megadermidæ, Rhinolophidæ, Hipposideridæ, Mystacopidæ, and Molossidæ. It seems probable that the degeneration of pm^2 is characteristic of the fruit-eating bats and their near relatives and that the reduction and disappearance of pm^3 occur in the insectivorous groups. As regards the small upper premolars, therefore, the families may be grouped as follows:

Dominant tooth, pm^2:	Dominant tooth, pm^3:
Megadermidæ.	Pteropidæ.
Rhinolophidæ.	Phyllostomidæ.
Hipposideridæ.	Natalidæ.
Myzopodidæ.	Furipteridæ.
Vespertilionidæ.	Thyropteridæ.
Mystacopidæ.	
Molossidæ.	

In the lower jaw pm_3 becomes reduced before pm_2 in all the groups of Microchiroptera, some members of which possess both teeth—the Rhinolophidæ, Phyllostomidæ, Natalidæ, Furipteridæ, Thyropteridæ, Myzopodidæ, and Vespertilionidæ. Hence it is probable that this is the normal process throughout the suborder. In the Megachiroptera, however, the opposite is taking place. In every known genus of Pteropidæ both pm_2 and pm_3 are present, but pm_2 is invariably the smaller tooth.

Molars.—While the posterior molar of both jaws is invariably reduced, it is never absent except in certain frugivorous and sanguivorous bats; that is, in various genera of Pteropidæ and Phyllostomidæ, and in all of the Desmodontidæ. The middle molar disappears in some of the Pteropidæ and Desmodontidæ, but is not yet known to be absent in any member of the Phyllostomidæ. The various ways in which these teeth are suppressed are as follows:

$\frac{5\ 6\ -}{5\ 6\ 7}$: *Harpyionycteris, Dobsonia, Artibeus* (part), *Vampyrodes, Mesophylla, Ariteus.*

$\frac{5\ 6\ -}{5\ 6\ -}$: *Balionycteris, Stylocteniun, Leptonycteris, Lichonycteris, Artibeus* (part), *Vampyriscus, Vampyressa, Chiroderma, Ectophylla, Pygoderma, Centurio, Sphæronycteris, Ametrida, Diphylla.*

$\frac{5\ -\ -}{5\ 6\ -}$: *Nyctymene, Cynopterus, Niadius, Thoopterus, Ptenochirus, Megærops, Sphærias, Scotonycteris, Epomophorus, Notopteris.*

$\frac{5\ -\ -}{5\ -\ -}$: *Desmodus, Diæmus.*

NORMAL CUSPS.

The typical Chiropterine dentition, which occurs essentially unmodified in at least some genera of every family except the Pteropidæ and Desmodontidæ, is as follows:

Upper incisors subulate, the point slightly curved backward; cingulum well developed, particularly on outer side; a posterior or lateral secondary cusp usually present on one or both teeth. Lower incisors with crown well differentiated from root, its length greater than height or width,[a] its cutting edge approximately horizontal, but with two evident notches. No striking differences in size or form between the teeth composing a series, except that the outer lower incisor is often wider than the others and with one or two blunt supplemental cusps posteriorly.

Canines simple, the upper larger than the lower and usually the highest tooth in the entire series. Cingulum well developed, that of the lower tooth conspicuously oblique. Shaft subterete, that of the upper tooth flattened or slightly concave on inner side, that of lower tooth similarly flattened or concave posteriorly. The shaft of the upper tooth at base occupies almost entire crown, while that of lower appears to be situated a little in front of middle of crown so that the posterior portion forms a slight heel.

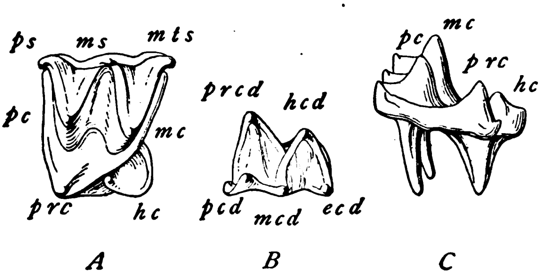

FIG. 4.—TYPICAL MOLAR TEETH OF AN INSECTIVOROUS BAT. *A*.—CROWN VIEW OF MAXILLARY MOLAR. *B*.—CROWN VIEW OF MANDIBULAR MOLAR. *C*.—SIDE VIEW OF MAXILLARY MOLAR.

ecd.—ENTOCONID.	*mts*.—METASTYLE.
hc.—HYPOCONE.	*pc*.—PARACONE.
hcd.—HYPOCONID.	*pcd*.—PARACONID.
mc.—METACONE.	*prc*.—PROTOCONE.
mcd.—METACONID.	*prcd*.—PROTOCONID.
ms.—MESOSTYLE.	*ps*.—PARASTYLE.

Premolars except *pm* [4] essentially like the canines, though very much smaller and with height of crown not conspicuously greater than length. Cingulum well developed, horizontal or slightly oblique. Posterior upper premolar much larger than either of the others, its cusp nearly as high as that of canine, from which it differs in shape in the presence of a conspicuous flange-like postero-external extension, with well-developed cutting edge and supported by a second root. Inner side of this extension flat, continuous, with flattened postero-internal surface of cusp; crown with a slight but evident postero-internal heel; cingulum well developed, often forming an anterior cusp at base of main cusp and occasionally another on heel.

The first and second upper molars resemble each other, though the second is usually the larger of the two. The crown (fig. 4) is much wider than long or high, three-rooted, and set obliquely, so that the outer portion is higher than the inner.[b] Its outer border is

[a] Length=diameter in axis of tooth row; width=diameter perpendicular to tooth row; height=distance from lower edge of cingulum to extremity of highest cusp.

[b] Strictly speaking, it is lower, more ventral, but in the position in which the teeth are always examined it is higher.

nearly straight, though usually marked by three projections and two indentations. The anterior border is unsymmetrically convex, the inner border variously truncate, rounded, or double convex, the posterior border with a concavity usually somewhat greater than convexity of anterior border. The inner posterior portion of the crown, bearing no large cusp, is usually flattened and often produced into a noticeable heel. The crown bears three main cusps, corresponding to those of the primitive tritubercular tooth, the inner anterior protocone (fig. 4, *prc.*), the outer anterior paracone (fig. 4, *pc.*), and the outer posterior metacone (fig. 4, *mc.*). Not infrequently the inner posterior hypocone (fig. 4, *hc.*) is also present, but in bats this cusp never attains a size sufficient to obscure the tritubercular aspect of the crown. Very rarely (in some Phyllostomidæ, particularly *Brachyphylla*, Plate VI, fig. 3) an intermediate cusp, the protoconule, occurs between protocone and paracone, and another, the metaconule, at inner base of metacone. At the extreme outer edge of the tooth are three small cusps, the anterior parastyle (fig. 4, *ps.*), the median mesostyle (fig. 4, *ms.*), and the posterior metastyle (fig. 4, *mts.*)[a]. The styles are connected with the main cusps of the outer row by four conspicuous, trenchant, slightly concave ridges, or flutings, the commissures (fig. 4), the first extending from parastyle to paracone, the second from paracone to mesostyle, the third from mesostyle to metacone, the fourth from metacone to metastyle. The commissures are approximately equal in length, though increasing slightly from first to fourth. Together with the cusps, which they connect, these ridges form a conspicuous W-pattern, the variations in the form of which are of much systematic importance. Of the three main cusps the protocone is situated at a lower level than the others. In form it is more robust, though usually less elevated; frequently it occupies nearly the entire inner section of the tooth. A narrow commissure extends forward from anterior side of this cusp, past base of para-

[a] In describing the molar teeth I have adopted the cusp nomenclature proposed by Osborn (*See* American Naturalist, XXII, p. 1072, December, 1888) as the most simple and convenient. The fact that it was based on a mistaken idea of the succession of cusps (*See* Gidley, Proc. Washington Acad. Sci., VIII, p. 106, July 10, 1906) is of little weight compared with the convenience of an exact name for each part of each tooth. The system of numbering the cusps (cusp No. 1=*ps*, No. 2=*ms*, No. 3=*mts*, No. 4=*pc*, No. 5=*mc*, No. 6=*pc*, No. 7=*hc*, etc.) proposed by Winge (Vidensk. Meddel. Naturhist. Foren., Kjøbenhavn, 1882, pp. 15–19, pl. III) and recently adopted by Andersen and Wroughton (Ann. Mag. Nat. Hist., 7th ser., XIX, p. 129, February, 1907) appears to be equally misleading as regards the succession of cusps, while it has the great disadvantage of furnishing no convenient names. With regard to the position of the primitive cusp: Winge placed it in the outer row (mesostyle), Osborn in the inner row (protocone), while the observations of Gidley, based on much more extensive material, shows almost conclusively that it is in the middle row (paracone).

cone to parastyle. A similar commissure occasionally extends posteriorly behind base of metacone to metastyle, but this is less constantly present. The paracone and metacone form the highest portion of the tooth; the metacone, together with third and fourth commissures, is usually larger than the anterior cusp and ridges. A faintly developed cingulum may usually be traced along anterior, inner, and posterior edges of crown. On outer side the cingulum is practically absent. The third molar is always smaller than either of the others, and some of its elements are reduced or absent. The process of reduction, which invariably proceeds from behind forward, varies, in teeth that can not be regarded as abnormal, from a mere shortening of the metastyle and fourth commissure, accompanied by diminution in height and diameter of the metacone, as seen in certain Rhinolophidæ (Plate I, fig. 1), to absence of everything except the parastyle, paracone, protocone, the first commissure, and a trace of the second, elements which are always present in this tooth. This condition is well illustrated by *Pachyotus* (Plate I, fig. 2).

In the mandible the first and second molars are also alike in form, with the second usually a little the larger. Five cusps are present, the outer anterior protoconid (fig. 4, *prcd.*), the inner anterior paraconid (fig. 4, *pcd.*), the inner median metaconid (fig. 4, *mcd.*), the outer posterior hypoconid (fig. 4, *hcd.*), and the inner posterior entoconid (fig. 4, *ecd.*). In general appearance these teeth resemble the outer higher portion of the upper molars reversed, the three inner cusps corresponding in form to the styles, and the protoconid and hypoconid to the paracone and metacone. The hypoconid is, however, lower than the protoconid, though the width of the tooth through the base of this posterior cusp is normally greater than that through the protoconid. The points of the cusps of the two rows are nearer together than in the upper teeth, and the commissures are shorter and more strongly concave, the third extending downward from point of hypoconid to base of metaconid. The two segments of the W are therefore disconnected, though this is not at first sight apparent when crowns are viewed from above. A well developed though not very prominent cingulum extends around outer base of crown from paraconid to entoconid. Third lower molar with posterior segment usually much smaller than the first, owing to the great reduction in size of both hypoconid and entoconid and the close approximation of these two cusps. In some Rhinolophidæ and Emballonuridæ, however, the tooth is practically identical with m_1 and m_2 (Plate II, fig. 1). In the first and second upper molars of insectivorous bats the metacone may be said to be the dominant cusp. It is not only the largest and the first to appear above level of alveolus as the teeth grow, but in the modifications to which the form of the crown is subjected the metacone invariably remains the most important cusp, drawing the protocone and paracone toward it, so to speak, and gradually absorbing them. This process may continue until the molars approximate the large premolar in form, though no genus is yet known in which the protocone and paracone are entirely obliterated. In the third upper molar, however, the paracone is the more permanent, as the successive shortening of the tooth from behind soon eliminates the metacone. In all the mandibular molars the protoconid is the chief cusp. Like the metacone of m^1 and m^2 it is the first to appear as the permanent teeth cut the gums, while it is the largest and most conspicuous cusp throughout all changes known to occur.

INTERRELATION OF TEETH.

Owing to the high cusps and deep hollows which cause the crowns to fit closely interlocked when the jaws are closed the interrelation between the teeth of the two jaws is very intimate, so much so that no modification can take place in a given region without its counterpart in the opposed structures. Lateral motion of the mandible, though supposed by at least one careful observer to be absent,[a] undoubtedly occurs to the extent of permitting the posterior surface of the lower canine to come in contact with the anterior surface of the corresponding upper tooth. In individuals with worn teeth the front face of the upper canine shows abrasion that could not otherwise be accounted for. This lateral motion is sufficient to give the opposed cusps and commissures of the molars the shearing action on which their effectiveness depends. In the typical condition with the maximum number of teeth present the interrelation of the two sets are as follows:

Incisors.—The inner upper incisor is opposed chiefly to i_3, the large median lobe of which fits into the notch formed by basal cusp of upper tooth; extreme tip of i^2 nearly in contact with inner edge of median lobe of i_2. Outer upper incisor with long posterior surface in contact with anterior surface of lower canine, the two teeth playing against each other with a shearing motion as the jaws close. The extreme tip of the tooth almost touches notch at posterior outer base of i_3 when jaws are tightly shut. Inner lower incisor not opposed to any tooth in upper jaw.

Canines.—The chief opposition of the canines is a shearing contact between the anterior inner edge of the upper tooth and the posterior outer edge of lower. The point and inner surface of the upper tooth also plays against the first lower premolar, or rather its inner posterior edge cuts any food material pressed upon it by the two small

[a] Gosse, Ann. and Mag. Nat. Hist., XX, p. 426, December, 1847. The animal observed was a *Noctilio*, and the motion of the jaws is described as vertical only.

premolars together. In the genera with large, triangular-crowned trenchant premolars (most Phyllostomidæ, Natalidæ, etc.) the inner posterior edge of the upper canine has become knife-like. It is crossed by the anterior edge of the anterior lower premolar with a true shearing motion, while its cingulum is so formed as to fit the point and posterior edge of the smaller tooth.

Premolars.—In bats with terete premolars the upper and lower teeth do not come actually in contact, those of the mandible lying distinctly nearer to the sagittal plane than those of the upper jaw. The point of pm^2 comes slightly below and behind that of pm_3, while that of pm_4 approaches pm^3 and the cingulum of pm^2. The large upper premolar (pm^4) shears with its interior inner surface close to but not in contact with the posterior outer surface of pm_4, while its main cusp and posterior cutting edge play against the cusp and anterior outer surface of *prd* 1[a], the extreme point of which nearly touches surface of heel. When the premolars are trenchant the anterior edge of each lower tooth shears against the posterior inner edge of the preceding upper tooth, while the posterior edge cuts upon the anterior edge of the corresponding tooth in the upper jaw. The relations of the first lower premolar to the upper canine have already been explained.

Molars.—As the distance between the two rows of mandibular teeth is sensibly less than that between the opposed sets,[b] it follows that to obtain a uniformly shearing action of the molars the jaws must be thrown either to the right or left before the beginning of the stroke. When the mandible is at its extreme lateral position the outer and inner cusps of the lower teeth are closely opposed, respectively, to the styles and highest cusps of the upper teeth—that is, in the outer rows; *prcd* 1 to *ps* 1, *hcd* 1 to *ms* 1, *prcd* 2 to *mts* 1 and *ps* 2, *hcd* 2 to *ms* 2, *prcd* 3 to *mts* 2 and *ps* 3, *hcd* 3 to *ms* 3, in the inner rows, *pcd* 1 to the apex of pm^4, *mcd* 1 to *pc* 1, *ecd* 1 and *pcd* 2 to *mc* 1, *mcd* 2 to *pc* 2, *ecd* 2 and *pcd* 3 to *mc* 2, *mcd* 3 to *pc* 3, *ecd* 3 to *mc* 3. The triangles of the lower teeth with their concave blade-like edges (commissures) tilted slightly inward, and terminated externally by the recurved cusps face the spaces between the similarly concave but outward-tilted edges of the upper triangles, each lower triangle lying in front of the corresponding triangle of

[a] For the sake of brevity the cusps of the three molars may be referred to by their abbreviation followed by the numbers 1, 2, and 3. Thus *prd* 1=protoconid of first lower molar; *mc* 3=metacone of third upper molar.

[b] In a specimen of *Noctilio* (No. 37435, Mona Island, West Indies), the greatest distance between outer edges of upper toothrows is 12.2 mm.; between outer edges of lower toothrows, 8.9 mm. In *Myotis californicus* (No. 25826, San Diego County, California) the same measurements are, respectively, 4.9 mm. and 2.8 mm.

the upper tooth. As the jaws close the cutting edges pass each other with a shearing motion, c_1 working against posterior edge of pm^4, c_2 against c^1, c_3 against c^2, c_4 against c^3, and so on to the end of the series. At the same time a less important though equally definite action takes place between the innermost cusps of both sets of teeth. This consists principally of the passing of the posterior inner side of *mcd* 1, 2, and 3 and anterior inner side of *ecd* 1, 2, and 3 across the inner surface of the three protocones, the point of the large cusp in each instance fitting closely to the angle between the two small ones. The paraconid of m_2 and m_3 also comes within cutting distance of the hypocone of m^1 and m^2 when it is large enough to be functional. As the stroke finishes each hypoconid scrapes through the hollow at middle of opposed crown, and finally comes in opposition with inner side of corresponding protocone, across which it passes as the jaw is moved downward and toward the opposite side to take its position for the next stroke. At the same time each protoconid passes through the space at front of its corresponding upper tooth and comes similarly in opposition with posterior heel of the tooth in front, or with its hypocone when this cusp is present. While the full stroke just described is taking place on one side, a somewhat reversed half stroke occurs on the other, the inner surface of the long outer cusps of the lower teeth cutting against the outer side of the opposed inner cusps of the upper teeth, the action between them being the exact reverse to that which takes place near the end of the full stroke. As the recovery for the next stroke proceeds, the rounded convex outer surface of the protoconids and hypoconids pass through the depressions between the paracones and metacones, while the similarly rounded inner surfaces of the upper teeth pass between the main cusps of the lower teeth, the result being a grinding and crushing action which must be very effective in the final trituration of small particles of food.

The foregoing description of the molars in action is primarily based on the genus *Noctilio*, in which the molars are large enough to be readily examined and in which their effectiveness of structure is at its maximum. The cutting apparatus is essentially the same in all bats with normal teeth, though its apparent effectiveness is in some instances reduced without any considerable change in the form of the cusps. Thus, in *Myotis myotis* the protoconids and hypoconids are so long and straight that they are less readily brought in contact with the styles, the stroke apparently losing thereby. In some Phyllostomidæ the lateral motion of the mandible is lessened by the large size of the canines, which in certain genera develop large cutting edges. When this occurs the outer portion of the upper molars appears to be invariably reduced, the corresponding change in the lower teeth showing itself in the lessened transverse diameter of the triangles.

This is well illustrated by the genera *Anthorhina* (canines small, lateral motion of mandible free, outer portion of upper teeth well developed), *Phyllostomus* (canines large, with strongly trenchant edges, lateral motion reduced, outer portion of upper teeth relatively less developed), and *Vampyrus* (canines very large, lateral motion nearly absent, outer portion of upper teeth noticeably degenerate), a series which also shows the exceedingly nice adjustment between the different parts of the cutting apparatus, since the gradually increasing size of the canines is closely followed by alterations in the cusps throughout the series of molar teeth.

MODIFICATIONS OF CUSPS.

While the majority of bats retain, together with their insectivorous habits, the typical primitive dentition almost unmodified, the members of certain groups show conspicuous changes in the form as well as in the function of the teeth. These alterations, which proceed chiefly by suppression of the original cusps, follow two main lines, one leading to a flat-crowned type of tooth effective for crushing the pulp of fruits, the other to a narrow, blade-like form most perfectly developed in those bats which subsist on blood.

Among insectivorous bats a third line of divergence seems to be incipient. In this the molars tend to assume a single-cusped form closely resembling the fourth premolar. This is accomplished by the reduction of the styles and commissures and by the blending of the protocone and paracone with the metacone and of the paraconid and metaconid with the protoconid. In the most extreme instance known, however, it is not complete, as the three cusps are still recognizable. The first step in this direction is seen in various unrelated genera and consists in the reduction of the mesostyle together with the second and third commissures, accompanied by a distinct drawing together of the three main cusps, a noticeable diminution in the size of the protocone and paracone, and the partial fusion of the latter with the metacone. In the mandibular teeth the corresponding change is seen in the reduced area of the triangle formed by the protoconid, paraconid, and metaconid as compared with the basal area of the crown. This condition occurs in the Nycteridæ, Megadermidæ, the genus *Vampyrus* (Plates I, II, fig. 3) and in *Pachyotus* (Plates I, II, fig. 2). In the Megadermidæ it shows various degrees of development, being well advanced in *Megaderma*, *Macroderma*, and *Cardioderma*, merely suggested in *Lavia*. In *Pachyotus* (Plates I, II, fig. 2) it has reached the same stage as in *Megaderma* in the maxillary teeth, while the mandibular teeth are slightly further advanced, having the second triangle noticeably smaller than the first. The next stage occurs in the genus *Harpiocephalus* (Plates I, II, fig. 4). In this the mesostyle has disappeared, together with the second and third commissures, and the parastyle and metastyle are closely approximated, though distinct and unusually large. The three main cusps are much closer together than in any other genus of bats, and the protocone and paracone are so reduced as to appear like mere appendages to the large metacone. The whole tooth thus rather closely resembles a normal fourth premolar, the first and fourth commissures representing the anterior and posterior cutting edges, respectively, and the metacone the main cusp. In the lower molars all of the cusps except the protoconid are so reduced that the teeth approximate the form of the lower premolars. While *Harpiocephalus* represents the extreme of this peculiar variation so far as at present known, it would not be surprising to find genera in which the metacone alone remains, thus forming the complete parallel to the similar changes which have resulted in the suppression of all but the paracone in such genera of Insectivora as *Centetes*, *Ericulus*, and others.[a]

The next and more important series of changes is that leading to the flat-crowned crushing tooth. This type of dentition, characteristic of fruit-eating bats, reaches its highest development in the Pteropidæ, but is found in various intermediate conditions in members of the Phyllostomidæ. As no transitory stages are known in the Pteropidæ, the conditions in the Phyllostomidæ present much the greater interest.

Among the Chilonycterinæ and Phyllostominæ, the two most primitive groups of the Phyllostomidæ, the teeth usually show no special modifications (Plates III, IV, fig. 1). The premolars, and occasionally the canines, are trenchant, and the molars retain their outer cusps and commissures well developed and functional, except where the lateral motion of the jaws is lessened by the excessive development of the canines, the extreme of which condition is seen in *Vampyrus* (Plates I, II, fig. 3). Such modification as occurs tends, therefore, rather toward the narrow, blade-like type.

In the Glossophaginæ the first stage in the flattening process is clearly seen (Plates III, IV, fig. 2). The molars of the upper jaw have nearly lost the mesostyle, while the parastyle in m^1 and in m^2 is practically indistinguishable from the base of the paracone. The metastyle, however, remains long, though low; fourth commissure well developed, but the other three reduced to a mere trace. In m^3 the parastyle remains long, while it is the metastyle that has disappeared. Paracone and metacone well developed, the metacone, as usual, the larger. Protocone low and broad, extending backward along inner margin of crown as a noticeable ridge. The three main cusps are wide apart, and the space between the protocone and those of the outer row is less encroached upon by the bases of the cusps. It thus suggests the first trace of the flattened crushing surface. The man-

[a] See Gidley, Proc. Washington Acad. Sci., VIII, p. 94, July 10, 1906.

dibular molars retain all of their cusps, but these are low and rounded. This is especially true of the paraconid, which is much the lowest of the cusps on inner side. The protoconid and metaconid, as well at the hypoconid and entoconid, stand nearly opposite each other, the anterior pair united by a rather high ridge, the remnant of the second commissure.

Another stage is represented by the Sturnirinæ (Plates III, IV, fig. 3). Here the styles and commissures have completely disappeared, leaving a parallel-sided, squarish, or oblong crown, the median portion of which is occupied by a broad groove nearly continuous from one tooth to the next. In the upper teeth the three primitive cusps are present and in practically their normal position, though all are much hollowed out from the inner side. The protocone is large, extending along entire lingual side of tooth. Paracone smaller, but better defined than metacone. Third molar with the elements so reduced that the homologies of the cusps are doubtful. In the lower teeth the reduction of the paraconid, begun in the Glassophaginæ, is carried so far that this cusp is absent in m_2 and m_3, while in m_1 it is decidedly the smallest of those on lingual side. The other cusps stand opposite each other in pairs, the metaconid facing the protoconid and the entoconid facing the hypoconid. They are of much the same character as those of the upper teeth, being placed at extreme edge of crown and with the inner side hollowed out to form the longitudinal furrow. Traces of the four principal cusps are visible in the posterior tooth.

In the typical genus of Phyllonycterinæ (Plates III, IV, fig. 4) a stage is reached in which the lower molars closely resemble those of the Pteropidæ, while the upper teeth remain more as in the Sturnirinæ. From those of the latter group the maxillary teeth differ, principally in the lowering of the protocone, so that the longitudinal groove becomes rather a broad, nearly flat, crushing surface. The paracone and metacone are also flattened, but their distinctness remains evident. In the slight hollow between them may often be seen the last trace of the mesostyle (not shown in the figure). In the mandible the crowns of the molars are flat, with a slightly raised rim, on which is faintly indicated a trace of the protoconid, metaconid, and hypoconid. So faint are these traces that they might readily escape notice. In m_1 the anterior portion of the crown is somewhat narrowed, bearing a rather prominent cusp, probably the protoconid, on the anterior inner side of which there is a slight concavity. This hollow may represent the space between protoconid and paraconid. A glance at fig. 4, Plate IV and Plate VIII, will show the striking similarity between these teeth and those of the Pteropidæ. Before passing to the latter, however, it may be well to describe a very important aberrant type of crushing dentition found in the Phyllostomidæ.

This aberrant type (Plates V and VI) is found throughout the large subfamily Stenoderminæ. In the maxillary teeth the paracone and metacone, with occasionally an intermediate cusp, perhaps the remnant of the mesostyle, form a cutting edge at outer margin, usually with a distinct cingulum in the normal position and an equally well-developed ridge on inner side extending from point or base of paracone to posterior base of metacone; the crowns are increased in width to form a large crushing area, the surface of which is usually roughened by folds or wrinkles, from which may be developed a definite protoconule and metaconule (Plate VI, fig. 3); and a very large hypocone is often as a conspicuous postero-internal heel, which, in the most extreme instances, occupies the entire lingual side of the tooth and assumes the appearance of a protocone, causing the latter to occupy the relative position of a protoconule, though always recognizable by its large size (Plate VI, fig. 2). In the mandibular teeth a similar widening and flattening of the crowns has taken place; the surface of the enamel is of the same character; the paraconid is absent, and the metaconid and entoconid tend to assume a subulate form, rising abruptly from the flattened surface of the crown (Plate V, fig. 2).

The Stenodermine dentition most nearly resembles the Sturnirine type, and it seems probable that the two had a common origin, though the Stenodermine type has now become much the more aberrant. Among the different genera there is considerable variation in the details of the tooth structure, though never enough to obscure the peculiar appearance characteristic of the type. The nearest approach to the Sturnirinæ is seen in *Vampyrops* and *Chiroderma*, both of which lack all definite trace of the hypocone.[a]

In the former the surface of the crowns is nearly smooth and the inner cingulum of the outer cusps is well developed, while in the latter the crown surface is coarsely wrinkled and the inner cingulum is absent. Either genus is readily distinguishable from *Sturnira* by the increased breadth of the crowns and the consequent replacing of the longitudinal groove by a wide crushing area. In *Uroderma* (Plate VI, fig. 1), the second upper molar shows a small shelf-like postero-internal projection, while in the first molar this has increased in size and assumed a distinct cusp-like form. About the same stage is represented by the first molar of *Pygoderma*, while an evident trace of the small hypocone can usually be detected in the greatly reduced second molar. A very rudimentary metaconule is present in m^1 and m^2 of *Uroderma*, and a similar but larger cusp is represented in the

[a] The faintest possible suggestion of this cusp, or rather of a cingulum in the position that the cusp occupies in other genera, is present in some specimens of *Vampyrops lineatus*.

same teeth of *Stenoderma* as figured by Peters.[a] *Artibeus* (Plate V, fig. 1), shows the hypocone of m^1 large and in characteristic position for the group—that is, mostly lingual to the protocone. In m^2, however, the condition is about the same as in *Uroderma*. The genera *Ariteus*, *Phyllops*, *Ardops*, and *Sphæronycteris* have the hypocone of m^2 well developed and of the same form as that in m^1, though not as large. This is accompanied by an increased widening of the crowns. The maximum of widening is seen in the first molar of *Centurio* (Plate VI, fig. 2), where the distance from hypocone to protocone is nearly equal to that from protocone to paracone, and the points of these three cusps are exactly in line with each other.

Between the bases of the paracone and metacone in the first and second molar of *Uroderma* (Plate VI, fig. 1) may be detected a slight depression, the middle of which is occupied by a faintly marked groove. This is probably the first trace of the peculiar structure that forms so conspicuous a feature in the second molar of each jaw in *Ectophylla*.

As already pointed out, a minute metaconule is present in *Uroderma* and *Stenoderma*, apparently developed as a specialization of the rugosity of the crushing surface. The same cusp is present in the first and second molars of *Brachyphylla* (Plate VI, fig. 3) as a low though evident longitudinal or oblique ridge, best developed in m^2. In the first molar there is a protoconule of somewhat the same size and form, though smaller and more strictly longitudinal. This cusp becomes of considerable importance in the second molar, where its height and its basal area are both fully half as great as in the protocone, which the new cusp resembles in form. So strong is this resemblance that were it not for its position on the crown and for the reversal of the relative sizes the protoconule might be mistaken for the protocone and the protocone for the hypocone of a somewhat aberrant tooth of the usual Stenodermine type. In the third molar a similar cusp is present, though not as high or as well defined. The inner margin of the teeth is without trace of cingulum or shelf-like rudiment of the hypocone. In the mandicular teeth the intermediate cusps are rather well developed in m_2, though absent or barely indicated in m_1 and in m_3. When present they assume the form of low, subterete elevations at base of metaconid and entoconid. The very peculiar arrangement of cusps in this otherwise primitive genus is probably a development from a type in which the teeth resembled those of *Chiroderma*.

The Pteropine dentition (Plates VII, VIII) though at first sight strikingly different from that of the typical Microchiroptera, has undoubtedly been developed from a primitive type similar to that

[a] Monatsber. k. preuss. Akad. Wissensch., Berlin, 1876, plate facing p. 434.

retained by the otherwise more highly modified insectivorous bats through a series of stages analogous to those that may now be seen in the Phyllostomidæ. Owing to the early and complete assumption of frugivorous habits these intermediate stages have disappeared among the Megachiroptera, and no fossil forms have yet been found in which they may be traced. While no genus of Microchiroptera, however strictly frugivorous its members may be, has teeth exactly resembling those of the Pteropidæ, the change that would be necessary to pass between such dentitions as those of *Pteropus* and *Phyllonycteris* is much less than those which can be observed step by step from the latter back to the normal primitive condition of the cusps.

In its simplest and most characteristic form, as seen, for instance, in *Pteropus* (Plates VII, VIII, fig. 1) this dentition is immediately recognizable by the bluntly rounded incisors, large and conspicuously ridged canines, and by the striking uniformity of the cheek teeth. The first and last cheek tooth both above and below is usually small or deciduous, its terete crown flat, concave, or slightly cusped. The others have oblong or squarish crowns bearing a large outer and a small inner elevation, these elevations high and cusp-like in the more anterior teeth, becoming successively lower toward the posterior end of the series, where, particularly in the lower jaw, they may be scarcely more than the rims of the conspicuous longitudinal median groove. The distinction between the inner and outer cusp is not always evident, particularly in the first large tooth of the lower jaw, and the space between them is usually somewhat filled in by the ridge-like inner bases of the cusps. Anteriorly where the cusps are high the crushing surface is strongly oblique, while posteriorly, where the cusps are low, it is nearly horizontal. While no intermediate stages are known directly connecting this type of dentition with normally cusped ancestral forms, it is safe to assume, from analogy with the frugivorous Phyllostomine bats, that in the upper molars the two cusps are the protocone and paracone and in the lower molars the protoconid and metaconid.

Teeth essentially like those of *Pteropus* are found in many genera of Megachiroptera. In *Styloctenium* and the long-tongued genera simplification has taken place, in the first instance by broadening and flattening the cusps and ridges until a nearly cushion-shaped crown results, in the second (Plates VII, VIII, fig. 4) by reduction in the size of both crowns and elevations. The more usual type of divergence is seen in the tendency to produce additional cusps and ridges not homologous with the parts of the primitive insectivorous tooth. This is well illustrated by *Nyctymene* (Plates VII, VIII, fig. 2) and *Niadius* (Plates VII, VIII, fig. 3). In the former the first, second, and third of the large mandibular cheek teeth develop an extra cusp behind the protoconid, while the upper canine has a new cusp on the outer side of its tip. In *Niadius* the extra canine cusp is at the posterior base, while the additions to the cheek teeth take the form of small terete cusps near middle of crushing surface. The latter region is occupied by a longitudinal ridge in *Dobsonia*. In *Pteralopex* and *Harpyionycteris* the tendency toward supernumerary cusps is carried to the greatest extreme, the penultimate cheek tooth of the latter, both above and below, containing no less than three well-developed, subequal cusps on each side, the resulting form closely resembling that of the molars of the Jurassic *Bolodon*.

The last series of changes leads to the cutting teeth of the sanguivorous bats. The chain of intermediate stages is here less complete than in that leading to the fruit-crushing type, as the teeth of the Desmodontidæ are so excessively modified as to stand quite alone. The first step in this direction may apparently be seen, however, in the Hemiderminæ and in the genus *Erophylla*.

The teeth of *Hemiderma* (Plates IX and X, fig. 1) are not conspicuously different from those of *Glossophaga*. The mesostyles have, however, completely disappeared, and the parastyles and metastyles have practically lost their identity in the large bases of the paracones and metacones. The two outer main cusps are well developed, and their edges, together with what remains of the commissures, are strongly trenchant. Protocone low, short, and rounded, widely separated from the outer cusps and forming entire inner section of crown. In the lower molars the original cusps may all be traced, but those of the outer row stand not far from middle of crown, where they form a nearly straight cutting edge, while those of the inner row are much reduced. The paraconid is present, however, in all three teeth, though in the first it is less developed than in the others, while the entoconid, though low and indistinct, is present as a postero-internal rim in all but the last. The process of reduction begun in this genus is carried much further in *Rhinophylla*. The protocone has here practically disappeared, being represented by a mere inner rim to the outer cusps, which now stand close to lingual side of crown. The paracone and metacone are low and very narrow, producing a faintly two-lobed cutting edge; paracone lower than metacone. On the outer side the crown is relatively wide, and the basal remnants of the parastyle and metastyle are evident. The corresponding changes in the lower molars have resulted in a form of crown scarcely distinguishable from that of the premolars, except by their slightly greater length and more distinct main cusp (protoconid). On close inspection the last trace of the hypoconid may be detected, appearing in profile as a mere backward prolongation of the median cutting edge, but showing a distinctly indicated thickened base when viewed from above.

From such teeth as those of *Rhinophylla* to the excessively modified molars of the Desmodontidæ (Plates IX and X, fig. 3) the transition could readily be made. The cutting edge in these minute teeth therefore probably represents the combined paracone and metacone in the maxillary teeth and the protoconid and hypoconid in the lower jaw. It is useless, however, to attempt to suggest exact homologies for the three cusps indicated in the posterior lower cheek tooth of *Desmodus*, as it is probable that these are mere secondary growths.

Another suggestion as to the probable origin of the Desmodontine molars is furnished by the teeth of *Erophylla* (Plates IX, X, fig. 2). These differ from those of *Phyllonycteris* (Plates III, IV, fig. 4) in their distinct narrowing and in the development of a well-defined cutting edge along the outer portion of the crowns, both above and below.

Order CHIROPTERA.

1779. *Chiroptera* BLUMENBACH, Handbuch der Naturgeschichte, p. 74.

Geographic distribution.—Eastern and western hemispheres to the northern and southern limits of tree growth. In the Pacific Ocean the range of the order extends to the Galapagos Islands and Hawaii from America, and to New Zealand, Samoa, the Caroline and Ladrone Islands from Asia.

Characters.—Mammals with the front limbs modified for true flight, the fingers greatly elongated (the third usually at least equal to head and body) and joined together by a membrane which extends to sides of body and legs; shoulder girdle much more developed than pelvis, the sternum usually keeled; knee directed backward owing to rotation of leg for support of wing membrane.

Number of forms.—There are at present recognized about 900 forms of Chiroptera, a number probably representing considerably less than half of what will eventually be known.

Principal subdivisions.—The families of bats fall naturally into two main groups representing, as Winge has shown, two distinct stages in the specialization of the anterior limbs for flight. They may be distinguished as follows:

KEY TO THE SUBORDERS OF CHIROPTERA.

Second finger retaining an evident degree of independence, its ungual phalanx present; humerus with trochiter and trochin small, the former never articulating with the scapula; mandible with angular process broad and low or practically absent; margin of ear forming a complete ring ________________________________ MEGACHIROPTERA, p. 44.

Second finger scarcely if at all independent from third, its ungual phalanx absent; humerus with trochiter and trochin large, the former usually articulating with the scapula; mandible with angular process well developed, long and narrow; margin of ear not forming a complete ring ____________________________________ MICROCHIROPTERA, p. 78.

Remarks.—The distinction between these two groups is so sharp and definite that it is a matter of great convenience to recognize the Megachiroptera and Microchiroptera as suborders, though it may be questioned whether they are of equal structural importance with other suborders of Mammalia.

Suborder MEGACHIROPTERA.

1821. *Fructivoræ* Gray, London Medical Repository, XV, p. 299, April 1, 1821.
1872. *Frugivora* Gill, Arrangement of the Families of Mammals, p. 18, November, 1872.
1875. *Megachiroptera* Dobson, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 346, November, 1875.
1878. *Megachiroptera* Dobson, Catal. Chiropt. Brit. Mus., p. 2.
1899. *Megachiroptera* Matschie, Flederm. des Berliner Mus. für Naturk., p. 1.

Geographic distribution.—Tropical and subtropical regions of the Old World, east to Australia, Samoa, and the Caroline Islands.

Characters.—In addition to the characters given in the key (p. 43) the following may be mentioned: Tragus never present; skull with rostral portion variable in length, but never specialized in form; premaxillary well developed, usually free, always without palatal branch; postorbital processes well developed; teeth very highly modified for frugivorism, the cheek teeth of upper and lower jaws closely resembling each other in form; molars normally with two blunt cusps on anterior portion of crown, these representing the protocone and paracone in upper teeth, the protoconid and metaconid in lower; mandibular incisors never more than 2–2.

Number of forms.—According to Matschie about 150 recognizable forms of Megachiroptera are now known.

Principal subdivisions.—The Megachiroptera are all members of one family, the Pteropidæ.

Remarks.—Though the structure of the teeth presents a high degree of specialization, the development of the wings and the form of the skull represent an evolutionary stage much nearer to normal mammals than that which has been reached by the Microchiroptera. The index finger retains its ungual phalanx and much of its primitive independence from the third digit; the humerus has not yet developed a high, flange-like deltoid crest for muscular attachment, nor has it acquired a secondary articulation with the scapula. Finally the whole general appearance of the skull is more nearly that of an ordinary mammal and less distinctively that of a bat. On the other hand, the molar teeth have nearly lost all distinct traces of their primitive structure. That this fact is of relatively little importance is shown, however, by the existence in a family of Microchiroptera, the Phyllostomidæ, of a complete series of stages connecting the normal form of the teeeth with one nearly resembling that of the Megachiroptera. But, even if this were not true, in a group of characteristically volant animals the chief taxonomic importance must be assigned to the development of the wings.

Family PTEROPIDÆ Gray.

1821. *Pteropidæ* Gray, London Medical Repository, XV, p. 299, April 1, 1821.
1827. *Pteropina* Lesson, Man. de Mammalogie, p. 99.
1831. *Pteropina* Bonaparte, Saggio di una distrib. metodica degli Anim. Vert., p. 15.
1838. *Pteropodidæ* Bonaparte, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.
1838. *Pteropina* Gray, Mag. Zool. and Bot., II, p. 502, December, 1838.
1854. [*Pteropidæ*] "Ptéropidés" Gervais, Hist. Nat. des Mamm., p. 184.
1865. *Pteropi* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256.
1872. *Pteropodidæ* Gill, Arrangement of the Families of Mammals, p. 18.
1875. *Pteropidæ* Dobson, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 346, November, 1875.
1878. *Pteropodidæ* Dobson, Catal. Chiropt. Brit. Mus., p. 3.
1892. *Pteropodidæ* Winge, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.
1899. *Pteropodidæ* Matschie, Flederm. des Berliner Mus. für Naturk., p. 1.

Geographic distribution.—Same as that of the suborder Megachiroptera.

Characters.—As in the suborder.

Principal subdivisions.—The family Pteropidæ is divisible into four groups worthy of recognition as subfamilies.

KEY TO THE SUBFAMILIES OF PTEROPIDÆ.

Premaxillaries broadly united anteriorly.
 Molars with blunt, indistinct cusps............... Nyctymeninæ, p. 75.
 Molars with at least 5 sharp cusps each...... Harpyionycterinæ, p. 77.
Premaxillaries separate or barely united anteriorly.
 Tongue not highly extensible; molars and incisors not specially reduced in size; braincase never strongly deflected; upper surface of mandibular symphysis forming conspicuous angle with alveolar line, Pteropinæ, p. 45.
 Tongue highly extensible; molars and incisors considerably reduced in size; braincase strongly deflected; upper surface of mandibular symphysis parallel with alveolar line.................. Kiodotinæ, p. 68.

Subfamily PTEROPINÆ.

1878. *Pteropodidæ* Dobson, Catal. Chiropt. Brit. Mus., p. 3 (part; *Pteropi* part).
1891. *Pteropodinæ* Flower and Lydekker, Mammals living and extinct, p. 650.
1899. *Pteropodidæ* Matschie, Flederm. des Berliner Mus. für Naturk., p. 1 (part).

Geographic distribution.—The same as that of the Megachiroptera (p. 44).

Characters.—Premaxillaries separate, though usually in contact anteriorly, retaining their distinctness throughout life; bony palate, narrowing gradually behind tooth rows, the width of interpterygoid fossa, including hamulars, distinctly less than distance between posterior molars; canines parallel when jaws are closed; cheek teeth well developed, without unusual development of cusps; tongue not specially elongated.

Principal subdivisions.—The Pteropinæ, the largest group of the Pteropidæ, includes at least 19 genera.

KEY TO THE GENERA OF PTEROPINÆ.

Occiput so little deflected that alveolar line projected backward falls outside of skull or at most passes through condyle.
  Upper cheek teeth more than 3–3.
    Upper incisors with widened, trenchant crowns; calcar absent. *Sphærias*, p. 53.
    Upper incisors styliform; calcar present.
      Lower incisors 2–2; outer upper incisor nearly as long as inner.
        Dentition normal; canines with secondary cusp; crown of cheek-teeth without median ridge.
          Crowns of molars longer than broad, without evident median cusp......*Cynopterus*, p. 47.
          Crowns of molars subquadrate, pm_4 and m_1 with distinct terete cusp slightly in front of middle of crushing surface......*Niadius*, p. 49.
        Dentition unusually heavy; canines without secondary cusp; crown of pm_4 and m_1 with distinct median ridge. *Thoopterus*, p. 50.
      Lower incisors 1–1; outer upper incisor conspicuously shorter than inner.
        Upper cheek teeth 5–5......*Balionycteris*, p. 52.
        Upper cheek teeth 4–4.
          Rostrum nearly straight above; tail present. *Ptenochirus*, p. 51.
          Rostrum strongly concave above; tail absent. *Megærops*, p. 51.
  Upper cheek teeth 3–3.
    Cheek teeth all subterete......*Scotonycteris*, p. 64.
    Cheek teeth not all subterete.
      Dorsal and ventral profiles of skull strongly converging anteriorly; lower molars with one cusp on outer side. *Epomophorus*, p. 65.
      Dorsal and ventral profiles of skull nearly parallel; lower molars with two cusps on outer side......*Hypsignathus*, p. 67.

Occiput so much deflected that alveolar line projected backward passes through or above root of zygoma.

Posterior portion of occiput not distinctly elongated and tubular.

Audital bulla with annular meatus; first lower molar scarcely longer than second ---------- *Rousettus*, p. 54.

Audital bulla with tubular meatus; first lower molar nearly as long as second and third together ---------- *Pterocyon*, p. 55.

Posterior portion of occiput distinctly elongated and tubular.

Incisors $\frac{2-2}{2-2}$.

Canines with well-developed secondary cusps -- *Pteralopex*, p. 60.

Canines without secondary cusps.

First and second lower molars with broad, flat postero-internal heel in addition to the two longitudinal ridges ---------- *Acerdon*, p. 59.

First and second lower molars without postero-internal heel.

Upper molariform teeth (pm^4 m^1 and m^2) subquadrate in outline, essentially alike in form; crown diameter of inner mandibular incisor about $\frac{1}{4}$ that of outer ---------- *Desmalopex*, p. 60.

Upper molariform teeth (pm^4 m^1 and m^2) not subquadrate, differing notably from each other in form; crown diameter of inner mandibular incisor about $\frac{1}{2}$ that of outer ---------- *Pteropus*, p. 56.

Incisors less than $\frac{2-2}{2-2}$.

Lower incisors 2–2; upper incisors wide apart ---- *Boneia*, p. 61.

Lower incisors 1–1; upper incisors close together.

Upper incisors 1–1; cheek teeth normal ---- *Dobsonia*, p. 63.

Upper incisors 2–2; cheek teeth with rounded crowns and broad low ridges ---------- *Styloctenium*, p. 62.

Genus CYNOPTERUS F. Cuvier.

1825. *Cynopterus* F. CUVIER, Des Dents des Mammifères, p. 248 (*Pteropus marginatus* Geoffroy=*Vespertilio sphinx* Vahl).

1828. *Pachysoma* IS. GEOFFROY, Dict. Class. Hist. Nat., XIV, p. 703, September, 1828. (*Pteropus melanocephalus*, *P. titthæcheilus*, *Pachysoma diardii*, *P. duvaucelii*, *P. brevicaudatum*). Not *Pachysoma* MacLeay 1821.

1878. *Cynopterus* DOBSON, Catal. Chiropt. Brit. Mus., p. 80 (part; *marginatus*, *scherzeri*, *brachysoma*).

1899. *Cynopterus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 74 (subgenus).

Type-species.—*Pteropus marginatus* Geoffroy=*Vespertilio sphinx* Vahl.

Geographic distribution.—India and the Malay region, east to the Philippine Islands.

Number of forms.—As here restricted, the genus *Cynopterus* contains about a dozen known forms, most of them closely related to *C. sphinx*.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -2\ 3\ 4\ 5\ -\ -}{1\ 2\ -.\ 1.\ -2\ 3\ 4\ 5\ 6\ -},\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{1-1}{2-2}=30.$$

Teeth without special modifications. Upper incisors in contact with each other, but separated from canine by wide diastema, nearly terete, their crowns slightly flattened antero-posteriorly, the inner tooth of each pair slightly longer than the outer. Lower incisors somewhat flattened laterally, the outer of each pair slightly the larger; cutting edge blunt, nearly flat, though divided by a shallow notch into two inconspicuous lobes. Canines both above and below with a secondary cusp on inner side formed by a slight prolongation of the cingulum and somewhat variable in its development in different species. Anterior upper premolar permanent, but scarcely larger than incisor in cross section and so short as barely to penetrate the gum. Its crown is nearly flat, though with a faintly indicated antero-external cusp. The corresponding lower tooth is considerably larger, its disk-shaped crown somewhat concave except for the minute antero - external cusp. The three suceeding cheek teeth almost exactly resemble each other above and below; pm^3 and pm_3 are higher and shorter than the others, and the inner ridge tends to form a blunt cusp opposite base of main cusp; pm^4, m^1, pm_4, and m_1 have the longitudinal furrow well developed and bounded on the inner side by a distinct, though low, ridge, and on the outer side by a much higher ridge, which rises anteriorly into a blunt cusp. Their crowns are noticeably longer than broad. The second lower molar closely resembles the anterior lower premolar, except that it lacks the small antero-internal cusp. The skull (figs. 5, 6) very primitive in form, the ventral profile nearly straight, the dorsal profile showing no special peculiarities. Floor of brain case scarcely

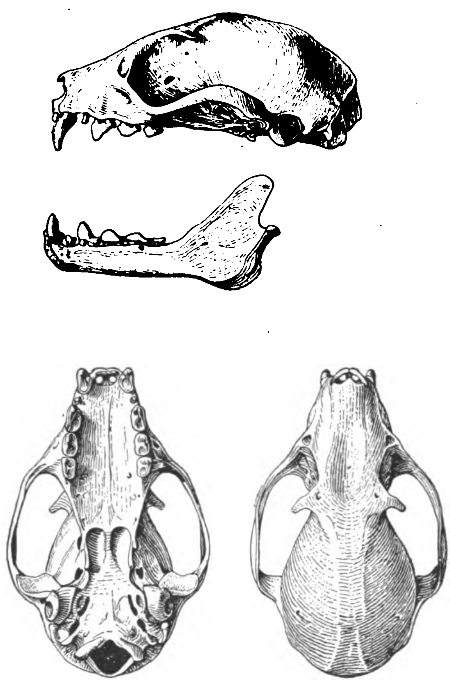

FIG. 5.—CYNOPTERUS SPHINX. ADULT FEMALE. MADRAS, INDIA. NO. 102430. ×1¼.

deflected, though placed at a slight angle with palate. Occipital region without trace of tubular elongation. Alveolar line projected backward barely touches audital bulla and occipital condyle. Rostrum short (least distance from orbit to nares less than lachrymal width), its dorsal profile slightly concave. Premaxillaries in contact anteriorly, but not fused, slender throughout, and tapering above to a recurved point distinctly below upper rim of nares. Palate normal. Audital bullæ well developed, but without tube or lip at meatus. Mandible with broad low angular process. External form short and heavy. Nostrils very prominent, almost tubular. Upper lip divided by a deep narrow vertical groove. Second finger with well-developed claw. Wings from sides of back. Tail distinct, its terminal half free from the interfemoral membrane. Calcar weak, its length about equal to breadth of foot.

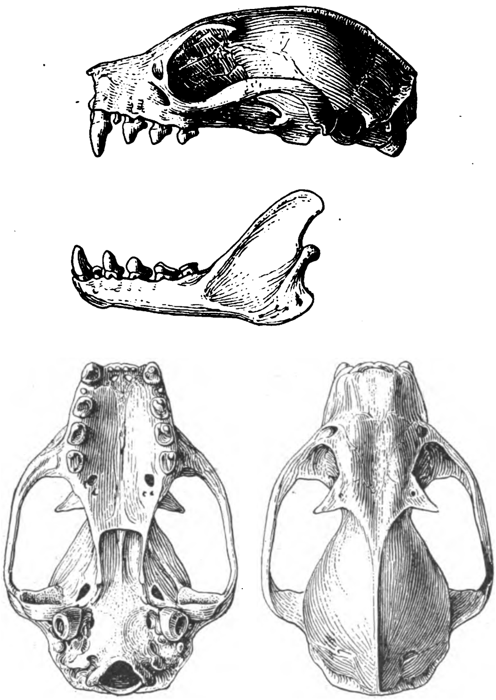

FIG. 6.—CYNOPTERUS MONTANOI. ADULT FEMALE. SINGAPORE, MALAY PENINSULA. NO. 102432. ×1½.

Species examined.—*Cynopterus sphinx* (Vahl), *C. angulatus* Miller, *C. montanoi* Robin, *C. titthæcheilus* Temminck, *C.* sp. (Celebes), *C. scherzeri* (Zelebor), *C. melanocephalus* (Temminck), *C. major* Miller, *C. pagensis* Miller, *C. brachyotis* (Müller).

Genus NIADIUS Miller.

1906. *Niadius* MILLER, Proc. Biol. Soc. Washington, XIX, p. 83, June 4, 1906.

Type-species.—*Cynopterus princeps* Miller.

Geographic distribution.—Nias Island, off west coast of Sumatra.

Number of forms.—The type is the only species known.

Characters.—Like *Cynopterus*, but with the larger cheek teeth broader and more squarish in outline; crown of pm_4 and m_1 with distinct terete cusp slightly in front of middle of crushing surface (Plate VIII, fig. 3).

Species examined.—*Niadius princeps* (Miller).

Remarks.—In the somewhat increased size and the squarish outline of the cheek teeth this genus shows a slight approach to *Thoopterus;* but the terete cusp in pm_4 and m_1 differs conspicuously from the ridge which occupies the same position in the related group.

Genus THOOPTERUS Matschie.

1878. ***Cynopterus*** **Dobson, Catal. Chiropt. Brit. Mus., p. 80 (part, *latidens*=*nigrescens*).**

1899. ***Thoopterus*** **Matschie, Flederm. des Berliner Mus. für Naturk., p. 77 (part). Subgenus of *Cynopterus* to contain *nigrescens*, *melanocephalus*, and *blanfordi*.**

Type-species.—*Cynopterus nigrescens* Gray (*C. latidens* Dobson).

Geographic distribution.—Borneo, Celebes, Morotai, and Luzon.

Number of forms.—Only two species of *Thoopterus* are known, *T. nigrescens* (Gray) and *T. spadiceus* Thomas.

Characters.—Like *Cynopterus* in external characters (tail and calcar present). Skull as in *Cynopterus*, except that interorbital region is narrower and zygomata stand out more widely. Teeth as in *Cynopterus*, but incisors smaller (though of the same proportions); upper canine without trace of secondary cusp, except a slight angular elevation of the cingulum postero-internally; lower canine with a rather abrupt lobule on inner side, developed from cingulum and not forming a distinct cusp; and cheek teeth (except the small pm^2 and pm_2) greatly enlarged, their crowns subquadrate in outline. The crown of pm_4 and m_1 is crossed by a distinct ridge, this better developed in *Thoopterus nigrescens* than in *T. spadiceus*, in which it is somewhat obscured by the unusually large inner lobe. In the type of *T. spadiceus* the smaller upper premolar is absent and no trace of its alveolus can be detected.

Species examined.—*Thoopterus nigrescens* (Gray), *T. spadiceus* (Thomas).

Remarks.—This genus is at once recognizable by its general resemblance to *Cynopterus* (though with the tail somewhat reduced), and the enlarged, subquadrate cheek teeth. As here used the limits of the group differ from those originally assigned to it by Matschie in the exclusion of the species *melanocephalus* and *blanfordi;* the first of which is a *Cynopterus;* while the second I have made the type of the genus *Sphærias*.

Genus PTENOCHIRUS Peters.

1861. *Ptenochirus* PETERS, Monatsber. k. preuss. Akad. Weissensch. Berlin, p. 707 (*jagori*, subgenus of*Pachysoma* = *Cynopterus*).
1878. *Ptenochirus* DOBSON, Catal. Chiropt. Brit. Mus., p. 81 (subgenus of *Cynopterus*).
1899. *Ptenochirus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 77 (part, subgenus).

Type-species.—*Pachysoma* (*Ptenochirus*) *jagori* Peters.

Geographic distribution.—Philippines, Borneo.

Number of forms.—Two species of *Ptenochirus* are now known.

Characters.—External and cranial characters like *Cynopterus* (tail and calcar present). Dental formula:

$$\frac{-\ 2\ 3.1.-\ 2\ 3\ 4\cdot 5\ -\ -}{-\ 2\ -\ 1.-\ 2\ 3\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{1-1}{2-2}=28.$$

Upper incisors smaller and more pointed than those of *Cynopterus*, distinctly though narrowly separated from each other, the outer tooth of each pair scarcely more than half as long as inner; lower incisor smaller than the corresponding tooth (i_2) in *Cynopterus*, nearly terete (not widened antero-posteriorly). Canines as in *Cynopterus*, but without secondary cusps. Cheek teeth differing from those of *Cynopterus* in a general widening and flattening of the crowns, the outline of which becomes subquadrate in pm^4, pm_4, and m_1, and the less distinctness of the median furrow encroached upon by the thickened inner ridge.

Species examined.—*Ptenochirus lucasi* Dobson, *P. jagori* Peters.

Remarks.—This genus differs from *Cynopterus* in the absence of the inner pair of lower incisors, the reduction in size of the outer upper incisors, and in the broader, flatter molariform teeth. The last character suggests *Thoopterus*, but is less pronounced and the teeth are not increased in size.

Genus MEGÆROPS Peters.

1841. *Megera* TEMMINCK, Monogr. de Mamm., II, p. 274 (*ecaudata*).
1841. *Megæra* TEMMINCK, Monogr. de Mamm., II, p. 359 (*ecaudata*); not of Wagler, 1830, or of Robineau-Devoidy, 1830.
1865. *Megærops* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 256. (Substitute for *Megæra*.)
1878. *Megærops* DOBSON, Cat. Chir. Brit. Mus., p. 87 (subgenus of *Cynopterus*).
1899. *Megærops* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 79 (subgenus of *Ptenochirus*).

Type-species.—*Megæra ecaudata* Temminck.

Geographic distribution.—Sumatra, Borneo.

Number of forms.—Only the type-species is known.

Characters.—Like *Ptenochirus*, but with no visible tail and with rostral portion of skull strongly concave both dorsally and laterally. The peculiar concave dorsal profile is shown in Matschie's figure.[a] In this skull the rostrum is also concave laterally, or perhaps the form might be better described as deeply compressed in and below the mid-nasal region.

Species examined.—*Megærops ecaudatus* (Temminck) from Borneo.

Remarks.—Though *Megærops* has been generally regarded as a subgenus of *Cynopterus*, and Matschie has placed it under *Ptenochirus*, I think that it may more naturally be allowed to stand as a distinct genus. By the tooth formula and the character of the cheek teeth it is rather closely allied to *Ptenochirus*, but the absence of any external tail and the peculiar form of the rostrum sufficiently differentiate it.

The type of "*Cynonycteris*" *grandidieri* Peters, which I have examined in Paris, somewhat closely resembles *Megærops* in the form of the rostrum (see Matschie's plate already referred to), but differs from this genus in the presence of 2–2 lower incisors. As Matschie suggests,[b] the supposed m^1 and m^2 are the two roots of the single molar tooth, the crown having been entirely worn away. In the lower jaw the anomalous "m_2" and "m_3" are likewise the remnants of the normal second molar. The animal had, therefore, the dental formula of *Cynopterus*. In its bad condition, however, the structure of the teeth being quite obscured by their excessive wear, I prefer not to attempt to assign the species to any genus.

Genus BALIONYCTERIS Matschie.

1899. *Balionycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 80. (*maculatus*.)

Type-species.—*Cynopterus maculatus* Thomas.

Geographic distribution.—Borneo.

Number of forms.—One, the type species.

Characters.—Like *Ptenochirus*, but without external tail and with 5 – 5 upper cheek teeth. Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{-\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -},\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{2-2}{2-2}=30.$$

Teeth closely resembling those of *Ptenochirus* except for the presence of the minute second upper molar. Incisors styliform; canines

[a] Die Flederm. des Berliner Mus. für Naturk., pl. [VIII], fig. 5. It is even more pronounced in a Bornean specimen in the British Museum (No. 95.10.4.1, Kina Balu, John Whitehead).

[b] Die Flederm. des. Berliner Mus. für Naturk., p. 71.

without supplemental cusps; crowns of larger cheek teeth subquadrate in outline, the median groove, as in *Ptenochirus*, less distinct than in *Cynopterus*. General form of skull as in *Cynopterus* and *Ptenochirus*.

Species examined.—*Balionycteris maculatus* (Thomas).

Remarks.—The only known species of this well-characterized genus is further recognizable by its excessively small size (forearm only 41 mm.) and by the conspicuous yellowish spotting of the wings.

Genus SPHÆRIAS Miller.

1899. *Thoopterus* MATSCHIE, Flederm. des. Berliner Mus. für Naturk., p. 77 (part).

1906. *Sphærias* MILLER, Proc. Biol. Soc. Washington, XIX, p. 83, June 4, 1906.

Type-species.—*Cynopterus blanfordi* Thomas.

Geographic distribution.—Burma.

Number of forms.—The type-species.

Characters.—Like *Cynopterus*, but without calcar and external tail; incisors with conspicuously developed, sharply pointed, cutting edges. Dental formula, as in *Cynopterus:*

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ -\ -}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{1-1}{2-2}=30.$$

Cheek teeth and canines as in *Cynopterus*, except that the canines show no trace of secondary cusps. Incisors better developed than in any of the related genera, and of conspicuously different form. In *Cynopterus* the cutting edge of the lower incisors is flat, though divided by a shallow emargination into two faintly indicated equal lobes. In *Sphærias* the outer lobe is practically absent, and the inner lobe is elongated and sharply pointed, so that the series of teeth, when viewed from in front, shows four conspicuous serrations instead of six low, ill-defined points, or four rounded or flattened surfaces. The upper incisors are even more peculiar, the crown being sharp edged and angular, well differentiated from the shaft, and having a large main cusp near the middle. Skull as in *Cynopterus*.

Species examined.—*Sphærias blanfordi* (Thomas).

Remarks.—The type and only known species of this genus was placed by Matschie in *Thoopterus*, but is strikingly different from all of its allies, particularly in the absence of the calcar, the very narrow interfemoral membrane, and the remarkably developed incisors. Though perhaps most nearly allied to *Cynopterus*, its relationships to the genera of the group to which it belongs can not be regarded as very intimate.

Genus ROUSETTUS Gray.

1821. *Rousettus* GRAY, London Medical Repository, XV, p. 299, April 1, 1821. (*ægyptiacus.*)
1829. *Cercopteropus* BURNETT, Quart. Journ. Sci. Lit. and Art, XXVII, p. 269, April–June, 1829. (*ægyptiacus, amplexicaudatus.*)
1843. *Xantharpyia* GRAY, List Spec. Mamm. Brit. Mus., p. 37. (*amplexicaudata.*)
1843. *Eleutherura* GRAY, Voyage of the Sulphur. Mamm., Pt. 2, p. 29. (*Pteropus hottentottus* Temminck=*P. collaris* Illiger.)
1852. *Cynonycteris* PETERS, Reise nach Mossambique, Zool., I, Säugeth., p. 25. (*collaris.*)
1870. *Senonycteris* GRAY, Catal. Monkeys, Lemurs, and Fruit-eating Bats, Brit. Mus., p. 115. (*Pteropus seminudus* Kelaart=*Rousettus amplexicaudatus.*)
1878. *Cynonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 70 (part).
1899. *Myonycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 63. (*torquatus.*)
1899. *Xantharpyia* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 65. (*brachycephala, brachyotis, ægyptiaca, collaris, amplexicaudata.*)

Type-species.—*Pteropus ægyptiacus* Geoffroy.

Geographic distribution.—Africa; Southern Asia to the Himalayas; Malayan region to the Philippines; New Guinea, Bismark Archipelago, Solomon Islands.

Number of forms.—Eight species are currently recognized.

Characters.—Dental formula:

$$\frac{-\,2\,3.\ 1.\ -\,2\,3\,4\,5\,6\,-}{1\,2\,-.\ 1.\ -\,2\,3\,4\,5\,6\,7}\ i\,\frac{2-2}{2-2},\ c\,\frac{1-1}{1-1},\ pm\,\frac{3-3}{3-3},\ m\,\frac{2-2}{3-3}=34.$$

Teeth essentially as in *Cynopterus*, but cheek teeth with cusps, ridges, and grooves less strongly developed. Upper incisors low, widely spaced, the central pair not higher than the outer teeth, the crowns bluntly rounded but distinctly differentiated from shafts; lower incisors with front surface marked by a groove which in some species is so deep as to produce distinct emargination of the cutting edge. Skull (fig. 7) differing from that of *Cynopterus* in the slightly greater deflection of the occipital region, the alveolar line projected backward, passing through middle of occiptal condyle, and in the longer rostrum (distance from orbit to nares greater than lachrymal breadth). External characters essentially as in *Cynopterus*, but muzzle less shortened. Second finger with well-developed claw; tail and calcar present.

Species examined.—*Rousettus ægyptiacus* (Geoffroy), *R. amplexicaudatus* (Geoffroy), *R. philippinensis* (Gray), *R. collaris* (Illiger), *R. brachyotis* (Dobson), and *R. torquatus* (Dobson).

Remarks.—As here understood the genus *Rousettus* includes the forms placed by Matschie in the subgenera *Rousettus* and *Myonycteris*.

Genus PTEROCYON Peters.

1861. *Pterocyon* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, I, p. 423 (*paleaceus*=*stramineus*).
1878. *Cynonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 70 (part).
1881. *Leiponyx* JENTINK, Notes from the Leyden Museum, III, p. 59. (*Leiponyx büttikoferi.*)
1899. *Pterocyon* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 62. (Subgenus of *Xantharpyia*=*Rousettus.*)
1899. *Leiponyx* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 85. (genus.)

Type-species.—*Pteropus stramineus* Geoffroy.

Geographic distribution.—Arabia; Africa south of the Sahara; Madagascar.

Number of forms.—Three species of *Pterocyon* are now known.

Characters.—Dental formula

$$\frac{-\,2\;3.\;1.\;-\;2\;3\;4\;5\;6\;-}{1\;2\;-.\;1.\;-\;2\;3\;4\;5\;6\;7}\; i\,\frac{2-2}{2-2},\; c\,\frac{1-1}{1-1},\; pm\,\frac{3-3}{3-3},\; m\,\frac{2-2}{3-3}=34.$$

Teeth as in *Rousettus* except that the crowns of the lower incisors are not grooved on the anterior face, and the cutting edges are uniformly rounded.[a] The skull (fig. 7), while in general closely resembling that of *Rousettus* is distinguished by the remarkable development of the audital bullæ, the outer portion of which is distinctly differentiated from the inner as a prominent lip or short tube surrounding the meatus. (Fig. 7.) Nothing comparable to this structure occurs in the related genera or in any of the bats that I have examined. External chraacters as in *Rousettus*.

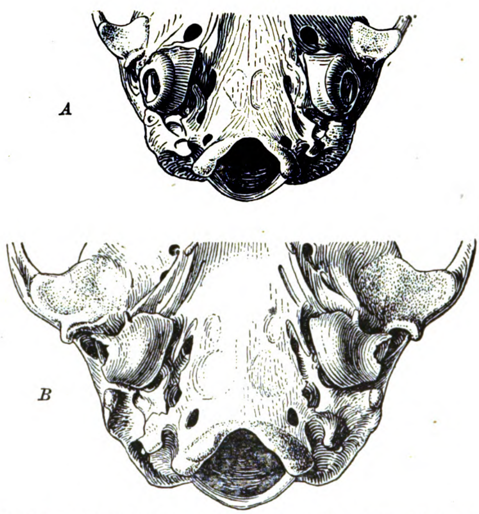

FIG. 7—*A*, ROUSETTUS AMPLEXICAUDATUS. ADULT FEMALE. CAVES NEAR MAULMAIN, BURMA. NO. 37930. ×2. *B*, PTERYCYON STRAMINEUS. ADULT FEMALE. ROBERTSPORT, LIBERIA. NO. 102461. ×2.

[a] In the species of *Rousettus* now known the crown of the first lower molar is scarcely longer than that of the second, while in *Pterocyon stramineus* and *P. dupreanus* it is about as long as the second and third together. This character has been made very prominent by Matschie, but I do not consider it of special taxonomic importance, however convenient it may be as a means of recognizing members of the two genera.

Species examined.—Pterocyon büttikoferi (Jentink) *P. dupreanus* (Pollen) and *P. Stramineus* (Geoffroy).

Remarks.—This genus is distinguishable from all other groups of Chiroptera by the structure of the audital bullæ, and from its nearest ally, *Rousettus*, by the entire-edged lower incisors as well.

The type specimen of *Leiponyx büttikoferi*, which I have examined in company with Doctor Jentink, appears to be unquestionably a *Pterocyon* in which the claw of the index finger is lacking. The individual is so old that the crowns of the molars are completely worn away, a fact that may have some bearing on the absence of the claws.[a] While the form of the molars can not be determined, the incisors, canines, and anterior premolars agree perfectly with those of *Pterocyon*, as do also the general aspect of the skull, the peculiar structure of the audital bullæ, and, with the one exception already noted, the details of external form.

Genus PTEROPUS Brisson.

1762. ***Pteropus*** **Brisson**, Regn. Anim. in Classes IX distrib., 2 ed., p. 13 (*vampyrus*).

1799. ***Spectrum*** **Lacépède**, Tabl. des Div. Sousdiv. Orders et Genres. des Mammif., p. 15 (*vampyrus*).

1866. ***Eunycteris*** **Gray**, Proc. Zool. Soc. London, p. 64 (*phaiops*).

1870. ***Pselaphon*** **Gray**, Catal. Monkeys, Lemurs and Fruit-eating Bats Brit. Mus., p. 110 (*ursinus*=*pselaphon*).

1878. ***Pteropus*** **Dobson**, Catal. Chiropt. Brit. Mus., p. 15 (part, included *Acerodon* and *Styloctenium*).

1899. ***Pteropus*** **Matschie**, Flederm. des Berliner Mus. für Naturk., p. 5 (part, included *Pteralopex* and *Acerodon*).

1899. ***Sericonycteris*** **Matschie**, Flederm. des Berliner Mus. für Naturk., p. 30 (subgenus of *Pteropus* containing the species *rubricollis*, *temmincki*, *petersi*, *personatus*, *capistratus*, *molossinus*, *woodfordi*).

1899. ***Eunycteris*** **Matschie**, Flederm. des Berliner Mus. für Naturk., p. 11 (subgenus of *Pteropus* containing the species *melanopogon*, *papuanus*, *degener*, *neohibernicus*).

1899. ***Spectrum*** **Matschie**, Flederm. des Berliner Mus. für Naturk., p. 19 (subgenus of *Pteropus* containing the species *poliocephalus*, *leucopterus*, *pselaphon*, *vetulus*, *vampyrus*, *anetianus*, *rayneri*, *samoensis*, *dasymallus*, *loochooensis*, *formosus*, *rodricensis*, *lombocensis*, *brunneus*, *scapulatus*, *livingstoni*, *macrotis*, *epularis*, *assamensis*, *hypomelanus*, *mariannus*.

Type-species.—Vespertilio vampyrus Linnæus.

Geographic distribution.—From the Comoro Islands, Madagascar, and India, to Tasmania, Samoa, the Ladrones, and southern Japan (Kiusiu).

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[a] Specimens with one or both claws very imperfectly developed, or perhaps reduced by disease or injury, have been observed in *Pteropus capistratus* (No. 122124, U.S.N.M.), *P. hypomelanus* (No. 105440), *P. modiglianii* (No. 140992), *P. poliocephalus* (No. 13594), and *Acerodon sp.* (No. 105454).

Number of forms.—About 70 forms of *Pteropus* are now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{1\ 2\ -\ \ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{2-2}{3-3}=34.$$

Incisors (Plates VII, VIII, fig. 1), terete with slightly differentiated crowns, the lower bluntly rounded, the upper with a fairly defined cutting edge. The upper incisors are in contact or nearly in contact with each other, but are separated from canine by wide diastema. They form a slightly convex row, and the outer tooth of each pair is distinctly shorter than the inner. Lower incisors separated from each other and from canines by minute spaces, the row slightly convex and the inner tooth of each pair smaller than the outer. Canines simple, without secondary cusps, the cingulum rather prominently developed on posterior and inner sides, and the shaft, especially of the upper teeth, marked by conspicuous longitudinal furrows. Anterior premolar (pm^2 and pm_2) small, that in upper jaw much smaller than incisors and deciduous, its crown bluntly pointed, that in lower jaw slightly larger than outer incisor, permanent, its crown rounded in outline, the surface concave, the outer edge usually somewhat higher than inner. Posterior molars (m^2 and m_3) essentially like anterior lower premolar in size and form, but m^2 usually with a more prominent inner edge and often with a distinct outer anterior cusp or tubercle. The remaining cheek teeth (pm^3, pm^4, m^1, and pm_3, pm_4, m_1, m_2) rather closely resemble each other and are all formed on the same general plan of a subquadrate or somewhat elongated crown with distinct median furrow in long axis of jaw and a well developed outer and inner ridge, each ridge tending to rise into a cusp a little in front of middle. The outer ridge and cusp is always larger than the inner, and in the region between the cusps the longitudinal groove is usually constricted or partly obliterated. This type of structure is most perfectly shown by m^1 and m_1, the ridges and cusps tending to become obsolete in the more posterior teeth, while they successively increase at the expense of the median furrow in the two large premolars, so that pm^3 and pm_3 assume almost the aspect of short canines, each with a well developed, or at least distinctly indicated, secondary cusp on inner side, the longitudinal groove having been made almost vertical by the elongation of the cusps. Skull (fig. 8) moderately elongate, the length of rostrum considerably greater than lachrymal breadth. Premaxillaries well developed, in contact anteriorly but not fused, their breadth along nasal suture at least equal to that at alveolus of outer incisor. Occipital region strongly deflected and distinctly tubular, the floor of the braincase forming so great an angle with palate that alveolor line projected backward passes through tympanic region or base of zygoma. Audital bulla reduced to a mere ring. Externally characterized by absence of tail, narrow interfemoral membrane, well developed calcar, and large claw on index finger.

Species examined.—*Pteropus admiralitatum* Thomas, *P. aldabrensis* True, *P. anetianus* Gray, *P. Brunneus* Dobson, *P. cagayanus* Mearns, *P. capistratus* Peters, *P. chrysoproctus* Temminck, *P. conspicillatus* Gould, *P. coronatus* Thomas, *P. dasymallus* Temminck, *P. edwardsi* Geoffroy, *P. faunulus* Miller, *P. fuscus* Dobson, *P. geminorum* Miller, *P. giganteus* (Brünnich), *P. gouldi* Peters, *P. grandis* Thomas, *P. hypomelanus* Temminck, *P. keraundren* Quoy and Gaimard, *P. lanensis* Mearns, *P. lanigera* H. Allen, *P. lepidus* Miller, *P. leucopterus* Temminck, *P. livingstoni* Gray, *P. lombocensis* Dobson, *P. loochooensis* Gray, *P. melanopogon* Schlegel, *P. modiglianii* Thomas, *P. molossinus* Temminck, *P. natalis* Thomas, *P. nicobaricus* Zelebor, *P. personatus* Temminck, *P. poliocephalus* Temminck, *P. pselaphon* Say, *P. rayneri* Gray, *P. rubricollis* Geoffroy, *P. samoensis* Peale, *P. scapulatus* Peters, *P. seychellensis* Milne Edwards, *P. temminckii* Peters, *P. vampyrus* Linnæus, *P. woodfordi* Thomas.

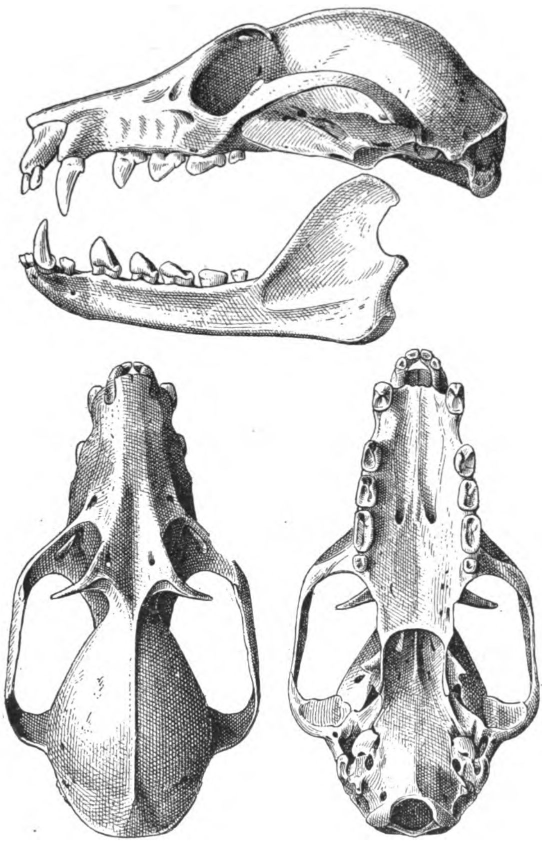

FIG. 8.—PTEROPUS LEPIDUS. ADULT FEMALE. SADDLE ISLAND, SOUTH CHINA SEA. NO. 101670, TYPE. ×1.

Remarks.—Members of the genus *Pteropus* may be recognized by the large number and simple structure of the teeth, combined with the absence of the tail, and the presence of a well developed claw on the index finger. The species are usually large, among them some of the largest bats.

In extent of distribution and in the number of its species *Pteropus* exceeds all other genera of Megachiroptera. It also has the most complete and least modified dentition. These two circumstances have caused the genus to be generally regarded as the most primitive of the group; but it seems probable that the deflection and tubularity of the brain case, the great reduction of the audital bullæ, and the complete absence of the tail are of more importance than the large number of teeth, and that *Pteropus* is in reality less primitive than *Cynopterus*, *Rousettus*, and *Pterocyon*.

Genus ACERODON Jourdan.

1837. *Acerodon* JOURDAN, Ann. Sci. Nat., Paris, 2e sér., VIII, Zool., p. 369 (*jubatus*).
1878. *Pteropus* DOBSON, Catal. Chiropt. Brit. Mus., p. 15 (part).
1899. *Acerodon* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 9 (subgenus of *Pteropus*.

Type-species.—*Pteropus jubatus* Eschscholtz.

Geographic distribution.—Eastern part of the Malayan region (Philippines, Djilolo, Batjan, Celebes, Flores, Timor, Sumba).

Number of forms.—Seven or eight forms of *Acerodon* have been described.

Characters.—Like *Pteropus*, but with smaller canines and larger, more complex molariform teeth. Dental formula as in *Pteropus*. Upper incisors as in *Pteropus*, but somewhat more elongate and less bluntly pointed. Lower incisors differing from those of *Pteropus* in the much greater contrast in size between the inner and outer tooth of each pair. Canines much shortened as compared with *Pteropus*, the mandibular canine little exceeding the height of pm_3. Though reduced in length the canines retain their thickness, and the cingulum is even better developed than in the related genus. Small premolars as in *Pteropus*. Upper molariform teeth differing from those of *Pteropus* in relatively greater size, greater breadth of crowns, greater distinctness of cusps, and a peculiar trenchant character of the edges and ridges. First large lower premolar (pm_3) essentially as in *Pteropus*. The three succeeding teeth differ from those of all other Pteropidæ in the presence of a broad, flat postero-internal heel, sharply differentiated from the two ridges and extending considerably beyond them, especially behind. Cranial and external characters as in *Pteropus*.

Species examined.—*Acerodon jubatus* (Eschscholtz) and several undetermined forms.

Remarks.—Although not generally recognized as distinct from *Pteropus* this genus is well characterized by the form of the lower cheek teeth. Additional characters are furnished by the reduced size of the canines and of the inner lower incisors.

DESMALOPEX, new genus.

Type-species.—Pteropus leucopterus Temminck (as understood by Dobson, Catal. Chiropt. Brit. Mus., p. 32. 1878).

Geographical distribution.—Philippine Islands.

Number of forms.—The type is the only species known.

Characters.—Like *Pteropus;* but skull with broader rostrum and palate, orbits directed slightly more upward, and teeth showing several peculiarities that suggest *Pteralopex.* Upper incisors subequal, distinctly larger than in *Pteropus*, the cross section of the crown nearly one-third that of canine, the cingulum produced into a noticeable shelf posteriorly. Lower incisors very unequal, the crown area of the outer nearly one-half that of canine, that of the inner scarcely more than one-half as great. Canines not peculiar, the upper without secondary cusps. Small upper premolar well developed, not deciduous, its diameter nearly half that of upper incisor, its crown flat. Small lower premolar relatively larger than in *Pteropus*, but smaller than in *Pteralopex*, its outer edge raised but not distinctly cuspidate. The remaining premolars, both above and below, agree with those of *Pteropus*, except that pm_3 shows no trace of cusp on inner side. Molars, both above and below, subquadrate in outline, the length of the crown never conspicuously greater than the width (m_3 and m^1 not elongated as in *Pteropus*). In the maxillary teeth the cusps are like those of *Pteropus* except that they are higher relatively to length of crown. Lower molars peculiar in that the ridges of m_1 and m_2 are each divided into two low but distinct rounded cusps. The quadritubercular form resulting from this is very noticeable in m_1, less so in m_2. Third lower molar as in *Pteropus.*

Species examined.—Desmalopex leucopterus (Temminck).

Remarks.—This genus is intermediate between *Pteropus* and *Pteralopex*, though nearer the former. In the broadened rostrum and slightly upturned orbits the skull distinctly suggests *Pteralopex*, while the same tendency is shown by the form and relative size of the incisors, the well-developed small upper premolar, the squarish outline of the molars, and the extra cusps of m_1 and m_2. Externally there are no characters worthy of note.

Genus PTERALOPEX Thomas.

1888. *Pteralopex* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., I, p. 155, February, 1888. (*atrata.*)

1899. *Pteralopex* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 11. (Subgenus of *Pteropus.*)

Type-species.—Pteralopex atrata Thomas.

Geographic distribution.—Solomon Islands.

Number of forms.—Only the type species has been thus far discovered.

Characters.—In general like *Pteropus*, but skull with broader, nearly parallel-sided rostrum, more upwardly directed orbits, and high sagittal crest, somewhat obscuring tubularity of occipital region, and both canines and cheek teeth conspicuously several-cusped. Except as noted, the skull does not differ particularly from that of *Pteropus*. The posterior portion of brain case is distinctly tubular and so deflected that the alveolar line, projected backward, passes just below root of zygoma. Premaxillaries rather shorter and broader than in *Pteropus*, and in contact for about 2 mm. anteriorly. Audital bullæ as in *Pteropus*. Dental formula as in *Pteropus*, but pm^2 larger and apparently persistent. "Upper incisors with broad posterior ledges. Upper canines short vertically, enormously thick antero-posteriorly, each with one stout secondary cusp halfway up its posterior edge, and two smaller postero-internal basal cusps. Premolars and molars short and broad, their anterior and posterior basal ledges so developed and their main cusps so conical as to destroy all the appearance of longitudinal grooving characteristic of the genus *Pteropus*. Lower incisors extremely disproportionate in size, the outer not less than about twenty times the bulk of the inner. Canines very short vertically, with a simple posterior basal ledge. Cheek teeth markedly cuspidate, the general longitudinal grooving quite obliterated. Posterior premolar and first molar each with three high anterior cusps, and a low posterior basal ledge."[a]

Species examined.—*Pteralopex atrata* Thomas.

Remarks.—The dentition of *Pteralopex* represents one of the extreme phases of that tendency to develop secondary cusps, which appears to be everywhere latent in the Pteropidæ. The stages through which it has passed are indicated in the genera *Acerodon* and *Desmalopex*. The much-reduced inner mandibular incisor, the broadened rostrum, and the complete, strongly upturned orbits are also highly specialized characters.

Genus BONEIA Jentink.

1879. *Boneia* JENTINK, Notes from the Leyden Museum, I, p. 117. (*bidens*.)
1899. *Boneia* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 69.

Type-species.—*Boneia bidens* Jentink.

Geographic distribution.—Celebes.

Number of forms.—Two species are now known.

Characters.—Like *Pteropus*, but with a distinct tail; only 1–1 upper incisors; cheek teeth with crowns much flattened. Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7};\ i\ \frac{1-1}{2-2}\ c,\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{2-2}{2-2} = 32.$$ Upper inci-

[a] Thomas, Proc. Zool. Soc. London, 1888, p. 473.

sor very small, the inner extremity of the premaxillary projecting beside it and appearing at first sight like a second tooth. Lower incisors as in *Pteropus*, but disproportion in size between outer and inner more evident. Canines not peculiar, except that the lower are more strongly curved backward and outward than in the related genera. Small upper premolar (pm^2) apparently permanent, considerably larger than in *Pteropus*. Except for the greater size of pm^2, the two anterior cheek teeth in each jaw are essentially as in *Pteropus*. The three posterior above (pm^4, m^1, and m^2) and the four posterior below pm_4, m_1, m_2, and m_3) are remarkable for their very flat crowns, with very low, though sharp, peripheral ridges. The crown of m^1 and of m_1 is crossed by a distinct transverse ridge between the two very rudimentary cusps. General outline of crowns as in *Pteropus*. Skull differing from that of *Pteropus* in the slightly greater deflection of the brain case (alveolar line projected backward passes slightly above root of zygoma) and in the low, weak posterior section of mandible, the coronoid process forming an unusually slight angle with the ramus. External characters as in *Pteropus*, except for the presence of a well-developed tail projecting distinctly beyond interfemoral membrane. Index finger with claw.

Species examined.—*Boneia bidens* Jentink and *B. menadensis* Thomas.

Genus STYLOCTENIUM Matschie.

1878. *Pteropus* DOBSON, Catal. Chiropt. Brit. Mus., p. 15 (part).
1899. *Styloctenium* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 33. (*wallacei.*)

Type-species.—*Pteropus wallacei* Gray.

Geographic distribution.—Celebes.

Number of forms.—One, the type species.

Characters.—Like *Pteropus*, but with only 1–1 lower incisors and 2–2 lower molars; cheek teeth subterete in outline and with smoothly rounded crowns. Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{-\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}\quad i\ \frac{2\text{–}2}{1\text{–}1},\ c\ \frac{1\text{–}1}{1\text{–}1},\ pm\ \frac{3\text{–}3}{3\text{–}3},\ m\ \frac{2\text{–}2}{2\text{–}2}=30.$$

Incisors both above and below terete, very straight, the crowns abruptly pointed and scarcely differentiated from shafts. Canines as in *Pteropus*, but rather short and thick. Small upper premolar (pm^2) deciduous, similar in size and form to that of *Pteropus*. Other anterior cheek teeth not peculiar, though rather less pointed than in *Pteropus*. Posterior three teeth in each jaw (pm^4, m^1, m^2, and pm_4, m_1, m_2), with crowns nearly circular in outline and with evenly rounded surface, the cusps and ridges, though normal in position, so flattened and broadened as to be scarcely noticeable. Skull as in *Pteropus.* Posterior portion of brain case strongly tubular, and occipital region so deflected that alveolar line projected backward passes through root of zygoma. Audital bullæ as in *Pteropus.* External characters as in *Pteropus.*

Species examined.—Styloctenium wallacei (Gray).

Remarks.—This genus is well differentiated from its allies by its peculiar dental formula and by the structure of the incisors and posterior cheek teeth.

Genus DOBSONIA Palmer.

1810. *Cephalotes* GEOFFROY, Ann. Mus. d'Hist. Nat. Paris, XV, p. 104 (part).
1828. *Hypoderma* IS. GEOFFROY, Dict. Class. d'Hist. Nat., XIV, p. 706 (not of Latreille, 1825).
1840. *Hypodermis* BLYTH, Cuvier's Animal Kingdom, p. 69.
1878. *Cephalotes* DOBSON, Catal. Chiropt. Brit. Mus., p. 91.
1898. *Dobsonia* PALMER, Proc. Biol. Soc. Washington, XII, p. 114, April 30, 1898.
1899. *Cephalotes* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 85.
1902. *Dobsonia* THOMAS, Proc. Biol. Soc. Washington, XV, p. 198, October 10, 1902.

Type-species.—Cephalotes peronii Geoffroy.

Geographic distribution.—Celebes, Moluccas, New Guinea, Bismark Archipelago, Solomon Islands.

Number of forms.—Three species are now recognized.

Characters.—Differs from Pteropus in absence of claw of index finger, presence of well-developed tail, attachment of membranes along middle of back, and in the presence of only 28 teeth. Dental formula:

$$\frac{-\ 2\ -\ .1.\ -\ -\ 3\ 4\ 5\ 6\ -}{-\ 2\ -\ .1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\quad i\ \frac{1-1}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{2-2}{3-3}=28.$$

Upper incisors short, but well developed, in contact or nearly so, the crowns about as wide as long and with distinct cutting edge. Lower incisors almost structureless spicules with barely indicated blunt crowns. Canines rather short, not peculiar in form, without secondary cusps, those of the lower jaw nearly in contact. No small upper premolar (pm^2). The corresponding tooth in the lower jaw is relatively larger than in *Pteropus*, and is not separated from canine or from first large premolar by any appreciable space. The other premolars both above and below differ from those of *Pteropus* in greater development of the cusps and in more trenchant ridges. Small posterior molars (m^2 and m_3) as in *Pteropus.* Anterior molars (m^1 and m_1, m_2) resembling the large premolars in their general characteristics as compared with the corresponding teeth in *Pteropus*, the crown of each with a distinct median longitudinal ridge at middle of furrow. This ridge is continuous nearly from end to end of m_2, in m^1 and m_1 it is confined to the region behind the cusps, and in some specimens is obsolete in the first lower molar. Skull much shorter and more heavily built than that of *Pteropus*, but of essentially the same type. Distance from orbit to nares about equal to lachrymal width. Posterior portion of brain case slightly tubular, and occipital region so deflected that alveolar line projected backward, passes just below root of zygoma. Premaxillaries very narrow, the width scarcely more than that of crown of incisor. The inner extremities barely come in contact. Audital bullæ somewhat wider than in *Pteropus*, but less developed than in *Cynopterus*. External characters unlike those of *Pteropus* in the absence of the claw of index finger, the presence of a distinct tail, and the attachment of the wing membranes along middle of back.

Species examined.—Dobsonia palliata (Geoffroy), *D. minor* (Dobson), and *D. magna* (Thomas).

Remarks.—The genus *Dobsonia* is one of the most aberrant of those associated with *Pteropus* by the form of the skull. Its chief modification is in the direction of a general shortening of the facial part of the skull, with crowding of the tooth rows and a tendency to eliminate the less important anterior teeth.

Genus SCOTONYCTERIS Matschie.

1894. *Scotonycteris* MATSCHIE, Sitz.-Ber. Gesellsch. naturforsch. Freunde. Berlin, No. 8, p. 200.

1899. *Scotonycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 70.

Type-species.—Scotonycteris zenkeri Matschie.

Geographic distribution.—West Africa (Kamerun and Fernando Po).

Number of forms.—Two species are now known, the type and *S. bedfordi* Thomas.

Characters.—Dental formula as in *Epomophorus* and *Hypsignathus*. Incisors and canines essentially as in *Epomophorus*, the former styliform and without noticeable contrast in size, the latter relatively larger than in the allied genera, though of the same form, the anterior surface smoothly rounded. Cheek teeth all subterete, essentially alike in form, the small lower premolar (pm_2) tapering to a point, the two lower molars flattish; other cheek teeth (pm^3, pm^4, m^1, pm_3, pm_4) with obliquely sloping crowns and no distinct flat crushing surface (their form closely resembling that of pm^3 in *Epomophorus comptus*). Skull not flattened as in *Epomophorus*, but resembling that of *Cynopterus* except that rostrum is compressed in region of diastema and the premaxillaries are spatulate instead of tapering above. Mandible remarkably slender and weak, its form almost exactly as in *Epomophorus*. Audital bullæ as in *Epomophorus*. Externally much as in *Epomophorus*, except that the lips are less developed. There is a rudimentary papilla-like tail, the calcar is present, as is the claw of the index finger, the wings are attached low on the sides, as in *Epomophorus*, and the fur is slightly woolly.

Species examined.—Scotonycteris bedfordi Thomas.

Remarks.—This genus has been placed near *Cynopterus* by Matschie, but it appears to be more closely related to *Epomophorus.* Though the skull more nearly resembles that of the former, this character seems to indicate merely a less specialized stage than has been reached by *Epomophorus.* Similarly primitive are the slightly developed lips. The number of teeth, the form of the mandible, and the broadly hairy back all resemble *Epomophorus*, while the structure of the teeth could easily be derived from that of the related genus by a process nearly the opposite to that which has taken place in *Hypsignathus.*

Genus EPOMOPHORUS Bennett.

1836. *Epomophorus* BENNETT, Proc. Zool. Soc., London (1835), p. 149, February 12, 1836. (*macrocephalus.*)

1866. *Epomops* GRAY, Proc. Zool. Soc., London, p. 65 (*franqueti*).

1878. *Epomophorus* DOBSON, Catal. Chiropt. Brit. Mus., p. 4 (part).

1899. *Epomophorus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 34 (part).

1899. *Epomops* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 56 (subgenus for *E. comptus*, *E. franqueti*, and *E. dobsonii*).

1899. *Micropteropus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 57 (subgenus for *E. pusillus*).

1899. *Nanonycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 58 (subgenus for *E. veldkampii*).

Type-species.—Pteropus epomophorus Bennett=*P. macrocephalus* Ogilby.

Geographic distribution.—Africa, south of the Sahara.

Number of forms.—About two dozen forms of *Epomophorus* are now known. Next to *Pteropus* this is the largest genus of Megachiroptera.

Characters.—General appearance much as in *Pteropus*, but lips fuller; tail present, though usually not visible externally; occipital portion of skull (fig. 9) slightly deflected and not tubular, and upper cheek teeth only 3–3. Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ -\ -}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{1-1}{2-2}=28.$$

Upper incisors small, styliform; the crowns pointed, but not much differentiated from shafts; the outer tooth of each pair shorter than inner, but not strongly contrasted in size. The incisors are separated from each other by narrow spaces and from the canine by a wide diastema. Lower incisors equal in size, forming a nearly straight row between the canines, separated from each other and from canines by narrow spaces, their crowns bifid or notched, rather distinctly marked off from shafts, sometimes by an evident constriction.[a] Canines small and weak, not peculiar in form, without secondary cusps or distinct ridges, the anterior surface without trace of longitudinal furrows. Except that the mandibular canines are smaller, they are almost identical in appearance with those of the upper jaw. No small maxillary premolar or molar (pm^2, m^2). The remaining maxillary teeth (pm^3, pm^4, and m^1) are essentially as in *Pteropus*, except that they are relatively smaller, and the cusps and ridges, though sharp and distinct, are not as large. Anterior premolar separated from canine by a noticeable diastema, and from next premolar by spaces relatively wider than in *Pteropus*. Small lower premolar (pm_2) of about the same relative size as in *Pteropus* (distinctly larger than incisors), but with an outer cusp and obliquely flattened surface. Other mandibular teeth differing from those of *Pteropus* about as in the case of the corresponding maxillary teeth, the small molar (m_2) closely resembling m_3 of *Pteropus*. Skull (fig. 9) broad and flattened, the depth of brain case usually little more than half its width. Deflection of occipital region slight, the alveolar line con-

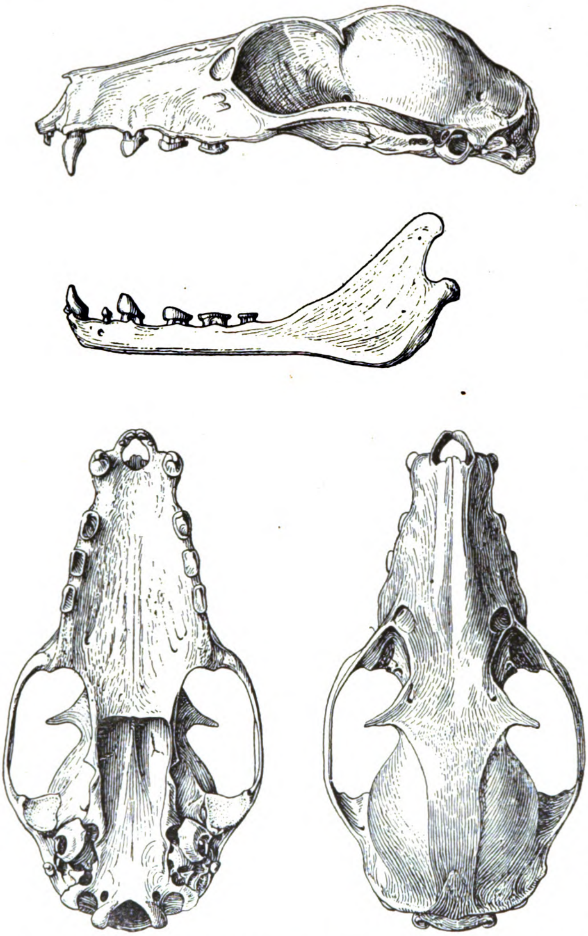

FIG. 9.—EPOMOPHORUS FRANQUETI. LIBERIA. No. 38189. ×1⅓.

[a] Very noticeable in an immature *E. franqueti* from Mount Coffee, Liberia (Cat. No. 83798, U. S. N. M.).

tinued backward usually passing through audital bulla and occipital condyle. Audital bullæ about as in *Cynopterus*, much better developed than in *Pteropus*. Mandible slender and weak, its depth between pm_3 and pm_4 scarcely greater than length of pm_3; coronoid low and very gradually sloping. In its external characters the genus differs from *Pteropus* chiefly in the very large full lips and the presence of a distinct, though very rudimentary tail consisting of two vertebræ and readily detected by touch. Males usually with conspicuous glandular mass and tuft of modified hairs on shoulder.

Species examined.—*Epomophorus comptus* H. Allen, *E. crypturus* Peters, *E. dobsonii* Bocage, *E. franqueti* Tomes, *E. gambianus* Jentink, *E. labiatus* (Temminck), *E. macrocephalus* (Ogilby), *E. minor* Dobson, *E. neumanni* Matschie, *E. pusillus* Peters, *E. wahlbergi* Sundevall; also several undetermined forms.

Genus HYPSIGNATHUS H. Allen.

1861. *Hypsignathus* H. ALLEN, Proc. Acad. Nat. Sci. Philadelphia, p. 156. (*monstrosus.*)

1862. *Sphyrocephalus* MURRAY, Proc. Zool. Soc. London, 1862, p. 8. (*labrosus*=*monstrosus.*)

1862. *Zygænocephalus* MURRAY, Proc. Zool. Soc. London, pl. I (misprint).

1878. *Hypsignathus* DOBSON, Catal. Chiropt. Brit. Mus., p. 6 (subgenus).

1899. *Hypsignathus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 42 (subgenus).

Type-species.—*Hypsignathus monstrosus* H. Allen.

Geographic distribution.—Western and central Africa from Gambia to the Uelle region and French Kongo.

Number of forms.—The type species only.

Characters.—Like *Epomophorus*, but with lips much more developed, the upper lip thrown into conspicuous folds anteriorly and about nostrils; beneath upper lip the mouth communicates with a paired sac extending from extremity of muzzle to halfway between eyes and ears. No shoulder glands. Tail reduced to a tubercle quite hidden beneath the skin and barely perceptible to the touch. Skull like that of *Epomophorus*, but with dorsal and ventral profiles nearly parallel, the depth of rostrum in males greater at diastema than in lachrymal region. Teeth as in *Epomophorus*, but incisors more widely spaced, lower incisors very obscurely or not bilobed, canines even more reduced in size, small lower premolar barely piercing gum, pm^4, m^1, pm_4, m_1, and m_2, with inner ridge much more developed than in *Epomophorus* and median furrow correspondingly deepened, outer ridge of lower molars divided into two distinct blunt cusps.

Species examined.—*Hypsignathus monstrosus* H. Allen.

Remarks.—The peculiarities of *Hypsignathus monstrosus*, especially those of the teeth, are too great to allow the animal to be placed in the genus *Epomophorus*.

Subfamily KIODOTINÆ.

1875. *Macroglossi* DOBSON. Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 346, November. 1875 (group of *Pteropidæ*).

1878. *Macroglossi* DOBSON, Catal. Chiropt. Brit. Mus., p. 4 (group of *Pteropidæ*).

1891. *Carponycteriinæ* FLOWER and LYDEKKER, Mammals living and extinct, p. 654.

1898. *Kiodotinæ* PALMER, Proc. Biol. Soc. Washington, XII, p. 111, April 30, 1898.

1899. *Pteropodidæ* MATSCHIE, Flederm. Berliner Mus. Naturk., p. 1 (part).

Geographic distribution.—Malay region from Darjiling to the Philippines; also New Guinea and northern Australia, and the neighboring islands east to the Fiji and Caroline groups. A single genus occurs in West Africa.

Characters.—Premaxillaries at first separate, but uniting and losing their distinctness later in life; bony palate narrowing gradually behind toothrows; mandibular symphysis elongated, its upper surface parallel with alveolar line; tongue highly extensible; teeth (except canines) much reduced in size.

Principal subdivisions.—Nine genera of Kiodotinæ are at present known.

KEY TO THE GENERA OF KIODOTINÆ.

Occipital portion of skull slightly deflected, the alveolar line when projected backward passing through root of zygoma.............. *Eonycteris*, p. 69.

Occipital portion of skull much deflected, the alveolar line when projected backward passing considerably above root of zygoma.

Lower cheek teeth 5–5; tail present.

Incisors $\frac{2-2}{1-1}$; upper cheek teeth 4–4; tail extending to heel. *Notopteris*, p. 74.

Incisors $\frac{2-2}{2-2}$; upper cheek teeth 5–5; tail not extending to knee. *Callinycteris*, p. 69.

Lower cheek teeth 6–6; tail absent.

Incisors $\frac{2-2}{1-1}$.................................... *Nesonycteris*, p. 74.

Incisors $\frac{2-2}{2-2}$.

Incisors well developed, the lower forming a continuous line between canines....................... *Syconycteris*, p. 72.

Incisors minute, the lower not forming a continuous line between canines.

First three maxillary cheek teeth approximately alike in size and form.

Upper cheek teeth 6–6.......... *Odontonycteris*, p. 71.

Upper cheek teeth 5–5................ *Kiodotus*, p. 70.

First three maxilliary cheek teeth differing conspicuously among themselves in size and form.

Length of mandibular symphysis nearly twice distance between outer surface of canines; lower incisors not bifid....................... *Melonycteris*, p. 73.

Length of mandibular symphysis scarcely greater than distance between outer surface of canines; lower incisors conspicuously bifid..... *Trygenycteris*, p. 73.

Genus EONYCTERIS Dobson.

1873. *Eonycteris* DOBSON, Journ. Asiat. Soc. Bengal, XLII, Pt. 2, p. 204.
1878. *Eonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 94.
1899. *Eonycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 89.

Type-species.—*Macroglossus spelæus* Dobson.

Geographic distribution.—Malay Peninsula, Sumatra, Java, and Borneo.

Number of forms.—The type is the only species yet known.

Characters.—Externally like *Rousettus*, except that muzzle is more elongate and the index finger has no claw. Tail and calcar well developed. Tongue with the usual characters of the subfamily, sharply pointed, and highly extensible. Skull not strikingly different from that of *Rousettus*, but more slender, and occipital region more deflected, the alveolar line when continued backward passing through or slightly above root of zygoma. Mandible not as heavy as in *Rousettus* and coronoid not rising as abruptly; otherwise differing only in the character of the symphysis peculiar to the subfamily. Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{2-2}{3-3}=34.$$

Upper incisors of equal size, simple, shorter than in *Rousettus*, but not distinctly different in form or position. Lower incisors apparently similar to upper (none seen with unworn crowns), directed distinctly forward, separated from each other and from canines by subequal spaces about as wide as diameter of incisor at alveolus. Canines slender and not very large, without secondary cusps and with barely indicated cingulum, the front surface of the upper canine marked by a deep longitudinal groove. Cheek teeth essentially as in *Rousettus*, but lateral ridges and median grooves less distinct.

Species examined.—*Eonycteris spelæa* (Dobson).

Remarks.—While this genus by the structure of the tongue and anterior portion of the mandible is evidently a member of the subfamily Kiodotinæ, it is the least characteristic of the group, lacking the noticeable deflection of the occipital region that occurs in all the others and showing in the form of the teeth and rostrum a stage of development intermediate between the more typical genera and *Rousettus*, which may be regarded as occupying a position near the point of departure of the long-tongued group.

Genus CALLINYCTERIS Jentink.

1889. *Callinycteris* JENTINK, Notes from the Leyden Museum, XI, p. 209, November, 1889.
1899. *Callinycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 90.

Type-species.—*Callinycteris rosenbergii* Jentink.

Geographic distribution.—Celebes.

Number of forms.—The genus is represented by the type species only.

Characters.—Like *Eonycteris*, but with wing attached to second toe instead of to first, and with lower molars 2–2 instead of 3–3. The teeth are throughout more robust than those of *Eonycteris*, and the crowns of the last upper premolar and first upper molar are distinctly broader in proportion to their length.

Species examined.—*Callinycteris rosenbergii* Jentink.

Remarks.—Though closely related to *Eonycteris* this genus appears to be well characterized by its heavier dentition and by the absence of the small m_3. Doctor Jentink has kindly sent me a photograph of the skull of the type, which shows that the specimen is a young adult with the teeth unworn.

Genus KIODOTUS Blyth.

1824. *Macroglossus* SCHINZ, Naturgesch. und Abbild. Säugeth., p. 71 (not *Macroglossum* SCOPOLI 1777).
1827. *Macroglossa* LESSON, Man. de Mammalogie, p. 115.
1840. *Kiodotus* BLYTH, Cuvier's Animal Kingdom, p. 69.
1848. *Rhynchocyon* GISTEL, Naturgesch. Thierreichs für höhere Schulen, p. ix (not of Peters, 1847).
1878. *Macroglossus* DOBSON, Catal. Chiropt. Brit. Mus., p. 95.
1891. *Carponycteris* LYDEKKER, in Flower and Lydekker, Mammals Living and Extinct, p. 654.
1899. *Macroglossus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 95 (part).
1898. *Kiodotus* PALMER, Proc. Biol. Soc. Washington, XII, p. 111, April 30, 1898.

Type-species.—*Pteropus minimus* Geoffroy.

Geographic distribution.—Malay region from Darjiling to the Philippines, New Guinea, and the Solomon Islands.

Number of forms.—Three or four species are currently recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{2-2}{3-3}=34.$$

Upper incisors subequal, minute, simple, distinctly projecting forward, the diameter of the crowns much less than that of posterior molars, the teeth of each pair separated by a space about equal to diameter of tooth at alveolus, the pairs separated from each other by a slightly wider space and from canines by diastemata double as wide. Lower incisors similar to upper in form and position, but outer tooth appreciably larger than inner and median space much wider than that between outer incisor and canine, the latter interval about equal to that between the incisors of each pair. Canines strong and well developed, without secondary cusps or prominent cingula, the maxillary canines with deep longitudinal groove on anterior surface. Cheek teeth small, without distinct contrasts of size or form, the two anterior in each jaw (pm^2, pm^3, pm_2, pm_3) with the crowns compressed and elevated into distinct though blunt cusp, the others (pm^4, m^1, m^2, pm_4, m_1, m_2, m_3) with narrow nearly flat crowns bounded by indistinct ridges, of which that on the outer side is the less developed. Anterior premolar, both above and below, close to canine, but separated from succeeding premolar by space about double as great as width of its crown. In both jaws the anterior premolar is smaller than the next. Skull (fig. 10) with a weak rostrum and large brain case, the occipital region not tubular but so strongly deflected that the alveolar line projected backward passes between root of zygoma and middle of braincase. Postorbital processes short and little curved. Development of audital bullæ about as in *Cynopterus*. Mandible very weak, and ramus distinctly concave beneath. Symphysis long, its greatest diameter equal to about twice the distance between outer sides of canines. Externally characterized by presence of well-developed claw on index finger, attachment of wing membrane to base of fourth toe, and rather low on sides of body. No external tail.

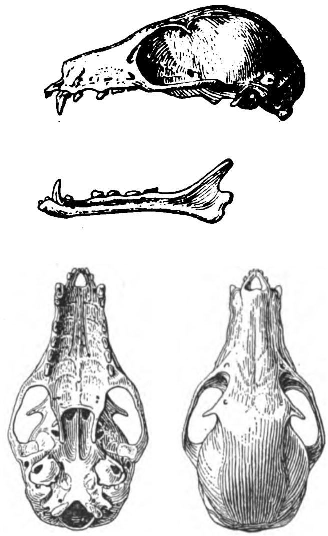

FIG. 10.—KIODOTUS LAGOCHILUS. ADULT FEMALE. PHILIPPINE ISLANDS. NO. 123440. × 1½.

Species examined.—Kiodotus minimus (Geoffroy) and *K. lagochilus* (Matschie).

Genus ODONTONYCTERIS Jentink.

1902. *Odontonycteris* JENTINK, Notes from the Leyden Museum, XXIII, No. 3 (July, 1901), p. 140. July 15, 1902.

Type-species.—Odontonycteris meyeri Jentink.

Geographic distribution.—Known only from two small islands south of the Philippines, Great Sangir and Cagayan Sulu.

Number of forms.—Only the type-species is known.

Characters.—Like *Kiodotus*, but upper molars 3–3 and papillæ of tongue less developed. The dental formula

$$\frac{-\,2\;3.\;1.\;-\,2\;3\;4\;5\;6\;7}{1\;2\;-.\;1.\;-\,2\;3\;4\;5\;6\;7}\; i\,\frac{2-2}{2-2},\; c\,\frac{1-1}{1-1},\; pm\,\frac{3-3}{3-3},\; m\,\frac{3-3}{3-3}=36$$

is unique among Pteropine bats. In actual form, however, the teeth do not differ very noticeably from those of *Kiodotus*. Incisors and canines quite as in that genus. Cheek teeth both above and below uniformly smaller than in *Kiodotus* (compared with a Philippine specimen of the *lagochilus* type), a character that is especially noticeable in the upper molars, the combined crown length of which (3 teeth) is scarcely more than in the related genus (2 teeth). Third upper molar well developed, nearly as large as m_3, its crown subcircular in outline. External characters as in *Kiodotus*. Tongue with the papillæ smaller than in *Kiodotus* (compared with Philippine *lagochilus* only), those at side and tip (except extreme anterior margin) so widely spaced that the surface of the tongue is plainly visible between them (in *Kiodotus* they overlap so that the surface of the tongue is quite hidden).

Species examined.—Odontonycteris meyeri Jentink or a closely related species from Cagayan Sulu (north of Sandakan, Borneo).

Remarks.—While the characters of the single specimen of *Odontonycteris* that I have examined (male, ad. Cat. No. 125316, U.S. N.M., collected by Dr. Edgar A. Mearns, February 25, 1904), might suggest an abnormal *Kiodotus*, they are too important to permit the name to be placed in synonymy. This individual has in the left mandible a small supplemental tooth behind the third molar.

Genus SYCONYCTERIS Matschie.

1899. *Syconycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 98. (Subgenus of *Macroglossus*=*Kiodotus*.)

1902. *Syconycteris* JENTINK, Notes from the Leyden Museum, XXIII, No. 3 (July, 1901), p. 131, July 15, 1902. (Genus.)

Type-species.—Macroglossus minimus var. *australis* Peters.

Geographic distribution.—New Guinea, northen Australia, and the neighboring islands (Bismarck Archipelago, Aru, Louisiade Islands).

Number of forms.—Four species are recognized.

Characters.—Like *Kiodotus*, but with much larger incisors, the height of those in upper jaw greater than width of premaxillaries, those in the lower jaw forming a continuous line between canines, and all, except the middle pair below (which are less than half as large as outer), approximately equal in diameter to posterior molars (m^3 and m_3). Occiput not as much deflected as in *Kiodotus*, the alveolar line when projected backward passing distinctly below middle of braincase.

Species examined.—Syconycteris crassa (Thomas).

Remarks.—As Doctor Jentink has pointed out, this group, originally defined as a subgenus of *Kiodotus* to contain the species *australis*, *papuanus*, *finschi*, and *crassus*, seems quite worthy of recognition as a genus.

Genus TRYGENYCTERIS Lydekker.

1885. *Megaloglossus* PAGENSTECHER, Zool. Anzeiger, VIII, p. 245, April 27, 1885. (Not *Megaglossa* Rondani, 1865.)
1891. *Trygenycteris* LYDEKKER, in Flower and Lydekker, Mammals living and extinct, p. 655.
1899. *Megaloglossus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 101.

Type-species.—Megaloglossus woermanni Pagenstecher.

Geographic distribution.—Western Africa from Liberia to the Kongo.

Number of forms.—The type species only has been thus far discovered.

Characters.—Like *Kiodotus*, but skull with occipital region less deflected (alveolar line projected backward, passing noticably below middle of braincase), mandibular symphysis scarcely or not longer than distance between outer edges of canines, incisors equally spaced, the middle upper teeth not projecting forward, the lower with distinctly bifid crowns, and anterior upper premolar (pm^2) conspicuously smaller than next succeeding tooth.

Species examined.—Trygenycteris woermanni (Pagenstecher).

Remarks.—This genus is unique among the Kiodotine bats in its perpendicular middle upper incisors and distinctly bifid lower incisors. In the shortness of the mandibular symphysis it is approached by *Eonycteris* only.

Genus MELONYCTERIS Dobson.

1877. *Melonycteris* DOBSON, Proc. Zool. Soc. London, p. 119, June, 1877 (see Catal. Chiropt. Brit. Mus., p. 97).
1877. *Cheiropteruges* RAMSAY, Proc. Linn. Soc. New South Wales, II, p. 17, July, 1877.
1899. *Melonycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 92.

Type-species.—Melonycteris melanops Dobson.

Geographic distribution.—Southwestern New Guinea and the Bismarck Archipelago.

Number of forms.—One; the type species.

Character.—Externally like *Kiodotus*, except that the nostrils are more projecting and the wing is attached to dorsum of foot slightly above base of third toe. (The only known species is not as small as the species of *Kiodotus*, head and body about 110 mm., and the color of the underparts, head, and face is much darker than that of back.) Skull not essentially different from that of *Kiodotus*, though larger and more heavily built. Teeth 34 (Plates VII, VIII, fig. 4) as in *Kiodotus* $\frac{-2\,3.\,1.\,-2\,3\,4\,5\,6-}{1\,2-.\,1.\,-2\,3\,4\,5\,6\,7}$ Upper incisors and outer lower incisors as small, relatively, as in *Kiodotus;* inner lower incisors smaller, contrasting with outer teeth almost as much as in *Syconycteris*, but separated in median line by a space equal to that occupied by each pair. Upper canines with broad, well-defined, longitudinal groove on anterior face, bounded on each side by a sharp ridge; cingulum ill defined; no trace of secondary cusps. Lower canine with barely indicated furrow on outer side. Anterior upper cheek tooth (pm^2) scarcely larger than incisor, close to base of canine. Anterior lower premolar (pm_2) considerably larger than corresponding maxillary tooth (its diameter about twice that of i_3), but similarly crowded against canine. Middle upper premolar (pm^3) conspicuously larger than the other cheek teeth, separated from pm^2 and pm^4 by spaces slightly greater than length of its alveolus. Other teeth essentially as in *Kiodotus*.

Species examined.—*Melonycteris melanops* Dobson.

Genus NESONYCTERIS Thomas.

1887. *Nesonycteris* THOMAS, Ann. and Mag. Nat. Hist., 5th ser., XIX, p. 147, February, 1887.

1899. *Nesonycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 91.

Type-species.—*Nesonycteris woodfordi* Thomas.

Geographic distribution.—Solomon Islands.

Number of forms.—One.

Characters.—Like *Melonycteris*, but index finger without claw, and lower incisor only 1–1. (The only known species is nearly uniform yellowish brown throughout, with no conspicuous contrasts of color.) Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{-\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{2-2}{3-3}=32.$$

In form the teeth closely resemble those of *Melonycteris*. Lower incisors almost in contact with canines, leaving a wide median space.

Species examined.—*Nesonycteris woodfordi* Thomas.

Genus NOTOPTERIS Gray.

1859. *Notopteris* GRAY, Proc. Zool. Soc. London, p. 36.

1878. *Notopteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 92.

1899. *Notopteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 88.

Type-species.—*Notopteris macdonaldii* Gray.

Geographic distribution.—Fiji Islands, New Hebrides, and Caroline Islands.

Number of forms.—Only the type is now known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ -\ -}{-\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{1-1}{2-2}=28.$$

Inner upper incisor very minute, not penetrating the gum; outer very small, but piercing the gum. Lower incisors about equal to outer upper incisor, placed close to canine, the mandible projecting considerably in front of it. Canines strong and well developed, not peculiar in form, the upper with deep longitudinal groove on front surface. Cheek teeth essentially as in *Melonycteris*. Skull much as in *Melonycteris*, but occiput not as strongly deflected (alveolar line projected backward passes a little below middle of brain case). Bullæ only a little wider than in *Pteropus*. Externally much like a rather small *Cynopterus*, but with middle of back bare owing to attachment of membranes along median dorsal line (a triangular furred area on rump), no claw on index finger, and tail so long that it reaches to the extended heel, therefore much longer than in any other known Pteropine bat. Caudal vertebræ 10.

Species examined.—*Notopteris macdonaldii* Gray.

Subfamily NYCTYMENINÆ.

1821. *Cephalotidæ* Gray, London Medical Repository, XVI, p. 299, April 1, 1821 (part, probably included both *Nyctymene* and *Dobsonia*).

1878. *Pteropodidæ* Dobson, Catal. Chiropt. Brit. Mus., p. 3 (part; *Pteropi*, part).

1899. *Pteropodidæ* Matschie, Flederm. des Berliner Mus. für Naturk., p. 1 (part).

Geographic distribution.—From Celebes and Halmahera to the Bismarck Archipelago and northern Australia.

Characters.—Premaxillaries broadly and solidly fused anteriorly (length of median suture almost equal to distance between canines), all their boundaries completely lost in adults; bony palate not narrowing behind tooth rows, the width of interpterygoid fossa (including hamulars) slightly greater than distance between posterior molars; canines parallel when jaws are closed, the lower canines in contact with each other; no lower incisors; cheek teeth not unusually cuspidate.

Principal subdivisions.—The subfamily Nyctymeninæ contains the single genus *Nyctymene*.

Genus NYCTYMENE Bechstein.

1800. *Nyctymene* Bechstein, Syst. Nebers. Vierf. Thiere, II, 615.

1810. *Cephalotes* Geoffroy, Ann. du Mus. d'Hist. Nat., Paris, XV, p. 104.

1811. *Harpyia* Illiger, Prodr. Syst. Mamm. et Avium, p. 118 (not of Ochsenheimer, 1810).

1837. *Gelasinus* Temminck, Monogr. de Mamm., II, p. 100.

1862. *Uronycteris* Gray, Proc. Zool. Soc. London, p. 262 (*Cynopterus albiventer* Gray=*Vespertilio cephalotes* Pallas *fide* Dobson).

1878. *Harpyia* Dobson, Catal. Chiropt. Brit. Mus., p. 88.

1895. *Uronycteris* Thomas, Novitates Zoologicæ, II, p. 163, June, 1895.

1899. *Gelasinus* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 81.
1899. *Bdelygma* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 82 (subgenus for *Harpyia major* Dobson).
1902. *Nyctimene* THOMAS, Proc. Biol. Soc. Washington, XV, p. 198, October 10, 1902.
1905. *Nyctymene* THOMAS, Proc. Zool. Soc. London (1904), p. 188, April 18, 1905.

Type-species.—Vespertilio cephalotes Pallas.

Geographic distribution.—From Celebes and Halmahera to the Bismarck Archipelago and northern Australia.

Number of forms.—Six forms of *Nyctymene* are now known.

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ -\ -}{-\ -\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}\ i\ \frac{1-1}{0-0},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{1-1}{2-2}=24.$$

Incisors large, completely filling space between canines, their crowns subterete and distinctly marked off from shafts by well-developed cingula; cutting edge well developed, notched near outer side. Canines (Plates VII, VIII, fig. 2) strong and rather short, their anterior surface smoothly rounded, the lower simple, in contact just above cingulum, their tips slightly diverging, the upper with well-developed secondary cusp usually present, though this occasionally (*N. robinsoni*) represented by a mere thickening of the enamel. Small premolar (pm^2 and pm_2) well developed, its crown terete and slightly flattened, the tooth just equal to cingulum of canine in height. Second lower molar like small premolar, but crown nearly double as large and obscurely quadrate in outline. Other cheek teeth (pm^3, pm^4, pm_3, pm_4, m_1, and m_2) essentially alike in form, those in each jaw gradually diminishing in size from before backward, the median groove deep but much distorted by the large anterior cusps which are so developed as to obliterate most of the horizontal surface of the crown except in the upper molar and first lower molar; inner cusp showing a distinct tendency to become terete, especially in pm^3 and pm_3, and outer cusp, except in pm^4 and m^1, tending to be bifid. Skull short and heavy, the distance from orbit to nares less than lachrymal width; brain case narrow and very little deflected, the alveolar line projected backward, passing about through condyle; occiput not tubular; audital bullæ better developed than in *Pteropus*, but less so than in *Cynopterus;* mandible practically without angular process. Externally characterized by presence of well-developed tail, a claw on index finger, conspicuously tubular nostrils, and attachment of wings low on sides of body and to bases of second and third toes.

Species examined.—Nyctymene cephalotes (Pallas), *N. major* (Dobson), *N. albiventer* (Gray), *N. aello* Thomas, *N. robinsoni* Thomas, and *N. lullulæ* Thomas.

Subfamily HARPYIONYCTERINÆ.

Geographic distribution.—Known only from Mindoro, Philippine Islands.

Characters.—Premaxillaries broadly and solidly fused anteriorly (length of median suture considerably less than distance between canines), all their boundaries completely lost in adults; bony palate narrowing rapidly behind tooth rows; canines crossing each other at nearly right angles when jaws are closed, the lower canines almost in contact with each other, and lower incisors probably absent; cheek teeth very unusually cuspidate, each molar with five or six distinct sharply pointed cusps.

Principal subdivisions.—This subfamily is represented by the genus *Harpyionycteris* only.

Genus HARPYIONYCTERIS Thomas.

1896. *Harpyionycteris* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., XVIII, p. 243, September, 1896.
1898. *Harpyionycteris* THOMAS, Trans. Zool. Soc., London, XIV, p. 384, pl. xxx (animal); pl. xxxv (skull and teeth).
1899. *Harpyionycteris* MATSCHIE, Flederm. des Berliner Mus. für Naturk., p. 70.

Type-species.—*Harpyionycteris whiteheadi* Thomas.

Geographic distribution.—Island of Mindoro, Philippine Islands.

Number of forms.—Only one species is known.

Characters.—Dental formula:

$$\frac{-\ 2\ \ -\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}{-\ -\ (3)\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{1-1}{0-0}\left(\text{or}\ \frac{1-1}{1-1}?\right)c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{2-2}{3-3}= 28 \text{ or } 30.$$

Upper incisor very large, completely filling space between canines, their form much as in *Eumops* (p. 257), that is, each with an obliquely projecting hooked cusp and a broad posterior heel, the two cusps in contact at middle, then diverging outward. Lower incisor a minute spicule, probably not normally present.[a] Canines slanting noticeably forward, very broad, with well developed cingulum and large posterior secondary cusp, this in the upper canine almost equal in diameter to main cusp, though much shorter. In the lower canine the cingulum forms a second supplemental cusp in front of the main shaft of the tooth. Small upper premolar well developed, though not unusually large, with distinct anterior cusp and narrow posterior heel. The corresponding tooth in the lower jaw (pm_2) is much larger, its size when viewed from the side nearly equaling that of the first molar. In form it somewhat resembles the canine though the cingulum and secondary cusp are

[a] In the type it occurs in the right mandible only.

less developed. Middle upper premolar (pm^3) large, almost equal to the canine, with well developed inner and posterior secondary cusps. It is closely resembled by pm_3, the main cusp of which is, however, more slender. The last premolar both above and below has a distinct inner and posterior secondary cusp and a bifid main cusp. First lower molar of the same type, but shorter. Second and third molars both above and below much shorter than the other teeth when viewed from the side, each with three outer and three inner cusps between which extends the fairly well-defined median groove. Skull not unlike that of *Pteropus* in general form, but occipital region apparently not tubular. The deflection of the occiput is so slight that the alveolar line when projected backward passes through base of zygoma. Externally characterized by unusually short legs, absence of tail, presence of claw on index finger, and attachment of wings low on sides of body.

Species examined.—*Harpyionycteris whiteheadi* Thomas.

Suborder MICROCHIROPTERA.

1821. *Insectivora* GRAY, London Medical Repository, XV, p. 299. April, 1, 1821.
1872. *Animalivora* GILL, Arrangement of the Families of Mammals, p. 16. November, 1872.
1875. *Microchiroptera* DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 346. November, 1875.
1878. *Microchiroptera* DOBSON, Catal. Chiropt. Brit. Mus., p. 2.
1899. *Microchiroptera* MATSCHIE, Flederm. des Berliner Mus. für Naturk, p. 1.

Geographic distribution.—The same as that of the order Chiroptera (p. 43).

Characters.—The following characters may be enumerated in addition to those mentioned in the key on page 43: Tragus normally present (absent in Rhinolophidæ and Hipposideridæ only); skull with rostral portion usually specialized in form; postorbital processes usually absent or rudimentary (well developed in Emballonuridæ); teeth of the insectivorous type, except in some of the Phyllostomidæ and in the Desmodontidæ, the cheek teeth of the upper and lower jaws very different from each other (except in the Desmodontidæ), the cusps of the molars when present homologous with those of the primitive tuberculo-sectorial tooth; lower incisors often 3–3.

Number of forms.—By far the greater number of known bats are members of the suborder Microchiroptera. At least 600 forms are now recognized.

Principal subdivisions.—As might be expected from the large number of its species, the suborder Microchiroptera presents much more diversity of structure than the Megachiroptera. The genera group themselves naturally into 16 families.

KEY TO THE FAMILIES OF MICROCHIROPTERA.

Premaxillaries absent .... MEGADERMIDÆ, p. 101.
Premaxillaries present.
  Premaxillaries usually free, always incomplete, their boundaries never obliterated.
    Premaxillaries represented by nasal branch only, or with a very incomplete palatal branch.
      Postorbital processes absent; second finger with two phalanges .... RHINOPOMIDÆ, p. 80.
      Postorbital processes present; second finger without phalanges .... EMBALLONURIDÆ, p. 82.
    Premaxillaries represented by palatal branch only.
      Toes with two phalanges each; pelvis with postacetabular foramen .... HIPPOSIDERIDÆ, p. 109.
      Toes (except hallux) with three phalanges each; pelvis without postacetabular foramen.
        Premaxillaries bony throughout, in contact with each other and with maxillaries; tragus present; fibula absent, NYCTERIDÆ, p. 99.
        Premaxillaries partly cartilaginous, free from each other and from maxillaries; tragus absent; fibula present, RHINOLOPHIDÆ, p. 106.
  Premaxillaries always fused with surrounding parts, complete or incomplete, their boundaries very early obliterated.
    Ischia fused together beneath posterior extremity of sacrum, NOCTILIONIDÆ, p. 95.
    Ischia not fused together beneath sacrum.
      Fibula robust (its diameter usually about half that of tibia), contributing largely to strength of short, stout leg.
        Third phalanx of middle finger cartilaginous except at extreme base; claws simple .... MOLOSSIDÆ, p. 241.
        Third phalanx of middle finger bony; claws with basal talon .... MYSTACOPIDÆ, p. 239.
      Fibula very slender or rudimentary, not contributing essentially to strength of long, slender leg.
        Third phalanx of middle finger cartilaginous except at extreme base.
          Humerus with trochiter much longer than trochin, projecting conspicuously beyond head, and forming a complete secondary articulation with scapula, VESPERTILIONIDÆ, p. 195.
          Humerus with trochiter scarcely longer than trochin, not projecting conspicuously beyond head, its articulation with scapula frequently slight or none.
            Presternum not broadened anteriorly; keel of mesosternum very high; claw of thumb well developed .... NATALIDÆ, p. 180.
            Presternum greatly broadened anteriorly; keel of mesosternum a mere ridge; claw of thumb rudimentary .... FURIPTERIDÆ, p. 186.
        Third phalanx of middle finger bony.
          Canine teeth very large, shearlike; molars enormously reduced, without trace of crushing surface, DESMODONTIDÆ, p. 176.

Canine teeth not shearlike or specially modified; molars well developed, with at least some trace of crushing surface.

Toes (except hallux) with three phalanges each; thumb and foot without sucking disk,
PHYLLOSTOMIDÆ, p. 116.

Toes with two phalanges each; thumb and foot with sucking disk.

Tragus free; no mushroom-shaped process in auditory meatus; second finger reduced to an incomplete metacarpal; sucking disks pedicillate__________THYROPTERIDÆ, p. 190.

Tragus adnate to ear conch; a conspicuous mushroom-shaped process in auditory meatus; second finger with well-developed metacarpal; sucking disks sessile,
MYZOPODIDÆ, p. 193.

Family RHINOPOMIDÆ.

1821. *Vespertilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.
1827. "Les Phyllostomes" LESSON, Man. de Mammalogie, p. 76 (part).
1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Phyllostomina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 15.
1838. *Vespertilionidæ* (part; *Rhinopomina*) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.
1838. *Vespertilionidæ* (part; *Phyllostomina*, part) GRAY, Mag. Zool. and Bot., II, p. 486, December, 1838.
1854. [*Rhinolophidæ*] "Rhinolophidés" GERVAIS, Histoire Naturelle des Mammifères, p. 200 (part).
1865. *Megadermata* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256 (part).
1866. *Rhinolophidæ* (part; *Rhinopomina*) GRAY, Proc. Zool. Soc. London, p. 81.
1872. *Rhinopomatidæ* DOBSON, Journ. Asiat. Soc. Bengal, XLI, Pt. 2, p. 221.
1875. *Emballonuridæ* (part; *Rhinopomata*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875.
1878. *Emballonuridæ* (part; *Rhinopomata*) DOBSON, Catal. Chiropt. Brit. Mus., p. 353.
1886. *Emballonuridæ* (part; *Rhinopomata*) GILL, Standard Natural History, V, p. 169.
1891. *Emballonuridæ* (part); *Emballonurinæ*, part, Rhinopomatine division) FLOWER and LYDEKKER, Mammals living and extinct, p. 666.
1892. *Emballonuridæ* (part; *Rhinopomatini*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—From Egypt through southern Asia to Burma and Sumatra.

Characters.—Humerus with trochiter well developed though not as large as trochin, not articulating with scapula, neither tubercle rising above head; epitrochlea not specially developed (about as in Pteropidæ), capitellum nearly in line with shaft; second manal digit with two distinct bony phalanges; third digit with two well-developed phalanges, but no trace of third; shoulder girdle (Plate XI, fig. 1) normal, the seventh cervical vertebra not fused with first dorsal; foot normal; fibula complete, threadlike; pelvis (Plate XI, fig. 2–4) normal, the boundaries of the sacral vertebræ clearly indicated; skull (fig. 11) without postorbital processes; premaxillaries separate, not fusing with surrounding parts, the nasal branch well developed, the palatal branch much shortened, appearing as a broadly angular thickening of lower portion of nasal branch; palate ending posteriorly in plane of last molars; teeth of the normal insectivorous type; tragus present, simple; muzzle with distinct ridgelike dermal outgrowth.

Remarks.—The family Rhinopomidæ is strikingly characterized by the presence of two phalanges in the second finger, the small trochiter of the humerus forming no secondary articulation with the scapula, the free premaxillaries from which the palatal branch is nearly lacking, and the absence of postorbital processes. The strongly primitive shoulder joint, differing from that of the Megachiroptera merely in the greater size of the humeral tuberosities, as compared with the head of the bone, indicates a low position for the group. This is confirmed by the retention of two distinct phalanges in the second finger, a character not found elsewhere in the Microchiroptera, and by the free premaxillaries closely resembling those of the Pteropidæ. As these primitive characters are not offset by any strong specializations it seems proper to regard this family as the lowest of the suborder. A similar conclusion was reached by Peters, and additional evidence in its favor has been brought forward by Winge, who, however, assigns to the group a higher rank.

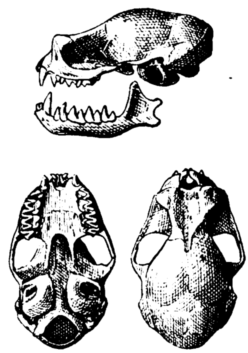

FIG. 11.—RHINOPOMA MICROPHYLLUM. IMMATURE FEMALE. EGYPT. NO. 37389. × 1¼.

Principal subdivisions.—The family Rhinopomidæ is represented by the single genus *Rhinopoma.*

Genus RHINOPOMA Geoffroy.

1813. *Rhinopoma* GEOFFROY, Descr. de l'Egypte, II, p. 113.
1821. *Rhynopoma* BOWDICH, Anal. Nat. Class. Mamm., p. 30.
1854. *Rhinopomus* GERVAIS, Hist. Nat. des Mamm., p. 202.

Type-species.—*Rhinopoma microphyllum* Geoffroy = *Vespertilio microphyllum* Brünnich.

Geographic distribution.—Same as that of the family (p. 80).

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=28.$$

Upper incisors, oblique, styliform, minute, barely penetrating the gum, the crowns scarcely differentiated from the shafts, and hardly exceeding tips of premaxillaries. Lower incisors equal, in contact with each other, but separated from canines by spaces about half width of outer tooth, their crowns with distinct outer and inner lobe and a minute, sometimes obsolete, median lobe. Canines simple, without distinct cingulum, the upper with well-developed anterior and posterior cutting edges. Cheek teeth normal, without noticeable peculiarities of any kind. Upper premolar (pm^3) with small but distinct anterior outer cusp. Molars with broad inner ledges, but no hypocone. Third upper molar with distinct metacone, mesostyle, and three commissures. Skull (fig. 11) without postorbital processes, but with lachrymal region distinctly swollen. Combined breadth of nasals greater than length. Premaxillaries tapering upward, in contact anteriorly, but not fused. Audital bullæ large, the outline on inner side flattened, but not emarginate. Externally characterized by the long tail, about equal to head and body in length and far exceeding the rather narrow interfemoral membrane. Ears rather large, extending a little beyond nostril when laid forward, broadly joined across forehead by deep band of membrane; antitragus low, ill defined; tragus large, membranaceous, not peculiar in form; keel barely indicated. Sides of muzzle much swollen laterally, the median region occupied by a deep, broad, longitudinal groove, which becomes almost pitlike posteriorly beneath ears. Nostrils opening forward by oblique slits (closed in alcoholic specimens) on the surface of an ill-defined pad, the upper edge of which is surmounted by a ridgelike, rudimentary noseleaf. Lips neither swollen nor wrinkled.

Species examined.—*Rhinopoma microphyllum* (Brünnich) and *R. cystops* Thomas.

Remarks.—The species of *Rhinopoma* are easily recognizable by the broad muzzle with its rudimentary, ridgelike noseleaf, very peculiar nostrils, and the excessively long slender tail.

Family EMBALLONURIDÆ.

1821. *Vespertilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.

1827. *Rhinolophina* LESSON, Man. de Mammalogie, p. 81 (part).

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Vespertilionina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 15.

1838. *Vespertilionidæ* (part; *Noctilionina*, part) GRAY, Mag. Zool. and Bot., II, p. 498, December, 1838.

1855. [*Vespertilionidæ*] "Vespertilionidés" (part); *Emballonurina*, part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 62.

1865. *Brachyura* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 257 (part).

1866. *Vespertilionidæ* (part; *Emballonurina* and *Diclidurina*) GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 92. February, 1866.

1867. *Noctilionidæ* (part; *Taphozoinæ*) JERDON, Mammals of India, p. 30.

1870. *Vespertilionies* (part; *Noctiliones*, part) FITZINGER, Sitzungsber. k. Akad. Wissench., Wien. Math. Naturwiss. Cl., LXI, Pt. 1, p. 458.

1872. *Noctilionidæ* (part; *Emballonurinæ*) GILL, Arrangement of the Families of Mammals, p. 17.

1875. *Emballonuridæ* (part; *Emballonuræ* and *Taphozoi*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349. November, 1875.

1878. *Emballonuridæ* (part; *Emballonuræ* and *Dicliduri*) DOBSON, Catal. Chiropt. Brit. Mus., p. 353.

1886. *Emballonuridæ* (part; *Emballonuræ* and *Dicliduri*) GILL, Standard Natural History, V, p. 169.

1891. *Emballonuridæ* (part; *Emballonurinæ*, part, *Emballonurina*) FLOWER and LYDEKKER, Mammals living and extinct, p. 666.

1892. *Emballonuridæ* (part; *Emballonurini*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Tropical portions of both hemispheres; in the Pacific Ocean east to Samoa, but not known in Australia or New Zealand.

Characters.—Humerus with trochiter well developed, though not as large as trochin, not articulating with scapula, neither tubercle rising above head; epitrochlea not specially developed, but with distinct spinous process (especially in *Taphozous* and *Diclidurus*), capitellum nearly in line with shaft; second manal digit with fully developed metacarpal, but no phalanges; third finger with two phalanges, of which the proximal is flexed on dorsal surface of metacarpal when at rest; shoulder girdle normal, the seventh cervical vertebra free; foot normal; fibula complete, thread-like; tibia flattened or grooved posteriorly; pelvis normal, except that boundaries of sacral vertebræ are nearly or quite obliterated; skull with well-developed postorbital processes (in *Diclidurus* these are obscured by the very wide supraorbital ridges); premaxillaries represented by nasal branches only, never fused with each other or with maxillaries; palate ending in plane of last molars or produced somewhat behind it, in the latter case very abruptly narrowed back of toothrows; audital bullæ emarginate on inner side; teeth normal; tragus present, simple; muzzle without special cutaneous outgrowths.

Remarks.—The members of the family Emballonuridæ are recognizable by their normal teeth, free premaxillaries, well-developed postorbital processes, the reduced condition of the index finger, and the primitive structure of the shoulder joint. Externally they may be distinguished by the combination of slender leg with reflexed proximal phalanx of third finger. In all the known genera the tail perforates the interfemoral membrane and appears on its upper surface distinctly back from the edge.

Next to the Rhinopomidæ the Emballonuridæ appear to combine the greatest number of primitive characters with the least degree of specialization. The head of the humerus is nearly as in *Rhinopoma*. As in the Rhinopomidæ the premaxillaries retain their Pteropine condition of freedom; while another character pointing in the same direction is seen in the long, curved postorbital processes. On the other hand, the index finger has completely lost its phalanges and a curious specialization appears in the flexing forward of the proximal phalanx of the third finger. The other portions of the skeleton as well as the general external structure are neutral.

History.—This family was first recognized as a distinct group by Gervais in 1855. It was treated by him as a tribe of the Vespertilionidæ under the name Emballonurina, and was composed of *Urocryptus* (=*Saccopteryx*), *Diclidurus*, *Emballonura*, *Proboscidea* (=*Rhynchiscus*), *Centronycteris*, and *Furia* (=*Furipterus*). Except for its subordinate rank it was therefore essentially the same as the present family Emballonuridæ, the only difference being the inclusion of the genus *Furipterus*, a member of the family Furipteridæ. Ten years later Peters enlarged the group by adding the genera *Mystacina* (=*Mystacops*), representing the family Mystacopidæ, and *Noctilio*, representing the family Noctilionidæ. He also discarded or overlooked the name proposed by Gervais, and substituted the new term *Brachyura*.[a] Gray, in 1866, practically returned to the classification of Gervais, but improved it by eliminating *Furipterus*. He also separated *Diclidurus* as a group Diclidurina, of equal rank with the Emballonurina, Furipterina, and his eight other subdivisions of the family Vespertilionidæ.[b] Fitzinger placed the group, enlarged by the addition of *Chilonycteris*, *Mormoops*, and *Noctilio*, as a subfamily Noctiliones of the family Vespertilionidæ ("Vespertiliones").[c] Gill returned to the more natural arrangement of Peters, but used Gray's name Noctilionidæ.[d] In 1875 Dobson combined the Brachyura and Molossi of Peters to form the family Emballonuridæ. This strikingly artificial assemblage has been accepted as a family by most recent authors. Both Winge[e] and Harrison Allen,[f] however, re-

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[a] Monatsber. k. preuss. Akad. Wissensch., Berlin, 1865, pp. 257–258.

[b] Ann. and Mag. Nat. Hist., 3d ser., XVII, pp. 92–93, February, 1866.

[c] Sitzungsber. k. Akad. Wissensch., Wien, Math. Nat. Cl., LXI, Abth. 1, pp. 458–530, 715–828; LXII, Abth. 1, pp. 13–66.

[d] Arrangement of the Families of Mammals, p. 17, November, 1872.

[e] Jordfundne og nulevende Flagermus (Chiropterà) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24, 1892.

[f] Monograph of the Bats of North America (1893), p. 162, March 14, 1894.

moved the Molossine genera to form a subdivision of the Vespertilionidæ.

Principal subdivisions.—The genera of Emballonuridæ as a whole form a very homogeneous group, but the South American *Diclidurus* is so different from the others that it must be regarded as forming a distinct subfamily.

KEY TO THE SUBFAMILIES OF EMBALLONURIDÆ.

Postorbital process slender, distinct; clavicle not expanded. *Emballonurinæ*, p. 85.
Postorbital process broad, almost obliterated by the very wide supraorbital ridge ; clavicle greatly expanded __________________ *Diclidurinæ*, p. 94.

Subfamily EMBALLONURINÆ.

1866. *Emballonurina*, GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 92. February, 1866.
1878. *Emballonuræ* DOBSON, Catal. Chiropt. Brit. Mus., p. 353.
1886. *Emballonuræ* GILL, Standard Nat. Hist., V, p. 169.

Geographic distribution.—Same as that of the family Emballonuridæ (p. 83).

Characters.—Postorbital processes long and curved, in no way obscured by supraorbital ridges, their length at least four times their width; clavicle normal, its greatest width about one-sixth its length; tibia either subterete or with outer side flattened.

Principal subdivisions.—At least eleven well-defined genera may be recognized among the members of the subfamily Emballonurinæ.

KEY TO THE GENERA OF EMBALLONURINÆ.

Upper incisors 2 – 2; wings without pouches ___________ *Emballonura*, p. 86.
Upper incisors 1 – 1; wings with or without pouches.
  Wings without pouches:
    Heavily built species with forearm usually more than 50 mm.; frontal region of skull conspicuously concave ___ *Taphozous*, p. 93.
    Lightly built species with forearm less than 50 mm.; frontal region of skull not conspicuously concave.
      Anterior upper premolar (pm^2) styliform; muzzle not noticeably produced _______________________________ *Coleura*, p. 87.
      Anterior upper premolar (pm^2) lancet shaped; muzzle noticeably produced ___________________________ *Rhynchiscus*, p. 88.
  Wings with pouches:
    Molars without hypocones; upper incisors absent in adult. *Myropteryx*, p. 91.
    Molars with hypocones; upper incisors present in adult.
      Premaxillaries rudimentary above, much exceeded by greatly inflated anterior portion of rostrum ___ *Balantiopteryx*, p. 92.
      Premaxilaries well developed above, their extremities lying distinctly on upper surface of rostrum.
        Muzzle and anterior root of zygoma so little expanded that tooth rows are visible from above. *Centronycteris*, p. 91.

Muzzle and anterior root of zygoma so expanded that tooth rows are hidden from above.
Interpterygoid fossa broad in front, the palate with evident median projection---------- *Cormura*, p. 90.
Interpterygoid fossa strongly narrowed anteriorly, the palate without median projection.
Upper surface of rostrum flat, with a slight median longitudinal groove----- *Saccopteryx*, p. 89.
Upper surface of rostrum distinctly swollen, convex, without noticeable median groove.
Rostrum so much swollen anteriorly that its dorsal profile is nearly parallel with tooth row--------------------- *Peropteryx*, p. 90.
Rostrum so little swollen anteriorly that its dorsal profile forms a conspicuous angle with tooth row--------------- *Peronymus*, p. 90.

Genus EMBALLONURA Temminck.

1838. *Emballonura* TEMMINCK, Van der Hoeven's Tijdschr. Nat. Gesch. en Physiol., V, p. 22.

1878. *Emballonura* DOBSON, Catal. Chiropt. Brit. Mus., p. 359.

Type-species.—*Emballonura monticola* Temminck. The genus contained four species, *monticola*, *saxatilis*, *caninus*, and *calcaratus* (=*maximiliani*), among which no type was designated. As all but the first have received other generic names, *monticola*, by elimination, becomes the type.

Geographic distribution.—From the Malay Peninsula and Sumatra east to Samoa. One species occurs in Madagascar.

Number of forms.—Seven forms of *Emballonura* are currently recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=34.$$

Upper incisors simple, small but well developed and permanent, subequal, the inner tooth of each pair slightly the larger. Lower incisors small, subequal, trifid, apparently often deciduous in old age. The first and second are in contact with each other, the third is slighty smaller than the others and separated from the second by a minute space and from the canine by an area equal to the length of an incisor. Canines small, with well-developed cingulum, but no posterior prolongation. Both above and below the cingulum develops a distinct anterior and posterior cusp. Small upper premolar (pm^2) a minute spicule in which no definite structure is visible. Lower premolars (pm_2 and pm_3) almost exactly resembling canine, but shorter and less slender. Upper molars broad, the first and second with distinct hypocones, the third with the metacone nearly as large as in the first and second, but with no trace of metastyle or of fourth commissure. Third lower molar smaller than first or second, but with all the elements complete. Skull (fig. 12) very delicate and lightly built, the rostrum about half as long as brain case, broad and flat, with distinct though not excessive lateral inflation and a broad median longitudinal groove. Anterior lower border of orbit so expanded that toothrows are not visible from above. Postorbital processes very slender, extending nearly to zygomata. Basisphenoid pits broad and shallow, the median division barely indicated by a low ridge. Audital bulla smaller than combined area of pits, distinctly emarginate antero-internally. Mandible with angular process bent conspicuously outward. Tibia scarcely flattened posteriorly. Externally characterized by the slender form and absence of both specially elongated muzzle and deep depression between eyes. Like all of the Old World members of the family, *Emballonura* lacks unusual glandular development in the wings.

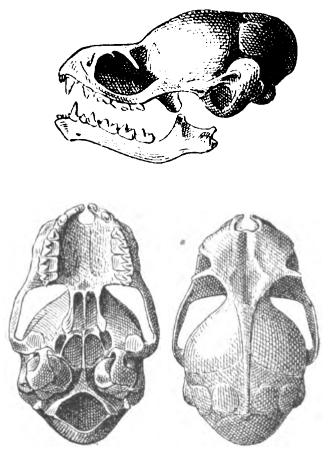


FIG. 12.—EMBALLONURA PENINSULARIS. ADULT MALE. TRONG, LOWER SIAM. No. 83556. ×2¼.

Species examined.—*Emballonura semicaudata* (Peale), *E. peninsularis* Miller, *E. anambensis* Miller, and *E. nigrescens* (Gray).

Remarks.—In the presence of 2 – 2 upper incisors, in the slight flattening of the tibia and in the special modifications that distinguish most of the other genera, *Emballonura* is the most primitive member of the family. It is also the most widely distributed genus in the group, in this respect approached by *Taphozous* only.

Genus COLEURA Peters.

1867. *Coleura* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 479.

1878. *Coleura* DOBSON, Catal. Chiropt. Brit. Mus., p. 364.

Type-species.—*Emballonura afra* Peters.

Geographic distribution.—Eastern Africa from Mozambique to upper Egypt; Seychelle Islands.

Number of forms.—Only two members of this genus have been described.

Characters.—Like *Emballonura*, but upper incisors only 1 – 1; premaxillary strongly bent inward above; basisphenoid pits coalesced, very deep posteriorly, where they are margined by a conspicuous overhanging edge.

Species examined.—*Coleura afra* (Peters).

Genus RHYNCHISCUS Miller.

1823. *Proboscidea* Spix, Simiarum et Vespertilionum Brasil. Spec. Nov., p. 61. (Not *Proboscidea* J. G. Brugière, 1791.)

1867. *Rhynchonycteris* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 477. (Not *Rhinchonycteris* Tschudi, 1844–46.)

1878. *Rhynchonycteris* Dobson, Catal. Chiropt. Brit. Mus., p. 366.

1904. *Proboscidea* Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 343, October 8, 1904.

1907. *Rhynchiscus* Miller, Proc. Biol. Soc., Washington, XX, p. 65, June 12, 1907.

Type-species.—*Proboscidea saxatilis* Spix=*Vespertilio naso* Wied.

Geographic distribution.—The mainland of tropical America.

Number of forms.—Only one species of *Rhynchiscus* is now known.

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{1-1}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisor minute, simple, persistent, inserted in main axis of premaxillary and at extreme tip of bone, the teeth, therefore, converging. Lower incisors small, trifid, forming a continuous, slightly concave line between canines. Canines and lower premolars as in *Emballonura*. Anterior upper premolar (pm^2) unusually large, its crown sharply pointed and noticeably flattened laterally, the outline being nearly an isosceles triangle. First upper molar with conspicuous antero-external cusp separate from small parastyle. Hypocone of m^1 and m^2 very distinct, subterete. Third upper molar with well-developed metacone and three commissures. Lower molars all alike in form, the third merely smaller than the others, all the cusps normal. Skull (fig. 13) with rostrum somewhat more than half as long as brain case, and so deep posteriorly that the forehead forms scarcely any angle with upper surface of rostrum. Lachrymal region slightly inflated. Premaxillaries short, very broad posteriorly, extending to upper surface of rostrum. Basisphenoid pits deep, their outer border sharply defined; but on inner side they merge into each other without dividing ridge. Audital bulla slightly larger than the two pits together. Mandible very abruptly bent upward behind tooth row. Externally characterized by the greatly elongated muzzle, and among the American genera by the absence of wing sacs. The only known species has the forearm sprinkled with

Fig. 13.—Rhynchiscus naso. Adult male. Escondido River, Nicaragua, 50 miles from Bluefields. No. 51565. ×2.

minute tufts of grayish fur, a character of much use in identifying specimens.

Species examined.—Rhynchiscus naso (Wied).

Genus SACCOPTERYX Illiger.

1811. *Saccopteryx* ILLIGER, Prodr. Syst. Mamm. et Avium, p. 121 (*leptura*).
1838–39. *Urocryptus* TEMMINCK, Van der Hoeven's Tijdschr. Nat. Gesch. en Physiol., V, p. 31 (*bilineata*).
1878. *Saccopteryx* DOBSON, Catal. Chiropt. Brit. Mus., p. 369 (part).

Type-species.—Vespertilio leptura Schreber.

Geographic distribution.—Mainland of tropical and subtropical America.

Number of forms.—About half a dozen species of this genus have been described.

Characters.—Teeth as in *Rhynchiscus*, except that pm^2 is a simple terete spicule, and the outer anterior cingulum cusp of m^1 is less developed. Skull (fig. 14) with broad flat rostrum considerably more than half as long as brain case, and so low posteriorly as to form a distinct angle with forehead. Sides of rostrum very slightly inflated and median groove obsolete. Lower rim of orbit so expanded as to hide tooth row when viewed from above. Premaxillaries large, expanded posteriorly, and terminating on dorsal surface of rostrum by an abruptly truncate margin. Postorbital processes large, broad, and flat. Brain case with distinct sagittal crest. Basisphenoid pits large, well defined, separated in middle by a distinct longitudinal plate. Audital bulla not as large as area of the pits, slightly but distinctly emarginate antero-internally. Externally distinguished by the presence of a glandular sac opening on upper surface of antebrachial membrane close to forearm near elbow. The sac is conspicuous in males, less developed in females.

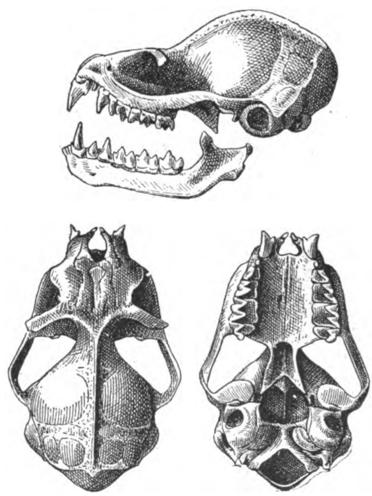


FIG. 14.—SACCOPTERYX BILINEATA. CAURA, TRINIDAD. NO. 6102, AMER. MUS. NAT. HIST. ×2.

Species examined.—Saccopteryx bilineata (Temminck), *S. leptura* (Schreber), *S. canescens* Thomas, *S. gymnura* Thomas, *S. centralis* Thomas.

Genus CORMURA Peters.

1867. *Cormura* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 475, plate opposite p. 480.

Type-species.—*Saccopteryx brevirostris* Wagner.

Geographic distribution.—Brazil.

Number of forms.—The type is the only known species.

Characters.—Skull as in *Saccopteryx*, but rostrum shorter; depth through lachrymal region greater; rims of orbits more widely expanded, palatal emargination extending back to level of small premolar; and interpterygoid fossa nearly parallel-sided, slightly constricted near middle, its anterior termination broad and encroached on by evident median palatal projection. Teeth not essentially different from those of *Saccopteryx*. Position of wing sac not known.

Species examined.—The characters of *Cormura* are known from Peter's description and plate only.

Remarks.—Though apparently a near ally to *Saccopteryx*, this genus is readily distinguishable by the structure of the interpterygoid region.

Genus PEROPTERYX Peters.

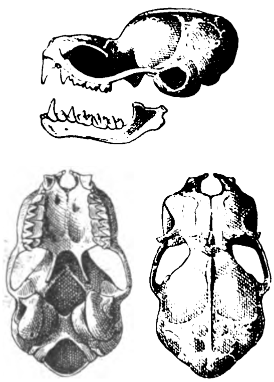


FIG. 15.—PEROPTERYX TRINITATIS TYPE. ADULT FEMALE. PORT OF SPAIN, TRINIDAD. NO. 7496, AMER. MUS. NAT. HIST. ×2.

1867. *Peropteryx* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 472 (genus).

1878. *Peropteryx* DOBSON, Catal. Chiropt. Brit. Mus., p. 370 (subgenus of *Saccopteryx*).

1899. *Peropteryx* MILLER, Bull. Amer. Mus. Nat. Hist., XII, p. 178, October 20, 1899 (genus).

Type-species.—*Vespertilio caninus* Wied.

Geographic distribution.—Tropical mainland of America, north to southern Mexico; southernmost Lesser Antilles.

Number of forms.—Three species of *Peropteryx* are now known.

Characters.—Like *Saccopteryx* but with rostrum (fig. 15) so inflated that it is uniformly convex both antero-posteriorly and laterally; depth of rostrum anteriorly great enough to make the dorsal profile nearly parallel with tooth row. Wing sac opening outward near the anterior border of antebrachial membrane. Ears separate.

Species examined.—*Peropteryx canina* (Wied), *P. kappleri* Peters, and *P. trinitatis* Miller.

Genus PERONYMUS Peters.

1868. *Peronymus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 145 (subgenus of *Peropteryx*).

Type-species.—*Peropteryx leucoptera* Peters.

Geographic distribution.—Northern South America.

Number of forms.—The type species is the only member of the genus now known.

Characters.—Like *Peropteryx*, but rostrum so little inflated anteriorly that its dorsal profile slopes conspicuously forward toward line of tooth row. Ears joined across forehead by a band of membrane 3 mm. high. In the only known species the wings are white from level of elbow outward (five specimens examined).

Species examined.—*Peronymus leucopterus* (Peters).

Remarks.—The peculiar form of the rostrum, together with the connected ears, seem enough to give *Peronymus* generic rank. Though in exactly the same position, the wing sac is better developed in the female of *Peronymus* than in that of *Peropteryx*.

Genus CENTRONYCTERIS Gray.

1838. *Centronycteris* GRAY, Mag. Zool. and Bot., II, p. 499 (subgenus of *Proboscidea*).

1867. *Centronycteris* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 478 (genus).

1878. *Centronycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 371 (subgenus of *Saccopteryx*).

Type-species.—*Vespertilio calcarata* Wied=*V. maximiliani* Fischer (*Saccopteryx wiedi* Palmer).

Geographic distribution.—Brazil and Peru.

Number of forms.—The type is the only known species.

Characters.—Similar to *Saccopteryx*, but whole animal, including skull, more slender. Lower edge of orbit so little expanded that tooth row is distinctly visible from above. Wing sac not known (all the specimens thus far taken have been females), but probably situated near edge of antebrachial membrane close to shoulder.

Species examined.—*Centronycteris maximiliani* (Fischer).

Genus MYROPTERYX Miller.

1906. *Myropteryx* MILLER, Proc. Biol. Soc. Washington, XIX, p. 59, May 1, 1906.

Type-species.—*Myropteryx pullus* Miller.

Geographic distribution.—Brazil and Dutch Guiana.

Number of forms.—The type is the only member of the genus yet known.

Characters.—Externally most nearly resembling *Peropteryx*, with which it agrees in position of wing sacs, but with broader head and more widely separated ears. Skull essentially like that of *Saccopteryx*, but with shorter, relatively deeper rostrum. Teeth differing from those of all the previously known sac-winged genera in the absence of hypocone in first and second upper molar, and in the minute, early deciduous upper incisor.

Species examined.—*Myropteryx pullus* Miller.

Remarks.—While examining the bats in the Royal Museum of Natural History in Berlin I found four specimens from Surinam collected by Kappler and labeled by Peters as *Cormura brevirostris.* On comparison with the original description and figure of this genus,[a] however, striking discrepancies were at once apparent. Another specimen of the same animal, from Baranciva, Brazil, was sent me by Dr. Lorenz von Liburnau, of Vienna, with the information that the type of *Cormura*, originally in the Natural History Museum, could no longer be found. The genus *Cormura* therefore rests wholly on the plate and description; and as these do not agree with the specimens it was necessary to name the animal represented in the museums of Vienna and Berlin. This genus is well characterized by the complete absence of hypocones in the upper molars and by the great reduction of the upper incisors. In the four adults examined the upper incisors are absent. In an immature individual, however, there are two very minute teeth in each premaxillary. Whether this condition is normal can only be conjectured, but neither tooth has the appearance of a remnant of the milk dentition, no trace of which can be found elsewhere. In the description of *Cormura* the upper incisors are merely said to be extremely small, while the figure shows them of normal size for members of the group. No mention is made of the hypocones of the upper molars, but these cusps are unmistakably indicated in the plate.

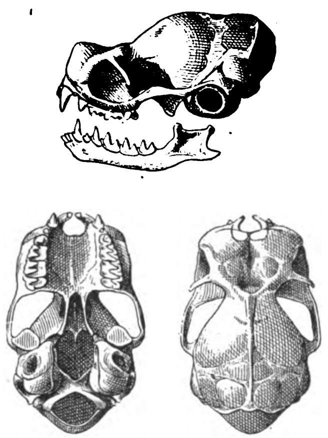


FIG. 16.—BALANTIOPTERYX PLICATA. ADULT FEMALE. MORELOS, TEHUANTEPEC, MEXICO. NO. 51142. × 2.

Genus BALANTIOPTERYX Peters.

1867. *Balantiopteryx* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 476 (genus).

1878. *Balantiopteryx* DOBSON, Catal. Chiropt. Brit. Mus., p. 371 (subgenus of *Saccopteryx*).

1904. *Balantiopteryx* ELLIOT, Land and Sea Mammals of Middle America and West Indies, p. 611 (genus).

Type-species.—*Balantiopteryx plicata* Peters.

Geographic distribution.—Tropical and subtropical mainland of America.

Number of forms.—Only two species of *Balantiopteryx* have been described.

[a] Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, 1867, p. 475, plate opposite p. 480.

Characters.—Distinguished from the other sac-winged bats by the great inflation of the rostrum (fig. 16), which rises anteriorly much above the extremities of the very slender, rudimentary premaxillaries and posteriorly forms a deep median concavity. Wing sac at middle of antebrachial membrane, its orifice directed inward and upward.

Species examined.—*Balantiopteryx plicata* Peters and *B. infusca* Thomas.

Genus TAPHOZOUS Geoffroy.

1813. *Taphozous* GEOFFROY, Descr. de l'Égypte, II, p. 113 (*perforatus*).
1842. *Saccolaimus* LESSON, Nouv. Tabl. Regn. Anim., Mamm., p. 19 (published as a synonym of *Taphozous*, from Kuhl manuscript).
1875. *Taphonycterics* DOBSON, Proc. Zool. Soc. London, p. 548 (subgenus for *Taphozous saccolaimus*, *T. affinis*, and *T. peli*).
1878. *Taphozous* DOBSON, Catal. Chiropt. Brit. Mus., p. 378.
1878. *Taphonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 379 (subgenus for *Taphozous saccolaimus*, *T. affinis*, and *T. peli*).

Type-species.—*Taphozus perforatus* Geoffroy.

Geographic distribution.—Africa (except northwestern portion), southern Asia, and the East Indies east to Australia, New Guinea, and the Philippine Islands.

Number of forms.—Sixteen forms of *Taphozous* are now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=30.$$

Upper incisor in main axis of premaxillary very minute, often absent in old individuals, its tip never attaining level of cingulum cusp of canine. Lower incisors large, imbricated, trifid, forming a continuous and strongly convex row between canines. Canines strong and with well-developed posterior extension, especially in the maxillary teeth. The cingulum of the upper canine develops two small though distinct cusps, one anteriorly, the other posteriorly. In the lower canine these are barely indicated. Cheek teeth showing no special peculiarities except that the small upper premolar (pm^2), though very low, its crown scarcely or not reaching level of cingulum of canine and large premolar, is unusually broad and is provided with a distinct main cusp and a posterior cingulum cusp, occasionally with an anterior cingulum cusp also. First and second upper molars subquadrate in outline, the W pattern rather shallow; no distinct hypocones. Third upper molar with only two commissures, the tooth terminating posteriorly at the mesostyle. The mandibular cheek teeth call for no special comment. Skull (fig. 17) with rostral portion short and flat, less than half the length of brain case, conspicuously narrowed in front of lachrymal region. Interorbital region strongly concave. Premaxillaries large, broadly rounded off posteriorly, extending to upper surface of rostrum. Postorbital process well developed, curved, terete, or slightly flattened. Pterygoids gradually diverging posteriorly, the hamulars nearly straight. Basisphenoid pits large and deep, separated by a conspicuous median plate. Audital bullæ large, conspicuously emarginate on inner side. Mandible with noticeable concavity in lower outline beneath premolars. Externally characterized by the short, very conical muzzle, deep hollow between eyes, long lower lip terminating anteriorly in two naked areas separated by a groove, slender foot, and simple tail, the latter perforating interfemoral membrane.

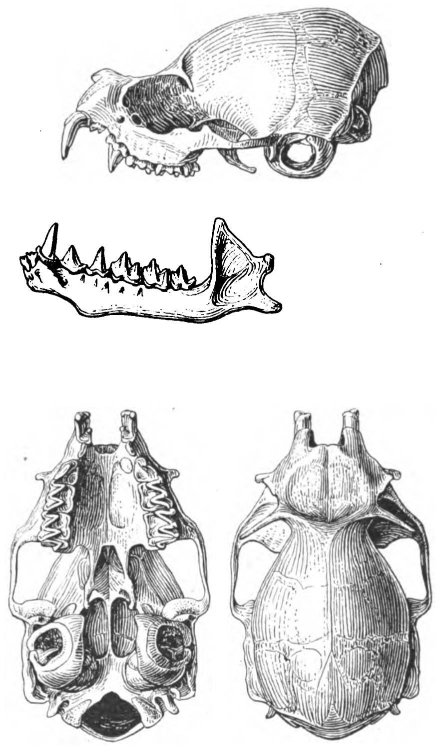


FIG. 17.—TAPHOZOUS SACCOLAIMUS. ADULT FEMALE. TARUSSAN BAY, SUMATRA. NO. 141092. × 2.

Species examined.—*Taphozous perforatus* Geoffroy, *T. mauritianus* Geoffroy, *T. melanopogon* Temminck, *T. nudiventris* Cretzschmar, *T. saccolaimus* Temminck.

Remarks.—Though showing no special peculiarities of external form this genus is probably the most aberrant of the Emballonurinæ. High specialization is shown in the form of the rostrum and anterior portion of the mandible, the deeply grooved tibia, and the high spinous process of the epitrochlea, all of which indicate affinities with the Diclidurinæ.

Subfamily DICLIDURINÆ.

1866. *Diclidurina* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 92, February, 1866.
1878. *Dicliduri* DOBSON, Catal. Chiropt. Brit. Mus., p. 355.
1886. *Dicliduri* GILL, Standard Nat. Hist., V, p. 169.

Geographic distribution.—Tropical America.

Characters.—Skull (fig. 18) with postorbital processes short and straight, scarcely more than the projecting median angle of the very wide supraorbital ridge; clavicle greatly expanded, its width just below middle more than one-third of its length; tibia (Plate XII, figs. 1, 2), with a longitudinal groove, so deep that the bone has the appearance of a hollow cylinder slit along the outer side.

Principal subdivisions.—The subfamily contains the one genus *Diclidurus.*

Genus DICLIDURUS Wied.

1819. *Diclidurus* WIED, Isis, p. 1629.
1878. *Diclidurus* DOBSON, Catal. Chiropt. Brit. Mus., p. 391.

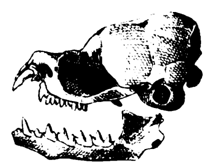
Type-species.—*Diclidurus albus* Wied.

Geographic distribution.—Same as that of subfamily.

Number of forms.—Three species are currently recognized.

Characters.—The characters of the genus *Diclidurus* are the same as those of the subfamily. The following may be added: Dental formula: $\frac{-2-.1.-2-4567}{123.1.-2-4567}$ $i\ \frac{1-1}{3-3}$, $c\ \frac{1-1}{1-1}$, $pm\ \frac{2-2}{2-2}$, $m\ \frac{3-3}{3-3}=32$.

Wing without sac. Tail curved upward and forward, its tip penetrating uropatagium and associated with structures in the membrane which appear to be glandular. In the three known species the color is white.



Species examined.—*Diclidurus scutatus* Peters and *D. virgo* Thomas.

Family NOCTILIONIDÆ.

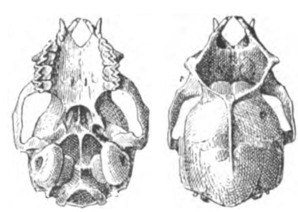


FIG. 18.—DICLIDURUS VIRGO. CHAMPERICO, GUATEMALA. NO. 120577. × 1¼.

1821. *Noctilionidæ* GRAY, London Medical Repository, XV, p. 299 (part), April 1, 1821.
1827. *Noctilionina* LESSON, Man. de Mammalogie, p. 99 (part).
1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Noctilionina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 14.
1838. *Vespertilionidæ* (part; *Noctilionina*, part) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.
1838. *Vespertilionidæ* (part; *Noctilionina*, part) GRAY, Mag. Zool. and Bot., II, p. 498, December, 1838.
1855. [*Vespertilionidæ*] "Vespertilionidés" (part: *Noctilionina*) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 52.
1865. *Brachyura* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 257 (part).
1866. *Noctilionidæ* (part; *Noctilionina*) GRAY, Ann. and Mag. Nat. Hist., 3d. ser., XVII, p. 92, February, 1866.
1870. *Vespertiliones* (part; *Noctiliones*, part) FITZINGER Sitz.-ber. kais. Akad. Wissensch., Wien. Math. Naturwissensch., Classe, LXI, Abth. I, p. 457.

1872. *Noctilionidæ* (part: *Noctilioninæ*) GILL, Arrangement of the Families of Mammals, p. 17.
1875. *Emballonuridæ* (part; *Emballonurinæ*, part, *Noctiliones*) DOBSON, Ann. and Mag. Nat. Hist., XVI, p. 349. November, 1875.
1878. *Emballonuridæ* (part; *Emballonurinæ*, part, *Noctiliones*) DOBSON, Catal. Chiropt. Brit. Mus., p. 353.
1886. *Noctilionidæ* GILL, Standard Natural History, V, p. 171.
1889. *Brachyuridæ* AMEGHINO, Actas de la Acad. Nac. de Ciencas de la Rep. Argentina en Córdoba, VI, p. 350.
1891. *Emballonuridæ* (part; *Emballonurinæ*, part, Noctilionine division) FLOWER and LYDEKKER, Mammals Living and Extinct, p. 666.
1892. *Phyllostomatidæ* (part; *Mormopini*, part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Tropical America, north to Cuba and southern Mexico.

Characters.—Humerus with trochiter much smaller than trochin, its articulation with scapula slight and indefinite, by an ill-defined surface less than one-third as large as glenoid fossa, the two tubercles rising barely to level of head, epitrochlea well developed, with distinct spinous process, capitellum slightly out of line with shaft; second manal digit with metacarpal as long as that of third, its single phalanx very short and rudimentary; third finger with two phalanges, the terminal of which, as well as that of fourth digit, lies folded beneath first when wing is at rest; shoulder girdle normal, the keel on the mesosternum (Plate XIII, fig. 2), slightly developed, seventh cervical vertebra not fused with first dorsal; foot normal, but with enormously developed bony calcar, supported by greatly enlarged, distally expanded, and flattened calcaneum (Plate XIII, fig. 1); fibula thread-like, extending to head of tibia, but cartilaginous at its upper extremity; pelvis (Plate XIII, figs. 3–6), abnormal, the ischia fused together and with under side of laterally-compressed, urostyle-like sacrum, a symphysis pubis also present in males; skull without distinct postorbital processes; premaxillaries represented by both nasal and palatal branches, fused in adult with each other and with maxillaries, the nasal branches unusually long and well developed, the palatal branches short and scarcely visible from below, though easily distinguishable in young skulls on floor of nares; palate completely closed anteriorly; teeth normal; ears separate; muzzle without leaf-like outgrowths; orifice of mouth transverse, not extending behind canines, the very full lips forming distinct cheek pouches.

History.—The history of the family Noctilionidæ is sufficiently indicated by the synonymy on page 95. From this it will be seen that the group was originally associated with the Vespertilionidæ, but that, by most recent authors, it has been placed in the Emballonuridæ. In 1886 Gill recognized it as a distinct family. Winge in 1892 united it with the Chilonycterinæ ('Mormopini') as a section of the Phyllostomidæ.

Remarks.—That this group should be regarded as a distinct family is sufficiently indicated by the peculiarities of the wing, shoulder joint, skull, and pelvis. Its relationships, however, are less clear. The large trochin and small trochiter with its slight articulation with the scapula indicate a low position near the Rhinopomidæ and Emballonuridæ, while the structure of the premaxillaries, though obscured by the early fusion of the elements of the rostrum, is not very different from that found in *Rhinopoma.* It seems probable, therefore, that the three families originated somewhat closely together among the more primitive of the Microchiroptera, though each throughout its subsequent development has followed a different path.

Principal subdivisions.—Two genera may be distinguished among the species of Noctilionidæ.

KEY TO THE GENERA OF NOCTILIONIDÆ.

Length of tibia and foot together more than half 'total length;' upper molars separated postero-internally by wide spaces; commissure of hypocone in m^1 and m^2 obsolete........................*Noctilio*, p. 97.

Length of tibia and foot together less than half 'total length;' upper molars separated postero-internally by narrow spaces; commissure of hypocone in m^1 and m^2 well developed....................*Dirias*, p. 99.

Genus NOCTILIO Linnæus.

1776. *Noctilio* LINNÆUS, Syst. Nat., I, 12th ed., p. 88.

1808. *Noctileo* TIEDEMANN, Zoologie, I, p. 536 (Nachtlöwe, *V[espertilio] leporinus* Linnæus).

1821. *Celæno* LEACH, Trans. Linn. Soc. London, XIII, p. 69 (*brooksiana*=*leporinus*).

1878. *Noctilio* DOBSON, Catal. Chiropt. Brit. Mus., p. 393 (part).

Type-species.—*Vespertilio leporinus* Linnæus.

Geographic distribution.—Tropical America north to Cuba and southern Mexico.

Number of forms.—Two forms, *leporinus* and *mastivus*, the status of which is not clearly understood, are now usually recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ -\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=28.$$

Upper incisors very unequal, closely crowded at middle of space between canines; the inner about twice as high as long, subterete, but with noticeable posterior heel, their shafts curving outward distally, strongly in contact at about middle; the outer placed somewhat behind inner, beyond the well-developed cingulum of which they scarcely extend, their terete crowns with small inner cusp; lower incisors closely crowded between canines, the crown larger than high, and about as broad as long, narrowed posteriorly, the upper surface with distinct concavity, and dull cutting edge distinctly, though not deeply, bilobed. Upper canines high and short, with distinct, though not unusually developed, very oblique cingulum, but no secondary cusps, the inner surface slightly concave, with median ridge, the outer surface uniformly convex; lower canines not peculiar except for a slight twist in the shaft at about middle. Cheek teeth both above and below essentially normal, except that the main cusps of the upper molars are placed unusually far inward and the mandibular molars project very noticeably beyond outer edge of jaw. Upper premolar nearly parallel sided, its crown more than twice as broad as long, its two cusps well developed and strongly resembling a protocone and paracone. Lower premolars showing no special peculiarities, the posterior (pm_4) almost in contact with canine, the anterior much crowded inward. First and second upper molars subequal, the four cusps, three styles, and the commissures all well developed; hypocone very distinct, terete, but with scarcely a trace of commissure. Posterior surface of each tooth strongly concave, so that the three molars are separated by very noticeable spaces. Third upper molar with about half the crown area of second, its three cones, two styles, and three commissures well developed. Lower molars with all the normal elements distinct. Form of skull highly characteristic; brain case deep, short oval in outline, with very prominently flaring, shelf-like mastoid region and distinct sagittal crest. This divides anteriorly into two rather high ridges extending out nearly perpendicularly and strongly downward over broadly terete interorbital region. Rostrum about half as long as braincase, highly arched, the nares almost tubular and opening directly forward except for a slight posterior emargination. Palate distinctly concave laterally, almost flat antero-posteriorly; behind tooth rows it narrows very gradually, much as in the Pteropidæ. Audital bullæ small, but covering about half surface of cochleæ. Ears separate, slender and pointed, with well-developed tragus. Muzzle pointed, the nostril pad strongly projecting, but nostrils not tubular. Lips very full. Chin with well-developed cross ridges. Tibia and foot together equaling about 60 per cent of total length. Tail well developed, considerably more than half as long as femur, extending about to middle of interfemoral membrane.

Species examined.—*Noctilio leporinus* (Linnæus), including both "*leporinus*" and "*mastivus*."

Remarks.—Except from the next genus *Noctilio* is so readily distinguishable that it requires no special comparison with any known group of bats. Externally it is perhaps most easily recognized by the excessively long legs and large feet, heavy, bony calcar, and long terminal phalanx of third finger, flexed under metacarpal; but its strongly wrinkled lips, sharp muzzle, and pointed, erect ears are also highly characteristic. In most of its peculiarities, undoubtedly to a considerable degree correlated with its largely fish-eating habits, *Noctilio* is the more specialized of the two genera comprised in the family.

Genus DIRIAS Miller.

1878. *Noctilio* DOBSON, Catal. Chiropt. Brit. Mus., p. 293 (part).

1904. *Dirias* MILLER, Proc. Biol. Soc. Washington, XIX, p. 84, June 4, 1906 (*albiventer*).

Type-species.—*Noctilio albiventer* Spix.

Geographic distribution.—Warmer parts of South America.

Number of forms.—*Dirias albiventer* (Spix) and *D. zaparo* (Cabrera).

Characters.—Like *Noctilio* externally but with less elongated leg and foot, the length of tibia and foot together scarcely exceeding 40 per cent of the " total length." Skull as in *Noctilio.* Teeth as in *Noctilio* except that the first and second upper molars are very slightly emarginate posteriorly, so that the spaces between the teeth are scarcely noticeable; hypocone relatively largely than in *Noctilio* and connected by a high, conspicuous commissure, with the commissure extending from protocone to metacone.

Species examined.—*Dirias albiventer* (Spix).

Family NYCTERIDÆ.

1821. *Vespertilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.

1827. *Rhinolophina* LESSON, Man. de Mammalogie, p. 81 (part).

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Phyllostomina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 15.

1838. *Vespertilionidæ* (part; *Rhinolophina*, part) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.

1838. *Vespertilionidæ* (part; *Vespertilionina*, part) GRAY, Mag. Zool. and Bot., II, p. 494, December, 1838.

1854. [*Rhinolophidæ*] "Rhinolophidés" GERVAIS, Hist. Nat. des Mammifères, p. 200 (part).

1855. *Nycterina* VAN DER HOEVEN, Handb. der Dierkunde, 2d ed., II, p. 1028 (part).

1865. *Megadermata* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256 (part).

1866. *Rhinolophidæ* (part; *Nycterina*) GRAY, Proc. Zool. Soc. London, p. 83.

1872. *Megadermidæ* GILL, Arrangement of the Families of Mammals, p. 17 (part).

1875. *Nycteridæ* (part; *Nycterinæ*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 348, November, 1875.

1878. *Nycteridæ* (part, *Nycterinæ*) DOBSON, Catal. Chiropt. Brit. Mus., p. 161.

1886. *Megadermidæ* (part, *Nycterinæ*) GILL, Standard Natural History, V, p. 165.

1891. *Nycteridæ* FLOWER and LYDEKKER, Mammals Living and Extinct, p. 658 (part).

1892. *Rhinolophidæ* (part; *Megadermatini* part, *Nycterides*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Africa, except northwestern portion; also the Malay Peninsula, Java, and Timor.

Characters.—Humerus with trochiter small, about equal to trochin, not articulating with scapula, the two tubercles rising very slightly above head; epitrochlea very large, with conspicuous styloid process, capitellum carried outward beyond line of shaft; second manal digit consisting of well-developed metacarpal only; third finger with two phalanges; shoulder girdle normal except that seventh cervical vertebra is fused with dorsal, and keel of sternum is unusually well developed, forming most of mesosternum, longitudinal portion of presternum is somewhat broadened, and first rib is noticeably strengthened; fibula absent; pelvis normal except that as a whole it is unusually short and broad, ischia wide apart posteriorly; skull (fig. 19) with postorbital processes present but obscured by the very broad supraorbital ridges; interorbital region deeply concave; premaxillaries represented by palatal branches only, these bony throughout and completely filling space between maxillaries; teeth normal; tragus present, simple; muzzle with cutaneous outgrowths margining a deep longitudinal groove.

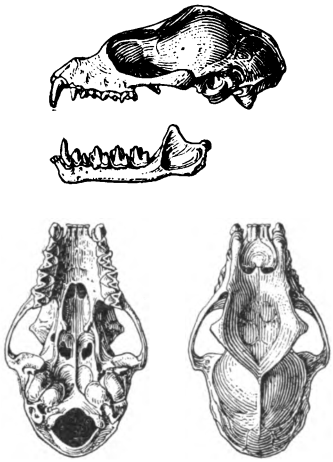


FIG. 19.—NYCTERIS JAVANICA. SEMBRONG RIVER, JOHORE. NO. 112608. × 1⅓.

History.—Though variously associated by the earlier authors with the Vespertilionidæ, Phyllostomidæ, or Rhinolophidæ this family was placed with the Megadermidæ by Peters as long ago as 1865. Since then it has remained in this position, the two groups being regarded as sections of a family Megadermidæ or Nycteridæ. Though undoubtedly this association is natural the peculiarities of the two seem great enough to warrant their recognition of separate families.

Remarks.—The Nycteridæ are at once recognizable by their long tails included to the tip in membrane, large ears with well developed tragi, and the deep frontal grove, margined by leaf-like outgrowth. Other diagnostic characters are the absence of the fibula, the well-developed palatal branches of the premaxillaries, and the peculiar structure of the frontal region of the skull.

Principal subdivisions.—The family Nycteridæ contains the single genus *Nycteris*.

Genus NYCTERIS Geoffroy.

1795. *Nycteris* GEOFFROY and CUVIER, Magasin Encyclopédique, 1e année, II, p. 186 (*nomen nudum*).
1803. *Nycteris* GEOFFROY, Cat. Mamm. Mus. National Hist. Nat., p. 64.
1803. *Nicteris* DESMAREST, Nouv. Dict. d'Hist. Nat., XV, p. 501.
1813. *Nycterus* G. FISCHER, Zoognosia, 3d ed., I, p. 18.
1838. *Petalia* GRAY, Mag. Zool. and Bot., II, p. 494. (*javanica.*)
1866. *Nycterops* GRAY, Proc. Zool. Soc. London, p. 83. (*pilosa=hispida.*)
1866. *Pelatia* GRAY, Proc. Zool. Soc. London, p. 83. (*javanica.*)
1878. *Nycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 161.

Type-species.—*Vespertilio hispidus* Schreber.

Geographic distribution.—Africa, except northwestern portion; also the Malay Peninsula, Java, and Timor.

Number of forms.—About a dozen forms of *Nycteris* are known, all but one of them African.

Characters.—The essential characters of the genus are the same as those of the family. In addition may be mentioned: Dental formula,

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=32;$$

upper incisors trifid, almost exactly resembling the lower both in size and form; outer lower incisor with crown not quite as large and distinctly trifid as in the two others; other teeth showing no special peculiarities, m^1 and m^2 with large postero-internal heel, but no hypocone, m^3 with metacone, mesostyle, and three commissures; pm_4 very small, almost concealed by pm_3 and m_1.

Species examined.—*Nycteris æthiopica* Dobson, *N. capensis* Smith, *N. fuliginosa* Peters, *N. grandis* Peters, *N. hispida* (Schreber), *N. javanica* Geoffroy, *N. luteola* Thomas, *N. thebiaca* Geoffroy.

Family MEGADERMIDÆ.

1821. *Vespertilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.
1827. *Rhinolophina*, LESSON, Man. de Mammalogie, p. 81 (part).
1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Phyllostomina*, part) BONAPARTE, Saggio di una distrib. methodica degli Anim. Vert., p. 15.
1838. *Vespertilionidæ* (part; *Rhinolophina*, part) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.
1838. *Vespertilionidæ* (part; *Phyllostomina*, part) GRAY, Mag. Zool. and Bot., II, p. 486. December, 1838.
1854. [*Rhinolophidæ*] "Rhinolophidés" GERVAIS, Hist. Nat. des Mammifères, p. 200 (part).
1864. *Megadermatidæ* H. ALLEN, Monogr. Bats N. Amer., p. 1 (part; *Macrotus=Otopterus*, and *Megaderma*, are the only genera mentioned).

1865. *Megadermata* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256 (part).
1866. *Rhinolophidæ* (part; *Megadermina*) GRAY, Proc. Zool. Soc., London, p. 83.
1872. *Megadermidæ* GILL, Arrangement of the Families of Mammals, p. 17 (part).
1875. *Nycteridæ* (part; *Megaderminæ*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 348.
1878. *Nycteridæ* (part; *Megaderminæ*) DOBSON, Catal. Chiropt. Brit. Mus., p. 154.
1886. *Megadermidæ* GILL, Standard Natural History, V, p. 164 (part).
1891. *Nycteridæ* FLOWER and LYDEKKER, Mammals living and extinct, p. 658 (part).
1892. *Rhinolophidæ* (part; *Megadermatini*, part, *Megadermata*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.
1907. *Megadermatidæ* ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., 7th series, XIX, p. 129, February, 1907.

Geographic distribution.—Tropical Africa, southern Asia, the Malay region to the Philippine Islands, Australia.

Characters.—Humerus and shoulder joint as in the Nycteridæ; second finger with one phalanx; third with two; shoulder girdle abnormal in the great widening of anterior portion of presternum (greatest width nearly four times length) and in the fusion of this widened portion, together with the first rib, first dorsal, and seventh cervical vertebræ, into a solid ring of bone; keel of sternum only moderately developed; fibula threadlike, less than half as long as tibia; pelvis normal, the ischia free posteriorly; skull with postorbital processes short or practically absent, usually obscured by wide supraorbital ridges; premaxillaries absent; upper canines projecting noticeably forward, the shaft with a large secondary cusp; tragus present, bifid; muzzle with conspicuous leaflike cutaneous outgrowths.

History.—The history of this family is the same as that of the Nycteridæ.

Remarks.—Although undoubtedly a near ally of the Nycteridæ, this group appears to be well characterized as a family. It closely resembles the Nycteridæ in the form of the humerus and structure of the shoulder joint, and usually though not invariably in the form of the skull. It differs from the related family in the presence of the fibula, the bifid tragus, long, erect noseleaf, rudimentary cartilaginous condition of the premaxillaries and consequent absence of the upper incisors, projection forward and bicuspidate structure of the upper canines, fused presternum and first sternal rib, and presence of well-developed phalanx in second finger. Externally the members of the group may be recognized by their very short tails, large ears with bifid tragi, and long, erect noseleaves.

Principal subdivisions.—Five genera are currently recognized.

KEY TO THE GENERA OF MEGADERMIDÆ.

Upper premolars 2 – 2; interorbital region not conspicuously concave.
  Lachrymal width much less than distance from orbit to canine, *Megaderma*, p. 103.
  Lachrymal width greater than distance from orbit to canine, *Lyroderma*, p. 104.
Upper premolars 1 – 1; interorbital region conspicuously concave.
  Rudimentary premaxillaries rather distinct, projecting beyond line of canines; width of frontal expansion much less than distance between outer sides of toothrows ________________ *Macroderma*, p. 105.
  Rudimentary premaxillaries practically absent; width of frontal expansion about equal to distance between outer sides of toothrows.
    Upper molars with W pattern distinct ______________ *Lavia*, p. 105.
    Upper molars with W pattern distorted by reduction of the mesostyles ________________________________ *Cardioderma*, p. 106.

Genus MEGADERMA Geoffroy.

1810. *Megaderma* GEOFFROY, Ann. Mus. Hist. Nat., Paris, XV, p. 197.
1866. *Spasma* GRAY, Proc. Zool. Soc. London, p. 83.
1878. *Megaderma* DOBSON, Catal. Chiropt. Brit. Mus., p. 154 (part, subgenus).
1907. *Megaderma* ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., 7th series, XIX, p. 130, February, 1907 (genus).

Type-species.—*Vespertilio spasma* Linnæus.

Geographic distribution.—From India, Ceylon, and the Malay Peninsula to Sumatra, Borneo, and the Philippine Islands.

Number of forms.—Four forms are recognized by Andersen and Wroughton.

Characters.—Dental formula:

$$\frac{-\ -\ -.\ 1.\ -2-4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -2-4\ 5\ 6\ 7},\ i\ \frac{0-0}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=28.$$

Lower incisors large, indistinctly trifid, forming a continuous, slightly convex row between canines, the inner tooth smaller than outer. Canines large, with well-developed cingula, the lower without secondary cusps, the upper with a minute anterior cingulum cusp and a large posterior cusp at base of shaft. Anterior upper premolar minute, on inner side of toothrow in angle between canine and large premolar. First and second upper molars with three main cusps rather close together, particularly in m^1, and mesostyle so reduced that the W pattern is considerably distorted by the partial obliteration of the median commissures. Postero-internal heel well developed but without trace of hypocone. Third upper molar with four cusps and two commissures. Lower molars with cusps near together and those on inner side reduced in size, particularly the entoconid, which is practically absent from m_3. Skull (fig. 20) with rostrum slightly less than half as long as braincase, slender, slightly concave above, without supraorbital ridges or special widening in interorbital or lachrymal regions, the postorbital processes reduced to the merest trace. Basisphenoid pits shallow but distinct, partly overhung by the concave-spatulate hamulars. Audital bullæ small, their greatest diameter less than width of space between them. Sagittal crest low and indistinct, bifurcating anteriorly into two lines terminating in the rudimentary postorbital processes.

Species examined.—*Megaderma carimatæ* Miller, *M. spasma* (Linnæus), and *M. trifolium* Geoffroy.

Remarks.—The genus *Megaderma* is recognized among its allies by the nearly unmodified rostrum and lachrymal region, and by the noticeably concave hamular processes.

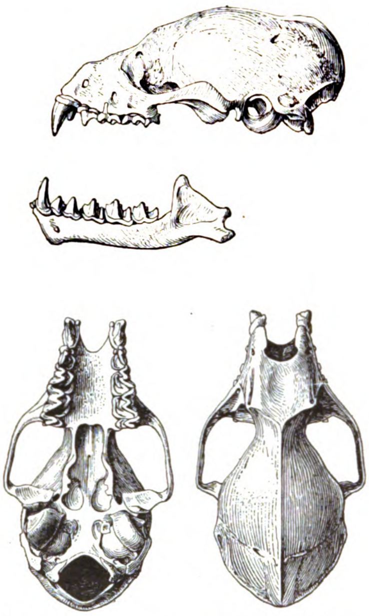


FIG. 20.—MEGADERMA SPASMA. TANJONG SIKA KAP, JOHORE. No. 112733. ×1¼.

Genus LYRODERMA Peters.

1847. *Eucheira* HODGSON, Journ. Asiatic Soc. Bengal, XVI, p. 891 (*schistacea=lyra*); not *Eucheira* WESTWOOD, Trans. Entom. Soc. London, I, 1836, p. 44.

1872. *Lyroderma* PETERS, Monatsber, k. preuss. Akad. Wissensch., Berlin, p. 195 (subgenus of *Megaderma*).

1907. *Eucheira* ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., 7th series, XIX, p. 134, February, 1907 (genus).

Type-species.—*Megaderma lyra* Geoffroy.

Geographic distribution.—Peninsula of India, Ceylon, and southern China.

Number of forms.—Three forms are recognized by Andersen and Wroughton.

Characters.—Similar to *Megaderma*, but skull with noticeably widened frontal region, and distinct supraorbital ridges which show evident traces of incipient postorbital processes. Base of brain case noticeably elongated, the basisphenoid pits obsolete; hamulars small, the pterygoid scarcely concave between the process and basisphenoid pit. Teeth slightly more aberrant than those of *Megaderma*, the principal triangle in the upper molars more reduced relatively to area of crown, the posterior border of crown more emarginate.

Species examined.—I have seen all the recognized forms of this genus.

Genus MACRODERMA Miller.

1906. *Macroderma* MILLER, Proc. Biol. Soc. Washington, XIX, p. 84, June 4, 1906.
1907. *Macroderma* ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., 7th series, XIX, p. 137, February, 1907.

Type-species.—*Megaderma gigas* Dobson.

Geographic distribution.—Australia (Queensland).

Number of forms.—The type species is the only form of *Macroderma* yet known.

Characters.—General form of skull much as in *Lyroderma*, but postorbital and antorbital processes more prominent, hamular region deeply concave internally as in *Megaderma*, and interpterygoid space extending forward to level of posterior border of second molar. Teeth more extremely modified than those of *Lyroderma*. The very small paracone and well-developed metacone separated from outer border of molars by a conspicuous nearly horizontal area. Small upper premolar absent.

Species examined.—*Macroderma gigas* Dobson (specimen from from Central Australia, No. 92, 5, 20, 2, Brit. Mus., and photograph of skull of type, kindly furnished by Professor Ehlers).

Remarks.—*Macroderma* represents the extreme phase of the peculiar tendency of molar development characteristic of the group.

Genus LAVIA Gray.

1838. *Lavia* GRAY, Mag. Zool. and Bot., II, p. 490.
1846. *Livia* AGASSIZ, Nomenclator Zoologicus, Addenda, p. 6.
1878. *Lavia* DOBSON, Catal. Chiropt. Brit. Mus., p. 155 (subgenus of *Megaderma*).
1905. *Lavia* MILLER, Proc. Biol. Soc. Washington, XVIII, p. 227, December 9, 1905 (genus).
1907. *Lavia* ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., 7th series, XIX, p. 138, February, 1907.

Type-species.—*Megaderma frons* Geoffroy.

Geographic distribution.—Tropical Africa.

Number of forms.—The genus is represented by two forms.

Characters.—Like *Megaderma*, but lacking the minute upper premolar (pm^3) frontal region of skull widely expanded and with conspicuous postorbital processes; basisphenoid pits obsolete; upper molars with well-developed mesostyles and normal W pattern; lower molars with outer and inner cusps not unusually close together, those on lingual side well developed, though m_3 is without distinct entoconid.

Species examined.—*Lavia frons* (Geoffroy) and *Lavia rex* (Miller).

Genus CARDIODERMA Peters.

1873. *Cardioderma* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 488 (subgenus of *Megaderma*).
1878. *Cardioderma* DOBSON, Catal. Chiropt. Brit. Mus., p. 155 (subgenus of *Megaderma*).
1907. *Cardioderma* ANDERSEN and WROUGHTON, Ann. Mag. Nat. Hist., 7th ser., XIX, p. 140, February, 1907.

Type-species.—*Megaderma cor* Peters.

Geographic distribution.—Eastern Africa.

Number of forms.—The type is the only species of *Cardioderma* at present known.

Characters.—Skull essentially as in *Lavia*, but with frontal concavity longer and considerably deeper; anterior palatal emargination longer and narrower. Teeth differing from those of *Lavia* and resembling those of *Megaderma* in the crowding of the main cusps both above and below, the reduction of the mesostyle in m^1 and m^2 and consequent distorting of the W pattern, and in the reduction of the posterior segment of the lower molars, this character being even more noticeable than in *Megaderma*.

Species examined.—*Cardioderma cor* (Peters).

Family RHINOLOPHIDÆ.

1821. *Vespertilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299. April 1, 1821.
1827. *Rhinolophina* LESSON, Man. de Mammalogie, p. 81 (part).
1831. *Vespertiliones* (*Vespertilionidæ* part; *Rhinolophina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 16.
1838. *Vespertilionidæ* (part; *Rhinolophina*, part) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.
1838. *Vespertilionidæ* (part; *Rhinolophina*, part) GRAY, Mag. Zool. and Bot., II, p. 491, December, 1838.
1854. [*Rhinolophidæ*] "Rhinolophidés" GERVAIS, Histoire Naturelle des Mammifères, p. 200 (part).
1865. *Rhinolophi* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256 (part).
1866. *Rhinolophidæ* (part; *Rhinolophina*) GRAY, Proc. Zool. Soc., London, p. 81.
1872. *Rhinolophidæ* GILL, Arrangement of the Families of Mammals; p. 17 (part).
1875. *Rhinolophidæ* (part; *Rhinolophinæ*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 348, November, 1875.
1878. *Rhinolophidæ* (part; *Rhinolophinæ*) DOBSON, Catal. Chiropt. Brit. Mus., p. 100.
1886. *Rhinolophidæ* (part; *Rhinolophinæ*) GILL, Standard Natural History, V, p. 164.
1891. *Rhinolophidæ* (part; *Rhinolophinæ*) FLOWER and LYDEKKER, Mammals living and extinct, p. 656.
1892. *Rhinolophidæ* (part; *Rhinolophini* part; *Rhinolophi*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Tropical and temperate portions of the Old World, east to the Philippine Islands, New Guinea, and northeastern Australia.

Characters.—Humerus with trochiter about as large as trochin and definitely articulating with scapula by an articular surface half as large as glenoid fossa, both tubercles rising slightly above level of head, epitrochlea large and with well-developed styloid process, capitellum nearly in line with shaft; second manal digit consisting of well-developed metacarpal alone; third finger with two phalanges; shoulder girdle highly abnormal, the seventh cervical vertebra and first dorsal so completely fused that their boundaries can not be detected; these are fused with first rib, which in turn is fused with presternum and ventral half of second rib, the region between which is completely filled with bone, the presternum appearing to be enlarged to form a broadly crescentic plate; foot normal, the hallux with two phalanges, the other toes with three; fibula complete, threadlike; pelvis abnormal, the ischium and pubis so reduced in size that dorsal and ventral profiles of innominate bone are nearly parallel, their width at the same time so increased that the thyroid foramen is scarcely more than twice as large as the acetabulum; lumbar vertebræ showing no tendency to become fused, but centrum of fifth or sixth, often of both, with distinct bifid or double hypophysis; skull without postorbital processes and with premaxillaries represented by ligulate palatal branches only, the two bones partly cartilaginous, and fused neither with each other nor with maxillaries; palate so deeply emarginate both anteriorly and posteriorly that its median length is less than least distance between tooth rows; teeth normal; ears large, without tragus; muzzle with conspicuous leaflike cutaneous outgrowths consisting of a horizontal anterior horseshoe, a perpendicular median sella, and a posterior erect lancet.

Remarks.—The large ears without tragus, the conspicuous noseleaves, and the normal feet are the characters by which the members of this family are most easily recognized. The degree of fusion of the elements of the shoulder girdle, and the very remarkable hypophyses of the fifth and sixth numbar vertebræ further distinguish the group.

History.—Associated with the Vespertilionidæ by the earlier writers, the family Rhinolophidæ appears to have been first recognized as distinct by Gervais in 1854. With it were combined the Hipposideridæ. Its separation from the latter took place in 1875 when Dobson recognized two subfamilies of Rhinolophidæ, the Rhinolophinæ and Phyllorhininæ. The only departure from this arrangement was made by Winge, who placed *Megaderma* and *Nycteris* in the family Rhinolophidæ, reduced the family as generally understood to the rank of a subfamily, and the two subfamilies to sections, Phyllorhinæ and Rhinolophi. The Rhinolophidæ are here for the first time regarded as a family distinct from the Hipposideridæ.

Principal subdivisions.—The family Rhinolophidæ contains the genus *Rhinolophus* only.

Genus RHINOLOPHUS Lacépède.

1799. *Rhinolophus* LACÉPÈDE, Tabl. des. div. sousdiv. ordres et genres des Mammifères, p. 15 (*ferrum-equinum*).

1836. *Rhinocrepis* GERVAIS, Dict. Pittoresque d'Hist. Nat., IV, Pt. 2, p. 617 (attributed to Geoffroy and Cuvier, Mag. Encyclopédique, 1795, but the name does not occur in the paper referred to).

1847. *Aquias* GRAY, Proc. Zool. Soc. London, p. 15 (*luctus* and *trifoliatus*).

1866. *Phyllotis* GRAY, Proc. Zool. Soc. London, p. 81 (*philippensis;* not *Phyllotis* Waterhouse, 1837).

1866. *Cœlophyllus* GRAY, Proc. Zool. Soc. London, p. 427 (*cœlophyllus*),

1878. *Rhinolophus* DOBSON, Catal. Chiropt. Brit. Mus., p. 100.

1901. *Euryalus* MATSCHIE, Sitzber. Gesellsch. naturforsch. Freunde, Berlin, p. 225 (*mehelyi*).

Type-species—*Vespertilio ferrum-equinum* Schreber.

Geographic distribution.—Tropical and temperate portions of the Old World, east to the Philippine Islands, New Guinea, and northeastern Australia.

Number of forms.—About 105 forms of *Rhinolophus* are now recognized.[a]

Characters.—Dental formula (Plates I, II, fig. 1):

$$\frac{-\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisor very small, but usually well formed and with distinct rounded crown with slight cusp on inner side. Lower incisors trifid, the outer larger than the inner, the four teeth forming a continuous row between canines. Upper canines heavy, but simple in form, without secondary cusps or conspicuous cingula. Lower canines rather weak. First upper premolar (pm^3) and second lower premolar small, functionless, usually crowded quite out of the tooth row. Other teeth showing no special peculiarities; m^1 and in m^2 without hypocone, m^3 with five cusps and three commissures, in most species a rudimentary fourth, the crown area of the tooth much more than half that of m^1 or m^2. Lower molars with the cusps all well developed and normal in position. Skull with distinct sagittal crest, small audital bullæ, and large cochleæ. Basisphenoid pits absent. Tail present, well developed.

Species examined.—Probably half of the known species have been examined during the preparation of this paper, including skeletons of *Rhinolophus ferrum-equinum* (Schreber), *R. affinis* Horsfield, *R. arcuatus* Peters, *R. capensis* Lichtenstein, *R. cornutus* Temminck, *R. hipposideros* (Bechstein), *R. larvatus* Milne Edwards, *R. minor* Horsfield, and *R. pearsonii* Horsfield.

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[a] See Andersen, Ann. and Mag. Nat. Hist., 7th ser., XVI, pp. 648–662, December, 1905.

Family HIPPOSIDERIDÆ.

1821. *Vespertilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.
1827. *Rhinolophina* LESSON, Man. de Mammalogie, p. 81 (part).
1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Rhinolophina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 16.
1838. *Vespertilionidæ* (part; *Rhinolophina*, part) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno 1, Tomo II, p. 112.
1838. *Vespertilionidæ* (part; *Phyllostomina*, part) GRAY, Mag. Zool. and Bot., II, p. 486. December, 1838.
1854. [*Rhinolophidæ*] "Rhinolophidés" GERVAIS, Histoire Naturelle des Mammifères, p. 200 (part).
1865. *Rhinolophi* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256 (part).
1866. *Rhinolophidæ* (part; *Rhinolophina*, part, and *Rhinonycterina*) GRAY, Proc. Zool. Soc. London, p. 81.
1872. *Rhinolophidæ* GILL, Arrangement of the Families of Mammals, p. 17 (part).
1875. *Rhinolophidæ* (part; *Phyllorhininæ*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 348, November, 1875.
1878. *Rhinolophidæ* (part; *Phyllorhininæ*) DOBSON, Catal. Chiropt. Brit. Mus., p. 123.
1886. *Rhinolophiæ* (part; *Phyllorhininæ*) GILL, Standard Natural History, V, p. 164.
1891. *Rhinolophidæ* (part; *Hipposiderinæ*) FLOWER and LYDEKKER, Mammals, living and extinct, p. 657.
1892. *Rhinolophidæ* (part; *Rhinolophini*, part, *Phyllorhinæ*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Tropical parts of the Old World, east to the Philippine Islands, New Ireland, and Australia; in Amoy and the Himalayas the range extends somewhat beyond the tropical region, as well as in Morocco, Africa.

Characters.—Like the Rhinolophidæ, but pectoral and pelvic girdles, more highly modified, toes with two phalanges each, and lumbar vertebræ showing a marked tendency to become fused into a solid rod. In the pectoral girdle the fusion of the first and second ribs involves the entire bone to and including the corresponding dorsal vertebræ. There is thus produced a solid ring of bone consisting of the seventh cervical vertebra, first and second dorsals, first and second ribs, and entire presternum, the elements of the ring indicated by a slit-like vacuity above, between the ribs and one or two small roundish vacuities below. Pelvic girdle like that of the Rhinolophidæ posteriorly, but anteriorly with a supplemental bridge of bone connecting acicular process with front of ilium and producing a preacetabular foramen slightly exceeding the thyroid foramen in size. Lumbar vertebræ fused, in many species so completely that the boundaries between the centra are quite obliterated; hypophyses absent.

Remarks.—While the Hipposideridæ are closely related to the Rhinolophidæ, the more highly modified character of the feet and of the pectoral and pelvic girdles appears to be of sufficient importance to allow the group to stand as a distinct family.

History.—The history of the family has been sufficiently treated under the family Rhinolophidæ.

Principal subdivisions.—Eight genera of Hipposideridæ are now known.

KEY TO THE GENERA OF HIPPOSIDERIDÆ.

Zygoma expanded into a wide plate, the height of which is nearly or quite equal to distance from m^3 to glenoid fossa.
- Braincase scarcely higher than rostrum; sagittal crest low, normal, *Triænops*, p. 115.
- Braincase much higher than rostrum; sagittal crest terminating abruptly in front of middle of braincase ---------- *Rhinonycteris*, p. 114.

Zygoma not specially expanded.
- Rostrum less than half as long as braincase; nasal inflation inconspicuous ---------- *Clœotis*, p. 114.
- Rostrum at least half as long as braincase; nasal inflation conspicuous.
  - Outer lower incisor separated from canine by space nearly equal to width of its crown; upper molars with styles unusually well developed ---------- *Cœlops*, p. 113.
  - Outer lower incisor in contact with canine; upper molars with normal styles.
    - Sagittal crest chiefly developed in interorbital region; toes with traces of original phalanges ---------- *Asellia*, p. 112.
    - Sagittal crest not chiefly developed in interorbital region; toes without traces of original phalanges.
      - Transverse diameter of cochlea less than twice width of basioccipital ---------- *Hipposideros*, p. 110.
      - Transverse diameter of cochlea more than three times width of basioccipital ---------- *Anthops*, p. 113.

Genus HIPPOSIDEROS Gray.

1831. *Hipposideros* Gray, Zoological Miscellany, p. 37 (*speoris*).

1837. *Phyllorhina* Bonaparte, Iconogr. della Fauna Italica, fasc. XXI (*diadema*).

1866. *Macronycteris* Gray, Proc. Zool. Soc. London, p. 82 (*gigas*).

1866. *Gloionycteris* Gray, Proc. Zool. Soc. London, p. 82 (*armigera*).

1866. *Speorifera* Gray, Proc. Zool. Soc. London, p. 82 (*vulgaris*).

1866. *Rhinophylla* Gray, Proc. Zool. Soc. London, p. 82 (*labuanensis*). Not *Rhinophylla* Peters, 1865.

1866. *Chrysonycteris* Gray, Proc. Zool. Soc. London, p. 82 (*fulvus*).

1871. *Doryrhina* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 314 (*cyclops*). Subgenus of *Phyllorhina*=*Hipposideros.*

1871. *Sideroderma* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 324 (*fuliginosa*). Subgenus of *Phyllorhina*=*Hipposideros.*

1871. *Ptychorhina* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 325 (*caffra*). Subgenus of *Phyllorhina*=*Hipposideros.*

1871. *Cyclorina* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 326 (*obscura* and *doriæ*). Subgenus of *Phyllorhina*=*Hipposideros.*

1871. *Thyreorhina* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 327 (*coronata*). Subgenus of *Phyllorhina*=*Hipposideros*.
1871. *Syndesmotis* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 329 (*megalotis*). Subgenus of *Phyllorhina*=*Hipposideros*.
1878. *Phyllorhina* DOBSON, Catal. Chiropt. Brit. Mus., p. 127.
1887. *Hipposiderus* BLANFORD, Proc. Zool. Soc. London, p. 637.

Type-species.—*Vespertilio speoris* Schreber.

Geographical distribution.—Tropical parts of Old World east to the Philippine Islands, New Ireland, and Australia, and northwest to Morocco, Africa.

Number of forms.—About forty forms of *Hipposideros* are now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{.1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=30.$$

Upper incisors very small, but usually well formed and with distinct, rounded crown with slight cusp on inner side. Lower incisors trifid, the outer larger than the inner, the four teeth forming a continuous row between canines. Upper canines heavy, but simple in form, without conspicuous cingula, though frequently with a secondary cusp near posterior base of shaft. Lower canines rather weak. First upper premolar (pm^3) small, functionless, closely crowded between cingula of canine and large premolar or forced outward completely from the tooth row; rarely absent. Other teeth showing no special peculiarities; m^1 and m^2 with main cusps normal and hypocone absent, m^3 usually with five cusps and three commissures, but the mesostyle and metacone are always closely approximated, the latter sometimes absent, leaving only two commissures. Lower molars with the cusps well developed and normal in position. Skull (fig. 21 B) with distinct, though low and not specially developed, sagittal crest, small bullæ, and moderately large cochleæ. Greatest depth of brain case (bullæ not included) at least equal to depth of rostrum, including molars. Zygoma abruptly expanded posteriorly, but height of expanded portion much less than distance from last molar to glenoid fossa. Lumbar vertebræ not fused. Ears either not joined across forehead or united by a low band. Tail well developed, longer than femur; caudal vertebræ 6 to 8.

Species examined.—I have examined at least half of the known species, including skeletons of *Hipposideros barbensis* Miller, *H. calcaratus* (Dobson), *H. caffer* (Sundevall), *H. larvatus* (Horsfield), *H. pygmæus* (Waterhouse), *H. speoris* (Schreber), *H. templetonii* (Kelaart), and *H. vittatus* (Peters).

Remarks.—The genus *Hipposideros*, which contains much more than half the species of the family, is recognizable by its dental formula, well-developed ears, crowded lower incisors, conspicuous nasal inflation, moderate posterior expansion of zygoma, and absence of noticeable sagittal crest in interorbital region. Superficially it rather closely resembles *Rhinolophus*, but is distinguishable, aside from the more important skeletal characters, by the smaller cochleæ and the absence of the small lower premolar (pm_3); the third upper molar is usually smaller than in *Rhinolophus*, and never as complicated as in some species of the latter. The species differ markedly among themselves in the form of the ears and noseleaf as well as in other characters, a fact which has given rise to a considerable number of generic and subgeneric names. For the present only one of these groups, *Asellia*, is recognized as distinct from *Hipposideros*; but further study of the species may show the convenience of distinguishing others.

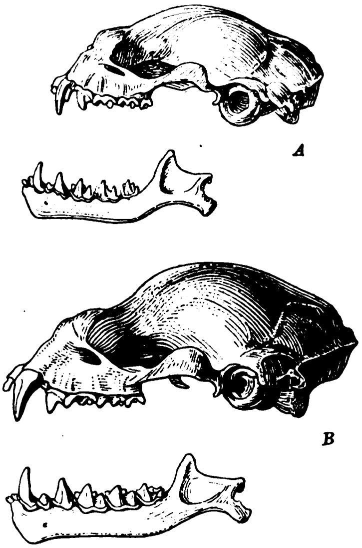

FIG. 21.—*A*, ASELLIA TRIDENS. ADULT FEMALE. EGYPT. NO. 38021. × 2. *B*, HIPPOSIDEROS LARVATUS. ADULT FEMALE. LOWER SIAM. NO. 83570. × 2.

Genus ASELLIA Gray.

1838. *Asellia* GRAY, Mag. Zool. and Bot., II, p. 493 (subgenus of *Hippisideros*).

1843. *Asellia* GRAY, List. spec. mamm. Brit. Mus., p. 24 (genus).

1871. *Asellia* PETERS, Monatsber, k. preuss. Akad. Wissench. Berlin (subgenus of *Phyllorhina=Hippisideros*).

1878. *Phyllorhina* DOBSON, Catal. Chiropt. Brit. Mus., p. 127 (part).

Type-species.—*Rhinolophus tridens* Geoffroy.

Geographic distribution.—Northeastern Africa and adjoining portions of Asia.

Number of forms.—Two forms of this group are currently recognized, *Asellia tridens* and *A. murraiana.*

Characters.—In general similar to *Hipposideros*, but skull with low braincase and deep rostrum (greatest depth of braincase distinctly less than that of rostrum, including molars), the sagittal crest greatly developed in interorbital region; distinction between the fused phalanges of third, fourth, and fifth toes persistent; small upper premolar (pm^3) absent; upper canine with slightly developed secondary cusp above middle of shaft; and third upper molar very narrow, with only four cusps and two commissures. Lumbar vertebræ, except last two, fused into a solid rod.

Species examined.—*Asellia tridens* (Geoffroy).

Remarks.—This genus is well differentiated from *Hipposideros*, especially by the nearly equal height of rostrum and braincase and the conspicuous knife-like development of the sagittal crest in the interorbital region (fig. 21 A). The dentition is more modified than that of *Hipposideros*, as shown by the absence of the small upper premolar, the more reduced condition of the third upper molar, and the very peculiar position of the secondary cusp of the upper canine. On the other hand, the persistence, even in very old individuals, of the distinctness of the fused elements of the toes is evidently a remnant of more primitive conditions.

In cranial and dental characters the genera *Hipposideros* and *Asellia* show a curious parallelism to *Nyctinomus* and *Molossus*. In both *Hipposideros* and *Nyctinomus* the sagittal crest is low, a small premolar is present, and the third molar has five cusps and three commissures, while in *Asellia* and *Molossus*, simultaneously with the development of a high sagittal crest in interorbital region, the small premolar has disappeared and the third molar has lost its third commissure and fifth cusp.

Genus ANTHOPS Thomas.

1888. *Anthops* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., I, p. 156, February, 1888.

Type-species.—*Anthops ornatus* Thomas.

Geographic distribution.—Solomon Islands.

Number of forms.—One, the type species.

Characters.—Similar to *Hipposideros*, but with tail reduced to less than half length of femur; caudal vertebræ, 4. Upper canine with rather large, blunt cusp at posterior base of shaft. Small upper premolar (pm^3) well developed, forced partly outward from the toothrow. Posterior upper molar as in maximum condition in *Hipposideros*. Cochleæ larger than usual in *Hipposideros*, their diameter more than twice width of basioccipital between them. Lumbar vertebræ fused as in *Asellia*.

Species examined.—*Anthops ornatus* Thomas.

Remarks.—Though closely related to *Hipposideros* in cranial and dental characters, this genus is at once distinguishable by the greatly reduced tail.

Genus CŒLOPS Blyth.

1848. *Cœlops* BLYTH, Journ. Asiat. Soc. Bengal, XVII, Pt. 1, p. 251.
1878. *Cœlops* TROUESSART, Revue et Magasin de Zoologie, 3e sér., VI, p. 223.
1878. *Cœlops* DOBSON, Catal. Chiropt. Brit. Mus., p. 152.

Type-species.—*Cœlops frithii* Blyth.

Geographic distribution.—Known only from Bengal and Java.

Number of forms.—Though two forms of *Cœlops* have been described (*C. frithii* from Bengal and *C. bernsteini* from Java), only the type species is currently recognized.

Characters.—Dental formula as in *Hipposideros*. Lower incisors not forming a continuous row between canines, the outer separated from canine by a space about equal to the width of its crown. Upper molars peculiar in the narrowness of the inner portion, the unusual development of the styles, and the great depth of the reentrant angles. The angles extend inward almost perpendicularly instead of with a noticeable forward slant. Last upper molar with a distinct, but short, fourth commissure. Skull as in *Hipposideros* except that nasal swelling is not as conspicuous. Tail rudimentary, less than 2 mm. in length.

Species examined.—*Cœlops frithii* Blyth.

Genus CLŒOTIS Thomas.

1901. *Clœotis* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., VIII, p. 28, July 1901.

Type-species.—*Clœtis percivali* Thomas.

Geographic distribution.—British East Africa.

Number of forms.—At present the type species only is known.

Characters.—Dental formula as in *Hipposideros*, except for absence of small upper premolar (pm^3). Teeth not peculiar in form, except that the third upper molar has the first V as large as in the other teeth and the commissure beyond the metacone indicating, as in *Cœlops*, a rudimentary second V, is larger than in the related genera. This tooth is therefore more developed than in any other known bat. As in *Cœlops*, which most nearly approaches it, the first V is distinctly smaller than in the other molars. Skull with anterior portion distinctly less than half as long as brain case and with nasal swelling very inconspicuous. Zygoma slightly expanded at extreme posterior base. Ears very short, appearing as though squarely cut down to a collar-like rim. Tail well developed, longer than femur.

Remarks.—This genus is strikingly characterized by the slight development of the rostrum and the short, squarely cropped ears.

Species examined.—*Clœotis percivali* Thomas.

Genus RHINONYCTERIS Gray.

1847. *Rhinonicteris* (sic) GRAY, Proc. Zool. Soc. London, p. 16.
1866. *Rhinonycteris* GRAY, Proc. Zool. Soc. London, p. 81.
1878. *Rhinonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 126.

Type-species.—*Rhinolophus aurantius* Gray.

Geographic distribution.—Australia.

Number of forms.—The type species is the only known form.

Characters.—Dentition essentially as in *Hipposideros*, except that there is only one upper premolar and the upper canine has a large secondary cusp rising to middle of posterior side of shaft. General form of skull as in *Hipposideros*. Rostrum moderately swollen and distinctly lower than braincase. Premaxillaries unusually thick, forming along line of contact a distinct ridge which terminates anteriorly in a noticeable backward-curved point. Zygoma greatly expanded posteriorly, the expansion conspicuously narrowed above, its height fully equal to distance between last molar and glenoid fossa. Sagittal crest beginning at middle of posterior portion of braincase (the hindermost rounded part of which is smooth) its height increasing rather rapidly until slightly in front of middle of braincase it reaches 1 mm. Here it abruptly terminates in a forward-curved point. In front of the crest the median region shows the usual ridges, but these are so reduced as to be scarcely visible by the unaided eye. Tail well developed, longer than femur.

Species examined.—*Rhinonycteris aurantius* (Gray).

Remarks.—This genus is very strikingly characterized by the large secondary cusp of the upper canine and the peculiar cranial characters.

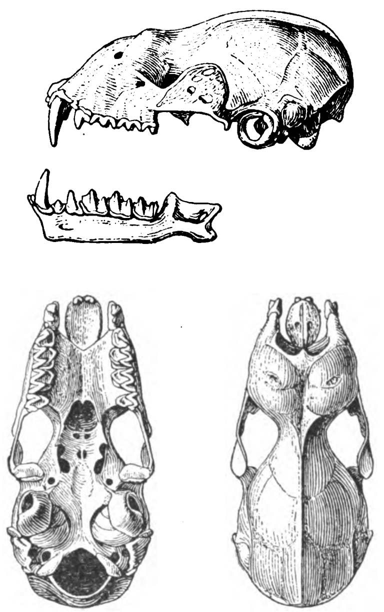

Fig. 22.—Triænops persicus. Aden, Arabia. No. 123439. ×2.

Genus TRIÆNOPS Dobson.

1871. *Triænops* Dobson, Journ, Asiat. Soc. Bengal, XI, p. 455.
1878. *Triænops* Dobson, Catal. Chiropt. Brit. Mus., p. 123.

Type-species.—*Triænops persicus* Dobson.

Geographic distribution.—Madagascar, eastern Africa, and Persia.

Number of forms.—Four species of *Triænops* are known.

Characters.—Dental formula and general structure of teeth as in *Hipposideros*, but upper incisors noticeably bifid and upper canine with a secondary cusp extending nearly to middle of shaft. Skull (fig. 22) with rostral portion greatly developed, much more than half as long and nearly as deep as brain case, the anterior nares very broad and with a short, but distinct, median spine on posterior border. Zygoma greatly expanded throughout, but most conspicuously behind, where the height is equal to distance between last molar and glenoid fossa. Cochlea large, the diameter more than twice as much as width of basioccipital. Lumbar vertebræ fused, as in *Asellia*.

Species examined.—Triænops persicus Dobson.

Family PHYLLOSTOMIDÆ.

1821. *Vespertilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.

1821. *Noctilionidæ* (part; Race 1, part, and Race 2) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.

1827. Les Phyllostomes (part) LESSON, Man. de Mammalogie, p. 76.

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Noctilionina*, part, and *Phyllostomina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 14.

1838. *Vampiridæ* BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.

1838. *Istiophori* (part; *Phyllostomina*, part) GRAY, Mag. Zool. and Bot., II, p. 486, December, 1838.

1839. *Phyllostomidæ* (part) WATERHOUSE, Zoology of the Voyage of H. M. S. *Beagle*, II, Mammalia, p. 1.

1840. *Istiophora* (part; *Phyllostomata*, part) WAGNER, Schreber's Säugthiere, Supplementb., I, p. 384.

1840. *Gymnorhina* (part; *Brachyura*, part) WAGNER, Schreber's Säugthiere, Supplementb., I, p. 445.

1855. [*Phyllostomidæ*] "Phyllostomidés" (part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 29.

1864. *Megadermatidæ* H. ALLEN, Monogr. Bats. N. Amer., p. 1 (part; *Macrotus*=*Otopterus*, and *Megaderma* are the only genera mentioned).

1865. *Phyllostomata* (part) PETERS, Monatsber. k. preuss, Akad. Wissensch., Berlin, p. 256.

1866. *Noctilionidæ* (part; *Phyllodiana*) GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 92.

1866. *Phyllostomidæ* (part) GRAY, Proc. Zool. Soc. London, p. 111.

1872. *Phyllostomidæ* GILL, Arrangement of the Families of Mammals, p. 16.

1875. *Phyllostomidæ* (part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875.

1875. *Phyllostomatidæ* COUES and YARROW, Rep. Geogr. and Geol. Expl. and Surv. west of 100th Merid., V, p. 79.

1878. *Phyllostomidæ* (part) DOBSON, Catal. Chiropt. Brit. Mus., p. 445.

1886. *Phyllostomidæ* GILL, Standard Natural History, V, p. 175.

1891. *Phyllostomatidæ* (part) FLOWER and LYDEKKER, Mammals living and extinct, p. 672.

1892. *Phyllostomatidæ* (part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Warmer parts of America north to the Bahama Islands and the southern border of the United States.

Characters.—Humerus with trochiter well developed, though not as large as trochin, usually articulating with scapula by a surface about one-third as large as glenoid fossa (not articulating in Chilonycterinæ), epitrochlea moderately developed, usually with distinct spinous process, capitellum distinctly out of line with shaft; second manal digit with well-developed matacarpal and small, distinct phalanx; third finger with three completely bony phalanges; shoulder girdle normal, the seventh cervical vertebra free from anterior dorsal; foot normal; fibula present, cartilaginous above, this cartilaginous portion usually beginning opposite a noticeable process on tibia considerably below proximal extremity; pelvis normal, except that elements of sacrum early disappear, the posterior half forming a narrow, transversely flattened urostyle, and ischia are closely approximated posteriorly, occasionally fusing with extremity of urostyle; skull without postorbital processes; premaxillaries complete, fused with each other and with maxillaries, their palatal branches isolating two lateral palatal foramina; teeth highly diverse in structure, those of different groups representing stages of development from the normal insectivorous type to the practical equivalent of the Pteropine form; tragus present, variously thickened and notched; a simple nose leaf generally present, through occasionally rudimentary or absent.

Remarks.—The members of the family Phyllostomidæ are recognizable by the presence of three completely bony phalanges in the third finger, the entire premaxillary, the slender, incomplete fibula, and the well-developed molar teeth. Though some of the genera lack cutaneous nasal outgrowths, those which have nose-leaves are the only American leaf-nosed bats, and these structures are never as highly developed as in some of the Old World families. This is the first family in which the humerus has a definite double articulation with scapula. In most of the genera the trochiter is applied to the scapula by an articular surface nearly one-third as large as glenoid fossa. This surface is, however, much smaller in the only skeleton of *Chrotopterus* that I have seen (Cat. No. 113852, U.S.N.M.), while in the three genera of Chilonycterinæ it is absent. The humerus in this subfamily is also peculiar in its narrow, somewhat oblique head, above the level of which the tubercles scarcely rise. In the other groups the head is nearly round, and is very distinctly exceeded in height by the tubercles.

History.—Though originally associated with the Vespertilionidæ, this family was recognized as a distinct group under the name Vampiridæ by Bonaparte as early as 1838. As such it has been almost universally regarded by subsequent authors, whose ideas are sufficiently presented in the synonymy.

Principal subdivisions.—The members of the family show such marked diversity in structure, principally of the teeth, that it seems necessary to divide them into seven subfamilies.

KEY TO THE SUBFAMILIES OF PHYLLOSTOMIDÆ.

Trochiter not articulating with scapula; nose leaf absent.
Chilonycterinæ, p. 118.

Trochiter articulating with scapula; nose leaf present, though occasionally much reduced.

Upper molars essentially normal, the cusps and commissures never so reduced that the W pattern is not evident__*Phyllostominæ*, p. 121.

Upper molars not normal, the cusps and commissures so reduced that the W pattern is absent or not evident.

Upper molars with a trace of the commissures and styles; lower molars with the usual five cusps__________*Glossophaginæ*, p. 136.

Upper molars without commissures and styles; lower molars with cusps when present strictly lateral.

Crowns of both upper and lower molars trenchant.
Hemiderminæ, p. 144.

Crowns of both upper and lower molars grooved or flattened.

Crowns of molars with well-developed cusps rising from a flattened crushing surface_______*Stenoderminæ*, p. 149.

Crowns of molars with distinct longitudinal groove, the cusps when present strictly lateral.

Crowns of lower molars with distinct cusps on both margins of groove_______________*Sturnirinæ*, p. 147.

Crowns of lower molars without distinct cusps on both margins of groove__________*Phyllonycterinæ*, p. 171.

Subfamily CHILONYCTERINÆ.

1838. *Noctilionina* (part) GRAY, Mag. Zool. and Bot., II, p. 498, December, 1838.

1840. *Brachyura* (part) WAGNER, Schreber's Säugthiere, Supplementb., I, p. 445.

1862–63. *Mormopida* "KOCH Ver. Naturk. in Nassau, Weisbaden, Heft XVII–XVIII, p. 358" (Palmer, Index Generum Mammalium, p. 754, January 23, 1904).

1865. *Mormopes* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 257.

1866. *Mormopsina* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 93, February, 1866.

1866. *Phyllodiana* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 93, February, 1866.

1870. *Noctiliones* (part) FITZINGER, Sitz.-ber. k. Akad. Wissensch., Wien, Math. Naturwissensch. Classe, LXI, Abth. I, p. 458.

1872. *Mormopidæ* GILL, Arrangement of the families of Mammals, p. 16.

1875. *Lobostominæ* DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350, November, 1875.

1878. *Lobostominæ* DOBSON, Catal. Chiropt. Brit. Mus., p. 447.

1886. *Mormophidæ* (sic.) GILL, Standard Natural History, V, p. 175.

1891. *Chilonycteriinæ* FLOWER, and LYDEKKER, Mammals living and extinct, p. 672.

1892. *Mormopini* WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

1892. *Lobostomidæ* H. ALLEN, Proc. U. S. National Museum, XV, p. 438, October 28, 1892.

1901. *Mormopinæ* REHN, Proc. Acad. Nat. Sci. Philadelphia, p. 297, June 8, 1901.

1901. *Chilonycterinæ* MILLER and REHN, Proc. Boston Soc. Nat. Hist., XXX, p. 275, December 27, 1901.

Geographic distribution.—Tropical America, north to Cuba and and the southern border of the United States.

Characters.—Teeth normal; humerus without secondary articulation with scapula, the tubercles short, rising scarcely above level of head, epitrochlea small, hardly more than base to large spinous process; muzzle without nose leaf; lower lip with plate-like outgrowths.

Principal subdivisions.—The members of the subfamily Chilonycterinæ are divisible into three genera.

KEY TO THE GENERA OF CHILONYCTERINÆ.

Braincase broader than long; the basioccipital region conspicuously elevated .... *Mormoops*, p. 121.

Braincase longer than broad; the basioccipital region not conspicuously elevated.

Wing membranes attached to sides of body; back evidently furred *Chilonycteris*, p. 119.

Wing membranes attached to middle of back; back apparently naked .... *Pteronotus*, p. 120.

Genus CHILONYCTERIS Gray.

1839. *Chilonycteris* GRAY, Ann. Nat. Hist., IV, p. 4 (*macleayii*).

1840. *Lobostoma* GUNDLACH, Wiegmann's Archiv. für Naturgeschichte, VI, Pt. 1, p. 357 (part).

1843. *Phyllodia* GRAY, Proc. Zool. Soc. London, p. 50 (*parnellii*).

1878. *Chilonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 447.

1904. *Chilonycteris* REHN, Proc. Acad. Nat. Sci. Philadelphia, p. 181, February, 1904, issued March 29, 1904.

Type-species.—*Chilonycteris macleayii* Gray.

Geographic distribution.—Warmer parts of America, north to Cuba and central Mexico.

Number of forms.—According to the most recent writer on the genus, Mr. Rehn, there are eleven forms of the restricted genus *Chilonycteris.*

Characters.—Dental formula:

$$\frac{-\;2\;3.\;1.\;-\;-\;3\;4\;5\;6\;7}{1\;2\;-.\;1.\;-\;2\;3\;4\;5\;6\;7}\,;\; i\,\frac{2-2}{2-2},\; c\,\frac{1-1}{1-1},\; pm\,\frac{2-2}{3-3},\; m\,\frac{3-3}{3-3}=34.$$

Upper incisors unequal, the inner at least twice as large as outer, its crown subquadrate or rhombic in section, the anterior face broader than high; cutting edge nearly straight or with distinct median notch. Outer incisor scarcely extending beyond alveolus of inner. The four teeth form a continuous row between canines, or there is a small diastema between canine and outer incisor. Lower incisors of about the same relative sizes as upper, but outer somewhat less reduced. The crown of the inner tooth is longer than broad and noticeably constricted posteriorly, that of the outer subterete; cutting edges trifid. The incisors form a continuous row between canines. Upper canines strong, with concave inner surface and distinct anterior and posterior cutting edge and fairly well developed cingulum, but no secondary cusps. Cheek teeth strictly normal; m^1 and m^2, with well-developed hypocone; m^3 with five cusps and three distinct commissures, its crown surface more than half that of m^1, middle lower premolar (pm_3) much smaller than other two. Lower molars with cusps normal in size and position. Skull with rostrum nearly as long as braincase, its sides slightly but distinctly inflated from orbit to nares, its dorsal surface with shallow longitudinal groove. Anterior portion of rostrum broad (palate broader anteriorly than posteriorly); nares subcircular, opening almost directly forward. Braincase subglobose, its length, breadth, and depth about equal. No distinct sagittal crest or ridges for muscle attachment. Floor of braincase slightly elevated above level of dorsal wall of choanæ. Audital bullæ small, covering not more than half of the large cochleæ. Wings from sides of body, the back completely furred. Dermal outgrowths on chin not excessively developed.

Species examined.—I have examined all of the known forms except *C. personata* Wagner.

Genus PTERONOTUS Gray.

1838. *Pteronotus* Gray, Mag. Zool. and Bot., II, p. 500.
1878. *Chilonycteris* Dobson, Catal. Chiropt. Brit. Mus., p. 447 (part).
1890. *Pteronotus* Allen, Bull. Amer. Mus. Nat. Hist., III, p. 178, December 10, 1890 (genus).
1901. *Dermonotus* Gill, Proc. Biol. Soc. Washington, XIV, p. 177, September 25, 1901.
1904. *Dermonotus* Rehn, Proc. Acad. Nat. Sci. Philadelphia, p. 250, March, 1904, issued April 7, 1904.
1905. *Pteronotus* Miller, Proc. Biol. Soc. Washington, XVIII, p. 223, October 17, 1906.

Type-species.—*Pteronotus davyi* Gray.

Geographic distribution.—Mainland of tropical America north to southern Mexico; also the islands of Trinidad and Dominica, West Indies.

Number of forms.—Three: two in South America and the West Indies, the other in Mexico.

Characters.—Like *Chilonycteris*, but with the wings attached along middle line of back.

Species examined.—*Pteronotus davyi* Gray and *P. fulvus* (Thomas).

Remarks.—This genus is immediately recognizable among American bats by the apparently bare back, the fur of the upper surface of the body being concealed by the wings.

Genus MORMOOPS Leach.

1821. *Aello* LEACH, Trans. Linn. Soc. London, XIII, Pt. 1, p. 69 (*cuvieri*).

1821. *Mormoops* LEACH, Trans. Linn. Soc. London, XIII, Pt. 1, p. 76 (*blainvillii*).

1829. *Mormops* CUVIER, Dict. Sci. Nat., LIX, p. 422.

1878. *Mormops* DOBSON, Catal. Chiropt. Brit. Mus., p. 454.

1901. *Mormoops* MILLER and REHN, Proc. Boston Soc. Nat. Hist., XXX, p. 277, December 27, 1901.

1902. *Mormoops* REHN, Proc. Acad. Nat. Sci. Philadelphia, p. 160, March, 1902, issued June 11, 1902.

Type-species.—*Mormoops blainvillii* Leach.

Geographic distribution.—Warmer parts of America, north to Cuba and the southern border of the United States (Texas).

Number of forms.—Six forms of *Mormoops* are now recognized.

Characters.—In general like *Chilonycteris*, but skull so greatly shortened that both rostrum and braincase are broader than long; braincase greatly deepened, its floor so elevated that lower rim of foramen magnum is above level of rostrum; teeth essentially as in *Chilonycteris*, except that lower incisors are of about equal size and uniform structure, the inner tooth lacking all trace of backward extension of the crown; dermal outgrowths on chin very highly developed.

Species examined.—All the known forms.

Subfamily PHYLLOSTOMINÆ.

1838. *Phyllostomina* (part) GRAY, Mag. Zool. and Bot., II, p. 486, December, 1838.

1840. *Phyllostomata* (part) WAGNER, Schreber's Säugthiere, Supplementb., I, p. 384.

1842. *Phyllostomineæ* (part) LESSON, Nouveau Tableau du Règne Animal, Mammifères, p. 30.

1855. *Glossophagina* (part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 40.

1855. *Vampyrina* (part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 44.

1865. *Vampyri* (part) PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256.

1866. *Lonchoronina* GRAY, Proc. Zool. Soc. London, p. 113.

1866. *Macrophyllina* GRAY, Proc. Zool. Soc. London, p. 113.

1866. *Vampyrina* GRAY, Proc. Zool. Soc. London, p. 113.

1866. *Phyllostomina* GRAY. Proc. Zool. Soc. London, p. 114.

1866. *Trachyopina* GRAY, Proc. Zool. Soc. London, p. 114.
1866. *Brachyphyllina* GRAY, Proc. Zool. Soc. London, p. 115.
1872. *Vampyrinæ* GILL, Arrangement of the families of Mammals, p. 17.
1875. *Vampyri* DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350, November, 1875.
1878. *Vampyri* DOBSON, Catal. Chiropt. Brit Mus., p. 458.
1886. *Phyllostominæ* GILL, Standard Natural History, V, p. 173.
1891. *Phyllostomatinæ* FLOWER and LYDEKKER, Mammals living and extinct, p. 672 (Vampyrine division).
1892. *Phyllostomata* WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Warmer parts of America, north to the Bahamas and southern California.

Characters.—Teeth essentially normal, though in some genera there occurs a reduced condition of the mesostyle and commissures of m^1 and m^2, and of the paraconid and metaconid of m_1 and m_2; humerus with definite secondary articulation with scapula, epitrochlea large, with slightly developed spinous process; muzzle with noseleaf; lower lip without plate-like outgrowths.

Principal subdivisions.—This subfamily, containing all the leaf-nosed American bats with normal teeth, has fourteen well defined genera.

KEY TO THE GENERA OF PHYLLOSTOMINÆ.

Lower incisors 1–1.
  Lower premolars 3–3 .... *Tonatia*, p. 128.
  Lower premolars 2–2.
    Audital bullæ very large, their height on inner side greater than width of basioccipital .... *Anthorhina*, p. 129.
    Audital bullæ not enlarged.
      Crown of outer upper incisor as wide as that of inner; audital bullæ well developed .... *Mimon*, p. 129.
      Crown of outer upper incisor much narrower than that of inner, audital bullæ very narrow .... *Chrotopterus*, p. 133.
Lower incisors 2–2.
  Lower premolars 2–2 .... *Phyllostomus*, p. 130.
  Lower premolars 3–3.
    Rostrum as long as braincase; molars wider than palate; the W-pattern much distorted .... *Vampyrus*, p. 134.
    Rostrum shorter than braincase; molars narrower than palate; W-pattern essentially normal.
      Middle lower premolar about as large as third.
        Audital bullæ large, their greatest diameter much more than distance between them .... *Otopterus*, p. 126.
        Audital bullæ small, their greatest diameter scarcely equal to distance between them.
          Inner upper incisor chisel-shaped, the front face of the two teeth together scarcely convex; second upper premolar without distinct style and with main cusp in front of middle of crown, its apex curved backward .... *Glyphonycteris*, p. 125.

Inner upper incisor not chisel-shaped, the front face of the two teeth together strongly convex or biconvex; second upper premolar with distinct style and with the main cusp at middle of crown, its apex straight.
Crown of inner upper incisor longer than wide; lower incisor row concave posteriorly.
Micronycteris, p. 123.
Crown of upper incisor wider than long; lower incisor row convex posteriorly.
Xenoctenes, p. 124.
Middle lower premolar much smaller than third.
First lower premolar in contact or nearly so with third, the second displaced inward from the tooth row.
Length of rostrum much less than breadth of brain-case .... *Dolichophyllum*, p. 127.
Length of rostrum about equal to breadth of brain-case .... *Trachops*, p. 132.
First lower premolar distant from third, the second in tooth row.
Dorsal profile of rostrum strongly convex; a deep depression between orbits .... *Lonchorhina*, p. 127.
Dorsal profile of rostrum not convex; no depression between orbits .... *Phylloderma*, p. 131.

Genus MICRONYCTERIS Gray.

1856. *Schizostoma* Gervais, Expéd. du Comte de Castelnau, Zool. Mamm., p. 49. Not of Bronn, 1835.

1862. *Schizastoma* Gray, Catal. Bones Mamm. Brit. Mus., p. 38.

1866. *Micronycteris* Gray, Proc. Zool. Soc., London, p. 113.

1872. *Vampyrella* Reinhardt, Vidensk. Meddelelser, Naturhist. Forening Kjöbenhavn, IV, p. iii. Not of Cienkowsky, 1865.

1878. *Schizostoma* Dobson, Catal. Chiropt. Brit. Mus., p. 476.

1891. *Micronycteris* Lydekker in Flower and Lydekker, Mammals, living and extinct, p. 673.

1906. *Micronycteris* Andersen, Ann. and Mag. Nat. Hist., 7th ser., XVIII, p. 50, July, 1906.

Type-species.—*Micronycteris megalotis* Gray.

Geographic distribution.—Warmer parts of the American mainland north to central Mexico.

Number of forms.—Four forms of *Micronycteris* are now recognized: *M. megalotis* Gray, *M. m. mexicanus* Miller, *M. microtis* Miller, and *M. minuta* Gervais.

Characters.—Dental formula (Plates III–IV, fig. 1):

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ \mathring{5}\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=34.$$

Upper incisors very unequal, completely filling space between canines. The inner tooth is large, the crown at least twice as high as wide, slightly projecting and somewhat oblique, so that the middle pair of teeth are strongly in contact distally, though the roots are rather wide apart; cutting edge faintly divided by notch near outer side into two very unequal lobes; anterior face convex, posterior concave; cingulum distinct. Outer incisor scarcely extending beyond cingulum of inner, its crown flat, with slight cusp on inner side and roundish in outline. Lower incisors small, simple, forming a continuous, slightly convex row between canines, the crowns subquadrate in outline, when viewed from above, the cutting edges faintly bifid and the anterior face of each tooth distinctly concave. Inner tooth of each pair slightly larger than outer. Canines strong, simple, with well-developed cingula, but no supplemental cusps, the anterior face of the shaft smoothly rounded. Anterior upper premolar (pm^3) large, its area when viewed from the side about equal to that of posterior tooth (pm^4), crown strongly trenchant. Posterior upper premolar (pm^4), with main cusp straight, situated at or near middle of crown; style well developed, but inner cusp obsolete, and longitudinal groove scarcely indicated. First lower premolar (pm_2) of much the same form, though smaller. Second lower premolar nearly as large or slightly smaller than first or third, perfectly in the toothrow. Other teeth showing no special peculiarities. Molars normal, though the paracone and metacone of m^1 and m^2 are situated farther outward than usual, causing a slight flatness in the W pattern; hypocone low but distinct. Third upper molar with less than half the crown area of m^2, its four cusps distinct, but the two commissures deeply emarginated. Lower molars, with the cusps, normal in position, and all well developed except the entoconid of m_3, which is so reduced as to be practically absent. Paraconid smaller than hypoconid, especially in m_1, where it is also less distinct from protoconid than in m_2 and m_3. Skull slender and light, the rostrum narrow and tapering, more than half as long as braincase, its upper surface evenly convex laterally. Braincase rather large, its surface with no conspicuous ridges. Anteriorly the forehead rises rather abruptly, and posteriorly the metencephalon is marked off by a distinct constriction. Audital bullæ small and well developed, covering about half of cochleæ. Ears variable in size, usually large, joined across forehead. Noseleaf well developed. Tail short but distinct, extending about to middle of very wide interfemoral membrane.

Species examined.—I have examined all of the known forms.

Remarks.—The species of *Micronycteris* are all rather small, delicately formed bats, having the forearm from 32 to 38 mm. in length. The tooth formula, short rostrum, well-developed middle lower premolar, and small audital bullæ distinguish the genus from all of the others except the closely related *Glyphonycteris* and *Xenoctenes*.

Genus XENOCTENES, New.

Type-species.—*Schizostoma hirsutum* Peters.

Geographic distribution.—Costa Rica.

Number of forms.—The type is the only species known.

Characters.—Externally similar to *Micronycteris*, but with connecting band of ears very low. Skull and teeth as in *Micronycteris*, except that the incisors both above and below are notably peculiar. Inner upper incisor subtereti-conical, the crown slightly wider than long at base, the shaft convex in front, concave behind, tapering to a simple, moderately acute point. The two teeth are set very obliquely, their bases wide apart, their shafts in contact just below tip. Cingulum very slightly developed, so that distinction between crown and root is made less evident than in *Micronycteris*. Outer incisor small, much as in *Micronycteris*, but somewhat overlapping base of inner tooth. Lower incisors much crowded between canines, the posterior outline of the row convex, the anterior margin slightly concave. The outer tooth is tightly wedged into angle between inner and canine, which are strongly in contact; crowns of both teeth, but especially of inner, much wider than long. Otherwise they resemble the lower incisors of *Micronycteris*.

Species examined.—*Xenoctenes hirsutus* (Peters).

Remarks.—While the upper incisors in this genus are less modified than those of *Micronycteris*, the lower incisors are distinctly more specialized in form.

Genus GLYPHONYCTERIS Thomas.

1896. *Glyphonycteris* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., XVIII, p. 301, October, 1896.

1906. *Glyphonycteris* ANDERSEN, Ann. and Mag. Nat. Hist., 7th ser., XVIII, p. 58, July, 1906.

Type-species.—*Glyphonycteris sylvestris* Thomas.

Geographic distribution.—Costa Rica, Peru, Guiana, and Brazil.

Number of forms.—Three species are known.

Characters.—Like *Micronycteris*, but ears separate; skull with antorbital region distinctly inflated, and basisphenoid pits deep and distinct, with sharp median dividing ridge; middle upper incisor with anterior face flat; upper premolars with main cusp situated distinctly in front of middle of crown, the point slender and slightly recurved, neither tooth with evident indication of rudimentary styles; the two teeth not differing conspicuously from each other in form, the inner border with well developed secondary cusp separated from main cusp by deep longitudinal groove; concave areas of molars larger proportionally to the cusps than in *Micronycteris;* lower incisors trifid, the division indicated nearly to base of crown by grooves along anterior face.

Species examined.—*Glyphonycteris sylvestris* Thomas, *G. behni* Peters, and *G. brachyotis* Dobson.

Remarks.—This genus, though closely related to *Micronycteris* and *Xenoctenes*, is sufficiently characterized by the form of the upper premolars and the inflated antorbital portion of the skull.

Genus OTOPTERUS Lydekker.

1843. *Macrotus* GRAY, Proc. Zool. Soc., London, p. 21. Not *Macrotis* Reid, 1837.

· 1878. *Macrotus* DOBSON, Catal. Chiropt. Brit. Mus., p. 463.

1891. *Otopterus* LYDEKKER, in Flower and Lydekker, Mammals, living and extinct, p. 673.

1904. *Macrotus* H. ALLEN, Monogr. Bats N. Amer., 1893, p. 33, March 14, 1894.

1904. *Macrotus* MILLER, Proc. U. S. National Museum, XXVII, p. 345, January 23, 1904.

1904. *Macrotus* REHN, Proc. Acad. Nat. Sci. Philadelphia, p. 427, April, 1904, issued June 29, 1904.

Type-species.—*Macrotus waterhousii* Gray.

Geographic distribution.—Warmer parts of middle America from Guatemala to southern California and Arizona, also the Greater Antilles and the Bahama Islands.

Number of forms.—Eight forms are recognized by Rehn, the most recent writer on the genus.

Characters.—Dental formula and structure of teeth, essentially as in *Micronycteris*, but first and second upper molars without hypocones, and entoconid of first and second lower molars not as well developed; paraconid of m_1 about as in *Micronycteris* or slightly more reduced. Skull like that of *Micronycteris* except that the brain case rises less abruptly in front, forming only a very slight angle with rostrum, the rostrum is distinctly flattened above, and the audital bullæ are conspicuously enlarged, covering almost the entire cochleæ, their greatest diameter distinctly greater than the width of the space between them; basisphenoid pits even less distinct than in *Micronycteris*. Externally distinguishable from *Micronycteris* by the even larger ears and by the much longer tail, the extremity of which projects beyond the hinder edge of the broad interfemoral membrane.

Species examined.—With the exception of *Otopterus pygmæus* I have examined all the known forms of this genus.

Remarks.—Although there seems to be no good reason for rejecting the name *Macrotus* of Gray on account of the previous use of the same word by Leach as a *nomen nudum* applied to the long-eared bat of Europe, or on account of Dejean's *Macrotis*, 1833, the case is different as regards Reid's *Macrotis* of 1837. This name is properly defined and is clearly of the same etymology as Gray's *Macrotus*. I therefore prefer to adopt *Otopterus*.

Genus LONCHORHINA Tomes.

1863. *Lonchorhina* TOMES, Proc. Zool. Soc. London, p. 81.
1878. *Lonchorhina* DOBSON, Catal. Chiropt. Brit. Mus., p. 461.

Type-species.—*Lonchorhina aurita* Tomes.
Geographic distribution.—West Indies (Trinidad and the Bahamas) and Venezuela.
Number of forms.—The type-species is at present unique.
Characters.—Dental formula:

$$\frac{-2\,3.\,1.--3\,4\,5\,6\,7}{1\,2-.\,1.-2\,3\,4\,5\,6\,7}\ i\,\frac{2-2}{2-2},\ c\,\frac{1-1}{1-1},pm\,\frac{2-2}{3-3},\ m\,\frac{3-3}{3-3}=34.$$

Teeth essentially as in *Micronycteris* except that crowns of lower incisors are wider (width about equal to height), the outer upper incisor has a distinctly hooked point close to inner tooth and a flattish heel extending outward and backward, the second lower premolar (pm_3) is smaller than either of the others, and the anterior upper premolar is scarcely larger than outer incisor. Skull showing a curious resemblance to that of *Chilonycteris;* a distinct concavity at base of rostrum between orbits; dorsal profile of nasals strongly convex, the anterior extremity of the bones projecting over the nares as a conspicuous, slightly downward-curved point; middle of braincase low, not rising conspicuously above occiput as in *Micronycteris;* basisphenoid pits very large and distinct, so carried forward that the anterior edge slightly overhangs; audital bullæ small, as in *Micronycteris.* Ears large, separate. Noseleaf very large, the horizontal portion with thickened ridge in front of nasal openings. Tail much longer than femur, produced to edge of wide interfemoral membrane.
Species examined.—*Lonchorhina aurita* Tomes.
Remarks.—This strikingly characterized genus appears to be not distantly related to *Micronycteris* and *Otopterus*, with which it agrees fairly well in the structure of the teeth and, except for the peculiar rostrum, in the form of the skull. The resemblance to *Chilonycteris* pointed out by Dobson appears to be wholly superficial.

Genus DOLICHOPHYLLUM Lydekker.

1838. *Macrophyllum* GRAY, Mag. Zool. and Bot., II, p. 489. Not *Macrophylla* Hope, 1837.
1878. *Macrophyllum* DOBSON, Catal. Chiropt. Brit. Mus., p. 468.
1891. *Dolichophyllum* LYDEKKER, in Flower and Lydekker, Mammals, living and extinct, p. 673.

Type-species.—*Phyllostoma macrophyllum* Wied.
Geographic distribution.—Brazil.
Number of forms.—Only the type species is thus far known.

Characters.—In general not unlike *Micronycteris*, but ears separate and tail longer than femur, continued to outer edge of broad interfemoral membrane. Skull with short rostrum, its length less than breadth of braincase; nares emarginate laterally and above, leaving a noticeable flattish area over roots of incisors; basioccipital pits obsolete; audital bullæ small, not covering half of cochleæ. Teeth essentially like those of *Micronycteris*, except that middle lower premolar (pm_3) is minute and so crowded inward that first and third are almost in contact, first upper premolar (pm^3) is not much larger than outer incisor, middle upper incisors project more conspicuously, and lower incisors have the crowns relatively wider.

Species examined.—*Dolichophyllum macrophyllum* (Wied).

Genus TONATIA Gray.

1827. *Tonatia* GRAY, Griffifth's Cuvier, Animal Kingdom, V, p. 71 (*Vampyrus bidens* Spix).

1836. *Lophostoma* D'ORBIGNY, Voyage dans l'Amérique mérid., pl. VI (*sylvicola*=*amblyotis* according to Dobson).

1878. *Lophostoma* DOBSON, Catal. Chiropt. Brit. Mus., p. 473.

1891. *Lophostoma* FLOWER and LYDEKKER, Mammals living and extinct, p. 673.

1898. *Tonatia* PALMER, Proc. Biol. Soc. Washington, XII, p. 110, April 30, 1898.

Type-species.—*Vampyrus bidens* Spix.

Geographic distribution.—Tropical America, from Brazil to Panama.

Number of forms.—Four forms of *Tonatia* are now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ -\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=32.$$

Teeth throughout more robust than those of *Micronycteris*, though not essentially different in structure. Inner upper incisors with lower, longer, more obliquely set crowns than those of *Micronycteris*, the posterior face more strongly concave and outer posterior border in contact with canine. Outer incisor crowded forward, completely filling angle between canine and inner incisor, its anterior surface nearly half as extensive as that of inner tooth. Lower incisor distinctly higher than wide, the anterior surface slightly concave, but cutting edge not distinctly emarginate. Canines showing no peculiarities except that the lower are in contact posteriorly. Cheek teeth essentially like those of *Micronycteris* except that anterior upper premolar is much broader than long and middle lower premolar is minute and quite functionless, crowded between the anterior and posterior teeth and not rising to level of cutting surface. First and second upper molars with small but distinct hypocone. Skull like that of *Micronycteris*, but not as lightly built. Zygoma with abrupt expansion near anterior base. Basisphenoid pits absent. Audital bullæ small, covering less than half surface of cocheleæ. Sagittal crest well developed, not divided anteriorly, but continued forward as a line traceable to posterior extremity of nasals. Noseleaf well developed. Ears large, separate or joined across forehead. Tail shorter than femur, extending about to middle of broad interfemoral membrane.

Species examined.—*Tonatia bidens* (Spix) and *T. venezuelæ* (Robinson and Lyon).

Genus MIMON Gray.

1847. *Mimon* Gray, Proc. Zool. Soc. London, p. 14.
1878. *Mimon* Dobson, Catal. Chiropt. Brit. Mus., p. 491.

Type-species.—*Phyllostoma bennettii* Gray.

Geographic distribution.—Tropical America, north to southern Mexico.

Number of forms.—Only the type species is at present recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ -\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=30.$$

Teeth like those of *Tonatia* except that the inner upper incisors are scarcely oblique and are separated from canines by distinct space occupied by well-developed outer incisor, lower canines are not in contact, and the rudimentary middle lower premolar has disappeared. Lower molars with paraconid slightly more distinct than in *Micronycteris*. First upper premolar (pm^3) much larger than outer incisor. Lower incisor higher than wide. Skull slender, but with rather broadly arched rostrum noticeably different from the almost half-terete form of the same region in *Tonatia*, *Otopterus*, and *Micronycteris*. Zygoma without expansion either in front or behind. Basisphenoid pits broad and shallow, separated by a prominent median ridge. Audital bullæ small, covering about one-half surface of cochleæ, but unusually narrow, with almost a ridge along ventral edge; height of bulla on inner side barely equal to width of basioccipital. Ears large, separate. Tail about as long as femur, terminating near middle of broad interfemoral membrane.

Species examined.—*Mimon bennettii* (Gray).

Genus ANTHORHINA Lydekker.

1855. *Tylostoma* Gervais, Expéd. du Comte de Castelnau, Amer. Sud., Zool. Mamm., p. 49. Not of Sharpe, 1849.
1878. *Tylostoma* Dobson, Catal. Chiropt. Brit. Mus., p. 488.
1891. *Anthorhina* Lydekker in Flower and Lydekker, Mammals living and extinct, p. 674.

Type-species.—*Phyllostoma crenulatum* Geoffroy.

Geographic distribution.—Tropical South America.

Number of forms.—Three species of *Anthorhina* are now known.

Characters.—Teeth essentially as in *Mimon*, the dental formula the same, and the inner upper incisor similarly vertical; anterior upper premolar (pm^3) scarcely larger than outer incisor; lower incisor with crown about as wide as high, and cutting edge faintly trifid; lower molars like those of *Micronycteris*. Skull not strikingly different from that of *Mimon*, but rostrum with indication of median groove, basisphenoid pits deep and distinct, and audital bullæ large, each covering more than half of cochlea, their height on inner side much greater than width of basioccipital. Ears large, separate. Tail about as long as femur, terminating at middle of very broad interfemoral membrane.

Species examined.—*Anthorhina crenulata* (Geoffroy), and *A. picata* (Thomas).

Genus PHYLLOSTOMUS Lacépède.

1799. ***Phyllostomus*** LACÉPÈDE, Tabl. des Div., Sousdiv., Ordres et Genres des Mammif., p. 16 (*hastatus*).
1800. ***Phyllostoma*** CUVIER, Leçons d'Anat. Comp., Tabl. I (described in Tabl. Elém. d'Hist. Nat., p. 105, 1798).
1866. ***Alectops*** GRAY, Proc. Zool. Soc. London, p. 114 (*ater*=*elongatum*).
1878. ***Phyllostoma*** DOBSON, Catal. Chiropt. Brit. Mus., p. 484.
1901. ***Phyllostomus*** MILLER and REHN, Proc. Boston Soc. Nat. Hist., XXX, p. 282, December 27, 1901.

Type-species.—*Vespertilio hastatus* Pallas.

Geographic distribution.—Tropical America, north to Honduras.

Number of forms.—Eight forms of *Phyllostomus* are now known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

In form the teeth for the most part resemble those of *Micronycteris*, there being no essential differences in the molars, canines, and upper incisors of the two genera. Hypocone distinct though low in m^1, obsolete in m^2. Paraconids as in *Micronycteris*. Premolars with thick, rather short shafts, and slightly developed cingula. Middle upper incisor simple, somewhat projecting, the front surface nearly as long as high, the posterior surface slightly concave; lateral incisor short and blunt, scarcely rising to level of indistinct cingulum of canine and middle incisor. Upper canine with a broad flattish groove on anterior face of shaft and a less developed one on antero-outer face. Lower incisors forming a continuous, nearly straight row between cingula of canines, the outer tooth slightly smaller than inner; upper surface of crown slightly longer than height of anterior surface; cutting edge faintly trifid, the middle lobe smallest. Skull heavy and robust, with broad, rather low and flattish rostrum, high sagittal crest and broadly expanded, shelf-like paroccipital processes. Zygomata heavy, a little expanded both anteriorly and posteriorly. Basisphenoid pits evident, though rather shallow. Floor of braincase forming an evident angle with roof of posterior nares. Audital bullæ small and flat, covering about one-half surface of cochleæ; the height considerably less than width. Ears moderately large, widely separate. Noseleaf well developed, though simple. Tail less than half as long as femur, projecting from base of moderately wide interfemoral membrane.

Species examined.—*Phyllostomus discolor* Wagner, *P. hastatus* (Pallas), *P. latifolius* Thomas, *P. verrucosus* Elliot.

Remarks.—This genus is at once recognizable by the robust, heavy form of its members, most of which are of medium or large size, the simple, well-developed noseleaf, moderately small, separate ears, short tail, heavy skull, and the combination of two lower incisors with two lower premolars.

Genus PHYLLODERMA Peters.

1865. *Phylloderma* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 513 (subgenus of *Phyllostomus*).
1866. *Guandira* GRAY, Proc. Zool. Soc. London, p. 114.
1878. *Phylloderma* DOBSON, Catal. Chiropt. Brit. Mus., p. 482 (genus).

Type-species.—*Phylloderma stenops* Peters.

Geographic distribution.—Cayenne.

Number of forms.—One, the type species.

Characters.—Dental formula:

$$\frac{-\;2\;3.\;1.\;-\;-\;3\;4\;5\;6\;7}{1\;2\;-.\;1.\;-\;2\;3\;4\;5\;6\;7}\;i\;\frac{2-2}{2-2},\;c\;\frac{1-1}{1-1},\;pm\;\frac{2-2}{3-3},\;m\;\frac{3-3}{3-3}=34.$$

Teeth much as in *Phyllostomus*, but differing in several details: Inner upper incisors bifid, the slender outer cusps longer than the inner; inner lower incisor nearly twice as wide as outer when viewed from the front, faintly bifid, the outer tooth not distinctly so (the same difference in size is noticeable in crown view of these teeth, and both crowns are more drawn out antero-posteriorly than in *Phyllostomus*); anterior face of upper canine without longitudinal groove; crowns of mandibular premolars narrower and more trenchant than in *Phyllostomus*, and a minute pm_3 wedged transversely between the two functional teeth; mandibular molars narrower than in *Phyllostomus*, with the W pattern somewhat flattened, though perfectly distinct owing to the presence of all the normal elements of the teeth. Skull apparently much like that of *Phyllostomus latifolius*, but nasals probably rising more abruptly behind nares, and rostrum probably deeper and shorter. Mandible deeper, and symphysis menti longer and more oblique than in *Phyllostomus latifolius*. External characters essentially as in *Phyllostomus*.

Species examined.—*Phylloderma stenops* Peters (type specimen of *Guandira cayenensis* Gray, of which the skull is badly damaged).

Remarks.—Although showing throughout a general resemblance to *Phyllostomus* this genus is readily distinguishable by the bifid middle upper incisors, the narrow lower molars, and the presence of the minute pm_3.

Genus TRACHOPS Gray.

1825. *Istiophorus* GRAY, Zool. Journ., II, p. 242, July, 1825 (part). Not of Lacépède, 1802.
1846. *Histiophorus* AGASSIZ, Nomenclator Zool., Index Univ., p. 183.
1847. *Trachops* GRAY, Proc. Zool. Soc., London, p. 14.
1865. *Trachyops* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 512.
1878. *Trachyops* DOBSON, Catal. Chiropt. Brit. Mus., p. 481.

Type-species.—*Trachops fuliginosus* Gray=*Vampyrus cirrhosus* Spix.

Geographic distribution.—Tropical America, north to southern Mexico.

Number of forms.—The type species is the only form now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1}\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=34.$$

Maxillary teeth like those of *Phyllostomus* (anterior face of canine similarly grooved), but outer incisor very small, almost hidden between canine and inner incisor, cheek teeth relatively larger than in *Phyllostomus*, the greatest transverse diameter of m^2 nearly equal to width of palate[a]; m^1 and m^2 with large, well-defined hypocone and noticeably elongated postero-external segment. Except for the presence of a minute pm_3 smaller than the lower incisors and crowded completely from toothrow on inner side, so as to be invisible from without, the mandibular teeth differ from those of *Phyllostomus* in the noticeable compression or narrowing of the crowns of the molars, and the general elevation of all the cusps except the hypoconid of m_1 and m_2, which is somewhat more reduced than in the related genus. The entoconid of these two teeth is, however, much more developed than it is in *Phyllostomus*. Skull more elongated and rounded than that of *Phyllostomus;* interorbital region smoothly rounded and somewhat depressed; posterior zygomatic expansion angular-emarginate in front, the anterior expansion barely indicated; audital bullæ covering about half surface of cochleæ, their height fully equal to width. Externally similar to

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[a] In *Phyllostomus hastatus* it is about one-half, in *P. discolor* considerably less than half, and in *P. latifolius* and *P. longifolius* slightly more than half.

Phyllostomus, but ear longer than head, and front and sides of lips and chin thickly beset with small cylindrical warts, most numerous anteriorly. Tail much shorter than femur, appearing on upper surface of broad interfemoral membrane.

Species examined.—*Trachops cirrhosus* (Spix).

Remarks.—This genus is at once recognizable by the wart-studded lips and the peculiar position of the small lower premolar.

Genus CHROTOPTERUS Peters.

1865. *Chrotopterus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 505 (genus).

1878. *Chrotopterus* DOBSON, Catal. Chiropt. Brit. Mus., p. 469 (subgenus of *Vampyrus*).

1900. *Chrotopterus* ALLEN Bull. Amer. Mus. Nat. Hist., XIII, p. 91, May 12, 1900 (genus).

Type-species.—*Vampyrus auritus* Peters.

Geographic distribution.—Tropical America, north to southern Mexico.

Number of forms.—The type is the only species known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ -\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ ;\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=32.$$

Maxillary teeth essentially like those of *Phyllostomus*, except that the inner incisors are lower and less projecting, the canine is less distinctly grooved on front surface, the anterior premolar (pm^3) is small, crowded outward from the toothrow, and so low that its short cusp barely exceeds cingulum of canine; molars with main cusps large and well developed, but with protocone lower in proportion to other cusps, and with paracone and metacone nearer each other than in the normal arrangement, and mesostyle, together with its commissures, notably reduced, so that the W pattern is distorted by the lengthening of the posterior limb and the shortening of the two median limbs. Mandibular incisors and canines as in *Phyllostomus*, though the canines more closely approach each other. Anterior premolar (pm_2) with the cusp broad and low, more resembling an angular cutting edge than a true cusp; middle premolar (pm_3) minute, crowded completely from toothrow on inner side as in *Trachops*, so that pm_2 and pm_4 are in contact. Lower molars with the cusps essentially unmodified, except that the hypoconid and entoconid are relatively lower than in *Phyllostomus* and the paraconid and metaconid of m_1 are nearer to the protoconid and less distinct from it. Skull essentially as in *Phyllostomus*, but less angular; rostrum and interorbital region subcylindrical; paroccipital expansion small but distinct; audital bulla small, covering less than half cochlea, its diameter nearly twice height at inner edge. Externally characterized by the very large though simple and separate ears (the middle of conch extends to nostril when laid forward); tail barely perceptible in base of very wide interfemoral membrane; lips and chin nearly smooth; fur unusually long and soft.

Species examined.—*Chrotopterus auritus* (Peters).

Remarks.—Though currently regarded as a subgenus of *Vampyrus*, this group is sufficiently well characterized to be recognized as a distinct genus. As pointed out by Dobson, it is in many respects intermediate between *Vampyrus* and the more ordinary members of the subfamily. The structure of its teeth also places it in an intermediate position, though nearer the more normal genera than to *Vampyrus*.

Genus VAMPYRUS Leach.

1821. *Vampyrus* LEACH, Trans. Linn. Soc. London, XIII, p. 79.
1878. *Vampyrus* DOBSON, Catal. Chiropt. Brit. Mus., p. 469.

Type-Species.—*Vespertilio spectrum* Linnæus.

Geographic distribution.—Tropical America north to southern Mexico; Greater Antilles.

Number of forms.—Only the type species is recognized.

Characters.—Dental formula (Plates I, II, fig. 3):

$$\frac{-\;2\;3.\;1.\;-\;-\;3\;4\;5\;6\;7}{1\;2\;-.\;1.\;-\;2\;3\;4\;5\;6\;7}\;i\;\frac{2-2}{2-2},\;c\;\frac{1-1}{1-1},\;pm\;\frac{2-2}{3-3},\;m\;\frac{3-3}{3-3}=34.$$

Middle upper incisors low and wide, their cutting edges strongly oblique, but entire, and almost in contact with canines laterally; outer incisors pushed slightly forward out of tooth row, barely rising to level of cingulum of canine. Canines relatively larger than in any other genus of Phyllostomidæ, flattened in front, the moderately developed cingulum forming a low but distinct postero-internal cusp. Anterior premolar (pm^3) with crown longer than wide, the height of its somewhat trenchant cusp barely equal to length of crown. Posterior premolar (pm^4) peculiar in the very slight indication of the postero-external thickening. Upper molars with the same peculiarities as in *Chrotopterus*, but much exaggerated; disproportion between height of protocone and that of outer cusps very great, owing less to suppression of forming than to unusual elongation of latter; paracone and metacone so high that the outer side of the teeth presents a conspicuous oblique surface, about half of which is limited above by the sharply trenchant edge of the fourth commissure, which has practically no posterior thickening to represent metastyle. The three main cusps are so near together that the triangle indicated by their points is scarcely more than one-fourth the area of base of crown.[a] Parastyle and mesostyle

[a] In *Chrotopterus* this triangle is about one-third of the crown area, while in *Phyllostomus* it is between one-third and one-half.

greatly reduced, though present. W-pattern even more distorted than in *Chrotopterus*, but still visible. Lower incisors very small, about equal in size, forming a concave row between canines and not rising to level of cingulum of the large teeth. Their crowns are very low, slightly wider than long, with an ill-defined cutting edge extending across middle. Lower canines very large, their bases nearly in contact postero-internally, the posterior face of shaft and outer portion of base flattened and slightly hollowed along region of contact with upper canine; cingulum indistinct and without secondary cusps. Lower premolars compressed, with rather dull cutting edges, the middle tooth (pm_3) fully in tooth row and about half size of anterior premolar, the posterior (pm_4) distinctly larger than pm_2, the height of its cusps about equal to length of crown. Lower molars still more highly modified than those of *Chrotopterus*, though in the same direction. In all three teeth the protoconid is very large, nearly twice as high as the hypoconid; in m_1 the paraconid and metaconid are so reduced as to appear as mere appendages to the protoconid, the former scarcely breaking the contour of the anterior cutting edge of the main cusp, the latter slightly less indistinct. With the increased height of the tooth both of these rudimentary cusps have been carried much farther above the base of the tooth than the position they normally occupy. The entoconid, however, remains in its usual position, though its size is less than in *Phyllostomus*. In m_2 the changes have not progressed so far, the paraconid and metaconid retaining their distinctness and normal positions with regard to the protoconid, though their size is reduced, and they are carried much above the level of the small entoconid. The posterior tooth is still less modified, though the same tendency is shown, and the entoconid is absent. Skull considerably elongated, the breadth of brain case less than one-third greatest length. Sagittal crest well developed, especially in occipital region. Paroccipital expansions distinct, though not very large, strongly concave beneath. Rostrum subcylindrical. Zygoma slightly expanded anteriorly and posteriorly. Audital bullæ very small, covering less than half cochlear surface, their height at inner edge less than diameter. Symphysis menti very long, the jaws strongly compressed above it. Externally much like *Phyllostomus*, but with the chin smooth as in *Chrotopterus*, the muzzle much elongated, and the tail absent; interfemoral membrane very wide; ear extending to extremity of muzzle; fur normal.

Species examined.—*Vampyrus spectrum* (Linnæus).

Remarks.—In the peculiar heightening and narrowing of the molars this genus shows the most aberrant type of tooth structure known in the subfamily. The tooth formula, however, has remained somewhat primitive in the presence of a large pm_3, a character probably due to the elongated condition of the mandible.

Subfamily GLOSSOPHAGINÆ.

1838. *Phyllostomina* (part) GRAY, Mag. Zool. and Bot., II, p. 486, December, 1836.
1842. *Phyllostomineæ* (part) LESSON, Nouveau Tableau du Règne Animal, Mammiféres, p. 30.
1845. *Glossophagina* "BONAPARTE, Cat. Met. Mamm. Europe, p. 5."
1855. *Glossophagina* (part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 40.
1865. *Glossophagæ* (part) PETERS, Monatsber, k. preuss. Akad. Wissensch., Berlin, p. 257.
1866. *Glossophagina* GRAY, Proc. Zool. Soc. London, p. 115.
1872. *Glossophaginæ* GILL, Arrangement of the Families of Mammals, p. 17.
1875. *Glossophagæ* (part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350, November, 1875.
1878. *Glossophagæ* (part) DOBSON, Catal. Chiropt. Brit. Mus., p. 497.
1886. *Glossophaginæ* (part) GILL, Standard Natural History, V, p. 173.
1891. *Phyllostomatinæ* (part; Glossophagine division, part) FLOWER and LYDEKKER, Mammals, living and extinct, p. 672.
1892. *Glossophagæ* (part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.
1898. *Glossophaginæ* (part) H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 237.

Geographic distribution.—Warmer parts of America, north on the mainland to southern Arizona and in the West Indies to Cuba.

Characters.—Teeth slightly abnormal. Upper molars with the styles reduced in size and closely approximated to the paracone and metacone, this in connection with the obsolescence of the commissures nearly obliterating the W-pattern. Lower molars with the five typical cusps present, but reduced in height, particularly the paraconid, the commissures very rudimentary. All of the cheek teeth elongated. Rostrum much produced. Tongue long and highly extensible, its surface armed with conspicuous bristle-like papillæ. Noseleaf present, well developed, though never very large.

History.—First recognized as a distinct group by Bonaparte in 1845, the Glossophaginæ have continued to be so regarded by practically all subsequent authors. Since the discovery of *Phyllonycteris* and *Reithronycteris* these genera have been placed with the Glossophaginæ, but this association appears to be quite unnatural. Except that these are now removed, the subfamily, as here understood, has the same limits as with most recent writers.

Remarks.—The members of the subfamily Glossophaginæ are recognizable by their elongated muzzle, highly extensible tongue, and slightly modified teeth. They are all small bats with well-developed through simple nose leaves, and small, separate ears.

Principal subdivisions.—Nine genera of Glossophaginæ are now known, based principally on differences in the number of teeth.

KEY TO THE GENERA OF GLOSSOPHAGINÆ.

Molars $\frac{2-2}{2-2}$.

Lower premolars 2–2 .... *Leptonycteris*, p. 142.

Lower premolars 3–3 .... *Lichonycteris*, p. 143.

Molars $\frac{3-3}{3-3}$.

Upper premolars 3–3.

A very rudimetary tail concealed in base of interfemoral membrane; zygomatic arch slender, but definitely ossified; outer upper incisor subterete; anterior upper premolar nearly in contact with canine .... *Lonchoglossa*, p. 140.

No external tail; zygomatic arch incomplete or partly ossified; outer upper incisor with section of crown conspicuously elliptical; anterior upper premolar separated from canine by space equal to length of its base .... *Anoura*, p. 139.

Upper premolars 2 – 2.

Lower incisors well developed in adult.

Upper incisors showing no marked contrast in size; lower incisors with broad, flat crown; zygomatic arch complete. *Glossophaga*, p. 137.

Upper incisors showing marked contrasts in size; lower incisors with narrow trenchant crowns; zygomatic arch incomplete .... *Lonchophylla*, p. 139.

Lower incisors minute or absent in adult.

Zygomatic arch complete; lower incisors usually present in adult, but very minute .... *Monophyllus*, p. 139.

Zygomatic arch not complete; lower incisors absent in adult.

Pterygoids convex on inner side, the hamular processes not in contact with audital bullæ .... *Hylonycteris*, p. 142.

Pterygoids deeply concave on inner side, the hamular processes in contact with audital bullæ. *Chœronycteris*, p. 141.

Genus GLOSSOPHAGA Geoffroy.

1818. *Glossophaga* GEOFFROY, Mém. Mus. d'Hist. Nat. Paris, IV, p. 418 (*soricina*).

1838. *Phyllophora* GRAY, Mag. Zool. and Bot., II, p. 489 (*amplexicaudata*=*soricina*). Not of Thunberg, 1812.

1847. *Nicon* GRAY, Proc. Zool. Soc. London, p. 15 (*caudifer*=*soricina*).

1878. *Glossophaga* DOBSON, Catal. Chiropt. Brit. Mus., p. 499.

1898. *Glossophaga* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 240.

Type-species.—*Vespertilio soricinus* Pallas.

Geographic distribution.—Warmer parts of America, north to central Mexico, and in the West Indies to Jamaica.

Number of forms.—Six species of *Glossophaga* are now recognized.

Characters.—Dental formula (Plates III, IV, fig. 2):

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\quad i\,\frac{2-2}{2-2},\ c\,\frac{1-1}{1-1},\ pm\,\frac{2-2}{3-3},\ m\,\frac{3-3}{3-3}=34.$$

Upper incisors well developed, distinctly projecting forward and forming a continuous row almost from canine to canine (the diastema less than width of outer incisor). Crown of inner tooth longer than high, the cutting edge straight, slightly oblique, the posterior surface flat and almost parallel with anterior surface. Outer tooth shorter, though with cutting edge in line with that of inner, its crown more oblique, though of about the same area. Lower incisors well developed, completely or nearly filling space between canines, the crowns very low and about as broad as long, the outline roundish or subquadrate, the upper surface with a faint median ridge. Canines strong, simple, with slightly developed cingula and no secondary cusps, the upper with distinct anterior and posterior cutting edge. Upper premolars with narrow trenchant crowns, longer than high, triangular in outline when viewed from the side, the main cusp slightly in front of the middle, the styles obsolete. First and second lower premolars similar, but with lower crowns; third with crown distinctly widened posteriorly. First and second upper molars with nearly half of the crown occupied by a conspicuous pit-like depression on the inner side of which is the narrow but distinct protocone, and on the outer side the paracone, metacone, and mesostyle. Parastyle and metastyle small, and commissures low; this, together with the distinct pushing outward of the paracone and metacone causing a noticeable flattening and widening of the W-pattern. Third upper molar with crown area more than half that of second, the median depression well developed, as are the protocone, paracone, and elongated, low parastyle; mesostyle and metacone somewhat reduced, and the three commissures distinct. Inner border of all three molars strongly convex. Lower molars with the usual five cusps present and distinct, the three teeth alike in form, but the last slightly smaller than either of the others. While the cusps are well developed the commissures are obsolete, giving the crowns a peculiar multituberculate appearance when viewed from above. Skull with braincase large and elongate, but low, rounded and smooth. Rostrum somewhat shorter than braincase, low and weak. A small but distinct lachrymal inflation. Basisphenoid pits distinct but shallow. Audital bullæ small, covering less than half surface of cochleæ, their greatest diameter slightly more than width of basioccipital. Tail not as long as tibia, extending barely to middle of broad interfemoral membrane.

Species examined.—*Glossophaga antillarum* (Rehn), *G. elongata* Miller, *G. longirostris* Miller, *G. mutica* Merriam, *G. soricina* (Pallas), and *G. truei* H. Allen.

Genus LONCHOPHYLLA Thomas.

1903. *Lonchophylla* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., XII, p. 458, October, 1903.

Type-species.—*Lonchophylla mordax* Thomas.

Geographic distribution.—Brazil and Venezuela.

Number of forms.—Two species of *Lonchophylla* are known.

Characters.—Like *Glossophaga*, but zygomatic arch incomplete; inner upper incisor higher than wide and more than double the bulk of outer tooth, which stands by itself near middle of space between large incisor and canine; lower incisors with narrow trifid cutting edges, the outer separated from canine by a space nearly equal to the length of its crown; and last upper molar nearly as large as either of the others, its parastyle short.

Species examined.—*Lonchophylla mordax* Thomas and *L. thomasi* J. A. Allen.

Remarks.—This genus is well characterized by the incomplete zygomatic arch, and by the form of the incisors both above and below. Externally it resembles *Glossophaga*.

Genus MONOPHYLLUS Leach.

1821. *Monophyllus* LEACH, Trans. Linn. Soc. London, XIII, p. 75.

1878. *Monophyllus* DOBSON, Catal. Chiropt. Brit. Mus., p. 503.

1898. *Monophyllus* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 247.

1900. *Monophyllus* MILLER, Proc. Washington Acad. Sci., II, p. 31, March 30, 1900.

Type-species.—*Monophyllus redmani* Leach.

Geographic distribution.—West Indies from Cuba to Barbados.

Number of forms.—Five species of *Monophyllus* are now known.

Characters.—In general like *Glossophaga;* zygomatic arch complete; tail about half as long as femur, projecting beyond edge of very narrow interfemoral membrane. Teeth essentially as in *Glossophaga*, but upper incisors much smaller and of equal length, the outer sharp pointed, the inner with flat cutting edge, neither of the incisors in contact with the other or with canine; lower incisors very minute, with roundish flat crowns, the four teeth standing as two pairs, one pair on each side of a broad median space; upper and lower premolars with conspicuous styles; upper molars with inner margin obliquely truncate.

Species examined.—I have examined all the known forms.

Genus ANOURA Gray.

1838. *Anoura* GRAY, Mag. Zool. and Bot., II, p. 490 (*geoffroyi*).

1844–46. *Rhinchonycteris* TSCHUDI, Fauna Peruana, p. 71 (*peruana*=*geoffroyi*).

1846. *Anura* AGASSIZ, Nomencl. Zool., Index Univ., p. 27.

1868. *Glossonycteris* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 365 (*lasiopyga*).

1878. *Glossonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 508.
1893. *Anura* THOMAS, Proc. Zool. Soc. London, p. 335.
1898. *Anura* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 256.
1901. *Anoura* MILLER and REHN, Proc. Boston Soc. Nat. Hist., XXX, p. 286, December 27, 1901.

Type-species.—Anoura geoffroyi Gray.

Geographic distribution.—Tropical America, north to southern Mexico.

Number of forms.—Only one species is currently recognized.

Characters.—Like *Lonchoglossa*, but with no external tail; zygomatic arch incomplete or imperfectly ossified; outer upper incisor noticeably elliptical in section, the outline of its anterior surface triangular; anterior upper premolar (pm^2) separated from canine by a space about equal to length of its base.

Species examined.—Anoura geoffroyi Gray.

Genus LONCHOGLOSSA Peters.

1818. *Glossophaga* GEOFFROY, Mém. Mus. d'Hist. Nat., Paris, IV, p. 418 (part).
1868. *Lonchoglossa* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 364.
1878. *Lonchoglossa* DOBSON, Catal. Chiropt. Brit. Mus., p. 506.
1898. *Lonchoglossa* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 256.

Type-species.—Glossophaga caudifera Geoffroy.

Geographic distribution.—Tropical South America.

Number of forms.—Two species are currently referred to this genus.

Characters.—Dental formula:

$$\frac{-\,2\,3.\,1.\,-\,2\,3\,4\,5\,6\,7}{-\,-\,-.\,1.\,-\,2\,3\,4\,5\,6\,7}\,.\; i\,\frac{2-2}{0-0},\; c\,\frac{1-1}{1-1},\; pm\,\frac{3-3}{3-3},\; m\,\frac{3-3}{3-3}=32.$$

Upper incisors minute, styliform, the inner smaller than the outer, the teeth of each pair close together, though not in contact, the inner teeth separated from each other and the outer separated from canines by spaces about equal to that occupied by the two incisors together. Anterior upper premolar (pm^2) much smaller than the others, nearly in contact with canine, but separated from second premolar (pm^3) by distinct space. Other teeth as in *Monophyllus*, except that inner border of upper molars is narrow and convex. Skull essentially as in *Monophyllus*, but zygomata very slender, basiphenoid pits obsolete, and hamular processes ligulate, curved outward and backward, and slightly twisted. Tail very rudimentary or absent, when present extending to edge of narrow interfemoral membrane, but the vertebræ incompletely ossified, so that the tail might easily be overlooked.

Species examined—Lonchoglossa caudifera (Geoffroy).

Remarks.—Though not very well characterized this genus is distinguishable from *Anoura* by the rudimentary though evident tail, the nearly terete outer upper incisors, and the position of the anterior upper premolars (pm^2) close to base of canine. The zygomatic arch though very slender is apparently always present and completely ossified.

The status of *Lonchoglossa wiedi* as a member of this genus seems open to much doubt. I have seen no authentic specimens, but the characters given by Peters and Dobson make it appear more probably an *Anura*, if, indeed, it is specifically separable from *A. geoffroyi.*

Genus CHŒRONYCTERIS Tschudi.

1844. *Chœronycteris* Tschudi, Weigmann's Archiv. für Naturgeschichte, 1844, I, p. 247. (*Nomen nudum.*)

1844–46. *Chœronycteris* Tschudi, Fauna Peruana. Mamm., p. 70 (subgenus of *Glossophaga*).

1868. *Chœronycteris* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 366 (genus).

1878. *Chœronycteris* Dobson, Catal. Chiropt. Brit. Mus., p. 509.

1898. *Chœrnycteris* (sic) H. Allen, Trans. Amer. Philos. Soc., n. s., XIX, p. 252.

Type-species.—*Chœronycteris mexicana* Tschudi.

Geographic distribution.—Warmer parts of America north to southern Arizona.

Number of forms.—Four species are now recognized.

Characters.—Dental formula:

$$\frac{-\,2\ 3.\ 1.\ -\,-\,3\ 4\ 5\ 6\ 7}{-\,-\,-.\ 1.\ -\,2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{0-0},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=30.$$

Upper incisors minute, in pairs, the teeth of each pair in contact with each other but separated from canine by distinct space and in middle by an interval nearly twice as great. Crowns of incisors much longer than high and nearly as wide as long, that of the inner tooth flat and horizontal, that of the outer oblique and with a low, blunt cusp on inner side. Canines and premolars with no special peculiarities, the latter long and narrow, with high main cusp and well-developed styles. Upper molars distinctly spaced, with parastyle and metastyle absent, and mesostyle greatly reduced, though indicated in all three teeth, the W pattern therefore barely suggested. The three molars are almost exactly alike in form, but the third is slightly smaller than either of the others. Lower molars with all the cusps present, but, with exception of protoconid, much reduced, the three teeth essentially alike. Skull with rostrum very greatly elongated in some species, in others not unusually so for members of the subfamily. Zygomata incomplete. Pterygoids strongly concave on inner side, the hamulars in contact with audital bullæ. Tail well developed, about half as long as femur, extending less than half way to edge of very wide interfemoral membrane. Calcar present, distinct though weak.

Species examined.—*Chœronycteris godmani* Thomas, *C. intermedia* Allen and Chapman, *C. mexicana*, Tschudi, and *C. minor* Peters.

Genus HYLONYCTERIS Thomas.

1903. *Hylonycteris* THOMAS Ann. and Mag. Nat. Hist., 7th ser., XI, p. 286. March, 1903.

Type-species.—*Hylonycteris underwoodi* Thomas.

Geographic distribution.—Costa Rica.

Number of forms.—Only the type species is known.

Characters.—Closely resembling *Chœronycteris* in all respects except that the pterygoids are not specially modified, their inner surface being convex and the hamular processes not coming in contact with the audital bullæ.

Species examined.—*Hylonycteris underwoodi* Thomas.

Remarks.—*Hylonycteris*, though very closely related to *Chœronycteris*, is well characterized by the form of the pterygoids. These bones are perfectly normal, quite as in other members of the subfamily, and lack all trace of the peculiar structure which they have assumed in the allied genus.

Genus LEPTONYCTERIS Lydekker.

1860. *Ischnoglossa* SAUSSURE, Rev. et Mag. de Zool., 2ᵉ sér., XII, p. 491. November, 1860. Not of Kraatz, 1856.

1878. *Ischnoglossa* DOBSON, Catal. Chiropt. Brit. Mus., p. 505.

1891. *Leptonycteris* LYDEKKER, in Flower and Lydekker, Mammals living and extinct, p. 674.

1898. *Leptonycteris* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 250.

Type-species.—*Ischnoglossa nivalis* Saussure.

Geographic distribution.—Mexico, Central America, and the island of Curaçao, off the coast of Venezuela.

Number of forms.—Two species of *Leptonycteris* are known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{2-2}{2-2}=30.$$

Upper incisors rather large, forming an almost continuous line between canines, or separated by median space into two pairs, the crowns projecting forward. Crown of inner incisor about as long as high, the cutting edge straight, nearly horizontal. Crown of outer higher than that of inner, its length about half height, the extremity rather sharply pointed. Lower incisors well developed, with low, flat, rounded crowns. They are almost equally spaced or thrown into two pairs by wider median gap. Upper canine with cingulum obsolete, but represented anteriorly and posteriorly by short though well-developed cusps, that at posterior base of main shaft the more conspicuous. Lower canine with large cingulum, but no secondary cusps. Premolars long and narrow, with high main cusps and distinct though small styles; anterior lower premolar (pm_2) noticeably concave on inner face and slightly convex externally. Molars showing no special peculiarities, except that the W pattern in m^1 is distorted by the great length and narrowness of the outer section of the tooth, and m^2 has the form usually characteristic of m^3. Inner edge of upper molars broadly convex. Skull of the normal Glossophagine type; zygomata slender, but complete; pterygoids rather short and thick, but not specially modified in form. Tail absent. Interfemoral membrance very narrow. Calcar small, but distinct.

Species examined.—*Leptonycteris nivalis* (Saussure) and *L. curasoæ* Miller.

Remarks.—The genus *Leptonycteris* is well characterized by its unique dental formula, though externally it rather closely resembles *Anoura* and *Lonchoglossa*. The only other known genus in which the third molar is lacking, *Lichonycteris*, differs very conspicuously in the peculiar form of the upper incisors and in the absence of the lower incisors.

Genus LICHONYCTERIS Thomas.

1895. *Lichonycteris* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., XVI, p. 55, July, 1895.

Type-species.—*Lichonycteris obscura* Thomas.

Geographic distribution.—Nicaragua and Dutch Guiana.

Number of forms.—Only the type species has been described.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{-\ -\ -.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{0-0},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{2-2}{2-2}=26.$$

Upper incisors evenly and widely spaced between canines, their crowns narrow though scarcely trenchant, longer than high, that of inner tooth distinctly emarginate on cutting edge, so that it appears bilobed when viewed from in front, that of outer tooth with sharp, backward-directed cusp near inner edge, and a flattish outer projection. Canines simple, with moderately developed cingula, but no secondary cusps. Premolars rather short and not as narrow as usual, the main cusp well developed except in pm_2, in which it is obsolete, the styles evident but low. Upper molars with W pattern obsolete owing to the great reduction of the styles and commissures.

As in *Leptonycteris*, m^2 has the appearance of a third molar. Lower molars with the cusps all reduced in size, the metaconid largest. Zygomata incomplete. Tail distinct, about half as long as femur, extending scarcely to middle of broad interfemoral membrane.

Species examined.—*Lichonycteris obscura* Thomas.

Remarks.—This genus appears to be most nearly related to *Leptonycteris*, with which it agrees in the very peculiar formula of the cheek teeth. It is, however, even more aberrant, having lost the lower incisors, and almost lost the W pattern of the upper molars.

Subfamily HEMIDERMINÆ.

1838. *Phyllostomina* (part) GRAY, Mag. Zool. and Bot., II, p. 486, December, 1838.

1855. *Glossophagina* (part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 40.

1865. *Vampyri* (part) PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 256.

1866. *Vampyrina* (part) GRAY, Proc. Zool. Soc. London, p. 113.

1875. *Vampyri* (part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350, November, 1875.

1878. *Vampyri* (part) DOBSON, Catal. Chiropt. Brit. Mus., p. 458.

1891. *Phyllostomatinæ* (part, Vampyrine division, part) FLOWER and LYDEKKER, Mammals living and extinct, p. 672.

1892. *Phyllostomata* (part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Warmer parts of America north to southern Mexico and in the West Indies to Jamaica.

Characters.—Teeth abnormal. First and second upper molars with protocone greatly reduced (*Hemiderma*) or obsolete (*Rhinophylla*), occupying entire very narrow inner edge of tooth; paracone and metacone large, trenchant; parastyle and metastyle present, though small; mesostyle absent; an angular-concave commissure nearly in line with main axis of toothrow connects the outer cones and styles, but without forming any trace of a W pattern. Third upper molar never half as large as first or second, either a practically structureless remnant or at most with two low cusps, apparently the paracone and parastyle. Lower molars with protoconid (in *Hemiderma* the hypoconid also) well developed and forming with its commissures a median longitudinal cutting ridge, close to the middle of which the rather small metaconid may be situated. (In *Rhinophylla* the metaconid is absent and the molars closely resemble the premolars in form.) Paraconid and entoconid small or absent. Rostrum, noseleaf, and tongue normal.

History.—Except that Gervais associated the genus *Hemiderma* with the Glossophagine bats in 1855, the Hemiderminæ have been almost universally referred without special comment to the Phyllostominæ. They are now for the first time recognized as a distinct subfamily.

Principal subdivisions.—Only two genera of Hemiderminæ have been described.

KEY TO THE GENERA OF HEMIDERMINÆ.

Lower molars distinctly different in form from premolars; tail present .... *Hemiderma*, p. 145.
Lower molars not distinctly different in form from premolars; tail absent .... *Rhinophylla*, p. 146.

Genus HEMIDERMA Gervais.

1838. *Carollia* GRAY, Mag. Zool. and Bot., II, p. 488. February, 1838. Not *Carolia* Cantraine, 1837.

1855. *Hemiderma* GERVAIS, Expéd. du Comte de Castelnau, Zool., Mammif., p. 43.

1866. *Rhinops* GRAY, Proc. Zool. Soc., London, p. 115 (*Rhinops minor* Gray= *Hemiderma perspicillatum*).

1878. *Carollia* DOBSON, Catal. Chiropt. Brit. Mus., p. 495.

1891. *Hemiderma* LYDEKKER in Flower and Lydekker, Mammals, living and extinct, p. 674.

1907. *Hemiderma* HAHN, Proc. U. S. Nat. Mus., XXXII, p. 108, February 9, 1907.

Type-species.—*Phyllostoma brevicaudum* Wied = *Vespertilio perspicillatus* Linnæus.

Geographic distribution.—Warmer parts of America north on the mainland to southern Mexico, and in the West Indies to Jamaica.

Number of forms.—Four forms of Hemiderma are at present recognized.

Characters.—Dental formula: (Plates IX and X, fig. 1.)

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisors strongly contrasted in size, completely filling space between canines. Inner incisors large, with projecting, obliquely set crowns about as high as long, strongly in contact near apex, the cutting edge entire, the outer surface convex, the inner surface slightly concave. Outer incisors minute, the rounded, flat crown barely rising to height of cingulum of canine. Lower incisors small, forming a slightly convex row between canines, the inner tooth larger than the outer, its crown somewhat extended backward and distinctly concave on inner surface; cutting edge of both teeth entire or slightly emarginate. Canines low and strong, simple in form and without secondary cusps or noticeable cingula. Premolars rather narrow, with well-developed main cusps and cutting edge, but no styles; inner surface slightly concave. First and second upper molar with low but distinct protocone forming entire very narrow inner side of tooth and isolated from outer cusps by a distinct median depression. Paracone and metacone well developed though narrow; parastyle and metastyle small; mesostyle absent. The cones and styles are connected by a commissure which forms a sinuous cutting edge but no W pattern. Third upper molar about half as large as first or second, consisting of a short, wide parastyle, a low paracone from which a slight commissure extends backward to edge of tooth. First and second lower molars with all the cusps indicated but only the protoconid and metaconid well developed. Third lower molar with no entoconid. Skull rather heavily built. Rostrum about two-thirds as long as brain case, the lachrymal region slightly swollen; lachrymal breadth equal to distance from orbit to gnathion. Braincase rising conspicuously though not abruptly above forehead. Zygomata incomplete. Basisphenoid pits broad and shallow. Audital bullæ small, covering less than half surface of cochleæ, their diameter slightly less than width of basioccipital. Ears small, separate. Tail short, extending to middle of moderately wide interfemoral membrane, its length about half that of femur.

Species examined.—I have examined all the known members of this genus.

Genus RHINOPHYLLA Peters.

1865. *Rhinophylla* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 355.

1878. *Rhinophylla* DOBSON, Catal. Chiropt. Brit. Mus., p. 495.

Type-species.—*Rhinophylla pumilio* Peters.

Geographic distribution.—Tropical South America.

Number of forms.—Only the type species is at present known.

Characters.—Like *Hemiderma*, but tail absent, skull with much broader rostrum and lower brain case, and teeth more highly modified, though of the same number. Upper incisors like those of *Hemiderma*, except that the outer is relatively larger, its crown distinctly pointed, and inner is bilobed on cutting edge, the lobes nearly equal in size. Premolars as in *Hemiderma*, but pm^3 very much smaller than pm^4. Molars with the Hemidermine peculiarities much exaggerated, the inner portion of m^1 and m^2 so greatly reduced that there is practically no protocone; parastyle and metastyle distinct, but low; paracone and metacone low and very narrow, producing a faintly two-lobed cutting edge, the posterior lobe of which (metacone) is distinctly higher than the anterior. A wavy commissure extends from parastyle to paracone and thence to metacone and metastyle. On m^1 a faint trace of the inner commissures may be detected, extending from the two main cusps downward to inner edge of crown. Third upper molar a mere rounded, structureless remnant lying directly in line with main cusps of the two preceding teeth and probably representing the paracone. Lower incisors strongly contrasted in size, the outer much reduced, the cutting edge of the inner obscurely trilobed, that of the outer bilobed. Lower molars essentially like lower premolars, differing only in their slightly greater length, slightly more distinct point, and in the presence of a low, barely indicated posterior cusp. This cusp appears as a mere backward prolongation of the cutting edge when teeth are viewed from the side, but in crown view it is seen to have a distinctly indicated thickened base. It is probably the remnant of the hypoconid. No positive trace of the three inner cusps can be detected. The three teeth decrease uniformly in size from first to third. Skull with rostrum very short, the distance from orbit to gnathion barely equal to width of interorbital constriction. Dorsal profile of brain case deflected immediately behind orbits. Ears small, separate. Tail none. Interfemoral membrane narrow.

Species examined.—*Rhinophylla pumilio* Peters.

Remarks.—This genus represents the extreme stage of development of the Hemidermine type. It is not distantly related to *Hemiderma*, but the differentiation of the teeth has reached a much more extreme stage.

Subfamily STURNIRINÆ.

1855. *Stenodermina* (part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 32.

1865. *Stenodermata* (part) PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 257.

1866. *Stenodermina* (part) GRAY, Proc. Zool. Soc. London, p. 116.

1875. *Stenodermata* (part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350. November, 1875.

1878. *Stenodermata* (part) DOBSON, Catal. Chiropt. Brit. Mus., p. 511.

1891. *Phyllostomatinæ* (part; Stenodermatine division, part) FLOWER and LYDEKKER, Mammals living and extinct, p. 675.

1892. *Stenodermata* (part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Tropical America, north to Jamaica and southern Mexico.

Characters.—Teeth highly abnormal, upper molars with distinct protocone, paracone, and metacone situated at extreme edges of crown, the space between occupied by a conspicuous longitudinal groove, continuous from one tooth to the next. Lower molars similarly grooved, the five typical cusps present at margins of crown, those on outer side low and indistinct, but metaconid and entoconid well developed. Rostrum, tongue, and noseleaf normal.

History.—The genus *Sturnira* has generally been associated with the Stenodermatinæ. Its tooth structure is so aberrant and highly specialized, however, that it is more naturally placed in a special subfamily. Dobson remarks that the molars resemble those of the frugiverous Pteropi more closely than those of any other [then known] bats, a statement that would have been true if he had excepted the mandibular teeth of *Phyllonycteris*. Winge passes the subject by with the mere remark that he regards the cheek teeth of *Sturnira* and *Vampyrops* as more primitive than those of the other Stenoderms, owing to the usual persistence of m^3, the large size of m^2, and the slight development of the upper cheek teeth.

Principal subdivisions.—The genus *Sturnira* is the only member of the subfamily yet known.

Genus STURNIRA Gray.

1842. *Sturnira* Gray, Ann. and Mag. Nat. Hist., X, p. 257 (*spectrum* = *lilium*).

1849. *Nyctiplanus* Gray, Proc. Zool. Soc. London, (1848), p. 58, January 30, 1849 (*rotundatus* = *lilium*).

1878. *Sturnira* Dobson, Catal. Chiropt. Brit. Mus., p. 538.

Type-species.—*Sturnira spectrum* Gray = *Phyllostoma lilium* Geoffroy.

Geographic distribution.—Tropical America, north to Jamaica and southern Mexico.

Number of forms.—Only the type species is now recognized.

Characters.—Dental formula (Plates III, IV, fig. 3):

$$\frac{-\,2\,3.\,1.\,-\,-\,3\,4\,5\,6\,7}{1\,2\,-.\,1.\,-\,2\,-\,4\,5\,6\,7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisors large, subequal in cross section, completely filling space between canines. Inner incisors with crowns higher than long, slightly oblique, strongly in contact near middle, the front surface convex, the posterior surface concave, the cutting edge entire or with the faintest possible suggestion of a terminal emargination. Outer incisors extending barely beyond cingulum of canine, longer than high, the crown broadly concave in front, narrowly convex behind, its cutting edge sharp, rising to an angular point at middle. Lower incisors small, closely crowded in a nearly straight line between canines, the roots projecting forward, the crowns rising perpendicularly at a distinct angle with roots; crowns of inner pair with narrow backward extension; cutting edge of all four teeth uniformly trilobate, the lobes equal. Canines strong, the upper more than half as long as high, the lower more slender and with narrow but distinct posterior heel. Inner surface of upper canine strongly concave. Premolars simple, rather low, each with an outer cusp and inner concavity. Upper molars quadratic in outline, slightly broader than long, the main portion of the crown occupied by a deep longitudinal groove extending without break from last molar to last premolar, inclusive. Protocone low and long, occupying the entire inner border of crown. Paracone and metacone low but distinct, their commissure deeply concave. A faintly defined cingulum extends along outer edge of tooth. Second molar smaller than first; third with about one-third the crown area of second, its protocone and median groove distinct, its outer cusps barely indicated, though present. First and second lower molars with median groove well developed, but less distinct and continuous from one tooth to the next than in upper molars; m^1 with paraconid low and hypoconid practically absent, but with protoconid, metaconid, and entoconid well developed; m_2 with distinct metaconid and protoconid exactly opposite each other at anterior corners of crown, and low entoconid at posterior inner corner, but hypoconid barely, if at all, indicated. Third lower molar with about one-third the crown area of second; it has two rather distinct cusps in position of protoconid and metaconid. Skull showing no special peculiarities, the braincase moderately high and with fairly developed sagittal crest, the rostrum somewhat more than half as long as braincase, its greatest interorbital width slightly more than depth in same region, and about equal to distance from incipient postorbital process to canine. Nares slightly extended backward by a squarish emargination more than half as wide as nasal aperture. Audital bullæ small, covering less than half surface of cochleæ. Noseleaf and ears normal. Tail absent. Interfemoral membrane moderately developed. Calcar present, though small. In males there is a conspicuous tuft of stiff, modified hairs at front of shoulder similar to the epaulettes of *Epomophorus*.

Species examined.—Sturnira lilium (Geoffroy).

Subfamily STENODERMINÆ.

1838. ***Phyllostomina*** (part) GRAY, Mag. Zool. and Bot., II, p. 486, December, 1838.

1855. ***Stenodermina*** (part) GERVAIS, Expéd. du Comte de Castelnau, Zool. Mamm., p. 32.

1865. ***Stenodermata*** (part) PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 257.

1866. ***Stenodermina*** (part) GRAY, Proc. Zool. Soc. London, p. 116.

1866. ***Centurionina*** GRAY, Proc. Zool. Soc. London, p. 118.

1875. ***Stenodermata*** (part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350, November, 1875.

1878. ***Stenodermata*** (part) DOBSON, Catal. Chiropt. Brit. Mus., p. 511.

1891. ***Phyllostomatinæ*** (part; Stenodermatine division, part) FLOWER and LYDEKKER, Mammals living and extinct, p. 672.

1892. ***Stenodermata*** (part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

1898. ***Brachyphyllina*** (part) H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 258.

1901. ***Centurioninæ*** REHN, Proc. Acad. Nat. Sci. Philadelphia, p. 296, June 8, 1901.

Geographic distribution.—Warmer parts of America north to Cuba, southern Florida, and central Mexico.

Characters.—Teeth highly abnormal. Upper molars with crowns elongated across main axis of toothrow (very broad and short). Paracone and usually the metacone also well developed at extreme outer margin of tooth, the two cusps together with their commissure forming a cutting edge, which is often rimmed by two cingula, an outer and an inner. Protocone at extreme inner margin, except when its place is taken by the shelf-like, often very large hypocone, which in extreme instances resembles a second protocone. The space between the inner and outer cusps is occupied by a wide, slightly concave crushing surface, the enamel of which is variously wrinkled and roughened, rarely almost smooth. Lower molars with main portion of crown nearly flat, its surface roughened as in the maxillary teeth. On the outer edge are two low, broad cusps (the second occasionally obsolete), the protoconid and hypoconid, between which a small third, possibly the mesostyle, is sometimes present. On the inner edge a conspicuous spike-like cusp arises opposite or slightly behind the protoconid and a less conspicuous cusp occupies the posterior inner angle of the crown. The larger of these cusps is the metaconid, as a rudimentary elevation representing the last trace of the paraconid is occasionally present in front of it (*Artibeus*). (Plates V and VI.) Tongue normal. Rostrum usually though not invariably much broadened and shortened. Antorbital canal indistinct, opening anteriorly by two or three minute orifices. Noseleaf usually present, though sometimes rudimentary or absent.

History.—This subfamily has been recognized as a distinct group since 1855. It was subdivided by Gray, who separated the Centurionina; by Harrison Allen, who removed *Brachyphylla* and associated it with *Phyllonycteris;* and by Rehn, who again regarded the Centurioninæ as distinct. The group as a whole appears to me very homogeneous, and I can see no reason to remove any of its genera.

Principal subdivisions.—Nineteen genera of Stenoderminæ are now known.

KEY TO THE GENERA OF STENODERMINÆ.

Rostrum much shortened, considerably less than half as long as braincase.

Molars $\frac{2-2}{2-2}$; upper incisors situated beneath edge of nares. *Centurio*, p. 168.

Molars $\frac{3-3}{3-3}$; upper incisors separated from nares by distinct horizontal area.

Anterior margin of orbit with a low but distinct bead; interpterygoid space practically absent, the hamular processes almost perpendicular to sagittal plane; choanæ forming a nearly circular backward-directed opening_____________________*Ametrida*, p. 171.

Anterior margin of orbit produced into a conspicuous plate; interpterygoid space evident, the hamular processes directed backward and slightly outward; choanæ normal____*Sphæronycteris*, p. 170.

Rostrum not specially shortened, at least half as long as braincase.
Rostrum deep, parallel sided, almost cuboid in form *Pygoderma*, p. 166.
Rostrum not cuboid.
Nasal region occupied by a narrow emargination extending back from nares to between orbits *Chiroderma*, p. 157.
Nasal region without emargination.
Interpterygoid space extended forward as a deep palatal emargination.
Rostrum strongly depressed between high supraorbital ridges; nares extending half way from front of premaxillaries to point of juncture of supraorbital ridges *Stenoderma*, p. 165.
Rostrum rising above level of low supraorbital ridges; nares extending much less than half way from front of premaxillaries to point of juncture of supraorbital ridges.
Borders of palatal emargination strongly converging anteriorly; inner upper incisor with crown slender, noticably higher than long *Phyllops*, p. 164.
Borders of palatal emargination not strongly converging anteriorly; inner upper incisor with crown short and thick, scarcely or not higher than long.
Upper molars 3–3 *Ardops*, p. 162.
Upper molars 2–2 *Ariteus*, p. 165.
Interpterygoid space not extended forward as a deep palatal emargination.
Inner upper incisor slightly higher than outer, but not twice as large, the two teeth usually not conspicuously different in form or size.
Length of rostrum fully ¾ that of brain case, depth of rostrum at front of second premolar more than ½ that of brain case *Uroderma*, p. 154.
Length of rostrum slightly more than ½ that of brain case; depth of rostrum at front of second premolar less than ½ that of brain case.
Inner upper incisor bifid, m^3 and m_3 present or absent, so reduced in size that their presence or absence does not affect the form of the surrounding bone *Artibeus*, p. 160.
Inner upper incisor entire, m^3 and m_3 well developed, effecting the form of the surrounding bone *Enchisthenes*, p. 162.
Inner upper incisor much higher than outer, usually, at least, twice as large, the two teeth conspicuously different in form and size.
First lower molar with distinct postero-internal cusp, the crown very different in form from that of the last premolar.
Crowns of molars both above and below heavily wrinkled; second upper molar with large protoconule; upper canine with large secondary cusp *Brachyphylla*, p. 152.

Crowns of molars both above and below nearly smooth; second upper molar without protoconule; upper canine with no secondary cusp.

Upper molars 3–3, the second with large metacone ------------------ *Vampyrops*, p. 155.

Upper molars 2–2, the second with metacone obsolete --------------- *Vampyrodes*, p. 156.

First lower molar without postero-internal cusp, the crown somewhat closely resembling that of last premolar.

Inner cusps of second lower molar very large, their height about half width of crown.

Lower incisors 2–2; surface sculpture on cheek teeth obsolete --------- *Vampyressa*, p. 156.

Lower incisors 1–1; surface sculpture on cheek teeth well developed -- *Vampyriscus*, p. 156.

Inner cusps of second lower molar obsolete or absent.

Second upper molar without median ridge; second lower molar scarcely wider than ramus of mandible, its crown with normal though very low cusps and no median ridge. *Mesophylla*, p. 158.

Second upper molar with median ridge; second lower molar with saucer-shaped crown much wider than mandible and with two-cusped median ridge ---- *Ectophylla*, p. 159.

Genus BRACHYPHYLLA Gray.

1834. *Brachyphylla* GRAY, Proc. Zool. Soc. London (1833), p. 122, March, 1834.

1878. *Brachyphylla* DOBSON, Catal. Chiropt. Brit. Mus., p. 540.

1898. *Brachyphylla* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 258.

Type-species.—*Brachyphylla cavernarum* Gray.

Geographic distribution.—Greater and Lesser Antilles.

Number of forms.—Two species of *Brachyphylla* are now recognized.

Characters.—Dental formula:

$$\frac{-\,2\;3.\;1.\;-\;-\;3\;4\;5\;6\;7}{1\;2\;-.\;1.\;-\;2\;-\;4\;5\;6\;7}\;i\,\frac{2-2}{2-2},\;c\,\frac{1-1}{1-1},\;pm\,\frac{2-2}{2-2},\;m\,\frac{3-3}{3-3}=32.$$

Upper incisors very strongly contrasted in size and form, the inner large with triangular crowns, higher than long, the front face convex, the inner face concave, and with distinct cingulum. Though far apart at root and apex, the inner incisors are strongly in contact where widest, that is at the base of their crowns. Outer incisor minute, rounded, flat crowned, barely extending beyond cingulum of canine and of inner incisor, between which it is closely wedged. The incisors thus completely fill the space between canines at level of cingula, though their roots and tips are wide apart, a very unusual condition, though the form of the inner incisor is somewhat closely approached in *Ectophylla*. Lower incisors with rounded subequal crowns crossed by a faint longitudinal ridge. They form a continuous, slightly convex row between canines. Upper canine with length of crown nearly equal to height, the cingulum well developed, especially on inner side, where it forms two low, but very distinct cusps; main shaft of tooth with a large secondary cusp extending nearly to middle of posterior edge, a character unique in the subfamily. Mandibular canine low, the cingulum forming a noticeable posterior heel. Anterior upper premolar minute, not extending beyond cingulum of canine, scarcely larger than outer incisor, which it resembles in form. Posterior upper premolar high and short, with distinct cingulum but no evident styles, the inner flat surface directed very slightly backward. Lower premolars well developed, showing no special peculiarities. First and second upper molars (Plate VI, fig. 3), with outer cusps large and unusually trenchant, without distinct cingula; m^1 with large protocone and small protoconule and metaconule, m^2 with protoconule about half as large as protocone, which it resembles in form; metaconule about as in m^1. The crushing surface of both teeth is concave laterally and very coarsely wrinkled, more coarsely than in any other member of the group. Third upper molar about half as large as second, and of approximately the same form. As in the second, the protoconule is large and much like the protocone in form, though not as high. First and second lower molars with protoconid, metaconid, hypoconid, and entoconid present, though rather low, the two inner cusps often, especially in m_2, bearing low but distinct secondary cusps in positions corresponding to those occupied by the protoconule and metaconule. Third lower molar more than half as large as second, its protoconid low but distinct, its hypoconid flat, its metaconid high, narrow, and more conspicuous than in either of the other molars. Skull rather long and slender for a Stenodermine bat, but showing no special peculiarities of form. Lachrymal breadth about one-half greater than depth in same region, and contained one and one-half times in length of rostrum. Width of palate between first molars equal to one-half length of toothrow (incisors excluded). Ears small, separate. Noseleaf, rudimentary, without upright process, the upper edge slightly emarginate at middle. Tail about one-fourth as long as femur, entirely concealed in base of rather wide interfemoral membrane; caudal vertebræ, 3. Tongue not specially modified.

Species examined.—*Brachyphylla cavernarum* Gray and *B. nana* Miller.

Remarks.—Although specialized in the reduced condition of the noseleaf and in the peculiarities of the upper incisors and canines and in the great development of the protoconule in m^2 and m^3, this genus appears to be the most primitive of the Stenodermines, a position indicated by the slightly modified form of the skull, and more especially by the large size and nearly complete condition of the posterior molar in both jaws. By Harrison Allen it was associated with *Phyllonycteris* as a section of the Glossophaginæ, while by Dobson it was regarded as a relative of the Desmodonts.

Genus URODERMA Peters.

1865. *Uroderma* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 587 (genus).

1878. *Uroderma* DOBSON, Catal. Chiropt. Brit. Mus., p. 515 (subgenus of *Artibeus*, part).

1901. *Uroderma* REHN, Proc. Acad. Nat. Sci. Philadelphia, 1900, p. 757. February 9, 1901 (genus).

Type-species.—*Uroderma bilobatum* Peters.

Geographic distribution.—Tropical America north to Panama.

Number of forms.—Two species of *Uroderma* are now known, *U. bilobatum* Peters and *U. convexum* Lyon. The species *planirostris*, an *Artibeus*, has been wrongly placed in this group on account of its tooth formula.

Characters.—Differing from *Artibeus* (p. 160) in the longer, much deeper rostrum, the well-developed last molar, both above and below, the bilobed outer upper incisor and in certain other details of tooth structure. Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Relative size and general form of incisors as in *Artibeus*, but i^3 with cutting edge distinctly and equally bilobed. Premolars and molars (Plate VI, fig. 1) as in *Artibeus*, except that the surface sculpture on molars is much coarser and less extensive, tending in m^1 and m^2 to form a rudimentary metaconule, m_1 lacks the metaconid, and m^3 and m_3 are well developed, though small teeth, the former broader than long and with about one-fourth the crown area of m^2, the latter subquadrate, with nearly half the crown area of m_2. Rostrum fully three-fourths as long as and more than half as deep as brain case, giving the skull a very different aspect from that of *Artibeus*. Length of rostrum much greater than lachrymal breadth and about equal to distance across palate, including first molars. Depth through lachrymal region nearly equal to lachrymal breadth and more than half depth of brain case.

Species examined.—*Uroderma bilobatum* Peters and *U. convexum* Lyon.

Remarks.—As first clearly pointed out by Rehn this genus differs conspicuously from *Artibeus* in the form of the skull. In this character it somewhat suggests *Vampyrops*, but the rostrum is deeper, while the dental peculiarities at once separate the two genera. The most convenient means of recognition is furnished by the upper incisors; these in *Uroderma* are subequal and bilobed, in *Vampyrops* strongly contrasted in size, and the inner with cutting edge entire.

Genus VAMPYROPS Peters.

1860. ***Platyrrhinus*** **SAUSSURE**, Rev. et Mag. de Zool., 2ᵉ sér., XII, p. 429. October, 1860. Not ***Platyrhinus*** Clairville, 1798.

1865. ***Vampyrops*** **PETERS**, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 356.

1878. ***Vampyrops*** **DOBSON**, Catal. Chiropt. Brit. Mus., p. 522.

1900. ***Vampyrops*** **THOMAS**, Ann. and Mag. Nat. Hist., 7th ser., V, p. 269, March, 1900.

Type-species.—*Phyllostoma lineatum* Geoffroy.

Geographic distribution.—Tropical America north to southern Mexico.

Number of forms.—Nine species of *Vampyrops* are now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisors very unequal, the inner more than twice as high as outer, the crowns obliquely set, in contact at tip, the cutting edge entire; outer incisor low but well developed, completely filling space between canine and inner incisor, its cutting edge faintly bifid. Lower incisors small, equal, forming a nearly straight line between canines, their cutting edge faintly bifid. Canines and premolars essentially as in *Artibeus*. First and second upper molars with the outer cusps and both cingula well developed, as in *Artibeus*, but with hypocone absent or very rudimentary and with crushing surface nearly smooth. The two teeth are essentially alike in form. Third upper molar always present, slightly larger than in *Artibeus*, its crown area about one-eighth that of second molar. Lower molars with surface of crowns nearly smooth; the two outer cusps well developed in m_1 and m_2 though hypoconid is usually very low, particularly in m_2; metaconid absent or represented by a minute rudiment in m_1, well developed in m_2; entoconid moderately large in both teeth; third lower molar with crown surface about one-fourth as great as that of second.

Species examined.—*Vampyrops dorsalis* Thomas, *V. fumosus* Miller, *V. helleri* Peters, *V. lineatus* (Geoffroy), *V. recifinus* Thomas, *V. umbratus* Lyon, *V. vittatus* Peters, *V. zarhinus* H. Allen.

Genus VAMPYRODES Thomas.

1900. *Vampyrodes* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., V, p. 270. March, 1900 (subgenus of *Vampyrops*).

Type-species.—*Vampyrops caracciolæ* Thomas.

Geographic distribution.—Island of Trinidad.

Number of forms.—The type is the only species yet known.

Characters.—Similar to *Vampyrops*, but with only 2–2 upper molars, and these conspicuously differing from each other in form, owing to the reduction of the metacone in the second to a mere trace.

Species examined.—*Vampyrodes caracciolæ* (Thomas).

Remarks.—Although *Vampyrodes* was originally defined as a subgenus of *Vampyrops*, it seems quite worthy of recognition as a genus. The third upper molar in *Vampyrops* is a well-developed tooth, the presence or absence of which would cause, contrary to the condition in *Artibeus*, a distinct difference in the form of the maxillary at back of toothrow. A character of more importance is furnished by the suppression of the metacone in the second molar.

Genus VAMPYRESSA Thomas.

1900. *Vampyressa* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., V, p. 270, March, 1900 (subgenus of *Vampyrops*).

Type-species.—*Phyllostoma pusillum* Wagner.

Geographic distribution.—Brazil.

Number of forms.—The type is the only species thus far discovered.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ -};\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2}\ m\ \frac{2-2}{2-2}=28.$$

In general like *Vampyrops* but molars only $\frac{2-2}{2-2}$, their surface sculpture much more distinct; middle upper incisor faintly bifid; metacone of m^2 so reduced that the tooth is irregularly pyriform in outline, the narrower portion (paracone) outward; first lower molar without cusps on inner side, the general appearance of the tooth not very different from that of last premolar.

Species examined.—*Vampyressa pusilla* (Wagner).

Genus VAMPYRISCUS Thomas.

1900. *Vampyriscus* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., V, p. 270. March, 1900 (subgenus of *Vampyrops*).

Type-species.—*Chiroderma bidens* Dobson.

Geographic distribution.—Peruvian Amazon region.

Number of forms.—One, the type species.

Characters.—Like *Vampyressa*, but with lower incisors only 1 – 1, and surface sculpture on molars obsolete. Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1\ -\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{2-2}{2-2}=26.$$

Species examined.—*Vampyriscus bidens* (Dobson).

Remarks.—*Vampyriscus*, like *Vampyressa* and *Vampyrodes*, seems too distinct from *Vampyrops* to be united with it as a subgenus. This is the most divergent of the three, having lost two of its lower incisors, and agreeing with *Vampyressa* in the reduced number of molars and in the simplified structure of m^2 and m_1.

Genus CHIRODERMA Peters.

1860. *Chiroderma* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 747.

1866. *Mimetops* Gray, Proc. Zool. Soc. London, p. 117 (cited as MS. synonym of *Chiroderma*).

1878. *Chiroderma* Dobson, Catal. Chiropt. Brit. Mus., p. 531.

Type-species.—*Chiroderma villosum* Peters.

Geographic distribution.—Tropical America, north to Costa Rica.

Number of forms.—Four species of *Chiroderma* are now known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{2-2}{2-2}=28.$$

Teeth in general similar to those of *Vampyrops*, but inner upper incisors more slender and slightly less oblique; lower incisors not as closely crowded; anterior premolar both above and below smaller and not in contact with posterior premolar, each with diameter of crown decidedly less than that of its respective canine, that of lower jaw with crown area scarcely more than four times that of a lower incisor and with cusp reduced or obsolete; upper molars with the cusps, notably the protocone, the base of which in m^2 is nearly terete, much thickened, so as to encroach on crushing area of crown, the surface of which is marked by a few coarse wrinkles; outer cusps with cingula obsolete or absent; lower molars with outer cusps similarly thickened as compared with those of *Vampyrops*, this particularly the case with the hypoconid, which, in both teeth, is distinctly subterete; inner cusps of m_1 practically absent, the tooth thus differing notably from that of *Vampyrops*, those of m_2, however, thickened and well developed, a supplemental cusp, probably homologous with that sometimes present in *Artibeus*, between metaconid and entoconid, and nearly as large as the latter. Skull essentially like that of *Vampyrops* but with nasal bones apparently absent, their place occupied by an emargination extending back from nares to between orbits.[a]

[a] I have seen no skulls sufficiently immature to show whether the nasals are completely absent or not.

Mandible with angular process remarkably short and ill defined. In external characters not essentially different from *Vampyrops*.

Species examined.—*Chiroderma salvini* Dobson, *C. jesupi* J. A. Allen, *C. doriæ* Thomas, and *C. villosum* Peters.

Remarks.—Although not distantly related to *Vampyrops* this genus is readily distinguishable by the apparent absence of the nasals, the different tooth formula, the reduced condition of pm^3 and pm_3, and the peculiar thickening of the cusps of the molars.

Genus MESOPHYLLA Thomas.

1901. *Mesophylla* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., VIII, p. 143. August, 1901.

Type-species.—*Mesophylla macconelli* Thomas.

Geographic distribution.—British Guiana.

Number of forms.—Only the type species is known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{2-2}{3-3}=30.$$

Upper incisors small but strongly contrasted in size, separated from each other and from canines by distinct spaces, the inner pair converging terminally, their cutting edge entire. Lower incisors small, subequal, forming a continuous, nearly straight line between canines. Canines slender and very sharply pointed, the upper long at base and with well-developed cingulum, the lower with base somewhat produced backward. Upper premolars acutely pointed, with distinct cutting edges and well-developed concave inner surface. Lower premolars approximately like lower canine in form, though smaller, each with a single main anterior cusp and a distinct, flat, posterior heel; pm_3 in contact with canine; pm_4 spaced both anteriorly and posteriorly. First upper molar much smaller than second, its crown triangular in outline, with barely indicated protocone and high paracone. Second upper molar with the crown basin-shaped and nearly smooth, its single cusp, probably the paracone, well developed and situated antero-externally. First lower molar resembling last premolar, its crown mostly flat, but with a single high cusp anteriorly. Second lower molar rather longer than first, its outline narrowly oval with narrow end forward, its width scarcely greater than that of mandibular ramus. The surface is basin-shaped, smooth, and the edges bear two distinct cusps on inner side of tooth and one at middle of front. Last lower molar very small, showing no definite structure, its size about equal to that of a lower incisor. Skull much as in *Vampyrops*, but with relatively smaller rostrum narrowing more noticeably in front. Nasal region depressed. Basisphenoid pits shallow and ill defined. Ears and noseleaf showing no marked peculiarities. Tail absent. Calcar short but distinct. Interfemoral membrane moderately wide.

Species examined.—*Mesophylla macconnelli* Thomas.

Remarks.—As pointed out by Mr. Thomas, this genus is intermediate between *Vampyrops* and *Ectophylla*. It seems much nearer the latter, however, with which it forms a distinct group characterized by the basin-shaped m^2 and m_2 and the almost exact approximation in form of m_1 and pm_4. This last character is foreshadowed in *Vampyressa* and *Vampyriscus*.

Genus ECTOPHYLLA H. Allen.

1892. *Ectophylla* H. ALLEN, Proc. U. S. National Museum, XV, p. 441, October 26, 1892.

1898. *Ectophylla* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 267, pl. XVI.

Type-species.—*Ectophylla alba* H. Allen.

Geographic distribution.—Honduras and Nicaragua.

Number of forms.—The type species.

Characters.—In general not unlike *Mesophylla*, but lower molars only 2–2, and basin-shaped crown of m^2 and m_2 crossed by a distinct median longitudinal ridge. Upper incisors with terete-conical crowns, the inner pair approximating basally. Canines, premolars (except pm_4), and lower incisors as in *Mesophylla*. First upper molar differing from that of *Mesophylla* in presence of a distinct though low protocone. Second lower molar basin-shaped, the bottom of the concavity occupied by a conspicuous though simple longitudinal ridge. As in *Mesophylla*, the tooth has only one cusp, a rather high paracone. Last lower premolar and first lower molar approximately alike and closely resembling the corresponding teeth in *Mesophylla*, except that each has a distinct though low postero-external cusp. Second lower molar very conspicuously basin-shaped, broadly oval, much wider than ramus of jaw, its edge with two small but distinct cusps on anterior border and a low, indistinct postero-external elevation. As in the corresponding upper tooth, the bottom of the concavity is crossed by a distinct longitudinal ridge. This ridge is noticeably bicuspidate, or perhaps might be better described as formed by the coalescence of two cusps.[a] Otherwise essentially like *Mesophylla*.

Species examined.—*Ectophylla alba* H. Allen.

Remarks.—This genus is not distantly related to *Mesophylla*. In dental characters it is one of the most aberrant of the Stenodermինæ, though the skull is not specially modified, and externally it has the appearance of a small, whitish *Vampyrops*.

[a] The peculiar cuspidate character of this ridge is not well shown in Harrison Allen's figure of the dentition. (Trans. Amer. Philos. Soc., n. s., XIX, pl. XVI, fig. 3.)

Genus ARTIBEUS Leach.

1821. *Artibeus* LEACH, Trans. Linn. Soc. London, XIII, p. 75 (*jamaicensis*).
1821. *Madatæus* LEACH, Trans. Linn. Soc. London, XIII, p. 81 (*lewisii*=*jamaicensis*).
1827. *Medateus* GRAY, Griffith's Cuvier, Animal Kingdom, V, p. 74.
1838. *Arctibeus* GRAY, Mag. Zool. and Bot., II, p. 487.
1843. *Medateus* GRAY, List spec. mamm. Brit. Mus., p. xviii.
1847. *Arctibius* BONAPARTE, Proc. Zool. Soc. London, p. 115.
1855. *Pteroderma* GERVAIS, Expéd. du Comte de Castelnau, Zool., Mammif., p. 34 ("*perspicillatum*" from Peru, Brazil, and Guiana).
1855. *Artibæus* GERVAIS, Expéd. du Castelnau, Zool., Mammif., p. 34.
1855. *Dermanura* GERVAIS, Expéd. du Comte de Castelnau, Zool., Mammif. p. 36 (*cinereum*).
1878. *Artibeus* DOBSON, Catal. Chiropt. Brit. Mus., p. 514.
1878. *Uroderma* DOBSON, Catal. Chiropt. Brit. Mus., p. 515 (subgenus, part).
1878. *Dermanura* DOBSON, Catal. Chiropt. Brit. Mus., p. 515 (subgenus).
1889. *Dermanura* COPE, Amer. Nat., XXIII, p. 130, February, 1889 (genus).
1892. *Artobius* WINGE, Jordfundne og Nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 10.

Type-species.—*Artibeus jamaicensis* Leach.

Geographic distribution.—Warmer parts of America, north to Cuba, southern Florida, and central Mexico.

Number of forms.—About 15 forms of *Artibeus* are now known.

Characters.—Dental formula (Plate V):

$$\frac{-\,2\,3.\,1.\,-\,-\,3\,4\,5\,6\,(7)}{1\,2\,-.\,1.\,-\,2\,-.\,4\,5\,6\,(7)}\; i\,\frac{2-2}{2-2},\; c\,\frac{1-1}{1-1},\; pm\,\frac{2-2}{2-2},\; m\,\frac{2-2}{2-2},\; \frac{2-2}{3-3},\ \text{or}\ \frac{3-3}{3-3}=$$
28, 30, or 32.

Upper incisors small, closely crowded, completely filling space between canines, the inner with a distinctly bilobed cutting edge, the outer simple, hardly extending beyond base of crown of inner, but about equal to it in length, the cutting edge entire, oblique. Lower incisors smaller than upper, closely crowded between canines, the crowns broader than long, with slightly bilobed cutting edge. Canines stout, simple, with distinct cingulum but no secondary cusps. Upper premolars with large triangular outer cusp and broad flattish or concave inner surface directed backward and slightly inward; styles slightly developed, but the posterior usually forming a noticeable cusp; second premolar with distinct though sometimes low inner basal cusp. Lower premolars not unlike the upper but broader relatively to their length and without the evident concave inner surface; the second often closely resembling the canine, especially in the smaller species. First upper molar with crown noticeably broader than long, much longer externally than internally, most of its surface occupied by a shallow-concave crushing area, the enamel of which is noticeably wrinkled; protocone and hypocone well developed and nearly equal in size, the widening and shortening of the crown displacing the latter cusp, so that both appear to be on anterior side of tooth, the hypocone suggesting a protocone and the protocone an enormously enlarged protoconule. Paracone and metacone well developed, forming, with their commissure, the trenchant outer edge of tooth. Outer cingulum obsolete in m^1, well developed in m^2. Inner cingulum distinct in both and extending to tip of paracone. Second upper molar slightly more than half as large as first, its greatest length at middle instead of along outer edge, the cusps all much reduced, particularly the metacone and hypocone, the latter being shelf-like in form and sometimes practically absent. Third upper molar reduced to the vanishing point, absent in some species and present in others as a rounded flattish remnant smaller than metacone of m^2, close beneath which cusp it is situated. This tooth is so small that its presence or absence has no effect on the form of the maxillary at back of tooth row. First and second lower molars alike in general structure, but first is the larger, and its greatest width is at middle or posteriorly, while that of the second is in front. The Stenodermine type of tooth is here seen in its most perfect development, though *Centurio* presents a more extreme phase. The crushing surface is large, finely and closely wrinkled, and slightly encroached upon by the cusps. Protoconid low, but long and well developed, without cutting ridge on inner side. Hypoconid distinct though low in m_1; obsolete or flat in m_2. Metaconid high, narrow, and subterete, connected with cingulum in m_2, the cingulum passing its base in m_1. Entoconid low but distinct, subterete. Between metaconid and entoconid the cingulum occasionally rises to a distinct trenchant cusp. Third lower molar absent or present. When present slightly larger than m^3 and with a small antero-internal cusp, probably the protoconid, but area of crown not or scarcely greater than that of metaconid of the other molars. Skull with moderately wide, slightly elevated brain case, wide-spreading zygomata and rather short, low rostrum. Length of rostrum slightly more than half that of brain case and about equal to lachrymal breadth; depth through lachrymal region less than half lachrymal breadth. Palate moderately wide, the distance between the second upper premolars about equal to that from incisor to hypocone of first molar. Ears separate. Noseleaf well developed. No external tail. Interfemoral membrane narrow. Calcar short but distinct.

Species examined.—*Artibeus coryi* (J. A. Allen), *A. glaucus* Thomas, *A. intermedius* J. A. Allen, *A. jamaicensis* Leach, *A. lituratus* Lichtenstein, *A. palmarum* Allen and Chapman, *A. parvipes* Rehn, *A. phæotis* (Miller), *A. planirostris* Peters, *A. quadrivittatus*

Peters, *A. ravus* (Miller), *A. rosenbergi* Thomas, *A. toltecus* Saussure, *A. watsoni* Thomas.

Remarks.—According to the presence or absence of the vanishing last molars, the species may be arranged as follows: Molars $\frac{3}{3}$, *planirostris;* molars $\frac{2}{3}$, *coryi*, *glaucus*, *intermedius*, *jamaicensis*, *lituratus*, *palmarum*, *parvipes*, *rosenbergi*, *watsoni;* molars $\frac{2}{2}$, *cinereus*, *phæotis*, *quadrivittatus*, *ravus*, *toltecus*. The species of the first group has been associated with the very different *Uroderma bilobatum*, those of the second are *Artibeus* in a restricted sense, while those of the third have been called *Dermanura*, either as a subgenus of *Artibeus* or as a distinct genus. After examining practically all the known species, I can see no good reason for subdividing the genus *Artibeus* further than by removing *Uroderma* and *Enchisthenes*. There appear to be no other characters correlated with the different tooth formulas; and the presence or absence of these terminal teeth, when reduced to the vanishing point and entailing no change in the form of the surrounding bone, is of little importance.

Genus ENCHISTHENES Andersen.

1906. *Enchisthenes* ANDERSEN, Ann. and Mag. Nat. Hist., 7th ser., XVIII, p. 420. December, 1906.

Type-species.—*Artibeus harti* Thomas.

Geographic distribution.—Island of Trinidad, West Indies.

Number of forms.—The type is the only species known.

Characters.—Similar to *Artibeus*, but inner upper incisor not bifid. and third molar both above and below well developed and effecting the form of the surrounding bone.

Species examined.—*Enchisthenes harti* (Thomas).

Remarks.—This genus is well differentiated from *Artibeus* by the simple form of the inner upper incisor and the large size of the posterior molar in both upper and lower jaws. The only species at present known is further distinguished from the members of the genus *Artibeus* by the presence in the tragus of "a pointed upwardly directed projection on the inner margin near the tip."

Genus ARDOPS Miller.

1891. *Stenoderma* THOMAS, Ann. and Mag. Nat. Hist., 6th ser., VII, p. 529. June, 1891 (part).

1898. *Stenoderma* TROUESSART, Catalogus mammalium, p. 162 (subgenus, part).

1906. *Ardops* MILLER, Proc. Biol. Soc. Washington, XIX, p. 84, June 4, 1906.

Type-species.—*Stenoderma nichollsi* Thomas.

Geographic distribution.—Lesser Antilles.

Number of forms.—Three species are known, *Ardrops nichollsi* (Thomas), *A. montserratensis* (Thomas), and *A. luciæ* (Miller).

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisors proportioned about as in *Artibeus* and forming a straight line between canines, the outer rising barely to level of cingulum of canine, its crown broader than long, deeply grooved on anterior face, its cutting edge entire and with faintly indicated cusp, but scarcely oblique, the inner about twice as high as outer, but with its length nearly equal to its height, its posterior surface concave, its cutting edge rising to a blunt main cusp on inner side and sometimes showing a rudimentary second cusp on outer side. Lower incisors subequal, smaller than upper, the crowns projecting conspicuously forward beyond roots, the anterior surface oblique, higher than wide, deeply grooved, the groove passing through cutting edge and short posterior surface. Canines stout, scarcely higher than large premolars (pm^4 and pm_4), the lower with well developed postero-external talon, this slightly indicated in upper. Anterior upper premolar (pm^3) essentially like canine, but not as high, and with better developed postero-external cingulum cusp. Posterior upper premolar (pm^4) about as high as canine, but with longer base and with a conspicuous, deep, postero-internal concavity for reception of protoconid of first lower molar; posterior cutting edge with large secondary cusp near middle in addition to the basal talon. Anterior lower premolar (pm_2) essentially like anterior upper premolar. Posterior lower premolar (pm_4) more nearly resembling lower canine and with similar large postero-external talon, but the length of crown greater in proportion to the height, and the shaft thicker basally. Upper molars as in *Artibeus* except that hypocone of m^2 is relatively larger and more distinct from protocone, which it nearly equals in height; m^3 about as large as metacone of m^2, its surface concave, with a minute inner cusp and two outer cusps, one of the latter situated distinctly inward from the cingulum. A distinct though small median cusp on outer side of m^2 is possibly a rudimentary mesostyle; outer cingulum obsolete, but inner unusually well developed, that of m^1 passing around anterior base of paracone. First lower molar differing noticeably from that of *Artibeus* in the relatively much larger and higher protoconid, the inner side of which is provided with a high ridge which obliterates metaconid and extends backward to beyond middle of crown; entoconid high and distinct, relatively much larger than in *Artibeus*. Second lower molar more nearly resembling that of *Artibeus*, but with the protoconid, metaconid, and entoconid high and styliform; hypoconid obselete, represented by a slight elevation in the ridge at edge of crown. Third lower molar slightly larger than m^3, its crown with two distinct styliform cusps (probably the protoconid and metaconid) near anterior edge and a cusp-like posterior elevation of cingulum. Skull essentially like that of *Artibeus* in general appearance, but somewhat broader in proportion to its length. Rostrum flattish above, the slightly arched nasals forming a longitudinal median ridge which rises slightly above level of thickened, rounded, supraorbital ridges. Near middle each supraorbital ridge forms a distinct, slightly angular swelling at point where it bends abruptly to pass obliquely across forehead to join sagittal crest. Nares opening forward and slightly upward, extending less than halfway from front of premaxillaries to anterior termination of sagittal crest. Interpterygoid space continued forward to level of first molar as a nearly parallel-sided palatal emargination. No appreciable space between incisive foramina and roots of incisors. Postglenoid process unusually well developed, its height noticeably greater than longitudinal width of glenoid surface. Externally as in *Artibeus*, but arching of second finger more conspicuous.

Species examined.—The three at present recognized.

Remarks.—Though externally so much like *Artibeus* that there are apparently no characters by which they may be positively distinguished, the members of the small group of genera, of which *Ardops* may be regarded as the best example, are at once recognizable by the deep emargination of the palate and the great development of the postglenoid process. It agrees with *Phyllops* and *Ariteus* and differs from *Stenoderma* in the unmodified form of the rostrum and the close approximation of the incisive foramina to the roots of the incisors, but is distinguishable from the first by the low, usually bicuspid inner upper incisor, and narrow, parallel-sided palatal emargination, from the second by the presence of a third upper molar, and from both by the complete absence of the metaconid in the first lower molar.

Genus PHYLLOPS Peters.

1865. *Phyllops* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 356.

1878. *Phyllops* DOBSON, Catal. Chiropt. Brit. Mus., p. 527 (subgenus of *Stenoderma*).

Type-species.—*Phyllostoma albomaculatum* Gundlach=*Arctibeus falcatus* Gray.

Geographic distribution.—Cuba.

Number of forms.—The type is the only species yet discovered.

Character.—Like *Ardops*, but inner upper incisor with crown higher than long, and without distinct secondary cusp, first and second upper molars with hypocone much lower than protocone, first lower molar with well-developed metaconid connected with ridge on inner side of protoconid, and palatal emargination with sides strongly converging, in continuation of the divergent pterygoids.

Species examined.—*Phyllops falcatus* (Gray).

Remarks.—This genus is well differentiated from *Ardops* by the structure of the first lower molar and the form of the palate.

Genus ARITEUS Gray.

1837. *Ariteus* GRAY, Mag. Zool. and Bot., II, p. 491, December, 1837 (*flavescens=achradophilus*).

1876. *Peltorhinus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 433 (*achradophilus*).

1878. *Peltorhinus* DOBSON, Catal. Chiropt. Brit. Mus., p. 527 (subgenus of *Stenoderma*).

Type-species.—*Ariteus flavescens* Gray = *Artibeus achradophilus* Gosse.

Geographic distribution.—Jamaica.

Number of forms.—The type species is the only form known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{2-2}{3-3}=30.$$

Like *Ardops*, but without the small upper molar; first lower molar with minute though evident metaconid.

Species examined.—*Ariteus achradophilus* (Gosse).

Remarks.—The presence of the metaconid in m_1 and the absence of m^3 distinguish *Ariteus* from *Ardops*. Not only is the last upper molar absent, but the maxillary is too narrow behind m^2 for the small tooth to occur.

Genus STENODERMA Geoffroy.

1813. *Stenoderma* GEOFFROY, Descr. de l'Égypte, II, p. 114 (*rufum*).

1855. *Artibæus* GERVAIS, Expéd. du Comte de Castelnau, Zool. Mamm., p. 34. (part, *undatus=rufus*).

1869. *Histiops* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 433 (*undatus=rufus*).

1876. *Stenoderma* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 430, pl. I, figs. 1–6 (*rufum*).

1878. *Stenoderma* DOBSON, Catal. Chiropt. Brit. Mus., p. 526 (part, *rufum*).

Type-species.—*Stenoderma rufum* Geoffroy.

Geographic distribution.—Unknown.

Number of forms.—The type is the only known species.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

In general like *Ardops*, but skull with nasal region much depressed between high supraorbital ridges; anterior nares directed chiefly upward and extending fully halfway from front of premaxillaries to point of juncture of supraorbital ridges which are not angulated at middle, but extend in a nearly straight line from front of orbit to sagittal crest; incisive foramina separated from roots of incisors by space equal to their greatest diameter; inner upper incisor with high slender crown, as in *Phyllops;* first and second upper molars with low but distinct metaconule on surface of crown between hypocone and metacone.

Species examined.—This genus is known from the published descriptions and figures only, as a second specimen has not been taken and the type is now lost. The details in Wagner's lithograph of the skull published by Peters are so complete as to leave no doubt that the animal represents a peculiar genus, characterized particularly by the form of the rostrum and the presence of the well-developed metaconule in the first and second upper molars. These peculiarities make it the most aberrant member of the restricted Stenodermine group.

Genus PYGODERMA Peters.

1863. *Pygoderma* PETERS, Monatsber. k. preuss. Akad. Wissensch, Berlin, p. 83 (subgenus of *Stenoderma*).
1865. *Pygoderma* PETERS, Monastber. k. preuss. Akad. Wissensch., Berlin, p. 357 (genus).
1878. *Pygoderma* DOBSON, Catal. Chiropt. Brit. Mus., p. 536 (genus).

Type-species.—*Stenoderma microdon* Peters.

Geographic distribution.—Warmer parts of America north to southern Mexico.

Number of forms.—Two species of *Pygoderma* are known—the type, and the better known, *P. bilabiatum* Wagner.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{2-2}{2-2}=28.$$

Upper incisors very unequal, forming a continuous row between canines; the inner large, nearly half as high as canine, conical, slightly higher than long, in contact basally, their tips wide apart, a faintly suggested secondary cusp near middle of outer side; the outer minute, nearly flat-crowned, barely extending to cingulum of canine. Lower incisors very small, closely crowded in a straight line between canines, their subequal crowns deeply grooved transversely to the tooth row. Canines low, stout, with prominent cutting edges and wide postero-internal heel, which, in mandibular tooth bears a distinct secondary cusp; in both mandibular and maxillary tooth the cingulum is moderately developed, forming a minute posterior cusp.

Premolars both above and below strongly resembling each other and canines, from which they differ chiefly in more reduced height and greater triangularity of outline of main cusp. Each has a large trenchant outer cusp and the two upper teeth a distinct inner cusp high and well developed in *pm* [4], low and obsolete in *pm* [3]. The lower premolars lack inner cusps, but the concave inner surface of the tooth is divided by a ridge extending from inner margin of tooth nearly to extremity of main cusp and strongly angled near middle. There is no indication of such a ridge in the upper premolars except a faint trace near summit of main cusp in *pm* [4], and the inner concave surface is very well developed, slightly roughened posteriorly in *pm* [4]. First upper molar not strikingly different from last premolar in form, but longer, less concave, and the main cusp (paracone) not as high. On its inner side are the low protocone and hypocone, occupying about the same relative position as in the second molar of *Artibeus*. From paracone a low, trenchant commissure extends along outer edge of tooth, near the posterior extremity of which is the rudimentary metacone. Outer and inner cingula very slight and irregular. Crushing surface concave, closely and finely wrinkled. Second upper molar with barely one-fourth area of first, but with the three main cusps indicated, and a small, wrinkled, concave median surface. First lower molar of the usual Stenodermine type, the outer cusps low, or rather joined by a high commissure, the two inner cusps well developed and in the normal position. A high, distinct ridge extends along anterior border of crown. Second lower molar less than half the size of first, its outer cusps obsolete, its two inner cusps relatively large. Skull (fig. 23) remarkable for its very deep, cuboidal rostrum, short, roundish palate (the inner line of the toothrows forms almost a circle except where broken posteriorly), and for the structure of the interpterygoid region. The pterygoids are rather short and moderately divergent posteriorly, with short straight hamular processes, but below and behind each hamular (when skull is viewed from below) extends a plate conspicuously concave on inner side and

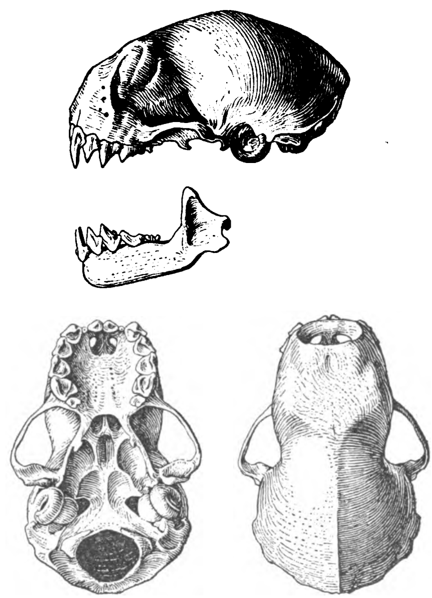

FIG. 23.—PYGODERMA BILABIATUM. SAPUCAY, PARAGUAY. No. 105685. × 1½.

uniting the pterygoids with inner edge of glenoid fossæ. Between these plates and the audital bullæ the median surface of the skull is occupied by a noticeable depression about as large as palate and divided by cross ridges into five secondary depressions, the two posterior of which represent the basisphenoid pits. Palatal branches of premaxillaries and the two rather large palatal foramina (each of which is encroached on by a posterior median spine) raised above level of palate, at the front of which is a secondary foramen, transversely elliptical in outline, extending from incisors to level of middle of anterior premolars. Audital bullæ small but rather high and narrow, covering less than half surface of cochleæ, their greatest diameter much less than distance between cochleæ. Ear and noseleaf moderately large, essentially as in *Artibeus*. Second finger strongly bowed outward, about two-thirds as long as metacarpal of third. No external tail. Calcar and interfemoral membrane moderately developed.

Species examined.—*Pygoderma bilabiatum* Wagner and *P. microdon* Peters.

Remarks.—The members of this genus are at once recognizable by the remarkably shortened and deepened cuboidal rostrum, a character not closely approached by any other known bats. Aside from the form of the rostrum, the skull is not unlike that of *Centurio*, *Sphæronycteris*, and *Ametrida*, with which it agrees in the strongly diverging hamulars, and the widening of the floor of the braincase between palate and audital bullæ, a peculiarity the first stages of which are seen in *Phyllops* and to a less degree in *Ardops*, *Ariteus*, and *Stenoderma*. The teeth also show a general resemblance to those of *Centurio* and its allies, though the distortion of the tooth rows as a whole is in the opposite direction. Externally the animals more closely resemble the true Stenodermine genera.

Genus CENTURIO Gray.

1842. *Centurio* GRAY, Ann, and Mag. Nat. Hist., X, p. 259.
1861. *Trichocoryes* H. ALLEN, Proc. Acad. Nat. Sci. Philadelphia, p. 359. Subgenus of *Centurio* (*mcmurtrii*=adult male *senex*).
1866. *Trichocorytes* GRAY, Proc. Zool. Soc. London, p. 118 (genus).
1878. *Centurio* DOBSON, Catal. Chiropt. Brit. Mus., p. 542.
1897. *Trichocoryctes* TROUESSART, Catalogus Mammalium, p. 164.
1901. *Centurio* REHN, Proc. Acad. Nat. Sci. Philadelphia, p. 297, June 8. 1901.

Type-species.—*Centurio senex* Gray.

Geographic distribution.—Central America and southern Mexico. The supposed Cuban record is erroneous.[a]

Number of forms.—Only one species is now recognized.

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[a] See Alston, Biol. Cent.-Amer. Mamm., 1879, p. 51

Characters.—Dental formula:

$$\frac{-\ 2\ 3.}{1\ 2\ -.}\frac{1.\ -\ -\ 3\ 4\ 5\ 6\ -}{1.\ -\ 2\ -\ 4\ 5\ 6\ -}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{2-2}{2-2}=28.$$

Upper incisors small, subequal, forming a discontinuous, nearly straight row between canines. Inner tooth larger than outer, its crown narrow, longer than high, the cutting edge rising to a point at middle and slightly emarginate on each side, the emarginations sometimes deep enough to make the crown appear tricuspid. Outer incisor with indistinct cusp at outer edge. Lower incisors equal, low, closely crowded in straight line between canines, their crowns transversely grooved. Upper canines flattened antero-posteriorly, the anterior surface concave just above base, the tip distinctly bent backward; posterior surface convex below, concave above; cutting edges well developed. Lower canines similar, but smaller, the front surface slightly and evenly convex from base to tip, the posterior surface concave. Premolars not very different from lower canines, the mandibular teeth almost exactly similar, except that their bases are longer and their shafts not as high. Posterior upper premolar with distinct though small supplemental cusp on posterior cutting edge, and with concave surface of crown noticeably roughened. Molars, both upper and lower, of the ordinary Stenodermine type, but with its peculiarities carried to the extreme; m^1 almost twice as broad as long; hypocone, protocone, and paracone directly in line with each other and nearly equidistant, all well developed; metacone long and low, a small supplemental cusp between paracone and metacone; outer cingulum obsolete, the inner well developed and extending to point of paracone; m^2 more than half as large as m^1, the four normal cusps present, but the two outer very short, almost terete, and the metacone considerably displaced inward by the abrupt rounding off of postero-external angle of crown. Crushing surfaces of both teeth finely and closely wrinkled. Lower molars not specially modified, each with the usual two inner and two outer cusps and a flattish, very wide, finely corrugated crushing surface. Anterior molar broadest posteriorly, posterior broadest anteriorly; m_2 with about two-thirds the crown area of m_1 (Plate VI, fig. 2). Skull with high, rounded, narrow braincase, and practically no rostrum, the nares being at level of anterior zygomatic root and opening directly above incisors. Sagittal crest distinct, extending over entire brain case. Palate very wide and short, its length only about half its width. Posteriorly it is angular-emarginate by forward extension of interpterygoid space. Pterygoids simple, rather strongly diverging posteriorly, with distinct, outward-curved hamular processes. Between pterygoids and audital bullæ lies a broad, flat space, traversed by a median longitudinal ridge.

Audital bullæ very small, covering much less than half surface of cochleæ. Rami of lower jaw strongly diverging, their spread posteriorly much greater than the length of each ramus. Ear with conspicuous inner lappet. No true noseleaf, but entire face and throat a complicated mass of naked dermal outgrowths. Second finger moderately bowed outward, about as long as metacarpal of third. Calcar well developed. No external tail. Interfemoral membrane moderately wide.

Species examined.—*Centurio senex* Gray.

Remarks.—Externally this genus is recognizable by the very short, broad face, completely covered with wrinkled dermal outgrowths. The skull is distinguished from that of the other short-snouted Stenodermines by the position of the external nares directly over the roots of the incisors. I can see no reason to make *Centurio* the type of a distinct subfamily. It is very closely related to *Sphæronycteris* and *Ametrida*, and in many ways is connected with the typical Stenodermines by such genera as *Pygoderma* and *Phyllops*. In spite of the great shortening of the rostrum and consequent distorting of the upper canines, the general type of the dentition is not very different from that of *Artibeus*.

Genus SPHÆRONYCTERIS Peters.

1882. *Sphæronycteris* PETERS, Sitzungsber. k. preuss. Akad. Wissensch., Berlin, p. 988.

Type-species.—*Sphæronycteris toxophyllum* Peters.

Geographic distribution.—Tropical South America (Peru and Venezuela).

Number of forms.—Only the type species is known.

Characters.—In general like *Centurio;* face hairy; muzzle with a thickened ridge-like outgrowth, best developed in males; skull with rostrum even more shortened than in the related genus, the nares so retracted between orbits that they are separated from incisors by a horizontal area the width of which is nearly equal to distance between canines; anterior edge of orbit produced into a conspicuous, thin plate; palate not twice as wide as long; zygoma noticeably expanded and bent upward at middle; upper incisors very unequal, the inner fully one-third as long as canine, conical, convex in front, concave behind; the outer minute, flat-crowned, closely crowded between first and canine; upper canine not concave at base; a minute, quadrate third lower molar. Structure of teeth in general quite as in *Centurio*, though the molars are less extreme in the development of the Stenodermine peculiarities.

Species examined.—*Sphæronycteris toxophyllum* Peters.

Remarks.—This genus is closely related to *Centurio*, and it is almost impossible to decide which of the two is the more highly specialized. In the reduction of the rostrum *Sphæronycteris* has certainly proceeded further; this is also true of the plate-like development of the anterior edge of orbits and of the widening and upward bending of the zygomata. On the other hand the persistence of the third lower molar is a more primitive character, the form of the upper canine and of the palate is less aberrant, and the development of the dermal outgrowths on face is much less extreme.

Genus AMETRIDA Gray.

1847. *Ametrida* GRAY, Proc. Zool. Soc. London, p. 15.
1878. *Ametrida*, DOBSON, Catal. Chiropt. Brit. Mus., p. 530.

Type-species.—Ametrida centurio Gray.

Geographic distribution.—Tropical South America.

Number of forms.—Two species are now known.

Characters.—Differs from *Sphæronycteris* in the presence of a small but normally formed noseleaf, in the still greater shortening of the rostrum, so that flat space in front of nares is wider than distance between canines, in the retraction of the anterior wall of orbit until orbital space is wider than long, in the presence of a mere bead along anterior rim of orbit, and in the practical absence of any interpterygoid space, the pterygoids being directed almost perpendicularly outward and the choanæ opening between them as a rounded vertical aperture facing backward. Teeth essentially as in *Sphæronycteris*, but upper incisors smaller and inner cusps of upper molars better developed, though in the same position. Minute third lower molar present as in *Sphæronycteris*.

Species examined.—Ametrida centurio Gray and *A. minor* H. Allen.

Remarks.—Of the three related genera, *Ametrida*, *Sphæronycteris*, and *Centurio*, the first is externally the least modified, retaining as it does its practically normal noseleaf. In dental characters it agrees with *Sphæronycteris*, which is in this respect less aberrant than *Centurio*. Its skull, however, is the most peculiar of the three, showing the greatest extreme of rostral shortening, and in addition having a structure of the choanæ that is unique among bats.

Subfamily PHYLLONYCTERINÆ.

1865. *Glossophagæ* (part) PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 257.
1875. *Glossophagæ* (part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350, November, 1875.
1878. *Glossophagæ* (part) DOBSON, Catal. Chiropt. Brit. Mus., p. 497.
1886. *Glossophaginæ* (part) GILL, Standard Natural History, V, p. 173.
1891. *Phyllostomatinæ* (part; Glossophagine division, part) FLOWER and LYDEKKER, Mammals, living and extinct, p. 672.
1892. *Glossophagæ* (part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.
1898. *Brachyphyllina* (part) H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 258.

Geographic distribution.—Bahama Islands and Greater Antilles.

Characters.—Teeth highly abnormal. Upper molars with low, indistinct paracone and metacone at extreme outer edge of crown. Protocone low or obsolete, situated at extreme inner margin. Intermediate region occupied by a wide, shallow groove, angled at middle. Lower molars very long and narrow, their cusps too indistinct to be positively identified; m_1, and usually m_2 and m_3 also, with distinct median longitudinal groove, their structure almost exactly similar to that in the Kiodotinæ. Noseleaf small or rudimentary. Rostrum and tongue elongated, the tongue armed with lengthened, bristle-like papillæ.

History.—Since the genus *Phyllonycteris* was discovered this group has not been distinguished from the Glossophaginæ except by Harrison Allen. He associated it with *Brachyphylla* to form a section, Brachyphyllina or "Glossophagina aberrantia," of the Glossophaginæ. That it should be separated from the Glossophagine bats there can be no doubt, but of its near relationship to *Brachyphylla* I can detect no indication. The Phyllonycterinæ may be an offshoot from some Hemidermine stock, as the teeth in one genus show such a resemblance to those of *Rhinophylla* that it may perhaps indicate more than a fortuitous likeness.

Principal subdivisions.—Three genera are represented among the species of Phyllonycterinæ thus far known.

KEY TO THE GENERA PHYLLONYCTERINÆ.

Base of brain case between pterygoids with deep, conspicuous, longitudinal groove .... *Reithronycteris*, p. 174.

Base of brain case between pterygoids flat with slightly developed median longitudinal ridge.

Second and third lower molars without cusps; calcar absent; interfemoral membrane extending to middle of tibia only. *Phyllonycteris*, p. 172.

Second and third lower molars with two low but distinct cusps each; calcar present; interfemoral membrane extending to calcar. *Erophylla*, p. 175.

Genus PHYLLONYCTERIS Gundlach.

1865. *Phyllonycteris* GUNDLACH, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 817 (part).

1878. *Phyllonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 501 (part).

Type-species.—*Phyllonycteris poeyi* Gundlach.

Geographic distribution.—Cuba.

Number of forms.—The type species only.

Characters.—Dental formula (Plates III, IV, fig. 4):

$$\frac{-\,2\,3.\,1.\,-\,-\,3\,4\,5\,6\,7}{1\,2\,-.\,1.\,-\,2\,-\,4\,5\,6\,7}\ i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisors small, in a slightly convex, continuous row, the outer separated from canine by space equal to length of cutting edge of i^1. Inner incisor fully double the bulk of outer, though the two when viewed from in front do not differ materially in form, their crowns being low, longer than high, with nearly horizontal cutting edge. Outer incisor wider relatively to its length than inner. Mandibular incisors very small, with low, flat, rounded crowns, the outer not as small as inner. They extend between canines in a slightly convex row broken by minute spaces, of which the median is the most distinct. Canines simple, without secondary cusps, the upper somewhat less than half as long as high, with well-developed cutting edges but with concave area on inner surface shallow. Lower canine slender, the shaft nearly terete, the posterior basal edge produced into a distinct heel. First upper premolar small, scarcely equal to inner incisor, its crown very low, longer than broad, with indistinct cutting edge rising to a slight angle anteriorly. Upper molars longer than broad; protocone low and broad, forming the entire shelf-like, broadly rounded inner edge of tooth; paracone and metacone low and long, about equal in m^1 and m^2, the metacone much smaller in m^3; between paracone and metacone a distinct though very small elevation, probably the remnant of the mesostyle; inner half of crown flat, outer half rising at a distinct angle; m^2 slightly smaller than m^1; m^3 more than half as large as m^2 slightly smaller than m^1; m^3 more than half as large as m^2. Lower molars long and narrow, the second somewhat more than half as long as first, the third about half as large as second. Crown of m^2 and m^3 flat, the central portion distinctly concave, the margin without cusps; m^1 with a similar concavity occupying posterior two-thirds of crown, the anterior third rising into a low cusp. This tooth is almost exactly similar to the posterior premolar except that it is nearly twice as long. Skull (fig. 24) essentially as in the less modified Glossophaginæ, but rostrum deeper; zygomatic arches incomplete. Base of brain case flat, showing no special peculiarities, the region between pterygoids with low median ridge. Basisphenoid pits barely indicated. Audital bullæ rather large, covering more than half surface of cochleæ. Ears moderately large, separate. Noseleaf rudimentary, the erect portion represented by a mere bluntly angular projection. Tongue long and extensible, armed with incurved papil-

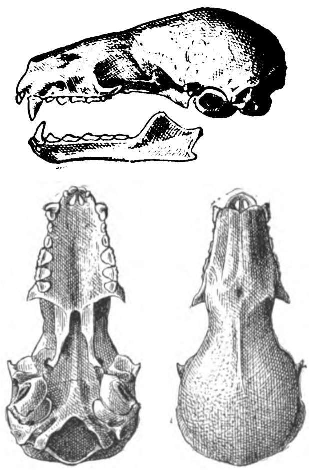

FIG. 24.—PHYLLONYCTERIS POEYI. ADULT FEMALE. GUANAJAY, CUBA. NO. 103585. ×1½.

læ at tip. Lower lip conspicuously divided in front. Calcar absent. Interfemoral membrane very narrow, extending to middle of tibia. Tail about half as long as femur, included to middle in interfemoral membrane.

Species examined.—*Phyllonycteris poeyi* Gundlach.

Remarks.—Superficially this genus might be mistaken for a member of the Glossophaginæ, but it is readily distinguishable by the absence of the calcar and by the narrow interfemoral membrane which does not extend below middle of tibia. The structure of its teeth is strikingly peculiar as compared with that in any of the Glossophagine bats.

Genus REITHRONYCTERIS Miller.

1898. *Reithronycteris* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 333, July 12, 1898.

1904. *Rhithronycteris* ELLIOT, Land and Sea Mammals of Middle America and the West Indies, p. 687.

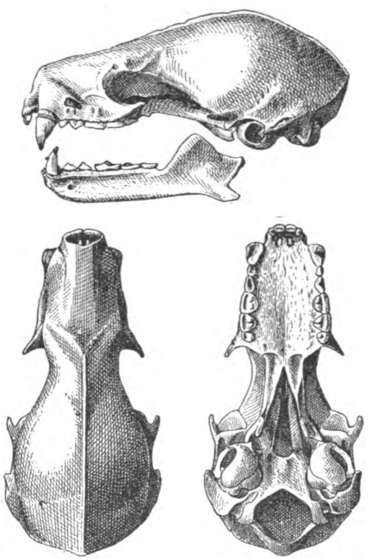

FIG. 25.—REITHRONYCTERIS APHYLLA. ADULT MALE. TYPE, NO. 9, MUSEUM, INSTITUTE OF JAMAICA. ×1⅗.

Type-species.—*Reithronycteris aphylla* Miller.

Geographic distribution.—Jamaica.

Number of forms.—Only the type species is thus far known.

Characters.—Similar to *Phyllonycteris*, but floor of brain case elevated out of its usual position, so that roof of posterior nares is formed by two longitudinal folds given off probably by the pterygoids and nearly meeting in median line in region usually occupied by basisphenoid and presphenoid.

Species examined.—*Reithronycteris aphylla* Miller.

Remarks.—Through the kindness of the authorities of the Jamaica Institute I have been enabled to reexamine the type of *Reithronycteris aphylla*, the only specimen by which the genus and species is known. I can therefore correct two inaccuracies in the original account: The tail is, like that of *Phyllonycteris*, only half as long as the femur, and the teeth do not in the least resemble those of *Brachyphylla*. The teeth, though slightly injured by decalcification, are evidently similar to those of *Phyllonycteris poeyi*, an animal with which I was not acquainted in 1898. The following differences may be noted: There is less contrast in both diameter and height of the upper incisors, the four teeth stand in an almost straight row, and the crown of the inner tooth is longer in proportion to its height, less oblique on cutting edge, and less concave posteriorly; the second upper molar is narrower on lingual side; the lower incisors are slightly smaller and more widely spaced, and the lower premolars are broader in proportion to their length. Skull (fig. 25) with rostral portion relatvely broader than in *Phyllonycteris poeyi*, and palate wider anteriorly. Between *Reithronycteris* and *Phyllonycteris* there appears to be no tangible difference in the tongue, though both are readily distinguishable by this character from *Erophylla.*

Genus EROPHYLLA Miller.

1864. *Phyllonycteris* GUNDLACH, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 817 (part).

1878. *Phyllonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 501 (part).

1898. *Phyllonycteris* H. ALLEN, Trans. Amer. Philos. Soc., n. s., XIX, p. 261 (part).

1906. *Erophylla* MILLER, Proc. Biol. Soc Washington, XIX, p. 84, June 4, 1906.

Type-species.—*Phyllonycteris bombifrons* Miller.

Geographic distribution.—Bahama Islands and Greater Antilles.

Number of forms.—Four species of *Erophylla* have been described: *E. bombifrons* (Miller), *E. planifrons* (Miller), *E. santacristobalensis* (Elliot), and *E. sezekorni* (Gundlach).

Characters.—Like *Phyllonycteris*, but calcar distinct, though short, interfemoral membrane extending to calcar, noseleaf with upright portion represented by an evident, pointed, median projection; skull with zygomatic arches complete, and lower molars all distinctly cuspidate and with noticeable cutting edge. Incisors, canines, and lower premolars essentially as in *Phyllonycteris*, except that pm^4 is relatively larger and much more noticeably concave on inner surface. Upper molars (Plate IX, fig. 2) differing from those of *Phyllonycteris* in the greater height and more trenchant character of the outer main cusps and the more distinct concavity of the crowns. In m^1 and m^2 there is no trace of the rudimentary mesostyle. First lower molar with a low, but distinct, posterior cusp, and an outer slightly trenchant ridge high enough to cause the concave surface to be directed somewhat inward. Second and third lower molars like first, but considerably shorter, the anterior and posterior cusp relatively more developed and their cutting edge near middle of crown instead of at outer border.

Species examined.—I have examined all the known species.

Remarks.—This genus is well differentiated from *Phyllonycteris* by the structure of its calcar and interfemoral membrane and by its distinctly cuspidate second and third lower molar. The species are also distinguishable from *Phyllonycteris poeyi* by the sharply pointed upper edge of noseleaf. *Erophylla* is less highly modified than *Phyllonycteris*, and the peculiarities of its dentition may indicate the descent of the subfamily Phyllonycterinæ from a Hemidermine stock.

Family DESMODONTIDÆ.

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Phyllostomina*, part) BONAPARTE, Saggio di una distrib. metodico degli Anim. Vert., p. 15.
1838. *Vespertilionidæ* (part; *Phyllostomina*, part) GRAY, Mag. Zool. and Bot., II, p. 486, December, 1838.
1839. *Hæmatophilini* WATERHOUSE, Zoology of the Voyage of H. M. S. Beagle, II, Mammalia, p. 3.
1840. *Istiophora* (part; *Desmodina*) WAGNER, Schreber's Säugthiere, Supplementb., I, p. 375.
1842. *Phyllostomineæ* (part) LESSON, Nouveau Tableau du Règne Animal, Mamm., p. 30.
1845. *Desmodina* BONAPARTE, Cat. Met. Mamm. Europ., p. 5.
1855. [*Phyllostomidæ*] "Phyllostomidés" (part; *Desmodina*, part) GERVAIS. Expéd. du Comte de Castelnau, Zool., Mamm., p. 30.
1865. *Phyllostomata* (part; *Desmodi*) PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 257.
1865. *Hæmatophilina* HUXLEY, Proc. Zool. Soc. London, p. 388.
1866. *Phyllostomidæ* (part; *Desmodina*) GRAY, Proc. Zool. Soc. London, p. 118.
1872. *Desmodidæ* GILL, Arrangement of the Families of Mammals, p. 16.
1875. *Phyllostomidæ* (part; *Phyllostominæ*, part; *Desmodontes*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 350, November, 1875.
1878. *Phyllostomidæ* (part; *Phyllistominæ*, part; *Desmodontes*) DOBSON, Catal. Chiropt. Brit. Mus., p. 545.
1886. *Desmodontidæ* GILL, Standard Natural History, V, p. 175.
1891. *Phyllostomatidæ* (part; *Phyllostomatinæ*, part; Desmodont division) FLOWER and LYDEKKER, Mammals Living and Extinct, p. 676.
1892. *Phyllostomatidæ* (part; *Phyllostomatini*, part; *Desmodontes*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Warmer parts of America, north to southern Mexico.

Characters.—Like the Phyllostomidæ in respect to the wing, pectoral girdle, and pelvis, except that the tuberosities of the humerus are more nearly equal in size, and both more distinctly exceed head. Fibula large, extending to head of tibia. All the long bones of the leg and wing deeply grooved for accommodation of muscles, this especially noticeable in tibia, fibula, and femur. Teeth very highly specialized for cutting, all trace of crushing surface being absent, and cheek teeth so reduced that the length of entire upper row is less than that of canine along alveolus. Stomach a slender cæcum-like structure. Nostrils surrounded by dermal outgrowths that form a very rudimentary noseleaf.

History.—Although recognized as a distinct group by Waterhouse as long ago as 1839, and again in 1872 and 1886 by Gill, the Desmodontidæ have been almost universally associated with the Phyllostomidæ. Winge placed *Brachyphylla* with them, but otherwise they have been regarded as the only members of the group.

Remarks.—The Desmodontidæ are somewhat closely related to the Phyllostomidæ, as shown by the structure of the palate, wing, and shoulder girdle, but their modification for strictly sanguivorous habits is so extreme that it seems quite unnatural to retain them in the same family. It is hardly possible to suggest which group of the Phyllostomes is likely to contain their nearest allies, though a possible relationship with the Hemiderminæ is suggested by the noticeably trenchant molars of *Rhinophylla.*

Principal subdivisions.—The members of this family represent three genera.

KEY TO THE GENERA OF DESMODONTIDÆ.

Outer lower incisor seven-lobed; lower cheek teeth four____*Diphylla,* p. 179.
Outer lower incisor with not more than two lobes; cheek teeth three.
  Inner lower incisor deeply two-lobed; thumb about one-fifth as long as third finger______________________________________*Desmodus,* p. 177.
  Inner lower incisor with large median lobe and a minute outer and inner lateral lobe; thumb about one-eighth as long as third finger____*Diæmus,* p. 178.

Genus DESMODUS Wied.

1824. *Desmodus* WIED, Abbild. Naturgesch. Brasilien, 5te Lief., pl. and text.
1834–36. *Edostoma* D'ORBIGNY, Voyage dans l'Amérique Mérid., p. VIII.
1878. *Desmodus* DOBSON, Catal. Chiropt. Brit. Mus., p. 546.
1905. *Desmodon* ELLIOT, Check List Mamm. North Amer. Cont. etc., p. 530.

Type-species.—*Desmodus rufus* Wied=*Phyllostoma rotundum* Geoffroy.

Geographic distribution.—Warmer parts of America, north to southern Mexico.

Number of forms.—The type species is the only form of *Desmodus* thus far known.

Characters.—Dental formula (Plates IX and X, fig. 3):

$$\frac{-\ 2\ -.\ 1.\ -\ -\ -\ 4\ 5\ -\ -}{1\ 2\ -.\ 1.\ -\ 2\ -\ 4\ 5\ -\ -}\ i\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{1-1}{1-1}=20.$$

Upper incisors very large, almost completely filling space between canines, the two teeth in contact anteriorly to beyond middle, strongly projecting, with acute triangular point and long, very sharp, slightly concave cutting edge. Lower incisors minute, straight, in pairs at outer sides of two deep pits in which the upper incisors fit when jaws are closed; the pairs separated from canines and from each other by spaces about equal to their own length. The crown of each tooth is deeply bilobed at the apex, the inner lobe slightly the larger.

Canines large, long, and narrow, with acute points and very sharp posterior cutting edge, the upper decidedly larger and more lancet-shaped than the lower. Upper cheek teeth minute, scarcely larger than lower incisors, the length of the two together scarcely equal to length of canine along alveolus. Viewed from the side they are subquadrate in outline, slightly higher than long, the cutting edge sloping a little backward. Viewed from above they are seen to be narrowly wedge-shaped and drawn down to a very acute, knife-like cutting edge. Second lower cheek tooth much like the two upper, but with cutting edge sloping forward instead of backward. Anterior tooth nearly one-half longer than posterior, its cutting edge very oblique, beginning anteriorly at level of alveolus and reaching height of next tooth at extreme posterior edge only. Posterior cheek tooth nearly as long as anterior, but with the cutting edge horizontal except for three or sometimes four irregular serrations (Plates IX and X, fig. 3). Skull with braincase large, very wide posteriorly, narrowing rapidly in front, the rostrum reduced to a mere support for the enormous incisors and canines. Palate deeply concave laterally, slightly concave longitudinally. Interpterygoid space distinctly wider posteriorly than anteriorly. Audital bullæ well developed, covering more than half surface of cochleæ. Lower jaw with posterior segment nearly as long as anterior, its upper and lower borders nearly parallel, its anterior border rising abruptly; angular process small, nearly in line with alveoli. Ears rather small, separate, distinctly pointed. Thumb about one-fifth as long as third digit, its metacarpal with a short rounded pad at base and a more elongate pad under outer half. Calcar reduced to a wart-like exerescence not connected with interfemoral membrane, the middle of which terminates about half way between knee and ankle. Tail absent.

Species examined.—*Desmodus rotundus* (Geoffroy).

Remarks.—This is the best known and most characteristic genus of the family. Except for the simple lower incisors it is the most specialized member of the group. It seems highly doubtful whether the animals would be able to take other food than blood.

Genus DIÆMUS Miller.

1906. *Diæmus* MILLER, Proc. Biol. Soc. Washington, XIX, p. 84, June 4, 1904.

Type-species.—*Desmodus youngi* Jentink.

Geographic distribution.—Brazil and Dutch Guiana.

Number of forms.—Only the type species is now known.

Characters.—Similar to *Desmodus*, but thumb much less elongated, only about one-eighth as long as third digit, the two pads on under side of its relatively short metacarpal coalesced; skull with posterior segment of mandible higher; teeth as in *Desmodus*, except that the lower incisors are less distinctly paired, their tips curve slightly inward, the cutting edge of the outer is entire and distinctly longer than that of inner, the inner tooth is trilobate, with large median lobe, a minute inner lobe near tip and an equally small outer lobe near base, and posterior lower cheek tooth rises to a distinct cusp near middle.

Species examined.—*Diæmus youngi* (Jentink).

Remarks.—The peculiar short thumb with single pad[a] under its metacarpal and the slightly recurved lower incisors with their different system of cusps are the principal characters which distinguish this genus from *Desmodus*. The thumb, in fact, is scarcely longer than in *Diphylla*, but it differs notably from that of the related genus in the presence of the large pad on metacarpal. So far as can be judged from the skins only, both legs and forearms share in the tendency to shortening so conspicuous in the thumbs. The two peripheral phalanges of the fingers are, however, as pointed out by Doctor Jentink, decidedly elongate as compared with the same bones in *Desmodus*, and this is another point of resemblance to *Diphylla*.

Genus DIPHYLLA Spix.

1823. *Diphylla* Spix, Simiar. et Vespert. Brasil. Spec. Nov., p. 68.
1878. *Diphylla* Dobson, Catal. Chiropt. Brit. Mus., p. 550.
1896. *Diphylla* H. Allen, Proc. U. S. Nat. Mus., XVIII, p. 769, October, 27, 1896.
1896. *Hæmatonycteris* H. Allen, Proc. U. S. Nat. Mus., XVIII, p. 777 (name based on a probably abnormal specimen of *Diphylla*).

Type-species.—*Diphylla ecaudata* Spix.

Geographic distribution.—Tropical America north to southern Mexico.

Number of forms.—Only the type species has thus far been discovered.

Characters.—Externally like *Desmodus*, but with shorter, broadly rounded ears, short thumb like that of *Diæmus*, but with no distinct pad under metacarpal, and a well-formed though small calcar. Skull differing from that of *Desmodus* in the much higher, broader interorbital region, nearly parallel-sided interpterygoid space, and low, weak posterior segment of mandible. Dental formula:

$$\frac{-\ 2\ 3.\ 1.}{1\ 2\ -.\ 1.}\frac{-\ -\ -\ 4\ 5\ 6\ -}{-\ 2\ -\ 4\ 5\ 6\ -}\ i\frac{2-2}{2-2},\ c\frac{1-1}{1-1},\ pm\frac{1-1}{2-2},\ m\frac{2-2}{2-2}=26.$$

Inner upper incisors as in *Desmodus*, but not as large, and in contact to about middle only. Outer incisor minute, structureless, barely if at all piercing gum, and situated close to middle of inner side of

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[a] The surface of this pad is crossed by a distinct furrow indicating its origin from the two pads of *Desmodus*.

canine. Lower incisors much larger than in *Desmodus* or *Diæmus*, forming a continuous convex row, separated, however, from canines by distinct spaces. The edges of the teeth are slightly recurved over the pits that receive tips of upper incisors, and when viewed from in front the upper surface is almost straight. The crowns in this view are fan-shaped, that of the inner tooth about as long (on cutting edge) as high, that of outer decidedly longer than high, and slightly one-sided, the inner border being longer than outer. Cutting edge of inner tooth with four equal beadlike lobes, that of outer with seven similar lobes. Upper cheek teeth as in *Desmodus*, except for the presence of the minute, structureless, styliform m^2, the point of which barely reaches level of cutting edge of the other teeth. Lower cheek teeth differing in several details from those of *Desmodus;* the first (pm_2) is not oblique, but has the cutting edge as high in front as behind and rising to a point at middle; third (m_1) similar to first, but intervening tooth (pm_4) with cutting edge almost straight; posterior tooth (m_2) similar to second, but smaller.

Species examined.—Diphylla ecaudata Spix.

Remarks.—Diphylla is recognizable externally by its short, broad ears, short thumb without pad on underside of metacarpal, and by the presence of a minute though evident calcar to which the very narrow uropatagium extends. Its most striking characters are, however, the form of the mandible, the tooth formula, and the structure of the lower incisors. The fan-shaped, seven-lobed outer lower incisor is unique among bats, and, so far as I know, there is no tooth similar to it in other mammals. In a certain way it suggests the lower incisors of *Cynocephalus* and *Colugo*, but the lobation is confined strictly to the edge. Except for the remarkable development of the lower incisors, *Diphylla* appears to be the least specialized of the Desmodontidæ, retaining as it does its calcar, i^2, m^2, and m_2, and showing to a less degree than the other genera the reduction of the rostrum and the high development of the cutting teeth.

Family NATALIDÆ.

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Vespertilionina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 15.

1838. *Vespertilionidæ* (part; *Vespertilionina*, part) GRAY, Mag. Zool. and Bot., II, p. 494, December, 1838.

1840. *Gymnorhina* (part; *Vespertilionina*, part) WAGNER, Schreber's Säugthiere, Supplementb., I, p. 483.

1855. [*Phyllostomidæ*] "Phyllostomidés" (part; *Vampyrina*, part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 44 ('*Spectrellum*'=*Natalus*).

1855. [*Vespertilionidæ*] "Vespertilionidés" (part; *Vespertilionina*, part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 52 (*Nycticellus*).

1855. *Vampyrina* (part; *Spectrellum*=*Natalus*) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 44.

1865. *Vespertiliones* PETERS, Monatsber, k. preuss. Akad. Wissensch., Berlin, p. 258 (part; '*Spectrellum*'=*Natalus*, and *Nyctiellus*).

1866. *Vespertilionidæ* (part; *Natalinia, Nycticellina*, and *Furipterina*) GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 91, February, 1866.

1866. *Noctilionidæ* (part; *Spectrellina*) GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 93.

1870. *Vespertiliones* (part; *Vespertiliones*, part) FITZINGER, Sitz. ber, kais. Akad. Wissensch., Math. Naturwissensch. Classe., Wien, LXII, Abth. I, p. 66.

1875. *Vespertilionidæ* (part; *Miniopteri*, part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875.

1878. *Vespertilionidæ* (part; *Miniopteri*, part) DOBSON, Catal. Chiropt. Brit. Mus., p. 170.

1886. *Vespertilionidæ* (part; *Miniopteri*, part) GILL, Standard Natural History, V, p. 166.

1891. *Vespertilionidæ* (part; Miniopterine division, part) FLOWER and LYDEKKER, Mammals, living and extinct, p. 660.

1892. *Phyllostomidæ* (part; *Natalinæ*) ALLEN, Proc. U. S. National Museum, XV, p. 437, October 28, 1892.

1892. *Vespertilionidæ* (part; *Natalini*, part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

1899. *Natalidæ* (part) MILLER, Bull. Amer. Mus. Nat. Hist., XII, p. 245, December 23, 1899.

Geographic distribution.—Warmer parts of America north to the Bahama Islands and central Mexico.

Characters.—Humerus with trochiter nearly as large as trochin and projecting noticeably farther beyond head, its surface of articulation with scapula nearly half as large as glenoid fossa and very definitely outlined, epitrochlea well developed, but short and thick, with broad spinous process, capitellum distinctly out of line with shaft; second manal digit with fully developed metacarpal but no phalanges; third finger with two phalanges; shoulder girdle normal in structure, but presternum relatively large and strong, its width equal to length of presternum and mesosternum together, its keel slanting backward; mesosternum very narrow, its keel much higher than its width posteriorly; xiphisternum scarcely longer than broad, its keel low but distinct; foot normal; fibula thread-like, usually cartilaginous at its upper extremity, which extends to head of tibia; pelvis essentially normal, but ilia unusually expanded laterally and dorsal and ventral profiles of ossa innominata more nearly parallel than in any other bats except the Rhinolophidæ and Hipposideridæ, sacrum with boundaries of vertebræ nearly or quite effaced, though general form of bone not peculiar; vertebræ from last dorsal to antepenultimate lumbar fused into a solid, laterally compressed mass from which all boundaries of the original elements are obliterated, last two lumbar vertebræ free; skull without postorbital processes; premaxillaries complete, the slender palatal branches fused in median line, leaving two small, lateral foramina and a slight anterior emargination; teeth normal; tragus present, variously distorted and thickened; muzzle without nose leaf in adult, though a structure resembling a rudimentary leaf has been described as occurring in the fetus of *Natalus;* chin occasionally with ridge-like outgrowths.

History.—As shown by the synonymy, this family has been associated by different authors with the Vespertilionidæ, Phyllostomidæ, and Noctilionidæ as a group of varying importance. In 1899 I regarded it as a distinct family, containing also the genera *Thyroptera*, *Furipterus*, and *Amorphochilus*. Further study of more extensive material convinces me that the family, as then understood, should be divided into three, the Natalidæ containing the genera *Natalus*, *Chilonatalus*, *Phodotes*, and *Nyctiellus*, the Furipteridæ containing *Furipterus* and *Amorphocilus*, and the Thyropteridæ *Thyroptera* alone.

Remarks.—The members of the family Natalidæ are small, delicately formed animals, in all but one genus (*Nyctiellus*) with distinctly funnel-shaped ears and noticeably elongated legs. The thumb is well developed and furnished with a normal claw, and there are no adhesive disks on thumb or sole. By these superficial characters alone they may generally be recognized among American bats. The position of the family is evidently near to the Phyllostomidæ, as shown by the structure of the premaxillaries; but the shoulder joint is of a distinctly higher type, clearly foreshadowing the complete double articulation of the Vespertilionidæ, Molossidæ, and Mystacopidæ. The fused lumbar vertebræ indicate a strong degree of specialization, but the same peculiarity is found in the high *Kerivoula* and in some genera of the relatively low Hipposideridæ. It therefore is of no assistance in determining the position of the group.

Principal subdivisions.—The family Natalidæ as now restricted contains four genera.

KEY TO THE GENERA OF NATALIDÆ.

Breadth of braincase about equal to that of palate, including third molars; canines reduced, scarcely higher than corresponding large premolar; legs and tail not specially elongated, the tail shorter than head and body -- *Nyctiellus*, p. 185.

Breadth of braincase much greater than that of palate including third molars; canines normal, much higher than corresponding large premolar; legs and tail noticeably elongated, the tail longer than head and body.

 Sides of rostrum from orbits to nares so inflated that molars are not visible when skull is viewed from directly above ---- *Phodotes*, p. 184.

 Sides of rostrum not inflated; molars distinctly visible when skull is viewed from above.

  Muzzle and chin simple; no glandular swelling on forehead in either sex -- *Natalus*, p. 183.

  Muzzle and chin with ridge-like dermal outgrowths; a large glandular swelling on forehead of males -------- *Chilonatalus*, p. 185.

Genus NATALUS Gray.

1838. *Natalus* GRAY, Mag. Zool. and Bot., II, p. 496, February, 1838 (*stramineus*).
1855. *Spectrellum* GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 51 (*macrourum*).
1878. *Natalus* DOBSON, Catal. Chiropt. Brit. Mus., p. 341 (part).
1892. *Natalis* WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 36.
1905. *Spectrellum* ELLIOT, Field Columb. Mus., Publ. 105, Zool. Ser., VI, p. 501, November, 1905.

Type-species.—*Natalus stramineus* Gray.

Geographic distribution.—Warmer parts of America, north to central Mexico, and in the West Indies to Santo Domingo.

Number of forms.—Three species of *Natalus* are now known—*N. stramineus* Gray, *N. mexicanus* Miller, and *N. major* Miller.

Characters.—Dental formula:

$$\frac{-\,2\,3.\ 1.\ -\,2\,3\,4\,5\,6\,7}{1\,2\,3.\ 1.\ -\,2\,3\,4\,5\,6\,7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{3-3}{3-3}=38.$$

Upper incisors low and strong, subequal or the outer slightly the larger, the four teeth in a straight line, broken in the middle by the shallow palatal emargination. The teeth of each pair are of equal height, slightly exceeding cingulum of canine, and are strongly in contact at middle, the tips diverging on account of the strong concavity on outer side of outer tooth and on inner side of inner tooth; cingulum indistinct, that of outer tooth strongly oblique. Outer incisor separated from canine by space about equal to diameter of its crown; median space equal to length of pair of incisors. Lower incisors small, trifid, the middle lobe distinctly the largest, the three teeth forming a strongly convex row between canines. Upper canine high, well developed, the shaft appearing compressed by reason of the extensive though shallow concavity of its inner surface; cingulum distinct, though small and without secondary cusps. Lower canine with exceptionally slender, subterete shaft. Upper premolars not strongly contrasted in size and form, though the posterior tooth is larger than either of the others. Each has a distinct, somewhat transverse cutting edge, a well-developed cingulum, and no secondary cusps. The middle and posterior teeth have a distinct inner posterior extension scarcely indicated in the first. Lower premolars compressed, well developed, closely similar to each other in size and form, the anterior tooth with the cusp slightly less acutely pointed than in the others. Molars normal; m^3 exceptionally large, its area nearly equal to that of m^1, its metacone and third commissure well developed. In all three teeth there is a faintly indicated hypocone. Anterior surface of m^1 and m^2 scarcely or not emarginate. Lower molars with the cusps normal in size and position; m_3 with distinct entoconid and a slight postero-internal cingulum cusp. Skull (fig. 26) with globular braincase rising abruptly above level of narrow, elongate rostrum. Greatest breadth of braincase about equal to depth, including audital bulla; rostrum about three-fourths as long as braincase, its width in lachrymal region about twice depth, its lateral walls thin and translucent, but not inflated. Anterior edge of orbit over middle of second molar. Antorbital canal very long, its anterior orifice over middle premolar, its posterior orifice occupying entire anterior wall of orbit, including region in which lachrymal foramen usually occurs. Base of braincase parallel with palate. Audital bullæ well developed, but small, covering about half surface of cochleæ. Externally characterized by the very long leg and tail, each of which exceeds the head and body in length, the large, funnel-formed ear (outer base slightly in front of inner), with thickened, distorted tragus, and the long muzzle with simple lips and chin; nostrils simple, directed outward and slightly downward.

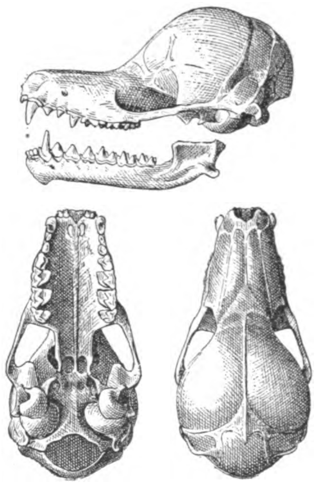

FIG. 26.—NATALUS MEXICANUS. ADULT FEMALE. MORELOS, MEXICO. NO. 102509. ×2¼.

Species examined.—I have examined the three known forms.

Genus PHODOTES Miller.

1906. *Phodotes* MILLER, Proc. Biol. Soc. Washington, XIX, p. 85, June 4, 1906.

Type-species.—*Natalus tumidirostris* Miller.

Geographic distribution.—Island of Curaçao, off coast of Venezuela.

Number of forms.—Only the type species is now known.

Characters.—Like *Natalus*, but maxillaries conspicuously inflated and translucent, the swollen region extending from orbit to nares and projecting so far laterally that the molar teeth are hidden when skull is viewed from above.

Species examined.—*Phodotes tumidirostris* (Miller).

Remarks.—The inflated, semitransparent maxillaries of the type species give the skull of *Phodotes* a very distinct aspect from that of *Natalus* and *Chilonatalus*. The rostrum of *Nyctiellus* is of somewhat the same form; but this genus is distinguished by the very different relative width of rostrum and braincase, *Phodotes* retaining in this respect strictly the proportions of *Natalus*. As I pointed out in the original account of *Natalus tumidirostris*,[a] the palate in the only two

[a] Proc. Biol. Soc. Washington, XIII, p. 160, October 31, 1900.

known specimens is deeply emarginate posteriorly to level of middle molar. This condition is probably due, at least in part, to faulty preparation, but it seems not improbable that the posterior region of the palate is extensively and irregularly fenestrate.

Genus CHILONATALUS Miller.

1898. *Chilonatalus* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 326 (subgenus of *Natalus*).

1903. *Chilonatalus* MILLER, Proc. Biol. Soc. Washington, XVI, p. 119. September 30, 1903 (genus).

Type-species.—*Natalus micropus* Dobson.

Geographic distribution.—Bahama Islands, Greater Antilles (Cuba, Jamaica), and Old Providence Island, Caribbean Sea.

Number of forms.—Three species of *Chilonatalus* are now recognized.

Characters.—Differs from *Natalus* in the presence of a ridge-like dermal outgrowth on muzzle, suggesting a rudimentary noseleaf, and another on chin, producing in profile a double-lipped aspect; males, with large glandular swelling between and in front of eyes. Skull (fig. 27) like that of *Natalus*, but with rostrum relatively longer, more slender, and more depressed posteriorly.

Species examined.—*Chilonatalus micropus* (Dobson), *C. brevimanus* (Miller), and *C. tumidifrons* (Miller).

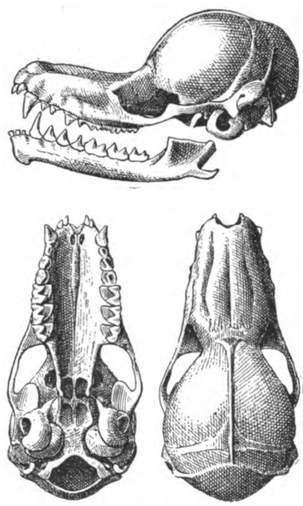

FIG. 27.—CHILONATALUS MICROPUS. ×2½.

Remarks.—Although distinguished chiefly by external characters, this genus differs from *Natalus* in the excessively attenuate, flattened rostrum. It contains the smallest known numbers of the family, *Nyctiellus lepidus* excepted.

Genus NYCTIELLUS Gervais.

1855. *Nyctiellus* GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 84.

1866. *Nycticellus* GRAY, Ann. and Mag. Nat. Hist., 3d ser., p. 91. February, 1866.

1878. *Natalus* DOBSON, Catal. Chiropt. Brit. Mus., p. 341 (part).

1904. *Nyctiellus* MILLER, Proc. U. S. National Museum, XXVII, p. 340. January 23, 1904.

Type-species.—*Vespertilio lepidus* Gervais.

Geographic distribution.—Cuba, including the Isle of Pines.

Number of forms.—The type species is the only form thus far discovered.

Characters.—Differs externally from its allies in the much shorter leg, proportionally about as long as in the small species of *Myotis*, and in the nearly unmodified ear, the anterior border of which arises directly above eye, the posterior border behind base of tragus, so that the peculiar funnel-like form characteristic of the other genera is scarcely indicated. Skull (fig. 28) differing from that of the allied genera in the low braincase and very large rostrum, the length of which, as in *Chilonatalus*, is fully equal to that of braincase, the breadth of palate including third molars equal to that above posterior roots of zygomata. Maxillaries swollen, but much less than in *Phodotes*, not enough to conceal molars when skull is viewed from above. Teeth not essentially different from those of *Natalus*, but canine and anterior premolar both above and below greatly reduced in size, the canine scarcely higher than its corresponding large premolar, and the first upper premolar scarcely as large as outer incisor. Lower premolars much less trenchant than in *Natalus*, the shafts almost terete, though retaining distinct traces of the cutting edges; pm_2 much reduced in size, its height scarcely half that of pm_3.

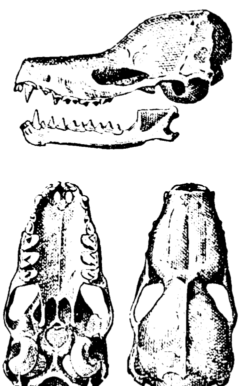

FIG. 28.—NYCTIELLUS LEPIDUS. ADULT FEMALE. ISLE OF PINES, CUBA. NO. 103898. ×2¼.

Species examined.—*Nyctiellus lepidus* (Gervais).

Remarks.—As compared with other members of its subfamily, *Nyctiellus* is distinctly less specialized externally; but in the peculiar form of the skull and in the reduced size of the anterior canine and premolar it represents a more advanced stage than any of the related genera, both of these characters suggesting the members of the next family.

Family FURIPTERIDÆ.

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Vespertilionina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 15.

1855. [*Vespertilionidæ*] "Vespertilionidés" (part; *Emballonurina*, part) GERVAIS, Expéd. dû Compte de Castelnau, Zool., Mamm., p. 52.

1865. *Brachyura* (part) PETERS, Monatsber, k. preuss. Akad. Wissensch., Berlin, p. 257.

1866. *Furipterina* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 91. February, 1866.

1872. *Noctilionidæ* (part; *Furiinæ*) GILL, Arrangement of the Families of Mammals, p. 18.

1875. *Emballonuridæ* (part; *Emballonuræ*, part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875.

1878. *Emballonuridæ* (part; *Furiæ*) DOBSON, Catal. Chiropt. Brit. Mus., p. 354.

1886. *Emballonuridæ* (part; *Furiæ*) GILL, Standard Natural History, V, p. 169.

1891. *Emballonuridæ* (part; *Emballonurinæ*, part, Furipterine division) FLOWER and LYDEKKER, Mammals, living and extinct, p. 666.

1892, *Vespertilionidæ* (part; *Natalini*, part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

1899. *Natalidæ* (part) MILLER, Bull. Amer. Mus. Nat. Hist., XII, p. 245, December 23, 1899.

Geographic distribution.—Warmer parts of South America.

Characters.—Wing as in the Natalidæ, except that the trochiter is slightly more developed and the greatly reduced thumb is included in the membrane to base of minute, functionless claw. Width of presternum slightly greater than length, the broad keel projecting forward; xiphisternum slender, fused with broad, flat presternum, the two together marked with a low median ridge, which is nowhere sufficiently developed to form a keel. Pelvis and lumbar vertebræ as in the Natalidæ. Skull differing from that of the Natalidæ in the extremely rudimentary condition of the palatal branches of the premaxillaries, these processes reduced to mere cartilaginous filaments. Antorbital canal short, extending from middle of pm^4 to middle of m^1; its length about equal to that of m^1; its posterior orifice normal, not situated in a funnel-shaped depression as in the Natalidæ. Teeth as in the Natalidæ, except that canines are, so far as known, invariably reduced to about the height of the corresponding large premolars (a character occurring in one genus of Natalidæ).

History.—Though originally placed with the typical Vespertilionine bats, the members of this group were associated with the Molossines as early as 1855, a position which they retained practically without question until their relationship with *Natalus* was pointed out by Winge in 1892. Though undoubtedly related to the Natalidæ, the group seems worthy of recognition as a family.

Remarks.—The Furipteridæ are distinguished from the Natalidæ by the less modified sternum, of which the anterior segment bears an almost normal keel, while the middle and posterior segments are essentially without keel, and the much reduced, functionless thumb, the latter a very remarkable character and, so far as I am aware, one which is unique among bats. The cartilaginous condition of the palatal branches of the premaxillaries and the reduction in the size of the canines are features of less importance, the latter being, in fact, almost exactly reproduced in the Nataline genus *Nyctiellus*. In both of the genera now known the rostrum is relatively much shorter than in the Natalidæ and there are only two upper premolars. This condition of the dental formula is approached by *Nyctiellus*, in which pm^2 is much more reduced than in the other members of its family. As compared with the Natalidæ, the more generalized and more specialized characters of this group are so nearly balanced that it is difficult to form an opinion as to the relative position of the two families. In the structure of the sternum the Natalidæ are evidently the more aberrant, but this is offset by the excessively abnormal thumb of the Furipteridæ. The Natalidæ show the more primitive condition of the teeth.

Principal subdivisions.—Two genera of Furipteridæ are now known.

KEY TO THE GENERA OF FURIPTERIDÆ.

Height of braincase, including audital bullæ, much less than distance from frontal angle to most posterior point of occipital region; muzzle and lips nearly simple ________ *Furipterus*, p. 188.

Height of braincase, including audital bullæ, equal to distance from frontal angle to most posterior point of occipital region; muzzle and lips with conspicuous warty outgrowths ________ *Amorphochilus*, p. 190.

Genus FURIPTERUS Bonaparte.

1828. *Furia* F. CUVIER, Mém. du Mus. d'Hist. Nat., Paris, XVI, p. 150. Not of Linnæus, 1758.

1837. *Furipterus* BONAPARTE, Iconogr. Fauna Ital., I, fasc. XXI, under *Plecotus auritus*.

1866. *Furiella* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 91, February, 1866.

1878. *Furia* DOBSON, Catal. Chiropt. Brit. Mus., p. 356.

1891. *Furipterus* FLOWER and LYDEKKER, Mammals, Living and Extinct, p. 666.

Type-species.—*Furia horrens* F. Cuvier.

Geographic distribution.—Tropical South America.

Number of forms.—Only one species of *Furipterus* is now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ 3\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7};\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=36.$$

Upper incisors subequal, in pairs set obliquely to the sagittal line, the space between outer tooth and canine about equal to diameter of its subterete, slightly antero-posteriorly flattened crown, the median space about twice as great. Each tooth has a sharply conical crown, the height of which about equals greatest diameter, and a well-developed, horizontal cingulum, which rises posteriorly into a small but distinct cusp; height of incisors about equal to that of cingulum of canine. Lower incisors forming a continuous convex row between canines, the outer slightly larger than the inner, their low crowns bluntly trifid on cutting edge, the middle segment larger than either of the others. Upper canine very small; its shaft about equal in height to large premolar, strongly flattened on inner surface; its posterior cutting edge with well-developed secondary cusp slightly below middle; its well-developed cingulum forming a conspicuous anterior basal cusp and a smaller posterior one. Lower canine even more reduced, closely resembling pm_3 in both size and form, except that its apex is less sharply pointed. The shaft is terete and the cingulum, though well developed, forms less distinct basal cusps than in the upper canine. Anterior upper premolar (pm^3) about half as high as canine, but resembling it in form even to the presence of the two cingulum cusps and the secondary cusp on posterior cutting edge. The shaft is, however, relatively lower and the small cusps are not as well developed. Posterior upper premolar, with inner cusp narrow, but high and very distinct, cingulum forming a sharp, somewhat recurved, antero-external cusp. Lower premolars alike in form, except that the anterior (pm_2) has the shaft less distinctly terete than the others. It is also much shorter than the others. Molars normal, the protocones high and short; no trace of hypocones; m^3 with three fully developed commissures; lower molars with distinct entoconids. Skull (fig. 29) with broad, flat rostrum (length from frontal angle scarcely greater than lachrymal breadth, but fully three times depth at pm^3), deeply furrowed in median line, and conspicuously emarginated in front by large narial opening. Antorbital foramen over base of anterior root of pm^4, the canal very short, its length scarcely exceeding that of this root. Brain case very large, its length twice that of rostrum; its height, including audital bullæ, equal to its greatest breadth, and about two-thirds its length. Base of brain case bent upward. Palatal emargination extending forward to level of posterior molars. Posterior opening of antorbital canal normal. Audital bullæ well formed, but small, covering less than half surface of cochleæ. Externally much as in *Natalus*, with similarly funnel-shaped ears and much distorted tragus (the latter noticeably triangular), but at once recognizable by the rudimentary thumb and shorter tail, which ends in interfemoral membrane a little beyond middle. Muzzle and lips without warty processes, other than an angular projection on upper lip at outer edge of downwardly opening nostril.

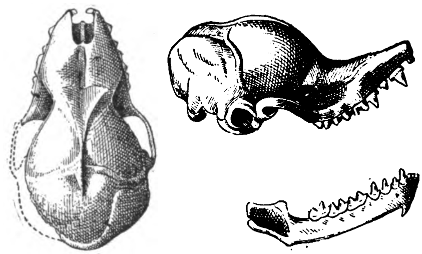

FIG. 29.—FURIPTERUS HORRENS. × 2⅔.

Species examined.—Furipterus horrens (F. Cuvier).

Genus AMORPHOCHILUS Peters.

1877. *Amorphochilus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 185.

1878. *Amorphochilus* DOBSON, Catal. Chiropt. Brit. Mus., p. 357.

Type-species.—*Amorphochilus schnablii* Peters.

Geographic distribution.—Tumbez, on the Gulf of Guayaquil, Peru.

Number of forms.—The type species.

Characters.—Like *Furipterus*, but height of braincase, including audital bullæ, fully equal to distance from frontal angle to most posterior point of occiput; palatal emargination not extending halfway from hamulars to posterior molars; nostrils opening forward at extremity of a conspicuous, snoutlike elevation; chin with a triangular, downward-turned flap, margined at each side with a small roundish wart; lower lip thickened at angle of mouth and with large warty protuberance slightly in front of middle; no angular elevation on upper lip at point where this occurs in *Furipterus*.

Species examined.—This genus is still known from Peters's description and figures only.

Family THYROPTERIDÆ.

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Noctilionina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 14.

1838. *Vespertilionidæ* (part; *Noctilionina*, part) GRAY, Mag. Zool. and Bot., II, p. 498, December, 1838.

1840. *Gymnorhina* (part; *Gymnura*, part) WAGNER, Schreber's Säugthiere. Supplementb., I, p. 466.

1842. *Noctilioninea* (part) LESSON, Nouveau Tableau du Règne Animal. Mamm., p. 16.

1855. [*Vespertilionidæ*] "Vespertilionidés" (part; *Molossina*, part) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 55.

1856. *Vespertilionidæ* (part) TOMES, Proc. Zool. Soc. London, p. 172.

1865. *Vespertiliones* (part) PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 258.

1866. *Vespertilionidæ* (part; *Natalina*, part) GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 90, February, 1866.

1870. *Vespertiliones* (part; *Vespertiliones*, part) FITZINGER, Sitz.-Ber. k. Akad. Wissensch., Wien, Math. Naturwissensch., Classe LXII, Abth. I. p. 66.

1875. *Vespertilionidæ* (part; *Miniopteri*, part) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875.

1878. *Vespertilionidæ* (part; *Miniopteri*, part) DOBSON, Catal. Chiropt. Brit. Mus., p. 170.

1886. *Vespertilionidæ* (part; *Miniopteri*, part) GILL, Standard Natural History, V, p. 166.

1891. *Vespertilionidæ* (part; Thyropterine division) FLOWER and LYDEKKER. Mammals, living and extinct, p. 660.

1892. *Vespertilionidæ* (part; *Natalini*, part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

1899. *Natalidæ* (part) MILLER, Bull. Amer. Mus. Nat. Hist., XIII, p. 245. December 23, 1899.

Geographic distribution.—Tropical America, north to Honduras.

Characters.—Shoulder joint and wing as in the Natalidæ, except that trochiter is distinctly larger than trochin, second finger is reduced to a rudimentary metacarpal less than half as long as that of third finger, there are three bony phalanges in third digit, and first phalanx of thumb bears a large sucking disk; shoulder girdle differing from that of the Natalidæ and resembling that of the Furipteridæ in the small size of the presternum, its width scarcely half length of presternum and mesosternum, its narrow keel slanting conspicuously forward, mesosternum broad and flat, its keel obsolete, xiphisternum long and slender, its keel reduced to a mere ridge; first and second dorsal vertebræ fused; foot abnormal, the toes with only two phalanges each, the third and fourth digits, together with their claws, anchylosed together from base to tip; fibula reduced to a minute osseous thread closely applied to the tibia and disappearing about midway between heel and knee; sole with well-developed sucking disk attached to metatarsals; pelvis not essentially abnormal, but with very small pectineal process, and with obturator foramen much reduced by bony outgrowth from its sides, as in the Hipposideridæ and Rhinolophidæ, ischia wide apart posteriorly, a symphysis pubis in males, sacrum with the posterior two vertebræ distinct, the others fused; lumbar vertebræ distinct; skull without postorbital processes, much as in the Natalidæ, the braincase large, smooth, and rounded, the rostrum slender and weak; premaxillaries complete, the very slender and easily broken palatal branches isolating two foramina; teeth normal, not essentially different from those of the Natalidæ; ear, tragus, and muzzle as in *Natalus*.

History.—As shown by the synonymy, this family has generally been united with the Vespertilionidæ or Molossidæ. Winge placed it with *Natalus*, *Furipterus*, and *Amorphochilus* to form the group Natalina, a section of the Vespertilionidæ; and this assemblage I regarded in 1899 as constituting the family Natalidæ.

Remarks.—The form of the sternum, the separate lumbar vertebræ, the greatly reduced second finger, the large third finger with fully ossified terminal phalanx, the peculiar structure of the toes, and the presence of sucking disk on thumb and sole are sufficient to distinguish this family from the Natalidæ. Contrary to what might be expected, the thumb has a well-developed claw. The Thyropteridæ are in some respects more highly specialized than the Natalidæ; in others, notably in the structure of the sternum and in the unfused lumbar vertebræ, much more primitive. As compared with the Furipteridæ this family represents about the same stage in the development of the sternum; the lumbar region is more primitive; the feet are more highly modified, and the thumb is perhaps equally aberrant, though in another way.

Principal subdivisions.—The family is represented by the single genus *Thyroptera*.

Genus THYROPTERA Spix.

1823. *Thyroptera* Spix, Simiar. et Vespert. Brasil. Sp. Nov., p. 61 (*tricolor*).
1854. *Hyonycteris* Lichtenstein and Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 335 (*discifera*).
1865. *Thyroptera* Peters, Monatsber, k. preuss. Akad. Wissensch., Berlin, p. 580.
1878. *Thyroptera* Dobson, Catal. Chiropt. Brit. Mus., p. 345.

Type-species.—*Thyroptera tricolor* Spix.

Geographic distribution.—Tropical America, north to Honduras.

Number of forms.—Though others have been described, only two species are now recognized.

Characters.—In addition to the characters of the family the following may be mentioned. Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{3-3}{3-3},\ m\ \frac{3-3}{3-3}=38.$$

Inner upper incisor larger than outer, but both teeth well developed, styliform, with small outer cusp, their extremities very slender and slightly curved inward, producing a faint suggestion of the milk dentition. Lower incisors 3-lobed, the outer tooth slightly larger than the others. Canines weak, not peculiar in structure. Premolars both above and below, long, narrow, moderately high, their points very slender and situated at about middle of crown. Third upper premolar with remarkably developed inner ridge, rising to a cusp anteriorly nearly as high as protocone of m^1 and m^2, and showing a slight though distinct posterior cusp, the two together strongly suggesting a protocone and hypocone. First and second upper molars with low but evident hypocone, the other cusps with their commissures normal. Third upper molar with five cusps and three well-developed commissures. Lower molar normal, the outer cusps particularly high and acute. Skull (fig. 30) with brain case about one and one-half times as long as rostrum, abruptly elevated anteriorly, its surface smooth and rounded. Rostrum narrow, weak, and low, the upper surface nearly flat, the sides distinctly inflated and translucent. Palate slightly concave laterally, nearly straight longitudinally. Behind tooth rows it is abruptly narrowed, and the posterior extension is parallel-sided. Basisphenoid region broadly concave, the concavity bounded anteriorly by a high trans-

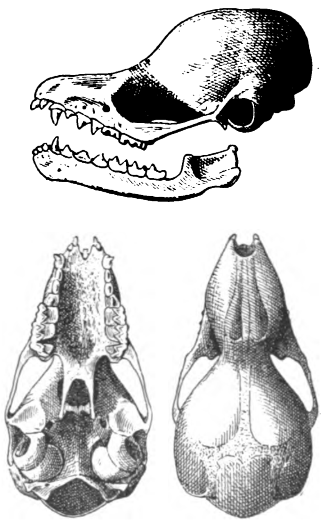

Fig. 30.—Thyroptera discifera. $\times 2\frac{2}{3}$.

verse ridge that extends across between pterygoids close to hamulars. Audital bullæ small, covering less than half surface of cochleæ. Externally as in *Natalus* except that the legs and tail are not elongated, the sole and thumb are provided with conspicuous adhesive disks, and the muzzle has a slight but evident wartlike elevation above the nostrils.

Species examined.—*Thyroptera tricolor* Spix and *T. discifera* (Lichtenstein and Peters).

Family MYZOPODIDÆ.

1891. *Vespertilionidæ* (part; Thyropterine division, part) FLOWER and LYDEKKER, Mammals, living and extinct, p. 665.

1898. *Vespertilionidæ* (part, *Myxopodeæ*) TROUESSART, Catalogus Mammalium, p. 134.

1904. *Myzopodidæ* THOMAS, Proc. Zool. Soc. London, II, p. 5, October 1, 1904.

Geographic distribution.—Madagascar.

Characters.[a]—Humerus with trochiter larger than trochin, the relations of the two about as in the Thyropteridæ,[b] surface of articulation between trochiter and scapula well developed, about as in *Natalus* or *Rhinolophus*, distal extremity of humerus essentially as in *Natalus*; second manal digit with fully developed metacarpal and " a short and very slender cartilaginous rod, probably representing the proximal phalanx " (Andersen), third finger with three bony phalanges; shoulder girdle normal, the sternum showing no special modifications; presternum small, much as in *Thyroptera* and with similarly forward-projecting manubrium; mesosternum slender, flat, slightly keeled; foot abnormal, the toes united to base of phalanges, thence free but closely approximated, only two phalanges in each toe; fibula thread-like[c]; pelvis essentially normal, though with pectineal process very short, a symphysis pubis in males, boundaries of sacral vertebræ distinct; lumbar vertebræ not fused or in any way specially modified; skull short, broad, and rounded, without postorbital processes; premaxillaries fused, complete, isolating two lateral palatal foramina; teeth normal; thumb and sole with sessile adhesive disks; ears separate, very large, tragus present but fused along its anterior edge with ear conch, meatus partly closed by a conspicuous mushroom-shaped process unlike anything known in other bats.

History.—Until recognized as a distinct family by Thomas, this group was regarded as a section of the Vespertilionidæ.

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[a] Details concerning several important characters of this family which I neglected to note when examining the skeleton in the British Museum, have been kindly furnished by Mr. Knud Andersen.

[b] "Tuberculum majus slightly more projecting than in *Rhinolophus*, but decidedly less so than in *Pterygistes*." (Andersen.)

[c] "I can not make out with certainty whether the extreme distal end of the tibia perhaps shows some trace of ossification." (Andersen.)

Remarks.—The members of the family Myzopodidæ may be at once recognized by the sessile adhesive disks on sole and thumb, and the large ear with its tragus adnate to the conch, and its meatus partly closed by the unique mushroom-shaped process. The skeleton is, as pointed out by Thomas, remarkable for its lack of special modifications. In general structure, however, especially in the form of the humerus and shoulder joint, it unquestionably agrees closely with the Natalidæ and Thyropteridæ, and I fully agree with Mr. Thomas that this resemblance indicates an actual relationship between the three groups.

Principal subdivisions.—As at present known, the family consists of the single genus *Myzopoda.*

Genus MYZOPODA Milne Edwards and Grandidier.

1878. *Myzopoda* MILNE EDWARDS and GRANDIDIER, Bull. Soc. Philomath., Paris, 7th ser., II, p. 220.

1878. *Myxopoda* DOBSON, Proc. Zool. Soc. London, p. 871.

1904. *Myzopoda* THOMAS, Proc. Zool. Soc. London, II, p. 2, pl. I, October 1, 1904.

Type-species.—*Myzopoda aurita* Milne-Edwards and Grandidier.

Geographic distribution.—Madagascar.

Number of forms.—Only the type species is known.

Characters.—Dental formula:

$$\frac{-2\,3.\,1.-2\,3\,4\,5\,6\,7}{1\,2\,3.\,1.-2\,3\,4\,5\,6\,7}\; i\,\frac{2-2}{3-3},\; c\,\frac{1-1}{1-1},\; pm\,\frac{3-3}{3-3},\; m\,\frac{3-3}{3-3}=38.$$

Upper incisors small, simple, with slightly developed cingula, the inner tooth distinctly smaller than outer, which is separated from canine by a narrow space; axis of both pairs in same line; canines simple, without secondary cusps or specially developed cingula; premolars both above and below essentially as in *Myotis*, pm^2 and pm^3 about equal to upper incisors in size, each separated by narrow spaces from the neighboring teeth; molars strictly normal, m^3 with well-developed metacone and third commissure, m^1 and m^2 without hypocone. Skull short, broad, and rounded, its general outline when viewed from above strongly suggesting that of *Noctilio*. General structure of anterior portion of palate about as in *Natalus*, the lateral foramina well developed and about as large as median emargination, the width of which is approximately equal to length of a pair of incisors. Pterygoids rather strongly divergent, the hamular processes unusually long. Basisphenoid pits well developed, circular in outline, narrowed superficially, separated by a flat median space the width of which is equal to about half surface diameter of pit. Audital bullæ and cochleæ rather large, but not peculiar in structure, the bullæ covering slightly more than half surface of cochleæ, its inner border not emarginate. Lips wide, the upper extending beyond lower, and somewhat obliquely truncate in front; ear much longer than head; thumb with rudimentary claw; tail projecting noticeably beyond free edge of interfemoral membrane.

Species examined.—*Myzopoda aurita* Milne-Edwards and Grandidier.

Family VESPERTILIONIDÆ.

1821. *Vespertilionidæ* (part; Race 2) GRAY, London Medical Repository, XV, p. 299, April 1, 1821.

1827. *Vespertilionina* LESSON, Man. de Mammalogie, p. 87.

1831. *Vespertiliones* (*Vespertilionidæ*) (part; *Vespertilionina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 15.

1838. *Vespertilionidæ* (part; *Vespertilionina*, part) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.

1838. *Vespertilionidæ* (part; *Vespertilionina*, part) GRAY, Mag. Zool. and Bot., II, p. 494. December, 1838.

1855. [*Vespertilionidæ*] "Vespertilionidés" (part; *Vespertilionina*) GERVAIS, Expéd du Comte de Castelnau, Zool. Mamm., p. 52.

1865. *Vespertiliones* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 258.

1866. *Vespertilionidæ* (part; *Scotophilina*, *Romiciana*, *Vespertilionina*, *Plecotina*, and *Nyctophilina*) GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 89, February, 1866.

1870. *Vespertiliones* (part; *Vespertiliones*, part) FITZINGER, Sitz.-ber. k. Akad. Wissensch., Wien, Math. Naturwiss., Classe, LXI, I Abth., p. 458.

1872. *Vespertilionidæ* GILL, Arrangement of the Families of Mammals, p. 17.

1875. *Vespertilionidæ* DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 348, November, 1875 (except genera *Natalus* and *Thyroptera*, p. 349).

1878. *Vespertilionidæ* DOBSON, Catal. Chiropt. Brit. Mus., p. 167 (except genera *Natalus* and *Thyroptera*, p. 341–347).

1886. *Vespertilionidæ* GILL, Standard Natural History, V, p. 165.

1891. *Vespertilionidæ* FLOWER and LYDEKKER, Mammals living and extinct, p. 660 (except *Natalus*, p. 664, and Thyropterine division, p. 665).

1892. *Vespertilionidæ* (part; *Vespertilionini*) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.

Geographic distribution.—Eastern and western hemispheres to the limit of tree growth; in the Atlantic to the Azores, and in the Pacific to the Galapagos and Hawaiian Islands from America, and to New Zealand and Samoa from Asia.

Characters.—Humerus with trochiter very noticeably larger than trochin and projecting distinctly beyond head, its surface of articulation on scapula decidedly more than half as large as glenoid fossa, distinctly concave and sharply outlined, epitrochlea obsolete, capitellum scarcely out of line with shaft; ulna usually fused with radius at its head, the shaft reduced to a scarcely ossified fibrous strand; second finger with fully developed metacarpal and one small bony phalanx; third finger with three phalanges, of which the distal is cartilaginous throughout except at extreme base, where distinct joint is formed with middle phalanx; shoulder girdle strictly normal in its general structure, the seventh cervical vertebra free except in Tomopeatinæ; the presternum small, with forward-projecting, variously developed median lobe, the mesosternum flat and scarcely keeled, usually slender; foot normal; fibula thread-like, complete or with upper extremity cartilaginous, extending to head of tibia; pelvis normal, the boundaries of the sacral vertebræ distinct, the ischia widely separated posteriorly, a symphysis pubis in males; lumbar vertebræ free; skull without postorbital processes; premaxillaries without palatal branches, the palate widely emarginate anteriorly; palate abruptly narrowed behind toothrows, the sides of its posterior extension parallel or nearly so; teeth usually normal, though in a few genera showing a tendency to reduction of the cusps; ears usually though not invariably separate, the anterior border with distinct basal lobe (except in Tomopeatinæ); tragus usually well developed, simple; muzzle without distinct leaf-like outgrowths; tail well developed, extending to edge of wide interfemoral membrane.

History.—The family Vespertilionidæ, with its almost universal distribution, and containing, as it does, the best known and most familiar species, has been very generally recognized in approximately the sense in which it is now understood. Certain genera formerly placed with it have been recently removed, but, on the whole, the group has been more uniformly treated than any other family except, perhaps, the fruit bats.

Remarks.—The members of this family are recognizable externally by their simple muzzles and lips, usually separate ears with well-developed, straight, or slightly curved tragi, long tails extending to edge of wide interfemoral membrane, but never much beyond; presence of only two bony phalanges in third finger, and absence of sucking disks on sole and thumb. Internally they are distinguished by the highly developed double articulation between scapula and humerus, the very rudimentary ulna, the essentially unmodified shoulder girdle and pelvis, the conspicuous anterior emargination of the bony palate, and the essentially normal teeth.

A very high position for the Vespertilionidæ is indicated by the structure of the wing, in which the family stands further removed from the Pteropidæ and from nonvolant mammals than any other group except the Molossidæ and Mystocopidæ. In the extreme reduction of the ulna it even surpasses both of these.

Principal subdivisions.—The known genera of Vespertilionidæ represent at least six subfamilies.

KEY TO THE SUBFAMILIES OF VESPERTILIONIDÆ.

Anterior upper premolar (*pm* ²) large, not differing conspicuously from posterior premolar (*pm* ⁴) in size or form; nostrils tubularly elongated
MURININÆ, p. 229.

Anterior upper premolars (*pm* ² and *pm* ³) greatly reduced in size or absent; when present conspicuously different from posterior premolar (*pm* ⁴) in both size and form; nostrils not tubularly elongated.

Sternum short and broad, its length in middle line not twice as great as breadth of presternum; four or five ribs connected with sternum; ear slightly but evidently funnel-formed .... KERIVOULINÆ, p. 232.

Sternum slender, its length in middle line more than twice as great as breadth of presternum; six or seven ribs connected with sternum; ear not funnel-formed.

Presternum with median lobe larger than body of bone; scapula with coracoid straight, directed inward; second phalanx of third finger nearly three times as long as first.
MINIOPTERINÆ, p. 227.

Presternum with median lobe much smaller than body of bone; scapula with coracoid curved outward; second phalanx of third finger not specially elongated.

Nostrils opening forward beneath a conspicuous horseshoe-shaped ridge or low noseleaf .... NYCTOPHILINÆ, p. 234.

Nostrils opening laterally or vertically, the muzzle occasionally with warty elevations, but never with horseshoe-shaped ridge or low noseleaf.

Seventh cervical vertebra fused with first dorsal; ear with rudimentary keel, but with no anterior basal lobe.
TOMOPEATINÆ, p. 237.

Seventh cervical vertebra free from first dorsal; ear without keel, but with well-developed anterior basal lobe .... VESPERTILIONINÆ, p. 197.

Subfamily VESPERTILIONINÆ.

1878. *Vespertiliones* DOBSON, Catal. Chiropt. Brit. Mus., p. 168 (except genera *Kerivoula* and *Harpiocephalus*).

1891. *Vespertilionidæ* (part, Vespertilionine division, except genera *Kerivoula* and *Harpiocephalus*) FLOWER and LYDEKKER, Mammals, living and extinct, p. 661.

1897. *Vespertilioninæ* and *Plecotinæ* MILLER, North American Fauna, No. 13, pp. 46 and 54, October 16, 1897.

Geographic distribution.—Same as that of the family.

Characters.—Sternum slender, its entire length considerably more than twice greatest width of presternum; median lobe much smaller than body of presternum; six ribs connected with sternum; seventh cervical vertebra not fused with first dorsal; scapula with coracoid curved outward; nostrils simple, sometimes tubularly elongated, but never margined by special outgrowths; lower incisors in all known genera 3–3.

Remarks.—Of the subfamilies of Vespertilionidæ this is distinctly the most primitive, being perhaps best characterized by the absence of the special modifications that distinguish the other groups.

Principal subdivisions.—The species now known represent 33 genera.

KEY TO THE GENERA OF VESPERTILIONINÆ.

Cheek teeth $\frac{6-6}{6-6}$.

Wing without glands .... *Myotis*, p. 200.

Wing with large gland near elbow .... *Pizonyx*, p. 202.

Cheek teeth less than $\frac{6-6}{6-6}$.

Upper premolars 2–2.

Upper incisors 1–1; metacarpal of third, fourth, and fifth fingers successively much shortened __________________ *Lasiurus*, p. 221.

Upper incisors 2–2; metacarpal of third, fourth, and fifth fingers about equal in length.

Lower premolars 3–3.

Audital bullæ not specially enlarged; rostrum broad, concave on each side above; ear shorter than head. *Lasionycteris*, p. 203.

Audital bullæ much enlarged; rostrum narrow, evenly convex above; ear much longer than head.

Anterior edge of orbit distinctly ridged; nostrils not overhung by glandular outgrowths from side of muzzle __________________________ *Plecotus*, p. 224.

Anterior edge of orbit smoothly rounded; nostrils overhung by conspicuous glandular outgrowth from side of muzzle ______________ *Corynorhinus*, p. 225.

Lower premolars 2–2.

Lower canine small, its tip unequally bifid; diameter of audital bulla equal to length of tooth row, exclusive of incisors; ear much longer than head ___ *Euderma*, p. 225.

Lower canine well developed, its tip not bifid; diameter of audital bulla much less than length of tooth row; ear not specially elongated.

Braincase conspicuously deepened, its depth including audital bullæ nearly equal to its width. *Chalinolobus*, p. 219.

Braincase normal, its depth including audital bullæ much less than its width.

Outer upper incisor not extending beyond cingulum of inner.

Outer upper incisor distinctly cuspidate. *Scotozous*, p. 206.

Outer upper incisor with flat crown. *Ia.*, p. 206.

Outer upper incisor extending distinctly beyond cingulum of inner.

Fifth finger only a little longer than metacarpal of fourth and third. *Pterygistes*, p. 207.

Fifth finger longer than metacarpal and first phalanx of fourth and third.

Upper surface of rostrum concave; ears joined ____________ *Barbastella*, p. 223.

Upper surface of rostrum convex; ears separate.

Outer upper incisor normal in position, its concavity directed backward __________ *Pipistrellus*, p. 204.

Outer upper incisor pushed outward from its normal position, the concavity directed outward. *Glischropus*, p. 205.

Upper premolars 1–1.
  Upper incisors 2–2.
    Ears noticeably enlarged.
      Audital bullæ as wide as space between them, *Lævphotis*, p. 215.
      Audital bullæ much wider than space between them, *Histiotus*, p. 214.
    Ears not noticeably enlarged.
      Depth of braincase, including audital bullæ, about equal to distance from incisors to posterior root of zygoma, *Glauconycteris*, p. 221.
      Depth of braincase, including audital bullæ, much less than distance from incisors to posterior root of zygoma.
        Skull noticeably flattened, the occipital depth less than one-third greatest length.
          Rostrum broad; lachrymal region so inflated as to be distinctly visible when skull is viewed from below________________*Mimetillus*, p. 213.
          Rostrum normal; lachrymal region quite hidden when skull is viewed from below, *Tylonycteris*, p. 212.
        Skull not noticeably flattened, the occipital depth more than one-third greatest length.
          Upper canine with distinct supplemental cusp at posterior base of shaft________*Philetor*, p. 213.
          Upper canine without supplemental cusp at posterior base of shaft.
            Outer upper incisor large, crowded inward between inner incisor and canine, *Hesperoptenus*, p. 211.
            Outer upper incisor small, on outer side of inner incisor and widely separated from canine.
              Surface of forearm, tail, and legs thickly sprinkled with small, pointed, horny outgrowths; upper toothrow strongly concave on inner side anteriorly, *Rhinopterus*, p. 210.
              Surface of forearm, tail, and legs smooth; upper toothrow slightly concave on inner side anteriorly.
                Rostrum evenly convex laterally; nares not extending half way to interorbital constriction; palatal emargination deeper than broad, *Eptesicus*, p. 207.
                Rostrum noticeably concave on each side of middle line; nares extending about half way to interorbital constriction; palatal emargination broader than deep. *Vespertilio*, p. 209.

Upper incisors 1–1.
Ears noticeably enlarged; audital bullæ much wider than space between them *Otonycteris*, p. 215.
Ears not noticeably enlarged; audital bullæ not as wide as space between them.
First and second upper molars with mesostyle reduced, the W pattern distorted or nearly absent; first and second lower molars with second triangle smaller than first. *Pachyotus*, p. 219.
First and second upper molars with normal cusps and ridges, the W pattern not distorted; first and second lower molars with second triangle larger than first.
Skull short and deep, the depth of braincase, including audital bulla, about one-half greatest length; metacarpal of 3d, 4th, and 5th fingers successively much shortened *Dasypterus*, p. 222.
Skull normal, the depth of braincase, including audital bulla, considerably less than one-half greatest length; metacarpal of 3d, 4th, and 5th fingers about equal in length.
Third lower incisor noticeably smaller than first or second.
Crown of third lower incisor in line with crowns of first and second, the tooth functional *Rhogeëssa*, p. 218.
Crown of third lower incisor scarcely visible under cingulum of canine, the tooth functionless *Bæodon*, p. 218.
Third lower incisor as large as first or second.
Third upper molar with well-developed mesostyle, metacone, and three commissures.
Lachrymal breadth greater than alveolar breadth *Scotœcus*, p. 217.
Lachrymal breadth less than alveolar breadth *Nycticeius*, p. 216.
Third upper molar with mesostyle rudimentary or absent, and metacone very minute; only two distinct commissures present.
Depth of maxillary emargination equal to distance between canines. *Scoteinus*, p. 217.
Depth of maxillary emargination scarcely more than one-half distance between canines *Scotomanes*, p. 217.

Genus MYOTIS Kaup.

1829. *Myotus* Kaup, Skizzirte Entw.-Gesch. u. Natürl. Syst. d. Europ. Thierw., I, p. 106 (*myotis*).
1829. *Nystactes* Kaup, Skizzirte Entw.-Gesch. u. Natürl. Syst. d. Europ. Thierw., I, p. 108 (*leisleri*). Not *Nystactes* Gloger, 1827.
1830. *Leuconoe* Boie, Isis, p. 256. (Die Wasserfledermäuse.)
1839. *Vespertilio* Keyserling and Blasius, Wiegmann's Archiv für Naturgesch., I, p. 306 (not of Linnæus, 1758).

1841. *Selysius* BONAPARTE, Iconografia della Fauna Italica, Introd., p. 3 (*mystacinus*).
1841. *Capaccinius* BONAPARTE, Iconografia della Fauna Italica (*capaccinii*).
1842. *Trilatitus* GRAY, Ann. and Mag. Nat. Hist., X, p. 258, December, 1842 (*hasseltii*, *macellus*=*adversus*, and *blepotis*=*Miniopterus* sp.).
1849. *Tralatitus* GERVAIS, Dict. Univ. d'Hist. Nat., XIII, p. 213.
1856. *Brachyotus* KOLENATI, Allgem. deutsch. Naturhist. Zeitung, Dresden, neue Folge, II, p. 131 (*mystacinus*, *daubentonii*, and *dasycneme*. Not *Brachyotus* Gould, 1837.
1856. *Isotus* KOLENATI, Allgem. deutsch. Naturhist. Zeitung, Dresden, neue Folge, II, p. 131 (*nattereri* and *emarginatus*).
1866. *Tralatitius* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 90.
1867. *Pternopterus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 706 (subgenus of *Vespertilio*=*Myotis*, type, *P. lobipes* Peters=*Vespertilio muricola* Hodgson).
1870. *Exochurus* FITZINGER, Sitzungsber. kais. Akad. Wissensch., Wien, Math.-Naturwissensch. Classe LXII, p. 75 (*macrodactylus*, *horsfieldii*=*adversus*, and *macrotarsus*). Not *Exochura* Kolenati, 1858.
1870. *Aeorestes* FITZINGER, Sitzungsber. kais. Akad. Wissensch., Wien, Math.-Naturwissensch. Classe LXII, p. 427 (*villosissimus*, *albescens*, and *nigricans*).
1870. *Comastes* FITZINGER, Sitzungsber. kais. Akad. Wissensch., Wien, Math.-Naturwissensch. Classe LXII, p. 565 (*capaccinii*, *megapodius*, *dasycneme*, and *limnophilus*).
1878. *Vespertilio* DOBSON, Catal. Chiropt. Brit. Mus., p. 284. Not *Vespertilio* Linnæus, 1758.
1894. *Vespertilio* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 70, March 14, 1894.
1897. *Myotis* MILLER, Ann. and Mag. Nat. Hist., 6th ser., XX, p. 382, October, 1897.
1897. *Myotis* MILLER, North Amer. Fauna, No. 13, p. 55, October 16, 1897.

Type-species.—*Vespertilio myotis* Bechstein.

Geographic distribution.—Entire mainland of Eastern and Western Hemispheres to limits of tree growth; also the Malay Archipelago, New Guinea, Australia, and Samoa, and in America the Lesser Antilles.

Number of forms.—About eighty species of *Myotis* are now known, making the genus one of the largest, as well as the most widely distributed of the order.

Characters.—Dental formula:

$$\frac{-\,2\,3.\,1.\,-\,2\,3\,4\,5\,6\,7}{1\,2\,3.\,1.\,-\,2\,3\,4\,5\,6\,7}\; i\,\frac{2-2}{3-3},\; c\,\frac{1-1}{1-1},\; pm\,\frac{3-3}{3-3},\; m\,\frac{3-3}{3-3}=38.$$

Upper incisors well developed, subequal, closely crowded, the crowns higher than long, subterete; the inner with a distinct posterior secondary cusp, the outer with a well-developed concave surface directed toward canine, from which it is separated by a space not quite equal to diameter of both incisors together. Lower incisors with crowns about equal in length, forming a continuous, strongly convex row between canines, the first and second with rather narrow, trilobed cutting edge, the third much wider, subterete, with three or four tubercles. Canines well developed, simple, with distinct though rather small cingulum and no secondary cusps. Cheek teeth both above and below strictly normal, m^1 and m^2 rather narrow on inner edge and with hypocone absent or very imperfectly developed, m^3 with three commissures and four or five cusps, according to the varying condition of the metacone, m_3, with second triangle smaller than first, but with all the elements of the tooth complete. Skull slender and lightly built, without special peculiarities of form, the rostrum nearly as long as braincase, the depth of braincase, including audital bulla, about equal to mastoid breadth, the sagittal crest low, but usually distinct, the palate deeply emarginate in front, abruptly contracted behind, the sides of its posterior extension parallel. Audital bullæ well developed and covering more than half surface of cochleæ, but simple in form and not very large, their diameter about equal to the distance between them. Ear well developed, slender, occasionally rather large; tragus slender and nearly or quite straight. Foot very variable in size, but never peculiar in form. Tail about as long as outstretched leg. Interfemoral membrane large, its surface furred at extreme base above.

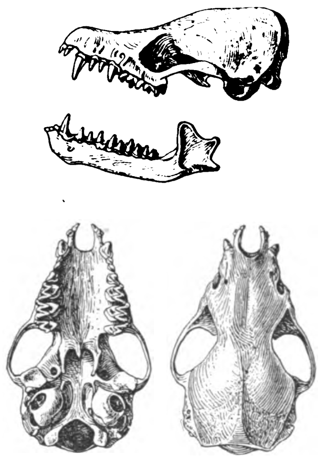

FIG. 31.—PIZONYX VIVESI. GUAYMAS. MEXICO. NO. 123701. ×1½.

Species examined.—I have examined about half the known forms of *Myotis*.

Remarks.—*Myotis* appears to be the most primitve genus of Vespertilionidæ, as it not only retains the maximum number of teeth known in the order, but it also has the slightest possible degree of special modification in external form.

Genus PIZONYX Miller.

1906. *Pizonyx* MILLER, Proc. Biol. Soc. Washington, XIX, p. 85, June 4, 1906.

Type-species.—*Myotis vivesi* Menegaux.

Geographic distribution.—Known only from two localities in northwestern Mexico; Cardonal Island, Gulf of California, and Guaymas, Sonora.

Number of forms.—Only the type species is thus far known.

Characters.—Like *Myotis*, but with foot (claws included) as long as tibia, the toes and claws greatly compressed, so that width of claw is only about one-eighth the height at base; wing with large glandular mass (in females 10 mm. long and 3 mm. wide) near middle of fore-arm. Skull (fig. 31) and teeth as in *Myotis*, but cingulum of lower canine forming a small cusp anteriorly and inner cusps of lower molars unusually well developed.

Species examined.—*Pizonyx vivesi* (Menegaux).

Remarks.—The size of the foot relatively to the tibia exceeds that in any of the large-footed species of *Myotis*, while the extreme compression of the claws is noticeably unlike any members of the related genus. The presence of the glandular masses in the wing is a character unique in the family, though apparently analogous structures occur on the ear of *Rhogeëssa gracilis*.

Genus LASIONYCTERIS Peters.

1831. *Vespertilio* LE CONTE. McMurtrie's Cuvier, Anim. Kingd., I, p. 31 (part). Not *Vespertilio* Linnæus 1758.

1864. *Scotophilus* H. ALLEN. Monogr. Bats N. Amer., p. 27, June, 1864 (part).

1865. *Lasionycteris* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 648.

1870. *Cnephalophilus* FITZINGER, Sitzungsber. kais. Akad. Wissensch., Wien, Math.-Naturwissensch. Classe LXII, p. 8 (part).

1875. *Vesperides* COUES, in Coues and Yarrow, Zoology of Wheeler's Exped., p. 83.

1878. *Lasionycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 238 (subgenus of *Vesperugo*).

1894. *Lasionycteris* H. ALLEN, Monogr. Bats N. Amer., 1893, p. 104, March 14, 1894.

1897. *Lasionycteris* MILLER, North Amer. Fauna, No. 13, p. 85, October 16, 1897.

Type-species.—*Vespertilio noctivagans* Le Conte.

Geographic distribution.—Northern North America south through the United States.

Number of forms.—The type species only.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=36.$$

Structure of teeth as in *Myotis;* upper incisors of same general form and relative size, the inner strongly bicuspidate, the outer simple; cheek teeth not peculiar except that pm^3 is absent, and the hypocone is distinctly indicated in first and second upper molars; third upper molar with more than half the crown area of first, its metacone nearly as large as paracone, and the three commissures well developed. Skull flattened, with broad rostrum, the depth of braincase including audital bullæ about three-fourths mastoid breadth; sagittal crest obsolete; interorbital region wide, flattish, the upper edge of orbit with a low "bead," which near middle forms an angle suggesting an incipient postorbital process; upper surface of rostrum with distinct concavity on each side between lachrymal region and nares; other features of skull essentially as in *Myotis*, except for a general tendency toward broadening and shortening. Ear short, nearly as broad as long, the tragus short, straight, and bluntly rounded, its width more than half length of anterior margin. Interfemoral membrane furred on basal half above.

Species examined.—*Lasionycteris noctivagans* (Le Conte).

Remarks.—In its dention, *Lasionycteris* very closely resembles *Myotis*, differing only in the absence of the small, middle upper premolar. In the form of the skull and in the peculiar short, broad ears it shows greater specialization than some of the genera with more highly modified teeth.

Genus PIPISTRELLUS Kaup.

1829. *Pipistrellus* KAUP, Skizzirte Entwick.-Gesch. u. natürl. Syst. d. europ. Thierw., I, p. 98 (*pipistrellus*).

1837. *Pipistrellus* BONAPARTE, Icon. della Fauna Ital., I, fasc., XX.

1838. *Romicia* GRAY, Mag. Zool. and Bot., II, p. 495, February, 1838 (*calcarata=kuhlii*).

1839. *Vesperugo* KEYSERLING and BLASIUS, Wiegmann's Archiv für Naturgeschichte, 5ter Jahrg., I, p. 312 (part).

1840. *Romicius* BLYTH, Cuvier's Animal Kingdom, p. 75.

1856. *Hypsugo* KOLENATI, Allgem. deutsch. naturhist, Zeitung, Dresden, neue Folge, II, p. 131 (*maurus* and *krascheninikowii*).

1856. *Nannugo* KOLENATI, Allgem. deutsch. naturhist, Zeitung, Dresden, neue Folge, II, p. 131 (*nathusii*, *pipistrellus*, and *kuhlii*).

1864. *Scotophilus* H. ALLEN, Monogr. Bats N. Amer., p. 27, June, 1864 (part).

1871. *Pipistrellus* DOBSON, Proc. Asiat. Soc. Bengal, p. 213.

1878. *Vesperugo* DOBSON, Catal. Chiropt. Brit. Mus., p. 183 (part).

1894. *Vesperugo* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 121, March 14, 1894.

1897. *Pipistrellus* MILLER, Ann. and Mag. Nat. Hist., 6th ser., XX, p. 384, October, 1897.

1897. *Pipistrellus* MILLER, North Amer. Fauna, No. 13, p. 87, October 16, 1897.

Type-species.—*Vespertilio pipistrellus* Schreber.

Geographic distribution.—Entire mainland of Eastern Hemisphere to limits of tree growth, also Malay Archipelago, New Guinea, Solomon Islands, and northern Australia; in America from northern United States (except in boreal zone) to southern Mexico.

Number of forms.—About 40 species of *Pipistrellus* are now recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.-2-4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.-2-4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=34.$$

Teeth strictly normal and not differing in any essential features from those of *Myotis* and *Lasionycteris*, except in the absence of both pm^3 and pm_3. Outer upper incisor not as large as inner, but extending considerably beyond its cingulum. Inner upper incisor simple, or more often with a well-developed secondary cusp.[a] Canines usually rather stout, the posterior cutting edge of upper tooth often, though not invariably, with incipient secondary cusp. Anterior upper premolar barely or not in toothrow. Other teeth with no special peculiarities. Skull (fig. 32) essentially as in *Myotis*, though with a tendency to greater breadth. External characters not essentially different from those of *Myotis*, but ear usually shorter and broader, and tragus less acutely pointed; in some species bent forward at tip.

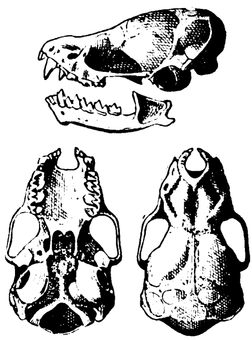

FIG. 32.—PIPISTRELLUS PIPISTRELLUS. × 2.

Species examined.—About half the known species have been examined.

Remarks. — As stated by Flower and Lydekker, the coracoid in *Pipistrellus* is bifid at tip, though very slightly. It differs further from that of *Myotis* in its much slighter curvature. The members of the genus are recognizable by their dental formula, large outer upper incisor, unmodified skull and ears, and the normally long fifth finger. The species are all small, some of them the smallest of known bats.

Genus GLISCHROPUS Dobson.

1875. *Glischropus* DOBSON, Proc. Zool. Soc. London, p. 472 (*nanus* and *tylopus*). Subgenus of *Vesperugo*.

1878. *Vesperugo* DOBSON, Catal. Chiropt. Brit. Mus., p. 183 (part).

Type-species.—*Vesperugo tylopus* Dobson.

Geographic distribution.—Borneo and Batchian.

Number of forms.—This genus, as here understood, contains the species *tylopus* Dobson and *batchianus* Matschie and *krefftii* Peters; *nanus*, although referred to it by Dobson, proves to have the teeth of true *Pipistrellus*.

Characters.—Externally like *Pipistrellus*, but with the callosities on sole of foot and ball of thumb usually more developed. Teeth as in *Pipistrellus* except that outer upper incisor is forced outward from the toothrow and so turned that its convexity is directed outward instead of backward.

Species examined.—*Glischropus tylopus* (Dobson) and *G. krefftii* (Peters).

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[a] This cusp is present in *Pipistrellus abramus*, *P. ceylonicus*, *P. chrysothrix*, *P. imbricatus*, *P. kuhlii*, *P. mimus*, *P. murrayi*, *P. papuanus*, *P. pipistrellus*, and *P. raptor*. It is absent in *P. ariel*, *P. crassulus*, *P. deserti*, *P. hesperus*, *P. nanus*, *P. nanulus*, *P. ridleyi*, and *P. subflavus*.

Genus SCOTOZOUS Dobson.

1875. *Scotozous* DOBSON, Proc. Zool. Soc. London, p. 372.
1878. *Scotozous* DOBSON, Catal. Chiropt. Brit. Mus., p. 243 (subgenus of *Vesperugo*).

Type-species.—*Scotozous dormeri* Dobson.

Geographic distribution.—India and northwestern Africa.

Number of forms.—Four, *Scotozous dormeri* Dobson, *S. rüppelii* Fischer (=*Vesperugo temminckii* of Dobson), *S. pulcher* Dobson, and *S. deserti* (Thomas).

Characters.—Like *Pipistrellus*, but with outer upper incisor very minute, its acutely pointed tip not extending beyond cingulum of inner. The small tooth lies external to the line between canine and inner incisor, and the large tooth is separated from canine by a space less than half its breadth. Premaxillary shortened proportionately with reduction of incisors. Upper canine without secondary cusp. Cheek teeth normal.

Species examined.—*Scotozous dormeri* (Dobson), *S. rüppelii* (Fischer), and *S. deserti* (Thomas).

Remarks.—In *Scotozous rüppelii* the inner upper incisor is strongly bicuspid (in *dormeri* it is simple) and the premaxillary is less shortened. The small outer incisor is, however, exactly as in *S. dormeri.*

Genus IA Thomas.

1902. *Ia* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., X, p. 163, August, 1902.

Type-species.—*Ia io* Thomas.

Geographic distribution.—Southern Hupeh, China.

Number of forms.—Only the type species has yet been discovered.

Characters.—Similar to *Scotozous*, but differing in the form of the outer incisor, the crown of which is flat, with well-developed cingulum and barely indicated central elevation, and in the less development of the mesostyle in m^1 and m^2, this cusp barely extending outward to line joining extremities of parastyle and metastyle, while in the related genera it extends distinctly beyond. The size of the only known species is much greater than in the members of the genus *Scotozous;* greatest length of skull 27 mm. instead of about 14 mm.

Species examined.—*Ia io* Thomas.

Remarks.—The relationship of *Ia* to *Scotozous* is undoubtedly very close, but the dental characters are perhaps sufficient to keep the genera separate. The difference in aspect due to the great size of *Ia io* is very striking.

Genus PTERYGISTES Kaup.

1829. *Pterygistes* KAUP, Skizzirte Entw.-Gesch. u. natürl. Syst. der europ. Thierw., I, p. 99 (*noctula*).
1839. *Vesperugo* KEYSERLING and BLASIUS, Wiegmann's Archiv. für Naturgesch., 5ter Jahrg., I, p. 312 (part).
1842. *Noctulinia* GRAY, Ann. and Mag. Nat. Hist., X, p. 258 (part; contained *proterus*=*noctula* and *fulvus*=*Scotophilus kuhlii.*)
1856. *Panugo* KOLENATI, Allgem. deutsch. naturhist., Zeitung, Dresden, neue Folge, II, p. 131 (*noctula* and *leisleri*).
1878. *Vesperugo* DOBSON, Catal. Chiropt. Brit. Mus., p. 183 (part).
1893. *Noctulinia* H. ALLEN, Proc. U. S. National Museum, p. 30, June 13, 1893.
1897. *Pterygistes* MILLER, Ann. and Mag. Nat. Hist., 6th ser., XX, p. 384, October, 1897.

Type-species.—*Vespertilio noctula* Schreber.

Geographic distribution.—Northern portion of Eastern Hemisphere from the Azores to Japan.

Number of forms.—Eight species of *Pterygistes* are known: *P. azoreum* Thomas, *P. lasiopterus* (Schreber), *P. leisleri* (Kuhl), *P. maxima* (Fatio), *P. noctula* (Schreber), *P. stenopterus* (Dobson), *P. madeiræ* Barrett-Hamilton, and *P. montanus* Barrett-Hamilton.

Character.—In general like *Pipistrellus*, with which it agrees in dental formula; fifth finger much shortened, scarcely longer than metacarpal of fourth and third; skull with nares extending unusually far back, half way to interorbital constriction, and with very large anterior palatal emargination; teeth as in *Pipistrellus*, but outer upper incisor very deeply concave and with a large anterior and small posterior secondary cusp; canine and pm^4 always strongly in contact; pm^3 very small, quite invisible from outer side; canines without trace of secondary cusps; first and second upper molars with small but rather distinct hypocones; third upper molar with about half the crown area of first, its metacone and three commissures well developed; lower molars strictly normal in all respects.

Species examined.—I have examined all the known species.

Remarks.—Though rather closely related to *Pipistrellus* and its allies, this genus is well differentiated by the shortened fifth finger. In the related genera with wing of normal form the fifth finger exceeds the combined length of metacarpal and first phalanx of fourth or third digit.

Genus EPTESICUS Rafinesque.

1820. *Eptesicus* RAFINESQUE, Annals of Nature, p. 2 (*melanops*=*fuscus*).
1829. *Cnephæus* KAUP, Skizzirte Entw.-Gesch. u. natürl. Syst. der europ. Thierw., I, p. 103 (*serotinus*).
1839. *Vesperugo* KEYSERLING and BLASIUS, Wiegmann's Archiv. für Naturgeschichte, 5ter Jahrg., I, p. 312 (part),

1839. *Vesperus* KEYSERLING and BLASIUS, Wiegmann's Archiv. für Naturgeschichte, 5ter Jahrg., I, p. 313 (subgenus of *Vesperugo*, part).

1841. *Noctula* BONAPARTE, Iconogr. Fauna Ital., fasc. XXI, in account of *Vespertilio alcythæ* (*scrotinus*).

1856. *Cateorus* KOLENATI, Allgem. deutsch. naturhist. Zeitung, Dresden, neue Folge, II, p. 131 (*scrotinus*).

1856. *Meteorus* KOLENATI, Allgem. deutsch. naturhist. Zeitung, Dresden, neue Folge, II, p. 131 (part).

1858. *Amblyotus* KOLENATI, Sitz. ber. kais. Akad. Wissensch., Wien, Math. Naturwissensch, Classe, XXIX, p. 252 (*atratus=nilssoni*).

1863. "*Aristippe* KOLENATI, Beiträge zur Kenntniss der Phthiriomyiarien, Petersburg, 1863" (part; included both *discolor=murinus* and *nilssoni*).

1864. *Scotophilus* H. ALLEN, Monogr. Bats N. Amer., p. 27, June, 1864 (part).

1866. *Pachyomus* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 90, February, 1866 (*pachyomus*).

1870. *Nyctiptenus* FITZINGER, Sitz. ber. kais. Akad. Wissensch., Wien, Math. Naturwissensch., Classe, LXII, p. 424 (*smithii*).

1878. *Vesperus* DOBSON, Catal. Chiropt. Brit. Mus., p. 184 (subgenus of *Vesperugo*) part.

1892. *Adelonycteris* H. ALLEN, Proc. Acad. Nat. Sci. Philadelphia, 1891, p. 466, January 19, 1892 (part: substitute for *Vesperus*, preoccupied).

1894. *Adelonycteris* H. ALLEN, Mongr. Bats N. Amer. (1893), p. 111, March 14, 1894.

1897. *Vespertilio* MILLER, Ann. and Mag. Nat. Hist., 6th ser., XX, p. 384, October, 1897 (part).

1897. *Vespertilio* MILLER, North American Fauna, No. 13, p. 95, October 16, 1897 (part).

1900. *Eptesicus* MÉHELY, Monogr. Chiropt. Hungariæ, p. 219 (part: included both *murinus* and *borealis=nilssoni*).

1900. *Eptesicus* MÉHELY, Monogr. Chiropt. Hungarlæ, p. 206.

Type-species.—*Eptesicus melanops=Vespertilio fuscus* Beauvios.

Geographic distribution.—Africa, Madagascar, Australia, Asia (except Malay region); America from southern Canada southward (except Lesser Antilles).

Number of forms.—About 45 species of *Vespertilio* are now known.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Teeth strictly normal throughout and showing no special peculiarities. Both upper incisors well developed, the inner larger than the outer and usually with distinct secondary cusp, the outer separated from canine by a space equal to its greatest diameter. Lower incisors subequal, trifid, the crown of the third wider than that of either the first or second. They are closely crowded and distinctly imbricated, forming a strongly convex row between canines. Canines simple, with distinct cingulum, but no secondary cusps. Premolars with no special peculiarities. Molars normal; m^1 and

m^2 with hypocone always indicated and in some species well developed, a distinct concavity between it and protocone; m^3 variable in form, usually with well developed metacone and three commissures in the smaller species, but with metacone and third commissure obsolete in the larger forms; lower molars with all the cusps present and of normal form. Skull not essentially different from that of *Pipistrellus*, the rostrum flattish or more usually rounded off above, the nares and palatal emargination not specially enlarged, the latter at least as deep as wide. Externally as in the related genera.

Species examined.—*Eptesicus capensis* (Smith) and related forms, *E. serotinus* (Schreber), *E. platyops* (Thomas), *E. megalurus* (Temminck), *E. matroka* (Thomas and Schwann), *E. rendalli* Thomas, *E. hillarii* (Geoffroy), *E. dorianus* (Dobson), *E. minutus* (Temminck), *E. matschiei* Thomas, *E. tenuipinnis* (Peters), *E. nilssoni* (Keyserling and Blasius), *E. fuscus* (Beauvois) and related forms.

Remarks.—Notwithstanding the great difference in size between such species as *Eptesicus pachyomus* and *E. pumilus*, the characters of the genus are very constant. In the smaller forms the skull is more slender and *Myotis*-like and the last upper molar is better developed, while in the larger species the skull is more angular.

Genus VESPERTILIO Linnæus.

1758. *Vespertilio* LINNÆUS, Syst. Nat., I, 10th ed., p. 31 (*murinus*).
1839. *Vesperugo* KEYSERLING and BLASIUS, Wiegmann's Archiv. für Naturgeschichte, 5ter Jahrg., I, p. 312 (part).
1839. *Vesperus* KEYSERLING and BLASIUS, Wiegmann's Archiv. für Naturgeschichte, 5ter Jahrg., I, p. 313. Subgenus of *Vesperugo* (part).
1856. *Meteorus* KOLENATI, Allgem. deutsch. naturhist. Zeitung, Dresden, neue Folge, II, p. 131 (part; included *nilssoni*, "*discolor*"=*murinus*, *savii*, *leucippe*, and *aristippe*).
1863. "*Aristippe* KOLENATI, Beiträge zur Kenntniss der Phthiriomyiarien, Petersburg, 1863" (part: included both *murinus* and *nilssoni*).
1872. *Marsipolæmus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 260 (subgenus of *Vesperugo* for *albigularis*=*murinus*).
1878. *Vesperus* DOBSON, Catal. Chiropt. Brit. Mus., p. 183 (subgenus of *Vesperugo*), part.
1897. *Vespertilio* MILLER, Ann. and Mag. Nat. Hist., 6th ser., XX, p. 384. October, 1897 (part).
1897. *Vespertilio* MILLER, North American Fauna, No. 13, p. 95, October 16, 1897 (part).
1900. *Vespertilio* MÉHELY, Monogra. Chiropt. Hungariæ, p. 219 (part: included both *murinus* and "*borealis*"=*nilssoni*).

Type-species.—*Vespertilio murinus* Linnæus.

Geographic distribution.—Northern portions of Europe and Asia.

Number of forms.—The genus *Vespertilio* as now restricted contains only two forms, *murinus* Linnæus and *superans* Thomas.

Characters.—Like *Eptesicus*, but ear much shortened and broadened, rostrum flattened above, with a deep concavity on each side between nares and lachrymal region; nares very large and extending back nearly half way to interorbital constriction, and palatal emargination extended so far laterally that its width is distinctly greater than its depth.

Species examined.—*Vespertilio murinus* Linnæus and *V. superans* Thomas.

Remarks.—With regard to the necessity for distinguishing *Vespertilio* generically from *Eptesicus*, I agree with Méhely. The species *nilssoni* (=" *borealis* "), however, shows none of the special cranial peculiarities of *Vespertilio*, but is in all respects a typical *Eptesicus* as the genera are here understood. The skull of *Vespertilio* shows a strong likeness to that of *Lasionycteris;* and it is worthy of remark that the members of the two genera further resemble each other in the rather unusual " frosted " coloring of the back. The type of *Vesperugo* (*Marsipolæmus*) *albigularis* Peters, which I have examined in Berlin, is, as suggested by Méhely, merely a specimen of *Vespertilio murinus.*

Genus RHINOPTERUS Miller.

1906. *Rhinopterus* MILLER, Proc. Biol. Soc. Washington, XIX, p. 85, June 4, 1906.

Type-species.—*Glauconycteris floweri* de Winton.

Geographic distribution.—Southern Soudan.

Number of forms.—Only the type species has been thus far discovered.

Characters.—Externally like a small *Eptesicus*, but upper surface of forearm, tail, and tibia thickly sprinkled with pointed, horny excrescences resembling those on edge of ear in some of the Molossidæ, but larger. Metacarpals as in *Eptesicus*. Skull differing from that of *Eptesicus* in much greater relative breadth of anterior portion of braincase, shorter, lower rostrum, and in the form of the upper toothrows as a whole, these being more concave on inner side and more convergent anteriorly. Teeth as in *Eptesicus.*

Type-species.—*Glauconycteris floweri* (de Winton).

Remarks.—The extraordinarily roughened surface of the forearm, tail, and tibia, together with the peculiar form of the skull and of the upper toothrow, distinguish this genus very sharply from its ally, *Eptesicus.*

Genus HESPEROPTENUS Peters.

1868. *Hesperoptenus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 626 (subgenus of *Vesperus*).
1878. *Hesperoptenus* DOBSON, Catal. Chiropt. Brit. Mus., p. 183 (subgenus of *Vesperugo*).

Type-species.—*Vesperus doriæ* Peters.

Geographic distribution.—India and the Malay region.

Number of forms.—Three species of *Hesperoptenus* are now known: *H. doriæ* (Peters), *H. tickelli* (Blyth), and *H. blanfordi* Dobson.

Characters.—Dental formula and general structure of teeth as in *Eptesicus* and *Vespertilio*; but outer upper incisor much larger, the area of its base more than half that of canine, which tooth, in its simple, strong shaft and well-developed cingulum, it rather closely resembles; space between inner incisor and canine scarcely perceptible, barely greater than width of cingulum of canine; outer upper incisor closely crowded between canine and inner incisor, forced backward from the toothrow, and quite invisible from the front; its crown scarcely reaching level of cingulum of the two neighboring teeth, but with area in cross section decidedly more than half that of inner incisor, the surface of the crown basin-shaped, with a large, but low, central cusp; other teeth like those of *Eptesicus*, the third upper molar with less than half the crown area of first, but with the metacone and three commissures distinct though small. Skull (fig. 33) broad, the zygomatic breadth nearly equal to upper length in median line, but with no special peculiarities in form; basisphenoid pits well developed, though shallow. Externally as in *Eptesicus*.

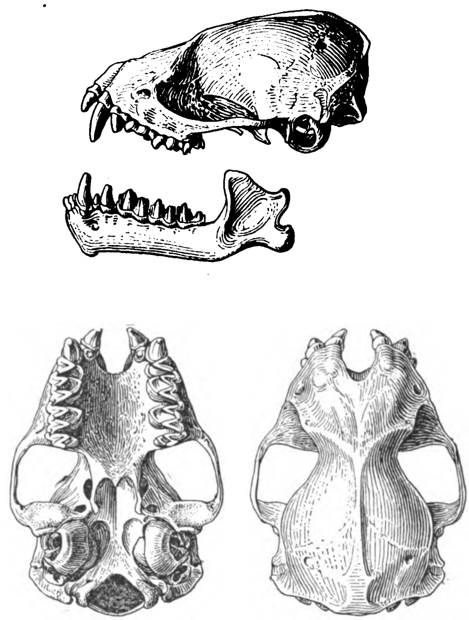

FIG. 33.—HESPEROPTENUS TICKELLI. CEYLON. No. 123437 ×2.

Species examined.—*Hesperoptenus tickelli* (Blyth).

Remarks.—It is with some hesitation that I apply the name *Hesperoptenus* to the genus represented by *H. tickelli*. I have not seen "*Vesperus*" *doriæ*, the type of *Hesperoptenus*, and certain features in the original description, notably what is said of the position of the outer upper incisor, make it seem possible that the animal is generically distinct from *tickelli* and *blanfordi*. The peculiarities of the prepuce and the presence of a large bone in the penis may indicate, as supposed by Dobson, that the three species form a single group, but the value of these characters is not yet well understood.

Genus TYLONYCTERIS Peters.

1872. *Tylonycteris* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 703.

1878. *Vesperus* DOBSON, Catal. Chiropt. Brit. Mus., p. 184 (subgenus *Vesperugo*) part.

1898. *Tylonycteris* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 321, July 25, 1898 (genus).

Type-species.—*Vespertilio pachypus* Temminck.

Geographic distribution.—Malay region from Tenasserim to the Philippine Islands.

Number of forms.—Only one species is now recognized.

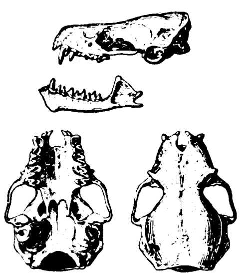

FIG. 34.—TYLONYCTERIS PACHYPUS. ADULT MALE. TRONG, LOWER SIAM. NO. 83526. ×1½.

Characters.—Externally like a small *Eptesicus* with the entire head greatly broadened and flattened and a conspicuous fleshy pad on ball of thumb and sole of foot. Skull (fig. 34) so broad that depth of brain case through audital bulla is barely one-half mastoid breadth; upper surface flat, sloping gradually forward to nares; rostrum very short and broad, its length scarcely equal to lachrymal breadth, its depth at front edge of orbit less than half breadth at same region; maxillaries not concealing tooth rows when viewed from above; a distinct blunt projection over anterior upper edge of orbit, perhaps representing an incipient postorbital process. Dental formula as in *Eptesicus*, and teeth not peculiar except in the following characters: Inner upper incisor conspicuously bicuspidate, its crown much longer than broad and nearly as long as high, the outer cusp projecting noticeably inward, so that the greatest width of the tooth is at level of its point; upper canine with a well-developed secondary cusp on posterior cutting edge, unconnected with cingulum and extending nearly to middle of main shaft.

Species examined.—*Tylonycteris pachypus* (Temminck).

Remarks.—This genus is well characterized by the remarkable flattening of the skull, a character which it shares with *Mimetillus* only, combined with the perfectly normal wing. The skull is so unusual in form that it appears almost as if artificially crushed. This tendency to widening is reproduced in the inner upper incisor, but not to any appreciable degree in the other teeth.

Genus MIMETILLUS Thomas.

1905. *Mimetillus* THOMAS, Proc. Zool. Soc. London, 1904, II, p. 188, April 18, 1905.

Type-species.—*Vesperugo moloneyi* Thomas.

Geographic distribution.—Fernando Po.

Number of forms.—The type species is the only form yet discovered.

Characters.—Dentition and skull as in *Tylonycteris*, but sides of rostrum projecting sufficiently to conceal tooth rows when viewed from above; antorbital foramina large and conspicuous, directed forward; inner upper incisor bifid though not specially modified in form; and upper canine without secondary cusp. Externally differing from all known bats in the greatly reduced wing, the third finger not longer than head and body; fifth metacarpal not quite equal to forearm in length, third and fourth equal to each other and slightly longer than forearm; tragus very short and broad, the free portion measured from anterior base less than one-third length of posterior border and barely equal to width at middle. Other external characters not essentially different from those of *Tylonycteris*.

Species examined.—*Mimetillus moloneyi* (Thomas).

Remarks.—The reduction in the size of the wings in *Mimetillus* is so great that specimens appear at first sight to be immature or even embryonic. Nothing comparable to this is known in other bats, since all of those with narrow wings, such as *Pterygistes*, *Lasiurus* and its allies, and the Molossidæ, have the third finger fully developed or even exaggerated in length, so that the wing loses none of its power.[a] Here, however, the third finger shares in the general shortening, and the efficiency of the wing is much impaired.[b]

Genus PHILETOR Thomas.

1902. *Philetor* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., IX, p. 220, March, 1902.

Type-species.—*Philetor rohui* Thomas.

Geographic distribution.—New Guinea.

Number of forms.—Only the type species is yet known.

Characters.—Dental formula and structure of teeth as in *Eptesicus* except that inner upper incisor is of the same lengthened, strongly two-pointed type as in *Tylonycteris*, the upper canine is similarly provided with a large secondary cusp, and the upper premolar is much crowded between canine and first molar, its width nearly three

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[a] That the *Lasiuri* are unusually strong of wing is shown by the fact that they alone have reached the Galapagos and Hawaiian Islands. The migratory habits of some of the species are well known.

[b] See Thomas, Ann. and Mag. Nat. Hist., 6th ser., VII, p. 528. June, 1891.

times its length along outer edge of alveolus. Skull (fig. 35) with rostrum relatively even more shortened than in *Tylonycteris*, and with very conspicuous peg-like projections over anterior edge of orbit, but without any of the flattening characteristic of *Tylonycteris* and *Mimetillus*, the depth of braincase through audital bulla nearly equal to width above posterior roots of zygomata. The general outline of the skull is therefore not unlike that of *Lasiurus*. Externally about as in *Pterygistes*, the fifth finger nearly as much shortened, its length equal to metacarpal and half of first phalanx of fourth. Penis with bone well developed as in *Hesperoptenus*, but distinctly expanded distally. Ear short.

Species examined.—*Philetor rohui* Thomas.

Remarks.—This very distinct genus appears to be related to *Tylonycteris*, though lacking the peculiar flatness of the skull.

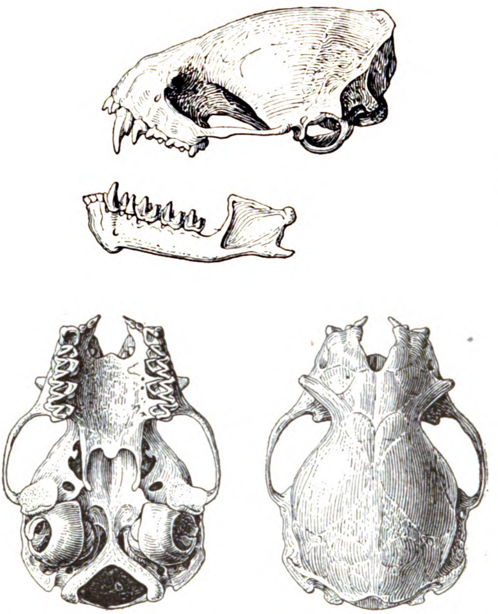

FIG. 35.—PHILETOR ROHUI. ALBERT, NEW GUINEA. NO. 123438. ×2⅔.

Genus HISTIOTUS Gervais.

1855. *Histiotus* GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 77.

1878. *Vesperus* DOBSON, Catal. Chiropt. Brit. Mus., p. 184 (subgenus of *Vesperugo*) part.

1900. *Histiotus* THOMAS, Ann. Mus. Civ. di Stor. Nat., 2d ser., XX, p. 546, July 4, 1900 (genus).

Type-species.—*Plecotus velatus* I. Geoffroy.

Geographic distribution.—South America.

Number of forms.—Five species of *Histiotus* are currently recognized.

Characters.—Dental formula and structure of teeth as in *Eptesicus*, but outer upper incisor considerably reduced, its tip scarcely extending beyond cingulum of inner. Skull as in *Eptesicus*, but more elongated and with larger audital bullæ, their diameter more than double width of space between them. Ears very large, at least as long as head, and united by a ridge or low band of membrane across forehead.

Species examined.—*Histiotus macrotus* (Poeppig), *H. velatus* (Geoffroy), and *H. montanus* (Philippi).

Genus LÆPHOTIS Thomas.

1901. *Læphotis* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., VII, p. 460, May, 1901.

Type-species.—*Læphotis wintoni* Thomas.

Geographic distribution.—British East Africa.

Number of forms.—Only the type species is thus far known.

Characters.—Very similar to *Histiotus*, but differing in the following particulars: Tragus spatulate, narrowed just above middle; skull with less elevated braincase, its general form much as in *Lasionycteris*, except that rostrum is slender and not flattened; zygomata longer and nearly parallel, not so abruptly bowed outward; audital bullæ smaller than in *Histiotus*, rather larger than in *Lasionycteris*, their diameter about equal to distance between them. The teeth are throughout as in *Histiotus*.

Species examined.—*Læphotis wintoni* Thomas.

Remarks.—The very striking similarity of this African genus to the South American *Histiotus* may be the result of parallel development from some *Eptesicus*-like ancestry, but I am inclined to believe that it indicates a relationship much less remote.

Genus OTONYCTERIS Peters.

1859. *Otonycteris* PETERS, Monatsber. k. preuss. Akad. Wissensch, Berlin, p. 223.

1878. *Otonycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 181.

Type-species.—*Otonycteris hemprichii* Peters.

Geographic distribution.—Northern Africa and central and southwestern Asia.

Number of forms.—Two species of *Otonycteris* are now known.

Characters.—Dental formula:

$$\frac{-2-.1.---4567}{123.1.-2-4567}\; i\, \frac{1-1}{3-3},\; c\, \frac{1-1}{1-1},\; pm\, \frac{1-1}{2-2},\; m\, \frac{3-3}{3-3}=30.$$

Externally like a large *Myotis*, the ears proportionally larger, but not differing appreciably in form. Skull essentially like that of the larger species of *Eptesicus*, but deeper in interorbital region and slightly narrower in general outline; interorbital region flat dorsally, the edge of the orbit forming a distinct angle that suggests an incipient postorbital process; audital bullæ very large, though not peculiar in form, their greatest diameter about three times the distance between them and slightly more than width of palate between last molars. The teeth resemble those of *Eptesicus*, except for the absence of the outer incisor and for the following details in structure:

Upper incisor (i^2) larger, its shaft unicuspid, but the cingalum produced into a conspicuous cusplike heel directed backward and outward and occupying much the same position as the outer tooth of *Eptesicus*; m^3 with practically no trace of mesostyle or metacone. the short commissure extending back from paracone directed inward instead of outward; lower teeth as in *Eptesicus*, except that the incisors are bicuspid and very slightly imbricated.

Species examined.—*Otonycteris hemprichii* Peters and *O. petersi* Anderson and de Winton.

Remarks.—Though readily distinguishable from its allies by the details of its characters, but especially by the greatly enlarged audital bullæ, this genus appears to be closely related to *Eptesicus*, *Scoteinus*, *Scotomanes*, and others with the auditory apparatus not specially modified. Its likeness to *Plecotus* is evidently more superficial than real, as the nostrils are strictly of the Vespertilionine type.

Genus NYCTICEIUS Rafinesque.

1819. *Nycticeius* RAFINESQUE, Journ. de Physique, LXXXVIII, p. 417. June, 1819.
1827. *Nycticeus* LESSON, Man. de Mammal., p. 98.
1827. *Nycticejus* TEMMINCK, Monogr. de Mammal., I, p. XVIII.
1830. *Nycticeyx* WAGLER, Natürl. Syst. der Amph, p. 13.
1831. *Nycticea* LE CONTE, McMurtrie's Cuvier, Anim. Kingd., p. 432.
1878. *Nycticejus* DOBSON, Catal. Chiropt. Brit. Mus., p. 266.
1894. *Nycticejus* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 131, March 14, 1894.
1897. *Nycticeius* MILLER, North Amer. Fauna, No. 13, p. 118, October 16. 1897.

Type-species.—*Nycticeius humeralis* Rafinesque.

Geographic distribution.—Southeastern United States; Cuba.

Number of forms.—Two species are known.

Characters.—External and cranial characters as in *Eptesicus*. Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{1\text{–}1}{3\text{–}3},\ c\ \frac{1\text{–}1}{1\text{–}1},\ pm\ \frac{1\text{–}1}{2\text{–}2},\ m\ \frac{3\text{–}3}{3\text{–}3}=30.$$

Upper incisor simple, unicuspid, nearly half as high as canine, with which it is in contact or nearly so. Lower incisors as in *Eptesicus*, the outer larger than either of the others. Upper premolar without cusp on inner side. Canines, molars, and lower premolars as in *Eptesicus*; m^3 with crown area more than half that of m^1 or m^2, its mesostyle, metacone, and three commissures well developed.

Species examined.—*Nycticeius humeralis* (Rafinesque) and *N. cubanus* (Gundlach)

Genus SCOTŒCUS Thomas.

1901. *Scotœcus* Thomas, Ann. and Mag. Nat. Hist., 7th ser., VII, p. 263, March, 1901.

Type-species.—Scotophilus albofuscus Thomas.

Geographic distribution.—Africa, except northern portion.

Number of forms.—Scotœcus albofuscus (Thomas), *S. hindei* Thomas, *S. hirundo* (de Winton).

Characters.—Externally like *Nycticeius.* Skull as in *Nycticeius*, but everywhere greatly broadened, the zygomatic breadth at least equal to basal length in median line; lachrymal region so wide that diameter of skull at front of orbits is considerably greater than that across outer edge of toothrows. Teeth as in *Nycticeius.*

Species examined.—I have examined all of the known species.

Remarks.—The great broadening of the skull, especially in the lachrymal region, combined with the perfectly *Nycticeius*-like teeth distinguish this genus from its allies.

Genus SCOTEINUS Dobson.

1875. *Scoteinus* Dobson, Proc. Zool. Soc. London, p. 371 (subgenus of *Scotophilus*).

1878. *Scoteinus* Dobson, Catal. Chiropt. Brit. Mus., p. 257 (subgenus of *Scotophilus*).

Type-species.—Scotophilus emarginatus Dobson.

Geographic distribution.—This genus is at present known from Africa, India, and Australia.

Number of forms.—Scoteinus balstoni Thomas, *S. emarginatus* (Dobson), *S. greyii* (Gray), *S. pallidus* (Dobson), and *S. schliefenii* (Peters).

Characters.—Externally like *Nycticeius.* Skull as in *Nycticeius*, but broader, though without the conspicuous widening in lachrymal region characteristic of *Scotœcus.* Teeth differing from those of both *Nycticeius* and *Scotœcus* in the reduction of the posterior portion of last molar both above and below; in m^3 both mesostyle and metacone are practically absent, though the position of each is indicated in the very short commissure back of protocone; m_3 with scarcely a trace of entoconid, and with second triangle very much smaller than first.

Species examined.—Scoteinus balstoni Thomas, *S. greyii* (Gray) and *S. schliefenii* (Peters).

Genus SCOTOMANES Dobson.

1875. *Scotomanes* Dobson, Proc. Zool. Soc. London, p. 371 (subgenus of *Scotophilus*).

1878. *Scotomanes* Dobson, Catal. Chiropt. Brit. Mus., p. 258 (subgenus of *Scotophilus*).

Type-species.—Nycticejus ornatus Blyth.

Geographic distribution.—Central and eastern Asia.

Number of forms.—Only the type species is yet known.

Characters.—Externally as in *Nycticeius* except that the fur has a distinct color pattern of white markings on a brown ground. Skull wider and not as deep as that of *Nycticeius*, the anterior palatal emargination relatively smaller than in any other member of the family, its greatest depth scarcely more than half as great as distance between upper canines. Lachmyral region somewhat expanded, and anterior edge of orbit distinctly beaded and angular.

Species examined.—*Scotomanes ornatus* (Blyth).

Genus RHOGEËSSA H. Allen.

1866. *Rhogeëssa* H. ALLEN, Proc. Acad. Nat. Sci. Philadelphia, p. 285.

1873. *Rhogoëssa* MARSCHALL, Nomenclator Zoologicus, Mamm., p. 11.

1878. *Rhogeëssa* DOBSON, Catal. Chiropt. Brit. Mus., p. 245 (subgenus of *Vesperugo*).

1894. *Rhogeëssa* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 132, March 14, 1894 (genus).

1897. *Rhogeëssa* MILLER, North American Fauna, No. 13, p. 122, October 16, 1897 (part).

Type-species.—*Rhogeëssa tumida* H. Allen.

Geographic distribution.—Warmer parts of America, north to central Mexico.

Number of forms.—Six species of *Rhogeëssa* are currently recognized.

Characters.—Like *Nycticeius*, but outer lobe of all three lower incisors obsolete and inner lobe practically absent also in the outer tooth, which is thus much reduced in size as compared with the other two, though its cutting edge, formed by the middle lobe, remains in line with the others, and functional.

Species examined.—*Rhogeëssa gracilis* Miller, *R. io* Thomas, *R. minutilla* Miller, *R. parvula* H. Allen, *R. tumida* H. Allen, and *R. velilla* Thomas.

Genus BÆODON Miller.

1897. *Rhogeëssa* MILLER, North American Fauna, No. 13, p. 122, October 16, 1897 (part).

1906. *Bæodon* MILLER, Proc. Biol. Soc. Washington, XIX, p. 85, June 4, 1906.

Type-species.—*Rhogeëssa alleni* Thomas.

Geographic distribution.—Jalisco, Mexico.

Number of forms.—The type is the only species known.

Characters.—Like *Rhogeëssa*, but with the 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. Third upper molar with posterior portion slightly more reduced than in *Rhogeëssa*.

Species examined.—*Bæodon alleni* (Thomas).

Genus PACHYOTUS Gray.

1821. *Scotophilus* Leach, Trans. Linn. Soc. London, XIII, p. 69 (*kuhlii*). Not *Scotophila* Hübner, 1816.

1831. *Pachyotus* Gray, Zoological Miscellany, No. 1, p. 38 (part). Name applied to a genus formed by combining *Nycticeius* and *Scotophilus*.

1878. *Scotophilus* Dobson, Catal. Chiropt. Brit. Mus., p. 256 (part).

Type-species.—*Scotophilus kuhlii* Leach.

Geographic distribution.—Africa, Madagascar, Southern Asia, and the Malay Archipelago.

Number of forms.—Ten species of this genus, the 'subgenus *Scotophilus*' of recent authors, are currently recognized.

Characters.—Externally as in *Eptesicus*. Skull with no special peculiarities; in the largest species a high backward-projecting occipital crest is developed. Teeth (Plates I, II, fig. 2) as in *Nycticeius*, except that the molars are distinctly abnormal. First and second upper molars with main cusps close together and so displaced outward that the protocone of m_1 is near middle of crown; styles reduced, particularly the mesostyle, which in some species (*gigas*, *heathi*, *nigrita*) is practically absent, thus greatly distorting the W pattern; third upper molar with protocone, paracone, parastyle, and two commissures, of which the second is very short. Lower molars with hypoconid and entoconid reduced in size, so that the second triangle in each tooth is smaller than the first and with the cusps noticeably lower; in m_3 the second triangle is so reduced that the homology of its single remaining cusp can not be satisfactorily determined.

Species examined.—*Pachyotus castaneus* (Horsfield), *P. gigas* (Dobson), *P. heathi* (Horsfield), *P. kuhlii* Leach, *P. nigrita* (Schreber), *P. wroughtoni* (Thomas).

Remarks.—From the related genera of Vespertilionidæ this group is readily distinguishable by the peculiarities of the molars. In the form of these teeth it is almost exactly paralleled by some of the quite unrelated Megadermidæ, while the line of development, of which this represents the first step, is carried much further in *Harpiocephalus*.

Genus CHALINOLOBUS Peters.

1866. *Chalinolobus* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 680.

1878. *Chalinolobus* Dobson, Catal. Chiropt. Brit. Mus., p. 246 (part).

Type-species.—*Vespertilio tuberculatus* Forster.

Geographic distribution.—New Zealand and Australia.

Number of forms.—Four species of *Chalinolobus* are currently recognized.

Characters.—Dental formula:

$$\frac{-\,2\,3.\ 1.\ -\,2\,-\,4\,5\,6\,7}{1\,2\,3.\ 1.\ -\,2\,-\,4\,5\,6\,7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=34.$$

Upper incisors simple, the four teeth lying almost in the same line, the outer well developed, but considerably smaller than the inner and separated from canine by a space about equal to the diameter of its crown; lower incisors trifid, their crowns strongly imbricated and increasing regularly in size from first to third, the series continuous between canines, and strongly, almost angularly convex. Canines well developed, simple. Cheek teeth strictly normal; pm^2 minute, crowded in inner angle between canine and large premolar, pm^4 with very small inner anterior cusp; m^1 and m^2 without hypocone, and with metacone, especially in m^1, unusually large, m^3 with rather more than half the crown area of m^1 or m^2, its mesostyle, metacone, and three commissures well developed; lower molars with the cusps normal in size and position. Skull (fig. 36) with rather short, deep braincase and broad, low rostrum, the length of which is about two-thirds that of braincase; a slightly angled ridge along edge of anterior portion of orbit; palate rising rather noticeably in front, and floor of braincase sloping upward posteriorly, so that the two surfaces are set at a distinct angle with each other; audital bullæ small; basisphenoid pits shallow and indistinct; palatal emargination broad and shallow, much as in *Lasiurus;* nares moderate, slightly longer than broad. Externally characterized by the short, broad head; low, rounded ears with tragus much widened above (its width along upper border nearly equal to length of anterior margin) and with antitragus continued forward to angle of mouth, where it terminates in a conspicuous lobe; swollen muzzle and chin, each of which is separated from wide lip by deep narrow groove; and slight or no graduation of metacarpals (fifth never less than third by more than one-eighth or one-tenth length of forearm).

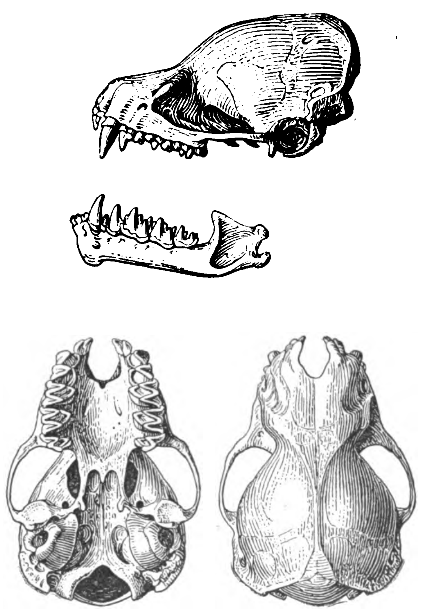

FIG. 36.—CHALINOLOBUS TUBERCULATUS. ADULT MALE. DUNNEDIN, NEW ZEALAND. NO. 38031. ×2⅔.

Species examined.—*Chalinolobus tuberculatus* (Forster), *C. signifer* Dobson, *C. gouldi* (Gray), and *C. nigrogriseus* (Gould).

Remarks.—In certain respects this genus and the next resemble *Lasiurus* and *Dasypterus*, particularly in the form of the head and ears and in the general structure of the skull. Externally the two

Old World genera are the more highly modified; but in cranial and dental characters the American forms depart more widely from the ordinary Vespertilionine type.

Genus GLAUCONYCTERIS Dobson.

1875. *Glauconycteris* DOBSON, Proc. Zool. Soc. London, p. 383 (subgenus of *Chalinolobus*).

1878. *Glauconycteris* DOBSON, Catal. Chiropt. Brit. Mus., p. 247 (subgenus of *Chalinolobus*).

1901. *Glauconycteris* DE WINTON, Ann. and Mag. Nat. Hist., 7th ser., VII, p. 46, January, 1901. Genus (part; included *Rhinopterus floweri*).

Type-species.—*Kerivoula poensis* Gray.

Geographic distribution.—Africa, south of the Sahara.

Number of forms.—Five species of *Glauconycteris* are now recognized: *G. argentatus* (Dobson), *G. beatrix* Thomas, *G. papilio* Thomas, *G. poensis* (Gray), and *G. variegatus* (Tomes).

Characters.—Very similar to *Chalinolobus*, but graduation of metacarpals more noticeable (one-fifth to one-sixth forearm), outer incisor crowded between canine and inner incisor, and small upper premolar (pm^2) absent. The third upper molar is relatively larger than in *Chalinolobus*, though of the same shape.

Species examined.—*Glauconycteris argentatus* (Dobson), *G. beatrix* Thomas, *G. papilio* Thomas, and *G. poensis* (Gray).

Genus LASIURUS Gray.

1831. *Lasiurus* GRAY, Zoological Miscellany, No. 1, p. 38.

1870. *Atalapha* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 907. Not *Atalapha* Rafinesque, 1814.

1878. *Atalapha* DOBSON, Catal. Chiropt. Brit. Mus., p. 267 (part).

1894. *Atalapha* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 141, March 14, 1894.

1897. *Lasiurus* MILLER, North American Fauna, No. 13, p. 105, October 16, 1897.

Type-species.—*Vespertilio borealis* Müller.

Geographic distribution.—America to the limits of tree growth, including the Bahama Islands and Greater Antilles; also the Galapagos and Hawaiian Islands.

Number of forms.—About a dozen forms of *Lasiurus* are now recognized.

Characters.—Dental formula:

$$\frac{-2-.1.-2-4\,5\,6\,7}{1\,2\,3.\,1.-2-4\,5\,6\,7}\ i\ \frac{1-1}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=32.$$

Upper incisor short and robust, in contact with canine, the greatest diameter of crown nearly equal to its height, the crown subterete though slightly triangular in outline; lower incisors closely imbricated, trifid, the outer slightly larger than either of the others;

canines well developed, not peculiar in form; anterior upper premolar minute, occupying the inner angle between canine and large premolar; other cheek teeth strictly normal; m^1 and m^2 without hypocone, m^3 much reduced, its crown area less than one-third that of m^1, the protocone, paracone, parastyle, and first commissure well developed, the mesostyle and second commissure obsolete, though not absent; lower molars with all the cusps well developed, m_3 with distinct entoconid. Skull short and broad, the brain case high and rounded, the rostrum sloping away rapidly in front so that its upper surface is nearly in line with that of brain case; nares and palatal emargination wide and shallow, the width of the emargination distinctly greater than its depth; palate sloping upward anteriorly, and floor of brain case rising posteriorly so that the two surfaces are set at noticeably different angles; audital bullæ well developed but not large, their diameter about equal to width of space between; basisphenoid pits narrow and elongate, but distinct; zygomata slender, not expanded at middle or elsewhere. Ear short, rounded. Wing with fifth finger much shorter than third, the third metacarpal usually exceeding fifth by at least length of thumb, though by distinctly less than length of thumb in *L. borealis.* Interfemoral membrane very large, most of its upper surface furred. Mammæ, 4.[a]

Species examined.—*Lasiurus borealis* (Müller) and the related forms, also *L. cinereus* (Beauvois) and *L. semota* (H. Allen).

Remarks.—This genus is well characterized by the short, deep skull, the graduated metacarpals, and the furred interfemoral membrane. The only genus that it is likely to be confused with is the closely related *Dasypterus*, from which it is distinguished by the presence of the small upper premolar (pm^2).

Genus DASYPTERUS Peters.

1864. *Lasiurus* H. ALLEN, Monogr. Bats N. Amer., p. 25 (part).

1871. *Dasypterus* PETERS, Monatsber, k. preuss. Akad. Wissensch., Berlin, 1870, p. 912 (subgenus of *Atalapha*).

1878. *Dasypterus* DOBSON, Catal. Chiropt. Brit. Mus., p. 274 (subgenus of *Atalapha*).

1894. *Dasypterus* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 137, March 14, 1894. (Genus.)

1897. *Dasypterus* MILLER, North American Fauna, No. 13, p. 115, October 16, 1897.

Type-species.—*Lasiurus intermedius* H. Allen.

Geographic distribution.—America, from the southern border of the United States (including Florida and the Gulf coast) southward; not yet recorded from the West Indies.

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[a] For notes on the mammæ and the unusual number of young in the Lasiurine bats, see Lyon, Proc. U. S. National Museum, XXVI, pp. 425–426, January 26, 1903, and Ward, Science, n. s., XXII, p. 20, July 7, 1905.

Number of forms.—Eight forms of *Dasypterus* are now known.

Characters.—Like *Lasiurus* but without the small upper premolar.

Species examined.—*Dasypterus egregius* (Peters), *D. ega* (Gervais) and its geographical forms, also *D. intermedius* (H. Allen) and *D. floridanus* Miller.

Remarks.—Though very closely related to *Lasiurus* this genus may, as a matter of convenience, be regarded as distinct.

Genus BARBASTELLA Gray.

1821. *Barbastella* GRAY, London Medical Repository, XV, p. 300, April 1, 1821.

1839. *Synotus* KEYSERLING and BLASIUS, Wiegmann's Archiv. für Naturgeschichte, 5ter Jahrg., I, p. 305.

1878. *Synotus* DOBSON, Catal. Chiropt. Brit. Mus., p. 175.

1897. *Barbastella* MILLER, Ann. and Mag. Nat. Hist., 6th ser., XX, p. 385, October, 1897.

Type-species.—*Vespertilio barbastellus* Schreber.

Geographic distribution.—Northern Africa; central and southern Europe; west central Asia to the Himalayas.

Number of forms.—Two species are known. *Barbastella barbastellus* (Schreber) and *B. darjelingensis* (Hodgson).

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=34.$$

Upper incisors well developed, the inner much larger than the outer, its inner cusp unusually distinct and producing a noticeable lengthening of the crown; outer incisor nearly in contact with canine, its crown with acuminate anterior cusp and distinct posterior concavity directed slightly outward; lower incisors subequal, trifid, the outer tooth larger than either of the others, the complete row very convex; upper canine simple, with distinct cingulum but no secondary cusps; lower canine with the cingulum produced into a noticeable anterior basal cusp; anterior upper premolar minute, crowded into angle between canine and large premolar; other cheek teeth, both above and below, normal; pm^4 with inner section unusually low and flat, without trace of inner cusp; m^1 and m^2 with very large protocone and no hypocone, m^3 with crown area distinctly more than half that of m^1 or m^2, its metacone and three commissures well developed; lower molars with the cusps all normal in position and size, though the protoconids are somewhat unusually slender and high. Skull with rather long, rounded brain case and weak rostrum, the upper surface of which is distinctly concave from edge of nares to faintly developed supraorbital ridges; audital bullæ not specially enlarged; zygomata not expanded at middle. Ears broad but not specially elongated (laid forward they do not reach tip of muzzle), joined across forehead. Nostrils opening upward and outward on a flat, median space between two high lateral swellings and behind a prominent median pad. Metacarpals very slightly graduated.

Species examined.—*Barbastella barbastellus* (Schreber).

Remarks.—Although differing very notably from the Plecotine *Plecotus*, *Corynorhinus* and *Euderma* in the dental formula, the small audital bullæ, and the simple zygoma, *Barbastella* is probably more closely related to these three genera than to any others. With them it shares the peculiar elongated, rounded, and rather low brain case, the weak rostrum, the distinctly graduated lower incisors, the slenderness and relatively great height of the protoconid of the lower molars, and a certain aspect of the upper molars. The last character is difficult to define, but it probably results from the wide spaces between the teeth, the large protocone, and a slight flattening of the W-pattern due to the somewhat decreased width of the outer section of the crowns.

Genus PLECOTUS Geoffroy.

1813. *Plecotus* GEOFFROY, Descr. de l'Égypte, II, p. 112.

1816. *Macrotus* LEACH, Catal. Spec. Indig. Mamm. and Birds Brit. Mus. (Willughby Society reprint, 1882), p. 1. *Nomen nudum.* The 'European Longear, *Macrotus europæus*.'

1878. *Plecotus* DOBSON, Catal. Chiropt. Brit. Mus., p. 177 (part).

Type-species.—*Vespertilio auritus* Linnæus.

Geographic distribution.—Temperate Europe, Asia, and northern Africa.

Number of forms.—Only the type species is at present definitely known.

Characters.—Dental formula:

$$\frac{-\,2\,3.\;1.\;-\,2\,-\,4\,5\,6\,7}{1\,2\,3.\;1.\;-\,2\,3\,4\,5\,6\,7}\;i\,\frac{2-2}{3-3},\;c\,\frac{1-1}{1-1},\;pm\,\frac{2-2}{3-3},\;m\,\frac{3-3}{3-3}=36.$$

Upper incisors well devoloped, each with a distinct secondary cusp, the inner tooth much smaller than the outer, and separated from canine by a space about equal to its diameter; lower incisors subequal, trifid, the crowns increasing in size from first to third, and forming a continuous, strongly convex row between canines. Upper canines rather small and weak, but not peculiar in form; lower canine with cingulum produced into a distinct though small anterior basal cusp. Cheek teeth normal, though rather small; anterior upper premolar (pm^2) in contact with canine, but separated from large premolar (pm^4) by a narrow space; posterior premolar with distinct though small inner cusp; upper molars short on inner side, the spaces between the crowns unusually large; m^1 and m^2 with no trace of hypocone; m^3 with crown area about half that of m^2, its metacone and third commissure small but distinct; lower molars with all the cusps present and well developed, the protoconid noticeably higher than the hypoconid. Skull with large, elongate and rounded brain case, but with rostrum slender and reduced, its upper surface, however, of the normal, laterally convex form; lachrymal ridges well developed; audital bullæ large, rounded, their greatest diameter equal to about three times the distance between them. Ears very large, much longer than head, joined across forehead; nostrils opening upward, their orifice continued backward by a slit-like prolongation, the warty outgrowths on muzzle not especially prominent.

Species examined.—*Plecotus auritus* (Linnæus).

Genus CORYNORHINUS H. Allen.

1831. *Plecotus* LE CONTE, McMurtrie's Cuvier, Animal Kingdom, I, p. 431 (part, see p. 84).

1364. *Synotus* H. ALLEN, Monogr. Bats N. Amer., p. 62 (not of Keyserling and Blasius, 1839).

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

1865. *Corynorhynchus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 524, October, 1865.

1878. *Corynorhinus* DOBSON, Catal. Chiropt. Brit. Mus., p. 180 (subgenus of *Plecotus*).

1894. *Corynorhinus* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 53, March 14, 1904 (genus).

1897. *Corynorhinus* MILLER, North American Fauna, No. 13, p. 49.

Type-species.—*Plecotus macrotis* Le Conte.

Geographic distribution.—Warmer portions of North America, from southern British Columbia and the southeastern United States to southern Mexico.

Number of forms.—Three forms are currently recognized.

Characters.—Externally like *Plecotus*, but glandular masses on muzzle rising high above nostrils; skull differing from that of *Plecotus* in the smoothly rounded lachrymal region; teeth as in *Plecotus*.

Species examined.—I have examined all the known forms.

Remarks.—The great development of the glandular masses on muzzle, and the absence of the distinct lachrymal ridge, distinguish this genus sufficiently from *Plecotus*.

Genus EUDERMA H. Allen.

1891. *Histiotus* J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., III, p. 195 (not of Gervais, 1855).

1892. *Euderma* H. ALLEN, Proc. Acad. Nat. Sci. Philadelphia, 1891, p. 467, January 12, 1892.

1894. *Euderma* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 60, March 14, 1894.

1897. *Euderma* MILLER, North Amer. Fauna, No. 13, p. 46, October 16, 1897.

1903. *Euderma* MILLER, Proc. Biol. Soc. Washington, XVI, p. 165, November 30, 1903.

Type-species.—*Histiotus maculatus* J. A. Allen.

Geographic distribution.—Southwestern United States.

Number of forms.—The type species is the only member of the genus thus far discovered.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=34.$$

Upper incisors alike in form, slender, with well-developed cingula, and simple, styliform crowns, the outer somewhat larger than inner, which is in contact or nearly so with canine; lower incisors trifid, the middle lobe largest, especially in i_2 and i_3. Upper canine small and weak, barely more than twice the height of inner incisor, which it rather closely resembles in form; lower canine relatively smaller than in any other known Vespertilionine bat, its crown scarcely higher than that of pm_4 and not as high as protoconid of m_1 or m_2, with a noticeable posterior heel rising at edge to a distinct cusp, and a large secondary cusp anteriorly rising above crown of outer incisor, and giving the tooth when viewed from the side and slightly in front an unequally bilobed appearance unique so far as I have seen in the order. Anterior upper premolar minute, scarcely more than one-third as large as outer incisor and rising barely to cingulum of canine. It stands in the tooth row at the middle of the narrow space between canine and large premolar, and in form resembles the incisors, except that the crown is relatively lower and thicker; large premolar of the usual form, but very deeply concave on anterior border; lower premolars of the ordinary Vespertilionine type. Molars normal; m^1 and m^2 with barely indicated hypocone, and with protocone separated from outer cusps by a rather unusually wide space, paracone and metacone high and slender, mesostyle rather short but W pattern very distinct; m^3 with well-developed metacone and three commissures, the area of its crown fully half that of either of the other molars; lower molars with all the cusps unusually high and slender, especially the protoconids, which considerably exceed the hypoconids; a distinct though low cingulum cusp behind the entoconid in each tooth. Skull (fig. 37) with large, rounded, though rather low brain case and excessively weak rostrum; zygomata abruptly expanded at middle; audital bullæ very large, and much

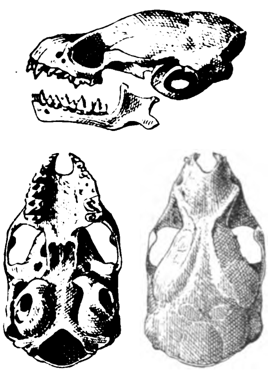

FIG. 37.—EUDERMA MACULATUM. ADULT MALE. MESILLA PARK, NEW MEXICO. NO. 122545. ×1½.

elongated, their greatest diameter about equal to length of tooth row exclusive of incisors, the inner edge strongly emarginated anteriorly. Ears very large, fully three-fourths as long as forearm, joined across forehead by a low band of membrane; tragus well developed. Nostrils simple, as in *Myotis* or *Eptesicus*. The only known species is nearly black with conspicuous white markings.

Species examined.—Euderma maculatum (J. A. Allen).

Remarks.—This strikingly characterized genus resembles *Plecotus* and *Corynorhinus* in its skull and teeth, though all of the peculiarities are much exaggerated. In its simple nostrils, strictly of the Vespertilionine type it differs, however, very notably from the other members of the Plecotine group.

Subfamily MINIOPTERINÆ.

1875. *Miniopteri* Dobson, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875 (part).
1878. *Miniopteri* Dobson, Catal. Chiropt. Brit. Mus., p. 170 (part).
1891. *Vespertilionidæ* (part: Miniopterine division, part) Flower and Lydekker, Mammals, living and extinct, p. 664.
1898. *Miniopteræ* Trouessart, Catalogus mammalium, p. 134.

Geographic distribution.—Northern Africa and southern Europe and Asia, including the Malay region.

Characters.—Like the Vespertilioninæ, but presternum with median lobe enormously developed and forming the greater part of the bone; scapula with the coracoid straight, directed conspicuously inward.

Remarks.—The two characters on which this group is based might seem insufficient were it not that they appear to be not only unique but directly contrary to the tendency of the corresponding structures in members of the related groups. I know of no other bat in which the presternum consists chiefly of the median lobe. The straight, inwardly directed coracoid is, however, found elsewhere, notably in the Molossidæ.

Principal subdivisions.—The subfamily contains the one genus *Miniopterus*.

Genus MINIOPTERUS Bonaparte.

1837. *Miniopterus* Bonaparte, Iconagr. della Fauna Italica, I, fasc. XX, under *Vespertilio emarginatus* (subgenus of *Vespertilio*).
1866. *Miniopteris* Gray, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 91, February, 1866.
1878. *Miniopterus* Dobson, Catal. Chiropt. Brit. Mus., p. 347.
1892. *Minyopterus* Winge, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 36.
1900. *Minneopterus* Lampe, Jahrbuch Nassau Ver. Naturkunde, Jahrg. 53, Catal. Säugeth.—Samml., p. 12.

Type-species.—Vespertilio ursinii Bonaparte=*V. schreibersii* Kuhl.

Geographic distribution.—Northern Africa and southern Europe and Asia, including the Malay region.

Number of forms.—Eight species are currently recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ 3\ 4\ 5\ 6\ 7};\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{3-3},\ m\ \frac{3-3}{3-3}=36.$$

Upper incisors low and robust, subequal, the outer lower than inner but with slightly greater cross section, each tooth simple, the apex of inner rather slender and directed strongly inward, that of outer broadly pointed and nearly erect, the teeth of each pair strongly in contact, but outer incisor separated from canine by distinct space; lower incisors forming a rather strongly convex row, their crowns trifid, the lobes of the first and second subequal, the middle lobe of the third much the largest, the outer almost obsolete. Canines slender, not peculiar in form, the upper with very slight cingulum, the lower with cingulum well developed and forming an indistinct anterior basal cusp. Premolars showing no special peculiarities except that the anterior upper tooth (pm^2) is unusually large, its shaft more than one-third as high as that of canine, to the base of which its crown area is nearly equal; lower premolars high and slender, with subterete though slightly four-sided shafts. Molars normal, though the outer section of the first and second upper teeth is somewhat narrowed; hypocone absent or barely indicated; m^3 with metacone and three commissures well developed, its crown area more than half that of m^1 or m^2; lower molars with all the cusps present, rather high and slender. Skull with large, high brain case, the anterior portion of which rises distinctly above occiput; rostrum slender and small, though not specially reduced or peculiar in form, its dorsal surface with a slight median longitudinal concavity between orbits; sagittal crest low, but rather distinct, not sending forward any branches to supraorbital region, which, with anterior border of orbits, is smoothly rounded; palate slightly concave both longitudinally and transversely, a noticeable foramen near its border close to inner extremity of each posterior molar; audital bullæ small, covering slightly more than half surface of cochleæ; floor of braincase forming no noticeable angle with plane of palate; basisphenoid pits indicated. Ear small, not peculiar in form; tragus high, slender, slightly curved forward at tip. Second and third metacarpals about equal; third distinctly shorter. Second phalanx of third finger nearly three times as long as first.

Species examined.—*Miniopterus schreibersii* (Bonaparte) and *M. newtoni* (Bocage), *M. natalensis* A. Smith, *M. fucas* Bonhote, *M. manavi* Thomas, *M. fraterculus* Thomas, *M. dasythrix* Thomas, *M. majori* Thomas.

Subfamily MURININÆ.

1878. *Vespertiliones* DOBSON, Catal. Chiropt. Brit. Mus., p. 168 (part).
1891. *Vespertilionidæ* (part: Vespertilionine division, part) FLOWER and LYDEKKER, Mammals, living and extinct, p. 661.

Geographic distribution.—Malay region, India, and central and eastern Asia to Japan.

Characters.—Anterior upper premolar (pm^2) very slightly reduced, scarcely smaller than posterior premolar (pm^4) and essentially like it in form; molars essentially normal or considerably modified, the metaconid always noticeably the largest cusp in m^1 and m^2; nostrils conspicuously tubular-projecting.

Remarks.—The very unusual structure of the anterior upper premolar suggests a primitive stage of development, preceding the tendency to reduction to which the premolars are subject elsewhere among the bats. The molars of *Harpiocephalus* are, on the other hand, very highly modified, more so than in any other genus of Vespertilionidæ, though a suggestion of the same form of tooth is found in *Pachyotus*. Both *Harpiocephalus* and *Murina* also show a high degree of specialization in the tubular nostrils. It seems most natural, therefore, to regard the group as a specialized offshoot from some low, *Myotis*-like Vespertilionine form.

Principal subdivisions.—Two very distinct genera of Murininæ are now known.

KEY TO THE GENERA OF MURININÆ.

Molars essentially normal .... *Murina*, p. 229.
Molars highly abnormal, m^1 and m^2 with main cusps closely approximated and mesostyle absent, m^3 reduced to an almost structureless, sometimes deciduous, remnant .... *Harpiocephalus*, p. 230.

Genus MURINA Gray.

1842. *Murina* GRAY, Ann. and Mag. Nat. Hist., X, p. 258, December, 1842 (*suillus*).
1842. *Ocypetes* LESSON, Nouv. Tabl. Règne Anim., p. 30 (part; included *cavernarum*=*harpia* and *suillus*); not *Ocypetes* Wagler, 1832.
1878. *Harpiocephalus* DOBSON, Catal. Chiropt. Brit. Mus., p. 276 (part: subgenus *Murina*, p. 277, and subgenus *Harpiocephalus*, p. 277, part).

Type-species.—*Vespertilio suillus* Temminck.

Geographic distribution.—Malay region, India, and central and eastern Asia to Japan.

Number of forms.—Eight species are known, including all of those currently referred to "*Murina*" and all the members of *Harpiocephalus* except *harpia*.

Characters.—Dental formula:

$$\frac{-\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{2-2}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3}=34.$$

Upper incisors well developed, without distinct secondary cusps, the outer larger than the inner, and closely crowded against canine, the four teeth almost exactly in line with each other; lower incisors essentially as in *Myotis*. Canines well developed, not peculiar in form. Second upper premolar (*pm* [4]) unusually large, but not peculiar in form, its cingulum when unworn produced antero-internally into the faint suggestion of a cusp; anterior premolar not as large, but of essentially the same structure. First and second upper molars with length along outer edge about equal to transverse diameter, the cusps normal in position, the W pattern present but somewhat distorted by the reduced condition of the parastyle; hypocone absent. Third upper molar not unusually reduced, the protocone, paracone, mesostyle, and first commissure of normal size, the second commissure and its terminal cusp both small. The mandibular teeth show no special peculiarities. Skull essentially as in the medium sized species of *Myotis*. External form peculiar in the projecting tubular nostrils only, the animals otherwise resembling the species of *Myotis* or *Kerivoula;* feet rather small; metacarpals not graduated.

Species examined.—*Murina suilla* (Temminck), *M. aurita* (Milne Edwards), *M. griseus* (Hutton), *M. tubinaris* (Scully), *M. cyclotis* (Dobson), and *M. leucogaster* (Milne Edwards). The two remaining species, *M. feæ* Thomas, and *M. hilgendorfi* (Peters), are so well described (the skull of *M. hilgendorfi* is figured) that there appears to be no doubt as to their position.

Genus HARPIOCEPHALUS Gray.

1842. *Harpiocephalus* Gray, Ann. and Mag. Nat. Hist., X, p. 259, December, 1842.

1842. *Ocypetes* Lesson, Nouv. Tabl. Règne Anim., p. 30 (part; included *cavernarum*=*harpia*, and *suillus*). Not *Ocypetes* Wagler, 1832.

1866. *Harpyiocephalus* Gray, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 90, February, 1866.

1878. *Harpiocephalus* Dobson, Catal. Chiropt. Brit. Mus., p. 276 (part).

Type-species.—*Harpiocephalus rufus* Gray=*Vespertilio harpia* Temminck.

Geographic distribution.—India and the Malay Region.

Number of forms.—As now restricted this genus includes the type species only.

Characters.—Externally as in *Murina*. Skull more heavily built than in the related genus but not differing noticeably in form except that the rostrum is relatively shorter, broader, and more abruptly truncate anteriorly. Teeth (Plates I, II, fig. 4) resembling those of

Murina in the slight contrast between anterior and posterior premolars, but this peculiarity carried still further. Upper incisors very large, the crown low and with distinct secondary cusps much like those of *Myotis*, closely crowded against each other and against canine, the four teeth, as in *Murina*, nearly in line with each other; lower incisors low and heavy but normal in form, the edge bluntly trifid. Canines excessively thick and low, though without peculiar cusps. Upper premolars large, the approximation in form between the two teeth carried even further than in *Murina*, so that the anterior is merely not as large as the posterior, the latter of the normal Vespertilionine form and with no distinct secondary cusp, except occasionally at middle of cingulum (see Plate I, fig. 4); lower premolars not peculiar, except that they are unusually large and robust. First and second upper molars closely resembling the premolars, owing to the fact that the protocone and paracone are greatly reduced from their normal size, and the mesostyle is absent. The outer side of the tooth therefore presents a rather shallow, wide V inclosing a noticeable concave depression, while the crown appears at first sight to have only one cusp, the metacone, much like the cusp of the premolars but lower and situated a little farther backward and inward. On closer inspection the small protocone and paracone are readily seen, both placed much nearer the metacone than in the normal tooth. Parastyle and metastyle unusually large though rather indistinctly outlined. Last upper molar reduced to a mere scale closely applied to posterior surface of m^2 immediately behind its metacone, its greatest diameter (transverse to the tooth row) scarcely one-fourth that of m^2. Though so greatly reduced this tooth retains a faint trace of an outer and inner cusp with the connecting commissure. Lower molars with all the cusps except protoconid much reduced so that the teeth strongly approximate the form of the lower premolars. The W pattern is practically absent owing to the reduced size of the second segment and the indistinctness of the commissures.

Species examined.—*Harpiocephalus harpia* (Temminck).

Remarks.—This genus is immediately recognizable by the peculiar tendency to approximation in the form of all the teeth. It appears to be one of the most aberrant of the Vespertilionidæ. The greatly developed anterior upper premolar, if not a primitive character, is certainly one that indicates a tendency directly opposed to the normal course of evolution in the family. The form of molars, though very peculiar, is merely an exaggeration of the conditions found in *Pachyotus*. The tubular nostrils of this genus and of *Murina* are not elsewhere met with except in *Nyctymene*, one of the fruit bats.

Subfamily KERIVOULINÆ.

1878. *Vespertiliones* DOBSON, Catal. Chiropt. Brit. Mus., p. 168 (part).
1891. *Vespertilionidæ* (part; Vespertilionine division, part) FLOWER and LYDEKKER, Mammals, living and extinct, p. 661.

Geographic distribution.—Africa, south of the Sahara; India and the Malay Region; New Guinea.

Characters.—Externally as in the Vespertilioninæ. Sternum very short, its length in median line not twice as great as breadth of presternum; median lobe of presternum small but distinct, upright; keel of mesosternum low. Only four or five ribs articulate with sternum. Coracoid curved outward as in the Vespertilioninæ.

Remarks.—The peculiar, shortened sternum distinguishes this group very readily from the other subfamilies of Vespertilionidæ.

Principal subdivisions.—The subfamily Kerivoulinæ is represented by two genera.

KEY TO THE GENERA OF KERIVOULINÆ.

Upper canine normal; middle lower incisor with three cusps. *Kerivoula*, p. 232.
Upper canine with shaft elongated and laterally compressed; middle lower incisor with four cusps .... *Phoniscus*, p. 233.

Genus KERIVOULA Gray.

1842. *Kerivoula* GRAY, Ann. and Mag. Nat. Hist., X, p. 258, December, 1842.
1849. *Kirivoula* GERVAIS, Dict. Univ. d'Hist. Nat., XIII, p. 213.
1860. *Nyctophilax* FITZINGER, Sitzungber. Math.-Nat. Cl. k. Akad. Wissensch. Wien, XLII, p. 390.
1878. *Kerivoula* DOBSON, Catal. Chiropt. Brit. Mus., p. 330.
1891. *Cerivoula* BLANFORD, Fauna Brit. India, Mamm., p. 338.

Type-species.—*Vespertilio hardwickii* Horsfield.

Geographic distribution.—Africa, south of the Sahara; India and the Malay Region; New Guinea.

Number of forms.—Eighteen species of *Kerivoula* are now recognized.

Characters.—Dental formula:

$$\frac{-2\,3.\;1.\;-2\,3\,4\,5\,6\,7}{1\,2\,3\;\;1.\;-2\,3\,4\,5\,6\,7}\;.\;i\,\frac{2-2}{3-3},\; c\,\frac{1-1}{1-1},\; pm\,\frac{3-3}{3-3},\; m\,\frac{3-3}{3-3}=38.$$

Upper incisors well developed, the outer about half the height, though of nearly the same diameter as inner, between which and canine it is closely crowded; main axis of each tooth nearly perpendicular; lower incisors trifid, slightly imbricated. Canines normal in form and rather small, the point of the upper tooth extending slightly beyond cingulum of lower when jaws are closed; lower canine with small antero-internal cingulum cusp. Premolars well developed, but not peculiar in form, those of mandible subequal, their crowns subquadrate in cross section and without distinct cutting edges. Molars normal; m^1 and m^2 without hypocone, m^3 with metacone and three commissures well developed, the area of the crown about half that of first or second; lower molars with all the cusps present and normal in form, no great contrast in height of protoconid and hypoconid in m_1 and m_2. Skull (fig. 38) slender and lightly built, the braincase large, smoothly rounded and abruptly elevated anteriorly, the rostrum slender and weak. There is no indication of sagittal crest or of supraorbital or lachrymal ridges. Nares very narrow, the width of the aperture as viewed from above scarcely or not half the length. Anterior palatal emargination about as wide as deep. Posterior extension of palate narrowed gradually backward, much as in *Natalus;* hamulars very short. Audital bullæ very small, covering much less than half surface of large cochleæ. Ears moderately long (extending slightly beyond nostrils when laid forward), separate, slightly funnel-formed owing to the fact that the outer border arises slightly in front of the inner, and its lower portion is unusually widened; tragus long and very slender. Muzzle simple. Third and fourth metacarpals about equal, fourth slightly shorter.

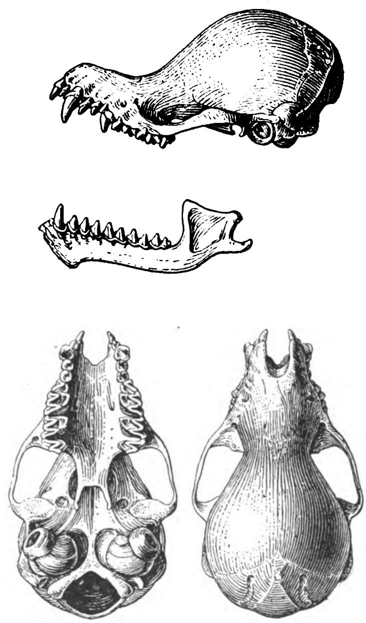

FIG. 38.—KERIVOULA HARDWICKII. ADULT MALE. WESTERN JAVA. NO. 141591. ×2⅔.

Species examined.—*Kerivoula africana* Dobson, *K. brunnea* Dobson, *K. hardwickii* (Horsfield), *K. harrisoni* Thomas, *K. minuta* Miller, *K. papillosa* (Temminck), *K. papuensis* Dobson, *K. picta* (Pallas), *K. pusilla* Thomas.

Remarks.—Among Old World bats the members of this genus are recognizable by their small size, delicate form, distinctly funnel-shaped ears, with very long, slender tragi, and the absence of peculiar developments of the nostrils, canines, or other parts. The fur is long and soft, and in some species the wing membranes have a conspicuous color pattern. Superficially they resemble some of the Natalidæ, but the lengthening of the legs and tail is much less.

Genus PHONISCUS Miller.

1905. *Phoniscus* MILLER, Proc. Biol. Soc. Washington, XVIII, p. 229, December 9, 1905.

Type-species.—*Phoniscus atrox* Miller.

Geographic distribution.—Eastern Sumatra.

Number of forms.—Only the type species is known.

Characters.—Like *Kerivoula*, but with upper canine strongly compressed, the shaft with deep longitudinal groove on outer side, and with conspicuous posterior cutting edge, its length so increased that the point extends noticeably beyond exposed portion of lower canine when jaws are closed; lower incisors imbricated, the crown relatively longer than in *Kerivoula*, that of inner tooth with four distinct cusps; lower premolars with crowns longer than wide, their shafts with well developed anterior and posterior cutting edges; skull with braincase so elevated anteriorly that the highest region is at middle instead of in occipital region; anterior portion of rostrum broader than in *Kerivoula*, the width of the nares rather greater than their length; palatal emargination distinctively broader than deep. Externally as in *Kerivoula*, but lower lip with a distinct though minute pocket to receive tip of elongated upper canine.

Species examined.—*Phoniscus atrox* Miller.

Remarks.—The greatly increased size and peculiar shape of the upper canine, and the four-cusped inner mandibular incisors distinguish this genus sufficiently from *Kerivoula.* But the modification is not confined to these teeth, as the premolars both above and below have become more pointed and trenchant, and the whole anterior portion of the rostrum is strengthened. Contrary to what might be expected, the lower canine remains unchanged. Externally the animal is quite as in *Kerivoula*, except for the pockets in the inner side of the lower lip, in which the extremities of the upper canines are sheathed.

Subfamily NYCTOPHILINÆ.

1865. *Nyctophili* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 524 (*Nyctophilus* and *Antrozous*).

1866. *Nyctophilina* GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 91, February, 1866. (*Nyctophilus* and *Antrozous.*)

1878. *Plecoti* Dobson, Catal. Chiropt. Brit. Mus., p. 168 (part).

1891. *Vespertilionidæ* (part: Plecotine division, part) FLOWER and LYDEKKER, Mammals living and extinct, p. 660.

1897. *Antrozoinæ* MILLER, North American Fauna, No. 13, p. 41, October 16, 1897. *Antrozous* only.

Geographic distribution.—From Timor to the Fiji Islands and Tasmania; warmer parts of western North America, from Texas to the Pacific coast and from the Columbia River to central Mexico.

Characters.—Differs from the Vespertilioninæ in the abruptly truncate muzzle, on the anterior face of which the nostrils open forward beneath a distinct horseshoe-shaped ridge or small noseleaf.

Remarks.—Though Dobson placed the genera *Nyctophilus* and *Antrozous* among the Plecotine bats, Peters had twelve years previously expressed the opinion that their relationships are elsewhere. By Harrison Allen[a] they were regarded as distantly allied, *Nycto-*

[a] Monogr. Bats N. Amer. (1893), p. 65, March 14, 1894.

philus being supposed to have strictly Vespertilionine relationships, while *Antrozous* appeared to be derived from some primitive Phyllostomine stock. While the genera are very distinct, I am inclined to accept Peters's view and place them together as a subfamily of Vespertilionidæ. In any event, *Nyctophilus* seems to be not specially allied to the Plecontines, as its muzzle is very differently formed, and the teeth show no tendency to become reduced in strength.

Principal subdivisions.—Two genera of Nyctophilinæ are now known, one peculiar to each of the regions inhabited by the group.

KEY TO THE GENERA OF NYCTOPHILINÆ.

Lower incisors 2–2; extremity of muzzle with distinct horseshoe-shaped ridge -- *Antrozous*, p. 235.
Lower incisors 3–3; extremity of muzzle with low but evident noseleaf -- *Nyctophilus*, p. 236.

Genus ANTROZOUS H. Allen.

1862. *Antrozous* H. ALLEN, Proc. Acad. Nat. Sci. Philadelphia, p. 247.
1878. *Antrozous* DOBSON, Catal. Chiropt. Brit. Mus., p. 170.
1894. *Antrozous* H. ALLEN, Monogr. Bats N. Amer. (1893), p. 64. March 14, 1894.
1897. *Antrozous* MILLER, North American Fauna, No. 13, p. 42, October 16, 1897.

Type-species.—*Vespertilio pallidus* Le Conte.

Geographic distribution.—Warmer parts of western North America, from Texas to the Pacific coast, and from the Columbia River to central Mexico.

Number of forms.—Three forms of *Antrozous* are now recognized.

Characters.—Dental formula:

$$\frac{-\ 2 - . - 1. - - - 4\ 5\ 6\ 7}{1\ 2 - . - 1. - 2 - 4\ 5\ 6\ 7}\ i\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=28.$$

Upper incisor large, simple, its shaft more than half as high as canine, against which the tooth is crowded at base; lower incisors subequal, trilobed, the high, narrow crowns very strongly imbricated. Canines moderately large, not peculiar in form, the cingulum distinct but small. Cheek teeth normal both above and below; m^1 and m^2 without hypocone, and with base of protocone so short that it does not extend back to level of metacone, the W pattern rather shallow but perfectly distinct, m^3 with less than half the crown area of m^1 or m^2, its protocone, paracone, and parastyle well developed, but no other cusps present, and the second commissure reduced to the merest trace; lower molars with outer cusps unusually high as compared with those of inner side; m_3 with second triangle much reduced, and apparently consisting of the hypoconid only. Skull with rather high, smooth braincase, deep interorbital region, and large rostrum, the dorsal profile with no special concavities or convexities; rostrum decidedly more than half as long as braincase, without distinct lateral ridges; no trace of basisphenoid pits; audital bullæ large but not peculiar in form, covering nearly the entire cochleæ, their diameater equal to nearly twice the distance between them. Ears separate but large, extending considerably beyond tip of muzzle when laid forward; tragus long and slender, straight. Muzzle squarely truncate, with low but distinct horseshoe-shaped ridge above nostrils; behind this a large flattish swelling on each side. Metacarpals of third and fourth fingers equal.

Species examined.—*Antrozous pallidus* (Le Conte), *A. pacificus* (Merriam), and *A. minor* Miller.

Remarks.—Among the American Vespertilionidæ this genus is at once recognizable by the form of the muzzle. The known species are all of large size for the group; and their color is a characteristic pallid tawny.

In the slight development of the nose leaf *Antrozous* is more primitive than *Nyctophilus.* The opposite is, however, true of the reduced number of lower incisors, the shortened protocone of m^1 and m^2 and the peculiar deepening of the anterior part of the skull.

Genus NYCTOPHILUS Leach.

1813. *Plecotus* GEOFFROY, Descr. de l'Égypte, II, p. 112 (part).
1822. *Nyctophilus* LEACH, Trans. Linn. Soc. London, XIII, p. 78.
1831. *Barbastellus* GRAY, Zoological Miscellany, p. 38. Not *Barbastella* Gray, 1821.
1878. *Nyctophilus* DOBSON, Catal. Chiropt. Brit. Mus., p. 171.

Type-species.—*Nyctophilus geoffroyi* Leach=*Plecotus timoriensis* Geoffroy.

Geographic distribution.—From Timor to the Fiji Islands and Tasmania.

Number of forms.—Three species of *Nyctophilus* are currently recognized.

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ 2\ 3.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{1-1}{3-3},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=30.$$

Except for the presence of the full number of lower incisors the teeth do not differ very noticeably from those of *Antrozous.* Lower incisors with the crowns of the usual low, long, trifid form, not high and narrow as in the related genus; upper incisor scarcely half as high as canine. Cheek teeth strictly normal, m^1 and m^2 with the protocone large, its base extending backward to line of metacone; neither tooth shows any distinct trace of hypocone; m^3 with rather more than half the crown area of m^1 or m^2, its metacone and mesostyle together with the commissures present though small; lower molars with the discrepancy in height between inner and outer cusps not specially exaggerated; m_3. with second triangle not unusually reduced, the entoconid small but distinct. Skull with form of brain case, and relative length of brain case and rostrum about as in *Antrozous*, but interorbital region not deepened, the forehead therefore rising at a distinct though slight angle with upper surface of rostrum; posterior portion of palate gradually narrowed (much more so than in *Antrozous*, which in this respect is essentially normal), much as in *Natalus* or *Kerivoula*. No basisphenoid pits. Ears large, extending nearly to or beyond extremity of muzzle when laid forward, usually joined across forehead by a conspicuous band of membrane, but this obsolete at middle in one species; tragus rather short and broad. Muzzle squarely truncate as in *Antrozous*, but with the horseshoe-shaped ridge developed into a low but distinct nose leaf; flattened swellings behind leaf more prominent than in *Antrozous*. Second and third metacarpals about equal, the third somewhat shorter.

Species examined.—*Nyctophilus timoriensis* (Geoffroy), *N. microtis* Thomas, and *N. walkeri* Thomas.

Subfamily TOMOPEATINÆ.

Geographic distribution.—Peru.

Characters.—Seventh cervical vertebra fused with first dorsal; ear with no anterior basal lobe, but with a distinct rudimentary keel; audital bullæ disk-shaped, owing to the great emargination of inner border. Otherwise as in the Vespertilioninæ.

Remarks.—This subfamily combines in a very remarkable manner the characters of the Vespertilionidæ and Molossidæ. The general external appearance, the thin membranes, broad wings, slender leg and foot, and the long tail wholly included in the uropatagium are strictly Vespertilionine. The same is true of the skeleton as a whole. The fibula, though perhaps larger than in most Vespertilionidæ, is scarcely better developed than that of *Tylonycteris*, while its form shows no departure from the general rule in the family. On the other hand, the seventh cervical vertebra is fused with the first dorsal, a character that I have not seen in any other genus of Vespertilionidæ, but which is apparently universal in the Molossidæ. The ear, both externally and in the peculiar emarginate-flattened form of the tympanic bone, is essentially Molossine in structure, though the conch shows no tendency to assume the leathery texture usually characteristic of this group. The upper lip, though more widely expanded than in any Vespertilionine bat that I have examined, is not heavily wrinkled, and the nostrils have no trace of the horny processes so characteristic of the Molossidæ. Neither are there any of the modified, spoon-shaped hairs on muzzle or chin.

Principal subdivision.—The subfamily is represented by the genus *Tomopeas* only.

Genus TOMOPEAS Miller.

1900. *Tomopeas* MILLER, Ann. and Mag. Nat. Hist., 7th ser., VI, p. 570, December, 1900.

Type-species.—*Tomopeas ravus* Miller.

Geographic distribution.—Peru.

Number of forms.—Only the type species is thus far known.

Characters.—Dental formula:

$$\frac{-\,2\,-.\ 1.\ -\,-\,-\,4\ 5\ 6\ 7}{1\ 2\,-.\ 1.\ -\,2\,-\,4\ 5\ 6\ 7}.\ i\,\frac{1-1}{2-2},\ c\,\frac{1-1}{1-1},\ pm\,\frac{1-1}{2-2},\ m\,\frac{3-3}{3-3}=28.$$

Upper incisor close to canine though not actually in contact its shaft subterete, nearly half as high as that of canine, strongly curved backward at extremity, the posterior surface slightly concave; cingulum forming a small but distinct inner basal cusp. Lower incisors subequal, trifid, slightly imbricated. Canines well developed, but showing no special peculiarities in form; shaft of upper canine slightly curved backward; cingulum of lower canine forming distinct anterior basal lobe. Upper premolar (pm^4) relatively large, its crown area more than three-fourths that of first molar, very slightly emarginate posteriorly, its inner cusp well developed. Lower premolars slender, not peculiar in form. Molars normal; m^1 and m^2 with large protocone, the commissure of which joins the very distinct hypocone; inner border of tooth with noticeable concavity just in front of hypocone; m^3 about as large as premolar, its metacone and three commissures well developed. Lower molars with all the cusps present, their development normal, except that the paraconid is unusually low. Skull with smoothly rounded, somewhat flattened braincase, the occipital depth about two-thirds breadth above posterior roots of zygomata. Rostrum considerably more than half as long as braincase, flattened above, with distinct median groove and a shallow though noticeable longitudinal concavity on each side. No sagittal crest, but edges of orbits distinctly ridged. Outline of nares forming rather more than half of a circle when viewed from above. Palate slightly concave longitudinally, distinctly concave laterally, its anterior emargination shallow, with distinct median projection, its posterior prolongation scarcely extending beyond molars. Pterygoids parallel, inclosing a nearly square space; hamulars minute, slightly bent inward. Audital bullæ large, their diameter noticeably exceeding space between them, but greatly emarginated on inner side and so flattened that they are almost discoid, the edge curving over postero-internally, but not elsewhere. No basisphenoid pits, Externally not unlike a small *Pipistrellus*, but upper lips very widely spreading, ear with no anterior basal lobe, but with a rudimentary keel; tragus short and blunt; antitragus small but distinct.

Third and fourth metacarpals equal, slightly longer than forearm; fifth metacarpal one-fifth shorter than third.

Species examined.—*Tomopeas ravus* Miller.

Remarks.—Although superficially resembling a small *Pipistrellus*, *Rhogeëssa*, or *Myotis*, this genus is at once recognizable by its essentially Molossine ear.

Family MYSTACOPIDÆ.

1857. *Noctilionina* Tomes, Proc. Zool. Soc. London, p. 138 (part).

1863. *Phyllostomidæ* Tomes, Proc. Zool. Soc. London, p. 84 (part).

1865. *Brachyura* Peters, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 257 (part).

1866. *Noctilionidæ* (part: *Noctilionina*, part) Gray, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 93, February, 1866.

1875. *Emballonuridæ* (part: *Molossinæ*, part, *Mystacinæ*) Dobson, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875.

1878. *Emballonuridæ* (part: *Molossinæ*, part, *Mystacinæ*) Dobson, Catal. Chiropt. Brit. Mus., p. 442.

1891. *Emballonuridæ* (part: *Molossinæ*, part, Mystacopine division) Flower and Lydekker, Mammals, living and extinct, p. 669.

1892. *Vespertilionidæ* (part: *Molossini*, part) Winge, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 36.

Geographic distribution.—New Zealand.

Characters.—Humerus essentially as in the Vespertilionidæ, the trochiter articulating with scapula by surface nearly as large as glenoid fossa, but its height fully equalled by the very large, broad trochin; ulna distinct, slightly less than half as long as radius, with which it is not fused proximally; second finger with well-developed metacarpal and one minute bony phalanx; third finger with three bony phalanges and a cartilaginous tip, the first flexed on upper surface of metacarpal when wing is at rest; shoulder girdle normal, the seventh cervical vertebra not fused with first dorsal [a]; foot short and broad, resembling that of the Molossidæ, but with the peculiarities less pronounced; fibula and tibia as in the Molossidæ; pelvis normal, but unusually elongated, the boundaries of the sacral vertebræ clearly indicated; lumber vertebræ distinct, the third with two minute ventral processes; skull distinctly Vespertilionine in aspect, the audital bullæ well developed, and without emargination of inner border; premaxillaries with palatal branches present, isolating two lateral foramina; posterior orifice of antorbital canal greatly enlarged; teeth normal; ear essentially Vespertilionine in its general form and in the size of tragus and antitragus, but anterior border of auricle without basal lobe; no trace of keel; muzzle obliquely

[a] Perhaps fused in old individuals, though from the distinctness of the bones in a young adult this seems unlikely.

truncate, with rudimentary nostril pad, and with a sprinkling of stiffened hairs, these, however, without spoon-shaped tips; wing not narrowed, of the usual Vespertilionine proportions; the fifth finger much longer than metacarpal of third; claws on thumb and toes with supplementary basal talon; membrances thick and leathery, the uropatagium narrow, the short tail projecting from near middle of its upper surface.

History.—When first described the genus *Mystacina* (=*Mystacops*) was compared to *Emballonura*. It was next regarded as a member of the '*Noctilionina*' by Tomes, who afterwards placed it in the Phyllostomidæ. Subsequently it was replaced among the 'Noctilionidæ' by Gray, who united it with the genus *Noctilio* to form the subfamily 'Noctilionina.' Dobson included it in the 'Emballonuridæ' as a section 'Mystacinæ,' of the subfamily Molossinæ, a position which it has retained, essentially unmodified, in subsequent works.

Remarks.—In the structure of the shoulder joint and in the broad wing this family is less modified than the Molossidæ. The palatal branches of the premaxillaries are larger and more distinct than in those genera of Molossidæ in which they are present, this character, together with the ossified third phalanx of the middle finger, suggesting the Phyllostomidæ. On the other hand, a high degree of specialization is indicated by the perfectly Molossine leg and foot and by the very remarkable secondary talons of the claws.

Principal subdivisions.—The family Mystacopidæ is represented by one genus only.

Genus MYSTACOPS Lydekker.

1843. *Mystacina* GRAY, Voyage of H. M. S. Sulphur, Mammalia, Pt. 2, p. 23. Not *Mystacinus* Boie, 1822.

1878. *Mystacina* DOBSON, Catal. Chiropt. Brit. Mus., p. 442.

1891. *Mystacops* LYDEKKER, in Flower and Lydekker, Mammals, living and extinct, p. 671.

Type-species.—*Mystacina tuberculata* Gray.

Geographic distribution.—New Zealand.

Number of forms.—The type is the only species known.

Characters.—Dental formula:

$$\frac{-2-.\,1.\,-2-4\;5\;6\;7}{1--.\,1.\,-2-4\;5\;6\;7}\;i\;\frac{1-1}{1-1},\;c\;\frac{1-1}{1-1},\;pm\;\frac{2-2}{2-2},\;m\;\frac{3-3}{3-3}=28.$$

Upper incisors more than half as large as canines, their crowns oblique, noticeably separated below, in contact at about middle, diverging at tip, the anterior surface convex, the posterior concave, with faintly indicated basal cusp; laterally they are separated from canines by narrow but evident spaces. Lower incisors well developed, functional, closely crowded between canines, their cutting edges evenly and deeply trifid, their crowns so extended backward that their width is distinctly greater than their length. Canines well developed, not peculiar in form, the lower approximated posteriorly, though not in contact, the antero-inner edge with distinct convexity just above level of incisors, the posterior base with small rounded, median cusp. Upper premolars well developed, the anterior (pm^2) very slightly smaller than posterior (pm^4) and closely approximating it in form, the posterior tooth with distinct antero-internal cusp, lower premolars large, the anterior (pm_2) not as high as posterior (pm_4) but fully equal to it in cross section of base; each tooth has a rounded postero-basal cusp much like that of lower canine. Molars normal; m^1 and m^2 with inner segment deeply divided from outer, its inner border squarely truncate, the protocone rather low but long, its commissure abruptly bent downward posteriorly at a point corresponding to the usual position of the hypocone when present, but with no other distinct trace of hypocone; a narrow but evident postero-internal heel present in both teeth, but particularly well developed in m^1; third upper molar with large metacone and third commissure; lower molars with all the cusps present and of the usual form, though rather low and thick; pm_3 with distinct entoconid. Skull in general appearance not unlike that of *Myotis myotis*, but somewhat smaller, distinctly narrower, and with much shorter, almost uniformly convex zygomata. Posterior opening of antorbital canal essentially as in *Natalus*, occupying practically the entire anterior wall of orbit and extending upward to and including region occupied in *Myotis* by the lachrymal foramen which here does not exist as a separate orifice; anterior opening of canal larger than in *Myotis*, but not extraordinarily so. Foramen rotundum very large, coalesced with optic foramen, the aperture broadest and squarely truncate anteriorly, where breadth is about equal to that of interptergoid space. Palate slightly concave both laterally and antero-posteriorly, the anterior portion entire except for two minute lateral foramina; pterygoids parallel. Basiphenoid pits barely indicated. Audital bullæ essentially as in *Myotis myotis*, but not as large. Mandible differing conspicuously from that of *Myotis* in the low coronoid (not exceeding articular process in height) and short angular process.

Species examined.—Mystacops tuberculatus (Gray).

Family MOLOSSIDÆ.

1821. *Noctilionidæ* (part; Race 1, part) GRAY, London Medical Repository, XV, p. 299, April, 1821.

1827. *Vespertilionina* LESSON, Man. de Mammalogie, p. 99 (part).

1831. *Vespertiliones* (*Vespertilionidæ*) (part: *Noctilionina*, part) BONAPARTE, Saggio di una distrib. metodica degli Anim. Vert., p. 14.

1838. *Vespertilionidæ* (part: *Noctilionina*, part) BONAPARTE, Nuovi Annali delle Scienze Naturali, Bologna, Anno I, Tomo II, p. 112.

1838. *Vespertilionidæ* (part; *Noctilionina*, part) GRAY, Mag. Zool. Bot., II, p. 498, December, 1838.
1855. [*Vespertilionidæ*] "Vespertilionidés" (part; *Molossina*) GERVAIS, Expéd. du Comte de Castelnau, Zool., Mamm., p. 52.
1865. *Molossi* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 258.
1866. *Noctilionidæ* (part; *Molossina*) GRAY, Ann. and Mag. Nat. Hist., 3d ser., XVII, p. 92, February, 1866.
1870. *Vespertiliones* (part; *Molossi*) FITZINGER, Sitz.-Ber. k. Akad. Wissensch., Wien, Math. Naturwiss. Classe, LXI, Abth. I, p. 458.
1872. *Molossidæ* GILL, Arrangement of the Families of Mammals, p. 17.
1875. *Emballonuridæ* (part; *Molossinæ*, part, *Molossi*) DOBSON, Ann. and Mag. Nat. Hist., 4th ser., XVI, p. 349, November, 1875.
1878. *Emballonuridæ* (part; *Molossinæ*, part, *Molossi*) DOBSON, Catal. Chiropt. Brit. Mus., p. 402.
1886. *Molossidæ* GILL, Standard Natural History, V, p. 170.
1889. *Gymnuridæ* AMEGHINO, Actas de la Acad. Nac. de Ciencias de la Rep. Argentina en Córdoba, VI, p. 351.
1891. *Emballonuridæ* (part: *Molossinæ*, part, Molossine division) FLOWER and LYDEKKER, Mammals living and extinct, p. 669.
1892. *Vespertilionidæ* (part; *Molossini*, part) WINGE, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien, p. 24.
1894. *Vespertilionidæ* (part; *Molossi*) H. ALLEN, Monogr. Bats. N. Am. (1893), p. 162, March 14, 1894.

Geographic distribution.—Warmer portions of both hemispheres; in the old world north to southern Europe and southern Asia, east to New Guinea, Australia, and Norfolk Island; in America north to the southern United States and throughout the West Indies.

Characters.—Humerus with trochiter much larger than trochin, the discrepancy in size usually more noticeable than in the Vespertilionidæ, trochin articulating with scapula by a surface nearly as large as glenoid fossa, epitrochlea short, but with very conspicuous spinous process, capitellum almost directly in line with nearly straight shaft; ulna less reduced than in the Vespertilionidæ, the very slender shaft usually about half as long as radius; second finger with well-developed metacarpal and one rudimentary phalanx; third finger with three phalanges, of which the first is flexed on upper side of metacarpal when wing is at rest, and third is cartilaginous except occasionally at extreme base, where distinct joint is formed with middle phalanx; fifth finger scarcely longer than metacarpal of first; shoulder girdle normal (Plate XIV, fig. 1), except that seventh cervical vertebra is fused with first dorsal; foot short and broad, but of normal structure; fibula complete, bowed outward from tibia, its diameter about half that of latter, entering conspicuously into mechanical scheme of the short, stout leg (Plate XIV, fig. 2); pelvis (Plate XIV, figs. 3–5) normal, the boundaries of the sacral vertebræ clearly defined; lumbar vertebræ not anchylosed; skull without postorbital processes; premaxillaries with nasal branches present or absent, when present forming two palatal foramina, when absent allowing the formation of one; posterior orifice of antorbital canal not enlarged; teeth normal; ears variable in size and form, sometimes joined across forehead, the tragus much reduced, the antitragus usually very large, the anterior border of auricle never with basal lobe; muzzle obliquely truncate, usually sprinkled with short, modified hairs with spoon-shaped tips,[a] the nostrils usually opening on a special pad, the upper surface of which is often set with fine horny excrescences; wing narrow; the fifth finger much shortened; membranes thick and leathery, the uropatagium short, the tail projecting conspicuously beyond its free edge.

History.—This group has been recognized as a distinct family by Peters, Gill, and Ameghino. By most other writers it has been regarded as of subordinate rank. Gray placed it in 1821 among the 'Noctilionidæ,' a family including the 'Molosses,' 'Nyctinomes,' 'Stenodermes,' and 'Vampyre,' of Geoffroy. Ten years later it was joined with the Vespertilionidæ by Bonaparte, where it was retained by subsequent authors, including Gray, in 1838, until 1865, when Peters first made it a distinct family. In 1866 Gray reverted to his family Noctilionidæ, now modified to contain the subfamilies Noctilionina, Mystacina, Mormopsina, Phyllodiana ('*Phyllodia*,' *Chilonycteris*, and *Pteronotus*), Spectrellina, and Molossina. Dobson united it with the Mystacinæ to form the subfamily Molossinæ, of the family Emballonuridæ, the other groups of equal rank being the Noctiliones, Rhinopomata, Taphozoi, and Emballonuræ, these four constituting the subfmily Emballurinæ. The same arrangement, slightly modified, was repeated in the 'Catalogue of Chiroptera,' and has remained in general use until now, though not adopted by Gill in 1886, and conspicuously departed from by Winge in 1891.

Remarks.—The characters of the leg and wing seem quite sufficient to warrant the recognition of the Molossidæ as a family distinct from the Vespertilionidæ. In the perfect development of the double articulation of the shoulder joint, together with the great narrowing of the wing, this family represents the extreme phase of the series of modifications through which the anterior limb of the Chiroptera has passed. The peripheral position of the group is further indicated by the structure of the leg, in which the fibula has become a functional part of the mechanical scheme, an arrangement which, except in the related family Mystacopidæ, is not known to occur elsewhere among bats.

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[a] Jablonowski, Abh. u. Ber. d. k. Zool. u. Anthrop.-Ethn. Mus. zu Dresden, VII, 1899, No. 7, pp. 32–55, pls. x, xi.

Principal subdivisions.—Ten genera of Molossidæ are now known.

KEY TO THE GENERA OF MOLOSSIDÆ.

Bony palate with conspicuous median emargination extending back of roots of incisors.
  Depth of brain case only about one-third width; coronoid process long and slender, conspicuously recurved; forearm covered with warty excrescences .... *Platymops*, p. 254
  Depth of brain case at least one-half width; coronoid process short and thick, not recurved; forearm without warty excrescences.
    Upper premolars 1–1 .... *Mormopterus*, p. 253
    Upper premolars 2–2 .... *Nyctinomus*, p. 251
Bony palate without conspicuous median emargination, but a small notch may be present which never extends back of roots of incisors.
  Upper incisor with length along cingulum equal to or greater than height of shaft.
    Skull without conspicuous sagittal crest; crown of first upper molar subquadrate; a space between upper incisor and canine .... *Cheiromeles*, p. 249
    Skull with high knife-like sagittal crest; crown of first upper molar much wider than long; no space between upper incisor and canine .... *Molossus*, p. 260
  Upper incisor with length along cingulum decidedly less than height of shaft.
    Crown of lower incisors with conspicuous concave posterior prolongation extending back between canines .... *Eomops*, p. 245
    Crown of lower incisors without posterior prolongation.
      Palate conspicuously domed (deeply concave both laterally and longitudinally) .... *Promops*, p. 259
      Palate arched (concave laterally but scarcely, if at all, longitudinally).
        Rostrum noticeably flattened, its length about equal to lachrymal breadth .... *Molossops*, p. 247
        Rostrum subcylindrical, its length considerably greater than lachrymal breadth.
          Upper incisors in contact with each other, their crowns expanded posteriorly .... *Eumops*, p. 257
          Upper incisors not in contact, their crowns not expanded posteriorly .... *Chærephon*, p. 244

Genus CHÆREPHON Dobson.

1874. *Chærephon* DOBSON, Journ. Asiat. Soc. Bengal, XLIII, Pt. 2, p. 144 (subgenus of *Nyctinomus*).

1878. *Nyctinomus* DOBSON, Catal. Chiropt. Brit. Mus., p. 420 (part).

1907. *Chærephon* ANDERSEN, Ann. Mus. Civ. di Stor. Nat. Genova, 3d ser., III, p. 35, April 10, 1907 (genus).

Type-species.—*Nyctinomus johorensis* Dobson.

Geographic distribution.—Africa, India, and the Malay region.

Number of forms.—Eleven species referable to this group are now known.

Characters.—Similar to *Nyctinomus* (p. 251) in all respects except that the premaxillary bones are complete, their palatal branches isolating two small palatal foramina, or filling the entire space occupied in *Nyctinomus* by the palatal emargination. When this closing of the emargination is complete a slight anterior median notch is sometimes developed, but this never extends behind incisors. Teeth similar to those of *Nyctinomus;* m^1 and m^2 with well-developed hypocone.

Species examined.—*Chærephon angolensis* (Peters), *C. emini* (de Winton), *C. gambianus* (de Winton), *C. hindei* Thomas, *C. jobensis* (Miller), *C. johorensis* (Dobson), *C. limbatus* (Peters), *C. major* (Trouessart), *C. plicatus* (Buchannan), *C. pumilus* (Cretzschmar), *C. pusillus* (Miller).

Remarks.—This genus, though so closely resembling *Nyctinomus* as to be indistinguishable except by the structure of the palate, is well characterized by the complete condition of the premaxillaries. It includes all the species without obvious palatal emargination, currently referred to *Nyctinomus*, and is evidently a natural genus. The character on which it is now based is wholly unrelated to that which Dobson originally assigned to the group.

Genus EOMOPS Thomas.

1813. ? *Myopterus* GEOFFROY, Descr. de l'Égypte, II, p. 113.

1905. *Eomops* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., XVI, p. 574. November, 1905.

Type-species.—*Mormopterus whitleyi* Scharff.

Geographic distribution.—West Central Africa.

Number of forms.—Only the type species is known.

Characters.—Dental formula:

$$\frac{-\,2\,-.\;1.\;-\,-\,-\,4\;5\;6\;7}{1\,-\,-.\;1.\;-\,2\,-\,4\;5\;6\;7}\; i\,\frac{1-1}{1-1},\; c\,\frac{1-1}{1-1},\; pm\,\frac{1-1}{2-2},\; m\,\frac{3-3}{3-3}=26.$$

Upper incisors strongly in contact with each other and with canines, the shafts very slightly curved forward, their anterior face evenly convex, their posterior face slightly concave; posterior basal expansion slight but evident, directed somewhat outward. Lower incisors in contact with each other and with canines, perfectly in toothrow though not rising to level of cingulum of canines; anterior face of crown slightly higher than long, deeply bifid, the inner lobe the larger; crowns extended back between canines in a concave posterior heel, the general outline of which rather closely resembles the anterior face in both size and form. Canines simple, with low but distinct cingula, that of the lower teeth forming a slight anterior cusp; lower canines separated by space equal to about one-fourth diameter of crown; anterior face of upper canines with barely indicated longitudinal groove. Upper premolar large, its crown area nearly three-fourths that of first molar, its antero-internal cusp small but distinct. Lower premolars closely crowded, the anterior smaller but with relatively more robust cusp than posterior, both teeth somewhat crescentic in outline when viewed from above, the outer lobe larger than inner. Molars strictly normal; m^1 and m^2 with hypocone indicated by thickening of posterior portion of inner segment; m^3 with well-developed second commissure, but no trace of third; m_1 and m_2 with low protoconid and high entoconid, m_3 with protoconid as in the other teeth, but with entoconid practically absent. Skull rather slender and rounded, the lachrymal breadth less than length of rostrum, which in turn is about three-fourths that of braincase; depth of rostrum about equal to that of braincase; sagittal crest barely indicated; antorbital foramina opening conspicuously forward, but not surrounded by noticeable ridges; palate slightly domed, but its longitudinal concavity less than the lateral; anterior portion of palate entire or with two minute foramina; basisphenoid pits large, separated by a narrow median ridge; audital bullæ less emarginate on inner side than usual in the family Molossidæ. External form with no striking peculiarities; ear extending not quite to nostril when laid forward, broadly triangular in general outline, the keel very low and antitragus small; tragus rather large for a member of the group, flattened, evenly rounded above; anterior bases of ears near together on forehead; muzzle pad very slightly indicated, its ridges without horny processes; front of upper lip thickly beset with very slender spoonhairs; both upper and lower lip scarcely expanded and little wrinkled; wings, legs, tail, and membranes of the usual Molossine type.

Species examined.—*Eomops whitleyi* (Scharff).

Remarks.—This genus, immediately recognizable among Molossine bats by the peculiar form of the lower incisors, more closely resembles the South American *Molossops* than it does any of the known Old World groups. The unusually slight emargination of the audital bullæ is a somewhat primitive character, and the backward prolongation of the crown of the lower incisor strongly suggests the Phyllostomidæ, but in other respects the genus is strictly Molossine.

While there is no question as to the distinctness of *Eomops* from all currently recognized genera, I feel some doubt as to its relationship to the *Myopterus* of Geoffroy. This genus, based on an animal supposed to be from Senegal, was determined by Peters to be the same as the South American *Molossops* at a time when the existence of a bat of this kind in the Old World was unknown. During my visit to Paris, in 1905, the skull of the type (all that remained when it was seen by Peters in 1869) could not be found; but from the figure published by Gervais[a] and the measurements given by Peters,[b] it is evident that in cranial characters the animal was much more like *Eomops* than *Molossops*. This is shown by the general outline of the

[a] Hist. Nat. des Mammif., I, p. 221.

[b] Monatsber. k. preuss. Akad. Wissensch., Berlin, 1869, p. 402.

skull, with its low, flat braincase and long, deep rostrum, without evident lachrymal ridge, and also by the slight zygomatic breadth as compared with the total length. Peters gives these measurements as 13 mm. and 22 mm., respectively, from which it follows that the ratio of breadth to length is only 59 +. In a somewhat immature specimen of *Eomops whitleyi*[a] in which the skull has probably not attained its full breadth, these measurements are 9.6 and 17, giving a ratio of 56 +. In *Molossops cerastes* and *M. temminckii*, on the other hand, the ratio of breadth to length is 68 and 69. While it is impossible, in the absence of the type specimen, to reach a definite conclusion other than that *Myopterus* is different from *Molossops*, it seems highly probable that *Myopterus daubentonii* is a large species of the same genus as *Eomops whitleyi*, occurring in Senegal, and related to *whitleyi* much as the large *Molossops cerastes* is to the small *M. temminckii*. The whitish underparts in the type of *Myopterus daubentonii* furnish another feature of similarity to the species of *Eomops* now known.

Genus MOLOSSOPS Peters.

1865. *Molossops* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 575 (subgenus of *Molossus*).

1869. *Myopterus* PETERS, Monatsber. p. preuss. Akad. Wissensch., Berlin, p. 402 (not *Myopterus* Geoffroy, 1813).

1878. *Myopterus* DOBSON, Catal. Chiropt. Brit. Mus., p. 408 (subgenus of *Molossus*).

Type-species.—*Molossus temminckii* Burmeister.

Geographic distribution.—South America.

Number of forms.—Four species of *Molossops* are now known.

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ (2)\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7}\ i\ \frac{1-1}{1-1}\ \text{or}\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=26\ \text{or}\ 28.$$

Upper incisors strongly in contact with each other, but separated from canines by narrow spaces; shaft slender, strongly hooked forward, the anterior face evenly convex, the posterior slightly concave; posterior basal expansion slight. Middle lower incisors crowded forward from tooth row, their height much less than that of cingulum of canine; crown narrow, with no posterior expansion, its anterior face slightly higher than long, its cutting edge deeply bifid, the lobes nearly equal; outer incisor when present smaller than inner, very strongly crowded against canine, the faintly trifid crown a little bent inward. Canines strong, simple, with small but distinct cingula and no secondary cusps except that formed by cingulum of lower tooth anteriorly; upper canine with broad groove on front surface of shaft;

[a] Male, Cat. No. 141532, U.S.N.M., Lower Niger, Africa.

lower canines in contact with each other or separated by a narrow space. Upper premolar large, its crown area slightly more than half that of first molar, its antero-internal cusp well developed. Lower premolars closely crowded, the anterior much smaller than posterior, the crowns of both teeth wider than long, and slightly crescentic in outline. Molars strictly normal, m^1 and m^2 with hypocone obsolete though obviously indicated, m^3 with second commissure always well developed, and a small third commissure sometimes present; m_1 and m_2 with low protoconid and large, long entoconid, m_3 with protoconid obsolete, and entoconid smaller than hypoconid. Skull (figs. 39 and 40) broad and flattened, the rostral portion marked by conspicuous lachrymal ridges, but sagittal crest obsolete; lachrymal breadth distinctly greater than length of rostrum, which in turn is about two-thirds that of brain case; depth of rostrum distinctly less than that of brain case; antorbital foramina opening very conspicuously forward at bottom of groove formed between side of rostrum and high lachrymal ridge; palate distinctly arched, and slightly domed, its anterior portion entire or with two minute foramina; basisphenoid pits obsolete or absent; audital bullæ strongly emarginate on inner side as usual in the family. External form thickset and heavy, much like that of *Eomops*. Ear short, orbicular, extending somewhat more than halfway from eye to nostril when laid forward; keel low but distinct; tragus small, narrowed above; antitragus well developed, but not thickened; anterior termination of ear on forehead close to that of opposite side. Lips much thickened, but not specially expanded or wrinkled, the upper lip sprinkled with spoon hairs, particularly in front. Muzzle pad indistinct, without definite ridges. Legs, feet, and tail thick and heavy. Membranes leathery.

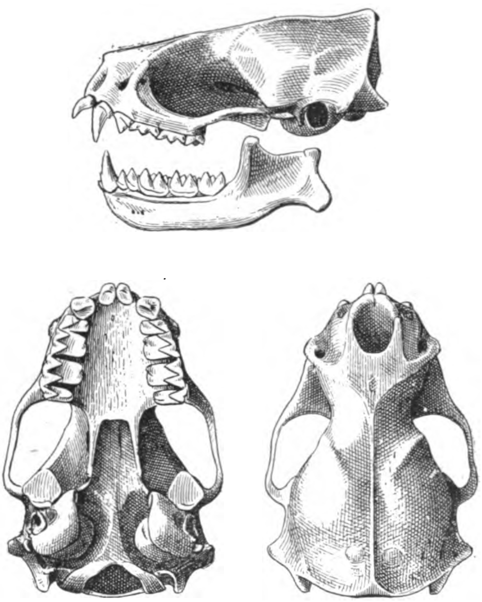
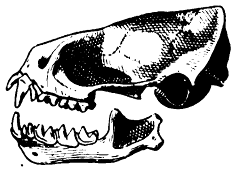


FIG. 39.—MOLOSSOPS PLANIROSTRIS. PARAGUAY. No. 37741. × 2.

Species examined.—*Molossops cerastes* (Thomas), *M. paranus* Thomas, *M. planirostris* Peters, *M. temminckii* (Burmeister).

Remarks.—Both externally and in the structure of the skull this genus resembles the African *Eomops*. The peculiarities of the skull are, however, more accentuated than in the Old World genus, while the lower incisors show no tendency to modification. The outer lower incisor is present in the larger species of the genus, but apparently always absent in the small *M. temminckii*. From the American members of the group it is at once distinguishable by the short, flattened rostrum with its high lachrymal ridges, and conspicuously forward-directed antorbital foramina. It is the only genus of American Molossines with complete premaxillaries, a character readily appreciable in young skulls, while even in adults some trace of the two palatal foramina usually persists. As I have already stated (p. 246) there is no reason to replace Peter's name *Molossops* by *Myopterus* Geoffroy. Whatever the latter name may apply to, a glance at Gervais's figure of the type skull is sufficient to show that Geoffroy's animal could have not been a member of the present group.



Genus CHEIROMELES Horsfield.

1824. *Cheiromeles* HORSFIELD, Zool. Researches in Java.
1841. *Chiropetes* GLOGER, Gemeinnutziges Hand-u. Hilfsbuch der Naturgesch., I, p. 49.
1846. *Chiromeles* AGASSIZ, Nomenclator Zoologicus., Mamm., Addenda, p. 3.
1878. *Cheiromeles* DOBSON, Catal. Chiropt. Brit. Mus., p. 405.

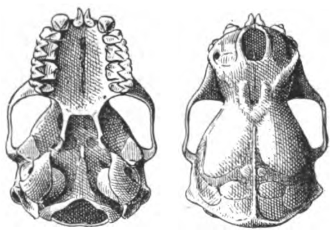


FIG. 40.—MOLOSSOPS TEMMINCKII. NO. 4530, MILLER COLL. × 2.

Type-species.—*Cheiromeles torquatus* Horsfield.

Geographic distribution.—Malay Peninsula, Sumatra, Java, and Borneo.

Number of forms.—The type is the only known species.

Characters.—Dental formula:

$$\frac{-2-.\ 1.\ ---4\ 5\ 6\ 7}{1--.\ 1.\ -2-4\ 5\ 6\ 7}, \ i\frac{1-1}{1-1}, \ c\frac{1-1}{1-1}, \ pm\frac{1-1}{2-2}, \ m\frac{3-3}{3-3}=26.$$

Upper incisors short and robust, their form much as in *Molossus*, the height of the crown barely equal to width through posterior expansion, the shafts oblique and closely in contact with each other, though there is a distinct space between incisor and canine. Lower incisors well developed, functional, perfectly in the tooth row, separated from each other by a narrow space, but in contact with canines, their crowns subterete, with broadly conical cutting edge.

Canines heavy, but not peculiar in form, the upper with deep longitudinal furrow on anterior face, and minute postero-basal cusp. Upper premolar large, with distinct antero-internal cusp, its crown sharing the general reduction of transverse diameter to which all the upper cheek teeth are subjected. First lower premolar (pm_2) small, scarcely functional, crowded between second premolar (pm_4) and canine; second premolar large, slightly exceeding anterior section of first molar. Upper molars normal, though the transverse diameter of the crowns is so reduced that m^1 and m^2 are subquadrate in outline; each of the larger teeth with slightly indicated hypocone; m^3 with crown area less than half that of m^1 or m^2, the metacone and third commissure very minute. Lower molars normal, except that paraconid is very low in all three teeth, and entoconid is absent in the third. Skull robust and heavily built, but rather smooth, the sagittal crest barely indicated except in overhanging occipital region, where it abruptly becomes prominent; lachrymal ridge slightly developed, succeeded posteriorly by a small but distinct peg-like process; rostrum considerably more than half as long as brain case, its lachrymal breadth about equal to its length, and nearly twice its depth, its upper surface broadly and smoothly convex; palate entire anteriorly or with two lateral foramina, its lateral concavity much more pronounced than the longitudinal; pterygoids parallel; no basisphenoid pits; audital bullæ small, their diameter barely more than half distance between them, their form as usual in the family. External form excessively robust and heavy, the size of the only known species the maximum for the family. Ears rather narrow, extending about half way from eye to nostril, widely separate, angular above, the keel low, broad, and rounded, the antitragus suborbicular, distinctly thickened; tragus small, its anterior edge adnate to side of head. Lips thickened, but scarcely expanded, and not much wrinkled, the upper lip as well as the cheeks sparsely beset with short, very stiff modified hairs, these crowded into a shagreen-like mass anteriorly. Muzzle pad ill-defined, without ridges or horny processes. Legs and feet unusually short and heavy, the toes more independent of each other than in any other known bat. Wing membranes attached to middle of back, the space between them and body converted into a large pouch by a supplemental membrane extending from under surface of humerus to side of body; this pouch is completely closed when wings are folded, and in the female it contains the nipple. Substance of interfemoral membrane and of that portion of wing that is exposed when closed much thickened; remainder of flight membrane thin and delicate, the dividing line between the two sharply defined and extending from wrist to ankle. Whole animal essentially naked, but with a sprinkling of fine short hairs on head, interfemoral membrane and under parts, and a ruff of hairs about 10 mm. in length on under side of neck in region of conspicuous gular sac.

Species examined.—*Cheiromeles torquatus* Horsfield.

Remarks.—Although so highly modified externally this genus is typically Molossine in its dental and skeletal characters. The skull, in fact, is less specialized in form than that of *Molossus*, *Platymops*, or *Molossops*, and the only noticeable peculiarity of the teeth is the reduced transverse diameter of the upper molars. This, however, is not accompanied by any modification of the cusps. The upper incisors are remarkably like those of *Molossus*, and the tragus resembles that of the same genus. It is unlikely that this indicates any near relationship, as *Molossus* is one of the genera with incomplete premaxillary, while in *Cheiromeles* the palatal branch is well developed, so that two palatal foramina are always formed.

Genus NYCTINOMUS Geoffroy.

1813. *Nyctinomus* GEOFFROY, Descr. de l'Égypte, II, p. 114 (*ægyptiacus*).
1821. *Nyctinoma* BOWDICH, Anal. Nat. Class. Mamm., p. 28.
1821. *Nyctinomes* GRAY, London Medical Repository, XV, p. 299, April 1, 1821.
1822. *Nyctinomia* FLEMING, Philos. of Zoology, II, p. 178.
1842. *Mops* LESSON, Nouv. Tabl. Règne Anim., p. 18 (*Mops indicus* LESSON = *Dysopes mops* F. Cuvier).
1878. *Nyctinomus* DOBSON, Catal. Chiropt. Brit. Mus., p. 420 (part).
1902. *Nyctinomops* MILLER, Proc. Acad. Nat. Sci. Philadelphia, p. 393, September 12, 1902 (*femorosaccus*).

Type-species.—*Nyctinomus ægyptiacus* Geoffroy.

Geographic distribution.—Warmer portions of both hemispheres, north to southern Europe and the southern United States, east to the Philippines and Norfolk Island.

Number of forms.—About 40 species of *Nyctinomus* are now recognized, 16 of which occur in America.

Characters.—Dental formula:

$$\frac{-2-.1.-2-4567}{12(3).1.-2-4567},\ i\,\frac{1-1}{2-2}\text{ or }\frac{1-1}{3-3},\ c\,\frac{1-1}{1-1},\ pm\,\frac{2-2}{2-2},\ m\,\frac{3-3}{3-3}=30\text{ or }32.$$

Upper incisors simple, well developed, about half as high as canines, wide apart at base, strongly converging at tip, separated from canine by space about equal to their greatest diameter, shaft narrowing both above and below slightly developed cingulum, its apex blunt. Lower incisors equal, bifid, their crowns in contact with each other and with canine, and usually somewhat imbricated, the cutting edge about on level with cingulum of canine; third incisor, when present (*N. tæniotis* and the *N. brasiliensis* group), less than half the size of the others, its crown scarcely bifid; canines strong and well developed, but not peculiar in form, the cingulum distinct, but not forming noticeable secondary cusps, except occasionally at posterior base of lower tooth. First upper premolar (pm^2) minute but perfectly in tooth row and not specially crowded. Second upper premolar (pm^4) not in contact with canine, well developed, and with large antero-internal cusp. Lower premolars normal in form and size, the first not as high as second, but with the cross section nearly as great. Molars normal; m^1 and m^2 with inner segment large, the terete hypocone unusually distinct; m^3 with crown area more than half as great as that of m^1 or m^2 and about equal to that of pm^4; the metacone and three commissures well developed. Lower molars with all the cusps normal in size and form, the three inner approximately equal in height. Skull (figs. 41–43) with rounded or some-

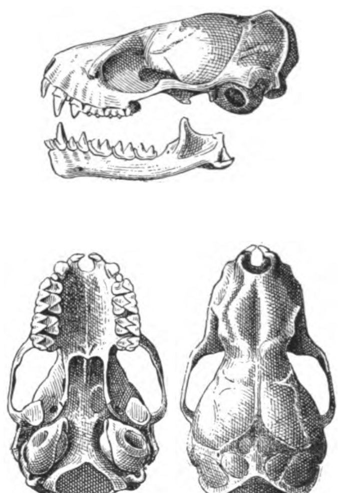


FIG. 41.—NYCTINOMUS BRASILIENSIS. PARANA, BRAZIL. NO. 37873. × 2.

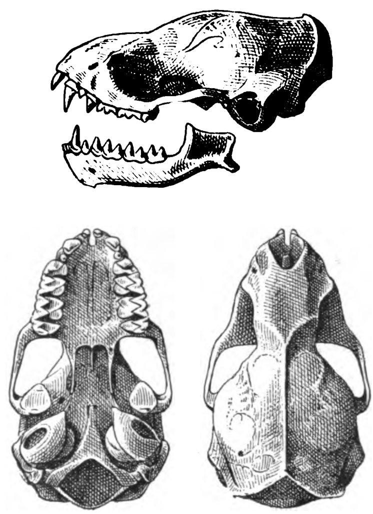


FIG. 42.—NYCTINOMUS EUROPS. ADULT FEMALE. BRAZIL. PARATYPE, NO. 101502. × 2½.

what flattened, moderately wide brain case about one and one-third times as long as rostrum, above level of which it is very slightly elevated, and at least half as deep as wide; a distinct depression in front of occipital region; sagittal crest scarcely indicated; lachrymal and supraorbital ridges low but evident; dorsal surface of rostrum with faint longitudinal concavity between orbits; zygoma slightly expanded at middle. Anterior palatal emargination about as large as base of canine, wider posteriorly than between incisors; palate slightly arched, but nearly flat antero-posteriorly; pterygoids parallel; basisphenoid pits moderately developed or obsolete. Ears large and rounded, arising from same point on forehead. Laid forward they extend distinctly beyond extremity of muzzle; anterior border of ear conch with 6 to 8 horny excrescences; keel well developed; tragus small, flattened, squarely truncate above; antitragus variable in form, sometimes low and indistinct. Muzzle pad well developed and sharply outlined, its upper margin thickly set with horny points like those on anterior margin of ear; a line of similar points extends downward across middle of pad between nostrils. Upper lip full and wrinkled, rather thickly sprinkled, as are also the muzzle and chin, with stiffened spoon-hairs, the extremities of which are very slightly expanded. Feet as usual in the family.

Species examined.—All of the American forms (*Nyctinomus* and "*Nyctinomops*"), also *N. ægyptiacus* Geoffroy, *N. africanus* Dobson, *N. anchietæ* Seabra, *N. bocagei* Seabra, *N. brachypterus* Peters, *N. brunneus* Seabra, *N. cisturus* Thomas, *N. lobatus* Thomas, *N. loriæ* Thomas *N. mops* (F. Cuvier), *N. norfolcensis* Gray, *N. thersites* Thomas, *N. tragatus* Dobson.

Remarks.—The genus *Nyctinomus* is the most widely distributed group of Molossine bats. Its members also present more variations in form than in perhaps any other genus of the entire order. So great are these differences that it seems probable that the genus must be subdivided into several groups of at least subgeneric rank. For the present, however, I see no better course than to unite all of the species with 2–2 upper premolars under the name *Nyctinomus*. The American forms, as I have already pointed out, fall naturally into two groups, but the distinctions between them become apparently worthless when the Old World species are considered. *Nyctinomus* is readily distinguishable from other genera of the family, though the superficial resemblance to some species of *Eumops* is occasionally deceptive, while that to *Chærephon* and *Mormopterus* is even more striking. The technical characters are, however, sufficiently distinct.

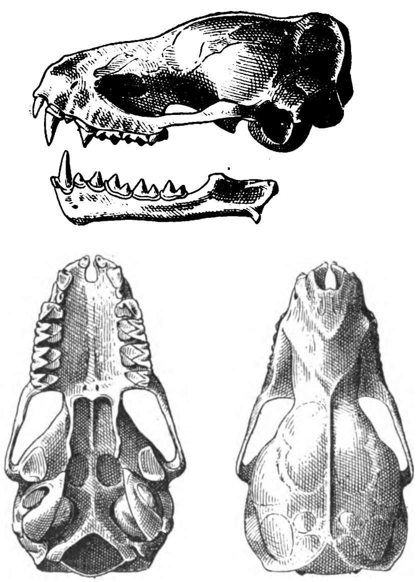


FIG. 43.—NYCTINOMUS MACROTIS. JAMAICA. NO. 3914, MILLER COLL. × ABOUT 2¼.

Genus MORMOPTERUS Peters.

1865. *Mormopterus* PETERS, Monatsber. k. preuss. Akad. Wissensch., Berlin, p. 258 (subgenus of *Nyctinomus*).

1878. *Mormopterus* DOBSON, Catal. Chiropt. Brit. Mus., p. 440 (subgenus of *Nyctinomus*).

Type-species.—*Nyctinomus jugularis* Peters.

Geographic distribution.—Southeastern Africa, Madagascar, Bourbon, and Mauritius; also Tropical America (Peru and Cuba).

Number of forms.—Eight forms are currently referred to this group.

Characters.—Dental formula:

$$\frac{-2\ -.\ 1.--4\,5\,6\,7}{1\,2\,(3).\ 1.-2\,4\,5\,6\,7}\ i\ \frac{1-1}{3-3}\ \text{or}\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=30\ \text{or}\ 28.$$

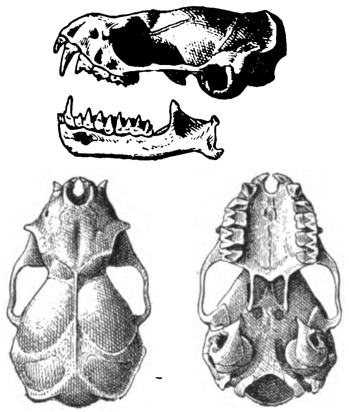


FIG. 44.—MORMOPTERUS MINUTUS. ADULT MALE. TRINIDAD, CUBA. NO. 4915. AMER. MUS. NAT. HIST. × 2¼.

Except in the constant absence of the small upper premolar this genus does not differ appreciably from *Nyctinomus.* The ears are usually smaller, however, and are never joined across forehead. The skull of *Mormopterus minutus* is shown in fig. 44.

Species examined.—*Mormopterus acetabulosus* (Demarest), *M. alliventer* (Dobson), *M. jugularis* (Peters), *M. kalinowskii* (Thomas), and *M. minutus* (Miller).

Remarks.—The constant absence of the small upper premolar and the generally smaller size of the ears as compared with those of *Nyctinomus* seem important enough characters to warrant the recognition of this genus. In the two known American species there are only 2–2 lower incisor teeth.

Genus PLATYMOPS Thomas.

1906. *Platymops* THOMAS, Ann. and Mag. Nat. Hist., 7th ser., XVII, p. 499, May, 1906.

Type-species.—*Platymops macmillani* Thomas.

Geographic distribution.—Northeast Africa (between Adis Ababa and Lake Rudolf).

Number of forms.—The type is the only species known.

Characters.—Dental formula:

$$\frac{-2\ -.\ -1.\ -2-4\,5\,6\,7}{1\,2\ -.\ -1.\ -2-4\,5\,6\,7}\ i\ \frac{1-1}{2-2}\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2}\ m\ \frac{3-3}{3-3}=30$$

Upper incisors bifid, more than half as high as canines, wider apart at base than at tip, separated from canines and from each other by space about equal to their greatest diameter; crown about half as long as high, its breadth at base slightly less than length; posterior surface of crown rather strongly concave; outer lobe slightly more than half as large as inner, its tip diverging a little outward. Lower incisors subequal, imbricated, forming a continuous, slightly convex row between canines; crowns deeply and unequally bifid, the outer lobe less than half as large as inner; height about equal to that of large cingulum of canine; no indication of backward prolongation of crowns. Canines relatively low and weak, the height of the upper teeth distinctly less than the distance between their bases, the diameter of the shaft in both maxillary and mandibular teeth much less relatively to that of crown than in *Nyctinomus;* anterior surface with longitudinal groove well developed, especially in upper teeth, and anterior cutting edge unusually prominent; cingulum well developed, forming a distinct posterior cusp above, and anterior and posterior cusp below. Anterior upper premolar (pm^3) a minute (sometimes deciduous) spicule considerably smaller than cingulum of canine. Posterior upper premolar (pm^4) essentially as in *Nyctinomus*, but main cusp smaller and lower, and postero-internal heel more developed; antero-internal cusp well developed but small. Lower premolars proportioned as in *Nyctinomus* but resembling the canine in the much reduced diameter of the cusp as compared with the crown. This is especially noticeable when teeth are viewed from above, the periphery of the crowns appearing like an enormously developed cingulum. Molars essentially normal, but differing from those of *Nyctinomus* in several important particulars. In all of the upper teeth the protocone is unusually narrow and ridge-like, leaving a very wide concave area between bases of cusps; hypocone barely indicated by a slight angularity of posterior commissure of protocone; m^3 with crown area fully three-fourths that of m^1 and much more than that of pm^4, the metacone and third commissure well developed. Lower molars peculiar in the very narrow triangles and strongly incurved main cusps. As in the upper teeth, the concavities of the crowns are unusually large as compared with the diameter of the cusps. Protoconid of m_2 and m_3 with a distinct incipient secondary cusp on outer side slightly above middle. Inner cusps as in *Nyctinomus*, the entoconid of m_3 equally well developed. Skull broad and much flattened, in general appearance not unlike that of *Tylonycteris*, the dorsal profile straight from nares to lambda; depth of braincase about one-third greatest breadth, its length about one and one-third times that of rostrum; depth of rostrum in lachrymal region slightly less than one-half lachrymal breadth and about one-half length of rostrum. Lachrymal ridges prominent, giving the rostrum a peculiar diamond-shaped outline. Antorbital foramen large, opening conspicuously forward. Palate broad, slightly arched, both laterally and longitudinally, the anterior emargination about twice as long as wide, extending back to middle of canine. Basisphenoid pits barely indicated. Pterygoids parallel. Audital bullæ about as in *Nyctinomus*, but slightly more emarginate on inner side. Zygoma weak, not expanded at middle. Mandible with coronoid process slender, high, and strongly curved backward, its form more resembling that seen in *Erinaceus* (except for the general outward deflection) than that characteristic of most bats. The angular process is also unusually slender, and is flattened vertically instead of horizontally. External characters in general not unlike those of *Nyctinomus*, but head very noticeably flattened; ears slender, wide apart at anterior base, their anterior margin without horny excrescences, the antitragus very obscurely marked off, the keel obsolete, the tragus well developed, not peculiar; lips slightly

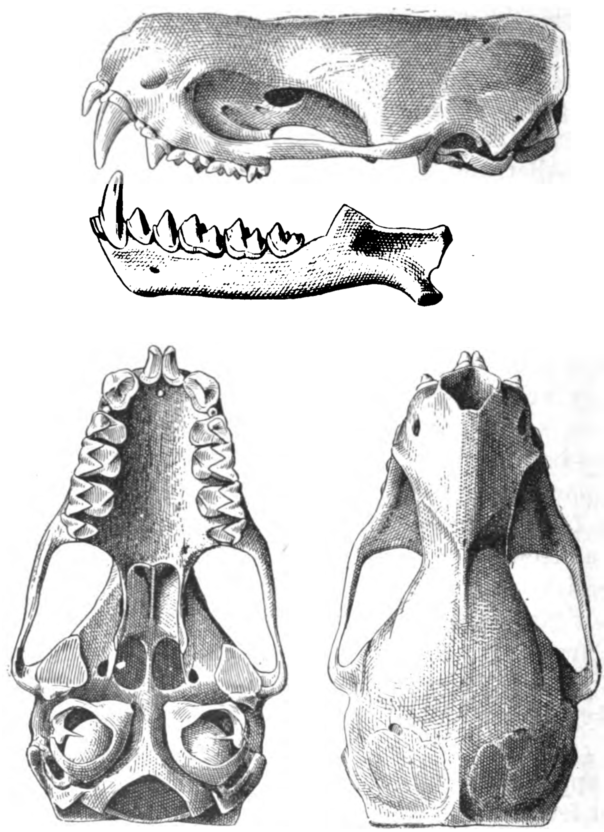


FIG. 45.—EUMOPS CALIFORNICUS. TUCSON, ARIZONA. NO. 88451. × 2.

expanded and obscurely wrinkled, thickly set throughout, though especially above, with very short, stiff modified hairs; nostril pad obsolete; dorsal surface of forearm and of third metacarpal thickly sprinkled with minute warty excrescences, a few of which are also present on thumb.

Species examined.—*Platymops macmillani* Thomas.

Remarks.—Though not distantly related to *Nyctinomus* this genus is readily distinguishable by the flattened head, the roughened forearm, and the peculiarities of the skull and teeth.

Genus EUMOPS Miller.

1878. *Promops* Dobson, Catal. Chiropt. Brit. Mus., p. 414 (part). Subgenus of *Molossus*. Not *Promops* Gervais.

1900. *Promops* Miller, Ann. and Mag. Nat. Hist., 7th ser., VI, p. 471, November, 1900 (genus)..

1906. *Eumops* Miller, Proc. Biol. Soc. Washington, XIX, p. 85, June 4, 1906.

Type-species.—*Molossus californicus* Merriam.

Geographic distribution.—Warmer parts of America, north to the southwestern United States; Greater Antilles.

Number of forms.—Ten species of *Eumops* are now recognized.

Characters.—Dental formula:

$$\frac{-2-.\,1.-(2)-4\,5\,6\,7}{1\,2-.\,1.-\;2\;-4\,5\,6\,7}\ i\ \frac{1-1}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2}\ \text{or}\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=30\ \text{or}\ 28.$$

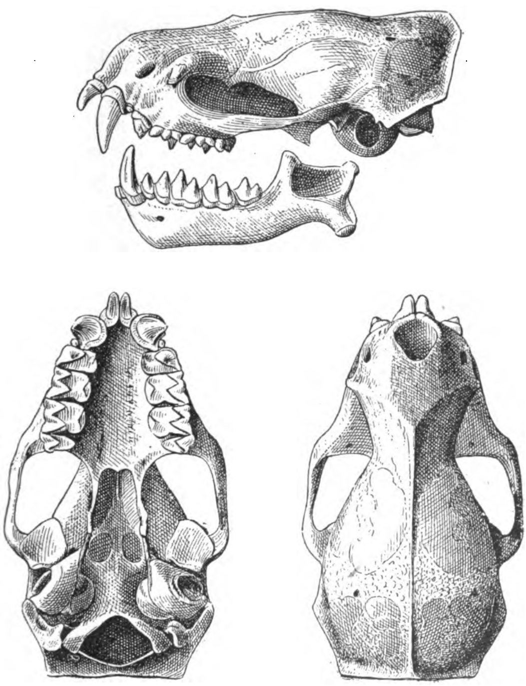
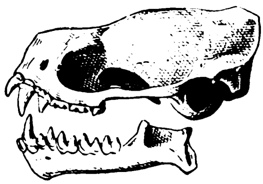


FIG. 46.—EUMOPS ABRASUS. ADULT MALE. SURINAM. No. 37456. × 2.

Upper incisors large, the slender shafts about one-half as high as that of canine, projecting forward and in contact with each other except at slightly diverging tips, the bases expanded posteriorly and almost or quite in contact with canines. Lower incisors subequal, bifid, much exceeded in height by cingulum of canines, beneath which they are crowded in a nearly semicircular row. Canines large and strong but not peculiar in form, the upper with shallow longitudinal groove on anterior face and distinctly flattened or concave on inner side, the lower with their bases almost in contact (less closely approximated in the smaller species). First upper premolar (pm^2) small, but usually well formed and not deciduous (though absent in only known specimen of *E. maurus*) either crowded between canine and second premolar (pm^4) or forced outward from the tooth row when the two large teeth are in contact; posterior premolar normal, its crown area more than half that of first molar, its antero-internal cusp well developed. Lower premolars not peculiar, the bases of the crowns about as long as broad, the shaft of the anterior not as high as that of posterior, but with about the same area in cross section. Molars normal; *m* [1] and *m* [2] with the inner section somewhat reduced but with distinct hypocone; *m* [3] with or without distinct metacone and third commissure; lower molars with the cusps in the usual position, but entoconid frequently reduced or obsolescent in m_3. Skull (figs. 45–47) strongly built, though rather slender and with sagittal crest absent or slightly indicated, the rostrum well developed, always more than half as long as brain case, the entire dorsal profile from nares to occiput nearly straight, or at least with no strongly contrasting elevations and depressions; interorbital region and rostrum subterete, in most of the species distinctly hour-glass shaped; a slight lachrymal ridge; palate slightly arched, with or without a small median anterior foramen, the premaxillaries without trace of palatal branches; pterygoids parallel; basisphenoid pits present, well defined. External form slender, much as in *Nyctinomus*. Ears very large, rounded or squarish in outline, joined across forehead, extending slightly beyond nostril when laid forward, the anterior margin without horny processes; antitragus distinct but not thickened; keel greatly developed, flattened and expanded at edge; tragus small, flat, its upper edge squarish or rounded; lips full and expanded, though not conspicuously wrinkled. Muzzle pad well developed, deeply emarginate above, its upper edge and median ridge with minute horny processes and small spoon hairs. Wings, feet, tail, and membranes not peculiar.



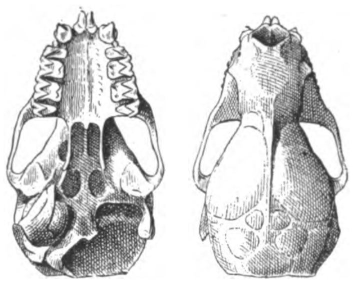


FIG. 47.—EUMOPS NANUS. TYPE. ADULT MALE. BOGAVA, CHIRIQUI, PANAMA. NO. 0. 7. 11. 99. BRIT. MUS. × 2.

Species examined.—*Eumops abrasus* (Temminck), *E. bonariensis* (Peters), *E. californicus* (Merriam), *E. glaucinus* (Wagner), *E. maurus* (Thomas), *E. milleri* (J. A. Allen), *E. nanus* (Miller), *E. orthotis* (H. Allen), *E. perotis* (Wied), and *E. trumbulli* (Thomas).

Remarks.—The members of this genus are easily recognizable by their Nyctinomine general form combined with the merely arched palate and the strongly projecting upper incisors completely filling space between canines. The small upper premolar is usually present and well formed.

Genus PROMOPS Gervais.

1855. *Promops* GERVAIS Expéd. du Comte de Castelnau, Zool. Mamm., p. 58.
1878. *Promops* DOBSON, Catal. Chiropt. Brit. Mus., p. 407 (part). Subgenus of *Molossus*.

Type-species.—*Promops ursinus* Gervais=*Molossus nasutus* Spix.

Geographic distribution.—Warmer parts of America, north to southern Mexico.

Number of forms.—This genus as now restricted contains only the type species and *Promops fosteri* (Thomas).

Characters.—Dentition as in *Eumops*, except that the upper incisors are not as high (barely one-half height of canine), the anterior upper premolar is reduced to a mere structureless, often deciduous, spicule, the lower premolars are greatly crowded, their width noticeably exceeding their length, and the upper molars lack all distinct trace of hypocones. Skull (fig. 48) differing conspicuously from that of *Eumops* in its general shorter, broader, and more rounded outline, the presence of a high sagittal crest extending forward almost to level of lachrymal region, the very marked shortening and deepening of the rostrum (horizontal distance from orbit to nares scarcely half depth through lachrymal region), the slightly emarginate audital bullæ (as in *Molossus* and *Eumops*), and the highly domed palate (antero-posterior concavity nearly as great as lateral). External form heavier and more robust than in *Eumops*. Ears short, rounded, arising from same point on forehead, extending barely to nostril when laid forward; keel low and rounded; antitragus very distinct, constricted at base, its substance noticeably thickened posteriorly; tragus minute, very slender though distinctly flattened. Muzzle pad very small but rather distinctly outlined, though without median ridge or horny processes; a keel-like ridge from immediately behind muzzle to point of origin of ears. Lips slightly expanded, scarcely wrinkled; spoon hairs small, forming a

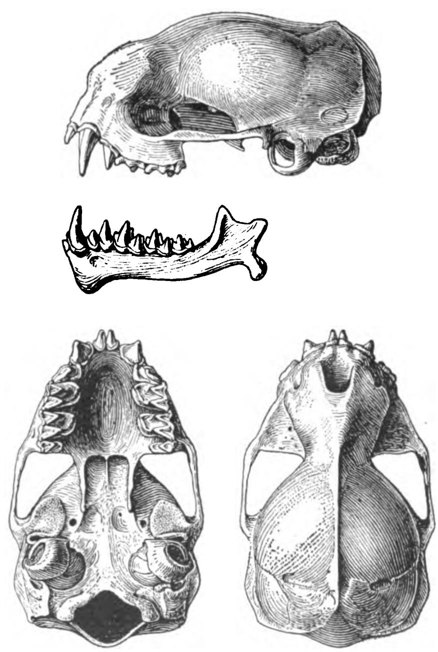


FIG. 48.—PROMOPS FOSTERI. ADULT FEMALE. VILLA RICA, PARAGUAY. No. 105677. × 2¼.

dense brush below nostrils. Wings, feet, tail, and membranes not peculiar.

Species examined.—*Promops nasutus* (Spix) and *P. fosteri* (Thomas).

Remarks.—This genus is in many respects intermediate between *Eumops* and *Molossus*, though nearer the latter. It is at once recognizable by the distinctly flattened tragus, the highly domed palate, the presence of the rudimentary small upper premolar, and of a second lower incisor.

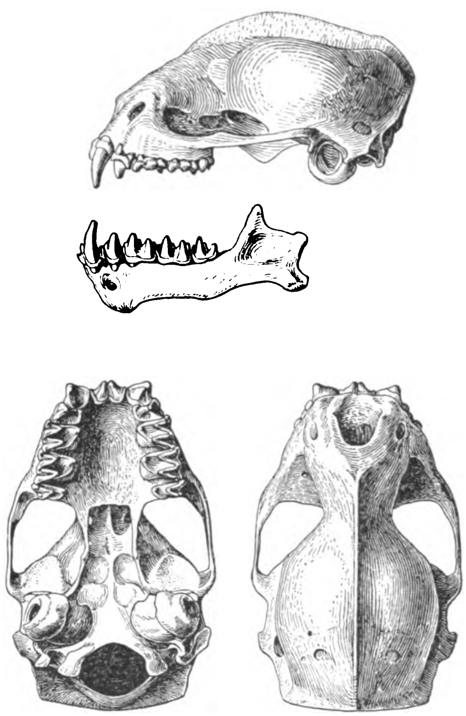


FIG. 49.—MOLOSSUS RUFUS. SAPUCAY, PARAGUAY. NO. 114885. × 2.

Genus MOLOSSUS Geoffroy.

1805. *Molossus* GEOFFROY, Ann. Mus. d'Hist. Nat., Paris, VI, p. 153 (*rufus*).

1811. *Dysopes* ILLIGER, Prodr. Syst. Mamm. et Avium, p. 122 (substitute for *Molossus*).

1878. *Molossus* DOBSON, Catal. Chiropt. Brit. Mus., p. 407 (part).

Type-species.—*Molossus rufus* Geoffroy.

Geographic distribution.—Warmer parts of America, north to central Mexico and Cuba.

Number of forms.—As now restricted the genus *Molossus* contains *M. rufus*, *M. obscurus*, and the numerous local forms of these species. The *M. fluminensis* of Lataste may also be a member of the same group.

Characters.—Dental formula:

$$\frac{-\ 2\ -.\ 1.\ -\ -\ -\ 4\ 5\ 6\ 7}{1\ -\ -.\ 1.\ -\ 2\ -\ 4\ 5\ 6\ 7};\ i\ \frac{1-1}{1-1},\ c\ \frac{1-1}{1-1},\ pm\ \frac{1-1}{2-2},\ m\ \frac{3-3}{3-3}=26.$$

Except for the absence of pm^2 and i_2 the teeth resemble those of *Promops*. The form of the upper incisor is, however, very characteristic, somewhat resembling that of *Cheiromeles*, the shafts scarcely projecting forward, and so reduced that their height is not equal to the width of the crown through the broad posterior heel. As in *Promops*, the upper molars usually show little or no distinct trace of hypocones, the large protocone occupying the entire inner side of the tooth; a low though distinct hypocone is, however, occasionally present. Skull (fig. 49) essentially like that of *Promops*, but sagittal crest even more conspicuously developed, and palate merely arched—that is, the antero-posterior concavity is much less than the lateral concavity. As in *Promops* and *Eumops*, the audital bullæ are much better developed than is usual in the family (the inner margin not emarginate), and the basisphenoid pits are distinct. External form thick and heavy. Ear as in *Promops*, except that the antitragus is even more constricted at base, suborbicular in outline, and more noticeably thickened; tragus minute, subterete. Muzzle and other external characters as in *Promops*.

Species examined.—*Molossus crassicaudatus* (Geoffroy), *M. currentium* Thomas, *M. nigricans* Miller, *M. obscurus* Geoffroy, *M. pretiosus* Miller, *M. pygmæus* Miller, *M. rufus* Geoffroy, *M. tropidorhynchus* Gray.

Remarks.—The genus *Molossus* is characterized by its short but high and rounded skull with greatly developed, knife-like sagittal crest, arched palate, short upper incisors, and 1 – 1 lower incisors. Externally the only tangible character by which it can be distinguished from *Promops* is the very minute, subterete tragus, unique in the group.

INDEX.

In this index terms relating to anatomical structures, systems of classification, genera, and higher groups occurring in the tables of synonymy and the specific names are printed in ordinary type. Names adopted for the genera and higher groups recognized in this work are printed in small capitals and the page number on which the main account of such groups occurs is printed in black-faced type.

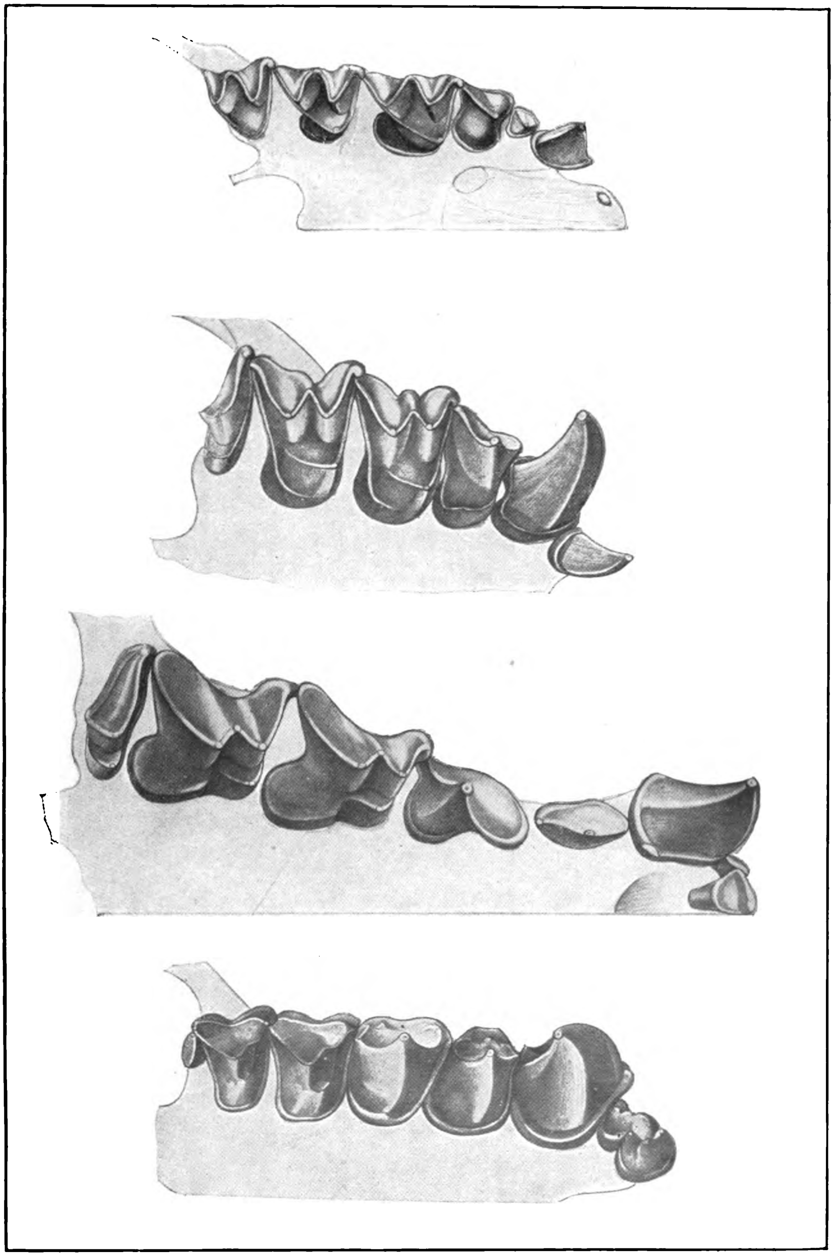
A.

B.

M.

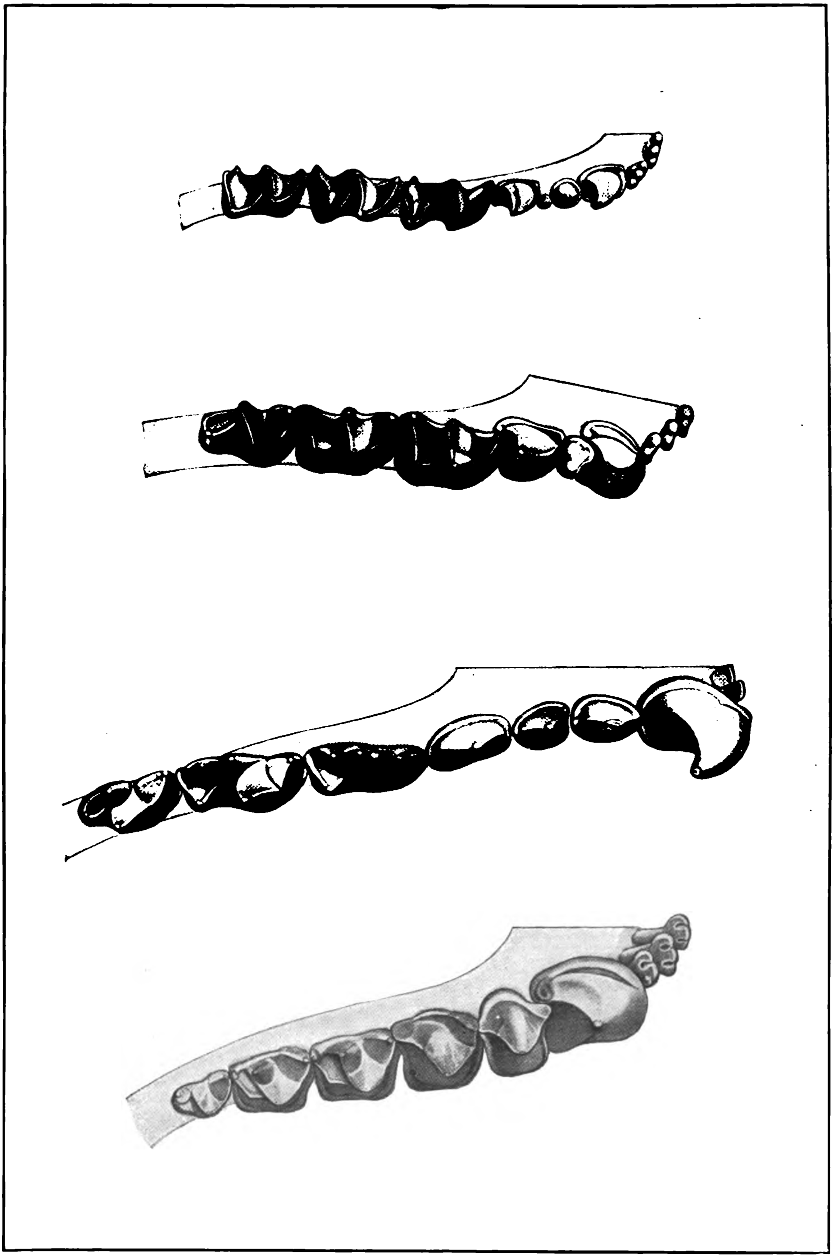
N.

O



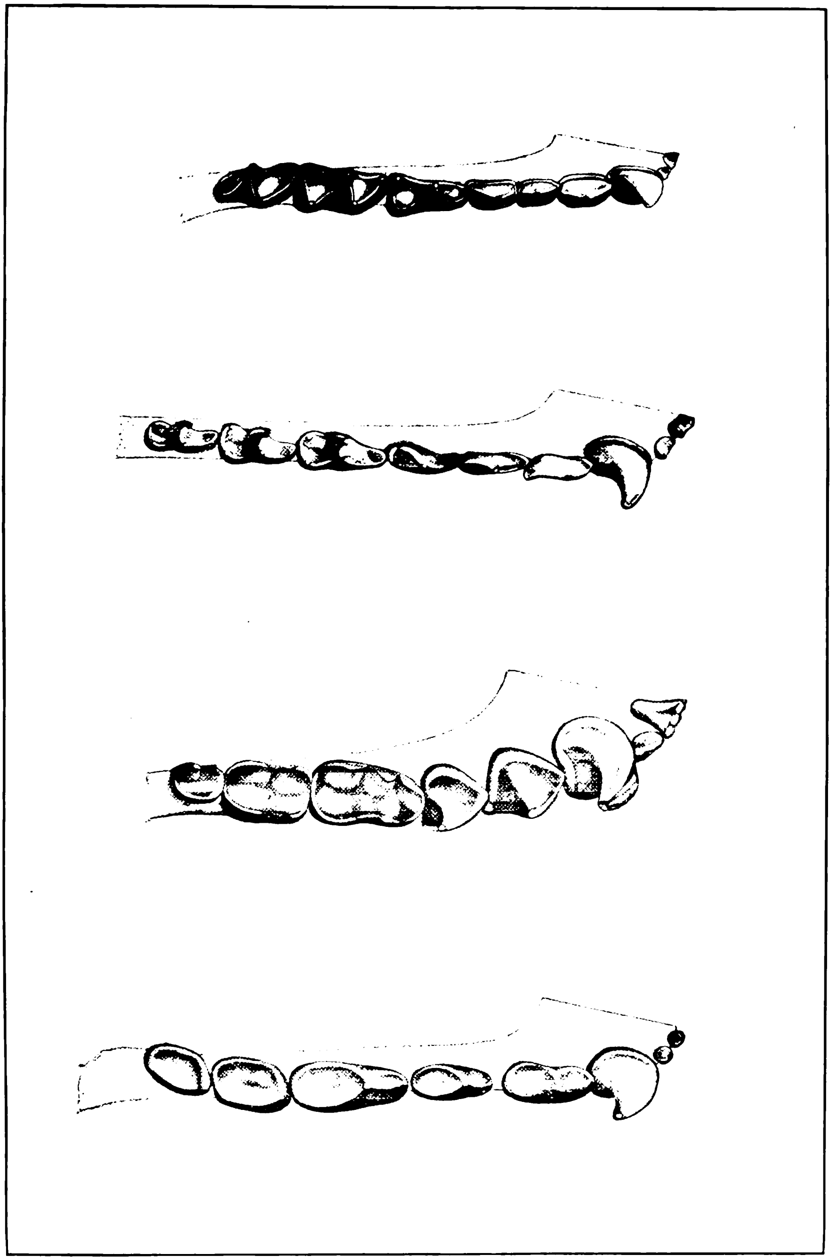
MAXILLARY TEETH OF RHINOLOPHUS, PACHYOTUS, VAMPYRUS, AND HARPIOCEPHALUS.

FOR EXPLANATION OF PLATE SEE PAGE XIII.



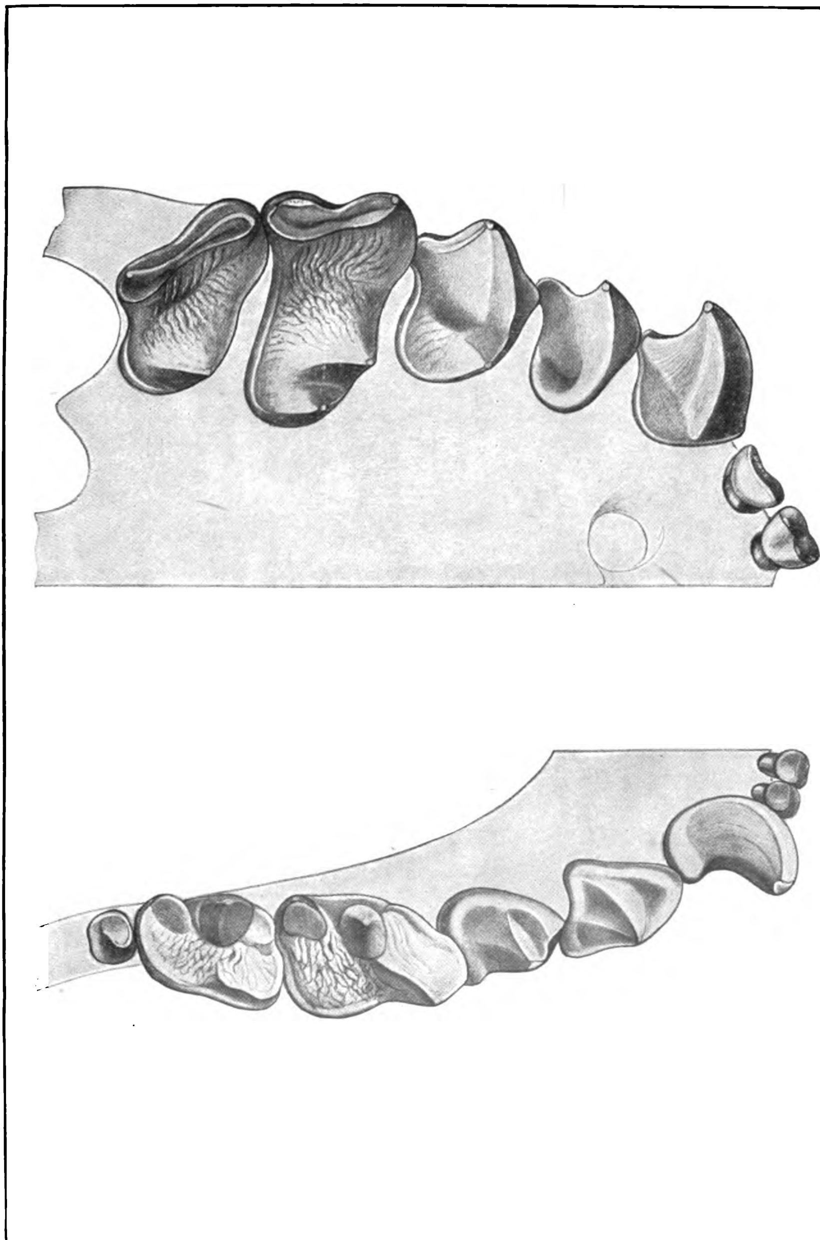
MANDIBULAR TEETH OF RHINOLOPHUS, PACHYOTUS, VAMPYRUS, AND HARPIOCEPHALUS.

FOR EXPLANATION OF PLATE SEE PAGE XIII.



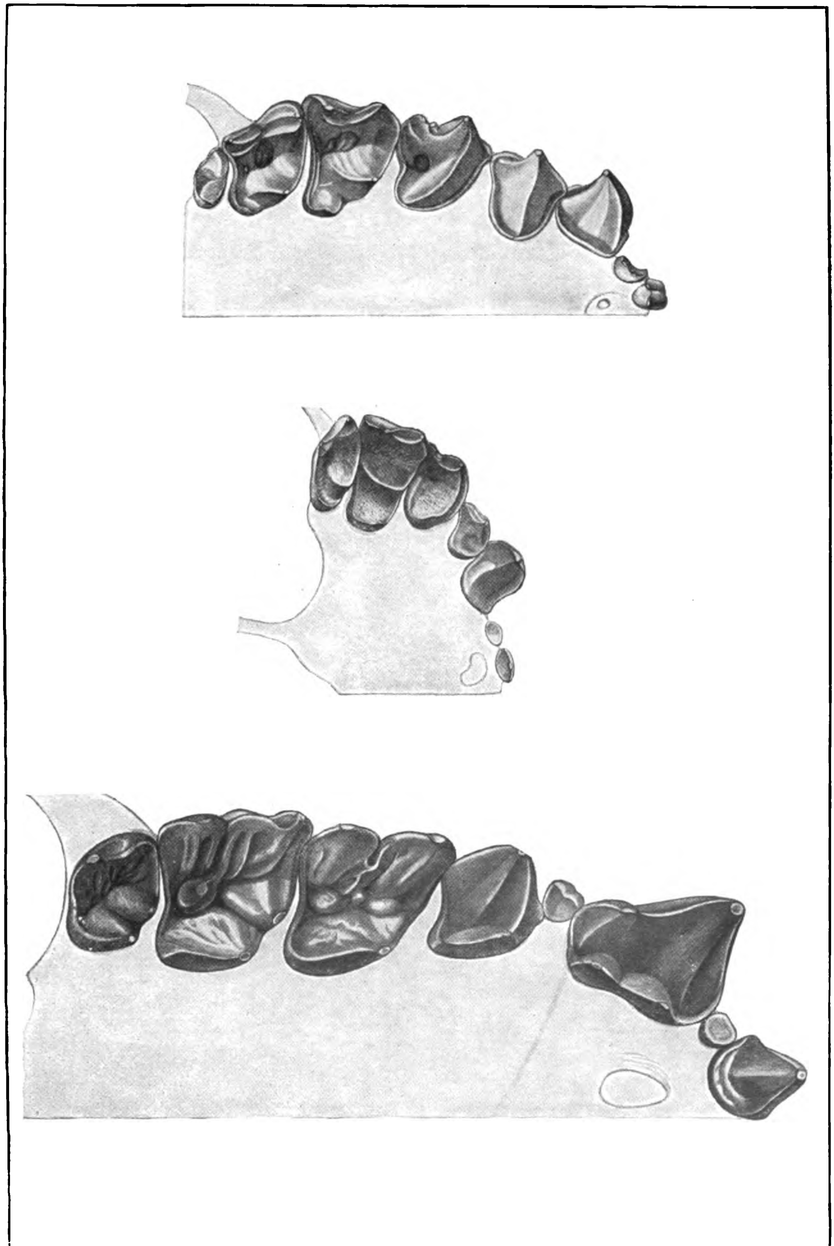
MANDIBULAR TEETH OF MICRONYCTERIS, GLOSSOPHAGA, STURNIRA, AND PHYLLONYCTERIS.

FOR EXPLANATION OF PLATE SEE PAGE XIII.



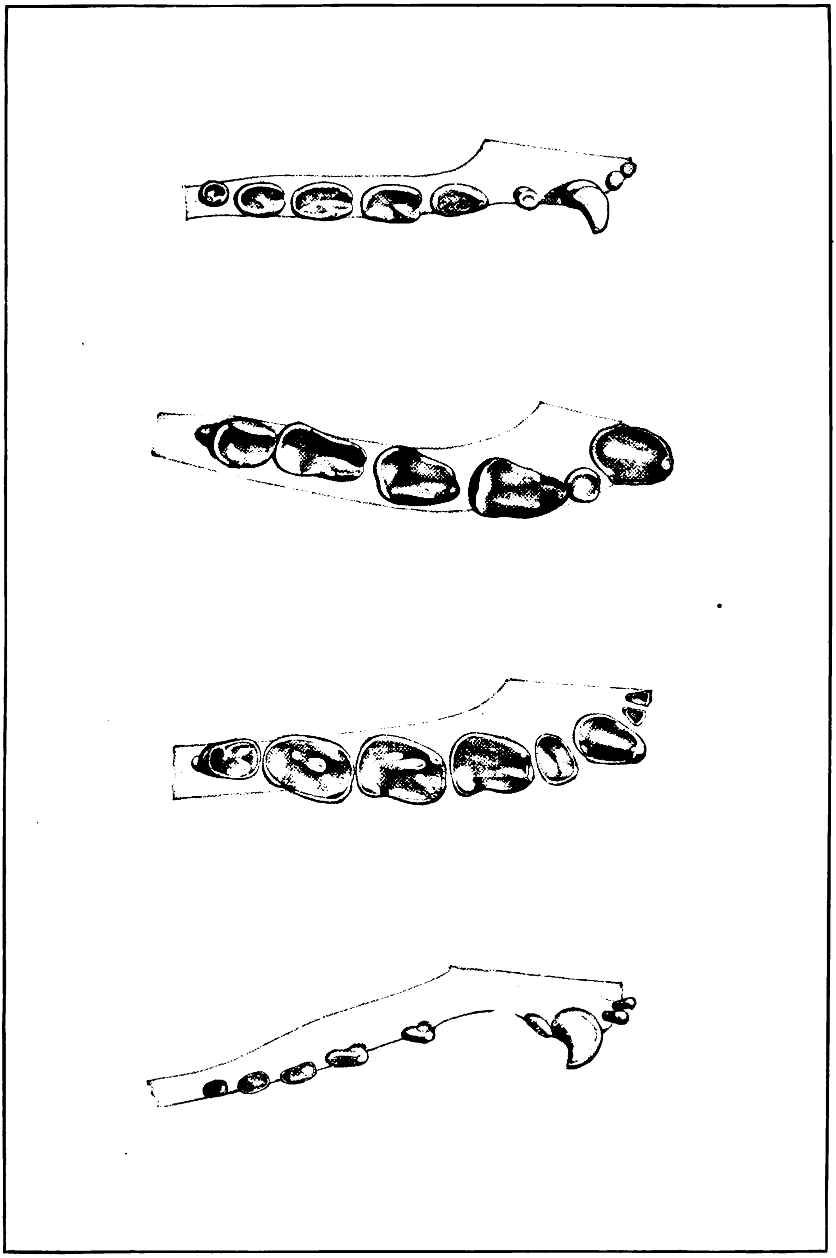
TEETH OF ARTIBEUS.

FOR EXPLANATION OF PLATE SEE PAGE XIII.



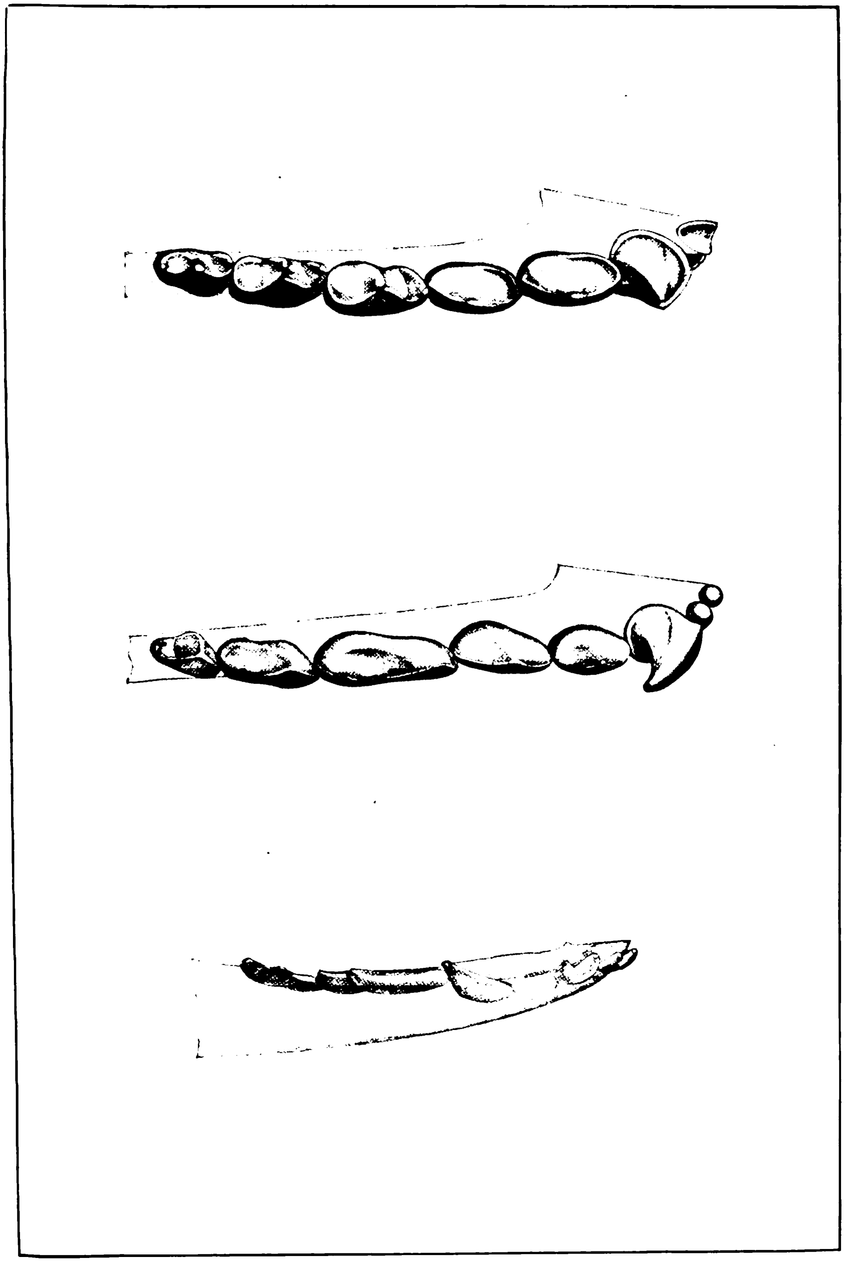
MAXILLARY TEETH OF URODERMA, CENTURIO, AND BRACHYPHYLLA.

FOR EXPLANATION OF PLATE SEE PAGE XIV.



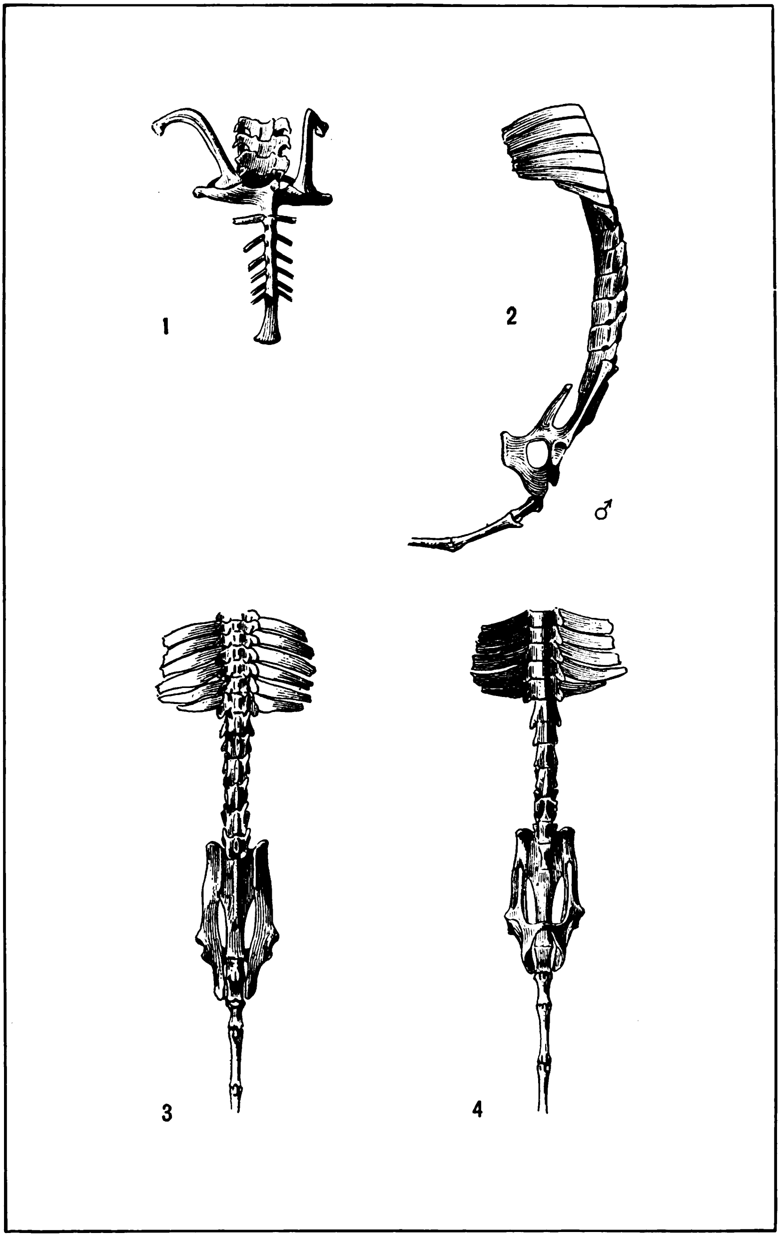
MANDIBULAR TEETH OF PTEROPUS, NYCTYMENE, NIADIUS, AND MELONYCTERIS.

FOR EXPLANATION OF PLATE SEE PAGE XIV.



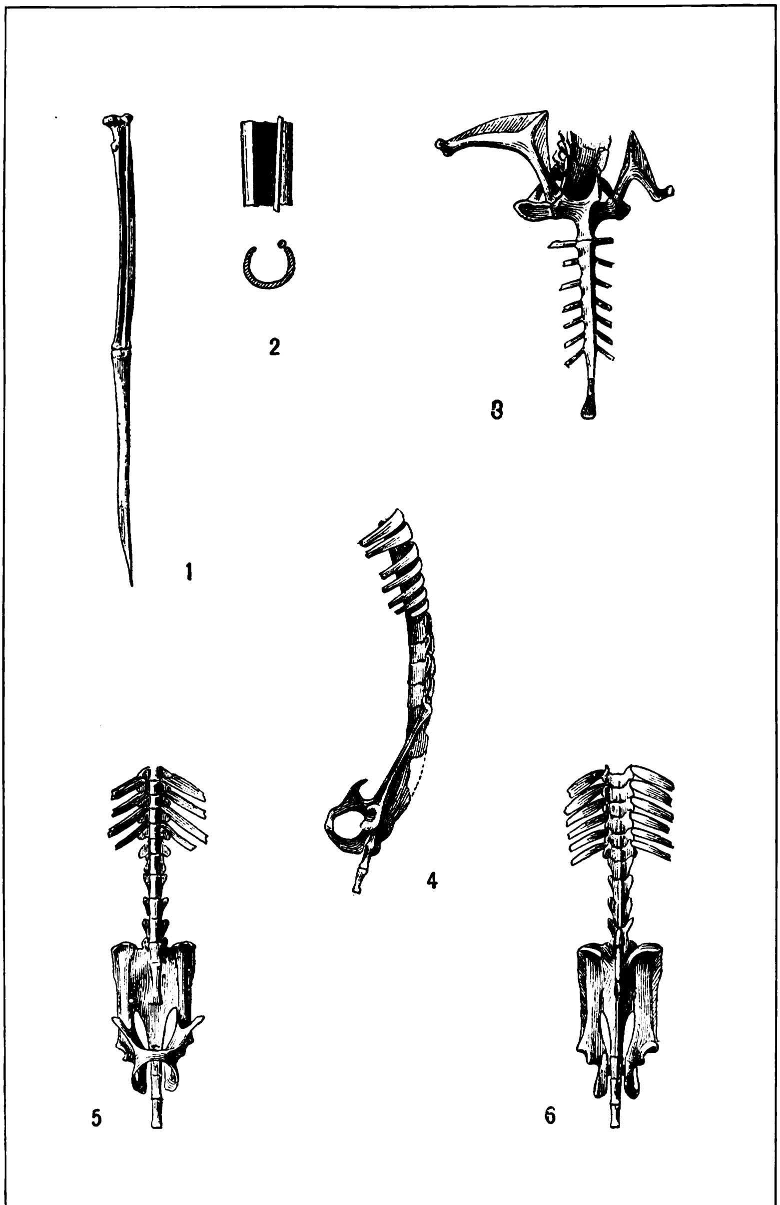
MANDIBULAR TEETH OF HEMIDERMA, EROPHYLLA, AND DESMODUS.

FOR EXPLANATION OF PLATE SEE PAGE XIV.



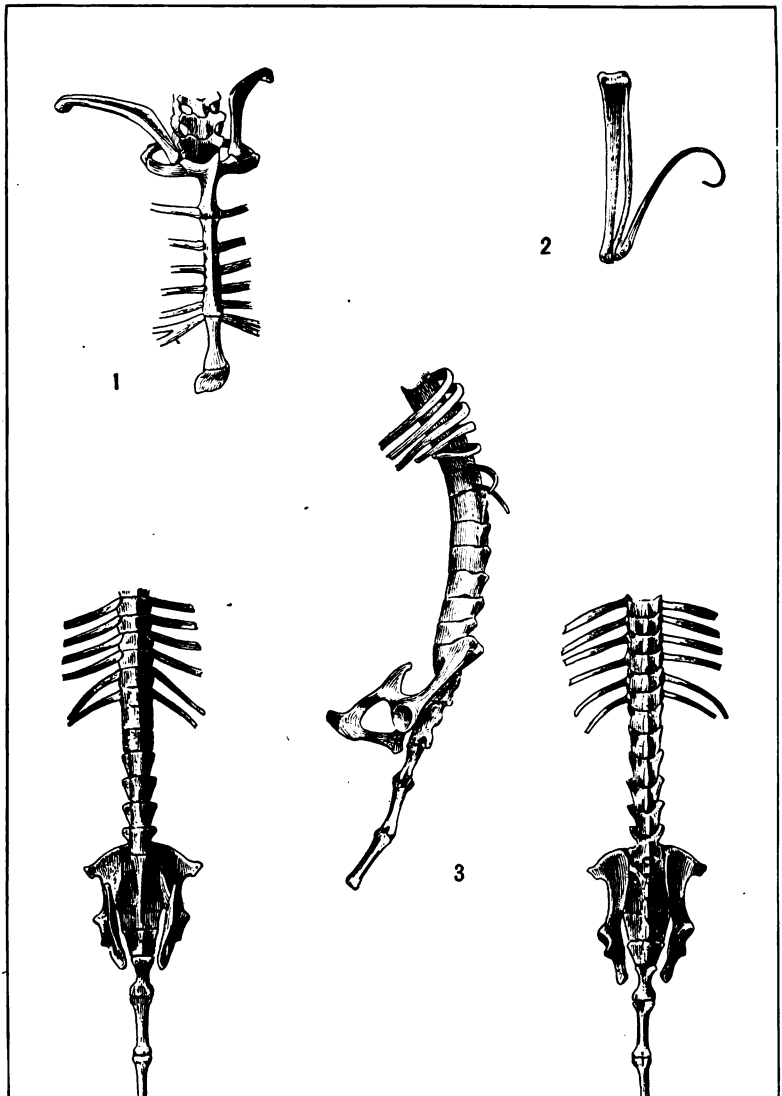
SHOULDER GIRDLE AND PELVIS OF RHINOPOMA.

FOR EXPLANATION OF PLATE SEE PAGE XIV.



SHOULDER GIRDLE, PELVIS, AND LEG BONES OF DICLIDURUS.

FOR EXPLANATION OF PLATE SEE PAGE XV.



SHOULDER GIRDLE, PELVIS, AND LEG BONES OF MOLOSSUS.

FOR EXPLANATION OF PLATE SEE PAGE XV.